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# Implementation of Nationally Determined Contributions

## Viet Nam Country Report

For our Environment

Umwelt Bundesamt

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Environment, Nature Conservation,
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# Implementation of Nationally Determined Contributions

Viet Nam Country Report

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## Introduction to the project

This country report is part of the "Implementation of Nationally Determined Contributions" (NDCs) project (FKZ 3716 4111 80), which considers NDC implementation in 10 countries: Colombia, Ethiopia, Georgia, Indonesia, Iran, Kenya, Marshall Islands, Morocco, Peru, and Viet Nam. This project places a special emphasis on identifying potential barriers to NDC implementation and mitigation potentials which could go beyond the current NDCs.

The country reports analyze the NDCs in terms of their robustness and coherence with other national or sectoral plans and targets, and put them into the context of additional mitigation potentials and other national circumstances. For countries where coal plays a critical role in consumption or national production, the analysis covers further details on this sector, including the economic relevance and local impacts of coal production or consumption. The content is based on available literature from research and public sector information on policies and institutions.

To be able to analyze the content in more detail, the authors focus the research on a number of relevant fields of action. The fields of action were selected based on historic and projected sectoral emissions development, comprehensive literature on GHG mitigation potentials, identified barriers and emissions reductions as well as feasibility, costs, and co-benefits.

The project was suggested and is financed by the Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety, supervised by the German Environment Agency and carried out by independent think tanks - NewClimate Institute and Wuppertal Institute. The studies are a continuation of similar previous efforts (project numbers 3713 41 102, 3711 41 120, 360 16 022, 364 01 003 and 363 01 128) and aim to inform policy makers and the interested public about the implementation of NDCs in individual countries. The choice of countries is based on developing countries with which Germany works closely on climate change topics.

The papers are scientific in nature, and all suggestions are derived by the authors from careful analysis, having in mind the individual backgrounds of countries. They aim to increase knowledge about implementation of mitigation potentials to meet the globally agreed goal of staying within a temperature increase of 1.5°C or well below 2°C above preindustrial levels, without intending to prescribe specific policies.

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## List of Abbreviations

| | |
|---|---|
| **ADB** | Asian Development Bank |
| **AVCT** | Avoided Cost Tariff |
| **BAU** | Business-as-Usual |
| **BMUB** | Bundesministerium für Umwelt, Naturschutz, Bau und Reaktorsicherheit |
| **BRT** | Bus Rapid Transit |
| **BUR** | Biennial Update Report |
| **CAT** | Climate Action Tracker |
| **CCRC** | Climate Change Research Centre |
| **CDM** | Clean Development Mechanism |
| **CMP** | Conference of Parties serving as the meeting of the Parties to the Kyoto Protocol |
| **COP** | Conference of Parties |
| **CSP** | Concentrated Solar Power |
| **CTCC** | Country Team on Climate Change |
| **DMHCC** | Department of Meteorology, Hydrology, and Climate Change |
| **DNA** | Designated National Authority |
| **ESMAP** | Energy Sector Management Assistance Programme |
| **EVN** | Electricity Viet Nam |
| **FAO** | Food and Agriculture Organization of the United Nations |
| **FCPF** | Forest Carbon Partnership Facility |
| **FiT** | Feed-in-Tariff |
| **GCF** | Green Climate Fund |
| **GDP** | Gross Domestic Product |
| **GEF** | Global Environment Facility |
| **GHG** | Greenhouse Gas |
| **GIZ** | Deutsche Gesellschaft für Internationale Zusammenarbeit |
| **HDI** | Human Development Index |
| **ICB** | Inter-ministerial Coordination Board |
| **IEA** | International Energy Agency |
| **IKI** | German International Climate Initiative |
| **IMHEN** | Viet Nam Institute of Meteorology Hydrology and Climate Change |
| **ISPONRE** | Institute of Strategy and Policy on Natural Resources and Environment |
| **JBIC** | Japan Bank for International Cooperation |
| **JCM** | Joint Crediting Mechanism |

| | |
|---|---|
| **JICA** | Japan International Cooperation Agency |
| **ktoe** | Kilotonnes oil equivalent |
| **kWh** | Kilowatt hours |
| **LNG** | Liquid Natural Gas |
| **LULUCF** | Land Use, Land Use Change, and Forestry |
| **MARD** | Ministry of Agriculture and Rural Development |
| **MBI** | Market Based Instruments |
| **MOC** | Ministry of Construction |
| **MOF** | Ministry of Finance |
| **MoIT** | Ministry of Industry and Trade |
| **MONRE** | Ministry of Natural Resources and Environment |
| **MOST** | Ministry of Science and Technology |
| **MPI** | Ministry of Planning and Investment |
| **MPI** | Ministry of Planning and Investment |
| **MRV** | Monitoring, Reporting, and Verification |
| **$MtCO_2e$** | Mega tonnes carbon dioxide equivalent |
| **MW** | Megawatt |
| **NAMA** | Nationally Appropriate Mitigation Actions |
| **NCCC** | National Committee on Climate Change |
| **NCCS** | National Climate Change Strategy |
| **NDC** | Nationally Determined Contribution |
| **NDF** | Nordic Development Fund |
| **NGGS** | National Green Growth Strategy |
| **NTP-RCC** | National Target Programme to Respond to Climate Change |
| **PD** | Project Development |
| **PDP** | Power development plan |
| **PFES** | Payment for Environmental Services |
| **PM** | Particulate Matter |
| **PV** | Photovoltaic |
| **RE** | Renewable energy |
| **REDD+** | Reducing Emissions from Deforestation and forest Degradation |
| **SOE** | State Owned Enterprise |
| **SPPA** | Standardized Power Purchase Agreement |
| **UN** | United Nations |
| **UNDP** | United Nations Development Programme |

| | |
|---|---|
| **UNFCCC** | United Nations Framework Convention on Climate Change |
| **UNITAR** | United Nations Institute for Training and Research |
| **USD** | United States Dollar |
| **VINACOMIN** | Viet Nam National Coal – Mineral Industries Group |
| **VND** | Vietnamese Dong (currency) |
| **VNEEP** | Viet Nam Energy Efficiency and Conservation Program |

# 1 Part I: Summary

## 1.1 Country background

**Geography**. Viet Nam is situated in Southeast Asia and borders China to the north, Laos and Cambodia to the west, and the East Sea to the east, south, and southwest. Viet Nam is characterised by its long coastline and a long, narrow shape extending 1,662 km from north to south and between 600 km from east to west at its widest and 50 km at its narrowest sections. Viet Nam has two major deltas, the Mekong River Delta and Red River Delta (Government of the Socialist Republic of Viet Nam, 2014c).

**Population**. In 2014, total population was 91 million (World Bank, 2017b). Population growth rates have been constantly declining over the last decades and are currently just over 1% per year and expected to decline further (United Nations Department of Economic and Social Affairs Population Division, 2015).

**Economy**. Viet Nam has experienced strong economic growth over the last decades. GDP in 2015 was USD 194 billion, up from around USD 6 billion in 1990 (World Bank, 2017b). Vietnamese growth is driven by international trade and foreign investment. The Human Development Index (HDI) has improved from 0.48 in 1990 to 0.67 in 2014. This puts it on a similar level to many Central American countries, but still quite a way from developed countries, such as Germany with a HDI of 0.92.

Certain sectors, e.g. industrial production, textile, shoe, electronics and seafood production have been growing rapidly. Per capita income has increased from around USD 100 in 1990 to USD 2,050 in 2014. The poverty rate declined from around 70% to 12% over the last fifteen years (World Bank, 2017b). Unemployment and underemployment are in general low, but is disproportionately high for young people (GSO, 2015).

Table 1: Key socio-economic figures (2014)

| Viet Nam | | | |
|---|---|---|---|
| Population [million] | 91 | Urban population [% of total] | 33% |
| GDP [current billion USD] | 186 | Electrification rate [%] | 99% |
| GDP/Cap [current USD/cap] | 2052 | HDI [1] | 0.67 |
| Gini-coefficient [1] | 37.6 | Corruption index [1] | 3.0 |

Data sources: ND-GAIN (2017); UNDP (2015); United Nations (2014); World Bank (2017b); GDP per capita calculated based on World Bank (2017b). HDI: 0 – 1, with 1 being highest. GINI Index 0 – 100, 0 = equal income distribution. Corruption index: CPIA transparency, accountability, and corruption in the public sector rating (1=low to 6=high). Vulnerability: 0-1, (0 low to 1 high), element of ND-GAIN index.

**Political system**. The Socialist Republic of Viet Nam is a one-party state, with the Communist Party of Viet Nam playing the leading role in all political areas. It is a communist system, with many economic areas run by the state, particularly in the energy sector. The National Assembly produces framework legislation, while the government provides guidance on the implementation of legislation (Nachmany et al., 2015). The country is, however, increasingly liberalizing the economy and opening for international investment (CIA, 2017). Nevertheless, the political and economic system is very much characterized by a top-down planning approach, with a series of 10-year socio-economic development strategies (SEDS) operationalized by 5 year planning cycles. Currently the Socio-Economic Development Plan from 2016 - 2020 (Government of the Socialist Republic of Viet Nam, 2016e) governs decision-making.

**Institutions**. The main body responsible for climate change activities is the National Committee on Climate Change, established in 2011 as one element of the National Climate Change Strategy, with the Ministry of Natural Resources and Environment acting as secretariat. It is supported by a Consultancy Council. The Ministry of Natural Resources and Environment is also responsible for the development of Nationally Appropriate Mitigation Actions (NAMAs) and for this purpose established the Inter-ministerial working group on NAMAs. Nevertheless, all Ministries carry out their individual activities and there is lack of information, communication and coordination.

Given the importance of the energy sector in the emissions profile, the Ministry of Industry and Trade (MoIT) plays a central role. It is responsible for the energy sector. The lack of expected contribution from the energy sector towards achieving the Nationally Determined Contribution (NDC) under the Paris Agreement and the exclusion of industry are indicators that a stronger institutional involvement of the MoIT in climate change activities is required to achieve a true low carbon economy. Within the MoIT, the Energy Efficiency and Conservation Office was established in 2006 to support implementation of the Viet Nam National Energy Efficiency Programme.

The Ministry of Planning and Investment (MPI) has the primary responsibility to perform the functions of State governance and management of planning and investment processes and to take the lead on the integration of climate change into national and provincial socio-economic development planning, strategies and programmes. It also coordinates and allocates funds for energy proposals submitted by line ministries and agencies.

Line ministries are responsible for developing and implementing strategies and action plans for their respective areas of responsibility as outlined in the National Climate Change Strategy (NCCS), including the Ministry of Agriculture and Rural Development, which is responsible for agriculture and forestry, and the Ministry of Transportation and the Ministry of Construction. The Ministry of Finance (MOF) manages disbursements and recurrent expenditures of the entire State economy. It formulates energy sector taxation and tariff, thus playing a crucial role in the energy sector.

**UNFCCC negotiations**. Viet Nam is member of the Group of 77 and China, but is otherwise not very active in the negotiations. It was one of the first non-Annex I countries to submit its Biennial Update Report (BUR) on 8 December 2014.

## 1.2 Emissions trends

**Emissions**. Total emissions reported in the last inventory were 246.8 $MtCO_2e$ in 2010 and 266 $MtCO_2e$ if excluding LULUCF (Government of the Socialist Republic of Viet Nam, 2014c). The latter are estimated to have further increased to 301 $MtCO_2e$ by 2014 (Gütschow et al., 2016), representing 0.6% of global emissions.

The largest contributor of non-LULUCF emissions is the energy sector representing around half of Vietnam's GHG (greenhouse gas) emissions. This is followed by the agricultural sector, which still accounts for almost a third of emissions, but has seen a modest absolute growth and a dramatic decline in relative importance, from 64% in 1994 to 34% in 2010. Although the shares of the industry and waste sectors have doubled since 1994, they still represent a small contribution to total emissions, with 8% for industry and 6% for waste. (Government of the Socialist Republic of Viet Nam, 2014c)

Figure 1: Emissions profile of Viet Nam

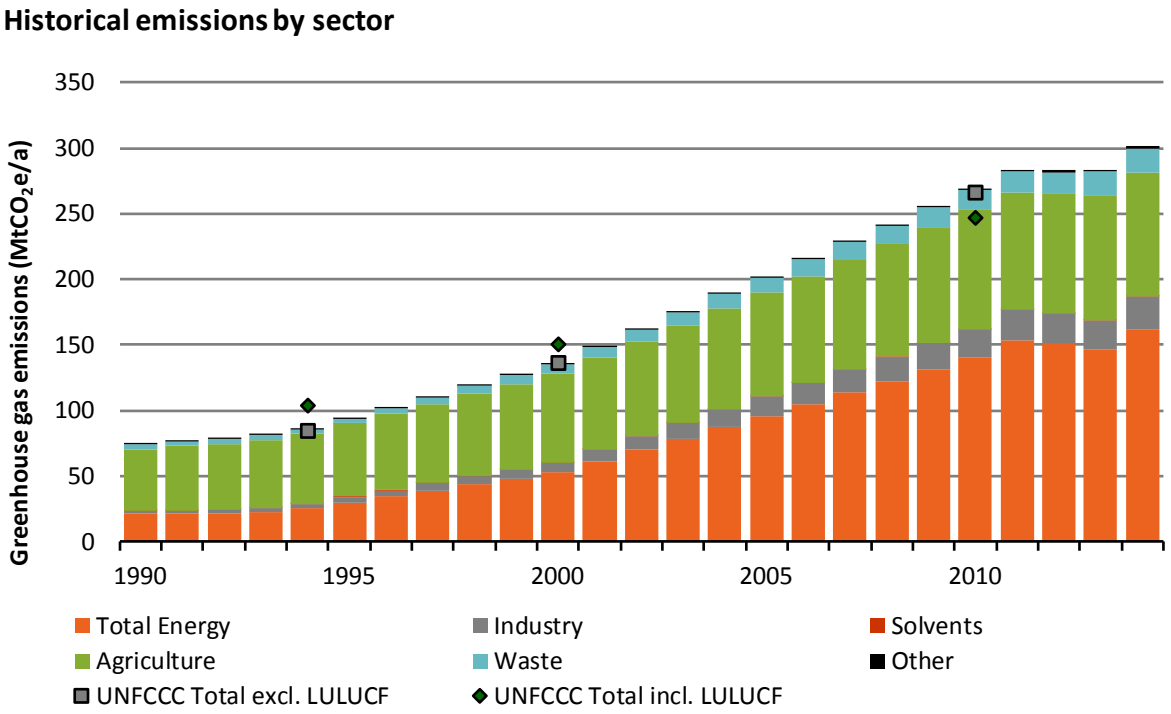



Table 2: 2014 emissions data from PRIMAP[1]

| Sector | Value | Unit | Share in 2014 |
|---|---|---|---|
| Total (excluding LULUCF) | 301 | $MtCO_2e$ | 100% |
| Total energy | 162 | $MtCO_2e$ | 54% |
| Industry | 25 | $MtCO_2e$ | 8% |
| Solvents | 0 | $MtCO_2e$ | 0% |
| Agriculture | 94 | $MtCO_2e$ | 31% |
| Waste | 19 | $MtCO_2e$ | 6% |
| Other | 1 | $MtCO_2e$ | 0% |

Table 3: 2014 emissions data from UNFCCC

| Sector | Value | Unit | |
|---|---|---|---|
| Total (excluding LULUCF) | 266 | $MtCO_2e$ | |
| LULUCF | -19 | $MtCO_2e$ | |

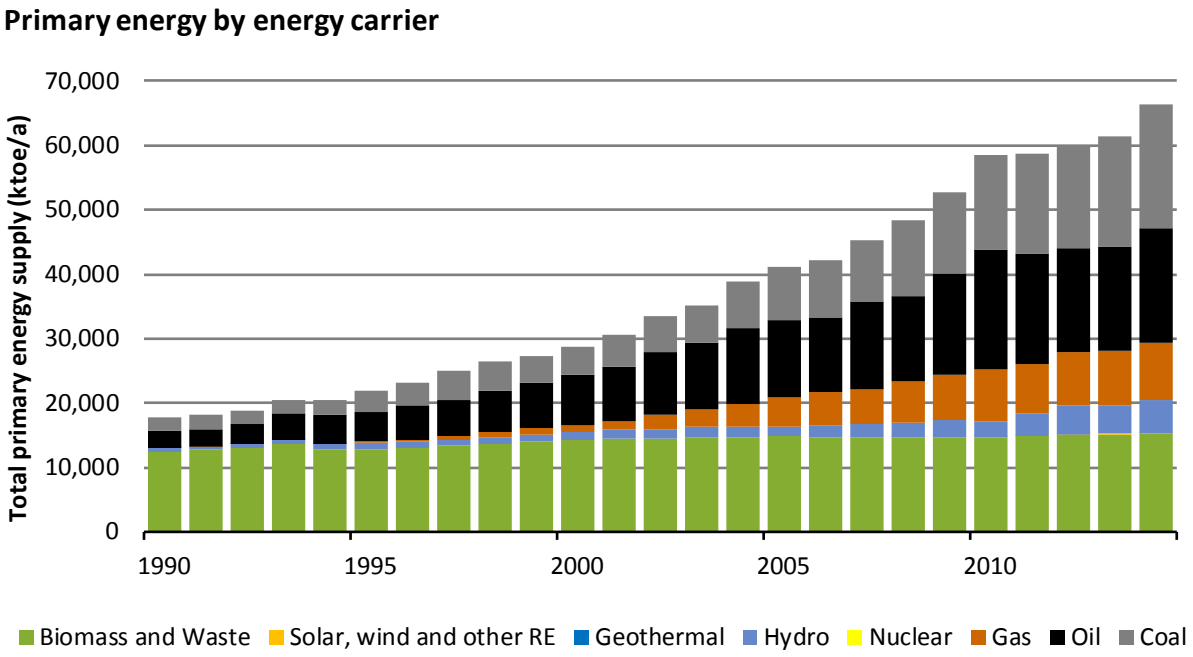
Data sources: EU JRC & PBL (2014); Gütschow et al. (2016); UNFCCC (2016).

[1)] The PRIMAP dataset is a time series based on a number of sources. Although national data is prioritized, it must meet certain requirements, and undergoes further processing. Therefore, UNFCCC and PRIMAP data do not always match. See Gütschow et al. (2016) for details.

**Energy system**. Primary energy use is dominated by fossil fuels. Coal is the largest energy source with 29% of total supply, followed by oil (27%), biomass and waste (23%), and gas (13%). The traditional use of biomass and waste has remained constant since the early 1990s and growing demand has been largely met by fossil fuels and an increasing share of hydro. The share of other renewable energy is as yet negligible in primary energy (IEA, 2016a) and constitutes only 3.7% of electricity generation with the bulk of electricity production almost equally distributed between coal, gas and hydro (GIZ, 2016c).

Viet Nam has substantial hard coal reserves as well as oil and gas. However, the demand in industry and for power generation is so high, that the country became a net importer of coal in 2015. Oil and gas reserves are also substantial and mainly located offshore. Exploration is ongoing and is expected to increase proven reserves further, although exploration may be technically and economically challenging. Viet Nam is a net exporter of crude oil, but a net importer of refined oil and is currently planning the extension of national refining capacity. All of the country's gas production is consumed nationally, although the import of LNG is planned with two import terminals scheduled to be completed by 2023 (EIA, 2016).

Figure 2: Energy profile of Viet Nam




Data sources: IEA (2016a)

Table 4: 2014 total primary energy supply by fuel from IEA

| Fuel | Value | Unit | Share in 2014 |
|---|---|---|---|
| Biomass and waste | 15337 | ktoe | 23% |
| Solar, wind and other RE | 7.5 | ktoe | 0% |
| Geothermal | 0 | ktoe | 0% |
| Hydro | 5035 | ktoe | 0% |
| Nuclear | 0 | ktoe | 0% |
| Gas | 8921 | ktoe | 13% |
| Oil | 17924 | ktoe | 27% |
| Coal | 19170 | ktoe | 29% |

Data sources: IEA (2016a)

**Power generation**. Viet Nam already achieved an electrification rate of 99%. Nevertheless, demand is expected to largely retain the past growth rates and rise from 143.7 billion kWh in 2015 to 572-632 billion kWh in 2030 (Government of the Socialist Republic of Viet Nam, 2016b), which has already been corrected downward compared to previous estimates. The already experienced and potential further impacts of climate change are expected to reduce the ability of the country to expand its hydro power capacity to meet future growth in demand. Based on the expected large growth in electricity demand, this is projected to lead to a decline in relative importance. The latest power development plan foresees this additional demand mainly being met through coal fired power production, although

Prime Minister Nguyen Tan Dung had in January 2016 asked the ministries to build no more coal-fired power plants (Government of the Socialist Republic of Viet Nam, 2016d). Coal is expected to generate over half of the electricity by 2030 (GIZ, 2016c), up from 39% in 2014 (IEA, 2016a). Viet Nam is also planning to have nuclear power contributing to electricity generation by 2030, which was originally scheduled to already be available by 2020 (GIZ, 2016c).

**Coal**. Viet Nam has the 13th largest hard coal reserves globally, with an estimated 3,116 Mt (BGR, 2014). Mining and power generation are in the hands of government-owned corporations, VINACOMIN and EVN. The economic importance of the coal sector as represented in the coal rent is fluctuating strongly and has decreased over the last years after a period of stronger influence, with the share of coal in GDP estimated at 0.16% for 2015, down from a peak value of 2.8% in 2008. For comparison: in Germany the respective share in 2015 was 0.013%, down from a peak value of 0.83% in 1982 (World Bank, 2017b). Demand increase has led to net imports since 2015 (EIA, 2016).

## 1.3 Ongoing activities and barriers

**Ongoing activities**. Viet Nam has an elaborate strategic framework that addresses climate change, including a National Climate Change Strategy, a National Green Growth Strategy and the National Strategy on Environment Protection, all supported by corresponding plans for implementation. While these strategic documents are important in setting the direction, their concrete implementation requires further operationalization into concrete laws and regulations, which is only slowly happening.

| | |
|---|---|
| Climate change strategy | ✓ |
| Green growth strategy | ✓ |
| Energy strategy aligned with CC/GG strategy | ✓ |
| Institutional coordination on climate change | ✓ |
| Renewable energy targets | ✓ |
| Level of NDC ambition (CAT rating) | n.a. |
| Reliance on coal (current) | **medium** |
| Expected reliance on coal (2030) | **high** |

The Law on Economical and Efficient Use of Energy was one of the first concrete outcomes and promotes economical and efficient use of energy, although it lacks any concrete obligations. It introduces energy audits and the development of a national target programme on economical and efficient use of energy, tax and other incentives for energy efficient manufacturers and products. Mandatory energy labelling regulations were specified in a separate legislative document in 2012 (Nachmany et al., 2015).

In 2015, the Renewable Energy Strategy was adopted, which sets ambitious goals that go beyond all previous documents. This has also impacted the revision of the National Power Development Plan VII 2016-2030, which was approved in March 2016 and which increased the expected share of renewables. However, the plan still rests heavily on the expansion of coal fired power and the small downward revision of electricity production from coal is compensated by increased use of gas.

The most concrete policies have been introduced through a range of support mechanisms for renewable energy. In 2012, a fixed purchase price of $0.078/kWh for wind power was introduced, plus a $0.01/kWh subsidy. This has led to a substantial increase in installed capacity from only 8 MW in 2008 to almost 50 MW in 2015. For other renewable electricity sources a reference price for projects was defined, based on the avoided cost of the national utility. Viet Nam's Investment Law also provides support for renewable energy projects. Fiscal incentives and export credits are provided to further incentivise renewable energy investment (ADB, 2015).

The support mechanism for biomass power projects, also approved in 2012, also introduces standardized power purchase agreements with a duration of 20 years. For combined heat and power projects it establishes a fixed feed-in-tariff at US$0.058/kWh. For other biomass power projects the avoided cost tariff applies. Off-grid projects receive preferential treatment, particularly with respect to taxes, duties and access to land. A regulatory framework to support solar PV was issued in April 2017 (Decision 11/2017/QD-TTg), which consist of a PV support law with a net metering scheme and further legal

and technical regulation, such as grid codes, standard power purchase agreements, etc. (Cattelaens, 2016).

In 2013, the **Viet Nam Energy Efficiency Building Code** was adopted, which provides mandatory technical standards to achieve energy efficiency in the design and construction/retrofit of civil buildings, such as offices, hotels, hospitals, schools, etc. with a gross floor area of 2,500 $m^2$ or larger. It provides technical requirements for the building envelope as well as equipment and systems (Asia Pacific Energy Research Centre, 2016).

Viet Nam is very active in the carbon market and is one of the most active countries in the clean development mechanism (CDM), mostly in the energy and waste sectors. It is also working with Japan to engage in the joint crediting mechanism (JCM) and has identified 28 projects, four of which (all related to energy efficiency in different sectors) were approved for implementation (Government of the Socialist Republic of Viet Nam, 2014c).

Related to the development of concrete activities the country is still in early stages. It has received support from various donors, including BMUB, FAO, UNDP, JICA and others, to build up capacity for NAMA design and the setting up of corresponding MRV systems. So far, most activities are preparatory, with the identification of potentials, co-benefits, design of MRV systems and general capacity-building. However, Viet Nam successfully secured GCF funding for a project in coastal communities with adaptation and mitigation components, operated through UNDP (GCF, 2017).

Overall, the country has put in place a solid framework that can help implement enhanced ambition. While important elements, such as strategies, laws and support mechanisms exist, they lack ambition and, in some cases, enforcement.

**Barriers**. As in most countries, government representatives, officials and politicians still perceive climate change mitigation as potentially hindering economic growth. There is potential to enhance awareness of the sustainable development benefits of climate mitigation actions and understanding in ministries and agencies of mitigation potentials and how to mainstream mitigation to decision-making. The perception of mitigation in Viet Nam is strongly influenced by CDM and installation-level and project-type activities. The lack of broader policy and programmatic approaches to mitigation poses a severe barrier to effective policy frameworks. As a result, the strategic frameworks set out in the various strategies lack further implementation at the legislative level. Where policies and regulations exist (e.g. in forestry), enforcement is lacking.

Low electricity and coal prices are a severe economic barrier to low carbon development, as they reduce incentives for energy savings and renewable energy options. Perceived high financial risks of investment and limited capacities for manufacture, installation and operation add to these unfavourable conditions (UNDP, 2016a).

**Bilateral cooperation with Germany**. Viet Nam is actively collaborating with Germany through various initiatives. GIZ has a strong local presence in Viet Nam with around 250 experts, local and international. Apart from a programme for the "creation of an overarching framework for nationally appropriate mitigation actions (NAMAs) and measurement, reporting and verification (MRV)", GIZ runs various projects in various sectors that support mitigation and adaptation planning and activities (GIZ, 2017a). Some of these projects and programmes are supported by the German International Climate Initiative (IKI), which in total supported/supports 48 projects in the country, which are run by a range of organizations. Viet Nam is also one of the two pilot countries for the NDC Partnership (Kipping, 2017).

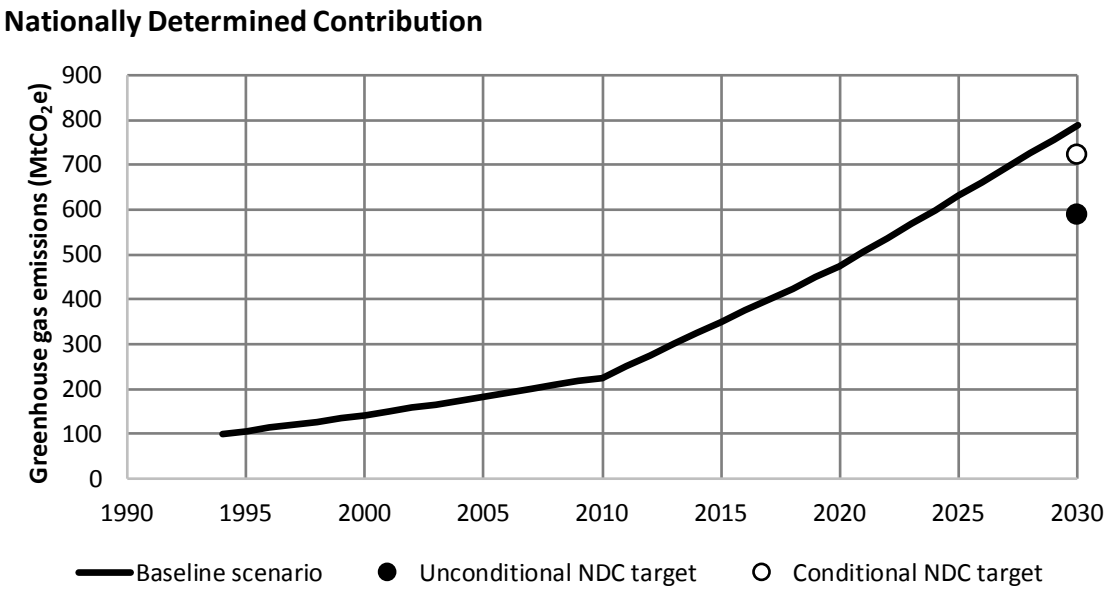
## 1.4 NDC and further mitigation potentials

**NDC**. The nationally determined contribution (NDC) of Viet Nam contains a conditional and an unconditional element. The unconditional contribution is to reduce GHG emissions by **8% below business-**

**as-usual (BAU) in 2030**. This could be increased to a reduction of **25% given sufficient international support**. The NDC covers all sectors, excluding GHG emissions from the industry sector. BAU emissions in 2030 are estimated at 787.4 $MtCO_2e$, more than tripling 2010 values of 246.8 $MtCO_2e$. Given this expected huge growth, the NDC does not represent a substantial deviation and likely falls within the uncertainty range of the BAU scenario.

Total GHG emissions in 2030 would be 724.4 $MtCO_2e$ for the unconditional contribution and 590.5 $MtCO_2e$ in the conditional case, the latter still representing more than twice the covered GHG emissions in 2010.

Figure 3: Illustration of the Nationally Determined Contribution of Viet Nam




Data source: Government of the Socialist Republic of Viet Nam (2014a).

**Beyond the NDC**. By 2030 the energy sector is expected to represent 80% of total emissions (excl. LULUCF). Nevertheless, within the NDC the sector is only expected to contribute 4.4% of the total reduction for the unconditional target and 9.8% to the conditional target. Considering the importance of the energy sector and particularly electricity generation, the main focus for additional mitigation activies could be on:

- Avoiding the expected quadruplication of energy demand by 2030, particularly for electricity; and
- To provide for remaining needed additional power generation capacity with renewable energy solutions instead of coal.

Additional areas with substantial potential beyond the NDC are the transport and industry sectors. With the development goal to transform Viet Nam into a highly industrialised country, measures in the sector are politically very difficult to implement. Energy efficiency measures in the sector (with a particular focus on electricity consumption) will, however, not only generate emissions savings, but also make the sector more cost efficient and thus increase competitiveness. There is very little quantitative information available for the sector.

**Mitigation potential**. The World Bank's low carbon development path (LCDP) published in 2016 estimates that energy efficiency in the household and industry sectors can reduce emissions by 10% compared to baseline, at an average negative marginal abatement cost. Electricity savings in industry and households could reach almost 64 billion kWh with measures up to the cost of US$10/tCO$_2$ (Audinet et al., 2016) (compare section 2.1). This shows that there is substantial potential beyond the efficiency measures included in the NDC.

Available studies looking at the potential for renewable energy, and particularly electricity supply, are often hard to compare due to the use of different units of measurement (tCO2e, MW, kWh, irradiation). Many do not assess total available potential, but rather evaluate effects of a pre-defined addition of renewable capacity compared to a baseline with no or limited renewables and many do not provide GHG emission savings, but use other units. Solar irradiation is estimated to be as strong as in most of the southwest United States and far superior to Germany (Audinet et al., 2016). Similarly, the technical potential for wind is substantial, particularly in coastal areas and in southern Viet Nam, and attractive for wind energy development (AWS Truepower, 2011). Overall, existing potentials mainly for wind and solar could be further exploited. (Compare section 2.2)

With a growing population and further urbanisation, transport will become a key sector for mitigation, with substantial mitigation potential as well as further sustainable development benefits.

# 2 Part II: Selected fields of action

The fields of action were selected after considering historic and projected sectoral emissions development; comprehensive literature on GHG mitigation potentials; identified barriers and emissions reductions; feasibility, costs, and co-benefits. For more information on mitigation potentials in Viet Nam, see section 3.6.

## 2.1 Increasing energy efficiency

The main driver for expected growth in GHG emissions in Viet Nam is the growing demand for energy, particularly electricity, to enable envisaged economic growth of a growing population. Demand for electricity is expected to rise from 143.7 billion kWh in 2015 to 572-632 billion kWh in 2030 (Government of the Socialist Republic of Viet Nam, 2016b). To allow time to revise supply options for replacing coal-fired power generation capacity it is essential to tap the existing efficiency potential in all electricity-consuming sectors as fast as possible.

Althoug Viet Nam has had the National Strategic Program on Energy Savings and Effective Use (VNEEP) in place since 2006, Viet Nam's energy intensity is the highest among major East Asian economies (Audinet et al., 2016), causing excess emissions and reducing the competitiveness of the country. The Law on Economical and Efficient Use of Energy from 2010, mandatory energy labelling regulations adopted in 2012 (Nachmany et al., 2015) and the Viet Nam Energy Efficiency Building Code from 2013 have so far not been able to substantially shift the trend.

The power sector is dominated by the state-owned 'Electricity Viet Nam (EVN)'. Electricity prices in Viet Nam are not determined by the market but fixed by the government at affordable levels. These are progressive, which means customers with higher consumption pay a higher price, while low consumption is supported with a subsidy. Overall electricity prices in real terms have decreased since 2003 (Ha-duong, Truong, Nguyen, Anh, & Trinh, 2016).

The VNEEP had the objective to promote energy conservation and a target to reduce energy use by 3%-5% in the 2006-2010 period and 5%-8% in the 2011-2015 period against baseline (Government of the Socialist Republic of Viet Nam, 2006). Within the Ministry of Industry and Trade (MoIT), the Energy Efficiency and Conservation Office was established in 2006 to support implementation of the Viet Nam National Energy Efficiency Programme.

The World Bank's low carbon development path (LCDP)[1] published in 2016 estimates that energy efficiency in the household and industry sectors can reduce emissions by 10% compared to baseline, at an average negative marginal abatement cost. Electricity savings in industry and households could reach almost 64 billion kWh with measures up to the cost of US$10/tCO$_2$ (Audinet et al., 2016).

This demonstrates the large untapped potential and illustrates the advantages of efficiency investments. A comprehensive framework could help enable this potential to be tapped. Possible measures include:

**Strengthen the legislative framework**. The country can build on its well-developed set of existing strategies and legislation. To enhance efficiency deployment, these could be revised, setting more ambitious targets and expanding the scope of mandatory efficiency standards. This can only lead to effective implementation if legislation is rigorously enforced and institutional capacities are scaled up to support implementation.

**Incentivizing efficiency investments**. The incentive for efficiency investments is closely linked to energy prices. With low energy prices largely being state-controlled, a pricing reform could substantially

[1] For more detail, see box 'Main sources' in chapter 3.6.2

enhance efficiency investments. The progressive electricity price system is a good starting point that can be further developed to support the adoption of efficient technologies and practices.

**Develop financing mechanisms**. One of the main barriers for energy efficiency investments is the availability of suitable financing mechanisms and the willingness of financial institutions to fund such activities. Utilizing international climate finance as well as technical support to set up adequate systems in collaboration with the private financial institutions on the ground could boost efficiency at household level and in industy.

**Promotion of energy efficiency technology**. Government procurement can play an important role in promoting energy efficiency technology. It saves government budget in the medium term and can help develop the national supply chain. This is particularly the case in socialist systems such as Viet Nam, with not only direct government investments being affected, but potentially also state-owned-enterprises, which could become frontrunners for efficiency, showcasing the economic attractiveness of such investments.

## 2.2 Incentivizing renewable electricity

Viet Nam already achieved an electrification rate of 99%. Nevertheless, demand is expected to largely retain the past growth rates. The latest power development plan foresees this additional demand mainly being met through coal fired power production. Coal is expected to generate over half of the electricity by 2030 (Government of the Socialist Republic of Viet Nam, 2016b), compared to around 30% today (IEA, 2016a).

The Renewable Energy Strategy up to 2030 was approved in 2015 with the objective to reduce emissions from energy by 25% by 2030 compared to BAU. The envisaged increase of the share of renewable energy in primary energy to 32.3% in 2030 and in electricity production to 32% by 2030 represents an increase of only around 1% for primary energy and a decrease by 10% for electricity production compared to 2014 (IEA, 2016a). The declining share of renewables in electricity generation comes from the fact that hydro is becoming less important as expansion here is limited and most new capacity is expected to be coal or gas.

The National Power Development Plan VII 2016-2030, which was approved in March 2016 increased the expected share of non-hydro renewables compared to previous versions. However, targets for wind and solar remain lower than envisaged in the renewable energy strategy and the plan still rests heavily on the expansion of coal fired power and foresees 77 new coal-fired power generation units by 2030 (see Annex I). Cost for energy imports are expected to increase, as domestic production is not expected to be able to satisfy increased demand.

The Ministry of Industry and Trade (MoIT) is responsible for the energy sector with the General Department of Energy and the Electricity Regulatory Authority. The power sector is dominated by the state-owned 'Electricity Viet Nam (EVN)'. Coal extraction is run by the Viet Nam National Coal - Mineral Industries Group (VINACOMIN), a state-owned enterprise. With this very centralized system, investment for new generation infrastructure currently mainly falls on the government.

Support mechanisms for wind (established 2011), biomass (2014) and recently solar PV (2017) open the sector for private investment and integrate these technologies in the overall planning process at all levels of governance. The mechanism includes the obligation for EVN to buy any electricity generated by such technologies, clarifies grid connection and includes standardized power purchase agreements (PPAs), which are valid for 20 years after signature. Financial incentives include a feed-in-tariff, duty exemptions and tax benefits.

Available studies looking at the potential for renewable energy, and particularly electricity supply, are often hard to compare due to the use of different units of measurement (tCO2e, MW, kWh, irradiation).

Many do not assess total available potential, but rather evaluate effects of a pre-defined addition of renewable capacity compared to a baseline with no or limited renewables. Solar irradiation is estimated to be as strong as in most of the southwest United States and far superior to Germany (Audinet et al., 2016). Similarly, the technical potential for wind is substantial, particularly in coastal areas and in southern Viet Nam, and attractive for wind energy development (AWS Truepower, 2011). Overall, existing potentials mainly for wind and solar could be further exploited. To do this, a number of factors need to be addressed:

**Strengthen existing support mechanisms**. The renewable energy strategy and the support mechanisms are a step in the right direction, but could go further to fully tap the available wind and solar resources. To achieve this, the existing support framework would need to be strengthened and supplemented. The current level of the feed-in-tariff is considered to be too low to attract large-scale investment. Strategic documents that send differing signals to investors are also not helpful to create an active investment environment. Harmonizing the different strategies and sending a clear and more ambitious signal would help spark investor intrest, if combined with a clear and easy to manage support framework.

**Attracting investment through price signals**. Low electricity prices and lack of competitiveness are a major barrier to the attractiveness for investment in renewable energy generation. Although consumption subsidies as calculated by the IEA have decreased over the last years, the built-up debt of state-owned energy companies and foregone revenues impact the competitiveness of different energy options. An energy pricing reform would not only need to tackle consumer prices, but also address issues such as discounted or free resources and infrastructure, preferential loans from state-owned banks, loan guarantees or bail out of loss-making units, a variety of corporate tax breaks and concessions and the social and environmental costs that result from energy production.

**Strengthening financial sector capacity**. Weak financial capabilities of commercial banks in assessing mitigation investments and a lack of capacity of investors to manage such projects (particularly for utility-scale renewables) have been identified as an important barrier to enhanced investment in renewables. As for energy efficiency, building the local and regional capacity of financial institutions is key to enhanced mitigation. This can be supported by international climate finance.

**Preparing the grid**. Grid planning is currently centered on new coal-fired power plants, linking sites with relevant industrial or urban centres. Integrating a larger share of renewables will require a different approach. A large expansion of the grid is planned up to 2030 to keep up with increased demand and generation capacity. Revising these plans to enable transmission from more decentralized areas with high wind and solar potential, together with necessary smart grid technology, peak load capacity and storage needs to support enhanced deployment of renewable power generation.

# 3 Part III: Full country analysis

## 3.1 Country background

**Geography**. Viet Nam is situated in Southeast Asia and borders China to the north, Laos and Cambodia to the west, and the East Sea to the east, south, and southwest. Viet Nam is characterised by its long coastline and a long, narrow shape with extending 1,662 km from north to south and between 600 km from east to west at its widest and 50 km at its narrowest sections. Viet Nam has two major deltas, the Mekong River Delta and Red River Delta (Government of the Socialist Republic of Viet Nam, 2014c).

Figure 4: Map of Viet Nam


Source: the Authors based on Google Maps

**Population**. In 2014, total population was 91 million (World Bank, 2017b). Population growth rates have been constantly declining over the last decades and are currently just over 1% per year and expected to decline further. This development is expected to lead to a population of 105 million by 2030 (United Nations Department of Economic and Social Affairs Population Division, 2015). Currently one third of the population lives in urban areas (World Bank, 2017b). Urbanization is expected to continue and by 2030 around 43% of the population is expected to live in urban areas (United Nations Department of Economic and Social Affairs Population Division, 2014).

**Economy**. Viet Nam has experienced strong economic growth over the last decades. GDP in 2015 was USD 194 billion, up from around USD 6 billion in 1990 (World Bank, 2017b). Vietnamese growth is driven by international trade and foreign investment. The Human Development Index (HDI) has improved from 0.48 in 1990 to 0.67 in 2014. This puts it on a similar level to many Central American countries, but still quite a way from developed countries, such as Germany with a HDI of 0.92. However, the country still suffers from relatively high levels of income inequality, disparities in healthcare

provision, and poor gender equality (UNDP, 2016b). In 2015, Viet Nam was the only country in South-east Asia to have experienced a boom in its exports, which constitute an important contribution to GDP. The impact of the financial crisis on Viet Nam was limited, and the country experienced a GDP growth of 6.0% in 2014 and 6.7% in 2015 (GSO, 2015).

Certain sectors, e.g. industrial production, textile, shoe, electronics and seafood production have been growing rapidly. Viet Nam's economic activity moderated in 2016, with GDP expanding by 6.21% (GSO, 2017). This slow-down is considered a result of severe drought, affecting agricultural production, and slower industrial growth. Growth has resulted in a reduction in poverty, and per capita income has increased from around USD 100 in 1990 to USD 2,050 in 2014. The poverty rate declined from around 70% to 12% over the last fifteen years (World Bank, 2017b). Unemployment and underemployment are in general low, but is disproportionately high for young people (GSO, 2015).

**Political system**. The Socialist Republic of Viet Nam is a one-party state, with the Communist Party of Viet Nam playing the leading role in all political areas. It is a communist system, with many economic areas run by the state, particularly in the energy sector. The National Assembly produces framework legislation, while the government provides guidance on the implementation of legislation (Nachmany et al., 2015). The General Secretary of the Communist Party performs numerous key administrative and executive functions, controlling the party's national organization and state appointments, as well as setting policy. Only political organizations affiliated with or endorsed by the Communist Party are permitted to contest in elections in Viet Nam.

The country is, however, increasingly liberalizing the economy and opening for international investment (CIA, 2017). Nevertheless, the political and economic system is very much characterized by a top-down planning approach, with a series of 10-year socio-economic development strategies (SEDS) operationalized by 5 year planning cycles. Currently the Socio-Economic Development Plan from 2016 - 2020 (Government of the Socialist Republic of Viet Nam, 2016e) governs decision-making.

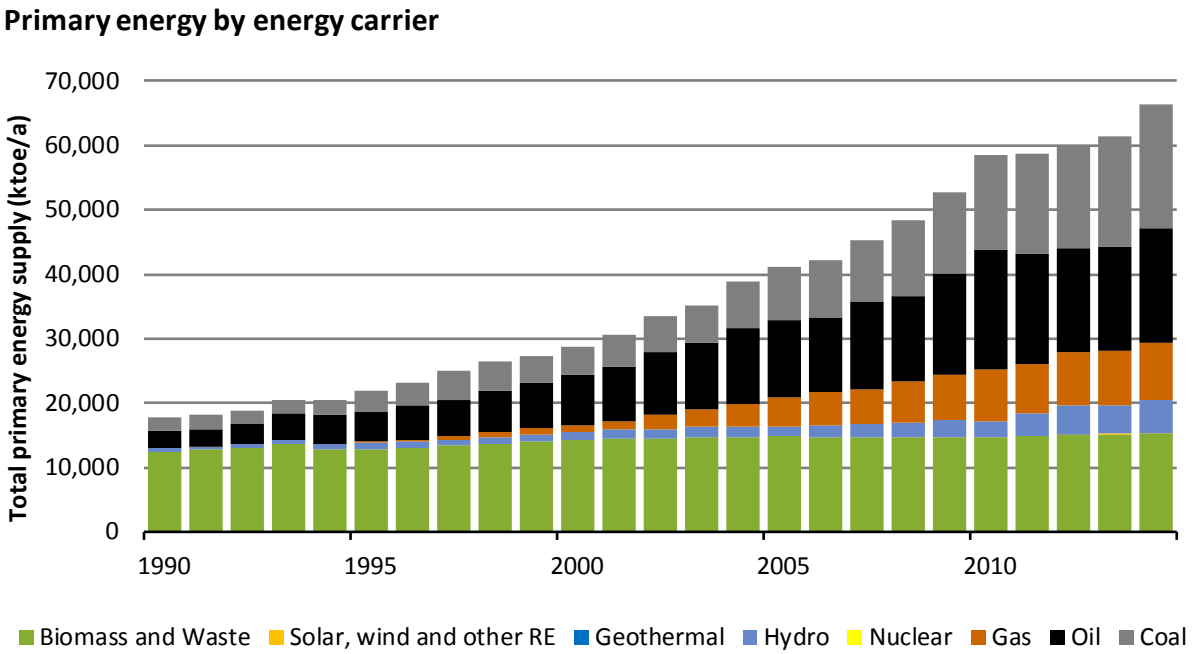
Table 5: Key socio-economic figures (2014)

| Viet Nam | | | |
|---|---|---|---|
| Population [million] | 91 | Urban population [% of total] | 33% |
| GDP [current billion USD] | 186 | Electrification rate [%] | 99% |
| GDP/Cap [current USD/cap] | 2052 | HDI [1] | 0.67 |
| Gini-coefficient [1] | 37.6 | Corruption index [1] | 3.0 |

Data sources: ND-GAIN (2017); UNDP (2015); United Nations (2014); World Bank (2017b), GDP per capita calculated based on World Bank (2017b)

**Energy system**. Primary energy use is dominated by fossil fuels. Coal is the largest energy source with 29% of total supply, followed by oil (27%), biomass and waste (23%), and gas (13%). The traditional use of biomass and waste has remained constant since the early 90s and growing demand has been largely met by fossil fuels and an increasing share of hydro. The share of other renewable energy is as yet negligible in primary energy (IEA, 2016a) and constitutes only 3.7% of electricity generation with the bulk of electricity production almost equally distributed between coal, gas and hydro (GIZ, 2016c).

Figure 5: Total primary energy supply by energy carrier



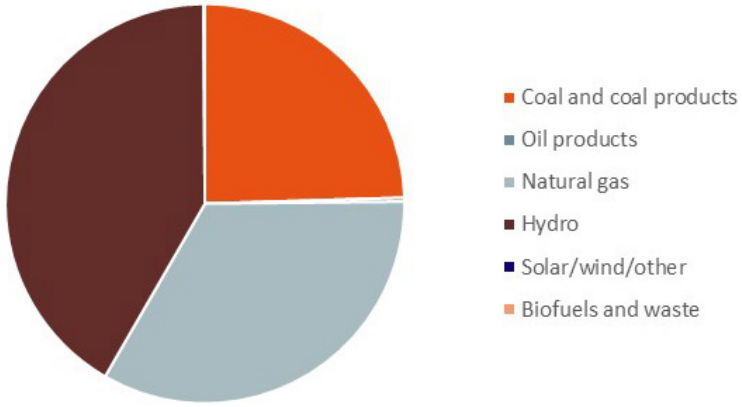

Data sources: IEA (2016a)

Viet Nam has substantial hard coal reserves as well as oil and gas. However, the demand in industry and for power generation is so high, that the country became a net importer of coal in 2015. Oil and gas reserves are also substantial and mainly located offshore. Exploration is ongoing and is expected to increase proven reserves further, although exploration may be technically and economically challenging. Viet Nam is a net exporter of crude oil, but a net importer of refined oil and is currently planning the extension of national refining capacity. All of the country's gas production is consumed nationally, and the import of LNG is planned with two import terminals scheduled to be completed by 2023 (EIA, 2016).

According to the Master Plan of Coal Industry Development in Viet Nam by 2020, with perspective to 2030, which was adjusted in 2016, total coal output (production) was planned at 41-44 million tons in 2016, 47-50 million tons (in 2020), 51-54 million tons (in 2025) and 55-57 million tons (in 2030) (Government of the Socialist Republic of Viet Nam, 2016a).

**Power generation**. Viet Nam already achieved an electrification rate of 99%. Nevertheless, demand is expected to largely retain the past growth rates and rise from 143.7 billion kWh in 2015 to 572-632 billion kWh in 2030. The already experienced and potential further impacts of climate change are expected to reduce the ability of the country to expand its hydro power capacity to meet future growth in demand. Based on the expected large growth in electricity demand, this is projected to lead to a decline in relative importance. The latest power development plan foresees this additional demand mainly being met through coal fired power production. Coal is expected to generate over half of the electricity by 2030. Viet Nam is also planning to have nuclear power contributing to electricity generation by 2030, which was originally scheduled to already be available by 2020 (GIZ, 2016c).

Figure 6: Fuel mix in electricity generation in 2014




Data sources: IEA (2016a)

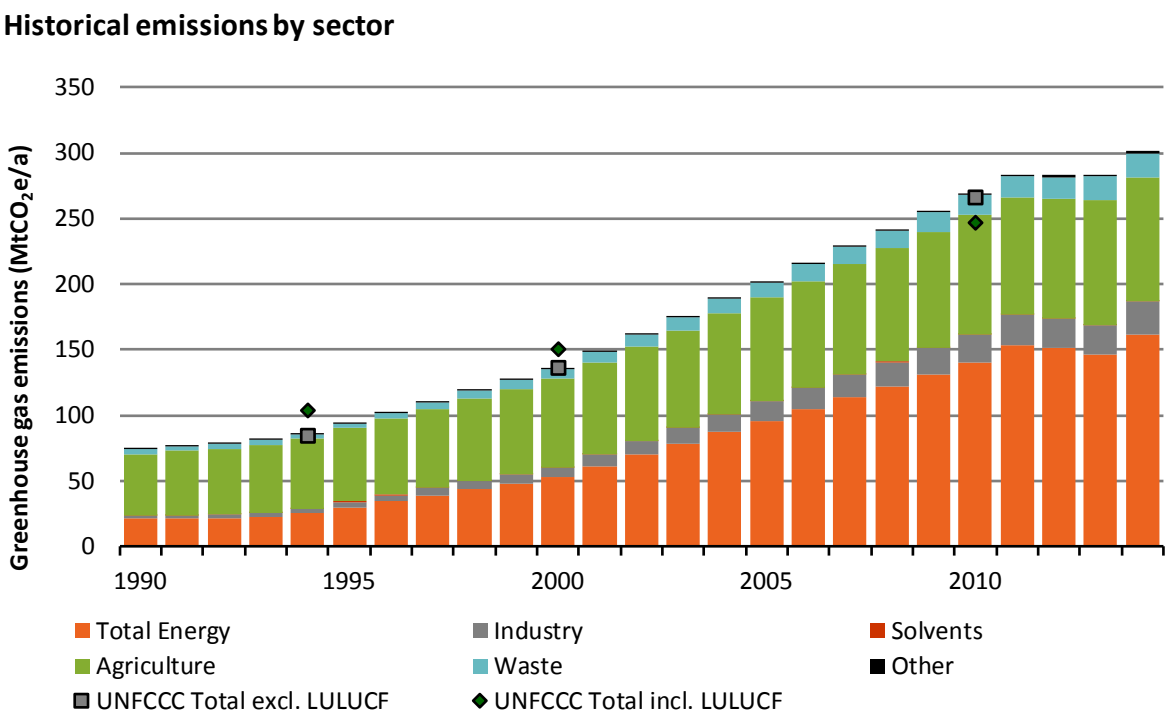
The power sector is dominated by the state-owned 'Electricity Viet Nam (EVN)'. Electricity prices in Viet Nam are not determined by the market but fixed by the government at affordable levels. These are progressive, which means customers with higher consumption pay a higher price, while low consumption is supported with a subsidy. Overall electricity prices in real terms have decreased since 2003 (Ha-duong et al., 2016).

**Emissions**. Total emissions for 2010 reported in the last inventory were 246.8 $MtCO_2e$ and 266 $MtCO_2e$ if excluding LULUCF (Government of the Socialist Republic of Viet Nam, 2014c). The latter are estimated to have further increased to 301 $MtCO_2e$ by 2014 (Gütschow et al., 2016), representing 0.6% of global emissions.

The largest contributor of non-LULUCF emissions is the energy sector representing around half of emissions, 88% of which from power generation. The sector has grown substantially in absolute emissions and relative importance over the past decades. This is followed by the agricultural sector, which still accounts for almost a third of emissions, but has seen a modest absolute growth and a dramatic decline in relative importance, from 64% in 1994 to 34% in 2010.

Although the shares of the industry and waste sectors have doubled since 1994, they still represent a small contribution to total emissions, with 8% for industry and 6% for waste. The technical analysis under the UNFCCC's international consultation and analysis (ICA) process indicated however that only emissions from cement and lime production are explicitly estimated under industry, with other emissions subsumed under energy, including feedstocks used as reductants. Improved attribution could increase the share of emissions and expected future industrial expansion could largely increase the importance of the sector (UNFCCC, 2015). While emissions and energy intensity per unit of GDP have decreased over the last decades, per capita emissions have roughly tripled over the same period from 1.1 $tCO_2e$ per capita in 1990 to 3.3 $tCO_2e$ in 2014, nevertheless remaining below world average.

Figure 7: Historical emissions profile by sector

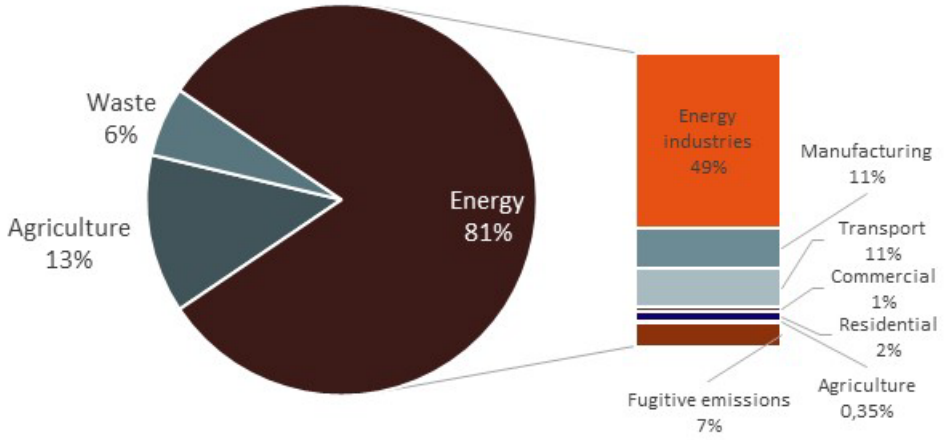



Data sources: EU JRC & PBL (2014); Gütschow et al. (2016); UNFCCC (2016)

The importance of energy related emissions is projected to increase even futher, representing 81% of baseline emissions excluding LULUCF and industry[2]. Half of this is expected to come from the energy industries sector, with an additional 7% from fugitive emissions, both closely related to fossil-fuel power generation. LULUCF emissions have changed from a source in previous inventories to a sink in 2010 and this sink is expected to roughly double by 2030 under the baseline scenario.

[2] Industry is excluded, as the NDC does not cover the sector

Figure 8: Projected emissions by sector in 2030




Data source: Ministry of Natural Resources and Environment (2015)

Table 6: Key emissions, energy and environmental data (2014)

| Viet Nam | | | |
|---|---|---|---|
| GHG/cap [tCO2e/cap] | 3.32 | Share of energy use imported | -16% |
| GHG/GDP [tCO2e/2012 USD] | 1616.50 | Air pollution index (P2.5) | 27 |
| Global share of emissions [%] | 0.6% | Vulnerability index [1] | 0.4 |

Data sources: Gütschow et al. (2016); IEA (2016b); ND-GAIN (2017); World Bank (2017b)

**Forestry**. In the past years, the forest cover of Viet Nam has increased significantly due to the establishment of plantations for commercial purposes, a result of the allocation of land use rights from the state to different entities. However, natural forests have decreased and become increasingly degraded due to a variety of causes. Deforestation and forest degradation in Viet Nam are mostly driven by forest conversion to other land uses (e.g., annual food crops, rubber, coffee, and hydropower dams) as a consequence of increasing demand for agricultural crops to meet local food needs and industrial and commercial plantations destined for the world's agricultural product markets (Do, 2015).

**Agriculture**. Agricultural production more than tripled between 1990 and 2013, with agro-food exports soaring, with cashews, black pepper, coffee, cassava, rice and fisheries being important export commodities (OECD, 2015). Nevertheless, the importance of the sector for the overall economy has decreased over the last years, with the share in GDP reducing from 22% in 2011 to below 19% by 2015, although still 44% of the population are employed in the sector (down from 70% in 1996) (World Bank, 2017b). Rice cultivation and agricultural soils are the main drivers for emissions in the sector, followed by enteric fermentation and manure management (Zeleke, Phung, Tulyasuwan, O'Sullivan, & Lawry, 2016).

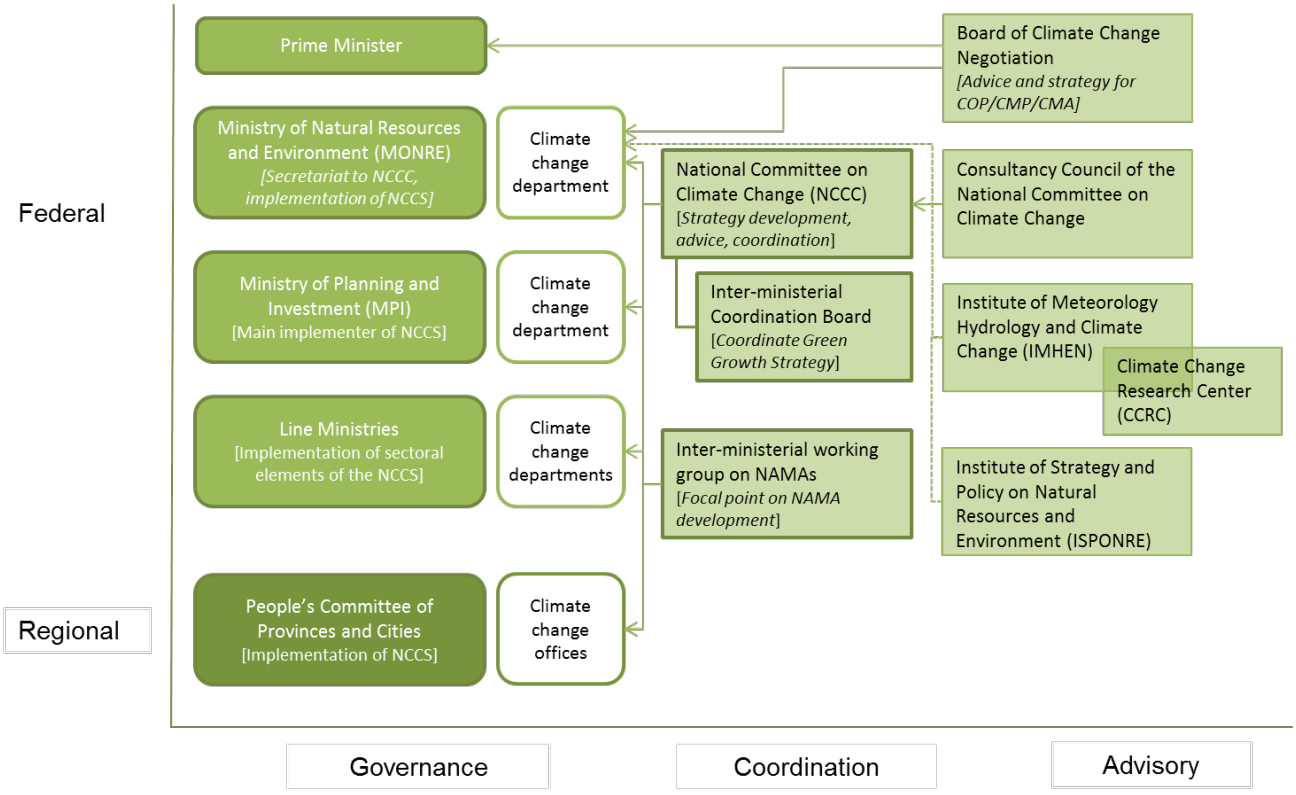
**UNFCCC negotiations**. Viet Nam is member of the Group of 77 and China, but otherwise not very active in the negotiations. It was one of the first non-Annex I countries to submit its Biennial Update Report (BUR) on 8 December 2014.

**Bilateral cooperation with Germany**. Viet Nam is actively collaborating with Germany through various initiatives. GIZ has a strong local presence in Viet Nam with around 250 experts, local and international. Apart from a programme for the "ceation of an overarching framework for nationally appropriate mitigation actions (NAMAs) and measurement, reporting and verification (MRV)", GIZ runs various projects in various sectors that support mitigation and adaptation planning and activities (GIZ, 2017b) Some of these projects and programmes are supported by the German Climate Initiative, which in total supported/supports 48 projects in the country, run by a range of organizations. Viet Nam is also one of the two pilot countries for the NDC Partnership (Kipping, 2017).

## 3.2 Institutional set up

Overall, Viet Nam has a highly developed institutional setup to address climate change issues. There are clear responsibilities assigned and coordination and advisory services are in place. However, the functioning of the system towards actual implementation largely rests on the willingness of individual line ministries and People's Committees and the availability of funding, either from national budgets or international support. The focus of advisory services in the past has been strongly towards climate impacts and adaptation options, based on the high vulnerability of the country. Recent and ongoing international support is also aiming to strengthen the capacities for mitigation at all levels. Figure 9 illustrates institutions on the regional and federal level and their respective roles, which the following sections describe further.

Figure 9: Flowchart of organisational setup




Source: Authors

### 3.2.1 Governance

As focal point for the State governance of all climate change related activities in Viet Nam, the **Ministry of Natural Resources and Environment (MONRE)** plays a central role. It is responsible for climate change related policies, for developing guidelines and designing response mechanisms. Moreover, MONRE has responsibilities concerning the implementation of policies, the supervision of their progress and the formulation of MRV frameworks. The GHG inventory is established under the lead of this ministry. The Department of Meteorology, Hydrology and Climate Change (DMHCC) with MONRE is Viet Nam's Designated National Authority (DNA) and the focal point for the CDM and NAMAs. It also serves as the standing office of the National Steering Committee to implement the NTP-RCC.

The **Ministry of Planning and Investment (MPI)** has the primary responsibility to perform the functions of State governance and management of planning and investment processes and to take the lead on the integration of climate change into national and provincial socio-economic development planning, strategies and programmes. In this function MPI developed the Green Growth Strategy of Viet Nam. It also coordinates and allocates funds for energy proposals submitted by line ministries and agencies.

**Line ministries** are responsible for developing and implementing strategies and action plans for their respective areas of responsibility as outlined in the National Climate Change Strategy (NCCS). The Ministry of Finance (MOF) additionally formulates energy sector taxation and tariff, thus playing a crucial role in the energy sector.

Given the importance of the energy sector in the emissions profile, the **Ministry of Industry and Trade** (MoIT) plays a central role. It is responsible for the energy sector with the General Department of Energy and the Electricity Regulatory Authority. The lack of expected contribution from the energy sector towards achieving the NDC and the exclusion of industry are indicators that a stronger institutional involvement of the Ministry in climate change activities is required to achieve a true low carbon economy. Within the MoIT, the Energy Efficiency and Conservation Office was established in 2006 to support implementation of the Viet Nam National Energy Efficiency Programme.

Line ministries are responsible for developing and implementing strategies and action plans for their respective areas of responsibility as outlined in the National Climate Change Strategy (NCCS), including the Ministry **of Agriculture and Rural Development**, which is responsible for agriculture and forestry, the **Ministry of Transportation** and the **Ministry of Construction**. The **Ministry of Finance** (MOF) manages disbursements and recurrent expenditures of the entire State economy. It formulates energy sector taxation and tariff, thus playing a crucial role in the energy sector.

### 3.2.2 Coordination

In 2011, the National Climate Change Strategy (NCCS) established an institutional setup for the coordination of climate change activities. It established the **National Committee on Climate Change (NCCC)**, with the Ministry of Natural Resources and Environment (MONRE) as permanent agency and main implementer and the Ministry of Planning and Investment (MPI) as main implementer in collaboration with the other line ministries, sectors and local entities.

The NCCC consists of representatives of 28 national ministries, departments and agencies and is chaired by the Prime Minister. The key function of the NCCC is to propose strategic solutions and mobilize and coordinate resources to respond to climate change, which includes adaptation and mitigation activities, although the focus has been on adaptation so far. The NCCC creates research proposals responding to climate change information requirements of the Government, assists the Prime Minister in the coordination between ministries and agencies, and develops interdisciplinary strategies and national programs concerning climate change and green growth projects.

Furthermore, the NCCC is the main institution for monitoring of climate change activities including NAMAs. The NCCC is the responsible committee for advising the Government on all issues concerning climate change policy in Viet Nam. Moreover, the NCCC is responsible for mobilizing and coordinating financial resources for implementation of the proposed strategies and programs in order to effectively respond to climate change.

The **Inter-ministerial Coordination Board (ICB)** was established under the National Committee on Climate Change to direct the implementation of the National Green Growth Strategy.

In 2013, the **Inter-ministerial working group on NAMAs** was established by MONRE to advise and propose on measures to establish the institutional framework including policies, documents for integration of NAMAs into the sustainable development strategies, programs and plans of the ministries, agencies and localities as relevant.

The **People Committees of provinces/cities** under the central government are required to cooperate with related ministries, agencies to participate in the national GHG inventory taking and to supervise the implementation of mitigation measures in their territories.

### 3.2.3 Advisory

In 2012, the **Board of Climate Change Negotiation** of Viet Nam was established. It is responsible for research[3] and proposing to the Prime Minister on the framework of alternatives, and long-term issues which should be included in the negotiations. The Board is in charge of developing annual plans for participation at the Conference of Parties (COP) and Conference of the Parties serving as the meeting of the Parties to the Kyoto Protocol (CMP).

The **Consultancy Council of the National Committee on Climate Change,** with 23 leading Vietnamese scientists providing consultancy advice to the National Committee related to National policy frameworks, strategies, action plans, programs on climate change and green growth.

The **Institute of Strategy and Policy on Natural Resources and Environment (ISPONRE)** is the state agency under MONRE which has the responsibility to support the Minister in researching, proposing and developing strategies and policies on fields and to implement scientific research and provide the public service, consultation and training on natural resource management and environmental protection according to law provisions. Its functions are those of an Environmental Protection Agency as found in many countries, such as the German 'Umweltbundesamt'.

The **Viet Nam Institute of Meteorology Hydrology and Climate Change (IMHEN)** is a governmental, research and implementation institution under MONRE of Viet Nam. IMHEN has long experience in conducting application research in the field of meteorology, hydrology, oceanography and environment. IMHEN has been registered with the Ministry of Science and Technology (MOST) for its R&D activities. The Climate Change Research Center (CCRC), established within IMHEN, studies climate change trends, adaptation and mitigation.

## 3.3 MRV of GHG emissions

Viet Nam submitted its second national communication to the UNFCCC in 2010 and is currently working on the third national communication, expected to be submitted in 2018. It submitted its first biennial update report in December 2014 and its reference levels for REDD+ in 2016.

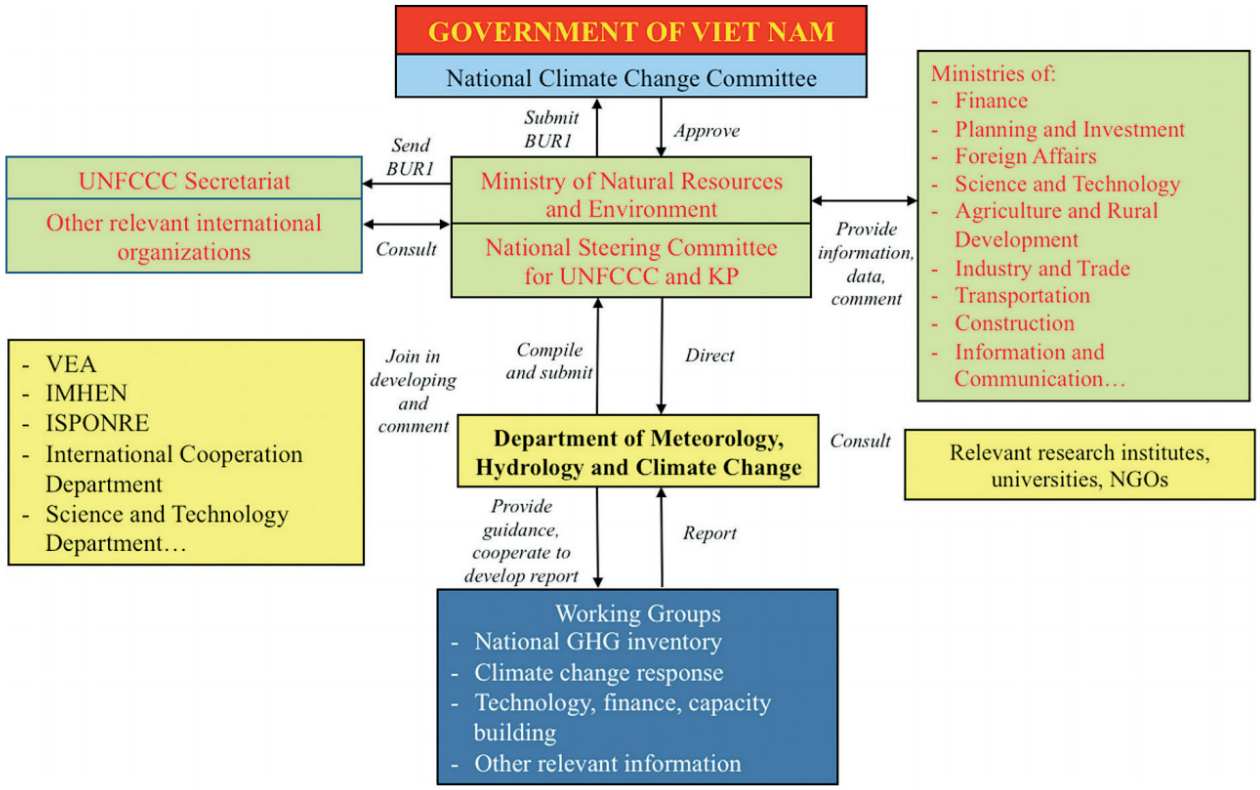
[3] There is potential overlap with research conducted by the NCCC, but the focus here is on the UNFCCC negotiations, while the NCCC addresses national implementation issues

The Ministry of Natural Resources and Environment (MONRE) is the focal agency of the Government and tasked with the preparation of future reporting to the UNFCCC. The Department of Meteorology, Hydrology and Climate Change (DMHCC) under MONRE has an advisory role.

Viet Nam has been working to establish an MRV system that operates on a continuous basis to allow timely submission of reporting to the UNFCCC. This includes all required reports and the inventory. The country received support from the Japan International Cooperation Agency (JICA) for preparing the first BUR, as well as designing and setting up the MRV system (Government of the Socialist Republic of Viet Nam, 2014c). Figure 10 illustrates the system used for the preparation for the first BUR, which is likely to be the model for future reporting.

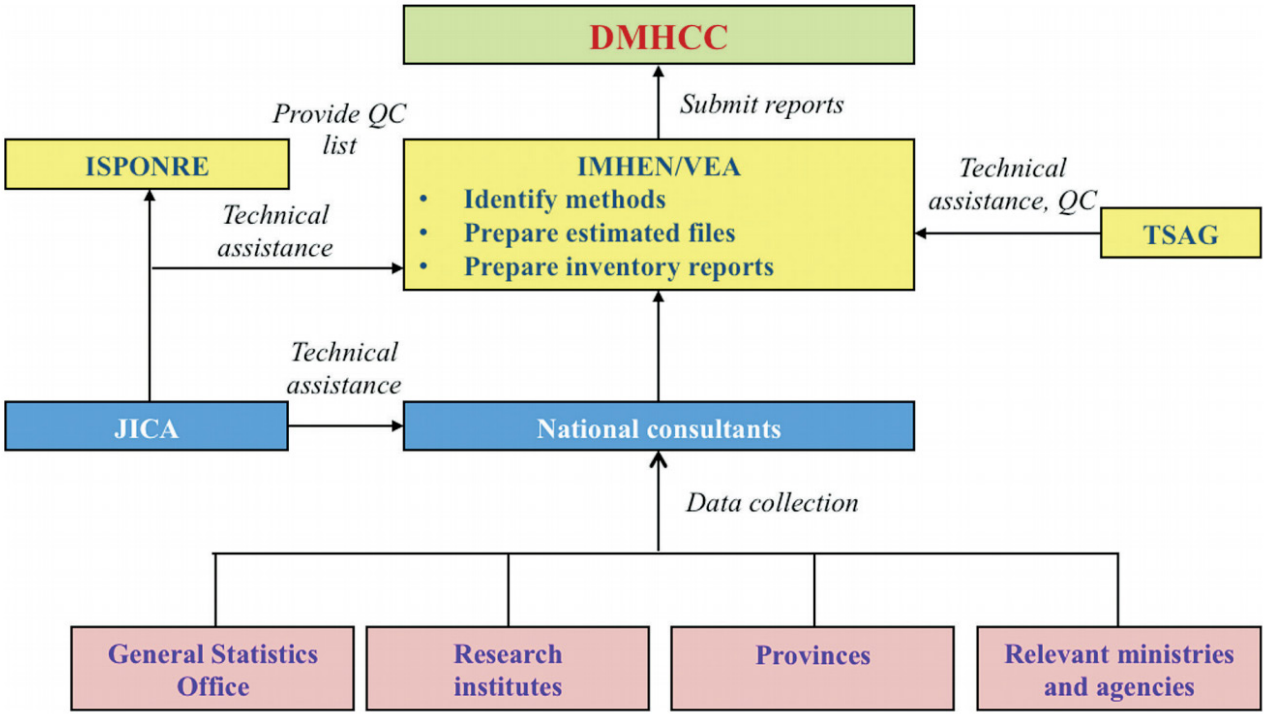
The inventory uses the Revised 1996 IPCC Guidelines and mainly applies tier 1 methodologies, with some country specific data in the agriculture, LULUCF and waste sectors. The analysis conducted as part of the international consultation and analysis (ICA) process commends Viet Nam on its progress in improving the process for inventory preparation and reporting, but also notes potential future improvements in moving to higher tiers for some sub-categories and attribution of emissions from industrial activities (UNFCCC, 2015). Figure 11 shows the setup for the preparation of the GHG inventory.

Figure 10: Institutional setup for BUR preparation




Source: Government of the Socialist Republic of Viet Nam (2014c)

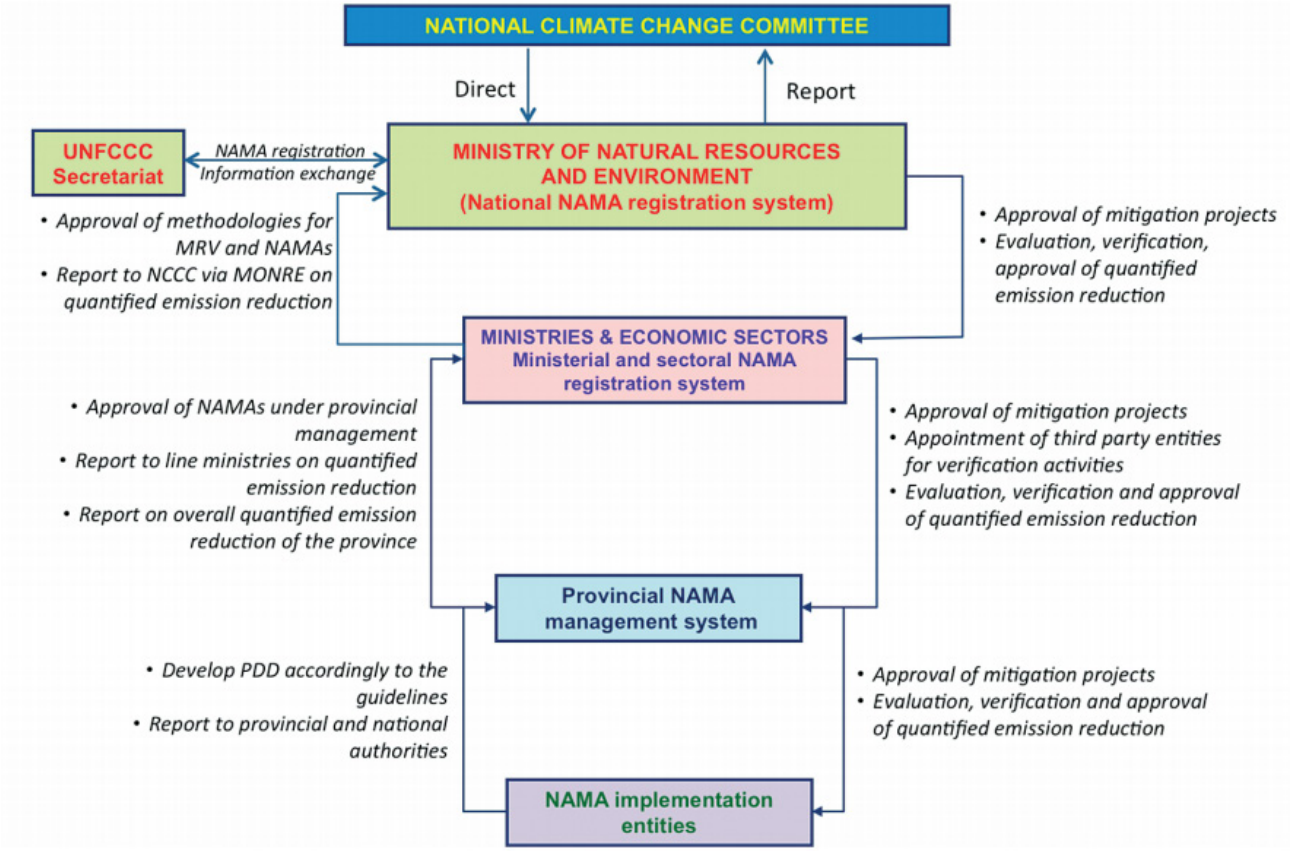
Figure 11: Institutional setup for GHG inventory preparation




Source: Government of the Socialist Republic of Viet Nam (2014c)

There is currently not yet a specific system to MRV mitigation actions, including NAMAs, but setting this up was a specific task for the period of 2012-2015 within the Plan of management of GHG emissions and management of carbon trading activities to the world market (Government of the Socialist Republic of Viet Nam, 2014c). The process so far resulted in the proposed institutional arrangement for national and sectoral MRV systems shown in Figure 12.

Figure 12: Proposed institutional setup for national and sectoral MRV




Source: Government of the Socialist Republic of Viet Nam (2014c)

## 3.4 Description and evaluation of the NDC

**The contribution**. The nationally determined contribution (NDC) of Viet Nam contains a conditional and an unconditional element. The unconditional contribution is to reduce GHG emissions by 8% below business-as-usual (BAU) in 2030. Viet Nam intends to achieve this target by reducing emissions intensity of GDP by 20% compared to 2010 levels and increasing the forest cover to 45%[4].

The target could be increased to a reduction of 25% given sufficient international support. In this case, emission intensity would be reduced by 30% compared to 2010 levels.

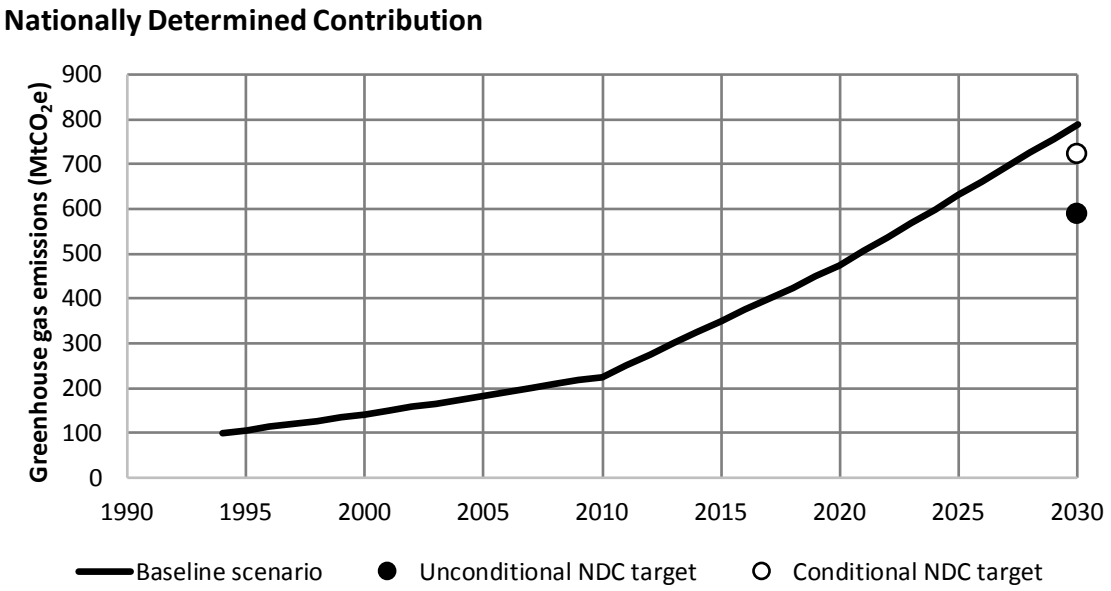
**Resulting emissions**. BAU emissions in 2030 are estimated at 787.4 $MtCO_2e$ incl. emissions from LU-LUCF, more than tripling 2010 values of 246.8 $MtCO_2e$. Given this expected huge growth, the NDC does not represent a substantial deviation and falls likely within the uncertainty range of the BAU scenario. Total GHG emissions in 2030 would be 724.4 $MtCO_2e$ for the unconditional contribution and 590.5 $MtCO_2e$ in the unconditional case, the latter still representing more than twice the covered GHG emissions in 2010.

**Coverage**. The NDC covers all sectors, excluding GHG emissions from the industry sector. These represented 7.9% of total emissions (excl. LULUCF) in the 2010 inventory as reported to the UNFCCC, even though this only covered emissions from cement and lime production, as other sub-categories were

[4] According to the FAO's 2015 Forest Resources Assessment, Vietnam forest cover is already 47.6%, thus surpassing the NDC target (FAO, 2015). However, the Vietnam Ministry of Agriculture and Rural Development (MARD)'s reported forest cover is usually lower than that of FAO. Based on MARD data, forest cover in Vietnam was 39.7% in 2013 (Do, 2015)

reported in the energy sector or not estimated (UNFCCC, 2015). The NDC does not provide an explanation for the exclusion of the sector from its contribution. Given the envisaged industrialization of the country, the sector can be expected to grow substantially and could deliver important mitigation potential.

Figure 13: Emissions levels under the NDC (incl. LULUCF, excluding industrial processes)




Source: own illustration based on Government of the Socialist Republic of Viet Nam (2014a)

**Assessment of the baseline**. The NDC does not specify which existing (or planned) strategies and policies are included in the baseline and which ones are considered part of the mitigation effort, which makes evaluation of 'additional' mitigation potential difficult. Apart from the restricted coverage of the NDC, there is also indication that the baseline may not appropriately reflect likely future developments, mainly due to assumptions in the energy sector. Here, outdated electricity demand projections were used that are not in line with the most current (lower) estimates from the Ministry of Energy (Ministry of Industry and Trade, 2015b) at the time of INDC preparation.

Additionally, the baseline assumes that all expected demand growth is delivered through new coal-fired power. The National Master Plan for Power Development from 2011 (Government of the Socialist Republic of Viet Nam, 2011b) includes a small, but growing share of renewable energy generation, with a share of 6% by 2030. The NDC baseline assumes a constant absolute amount of renewable electricity generation at 2010 levels up to 2030, effectively decreasing the share of renewables in total generation from 3.5% to 0.4%. This is not only inconsistent with existing strategies and the baseline as reported in the first biennial update report (BUR) (Government of the Socialist Republic of Viet Nam, 2014c), but considering the dynamic of renewable energy deployment globally and in the region highly unrealistic.

Transport sector emissions are estimated to remain constant between 2020 and 2030. The World Bank, however, estimates energy demand of the sector to increase by 7.6% per year, with emissions rising by 140% between 2010 and 2030 (Audinet et al., 2016).

No detailed information on baseline assumptions for LULUCF is provided. The sector plays an important role and is expected to generate a substantial share of emission reductions under the NDC. Provided information indicates that under BAU no land is expected to be converted to forest land by 2020 and 2030. This would not be consistent with the existing strategies and decisions. Overall, the

FREL/FRL (Government of the Socialist Republic of Viet Nam, 2016f) shows that there are no clear trends over the reference period, which highlights the high uncertainty connected to the sector.

Emissions from solid waste increase by around 580% between 2010 and 2030 in the BAU. This can not be explained through population growth. Using UN population projections (United Nations Department of Economic and Social Affairs Population Division, 2015), per capita emissions from the sector also increase by around 490% between 2010 and 2030.

**Policies and actions in the NDC**. The NDC contains a wide range of measures that aim to support implementation of the contribution. They cover all sectors included in the NDC and mainly remain at a general level, indicating the need to develop appropriate policies and instruments. The technical paper forming the basis for the NDC contains a range of more concrete technical potentials, quantifying the contribution of different sectors based on these technical potentials. For the agriculture, waste and LU-LUCF sectors the target, particularly to the conditional contribution, represents a significant deviation from BAU.

Table 7: GHG emission reduction targets compared to BAU in 2030

| 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: Ministry of Natural Resources and Environment (2015)

**Development process**. Viet Nam's NDC was developed with the participation and contributions from different line ministries, non-governmental organisations, research institutions, business sector representatives as well as international development partners. The process was supported financially by UNDP and GIZ, involving technical support through a number of external consultants.

**Consistency with other national targets**. Before the NDC, several legal documents already set mitigation targets. The first was Decision 1775 on the approval of the project "GHGs emissions management: management of carbon credit trading on the global market", which set sectoral targets for 2020. The National Green Growth Strategy also sets national targets for 2020, using a different base year, and sets an annual reduction target for the period 2020 to 2030.

Table 8: Comparison of NDC with other national targets

| Document | Reference | Target |
|---|---|---|
| Decision 1775 (2011) | 2005 base year (2020 target) | 8% energy and transportation<br>20% agriculture<br>20% LULUCF<br>5% waste |
| National Green Growth Strategy (2012) | 2010 base year (for 2020 target) | 2020: Reduce intensity of GHG emissions per unit of GDP by 8-10% or double the target with international support |

| Document | Reference | Target |
|---|---|---|
| | | 2030: Reduce total GHG emissions by at least 1% per year without and 2% with international support |

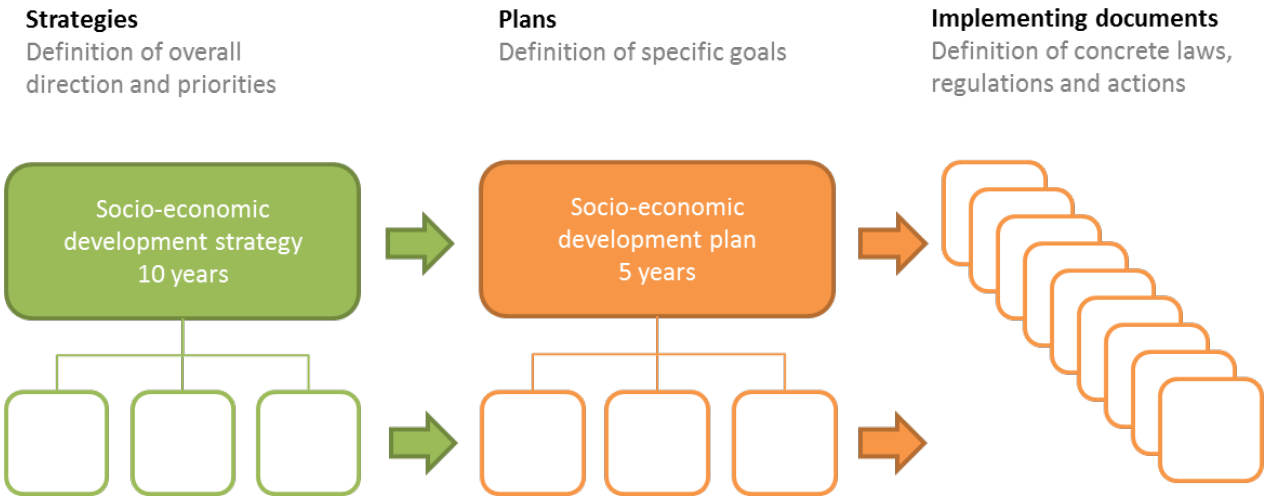
Due to the differences in reference[5], time frames and types of targets, the different documents are hardly comparable. However, it can be assumed that the 2020 targets, if implemented, should lead to lower projections for the 2020 to 2030 period than the baseline presented in the NDC.

## 3.5 Climate change mitigation policies and strategies

### 3.5.1 Regulatory framework

Viet Nam defines a clear hierarchical order of sources of law with 12 different levels. At the same time it includes different types of statutory documents issued by these different sources, making the legal system of Viet Nam quite complicated (PHAN, 2014). It is important to understand the main principles of the legislative system to understand the relevance and potential effectiveness of mitigation policies and strategies.

Figure 14: The legislative system in Viet Nam




Source: Authors

Figure 14 illustrates the relationship of the different strategy documents, plans and other legal documents. With the strong top-down approach to governance, it is important to implement climate change mitigation elements on all levels. While theoretically all documents should build on each other and respect higher-level legislation, in reality many inconsistencies exist. These can sometimes be based on revised information for newer documents. However, they can also result from lack of coordination and differing political interests.

Although all levels are binding, strategies and plans depend on 'inferior' documents, including Decrees and Circulars to support implementation (PHAN, 2014). The vast number of such documents makes it hard to evaluate how effective the strategic documents are in reality. Table 9 provides an overview of the most relevant strategies, plans and other legislative documents, the most important being described in more detail below.

[5] Some authors consider the absolute nature of the target set out in decision 1775 to be based on a mistake (KEPA & GreenID, 2014)

Table 9: Overview of relevant climate change mitigation policies and strategies

| Strategies | Plans | Other documents |
|---|---|---|
| Socio-economic development strategy for 2011-2020 (*4/2012*) | Socio-economic development plan for 2016-2020 (*4/2016*) | |
| National Energy Efficiency Program (*2006*) | Target Programme for Energy Efficiency and Conservation 2011-2015 (*10/2012*) | Law on Economical and Efficient use of Energy (*6/2010*)<br>Mandatory energy labelling regulations (*2012*) |
| National Climate Change Strategy (*12/2011*) | Target Programme on Climate Change Response and Green Growth 2016-2020<br>National Action Plan to Respond to Climate Change in 2012-2020 (*10/2012*)<br>Plan for implementation of the Paris Agreement (*10/2016*) | |
| National Green Growth Strategy (*9/2012*) | National Action Plan on Green Growth 2014-2020 (*3/2014*) | |
| National Strategy on Environment Protection to 2020 (*9/2012*) | | Law on Environmental Protection (*6/2014*) |
| National Energy Development Strategy up to 2020 (*12/2007*) | Revised National Power Development Plan VII (PDP 7 rev) 2016-2030 (*3/2016*)<br>National program for development bio-fuels up to 2015 (*11/2007*) | |
| Renewable Energy Development Strategy up to 2030 (*11/2015*) | | Mechanism to support the development of wind power projects (*03/2011*)<br>Mechanism to support the development of biomass power projects (*03/2012*)<br>Mechanism to support the development of solar PV (*04/2017*) |
| Viet Nam Forestry Development Strategy 2006 to 2020 (*02/2007*) | National REDD Action Programme 2011-2020 (*2012*) | |
| | | Resolution “Pro-actively responding to climate change, enhancing natural resource management and environmental protection” (*6/2013*) |

Note: approval dates are in brackets (*month/year*)

#### 3.5.1.1 Strategic framework

Climate change activities in Viet Nam have a long history. Already in 1992, with support from GEF and UNITAR, Viet Nam participated in the “Climate Change-Train” project. As a result, the Country Team on

Climate Change (CTCC) was established, responsible for coordinating and implementing climate change activities.

In 2007, the Government of Viet Nam approved the plan on the implementation of the Kyoto Protocol for the 2007-2010 period, which mandated the elaboration and completion of a legal framework and legal documents on the Climate Change Convention, Kyoto Protocol and Clean Development Mechanism (CDM).

The **Sustainable Development Strategy** is the overarching guidance for the period of 2011-2020. It requires that sustainable development is incorporated in a reasonable and harmonious way into the socio-economic development process and stresses that the protection of natural resources and the environment to ensure social security (Government of the Socialist Republic of Viet Nam, 2012). It is operationalised in the **Socio-economic Development Plan** for 2016-2020. The targets set out here that are most relevant for climate change mitigation are:

- Energy consumption based on GDP will reduce by 1%-1.5%/year.
- Forest cover will reach about 42% by 2020.

The target to develop a modern industrial economy will affect the sectoral structure of the economy and will place more importance on the industry sector (Government of the Socialist Republic of Viet Nam, 2016e).

The **National Climate Change Strategy** (NCCS), approved in 2011, sets out mainly the broad framework to incorporate climate change into sustainable development in all aspects of decision making, addressing both mitigation and adaptation. The strategy also establishes the NCCC and MONRE as the permanent agency for the NCCC and the MPI as the main implementation entity. But it also contains a wide range of concrete targets and plans to be prioritised in the period 2011-2015. The main targets relevant for mitigation include (Government of the Socialist Republic of Viet Nam, 2015a):

- Increase hydroelectric generation capacity to 20,000-22,000 MW by 2020
- Increase share of new and recycled energy to 5% of primary commercial energy by 2020
- Establish a new pricing system for energy by 2015 to enable energy savings
- 90% of industrial production facilities to use cleaner technologies and save energy, fuel and materials
- Reduce emissions from agriculture by 20% every 10 years
- Achieve 85% recycling/reuse rate of urban domestic solid waste by 2020
- Raise forest area to 45%

Some of these targets are not very ambitious or have been surpassed by more recent strategies. According to FAO Viet Nam has for example already surpassed its target of a 45% forest cover in 2015 (FAO, 2015) and the renewable energy target is superseded by the Renewable Energy Strategy (see below). Overall the strategy seems to lack a vision how to achieve the many good intentions stated.

The **National Action Plan on Climate Change** for the 2012-2020 period details the implementation of the goals set out in the NCCS, comprising 65 programmes, projects and tasks that aim to develop an adaptive and low carbon economy by 2020, with 10 priority tasks.

There are also a number of sectoral Action Plans of Climate Change Response:

- Action Plan on Climate Change Response of Agriculture and Rural Development Sector in the Period 2016-2020 (Decision No. 819/QĐ-BNN-KHCN)
- Action Plan of Climate Change Response and Green Growth in the period 2016 – 2020 in Transportation sector (Decision No. 1456/QĐ-BGTVT)

- Action Plan of Climate Change Response in Industry and Trade sector (Decision No. 4103/QĐ-BCT)
- Action Plan of Climate Change Response in the period 2014 – 2020 in Construction sector (Decision No. 209/QĐ-BXD)

The **National Green Growth Strategy** (NGGS), approved in 2012, aims to achieve a low carbon economy by greening the existing sectors and current lifestyles, and by encouraging development of new economic sectors using efficiently energy and resources with high added values. The strategy contains specific targets for 2020, 2030 and 2050 (Nachmany et al., 2015):

For 2020:

- GDP per capita doubled compared to 2010
- Reduce energy consumption per unit of GDP by 1.5-2% per year
- Reduce intensity of GHG emissions per unit of GDP by 8-10% or double the target with international support

For 2030:

- Reduce total GHG emissions by at least 1% per year without and 2% with international support.
- Environmental degradation is addressed and natural capital stocks are to be improved while access to and use of clean and green technology is significantly enhanced.

For 2050:

- Viet Nam has mainstreamed Green Economic Development.

In 2014, the NGGS was operationalised in the **National Action Plan on Green Growth** for the 2014-2020 period. The Action Plan includes 20 measures divided into 4 main groups: industry, transportation, agriculture and forestry.

The **Renewable Energy Strategy** up to 2030 was approved shortly after submission of the INDC and goes far beyond the international contribution. It has the objective to reduce emissions from energy by 25% by 2030 compared to BAU, increase the share of renewable energy in primary energy to 32.3% in 2030 and in electricity production to 32% by 2030. It contains additional targets specific to individual technologies, such as solar water heating, biogas and biofuels, as well as goals to increase efficiency of biomass-based stoves.

This has also impacted the revision of the **National Power Development Plan VII** 2016-2030, which was approved in March 2016 and which increased the expected share of renewables. However, the plan still rests heavily on the expansion of coal fired power and foresees 77 new coal-fired power generation units by 2030 (see Annex I), despite a statement from Prime Minister Dung in January 2016 to "build no more plants and gradually replace coal by gas while following strictly international commitments on cutting emission and promoting the development of renewable energy" (Government of the Socialist Republic of Viet Nam, 2016d).

To date, 11 ministries have developed and issued action plans on climate change response. The level of detail and extent of involvement in climate change response varies from one ministry to another, with MONRE considered the flagship ministry (Government of the Socialist Republic of Viet Nam, 2015a).

Already in 2006, Viet Nam adopted the **National Strategic Program on Energy Savings and Effective Use** (VNEEP) with the objective to promote energy conservation and a target to reduce energy

use by 3%-5% in the 2006-2010 period and 5%-8% in the 2011-2015 period against baseline. It covers industry, buildings and transport. The first phase (2006-2010) focused on education, awareness raising and research and in 2010 resulted in the adoption of the **Law on Economical and Efficient Use of Energy** (Asia Pacific Energy Research Centre, 2016). In April 2017 the World Bank approved a USD 102 million loan to support energy efficiency in industry (World Bank, 2017a).

By the end of 2016, the Vietnamese government approved the **Plan for Implementation of the Paris Agreement** (Government of the Socialist Republic of Viet Nam, 2016c). This is considered the highest legal basis for the implementation of the NDC in Viet Nam. The plan is a frame of action including a list of necessary activities by 2030, although it is less detailed than the NDC and in parts not consistent, for example in the use of terminology and sector definitions.

The plan is at a very general level and detailed actions for mitigation implemented by line ministries have not been designed yet. The implementation plan provides for the periodic evaluation of efforts in mitigation and adaptation, including assessment of Viet Nam's efforts to update the NDC, starting with the global stocktake in 2018 and lays out the task to define and implement a Law on Climate Change by 2020.

The **Viet Nam Forestry Development Strategy** 2006-2020 has the objective to sustainably establish, manage, protect, develop and use 16.24 million ha of land planned for forestry; to increase the ratio of land with forest up to 42 – 43% by the year 2010 and 47% by 2020 (which would already surpass the NDC target for 2030). It also includes an objective to achieve certification for 30% of the total production forest area by 2020 (Government of the Socialist Republic of Viet Nam, 2007). However, until the end of 2012 the total certified area of forests was just about 45,000 ha (less than 1% of the total forest area in Viet Nam) (Do, 2015).

The **Master Plan for Agricultural Production** development through to 2020, approved in 2012, lays out the objectives for agricultural production, including food security and enhanced incomes and living conditions in the sector. In 2013, the **Plan for Restructuring the Agricultural Sector** added long-term economic, social and environmental objectives, marking a change from a purly quantitative expansion to a qualitative development (OECD, 2015). In response to the high vulnerability of the country, so far, the focus in agriculture has been on adaptation and enhancing resilience of the sector, although the sector is addressed in the NCCS and NGGS and its respective action plans.

#### 3.5.1.2 Legislation, regulation and other legal documents

In 2013, the 7th Congress of the 11th Party Central Committee adopted Resolution No. 24-NQ/TW on "**Pro-actively responding to climate change, enhancing natural resource management and environmental protection**." The high-level legal document contains the specific objective to reduce GHG emissions per unit of GDP by 8-10% by 2020 compared to 2010.

The **Law on Economical and Efficient Use of Energy,** based on the VNEEP covers all areas of the economy and promotes measures to promote economical and efficient use of energy, including scientific and technological development and the development of education and consultancy services in the energy sector. It introduces energy audits and the development of a national target programme on economical and efficient use of energy, tax and other incentives for energy efficient manufacturers and products. The government issued 10 decisions, decrees, and circulars as secondary legislation to support the law (Audinet et al., 2016), including mandatory energy labelling regulations which were specified further in 2012 (Nachmany et al., 2015). Labeling is currently mandatory for refrigerators, fans, washing machines, rice cookers, TVs, lighting equipment, air conditioners, three-phase electric motors and transformers (Asia Pacific Energy Research Centre, 2016). However, the law is barely enforced and has had limited success so far (Audinet et al., 2016).

In 2013, the **Viet Nam Energy Efficiency Building Code** was adopted, which provides mandatory technical standards to achieve energy efficiency in the design and construction/retrofit of civil buildings, such as offices, hotels, hospitals, schools, etc. with a gross floor area of 2,500 $m^2$ or larger. It provides technical requirements for the building envelope as well as equipment and systems (Asia Pacific Energy Research Centre, 2016).

The most concrete policies were introduced in the form of different **support mechanisms for wind power development**. In 2011 a fixed purchase price of US$0.078/kWh for wind power was introduced, plus a $0.01/kWh subsidy (Government of the Socialist Republic of Viet Nam, 2011a) and wind power development was included in the regular planning cycle. The buyer (EVN) has to purchase all electricity supplied by wind projects. This has led to a substantial increase in installed capacity from only 8 MW in 2008 (ADB, 2015) to almost 140 MW in 2015 (Government of the Socialist Republic of Viet Nam, 2016b). For other renewable electricity sources a reference price for projects with installed capacity of less than 30 MW was defined, based on the avoided cost of the national utility. Viet Nam's Investment Law also provides support for renewable energy projects, both for domestic and foreign investors. Fiscal incentives and export credits are provided to further incentivise renewable energy investment (ADB, 2015).

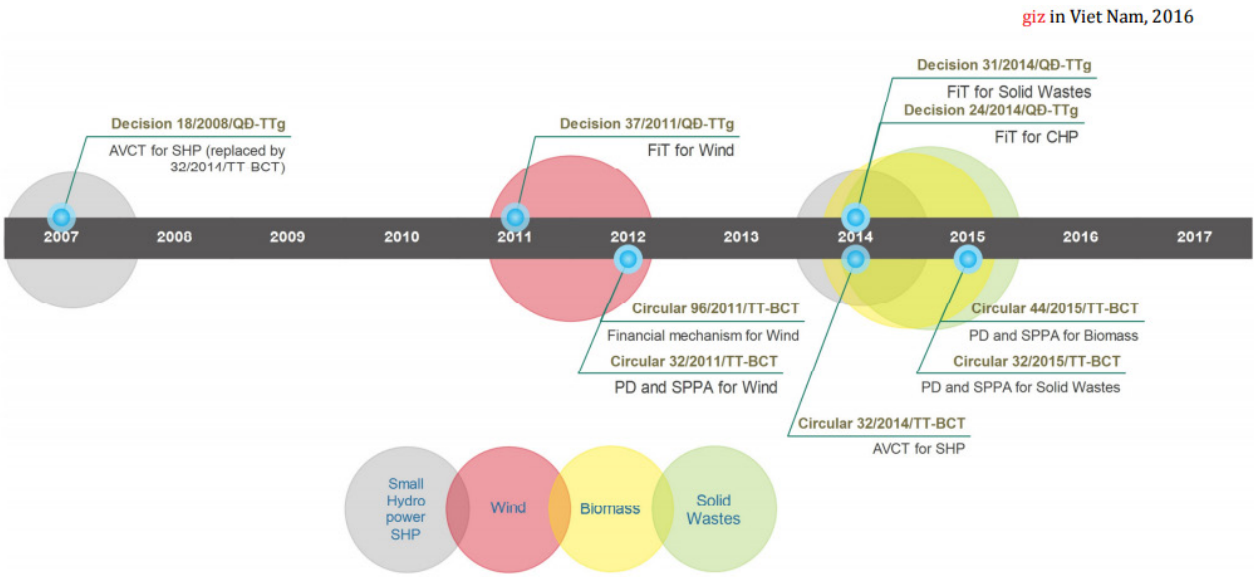
The support mechanism for biomass power projects also introduces standardized power purchase agreements with a duration of 20 years. For combined heat and power projects it establishes a fixed feed-in-tariff at US$0.058/kWh. For other biomass power projects the avoided cost tariff applies. Off-grid projects receive preferential treatment, particularly with respect to taxes, duties and access to land (Government of the Socialist Republic of Viet Nam, 2014b).

The most recent decision introduced a **regulatory framework to support grid-connected solar PV,** which mirrors the support mechanism for wind and was issued in April 2017 (Government of the Socialist Republic of Viet Nam, 2017). The framework puts the Ministry of Industry and Trade (MoIT) in charge and establishes a regular planning process for solar power development at national and provincial level. The framework further establishes a support mechanism, with the following elements:

- It obliges the national utility EVN to buy all power from solar power projects based on a standard power purchase agreement, which is valid for 20 years.
- Exemption from import duty for imported goods which serve project production and exemption and reduction of corporate income tax similar to projects in fields of investment priorities
- Exemption from land use charges and rent for land used for solar power projects, transmission lines[6] and transformers and the obligation for the Provincial People's Commettee to allocate appropriate land
- Fixed feed-in-tariff for grid-connected projects (utility-scale), at US$0.0935/kWh, with the FiT in VND based on exchange rates
- Net-metering for roof-mounted PV

[6] Although the cost for necessary transmission lines and grid connection remain with the project developer

Figure 15: Summary of key support mechanisms for renewable energy in Viet Nam




Note: PD = Project Development, SPPA = Standardized Power Purchase Agreement, AVCT = Avoided Cost Tariff, FiT = Feed-in Tarif; Support mechanism for solar PV was approved April 2017

Source: GIZ (2016a)

To promote the use of renewable fuel (biofuel) in the transport sector, the government aims to introduce E 5, a blend of gasoline with 5% biofuel. Original plans had envisaged making this mandatory by December 2014 in seven cities and provinces (ADB, 2015), but the time line has repeatedly been shifted (Petrolworld.com, 2017).

The **Law on Environmental Protection** from 2014 is based on an earlier version and for the first time includes a chapter on responding to climate change. In the Law, not only greenhouse gases are mentioned, but also the definition of response to climate change which is human activities aiming to adapt to and mitigate the climate change and carbon credits are stated. Additionally, one of the encouraged environmental protection activities is responding to climate change, including the development and use of clean and renewable energy and mitigation of GHG emissions. There is also a chapter in response to climate change which aims to integrate climate change response into strategies, planning, socio-economic development plans, etc.

A number of laws, decrees and decisions regarding **forestland allocation** have been promulgated over the last 25 years, handing over forestland use rights to different economic entities, including non-state sectors (households and private actors) for long-term management although the government still retains state ownership over forestland. For natural forests, land users receive annual payment from the government for their forest protection activities instead of being granted land use rights. Low payment for patrolling activities and poor quality and value of the allocated forests do not make this a sustainable strategy for forest protection. Viet Nam was the first country in Asia to initiate a nationwide payment for environmental services (PFES) scheme. In 2008, Decision 380 established conditions to support two PFES pilot projects, and in 2010 Decree 99 mandated the implementation of PFES nationwide starting from 1 January 2011. It defines four types of forest environment services: watershed protection, landscape amenity, carbon sequestration, and provision of spawning grounds. Unclear boundaries and overlapping property rights (Do, 2015).

### 3.5.2 Project and programme based activities

In 2008, the **National Target Programme to Respond to Climate Change (NTP-RCC)**, mainly targeting adaptation activities, was approved by the Prime Minister, with three phases of implementation: Start-up phase (2009-2010), Implementation phase (2011-2015) and Development phase (post-2015). Out of the 400 projects, 62 were selected for priority implementation, but only 16 received funding by 2014 (Government of the Socialist Republic of Viet Nam, 2014c).

Related to the development of concrete mitigation activities the country is still in early stages. It has received support from various donors, including BMUB, FAO, UNDP, JICA and others, to build up capacity for NAMA design and the setting up of corresponding MRV systems. So far, most activities are preparatory, with the identification of potentials, co-benefits, design of MRV systems and general capacity-building. However, Viet Nam successfully secured GCF funding for a project in coastal communities (GCF, 2017) with adaptation and mitigation components, operated through UNDP.

Viet Nam has registered two NAMAs seeking support in the UNFCCC NAMA registry, one on biogas in pig farms and a support programme for wind power development (UNFCCC, 2017). A number of further NAMAs is under development.

Table 10: Status of NAMA development

| NAMA | Status | Support | Related standard measure |
|---|---|---|---|
| Biogas for onsite power generation for medium/large pig Farms | Registered with UNFCCC<br>Seeking support | UNEP | Use of sustainable bioenergy |
| Supporting Program for Wind Power Development in Viet Nam | Registered with UNFCCC<br>Seeking support | UNEP | Renewable energy (non-bio) |
| Wind NAMA | Under development | UNEP | Renewable energy (non-bio) |
| Waste Sector NAMA: Waste to Resources for Cities | Under development | UN-ESCAP (technical) | Renewable energy (non-bio) |
| Supporting up-scaled mitigation in the cement sector | Pilot phase<br>Seeking support for further implementation | NIRAS, NOAC, NDF<br>Green Stream, Climate Focus (technical) | Energy efficiency of processes |
| Low-carbon bus NAMA | Under development | UNDP, KfW<br>GIZ (technical) | Efficiency improvements<br>Fuel switch |
| Fuel efficiency NAMA | Under development | BMZ<br>GIZ (technical) | Efficiency improvements |

Source: Ecofys (2017)

The **Viet Nam Energy Efficiency & Conservation Program** (VNEEP) aims to promote energy efficiency across sectors. It implements the Law on Economical and Efficient use of Energy and runs information campaigns and projects. In April 2017 for example, the World Bank approved a US$ 102 million loan to help improve efficiency in the industrial sector[7].

[7] http://vneec.gov.vn/

From 2011-15 the **solar water heater program**, run by EVN, worked with 6 domestic suppliers and 8 domestic suppliers and supported solar water heaters with the subsidy of 1 million VND/unit. The 2011-2013 implementation has demonstrated positive results. However, due to limited financial resources, the program was only able to provide financial support to a limited number of units. The target planned for the program was only 30,000 units in 5 years, of which 5,000 units in Ho Chi Minh City, 4,000 units in Ha Noi and 5,000 units in the Centre (Energy and Environment Consultancy Joint Stock Company, 2015).

During 1998- 2010, in order to halt deforestation and increase forest cover to 43% by 2010, the government implemented publicly funded forestry projects under the Five Million Hectares Reforestation Program (Do, 2015).

In May 2017 Viet Nam started a consultation process in collaboration with the Japan International Cooperation Agency (JICA) entitled "Decree on greenhouse gas reduction roadmap and modality for Vietnam to participate in global GHG mitigation" to ensure the effectiveness of Nationally Determined Contribution (NDC) (Ministry of Natural Resources and Environment, 2017).

### 3.5.3 Market-based activities

Viet Nam is very active in the carbon market and is one of the most active countries in the clean development mechanism (CDM), mostly in the energy and waste sectors. It is also working with Japan to engage in the joint crediting mechanism (JCM) and has identified 28 projects, four of which (all related to energy efficiency in different sectors) were approved for implementation (Government of the Socialist Republic of Viet Nam, 2014c).

In 2012, the Prime Minister approved the project "**GHGs emissions management: management of carbon credit trading on the global market**". The project identifies clear targets for reducing emissions and increasing the capacity to absorb GHGs in some sectors by 2020 (compared to 2005): i) 8% for energy and transportation, ii) 20% for agriculture, iii) 20% for LULUCF; and iv) 5% for waste (source). Viet Nam is receiving support from the World Bank's Partnership for Market Readiness to implement market-based instruments (WB PMR, 2017):

Phase 1: 2013-2018 Establish legal frameworks and a pilot market based instruments in selected sectors/regions

- Study and propose the required legal framework to implement selected MBIs;
- Set up Institutions required to ensure the success of pilot MBIs;
- Creation and testing of institutional, technical and regulatory instruments and feed back for further refinement of MBIs.

Phase 2: 2018-2020 Establishment of a domestic carbon market instrument and connection to international market

- Broaden coverage of MBIs, ideally to achieve a comprehensive carbon pricing scheme;
- Integration with the international market.

Viet Nam is one of the nine countries initially identified for country programming under the UN-REDD Program and one of the first countries to receive approval for its Readiness Project Identification Note (R-PIN) under the World Bank's Forest Carbon Partnership Facility (FCPF) (Do, 2015).

### 3.5.4 Conclusions

In general, the legal framework for climate change mitigation in Viet Nam is quite elaborate at the strategic level, although the level of ambition, particularly in the energy sector, leaves room for improvement. With the strong top-down governance of the socialist system, the importance of these high-level strategic documents containing climate mitigation elements cannot be underestimated.

However, the translation of these strategies and action plans into concrete laws and activities remains an issue. They often mainly depend on the domestic voluntary actions and additional international support (Ministry of Industry and Trade, 2015a). While some of the strategies and action plans contain very concrete projects, the implementation rate of the NTP-RCC shows that implementation is falling behind the intended ambition (Government of the Socialist Republic of Viet Nam, 2014c).

Recent developments with the establishment of the regulatory framework for grid-connected solar PV and wind are promising. Compared to other countries in the region and the world, the supported price of wind power in Viet Nam is still low and does not fully tap existing technical potentials. Also, the fact that the policies are separately stipulated in different laws can lead to confusion in their application (Ministry of Industry and Trade, 2015a).

There is no comprehensive policy or plan for enhancing access to all forms of thermal energy for households, such as for example biogas digester, solar water heaters (Ministry of Industry and Trade, 2015a).

Although the Department of Climate Change (MONRE) is the national focal point for mitigation management in Viet Nam, there is an absence of a guidance or a framework for the implementation of MRV in Viet Nam. This reduces attractiveness to invest in mitigation actions in Viet Nam, particularly related to climate finance.

## 3.6 Additional mitigation potential

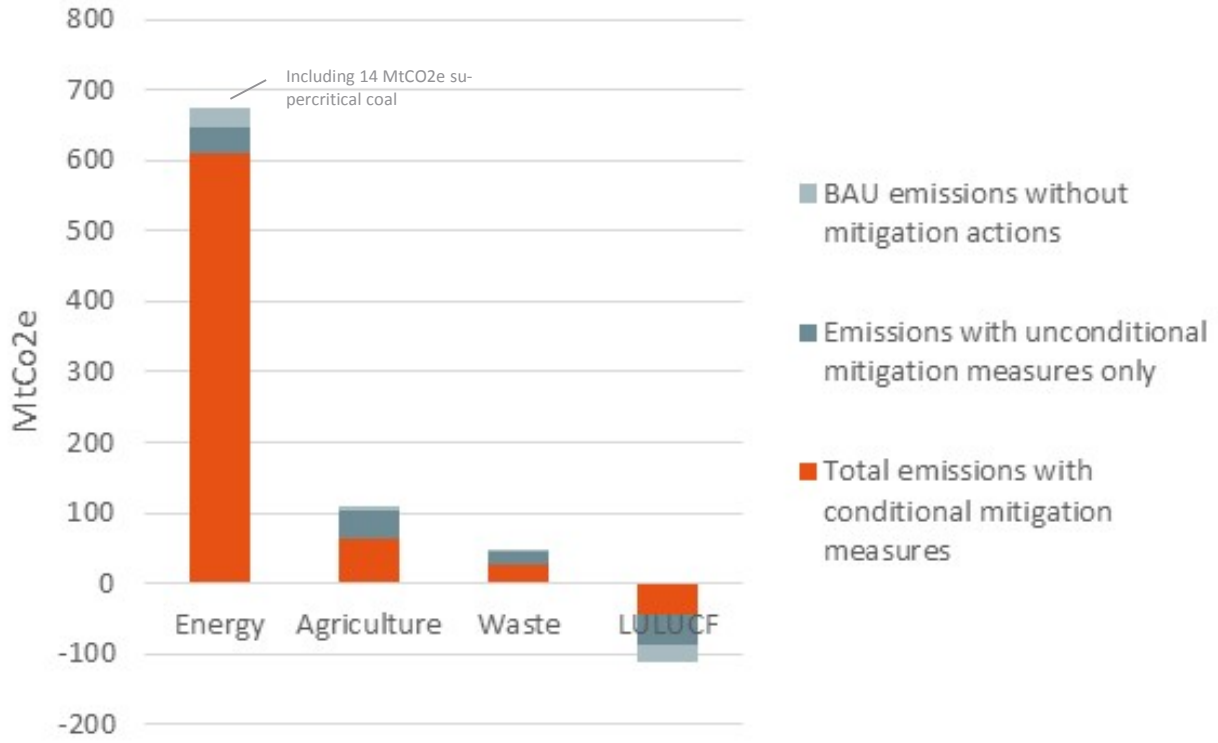
Considering the importance of the energy sector and particularly electricity generation in the projected emission profile of Viet Nam (see Figure 16), additional mitigation activies could focus on:

- avoiding the expected energy demand, particularly for electricity; and
- replacing remaining needed additional power generation capacity with renewable energy solutions instead of coal.

Additional areas with substantial potential beyond the NDC are the transport and industry sectors. With the development goal to transform Viet Nam in a highly industrialized country, measures in the sector are politically very difficult to implement, as demonstrated by the exclusion of the sector in the NDC. This study therefore concentrates on energy efficiency measures in the sector (with a particular focus on electricity consumption) that will not only generate emissions savings, but also make the sector more cost efficient and thus increase competitiveness.

The integrated assessment of mitigation potential and actions in this section, explicitly includes an analysis of strategies and measures, which would help to reach both the conditional and unconditional mitigation contribution, but also contain assessments that could help to overachieve the existing targets. A stringent differentiation of measures included in the NDC and potentials going beyond the contributions is not always possible.

Figure 16: Contribution of sectors to the NDC




Source: Ministry of Natural Resources and Environment (2015)

Overall, very little recent quantitative information on mitigation potentials exists for Viet Nam. Many studies are outdated. Particularly those looking at economic renewable energy potentials are strongly affected by the drastic changes in price structures and project development dynamics and cannot be utilized. The main source for quantitative information is therefore the low carbon development path (LCDP) published by the World Bank in 2016 (Audinet et al., 2016).

Potentials estimated in the various NAMA proposals are presented where available, although none of these address energy efficiency.

### 3.6.1 Energy efficiency in industry and buildings

Growth in electricity demand is one of the key drivers of expected future GHG emission increases under BAU, with demand expected to rise from 143.7 billion kWh in 2015 to 572-632 billion kWh in 2030 (Government of the Socialist Republic of Viet Nam, 2016b). To allow time to revise supply options for replacing coal-fired power generation capacity it is essential to tap the existing efficiency potential in all sectors as fast as possible. At the same time, this is highly cost-efficient and can enhance the competitiveness of the economy.

**NDC measures**. The NDC assessed limited measures to enhance efficiency related to residential and commercial air-conditioning, residential lighting, cement and brick production, representing reductions of around 13.9 $MtCO_2e$ in 2030 or 2% of BAU emissions in the energy sector (Ministry of Natural Resources and Environment, 2015). Measures in the cement and brick sectors assessed in the NDC are likely to mostly reduce energy use in manufacturing rather than electricity use (Ministry of Natural Resources and Environment, 2015).

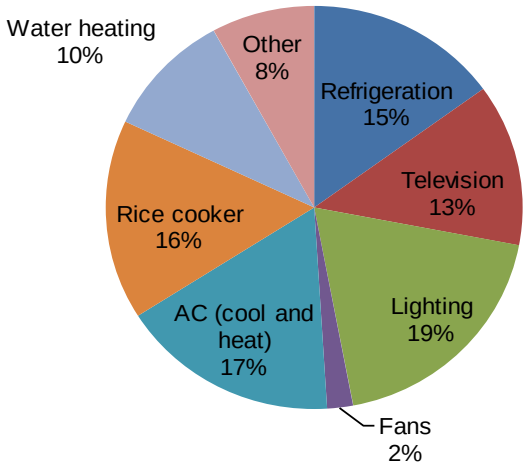
**Low carbon development study aggregate results**. The low carbon development path (LCDP) published by the World Bank in 2016 comes to the conclusion that almost 64 billion kWh could be saved in

industry and households with measures up to the cost of US$10/tCO$_2$ (Audinet et al., 2016), representing 10%-11% of expected BAU demand in 2030.

Implementing the energy-efficiency measures identified would reduce required power capacity additions in 2015–30 by 11.7 GW (7%), reduce 2030 generation requirements by 11%, reduce capital expenditure (CAPEX) for power plants by $19.1 billion, and reduce imported coal requirements by 24 million tons per year. The implementation of industrial energy efficiency measures alone could generate $10 billion in financial savings by 2030 compared with BAU (Audinet et al., 2016).

**Households**. Energy consumption is almost equally dispersed across houshold appliances without any main user in term of energy consumption (see Figure 17). Therefore, solutions in improving energy efficiency also need to be approached comprehensively, covering a broad range of appliances.

Figure 17: Distribution of household electricity consumption by appliance type




Source: Energy and Environment Consultancy Joint Stock Company (2015)

The LCDP evaluates two groups of measures in the household sector (Audinet et al., 2016):

- *Top 5 household uses*: Lighting; refrigerator, air conditioner, water heaters, fans
- *Next 8 household uses*: Radio, stereo, cd player, tv, dvd/vcr, computer, washing machine, thermo pot

Supporting energy efficiency in the five main household end uses reduces cumulative CO$_2$ emissions by 120 MtCO2e by 2030. All measures in the household sector are estimated to have negative cost (Audinet et al., 2016).

Well-developed efficiency standards enforced at the point of sale can provide these emissions reductions. The World Bank estimates that efficiency improvements for refrigerators and air conditioners can be achieved with no incremental investment. Although new, more efficient refrigerators tend to have higher sticker prices, the increases are principally due to added size and features rather than to the inclusion of energy-efficient technology.

Potentials for efficient lighting are only modest as they assume replacement of incandescent bulbs with compact fluorescent lamp (CFL), while much greater efficiency could be gained by replacing them with lightemitting diodes (LEDs).

A study under the guidance of MONRE (Energy and Environment Consultancy Joint Stock Company, 2015) assesses a number of measures for different types of buildings:

- *Residential*: solar water heaters
- *Commercial & offices*: air conditioning and building energy management systems

They come to the conclusion that up to 8% of residential, 15% of commercial and 25% of office building electricity consumption can be saved. Applying a base year approach with 2010 as the reference year, this would translate into GHG reductions of 5.4 $MtCO_2e$ for residential, up to 0.9 $MtCO_2e$ for the commercial sector and 0.3 $MtCO_2e$ for offices (Energy and Environment Consultancy Joint Stock Company, 2015).

**Electricity use in industry**. Measures saving electricity could reduce GHG emissions by an estimated 52.6 $MtCO_2$ beween 2015 and 2030 (see Table 11). More than 60 percent of emissions reductions from reduced grid electricity demands by the large industry sector come from waste-heat recovery power generation at large iron&steel (I&S) and cement production facilities. The weighted average of industrial electricity efficiency measures affecting electricity demand is estimated at US$-5.03/$tCO_2$ (Audinet et al., 2016).

To fully capture these potentials the Energy Efficiency and Conservation Law needs to be enforced. Combined with accessing financial resources, strengthening energy-efficiency institutional capacity, as well as reviewing the adequacy of public and private investments in energy efficiency this could capture the substantial benefits from implementation of these measures (Audinet et al., 2016).

**Reducing energy use in industry**. Overall Viet Nam's industry has a high energy intensity compared to global benchmarks, mainly because many key sectors operate with relatively old technology. Investing in efficiency will therefore not only reduce GHG emissions, but help enhance the competitiveness of the sectors (Audinet et al., 2016).

Effects of measures to reduce energy are estimated at a total of 256 $MtCO_2$ beween 2015 and 2030 (accumulative), including the electricity savings above. The largest, and most uncertain, share is for 'other industries' with 152 $MtCO_2$, which are only indicative and estimated based on typical results achieved in other countries. 77% (81 $MtCO2_e$) of the rest comes from efficiency measures in the iron & steel sector and 16% (16.6 $MtCO_2$) from measures in the cement sector (Audinet et al., 2016).

Table 11: Industrial marginal abatement cost for measures affecting electricity demand

| Industry sector | EE measure | 2015 – 30 $MtCO_2$ Emissions Reductions | % Shares | MAC $/$tCO_2$ | 2015 – 30 CAPEX MUSD |
|---|---|---|---|---|---|
| Small I&S | Improved process control | 3.10 | 5.9 | (9.59) | 5.1 |
| Small I&S | Transformer efficiency | 0.97 | 1.8 | (7.33) | 9.1 |
| Large I&S | Installation of VFD | 32.93 | 62.6 | (8.88) | 56.2 |
| Large I&S | Variable frequency drives | 0.09 | 0.2 | (7.81) | 0.6 |
| Large I&S | NG injection | 3.82 | 7.3 | (3.96) | 52.2 |
| Large I&S | Heat recuperation from hot blast stoves | 3.26 | 6.2 | 12.49 | 204.3 |
| Cement | Variable frequency drives | 0.58 | 1.1 | (8.17) | 2.7 |
| Cement | Waste heat recovery power | 4.76 | 9.0 | 0.46 | 232.1 |

| Industry sector | EE measure | 2015 – 30 $MtCO_2$ Emissions Reductions | % Shares | MAC $/$tCO_2$ | 2015 – 30 CAPEX MUSD |
|---|---|---|---|---|---|
| Cement | Vertical roller mill | 2.85 | 5.4 | 11.46 | 174.6 |
| Fertilizer | Variable frequency drives | 0.02 | 0.0 | (7.63) | 0.0 |
| Pulp & Paper | RTS pulping | 0.28 | 0.5 | 33.74 | 50.1 |
| Total | | 52.64 | 100.0 | | 787.0 |
| Weighted Average | | | | (5.03) | |

Source: Audinet et al. (2016), based on World Bank estimates. Note: CAPEX = capital expenditure, EE = energy efficiency, I&S = iron and steel, MAC = marginal abatement cost, MUSD = millions of US dollars, RTS = lower retention time, higher temperature, higher refiner speed. Values in parentheses indicate negative marginal abatement costs.

The sustainable and low carbon development of the cement sector is a high priority for the Ministry of Construction of Viet Nam (MOC) and MOC has gained support from the Nordic Development Fund (NDF) under the framework of the Nordic Partnership Initiative with the project "Pilot Programme for Supporting Up-scaled Climate Change Mitigation Action in Viet Nam's Cement Sector". According to the estimates conducted under the pilot, the sector could reduce up to 164 $MtCO_2e$ between 2015 and 2030, with blending, alternative fuels and process improvements as the major areas for reductions, most of which, particularly the blending, was not analysed in the LCDP, so could partly be additional to the reduction potential estimated in the LCDP. The total initial investment required for all 12 options would be around US$ 906 million (Pedersen et al., 2016).

### 3.6.2 Decarbonizing energy supply

The World Bank's Energy Sector Management Assistance Programme (ESMAP) in partnership with GIZ is currently conducting a renewable energy resource mapping in Viet Nam. The exercise looks at biomass, small hydro, solar and wind and is scheduled to be completed in 2019.[8] Currently, they mainly provide solar radiation maps and wind resource maps, which can serve as input to future planning and potential analysis.

Available studies looking at the potential for renewable energy, and particularly electricity supply, are often hard to compare due to the use of different units of measurement ($tCO_2e$, MW, kWh, irradiation). This section will look at the different available technologies and present values as stated in the original publication. Many available studies do not assess total available potential, but rather evaluate effects of a pre-set addition of renewable capacity compared to a baseline with no or limited renewables.

**Main sources**

The **low carbon development path (LCDP)** study conducted by the World Bank largely quantifies the effects of the latest revision of the power development plan (PDP 7) against a baseline scenario that contains no additional additions to renewable generation capacity until 2030 (Audinet et al., 2016). In the study electricity demand is corrected in line with the revised PDP 7 and further reduced through energy efficiency measures as described in the previous chapter. Baseline assumptions are in line with the NDC.

[8] Initial results can be viewed on the IRENA Global Atlas and on the ESMAP website

Another **low carbon development strategy (LCDS)** was developed by the Ministry of Industry and Trade together with UNEP-DTU in 2015 (Ministry of Industry and Trade, 2015a). It assesses options to achieve the 5% target for renewable energy in total primary commercial supply by 2020 set in the original PDP 7, but also provides estimates for 2030. The study assumes an electricity demand of 515 TWh by 2030, much lower than the estimate in the PDP 7. It largely confirms the feasibility of achieving the renewables target set out in the original PDP 7, but assumed capacity additions do not achieve the renewables strategy and the revised PDP 7. As this study is very similar in results to the LDCP, which is using more recent information, this study is not presented in more detail in the following section.

The IEA (Ölz & Beerepoot, 2010) estimated the **potentials for renewables in Southeast Asia**, including Viet Nam. They assess 'realisable potentials', reflecting the maximum deployment possible over time assuming best policy practice. This considers overall energy system constraints, but not relative cost and is as such not affected by the considerable changes in prices for some technologies over the last years. The realisable potential includes already achieved potential, which represents only a small fraction, except in the case of hydropower.

**NDC measures**. The unconditional contribution contains 2,400 MW of small hydro and 100 MW of domestically funded wind capacity. Together these are estimated to reduce emissions by 8.2 $MtCO_2e$ in 2030. The conditional NDC contains an additional 6,070 MW of wind, as well as 2,000 MW of solar PV, 150 MW of biogas power plants, 60 MW of biomass plants and 21,600 MW of ultra-supercritical coal (replacing traditional coal-fired capacity). Together the renewables are estimated to reduce emissions by 20.7 $MtCO_2e$ in 2030. Ultra-supercritical coal is estimated to save 14.2 $MtCO_2e$ in 2030 (Ministry of Natural Resources and Environment, 2015).

**Wind**. According to the revised PDP 7, installed capacity was 140 MW in 2015. The plan to scale this up to 6,000 MW (Government of the Socialist Republic of Viet Nam, 2016b) would almost fully deploy the potential of 6,200 MW indicated by ESMAP (ESMAP, 2014). For comparison, in 2016 alone 5,443 MW of wind power were installed in Germany (Bundesverband Windenergie, 2017).

The wind power NAMA, developed with support from UNEP-DTU, plans that the total installed capacity will increase to 1,000 MW in 2020 and 6,200 MW in 2030 as planned in PDP 7 and thus quantifies the current power development plan. The NAMA project could reduce annual GHG emissions of 1.5 $MtCO_2e$ in 2020 and 10.1 $MtCO_2e$ in 2030 compared to a baseline scenario with 200 MW additional wind capacity. Cumulative reductions by 2030 are estimated at 66.6 $MtCO_2e$ (UNEP-DTU, 2016b).

The LCDP is less ambitious with 1,800 MW added between 2021 and 2030. To address fluctuations in renewable supply and ensure peak demand is met, the LCDP calculates a 100% backup with combined cycle gas turbines (CCGT) running on liquefied natural gas (LNG). The suggested capacity additions would reduce cumulative emissions through 2030 by 41.3 $MtCO_2e$ (Audinet et al., 2016).

IEA estimates that on- and offshore wind could generate 43,960 GWh of electricity by 2030 (Ölz & Beerepoot, 2010), representing 6.9%-7.7% of expected electricity demand in 2030. The ADB arrives at even higher, although indicative theoretical, potential of 64,350 GWh per year and 26,763 MW of capacity (ADB, 2015), while in 2011 the 'Wind Resource Atlas of Vietnam' estimated a total theoretical potential of over 2,000 GW, based on areas suitable for wind development and average wind speeds (AWS Truepower, 2011). This does not consider economic viability, local siting contraints, availability of transmission lines, etc., but does exclude protected areas, urban areas, wetlands and water bodies.

**Solar**. For solar PV, the estimates for potential have a wide range. The underlying solar irradiation is estimated to provide on average 4-5 $kWh/m^2$ (ESMAP, 2014), with the mapping conducted through the MoIT coming to slightly lower values at 3.4-4.8 $kWh/m^2$ for horizontal irradiation. The LCDP estimates that solar irradiation is as strong as in most of the southwest United States and far superior to

Germany. For comparison, in 2016 Germany produced 38 TWh of electricity from solar PV, representing 5.9% of total generation, with 1,476 MW being newly installed in 2016 (BMWi, 2017).

MoIT came to the conclusion that the technical potential across the country is placed in the range of 60-100 GWh per year for concentrated solar power (CSP) systems, and 0.8-1.2 GWh per year in the case of PV systems (Polo et al., 2015). This assesses only utility-scale PV with a minimum size of one $km^2$.

IEA, however, estimates the potential for solar PV to be 27,260 GWh (Ölz & Beerepoot, 2010), representing 4.2%-4.5% of expected electricity demand in 2030. Their assessment of CSP systems reaches a potential of only 10 GWh, based on the high humidity in the region, affecting the effectiveness of the technology.

The ADB assessed the technical solar potential as the product of the total suitable land area in square meters (220,000 $km^2$) and the installable capacity of 0.06 $kWp/m^2$. They arrive at a technical solar potential of about 18,000 GWh per year, with more than 60% of this attributable to areas with the highest irradiation levels, which are in the southern half of the country (ADB, 2015).

The LCDP assumes 1,500 MW of solar PV capacity by 2030 (Audinet et al., 2016), remaining below the assessed 2,000 MW in the NDC (Ministry of Natural Resources and Environment, 2015) and far below the envisaged 12,000 MW in the revised PPD 7 (Government of the Socialist Republic of Viet Nam, 2016b). Combined with CCGT this would reduce cumulative emissions through 2030 by 30.1 $MtCO_2e$ (Audinet et al., 2016).

**Biomass**. Biomass and biogas play an important part in most scenarios. The IEA estimates that the potential for the two technologies combined is 60,320 GWh per year (Ölz & Beerepoot, 2010), representing 9.5%-10.5% of expected electricity demand in 2030.

The LCDP assume that by 2030 up to 2,000 MW of biomass would be installed, as outlined in the PDP 7, producing 13,140 GWh per year (Audinet et al., 2016). Biomass could include rice husks, bagasse and waste wood, although for the LCDP mainly rice husk was assumed. They do not provide estimates for biogas power generation. ESMAP estimates the potential for biomass to be above 2,500 MW (ESMAP, 2014), slightly higher than the LDCP.

The biogas NAMA proposal assumes that 2,158 farms could have biogas generators installed by 2020. This would produce 1,100 GWh per year, contributing to GHG reductions of 0.6 $MtCO_2e$ per year. In 2030, implementation for 4,810 farms can produce 2,500 Gwh per year, reducing GHG emissions by 1.4 $MtCO_2e$ per year (UNEP-DTU, 2016a). Biogas offers a win–win outcome, both as a clean fuel and as a response to the waste problem (ADB, 2015).

**Hydro**. Hydropower currently supplies around a third of electricity and has just under 17,000 MW installed capacity, including small-, medium and large faciltities. Although the PDP 7 expects to expand this capacity to 21,600 MW by 2020 and 27,800 MW by 2030, the relative share in electricity production is expected to decrease to 15.5% in 2030 (Government of the Socialist Republic of Viet Nam, 2016b). Based on estimated total production this would translate to 78,000 GWh by 2030. IEA estimates the potential for hydropower to be 74,210 GWh (Ölz & Beerepoot, 2010), just under the planned expansion.

Other sources only estimate potential from small hydro. The LCDP looks at the effects of 2,800 MW of run-of-river (ROR) hydro and project these to generate 12,264 GWh per year, saving 92.4 $MtCO_2e$ over the 2010-2030 period (Audinet et al., 2016). ESMAP estimates the potential for small hydro to be above 7,000 MW (ESMAP, 2014).

**Geothermal**. Both IEA does not see any significant geothermal potential in Viet Nam by 2030 (Ölz & Beerepoot, 2010) and World Bank doesn't estimate the potential, although it suggests that there could

be unexploited potential in this area (Audinet et al., 2016). ESMAP gives a geothermal of 340 MW (ESMAP, 2014)

### 3.6.3 Transport

Emissions from the transport sector are expected to represent 22% of total enery related emissions in 2020, with 88 MtCO2e representing around half of the emissions of the energy industries sector. The NDC baseline assumes these emissions to remain constant until 2030. Considering the expected population and economic growth this seems highly unlikely, as both are key drivers for transport sector emissions. Historically, the sector has seen tremendous growth. Gasoline and diesel consumption doubled during the 2002 - 2009 period and estimates from the Ministry of Industry and Trade show that they are expected to double again by 2025 compared to 2015 levels (ADB, 2015).

**NDC measures**. The unconditional NDC estimates the effect of switching 15% of passenger transport from motorbikes to public transport and 5% of freight from road cargo to sea- and river-borne transportation. Together this is estimated to reduce emissions by 4.8 $MtCO_2e$ in 2030. The conditional NDC additionally looks at the increasing the share of ethanol in gasoline from 3% under BAU to 10%. This is expected to reduce emissions by 1.5 $MtCO_2e$ in 2030 (Ministry of Natural Resources and Environment, 2015), but stays under the share of 13% envisaged in the renewable energy strategy (Government of the Socialist Republic of Viet Nam, 2015b).

**Modal shift**. In Viet Nam modal shift includes the shift from road to rail, but also to waterborne transport modes for freight and passengers. The LCDP estimates that these measures can reduce emissions by 7.3 $MtCO_2e$ for the 2010-2030 period. Most of the measures are estimated to have negative cost, with the exception of shifting passenger travel to rail and new BRT lines. The LCDP also stresses the importance of urban planning to reduce congestion and discourage vehicle use within densly populated centres, but does not quantify the effects (Audinet et al., 2016).

**Fuel switch**. The revised PDP 7 envisages an increase in the production of **biofuels** to around 5% of transport sector's fuel demand in 2020; and 13% by 2030 (Government of the Socialist Republic of Viet Nam, 2015b). The LCDP only estimates the effect of a share of 4.2%, compared to a baseline with 2.75%. This would reduce emissions by 3.78 $MtCO_2e$ for the 2010-2030 period (Audinet et al., 2016). The NDC estimates an increase to 10% by 2030 compared to 3% in the baseline case, which is estimated to reduce emissions by 14.2 $MtCO_2e$ for the 2010-2030 period or 1.5 $MtCO_2e$ in 2030 (Ministry of Natural Resources and Environment, 2015).

The LCDP estimatest that the switch of 60% of busses from diesel to compressed natural gas (CNG) (compared to 20% under the baseline scenario) would lead to emission reductions of 3.58 $MtCO_2e$ between 2010 and 2030 (Audinet et al., 2016). A NAMA for low carbon buses, that was submitted to the NAMA Facility in 2016, provides estimates for different technologies, including CNG and various hybrid and electric options. Replacing diesel with CNG can decrease emissions per km by 19%, combined with a hybrid approach 39% and with plug-in up to 47% (GIZ, 2016b).

The by far largest mitigation potential in the LCDP is the use of **electric bikes**, assuming that 90% of new sales are electric by 2030 (compared to 40% in the baseline). with 27.13 $MtCO_2e$ in emission reductions over the 2010-2030 period (Audinet et al., 2016). The assumptions for this measure are, however, not clear and it is uncertain whether the emissions from (mainly coal-based) electricity generation have been accounted in this calculation.

**Efficiency**. The LCDP concentrates on two areas for efficiency improvements: replacing smaller vessels with larger, more efficient ones for coastal freight and inland waterways and moving private vehicles from EURO 3 to EURO 6 standard. The first measure is estimated to reduce emissions by 7.4 $MtCO_2e$, improving vehicle efficiency 9.1 $MtCO_2e$ (Audinet et al., 2016). The low carbon bus NAMA estimates that up to 9% of fuel and emissions can be saved with a combination of improved tires, optimal tire pressure, idling stop devices and eco driving (GIZ, 2016b).

## 3.7 Barriers to implementation of additional actions

**Institutional/political**. As in many countries, climate change mitigation is still perceived as potentially hindering economic growth. The perception of mitigation in Viet Nam is clearly shaped by CDM and installation-level and project-type activities, strongly influencing the institutional and political framework. The lack of broader policy and programmatic approaches to mitigation poses a severe barrier to effective policy frameworks.

As a result, the strategic frameworks set out in the various strategies lack further implementation at the legislative level (Government of the Socialist Republic of Viet Nam, 2014c) and fail to provide sufficient incentive for the implementation of mitigation activities (Tatrallyay & Stadelmann, 2011). Where policies and regulations exist (e.g. in forestry), enforcement is lacking. The lack of regulation and clear procedures for planning, installing, connecting and operating RE power projects remains an issue, particularly cumbersome requirements for establishing plans for RE development (Ministry of Industry and Trade, 2015a).

Division of authority and coordination among government bodies at different levels and with relevant stakeholders is not seen as very effective (Government of the Socialist Republic of Viet Nam, 2014c; Tatrallyay & Stadelmann, 2011) also resulting in inconsistency between baselines, targets and strategies, causing confusion and influencing resource allocation (KEPA & GreenID, 2014). Ineffective coordination has also led to overlapping NAMA readiness activities.

The fact that provision of adequate information for decision-making, particularly on GHG data, has so far only been produced on a project base has been identified as a key limiting factor for enhanced policy-making. A comprehensive system to provide this information on an ongoing basis, defining an institutional system with clear responsibilities, is currently under development with the support of international donors. MRV systems to allow the effective evaluation of implemented measures are also still under development (Government of the Socialist Republic of Viet Nam, 2014c).

**Financial/economic**. Low electricity and coal prices are a severe economic barrier to low carbon development, as they reduce incentives for energy savings and renewable energy options (Tatrallyay & Stadelmann, 2011; UNDP, 2016a). Low electricity tariffs due to indirect subsidies to power production from natural gas and coal make RE power difficult to compete with other conventional power plants (Ministry of Industry and Trade, 2015a).

Particularly for energy efficiency measures insufficient cost consciousness, the assignment of a lower priority to cost savings compared to expansion in investment, high transaction costs, perceived high investment risks, and market failures hinder effective implementation of available potentials (Audinet et al., 2016).

Weak financial capabilities of commercial banks in assessing mitigation investments and a lack of capacity of investors to manage such projects (particularly for utility-scale renewables) lead to an unwillingness to provide financing in immature markets (Tatrallyay & Stadelmann, 2011)

The fact that the power sector and industrial sector are dominated by state-owned enterprises (SOEs) further aggravates this challenge. In industry, for example, sixty percent of lending is tied to SOEs, creating a barrier for private enterprises that would otherwise use energy efficiency as a competitive instrument (Audinet et al., 2016).

Government spending has so far mostly been dedicated to adaptation activities, effectively leaving funding for mitigation to the private sector and international sources. Given the gaps in the institutional/political area described above, particularly the lack of coordination and clear legal frameworks, makes it hard to mobilise international funds (Government of the Socialist Republic of Viet Nam, 2014c).

**Technical**. Overall the abatement technology market in Viet Nam has as yet limited capacities for manufacture, installation and operation. Only a few large domestic technology providers active in relevant sectors (Tatrallyay & Stadelmann, 2011; UNDP, 2016a). Domestic technologies are not yet developed, leading to most RE technologies having to be imported (Ministry of Industry and Trade, 2015a).

Inadequate infrastructure and the remoteness of resources makes project development for some areas challenging, particularly for hydro and geothermal power generation (Tatrallyay & Stadelmann, 2011).

**Informational/capacities**. The awareness of mitigation opportunities and related sustainable development benefits at government, private sector and household level is limited. The lack of readiness to make use of mitigation options (technical and non-technical) and their potential (Tatrallyay & Stadelmann, 2011), NAMAs (Government of the Socialist Republic of Viet Nam, 2014c) and how to mainstream mitigation to decision-making strongly affects the ability to tap existing mitigation potentials.

The lack of technical and financial capacities to plan and implement mitigation options at government and private sector level, including the financial sector, pose an additional challenge (Audinet et al., 2016).

The lack of high quality information on GHG emissions is impacting the ability to assess mitigation options and monitor the effectiveness of activities. The inventory is not comprehensive and activity data is inadequate. The inventory also still relies heavily on IPCC default values (Government of the Socialist Republic of Viet Nam, 2014c).

Table 12: Overview of barriers to implementation

| Category | Barriers |
|---|---|
| Institutional / political | ► Lack of broader policy and programmatic approaches to mitigation<br>► Ineffective division of authority and coordination among government bodies<br>► Lack of incentives for the implementation of mitigation activities<br>► Lack of regulation and cumbersome planning and approval for RE development<br>► Lack of enforcement |
| Financial / economic | ► Low electricity and coal prices<br>► Perceived high investment risks<br>► Weak financial capabilities of commercial banks and lack of capacity of investors<br>► Domination of state-owned enterprises (SOEs) in relevant sectors<br>► Lack of domestic funds for mitigation |
| Technical | ► Immature abatement technology market<br>► Inadequate infrastructure and remoteness of resources |
| Informational / capacities | ► Awareness of mitigation opportunities and related sustainable development benefits at government<br>► Lack of technical and financial capacities to plan and implement mitigation options<br>► Lack of high quality information on GHG emissions |

Table 13: Relevance of barriers for different stakeholder groups

| | Government | Economic / private sector* | Households |
|---|---|---|---|
| Institutional / political | high | medium | low |
| Financial / economic | low | high | medium |
| Technical | low | high | low |
| Informational / capacities | medium | low | medium |

* includes state owned enterprises

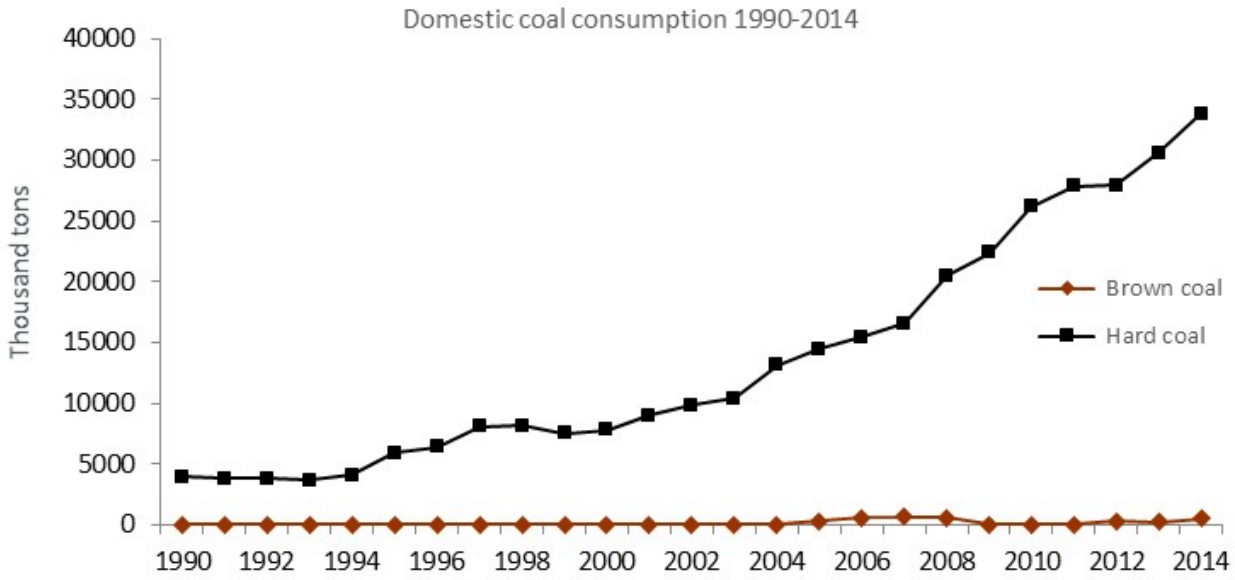
## 3.8 Assessment of the relevance and perspective of coal use

Viet Nam has substantial coal resources, the 13th largest hard coal reserves globally, with an estimated 3,116 Mt (BGR, 2014). Coal use is playing an increasing role in the energy mix and according to current planning this role is to increase further. This chapter explores the developments of the sector, its role in the economy and local impacts of mining and use in more detail.

### 3.8.1 Overview of coal use - historic development and status quo of coal

Coal consumption in Viet Nam has increased rapidly over the last 20 years. Brown coal plays no significant role, but the use of hard coal is more than 8 times that of 1990.

Figure 18: Domestic coal consumption 1990 - 2014




Data sources: IEA (2016a)

In 2014, around half of the coal was used in the industry sector. A further 39% were used for power generation with the rest being utilized in residential and commercial sectors. Within industry the by far largest use sector is non-metallic minerals with 75% of total consumption within industry.

Figure 19: Coal use in 2014 by type and sector (share of consumption in tonnes of coal)

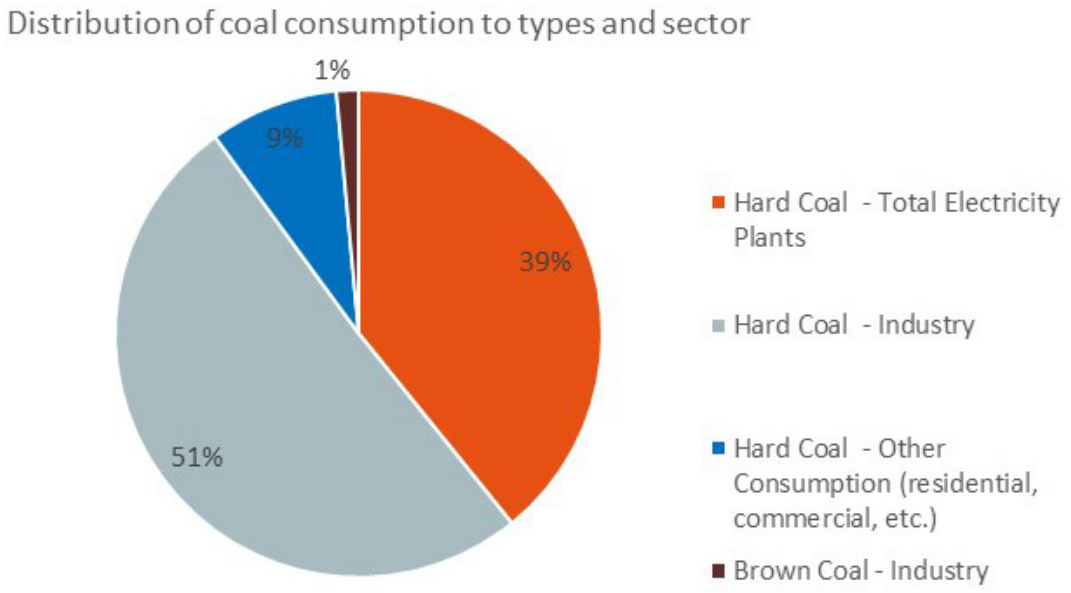
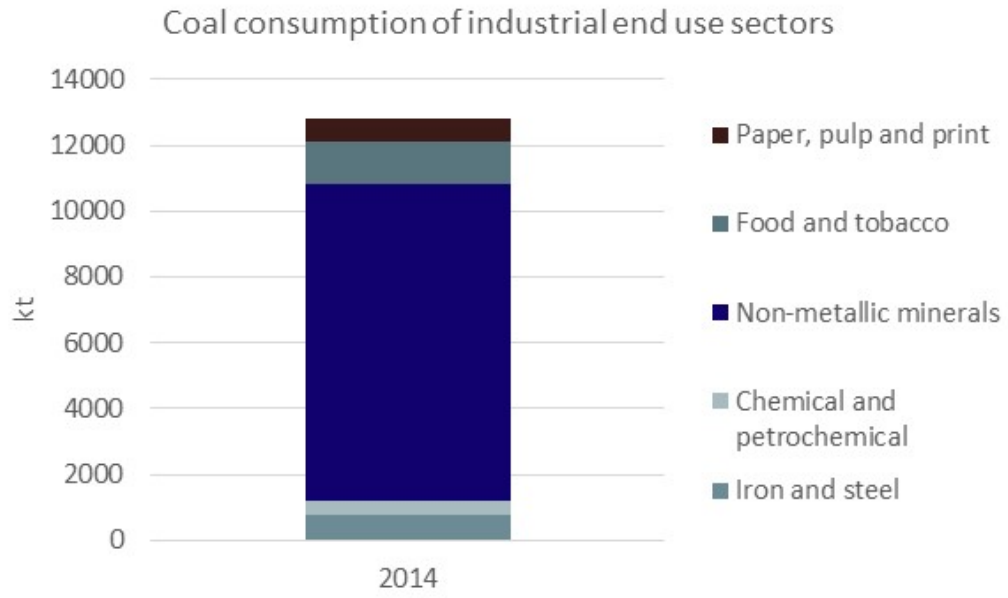


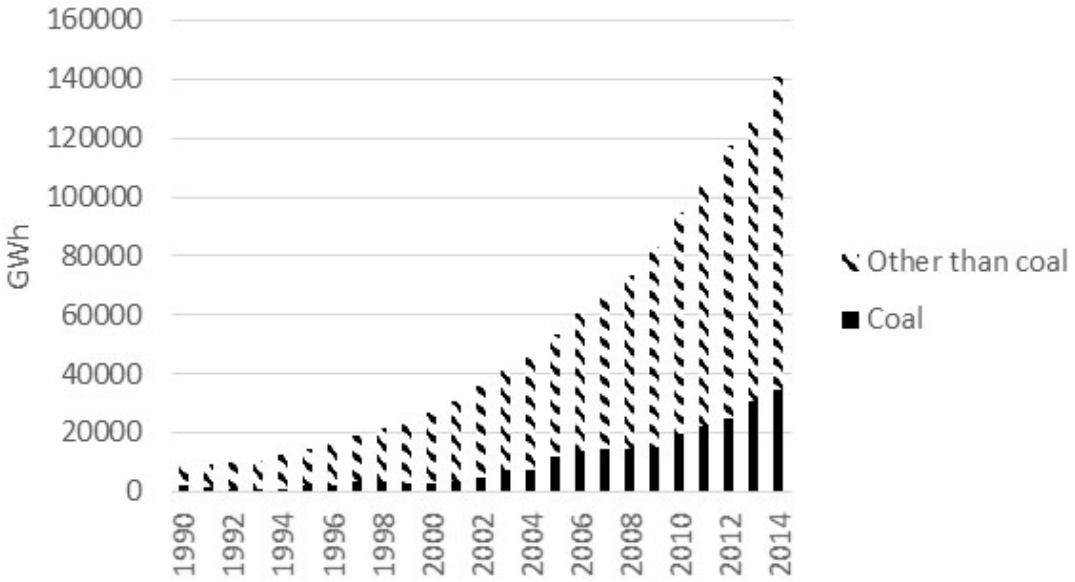

Figure 20: Coal use in 2014 by industrial end use (share of consumption in tonnes of coal)




Data sources: IEA (2016a)

In power generation coal did not play any signigicant role until the early 2000s. Electricity generation from coal has has doubled between 2007 and 2014 and increased 16 times compared to 1990.

Figure 21: Electricity generation from coal and non-coal



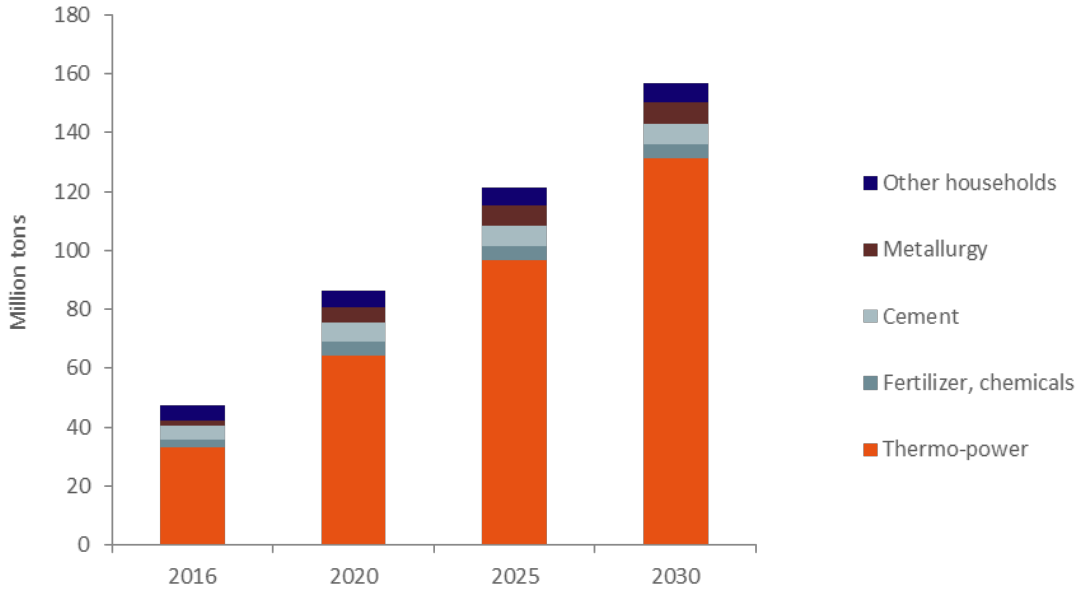

Data sources: IEA (2016a)

### 3.8.2 Future outlook on coal use

**Total coal consumption**. According to the Master Plan of Coal Industry Development in Viet Nam by 2020, with perspective to 2030, which was adjusted in 2016, total coal output was planned at 41-44 million tons in 2016, 47-50 million tons (in 2020), 51-54 million tons (in 2025) and 55-57 million tons (in 2030) (Government of the Socialist Republic of Viet Nam, 2016a). This constitutes a substantial downward revision compared to the previous version, where 75 million tons were expected to be extracted by 2030. This goes together with a drastic reduction in expected capital demand, which in the adjusted plan is only half the annual investment.

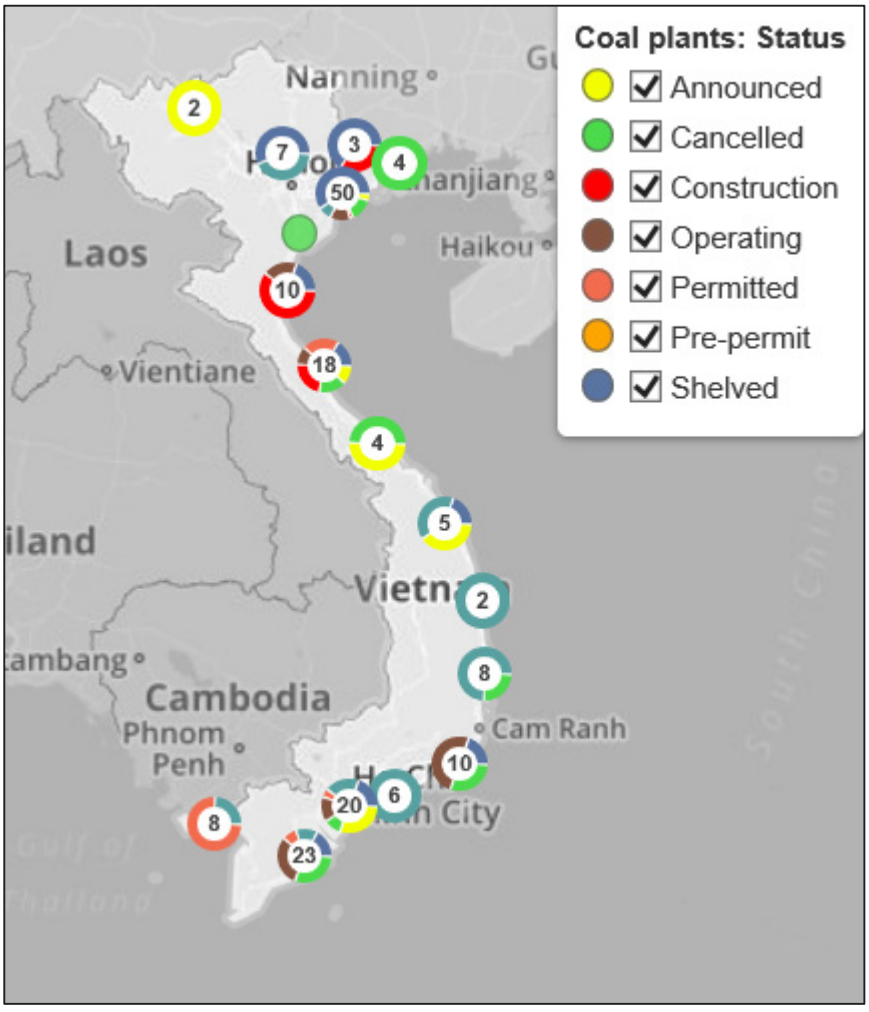
Despite this cut in expected output, overall coal consumption is planned to further increase, from 34 million tons in 2014 (IEA, 2016a) to 156 million tons in 2030, with the vast majority of growth in the power sector (Government of the Socialist Republic of Viet Nam, 2016a).

Figure 22: Coal consumption plans




Data sources: Government of the Socialist Republic of Viet Nam (2016a)

Figure 23: Status of coal plants in Viet Nam




Source: CoalSwarm (2017); Note: number is number of coal plants per region.

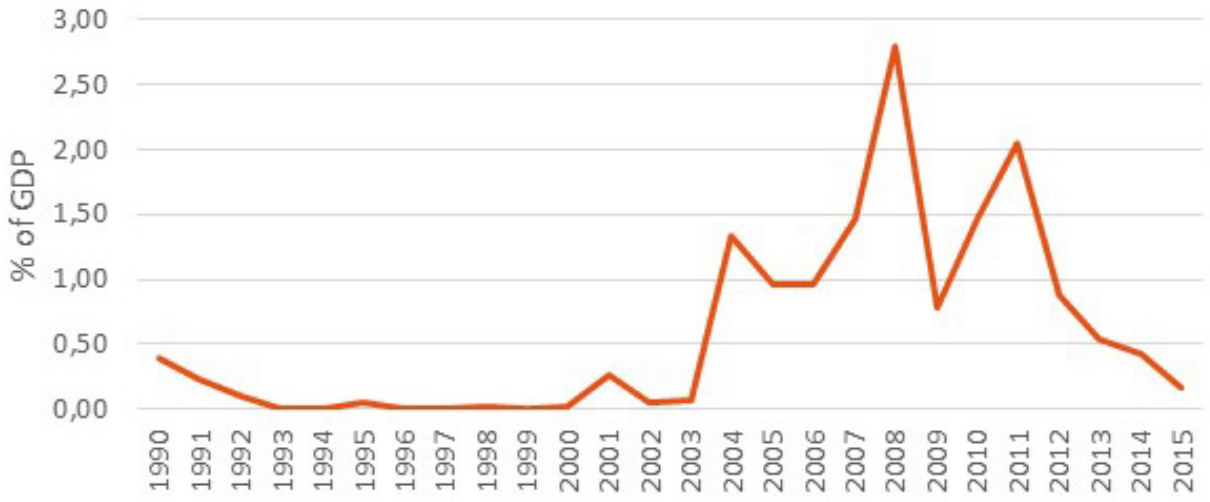
**Coal-fired power generation**. By 2020, total installed capacity of coal fired power is expected to be 26,000 MW, producing around 131 billion kWh which accounts for 49.3% total electricity production and will consume about 63 million tons of coal. By 2030, total installed capacity of coal fired power is planned to be 55,300 MW, producing 304 billion kWh which accounts for 53.2% total electricity production and will consume around 129 million tons of coal (Government of the Socialist Republic of Viet Nam, 2016b).

54 new power plants were in different stages of planning and 34 were under construction in January 2017. They represent almost 30 GW of capacity in planning and 15 GW under construction, with almost 5 GW having become operational in 2016. Compared to previous years there is a decreasing trend in new planning, although construction has picked up from 2015 by 3 GW. At the same time more than 17 GW of capacity were shelved or cancelled, some of which were converted to gas-fired power generation, such as the Dung Quat power station (CoalSwarm, 2017). Revised demand projections can be one explanation for this observation, but increased local resistance, growing environmental concerns and economic factors may also play a role, leading to a gradual re-thinking at the political level. In early 2016, the Prime Minister asked the sector to review development plans and build no more plants, but does not put a moratorium on new plants (Government of the Socialist Republic of Viet Nam, 2016d).

### 3.8.3 The economic role of coal

**Coal mining**. The economic importance of the coal sector as represented in the coal rent (share of GDP generated in the sector) is fluctuating strongly and has decreased over the last years after a period of stronger influence, with the share of coal in GDP estimated at 0.16% for 2015, down from a peak value of 2.8% in 2008. For comparison: in Germany the respective share in 2015 was 0.013%, down from a peak value of 0.83% in 1982 (World Bank, 2017b).

Figure 24: Development of coal rent




Data sources: World Bank (2017b)

Coal extraction is run by the Viet Nam National Coal - Mineral Industries Group (VINACOMIN), a state-owned enterprise. In the period of 2011 - 2015, Vinacomin estimated total revenue of VND 527,878

billion (USD 23.5 billion[9]), up 15% compared to the Resolution of the first Party Congress. The total profit for the whole period was estimated at VND19,413 billion (USD 0.8 billion) (Vinacomin, 2016).

The most recent update of the master plan for coal development estimates that Viet Nam has almost 2.3 billion tons of coal reserves and almost 47 billion tons of resources, most of which estimated or forecast (Government of the Socialist Republic of Viet Nam, 2016a).

[9] Conversion using exchange rates from 1 June 2017, retrieved from www.oanda.com

Table 14: Coal reserves by region in 1000 t

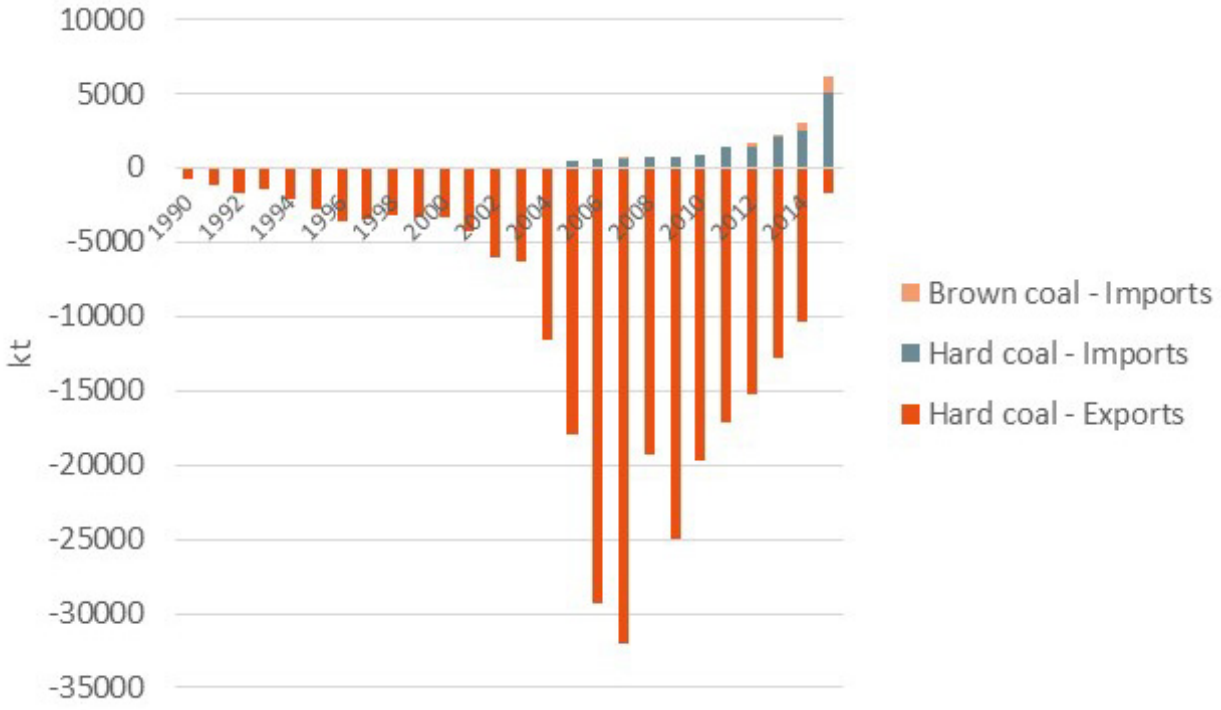
| Region | Total | Reserve | Resources | | | | |
|---|---|---|---|---|---|---|---|
| | | | Total | Proved | High possibility | Estimated | Forecasting |
| Dong Bac coal mines | 6,287,077 | 2,218,617 | 4,068,460 | 109,452 | 394,958 | 1,585,050 | 1,979,000 |
| Song Hong coal mines | 42,010,804 | | 42,010,804 | | 524,871 | 954,588 | 40,531,345 |
| Domestic coal mines | 206,255 | 41,741 | 164,514 | 51,559 | 73,967 | 32,345 | 6,643 |
| Local coal mines | 37,434 | | 37,434 | | 10,238 | 8,240 | 18,956 |
| Peat coal mines | 336,382 | | 336,382 | | 133,419 | 106,611 | 96,352 |
| Total | 48,877,952 | 2,260,358 | 46,617,594 | 161,011 | 1,137,453 | 2,686,834 | 42,632,296 |

Data sources: Government of the Socialist Republic of Viet Nam (2016a)

**Trade**. Viet Nam has a long history of coal exports, mainly hard coal. In 2005, it first started importing coal and imports have increased steadily while eports have decreased sharply since 2007. In 2015 Viet Nam became a net importer for the first time (IEA, 2016a). The recent decline in coal exports is based on the Government's policy of restricting coal exports to ensure national energy security and domestic demand in the light of increased domestic demand. If the trend of increasing demand continues, coal imports could become a significant burden on national accounts, which is already characterized by a negative export/import balance (General Statistics Office of Viet Nam, 2017).

The revised PDP 7 expects coal imports to rise to 129 million tons for power generation alone (Government of the Socialist Republic of Viet Nam, 2016b). Assuming a cost of imported coal of 40 to 50 USD/t, this could amount to 5.1 – 6.4 billion USD/yr, equivalent to 2.7% - 3.4% of the current GDP.

Figure 25: Development of coal imports and exports




Data sources: IEA (2016a)

Overall the importance of fuel exports (including coal, oil and gas) has decreased dramatically in importance from over 26% in total merchandise exports in 2000 to 6% by 2014, with manufactured products increasing in importance from 43% to 76% in the same period (World Bank, 2017b).

**Employment**. In 2015, around 238,000 people were employed in the 'mining and quarrying' sector in Viet Nam, representing 0.45% of the total workforce, of which coal only represents part. Likewise, the 'electricity, gas, stream and air conditioning supply' sector employed 0.25% of the workforce in 2015, with only a share of this being related to coal-fired power generation (General Statistics Office of Viet Nam, 2017).

The construction of coal-fired power plants can contribute to local economies, as well as domestic equipment suppliers. The power plant construction requires skilled workers and engineers, therefore creating job positions with high wages (Ha-duong et al., 2016). With the scale of planned expansion (see Annex I), this could have visible impact on employment in the relevant sectors for the duration of construction.

**Subsidies**. Most fossil fuel subsidies are indirect and not recorded as actual fiscal transfers, making them particularly difficult to quantify. Support for fossil fuel consumption in Viet Nam comes in the form of various price controls and provisions to energy producers and distributors, the overwhelming majority of which are state owned enterprises (SOEs). These provisions include price controls, discounted or even free resources and infrastructure, preferential loans from state-owned banks, loan guarantees or bail out of loss-making units, and a variety of corporate tax breaks and concessions. Companies are also rarely made to incur the social and environmental costs that result from energy production.

Fossil fuel subsidies in Viet Nam as calculated by the IEA have decreased over the last years and reached an all-time low in 2015, with USD 211 billion and an average subsidization rate of 1.1%. This represents only 0.1% of GDP and translates to USD 2.3 per person (IEA, 2016c).

Table 15: Consumption subsidies for fossil fuels in Viet Nam (Real 2015 billion USD)

| Energy source | 2013 | 2014 | 2015 |
|---|---|---|---|
| Oil | 16,7 | - | - |
| Electricity | 1.290,1 | 783,9 | 36,0 |
| Natural gas | 495,0 | 246,1 | 172,4 |
| Coal | 5,6 | 3,4 | 2,7 |
| Total | 1.807,4 | 1.033,3 | 211,0 |

Data sources: IEA (2016c)

SOEs dominate energy markets, so as they are forced to lower their profits or make losses due to price caps and operational inefficiencies, they build up debt. The Government is foregoing revenue and eventually will need to cover losses. By the end of 2015, debt of Vinacomin was approximate VND 100,343 billion (USD 4.5 billion[10]) (Vinacomin, 2016). In 2016, EVN had a debt of VND 475,357 billion (USD 21.2 billion) (EVN, 2016).

### 3.8.4 Local impact of coal use

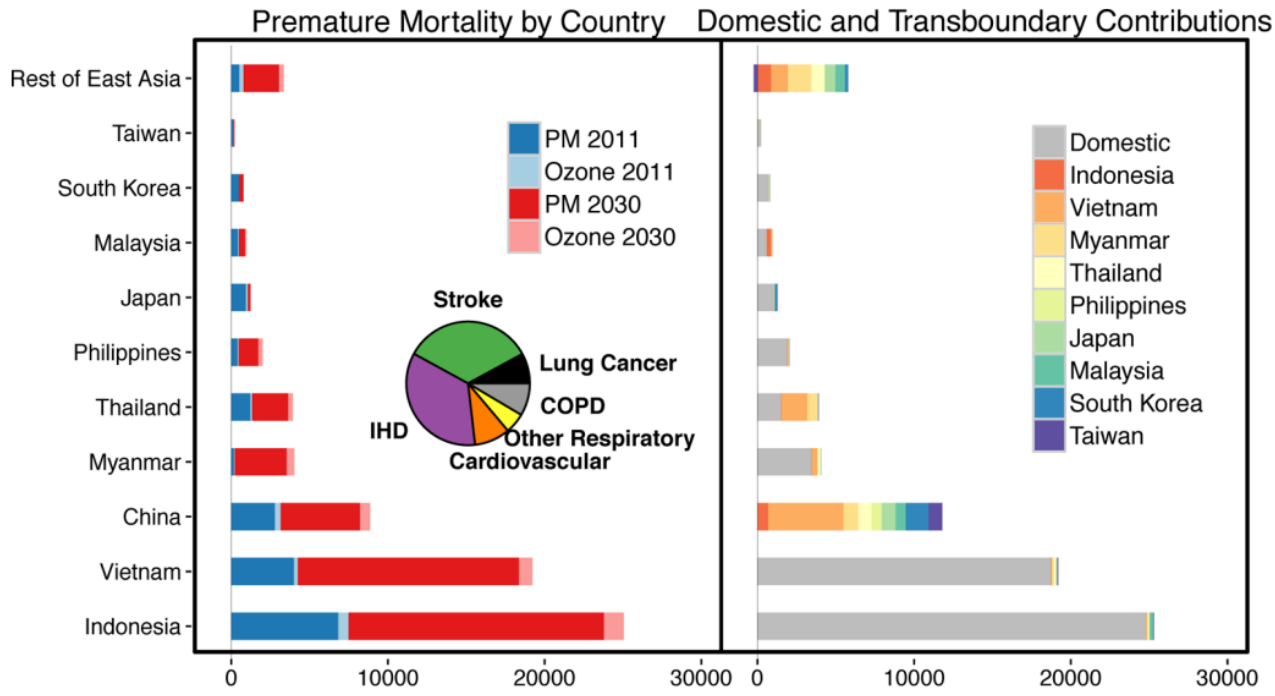
**Air quality**. Most coal power plants operating in Viet Nam as of 2016 are based on old technology (sub-critical power plants), and some lack emission control equipment. This leads to relatively high emissions at these plants.

Monitoring results from MONRE showed that in 100% of coal mining and processing facilities, concentrations of dust in the air exceeded the Vietnamese standard (QCVN06:2009/BTNMT) from 30 to 300 times (Ha-duong et al., 2016) . According to QCVN06:2009, the maximum allowed dust concentration is 0.15mg/$m^3$.

The Vietnamese standards on Ambient Air Quality (QCVN05:2013/BTNMT) set the national standards for particulate matter (PM). PM10 concentration is set at 50 µg/$m^3$ (measured as an annual mean) and 150 µg/m3 (measured as a daily concentration). The standard for PM2.5 is 25 µg/$m^3$ and 50 µg/$m^3$, respectively. Figure 26 illustrates the estimated premature deaths related to particulate matter and ozone emissions from coal-fired power plants in Viet Nam and other South-East Asian countries (Koplitz, Jacob, Sulprizio, Myllyvirta, & Reid, 2017).

[10] Conversion using exchange rates from 1 June 2017, retrieved from www.oanda.com

Figure 26: Coal-related mortality due to emissions in Southeast Asia

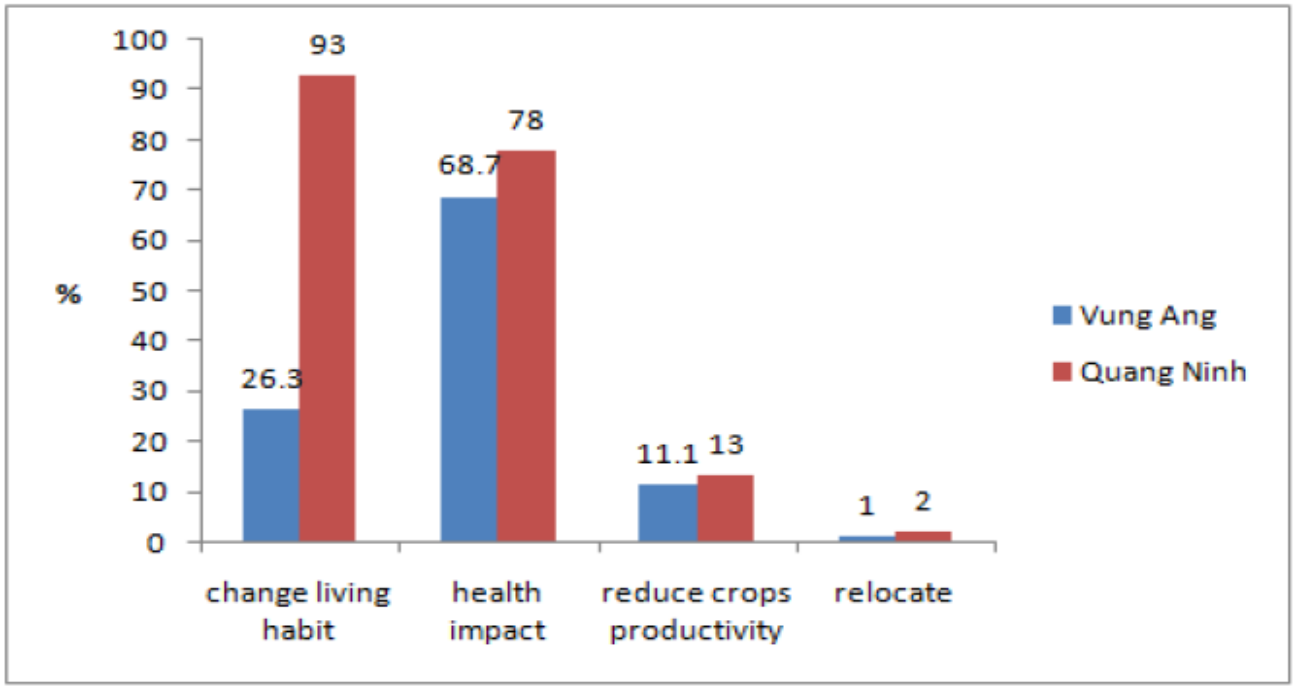



Source: Koplitz et al. (2017)

According to Dinh-Hieu, Xuan-Nam, & An Hai (2012), the coal mines of Cam Pha, Uong Bi and Ha Long city had shown a high level of dust pollution. The largest sources of dust emission are the process of sorting coal and cost transport. Also, dust generated from active waste rock dumps or closed waste rock dumps which are not yet recultivated.

Air pollutants, especially dusts, produced from coal power plant operation (coal transportation to the plant, coal combustion, ash transportation and storage) is significantly affecting people's health and daily activities in the area around the plant sites (Ha-duong et al., 2016).

Figure 27: Impact of air pollution




Sources: Ha-duong et al. (2016)

**Worker safety and health**. Spontaneous combustion of coal in the waste rock pile coal yards of some mines e.g Lang Cam, Phan Me (in Thai Nguyen province), Khe Bo (Nghe An province), Uong Bi and Southeast Company, has been recognized since the seventeenth century. The spontaneous combustion of coal has seriously impacted the environment, safety and occupational health of the miners.

Inspection in mining areas revealed that the noise intensity there could reach 97 – 106 dB. This noise exceeds the allowed value of 75 dB according to the Vietnamese standard TCVN 5949:1998 which results in many cases of occupational deaf among mining workers.

**Water**. A study on Lo Tri coal mine in Quang Ninh showed a high risk of streams around the coal mine being acid contaminated in the dry season (Le & Nguyen, 2012). A recent survey of Quang Ninh coal power plant (Ha-duong et al., 2016) showed that water quality at the area receiving waste water of the cooling process has high temperature, ranging from 38.1°C to 38.9°C; this temperature is 7.9°C to 12.9°C higher compared to that of water source before entering the plant and 6.2°C – 16.1°C higher compared to that after exiting the plant as input of the cooling process[11]. The sudden increase of temperature of water will cause the temperature shock of living organisms in the ecosystem, increasing the living activities in water and the dissolved oxygen (DO) in water as well as the dissolution of toxic matters in water, resulting in an imbalanced ecosystem. Pollution is found to be higher in the rainy season and even areas further from the waste water discharge point and coastal areas are moderately affected. The survey of Mao Khe coal power plant in 2015 also revealed the same problem of thermal pollution at the point of discharge of cooling water to the Suoi Gao stream (CEWAREC, 2015).

[11] For comparison: in Hamburg the allowed temperature difference induced through cooling water is 3°C (Projektgruppe Wärmelastplan Tideelbe, 2008)

While there was only one mine with a mine water treatment station before 2009, VINACOMIN has been investing into further treatment stations. By 2012, there were 29 mine water treatment projects completed and operated in the Quang Ninh basin (Mien, 2012).

The ion concentrations of copper, lead, zinc, and iron in the wastewater of many mines are higher than the acceptable standards[12]. Zinc ion concentration in Lang Hich mine, for example, exceeded the acceptable standard by 1.4 to 3.39 times, the zinc and lead ion con-centration in Cho Dien mine exceeded the acceptable standard of 1.4 -3.6 and 1.9 - 6.93 times cor-relative (My, 2010).

**Soil**. A study of rice paddy soil composition in Cam Pha, Quang Ninh province, showed the presence of cadmium, copper and lead at higher concentrations than calculated background concentrations (Martinez, Marquez, Hoang, & Gieré, 2013). Metals and metalloids in Cam Pha rice paddy soils, including Arsenic (As), Cadmium (Cd), Chromium (Cr), Copper (Cu), Mercury (Hg), Manganese (Mn), Nickel (Ni), lead (Pb) and Zinc (Zn), were found in concentrations ranging from 0.2 to 140 mg/kg, which were in close agreement with toxic metal contents in mine tailings and Coc Sau coal samples, suggesting mining operations as a major cause of paddy soil contamination. Solid waste is also one of the causes of changes in soil properties in the area. Coal mine wastes of Nui Beo contain high levels of Iron and Manganese to the flow through the soil surface will increase metal concentrations of iron, manganese in the soil.

Storage of coal ash is a major challenge, due to the large amount of coal ash generated by coal power plants in Viet Nam. According to the survey of the Japan Bank for International Cooperation (JBIC), 673,600 tonnes of coal ash is produced every year from just 5 EVN's coal power plants (with total capacity of 1 500 MW, which account for 10% of total installed capacity of all coal power plants in Viet Nam) in the Northern region. With an expected installed capacity of coal power plants of 55 300 MW by 2030, the amount of coal ash could be up to 25 million tonnes per year, requiring up to 22 000 ha of land for coal ash storage (Nga & Hoa, 2015).

**Local livelihoods**. The most important impact to the livelihood of local people comes from land acquisition and resettlement. For example, due to the construction of Hai Phong Coal Power Plant, 53% of affected people became unemployed after their land was acquired. Of these, only 20% found new jobs or new ways of making a living such as opening small restaurants or entertaining services. Only a few got a job in Hai Phong Coal Power Plant.

Coal mining in Quang Ninh province impacted 750 ha of forest, caused the agriculture land to shrink by 79 ha compared to 1985 value, of which 30 ha lost was paddy field (Ha-duong et al., 2016). The coal mines do not have effective measures to restore the cultivation land, thus affect the agricultural activities of local farmers and reduce crops yield.

In Quang Ninh, illegal underground coal mining cause land sinking in the residential area. This phenomenon was threatening the stability of buildings in this area and affecting 80 households forcing them to relocate.

Coal-fired power plants located next to the sea are expected to affect aquaculture production and farming. Vung Ang Coal Power Plant discharge to Mui Dung Sea is, for example, seen as one of the reason for decreasing fishery products and aquaculture. Nevertheless, more studies are needed to provide concrete evidences for this link.

**Health**. According to the National Environmental Report 2013 (Ministry of Natural Resources and Environment, 2014), almost 50% of total cases of silicosis in Viet Nam are concentrated around the mining areas.

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[12] Compliant to QCVN 40:2011/BTNMT on wastewater quality of indutrial facilities before discharging to the environment

Health impact from coal power plant construction and operation is assessed through the survey (Haduong et al., 2016). Around Duyen Hai Coal Power Plant, 73% surveyed households said that their health care expenses have increased substantially since the plant construction started compared to previous years. 51% interviewed people live near Vung Ang Power Plant claimed that their physical and mental health is affected by water pollution. Some households even planned to relocate due to low water quality in the neighbourhood.

Respiratory diseases are the most common health problem in the area (69%), followed by eye diseases (32%), skin (26%) and digestive diseases (19%). Health care expenses of 45% survey households have increased in 2014 (when Vung Ang coal power plant was in construction). This number is 48% in case of Hai Phong coal power plant. In Ha Long city, where main coal mines are concentrated and Quang Ninh Coal Power Plant is located, health impact is a serious problem. One third of the interviewed households said that the frequency of hospitalization in 2014 was higher than previous years. 77% households have family members who have respiratory diseases, of which 44% households have members who diagnosed with chronic diseases.

A recent study (Koplitz et al., 2017) estimated that the coal power plants operating in Viet Nam were responsible for 4,250 cases of premature death in 2011 due to exposure to airborne pollutant emissions and is projected to rise to 19,220 by 2030, if Viet Nam continues to develop coal power plants as planned in the current PDP.

### 3.8.5 Conclusions on coal mining and use

Meeting the growing energy demand is the main driving force behind the planned expansion of coal extraction and use. The economic importance related to the national income and employment are currently small, but not insignificant. With the envisaged expansion, the sector would certainly provide additional jobs, although it is unclear if, considering population growth, this would be enough to increase the share of employment of the sector.

The country's efforts to enhance energy security and meet domestic demand have led to reduced coal exports over the last years. The growing dependence on coal imports envisaged in the most recent energy master plan counters these endeavours and can lead to a further increase in the existing foreign trade deficit.

The currently envisaged expansion of coal-fired power generation is largely in line with the business-as-usual communicated in the NDC, although the latest revision of the energy master plan has lower electricity demand and higher shares of renewables. Since the NDC does not include major contributions by the energy sector, stronger mitigation ambitions would necessarily mean a reduction in coal-fired power generation compared to envisaged plans. All capacity that is currently in planning or under construction would -if completed- still be within their operational lifetime by 2050, increasing the global challenge to achieve net zero emissions in the second half of this century.

With much of the foreseen coal-fired capacity not yet built, opportunity cost for reductions from the sector are -still- comparatively low, particularly if based on reduced demand. If additionally, the cost and energy security issues related to coal imports and the substantial environmental and health effects of coal mining and power generation are taken into account, increased efforts to support renewable energy sources would generate multiple benefits for the country.

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## 3.10 Annex I List of new coal fired power plants to become operational until 2030

| No | Name | Installed capacity (MW) | Investor |
|---|---|---|---|
| | **2016** | | |
| 1 | Formosa Ha Tinh #2 | 150 | IPP – coal fired |
| 2 | Formosa Ha Tinh #5 | 150 | IPP – coal fired |
| 3 | Formosa Dong Nai #3 | 150 | IPP – coal fired |
| 4 | Ve Dan power plant | 60 | IPP – co-generation (coal fired) |
| 5 | Duyen Hai III #1 | 600 | EVN |
| | **2017** | | |
| 6 | Thai Binh power plant I #1,2 | 2x300 | EVN |
| 7 | Thai Binh power plant II #1 | 600 | PVN |
| 8 | Duyen Hai power plant III #2 | 600 | EVN |
| | **2018** | | |
| 9 | Thang Long power plant #1 | 300 | Thang Long Power Jsc.Co |
| 10 | Vinh Tan power plant IV #1,2 | 2x600 | EVN |
| 11 | Thai Binh power plant II #2 | 600 | PVN |
| 12 | Long Phu I #1 | 600 | PVN |
| | **2019** | | |
| 13 | Thang Long power plant #2 | 300 | Thang Long Power Jsc.Co |
| 14 | Hai Ha cogen power plant 1 | 2x50 | IPP |
| 15 | Na Duong II power plant | 110 | Vinacomin |
| 16 | Long Phu I power plant #2 | 600 | PVN |
| 17 | Song Hau I power plant #1,2 | 2x600 | PVN |
| 18 | Duyen Hai III power plant (extent) | 660 | EVN |
| 19 | Vinh Tan I power plant #1,2 | 2x600 | CSG – CPIH – Vinacomin (BOT) |
| 20 | Vinh Tan IV power plant (extent) | 600 | EVN |
| | **2020** | | |
| 21 | Formosa Ha Tinh #6,7 | 2x150 | IPP – coal fired |
| 22 | Formosa Ha Tinh #10 | 150 | IPP – coal fired |
| 23 | Hai Duong power plant #1 | 600 MW | Jaks Resources Bhd (BOT) |
| 24 | Cam Pha III power plant #1,2 | 2x220 | Vinacomin |
| 25 | Cong Thanh power plant | 600 | Cong Thanh Power jsc.co |
| | **2021** | | |
| 26 | Nghi Son II power plant #1 | 600 | Marubeni – Kepco (BOT) |
| 27 | Vung Ang II power plant #1 | 600 | VAPCO (BOT) |
| 28 | Hai Duong power plant #2 | 600 | Jaks Resources Bhd (BOT) |
| 29 | Nam Dinh I power plant #1 | 600 | Teakwang Power Holdings – ACWA Power (BOT) |

| No | Name | Installed capacity (MW) | Investor |
|---|---|---|---|
| 30 | Quang Trach I powr plant #1 | 600 | PVN |
| 31 | Duyen Hai II power plant #1,2 | 2x600 | Janakuasa SDN BHD (BOT) |
| 32 | Song Hau II power plant #1 | 1000 | Tokyo Ink (BOT) |
| 33 | Long Phu II power plant #1 | 660 | TATA Power (BOT) |
| 34 | Long Phu III power plant #1 | 600 | PVN |
| | **2022** | | |
| 35 | Hai Ha co-gen power plant 2 | 5x150 | IPP |
| 36 | Luc Nam power plant #1 | 50 | IPP |
| 37 | Quynh Lap I power plant | 600 | Vinacomin |
| 38 | Vung Ang II power plant #2 | 600 | VAPCO (BOT) |
| 39 | Nghi Son II #2 | 600 | Marubeni – Kepco (BOT) |
| 40 | Nam Dinh I #2 | 600 | Teakwang Power Holdings – ACWA Power (BOT) |
| 41 | Quang Trach I #2 | 600 | PVN |
| 42 | Vinh Tan III #1 | 660 | VTEC (BOT) |
| 43 | Song Hau II #2 | 1000 | Tokyo Ink (BOT) |
| 44 | Long Phu II #2 | 660 | TATA Power (BOT) |
| 45 | Long Phu III #2,3 | 2x600 | PVN |
| 46 | Van Phong I #1 | 660 | Sumitomo (BOT) |
| | **2023** | | |
| 47 | Quynh Lap I #2 | 600 | Vinacomin |
| 48 | Luc Nam #2 | 50 | IPP |
| 49 | Quang Tri #1 | 600 | EGATi (BOT) |
| 50 | Vinh Tan III #2,3 | 2x660 | VTEC (BOT) |
| 51 | Van Phong I #2 | 660 | Sumitomo (BOT) |
| 52 | **2024** | | |
| 53 | Vung Ang III #1 | 600 | Samsung C&T (BOT) |
| 54 | Quang Tri #2 | 600 | EGATi (BOT) |
| 55 | Long An I #1 | 600 | |
| | **2025** | | |
| 56 | Hai Phong III #1 | 600 | Vinacomin |
| 57 | Hai Ha co-gen 3 | 2x300 | IPP |
| 58 | Rang Dong co-gen | 100 | IPP |
| 59 | Vung Ang III #2 | 600 | Samsung C&T (BOT) |
| 60 | Long An I #2 | 600 | |
| | **2026** | | |
| 61 | Hai Phong III #2 | 600 | Vinacomin |

| No | Name | Installed capacity (MW) | Investor |
|---|---|---|---|
| 62 | Quynh Lap II #1 | 600 | BOT |
| 63 | Long An II #1 | 800 | |
| | **2027** | | |
| 64 | Quynh Lap II #2 | 600 | BOT |
| 65 | Long An II #2 | 800 | |
| 66 | Tan Phuoc I #1 | 600 | |
| | **2028** | | |
| 67 | Hai Ha 4 co-gen | 2x300 | IPP |
| 68 | Quang Trach II #1 | 600 | |
| 69 | Tan Phuoc I #2 | 600 | |
| 70 | Tan Phuoc II #1 | 600 | |
| | ***2029*** | | |
| 71 | Quang Ninh III #1 | 600 | |
| 72 | Vung Ang III #3 | 600 | |
| 73 | Tan Phuoc II #2 | 600 | |
| 74 | Bac Lieu I #1 | 600 | |
| | 2030 | | |
| 75 | Quang Ninh III #2 | 600 | |
| 76 | Vung Ang III #4 | 600 | |
| 77 | Bac Lieu I #2 | 600 | |

Source: Government of the Socialist Republic of Viet Nam (2016b)