

COUNTRY PROFILE VIETNAM

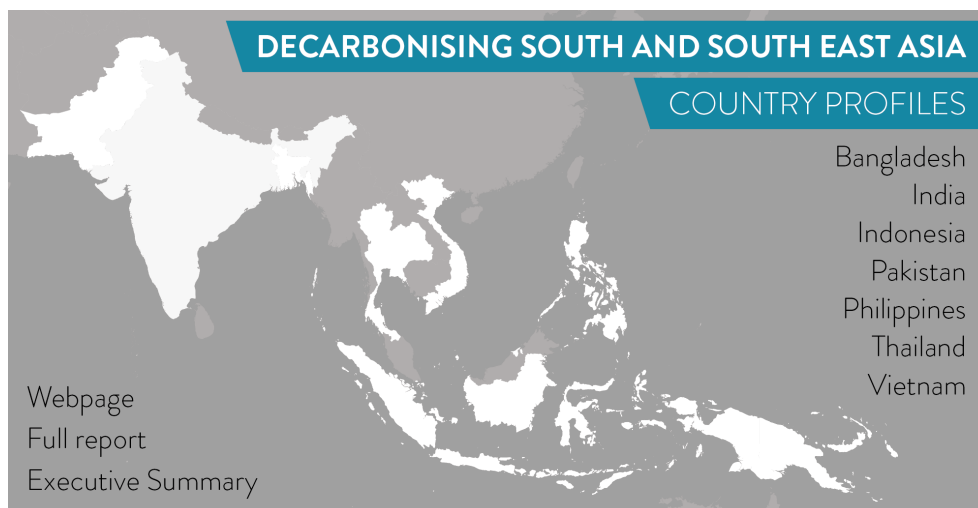
DECARBONISING SOUTH AND SOUTH EAST ASIA

Shifting energy supply in South Asia and South East Asia to non-fossil fuel-based energy systems in line with the Paris Agreement long-term temperature goal and achievement of Sustainable Development Goals

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This country profile is part of the **Decarbonising South and South East Asia** report and examines how to shift the energy supply in South Asia and South East Asia to non-fossil fuel-based energy systems in line with the Paris Agreement long-term temperature goal and achievement of Sustainable Development Goals.

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VIETNAM

Key Messages

Climate change impacts – Paris Agreement temperature goal matters for Vietnam

- Vietnam is already highly vulnerable to climate impacts at present levels of global warming of about 1°C above pre-industrial levels.
- Risks associated to extreme heat, droughts and flooding are projected to be very high in a 3°C warmer world, which is the projected level of warming resulting from current round of NDCs
- Warming beyond 1.5°C would result in sea level rise of 2 m in the long run, threatening coastal regions and important areas for agricultural production like the Mekong delta.

Vietnam's energy system: from net energy exporter to importer with plans for a massive coal expansion

- Due to strong economic growth and progress in poverty eradication, Vietnam's energy use has doubled and CO₂ emissions per capita have tripled within less than two decades.
- Industry is the largest energy user in Vietnam, with a share of almost 40% of total final energy consumption.
- Coal accounts for more than 40% of the energy use in industry, which tripled between 2003 and 2015, with massive coal fleet expansion planned.
- While energy demand is increasing and fossil (oil and gas) resources are running out, Vietnam has turned from a net energy exporter to a net energy importer in 2015, and is expected to increase the share of imports in total primary energy supply to almost 40% in 2025 and almost 60% in 2035.
- Hydropower plays a dominant role in electricity from renewable energy, despite recent added capacities in wind (onshore as well as offshore), solar PV and solid biomass. Hydropower capacities have almost doubled between 2000 and 2017.
- The country reached a 100% electrification rate in 2016, and electricity demand is growing at a much higher rate than the economy.

Transition to renewable energy offers substantial benefits

- Vietnam has large untapped renewable energy potentials, in particular solar and wind. Covering 1.5% of Vietnam's land area with optimally oriented PV panels could potentially generate seven times as much electricity as is currently consumed. The coastal regions of Vietnam offer good wind potential. Despite these potentials, wind and solar together accounted for less than 1% of electricity generation in 2016.
- Vietnam can benefit substantially from a rollout of renewable energy, in particular from reducing external costs from air pollution, with annual average air pollution cost savings in 2025 amounting to about 2.6 billion USD.
- Vietnam could in addition benefit from creating local job opportunities in the renewables sector, reducing fuel import dependency and reducing indoor air pollution and related health impacts.

Targets, projections, and Paris Agreement benchmarks

- Vietnam's NDC commits the country to an 8% reduction in emissions compared with Business-as-Usual emissions by 2030. This can rise to 25% conditional upon international support.
- The NDC target can be reached through a scenario achieving the RE target for 2030: 30% RE share in power generation including large hydro, with wind and solar together reaching 6.8% of power generation in 2030, and 28% share in primary energy supply. An IRENA remap analysis shows the potential to reach a higher share of 35% renewables in electricity generation by 2025.
- Based on the Paris Agreement consistent scenario analysed in Chapter 2 of the report, South East Asia would need to reach a share of 50% of decarbonised electricity generation in 2030.
- Other regional modelling studies show that a faster decarbonisation is possible, with an increase of renewable electricity to up to 100% by 2050, and energy efficiency and sector coupling allowing for the overall system transformation and decarbonisation necessary for progress towards meeting the long-term temperature goal of the Paris Agreement.
- In contrast, currently planned coal fleet expansions would lead to a dramatic increase in emissions, with committed emissions from coal-fired power plants likely to peak only by 2040, with an eventual phase-out only by 2070. This far exceeds the phase-out date derived from regional benchmarks in a Paris Agreement consistent pathway, which sees coal-fired power being phased out in the ASEAN region by 2040.
- There is scope for enhancing the NDC, accelerating renewable energy update, and developing a long-term strategy towards 100% renewable energy power generation and electrification of end use sectors, which would also align with the aspirational goal of supplying 100% of its power with renewable energy, as part of a commitment by the Climate Vulnerable Forum, of which Vietnam is a member.

Introduction

Vietnam's profound political and economic reforms launched in 1986 have transformed it from one of the world's poorest countries to a "lower middle-income country" in less than 25 years. It has made remarkable progress in terms of economic development, boosting its per capita income by a factor of six between 2000 and 2017, as well as in terms of socio-economic development, substantially improving its Human Development Index, reducing poverty rates, and achieving full energy access.

The strong economic growth and progress in poverty eradication had implications for energy demand and related emissions. Total energy use has doubled and CO₂ emission per capita have tripled. The industry sector is the largest energy user in Vietnam, with a share of almost 40% of total final energy consumption (IRENA 2018). To meet electricity demand, massive coal fleet expansions are planned. Coal accounts for more than 40% of the energy use in industry; the share of coal tripled between 2003 and 2015 (IRENA 2018).

As energy demand skyrockets while domestic fossil energy resources shrink, Vietnam became a net fuel importer in 2015, raising energy security concerns.

Recognising its own high vulnerability to climate impacts and acknowledging that all countries need to take responsibility for their contribution to climate change, Vietnam had launched a Green Growth Strategy in 2013 which aims for low-carbon development (Zimmer et al 2015). Yet, despite a vast potential for solar and wind energy, the share of these sources in power generation has remained very low, while coal expansion plans are not in line with the Paris Agreement climate targets, of which Vietnam is a signatory.

As the awareness that fossil fuel use causes environmental degradation and negative health impacts grows, and citizens become especially increasing concerned about air pollution, Vietnam stands to reap multiple benefits of transitioning to modern renewable energy sources, from tackling environmental degradation and improving health of its citizens to improving its energy security by reducing fuel imports.

1 Climate Change Impacts: Risks, vulnerability and benefits of limiting mean temperature rise to 1.5°C

1.1 Present day vulnerabilities and risks

Vietnam is one of world's most hazard-prone countries due to its vulnerability to climate change. As shown in the Table 1, storms are the most devastating disaster type in the last 30 years, causing the highest number of deaths as well as the highest amount of financial losses. Flooding events - also a prominent disaster type - are causing heavy losses, both in terms of financial losses and human mortality. Typhoons, floods and droughts are recurrent, making Vietnam world's ninth most vulnerable country to climate change, according to the Germanwatch climate risk index¹ (Eckstein *et al* 2018).

¹ The Germanwatch Global Climate Risk Index is an analysis based on one of the most reliable data sets available on the impacts of extreme weather events and associated socio-economic data. However, the index must not be mistaken for a comprehensive climate vulnerability scoring. It represents climate-related impacts and associated vulnerabilities but, for example, does not take into account important aspects such as rising sea-levels, glacier melting or more acidic and warmer seas (see <https://germanwatch.org/en/crri>).

Table 1: Climate disaster statistics for Vietnam based on EM DAT database² for the period 1989-2018

Disaster Type	Events Count	Total Deaths	Total affected (million people)	Damage (million US\$)
Drought	5	No data	7.9	7399.1
Extreme temperature	80	4828	25	4312
Floods	89	8304	28.6	10072.8
Storm	5	No data	7.9	7399.1

1.2 Projections on climate impacts comparing 1.5°C and temperature increase under current pledges

If global mean temperature increases by 3°C above pre-industrial levels, corresponding to the warming projected for current round of Paris Agreement climate pledges (NDCs), drought days and extreme heat projected for Vietnam show a higher increase as compared to a 1.5°C warmer world corresponding to the temperature limit of the Paris Agreement. Similarly, flood intensity is projected to increase quite substantially (approx. 13%) in a 3°C warmer world.

Table 2: Future projections of different climatic variables over Vietnam, based on an ensemble of CMIP5 Global Climate Models for 1.5°C and 3°C warmer than pre-industrial worlds³

Indicator	Historical (1986–2015)	+1.5°C World (Paris Agreement)	+3.0°C World (Current NDCs)
Annual Averages			
Near-Surface Air Temperature (°C)	23	+1.1	+2.9
Precipitation	936 mm	+2%	+5.6%
Extreme Events			
Drought: Consecutive drought days (Days)	79	+0.6	+5.5
Heat: Annual Maximum of Daily maximum Air Temperature (°C)	42	+1.0	+2.8
Flooding: Annual Maximum 5-day Consecutive Precipitation (mm)	131mm	+4.8%	+9%
Extreme Precipitation: 1 in 20 year Maximum 5-day Consecutive Precipitation Event (mm)	235mm	+4.2%	23%

² <https://www.emdat.be>

³ The presented values are based on an ensemble of general circulation models (GCMs) from CMIP5 archive. Global Mean Temperature (GMT) increase of 1.5 and 3°C above pre-industrial levels are derived for 20-year time slices with the respective mean warming for each model separately. The warming levels are derived relative to the historical period 1986-2005 and this period is considered to be 0.6°C warmer than pre-industrial levels (1850–1900). For definitions of extremes indicators, please see (Schleussner et al 2016)

Vietnam has a long coastline and especially the Mekong delta – the rice basket of the entire region – is threatened by sea level rise (SLR) and salt water intrusion due to global warming, affecting agricultural yields and food security (Vu *et al* 2018). Limiting warming to 1.5°C would result in substantially lower sea level rise than for higher levels of warming, in particular in the long run. In a 4.3°C warmer world sea levels would rise by around 2 meters by the end of the 22nd century compared with less than 1 meter in a 1.6°C warmer world (Table 3)⁴. Also, risks posed by tropical cyclones are projected to increase substantially. Under a 2.4°C scenario, the number of Category 5 cyclones will increase by about 80% (Bhatia *et al* 2018). The severity of the tropical cyclone hazard will be further amplified by increases in extreme precipitation and sea level rise.

Table 3: Future projections of Sea Level Rise (cm) as compared to today’s level for Vietnam based on the data from (Kopp et al 2014). Averaged values of 4 tide gauged stations are presented. The values in the brackets in the left column are the temperature difference for each future scenario between the end of 21st century (2081-2100) and pre-industrial period (1850-1900)

Sea Level Rise (cm)	2050	2100	2150	2200
RCP 2.6 (1.6°C)	23	49	71	95
RCP 4.5 (2.4°C)	25	59	93	125
RCP 8.5 (4.3°C)	28	79	131	197

2 Socio-economic context

2.1 Economic background

Table 4: Overview on socio-economic characteristics and development over time (Vietnam)

Indicators on economic and human development		Source	2000	2010	Most recent (2017)
Per capita income	GDP/capita in current US\$	WB-WDI	388	1,310	2,342
	GDP/capita adjusting for purchasing power (in PPP, constant 2011 international \$)	WB-WDI	2,562	4,408	6,172
Economic growth	GDP growth rate per capita (annual, in %)	WB-WDI	5.6%	5.3%	5.7%
Human development	Human Development Index (HDI)	UNDP	0.579	0.654	0.694 (Rank 116)
Population	Population in millions	WB-WDI	80	89	96

Notes: PPP – Purchasing Power Parity. GDP – Gross Domestic Product.

Sources: WB-WDI – World Bank World Development Indicators (The World Bank 2019). UNDP – United Nations Development Program (United Nations Development Program 2018a).

⁴ Due to a lack in the scientific literature, we cannot yet provide projections for a 1.5°C scenario. However, global sea level rise by 2100 is about 10cm lower under a warming at 1.5°C compared to a 2°C scenario [IPCC 1.5°C Special Report]. Beyond 2100, only limiting warming to 1.5°C may limit global sea level rise to below 1m, at least 0.5m less than what a 2°C would entail.

Vietnam has over 95 million inhabitants. Its political and economic reforms launched in 1986 have transformed Vietnam from one of the poorest countries in the world to being classified by the World Bank as a “lower middle-income country” since 2009.

Vietnam has achieved enormous economic growth rates (per capita): between 4% and 6% since 2010 (The World Bank 2019). Between 2000 and 2017, Vietnam has increased its per capita income (in US\$) by a factor of six and more than doubled it in terms of purchasing power parity in the same period (see Table 4).

Vietnam also made substantial progress in reducing poverty, decreasing the share of people living in extreme poverty (with less than 1.90\$ (2011 PPP) a day) from almost 38% in 2002 to 2% in 2016 (The World Bank 2019). In 2016, still over 28% of the people in Vietnam have been living with less than 5.50\$ (2011 PPP) a day compared with over 89% in 2002 (The World Bank 2019).

Between 1990 and 2017, Vietnam has increased its Human Development Index (HDI) value from 0.475 to 0.694, an increase of about 46% (United Nations Development Program 2018b). Vietnam’s 2017 HDI is above average of all countries in the HDI-category of ‘medium human development’, but below the average for countries in East Asia and the Pacific (United Nations Development Program 2018b). When Vietnam’s 2017 HDI value is discounted for inequality, it falls to 0.574, a loss of 17% due to inequality (United Nations Development Program 2018b).

2.2 Energy System status and historic development

Table 5: Energy system indicators for Vietnam: current status and recent development

Energy system indicators		Source	2000	2010	Most recent	
					Value	Year
Primary Energy intensity of the economy (energy / GDP)	Energy intensity level of primary energy (MJ/\$2011 PPP GDP)	WB-WDI*	5.85	6.32	5.99	2017
Carbon intensity of energy	kg CO ₂ per MJ energy use	WB-WDI	78.16	101.44	102.86	2013
Carbon emissions per capita⁺	t CO ₂ /population	EDGAR	0.68	1.74	2.18	2016
Fossil fuel share in total energy	Share in total primary energy (%)	WB-WDI	46.27	70.33	69.82	2013
Electricity use	Electric power consumption (kWh per capita)	WB-WDI	285.28	1,016.6	1,410.9	2014
Fossil fuel share in electricity production	Electricity production from oil, gas and coal sources (% of total)	WB-WDI	45.22	70.86	63.27	2015
Share of coal in electricity production	Electricity production from coal sources (% of total)	WB-WDI	11.80	20.75	29.57	2015
Modern RE share in electricity production	Electricity production from renewable sources, excluding hydroelectric (% of total)	WB-WDI	0.00	0.11	0.12	2015
Renewable energy capacities	Installed RE capacity (in MW)	IRENA				
	<i>Wind (onshore)</i>		-	31	61	2017
	<i>Wind (offshore)</i>		-	-	99	2017
	<i>Solar (Concentrated)</i>		-	-	-	-
	<i>Solar (Photovoltaic)</i>		-	-	7	2017
	<i>Biogas</i>		-	-	-	-
	<i>Bioenergy (Solid Biomass)</i>		125	125	176	2017
	<i>Hydropower</i>		3,274	8,610	17,088	2017
	<i>Geothermal</i>		-	-	-	-

Notes: *Calculation of most recent value based on latest available WB-WDI data and growth rates from BP (BP 2018). ⁺CO₂ emissions do not include emissions from LULUCF. PPP – Purchasing Power Parity. GDP – Gross Domestic Product.

Sources: WB-WDI – World Bank World Development Indicators (The World Bank 2019). IRENA – International Renewable Energy Agency Database (IRENA 2019). EDGAR emissions database (JRC 2016).

Total energy use in Vietnam has doubled between 2000 and 2013 (The World Bank 2019). In per capita terms, Vietnam's energy use has increased by 80% in the same period and was only about a third of the world average in 2013 and slightly above the average lower middle income country energy use (The World Bank 2019).

After an increase in the energy intensity of its economy between 2000 and 2010, Vietnam has managed to decrease it again between 2010 and 2017. However, the carbon intensity of energy has increased between 2000 and 2014. Vietnam's share of fossil fuels in total energy consumption has risen from below 46% in 2000 to 70% in 2010, then fell again to below 70% in 2013.

Vietnam's CO₂ emissions per capita⁵ have tripled from 0.68 to 2.18 metric tons between 2000 and 2016 (see Table 5) but remain below the world average of 4.8 tCO₂/capita (JRC 2016).

Between 2000 and 2014, electricity consumption per capita has increased fivefold (see Table 5). The share of fossil fuels in electricity production had increased substantially from close to 45% to almost 71% between 2000 and 2010, and then decreased again to 63% in 2015. The share of coal in electricity production has increased from 11.8% (2000) to almost 30% (2015). At the same time, the share of electricity produced from renewable sources (excluding hydro) has increased slightly from 0% in 2010 to 0.1% in 2015 and remains very low. If hydropower is taken into account, the share of RE increases substantially to over 36% in 2015 (The World Bank 2019). So far, hydropower plays a dominant role in electricity from RE, despite recent added capacities in wind (onshore as well as offshore), solar PV and also solid biomass. Hydropower capacities have almost doubled between 2000 and 2017.

Between 2000 and 2014, Vietnam decreased the share of electric output lost due to transmission and distribution losses from over 13% to about 9% (The World Bank 2019).

⁵ Excluding carbon emissions from land-use, land-use change and forestry (LULUCF).

2.3 Energy system and sustainable development – potential for benefits of a transition to renewable energy

Table 6: Indicators showing sustainable development implications of the current energy system and potential for benefits of a transition to renewable energy (co-benefits) (Vietnam)

Indicators for co-benefits potential		Source	Most recent	
			Value	Year
Fuel import dependency	Share of national income (GDP) spent on fuel imports (%)	WB-WDI ⁺	3.8	2016
	Public expenditures spent on fuel imports (in billion current US\$)	WB-WDI ⁺	7.7	2016
Reliability of electricity supply	Share of firms experiencing electrical outages (%)	WB WDI	26.3	2015
	Power outages in firms in a typical month (number)	WB WDI	0.2	2015
	Share of sales lost for firms subject to power outages (%)	WB WDI	2.2	2015
Access to modern energy	Share of population with access to electricity (in %)	WB WDI	100.0	2016
	Share of rural population with access to electricity (in %)	WB WDI	100.0	2016
	Share of urban population with access to electricity (in %)	WB WDI	100.0	2016
	Share of primary schools with access to electricity (in %)	SDG-database	NA	NA
	Share of population with access to clean fuels or technologies for cooking (in %)	WB WDI	67	2016
Indoor air pollution and health impacts	Number of deaths attributed to indoor air pollution* (per 100 000 inhabitants)	SDG-database	35	2016
Outdoor air pollution and health impacts	Share of population exposed to levels of fine particulate matter (PM 2.5) exceeding WHO guidelines (in %)	WB WDI	100.0	2016
	Number of deaths attributed to ambient air pollution* (per 100 000 inhabitants)	SDG-database	36	2016

Note: *age standardised mortality rate of WHO. ⁺Own calculations based on WB-WDI. GDP – Gross Domestic Product. WHO – World Health Organisation.

Sources: WB WDI – World Bank World Development Indicators (The World Bank 2019). SDG-database -Sustainable Development Goals data base (United Nations 2019).

Vietnam’s domestic primary energy resources such as crude oil, coal, natural gas and hydro power, have been an important factor for its economic development over the last two decades. Yet, with increasing energy demand and ceasing fossil resources, Vietnam has turned from a net energy exporter to a net energy importer in 2015, and is expected to increase the share of imports in total primary energy supply to almost 40% in 2025 and almost 60% in 2035 (Danish Energy Agency 2017). In 2015, it has spent about

3.8% of its GDP **on fuel imports**, amounting to public expenditures of about 7.7 billion USD (see Table 6). The increasing dependency on imports, especially coal, raises energy security concerns. A transition to renewable energy could contribute to reducing energy security concerns and public expenditures on fossil fuel imports freeing resources for other investments.

Reliability of electricity supply leaves room for improvement in Vietnam. Over a quarter of businesses in Vietnam (26%) reports to have been affected by power outages in 2015, however with only one outage happening every five months on average (see Table 6). Yet, these firms are estimated to have lost a value of about 2.2% of their sales due to the outages.

Regarding **access to modern energy**, Vietnam has achieved full access to electricity, both in rural and in urban areas. Yet in 2016, the share of people with access to clean cooking fuels was still only 67% (see Table 6), leaving about a third of the population exposed to health hazards from **indoor air pollution** due to the burning of traditional biomass inside dwellings. Accounting for age structure, about 35 out of every 100 000 inhabitants in Vietnam die due to indoor air pollution. The World Health Organisation (WHO) estimated the number of deaths attributed to indoor air pollution in Vietnam to over 32 000 in 2016 (World Health Organisation 2018).

Outdoor air pollution is also a serious health concern, especially in urban areas. In 2016, all of Vietnam's population was exposed to fine particulate matter concentration levels exceeding recommended limits by the WHO. The number of deaths attributed to outdoor air pollution in Vietnam was about 34 000 in 2016 (World Health Organisation 2018) – with about 36 out of 100 000 inhabitants dying because of outdoor air pollution.

3 Policies and projections on future development

In its NDC Vietnam pledged an unconditional emissions reduction of 8% by 2030 compared with BAU scenario. Specifically, it pledged to reduce the emissions intensity per unit of GDP by 20% compared with 2010 levels. Conditional upon international support, Vietnam could reduce emissions by 25% compared with BAU, with a 30% reduction in emissions intensity per GDP unit (Vietnam Government 2015).

The country reached a 100% electrification rate in 2016 (ESMAP 2019), earlier than the planned timeline of 2022. Vietnam's electricity demand increases much faster than its GDP. In 2018, it increased by 10%, which is double the GDP growth rate (VietnamNet 2019).

In addition to the NDC, Vietnam has a target to increase the renewable energy share in primary energy supply to more than 30% by 2030, and renewable energy capacity (excluding hydro) to 12.5% by 2025 and 21% by 2030 (GIZ 2016). Coal would have a share of 43% in 2030. The target for the share of renewable energy in electricity production including large hydro corresponds to 32% in 2030 and 43% in 2050 (Danish Energy Agency 2017). According to the Energy Outlook Report (Danish Energy Agency 2017), the NDC target can be achieved through a scenario with a much higher share of wind and solar together reaching 6.8% of power generation in 2030.

In addition, Vietnam has an aspirational goal to supply 100% of its power from renewable energy, as part of a commitment of the Climate Vulnerable Forum countries.

BOX: relevant key policies related to energy supply sector

- **Nationally Determined Contribution (NDC):** Unconditional 8% emissions reduction by 2030, with 20% reduction in emissions intensity per GDP unit and an increase of forest cover to 45%. Conditionally, 25% emissions reduction with a 30% reduction in emissions intensity per GDP unit could be achieved.
- **Renewable Energy Development Strategy (2015):** Aiming at increasing renewables share and use to 31% in 2020, 32% in 2030, 44% in 2050.
- **Feed-in Tariffs (FIT) for solar energy:** Introduced in 2017, the FITs guarantee a fixed income per kWh generated for 20 years. They are subject to change in 2019 to facilitate a more balanced PV development by granting higher rates in the less sunny northern part of the country (PV Magazine 2019, LSE 2017).
- **Sustainable Renewable Energy Fund:** Financed from the state budget and environmental fees for fossil fuels, the Fund aims to help achieving the goals of Vietnam's Renewable Energy Development Strategy of i.e. increasing the share of households using solar heat equipment from 4.5% in 2015 to 12% in 2020, to 26% in 2030 and to 50% in 2050 (Enerdata 2016)

4 Projections on planning for coal

Vietnam has substantial coal resources and reserves, and had been traditionally a coal exporter. Consequently, coal use has been playing an increasing role in the energy mix, where electricity generation is expanding rapidly to meet the growing energy demand. According to current planning, its role is to increase further with 44 GW of coal power plants currently in the pipeline, which is the biggest planned expansion in all South East Asia and accounts for 12% of the global coal fleet expansion. Despite its own vast coal reserves, due to the fast increase in domestic coal use, Vietnam has been importing coal since 2005 and became a net importer of coal for the first time in 2015 (IEA 2016). In this context, the government started to restrict coal exports and increase production to ensure domestic demand is met. However, under current expansion plans the increasing domestic coal demand will continue and coal imports could become a significant burden on national accounts.

Focus: The 7th Power Development Plan

The 7th Power Development Plan (PDP) for Vietnam, released by the Vietnamese government in collaboration with the Danish Energy Agency, shows that the government aims to increase the share of coal-based capacity from 34% (2015) to 43% (2030) (Danish Energy Agency 2017). This will see the share of coal in power generation rise to nearly 55% in the corresponding period.

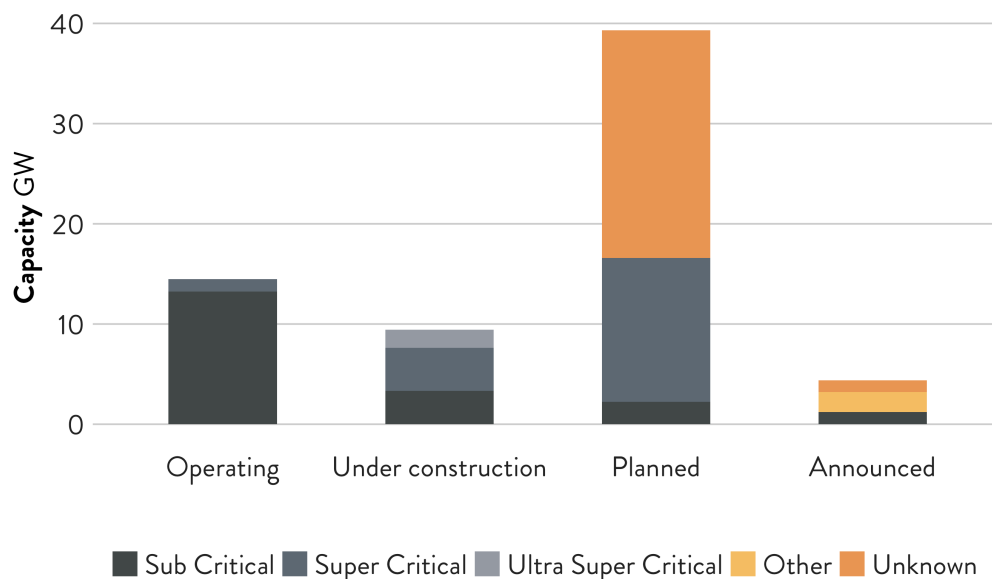
Vietnam's coal-fired expansion plans amount to nearly 183% of the current capacity⁶ (Figure 1). At a global level, this accounts for nearly 12% of the global coal-fired expansion plans. Nearly all of the existing capacity is sub-critical, with higher emission intensity. However, most of the coal plants under construction are either super- or ultra super-critical, with a lower emission intensity.

The planned coal fleet expansions would lead to a dramatic increase in emissions. If all the plants in the pipeline are built, the committed emissions are likely to peak only by 2040, with an eventual phase-out only by 2070, reflecting the large expansion status relative to the existing capacity (Figure 2). This far exceeds the phase-out date derived from regional benchmarks for the ASEAN region: 2040.

⁶ Here, we define current capacity as total operating capacity + capacity under construction, and to expansion plans as planned capacity (permitted and pre-permitted units that have not started construction) + announced capacity.

COAL FLEET IN VIETNAM

POWER PLANT CAPACITY BY STATUS AND TECHNOLOGY

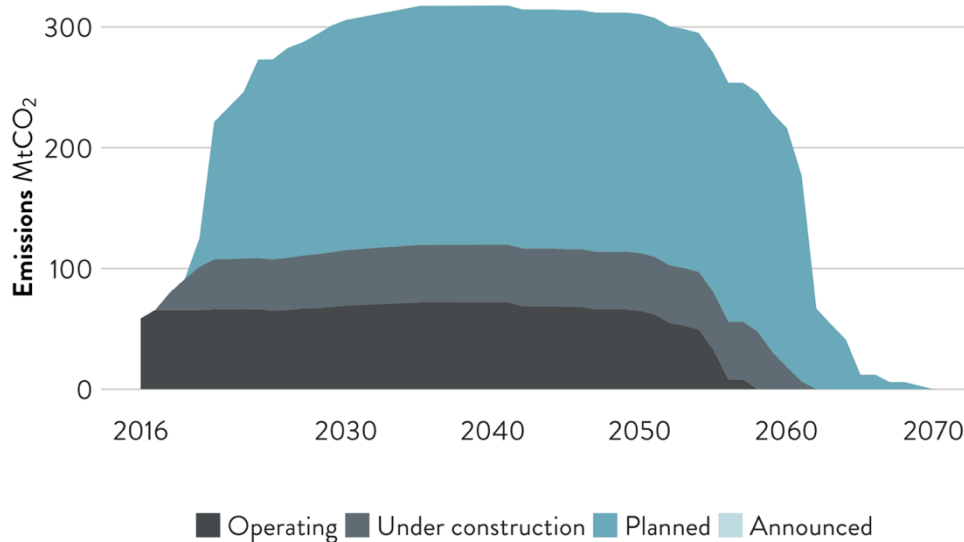


SOURCE : PLATTS WEPP GCPT

Figure 1: Vietnam's coal fired power generation capacity

COAL PLANT EMISSIONS IN VIETNAM

ORDERED BY STATUS



SOURCE : OWN CALCULATIONS BASED ON PLATTS WEPP , GCPT

Figure 2: Committed emissions from Vietnam's coal plants

Our analysis shows that Vietnam's planned massive expansion is totally inconsistent with the Paris Agreement. Construction of these plants could lock Vietnam's energy system into a carbon intensive path for decades, and would be a huge missed opportunity for building a carbon-free and climate-resilient energy system while avoiding the risk of stranded assets.

5 Transition to renewable energy – pathway characteristics, benchmarks, options, potentials, benefits

5.1 Potential and technology options for renewable energy

Potentials and costs

The southern regions of Vietnam offer good solar potential, where daily Global Horizontal Irradiance values exceeding 5.4 kWh/m² (see Figure 3). Covering 1.5% of Vietnam’s land area with optimally oriented PV panels could potentially generate 3080 TWh of electricity, which is equivalent to seven times the total consumption of electricity in 2016 (NREL 2014, BP 2018). The coastal regions of Vietnam offer good wind potential, with mean power densities in excess of 600 W/m² at a height of 100m. However, wind and solar together accounted for less than 1% of electricity generation in 2016 (International Energy Agency (IEA) 2018).

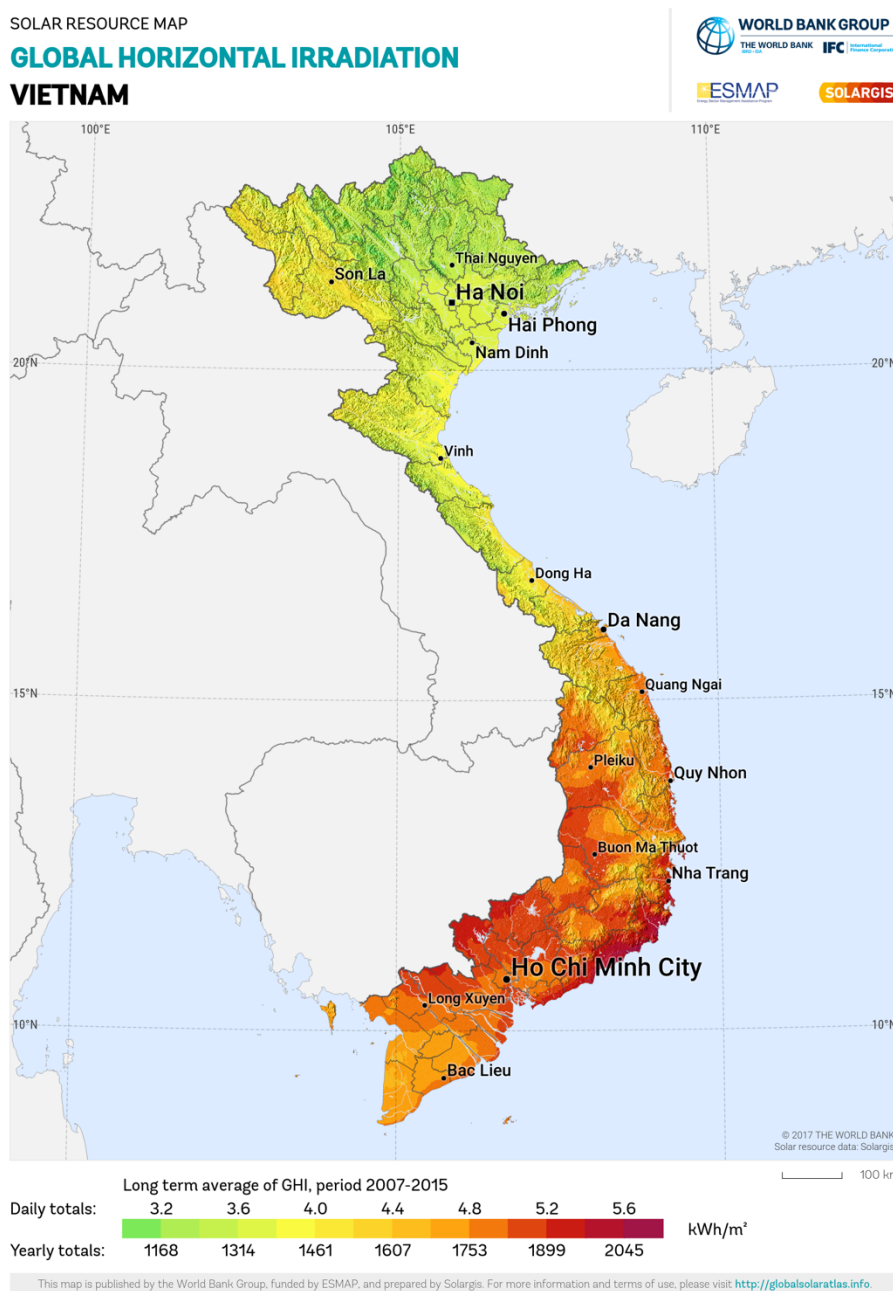


Figure 3. Global horizontal irradiation based on Global Solar Atlas (The World Bank Group 2016)

5.2 Reaping opportunities of transitioning to renewable energy: Implications for local jobs and affordability of energy

Vietnam can benefit substantially from a rollout of renewable energy. IRENA has estimated various benefits in a report on ASEAN, in particular from reducing external costs from air pollution, with annual average air pollution cost savings in 2025 amounting to about 2.6 billion USD with regard to reduced outdoor air pollution implementing the REMAP options (IRENA 2016).

Beyond these benefits of a transition to modern renewable energy, Vietnam could benefit from creating local job opportunities in the RE sector, reducing fuel import dependency and reducing indoor air pollution and related health impacts.

6 Gap analysis: targets, projections, and Paris Agreement benchmarks

Vietnam's NDC commits it to an 8% reduction in emissions compared to Business-As-Usual emissions by 2030. This can rise to 25% conditional upon international support.

According to the Energy Outlook Report (Danish Energy Agency 2017), the NDC target can be achieved through a scenario achieving the RE target for 2030 (30% RE share in power generation including large hydro, with wind and solar together reaching 6.8% of power generation in 2030, and 28% share in primary energy supply. An IRENA remap analysis shows the potential to reach a share of 35% renewables in electricity generation by 2025.

Based on the Paris Agreement consistent scenario analysed in Chapter 2 of the report, South East Asia would need to achieve a share of 50% of decarbonised electricity generation in 2030.

The model developed by the Lappeenranta University of Technology (Manish Ram *et al* 2017) reaches 100% renewable electricity in Vietnam by 2050, utilising solar PV as the anticipated cheapest source of generating capacity over the long term. Solar PV increases from zero currently to 42% by 2025 and 81% of electricity production by 2050. Overall electricity production increases by a factor of nearly 10 times over the time period to mid-century, implying that the cost-optimal energy system solution is to make nearly all new generating capacity be from solar PV.

Thus, there is scope for enhancing the NDC, accelerating the uptake of Renewable energy in the power sector, and developing a long-term strategy towards 100% renewable energy power generation and electrification of end use sectors, which would also align with the aspirational goal of supplying 100% of its power with renewable energy, as part of a commitment by the Climate Vulnerable Forum countries.

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