COUNTRY PROFILE THAILAND

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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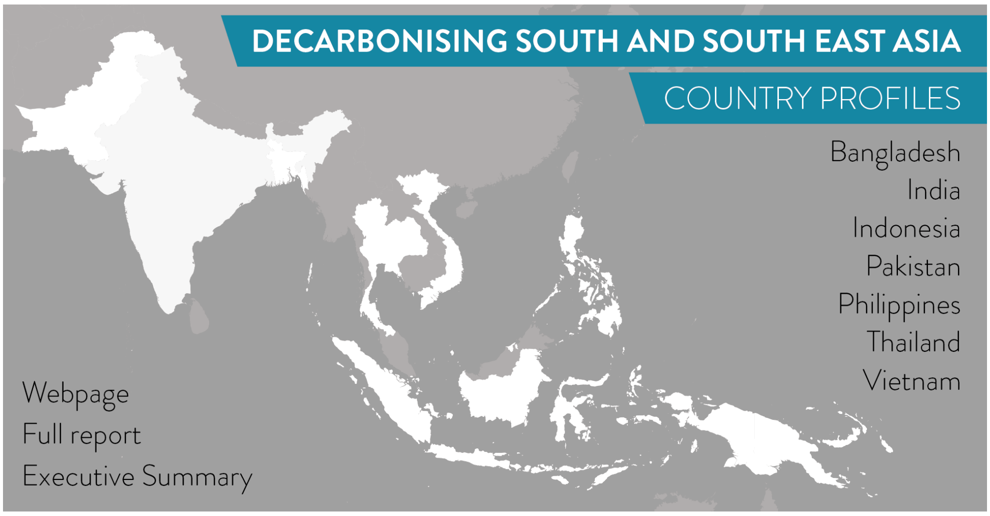

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Key Messages

Climate change impacts – sea level rise and increased threat of flooding especially damaging

- Thailand is already highly vulnerable to climate impacts at present levels of global warming of about 1°C above pre-industrial levels.
- Risks associated with extreme heat, droughts and flooding are projected to be very high in a 3°C warmer world, which is the warming level resulting from the current round of NDCs; the number of drought days is projected to increase by 10%.
- Warming beyond 1.5°C would result in sea level rise of well over 2 meters in the long run – almost twice the sea level rise compared with staying below the Paris Agreement limit.
- The threat of flooding would increase by 13% in a 3°C warmer world compared with a 3% increase in a Paris Agreement-compatible scenario.

Thailand's energy system: Still relying on fossil fuels, but advancing renewable energy expansion

- As energy consumption increased by 85%, the carbon intensity of the energy decreased only slightly – by around 4.7%.
- The share of fossil fuels in electricity generation has decreased slightly but remains very high – above 91%.
- At the same time, the share of electricity produced from renewable sources (excluding hydro) has increased from 0.5% in 2000 to almost 6% in 2015, with substantial added capacities in wind (onshore), solar PV and also solid biomass.
- The share of coal in electricity production has remained almost constant, and plans for new coal-fired power plants met with strong public resistance resulting in decreasing the role of coal in the future energy supply.
- However, natural gas is still going to play an important role according to the government's plans, deepening country's energy dependency on imported fuels.
- The planned coal fleet expansions would result in exceeding the phase-out date derived from regional benchmarks, which sees coal-fired power being phased out in the ASEAN region by 2040.

Transition to renewable energy offers massive benefits

- Thailand has a significant and largely untapped solar and bioenergy potential. The potential for wind is modest, whereas the expansion of hydro energy is limited by environmental considerations.
- Decreasing the role of fossil fuels will improve air quality, decrease Thailand's energy dependency, and result in lower energy cost with saving estimated at USD 1.2bn per year
- Utilisation of bioenergy, especially residues from the agriculture sector, will result in job creation distributed across the country.

Targets, projections, and Paris Agreement benchmarks

- In its NDC Thailand commits to a 20% reduction in GHG emissions compared with Business-as-Usual emissions by 2030. This can rise to 25%, conditional on international support.
- Thailand's Ministry of Energy's Alternative Energy Development Plan (AEDP2015) aims to increase the share of renewables in final energy consumption to 30% by 2036, and in the electricity sector to between 15-20% in 2036.
- The renewables target for the electricity sector is expected to be achieved earlier; it has been increased 21 GW in 2037.
- A Paris Agreement consistent pathway shows a share of 50% of decarbonised electricity by 2030 and full decarbonisation by 2050 for the ASEAN region. Other scenarios show that a share of more than 60% can be achieved by 2030 for Thailand, including a role in decarbonising end use sectors.
- The planned coal fleet expansions would add substantially to Thailand's emissions profile and delay the peaking and phase-out of emissions by more than 10 years. If all the plants in the pipeline were built, the committed emissions from coal-fired power plants would likely peak between 2021 and 2032, with an eventual phase-out only by 2069 (Figure 2). This far exceeds the phase-out date derived from regional benchmarks, which sees coal-fired power being phased out in the ASEAN region by 2040.

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Introduction

With a growing population and increasing GDP, Thailand's energy consumption increases as well. Fossil fuels supply a significant and relatively constant share to meet the growing demand. This does not only contribute to climate change but also deepens Thailand's dependency on energy imports, especially as its own reserves of natural gas are running out. Reliance on fossil fuels also leads to worsening air pollution, with 68 deaths per 100 000 inhabitants attributed to either indoor or outdoor air pollution.

At the same time, Thailand has a significant renewable energy potential, especially from solar energy and residual biomass from agriculture. Its utilisation would not only increase Thailand's energy independence, but would also result in saving thousands of lives, and creating new jobs, especially in less affluent rural areas. Furthermore, as pointed out by some studies, renewables-based energy sector would result in very concrete financial savings.

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

1.1 Present day vulnerabilities and risks

Similar to other countries of the region, Thailand is vulnerable to climate change and has witnessed a number of climate disasters in the last thirty years (Table 1). Flooding events top the ranking with 67 occurrences in the last 30 years resulting in the highest number of deaths (approx. 3000) and huge losses to the economy (45.753 billion USD), followed by storm events, which have also resulted in hundreds of deaths. Droughts have also resulted in heavy economic damages. Thailand holds 13th position in the Germanwatch long-term climate risk index[1] (Eckstein, Hutfils, & Winges, 2018).

Table 1: Climate disaster statistics for Thailand based on EMDAT database[2] for the period 1989-2018

Disaster Type	Events Count	Total Deaths	Total affected (million people)	Damage (million US$)
Drought	11	No Data	42	3 726
Extreme temperature	2	77	1	No Data
Floods	67	2 905	51	45 753
Storm	32	843	4.2	880

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 vulnerability1 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. https://germanwatch.org/en/cri

2 https://www.emdat.be

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

With a global mean temperature increase of 3°C above pre-industrial levels, corresponding to the warming projected for current NDCs, the risks associated with the droughts, extreme heat and flooding are projected to be much higher than in a 1.5°C warmer world. At 3°C, the number of drought days is projected to increase by 10% compared with 2.6% increase if the Paris Agreement 1.5°C limit is met. Similarly, holding warming to 1.5°C would keep the increase in flooding intensity to 3% compared with 13% increase in a 3°C warmer world.

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

Indicator	Historical (1986–2015)	+1.5°C World (Paris Agreement)	+3.0°C World (Current NDCs)
Annual Averages			
Near-Surface Air Temperature (°C)	25	+1.1	+2.6
Precipitation	1528 mm	+2.5%	+10%
Extreme Events			
Drought: Consecutive drought days (Days)	63	+1.7	+6
Heat: Annual Maximum of Daily maximum Air Temperature (°C)	39	+1.1	+3
Flooding: Annual Maximum 5-day Consecutive Precipitation (mm)	150	+1.1%	+3%

Table 3: Future projections of Sea Level Rise (cm) as compared to today's level for Thailand based on the data from Robert Kopp et al. (2014). Average values of 7 tide gauged stations across Thailand 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)	33.5	69	102	136.5
RCP 4.5 (2.4°C)	35	80	124	166
RCP 8.5 (4.3°C)	38	99	163	239

Thailand's coastline also makes it vulnerable to sea level rise (SLR) due to global warming. Paris Agreement 1.5°C limit would result in substantially lower sea level rise than for higher levels of warming,

[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°C 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)

in particular in the long run, with sea level rise of around 2.39 meters in a 4.3°C world compared with 1.36 meters in a 1.6°C warmer world by the end of the 22nd century (Table 3)[4]. Risks posed by tropical cyclones are projected to increase substantially. Under a 2.4°C scenario, the number of Category 4 and 5 cyclones will increase by about 130%[5]. The severity of the tropical cyclone hazard will be further amplified by increases in extreme precipitation and sea level rise.

2 Socio-economic context

2.1 Economic background

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

Indicators on economic and human development		Source	2000	2010	Most recent (2017)
Per capita income	GDP/capita in current US$	WB-WDI	2 008	5 075	6 595
	GDP/capita adjusting for purchasing power (in PPP, constant 2011 international $)	WB-WDI	9 189	13 487	16 279
Economic growth	GDP growth rate per capita (annual, in %)	WB-WDI	3.4%	7.0%	3.7%
Human development	Human Development Index (HDI)	UNDP	0.649	0.724	0.755 *(Rank 83)*
Population	Population in millions	WB-WDI	63	67	69

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).

Thailand has a population of almost 70 million. Over the last decades, it has made substantial progress in terms of economic and social development, transforming from a low-income country to one being classified by the World Bank as a "upper middle-income country" since 2010 (The World Bank, 2018).

Thailand was heavily hit by the Asian financial crisis in the late 1990s but returned to high growth rates afterwards. The growth slowed down again in 2009, 2011, with fast rates of growth exceeding 6% in between. After a slowdown in 2014, the recovery progressed slower, with GDP growth of 3.7% in 2017 (see Table 4). Between 2000 and 2017, Thailand increased its per capita income by a factor of three and almost doubled it in terms of purchasing power parity in the same period.

Thailand also made enormous progress in reducing poverty, eradicating extreme poverty (less than 1.90$ (2011 PPP) a day) and decreasing the share of people living with less than 5.50$ (2011 PPP) a day from almost 49% in 2000 to 7% in 2015 (The World Bank, 2019).

[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.

[5] Relative to 1986-2005 for the North Indian Ocean basin, from Bhatia K, Vecchi G, Murakami H, et al (2018) Projected Response of Tropical Cyclone Intensity and Intensification in a Global Climate Model. J Clim 31:JCLI-D-17-0898.1. doi: 10.1175/JCLI-D-17-0898.1

Between 1990 and 2017, Thailand increased its Human Development Index (HDI) value from 0.574 to 0.755, an increase of about 31% (United Nations Development Program, 2018b). Thailand falls into the "high human development" country group. Its 2017 HDI is below the average of all countries in the HDI category of 'high human development', but above the average for countries in East Asia and the Pacific Region. When Thailand's 2017 HDI value is discounted for inequality, it falls to 0.636, a loss of almost 16% due to inequality (United Nations Development Program, 2018b).

2.2 Energy System status and historic development

Table 5: Energy system indicators for Thailand: 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*	5.23	5.45	5.32	2017
Carbon intensity of energy	kg CO_2 per MJ energy use	WB-WDI	104.99	100.17	98.25	2014
Carbon emissions per capita⁺	t CO_2 /population	EDGAR	2.70	3.61	3.93	2016
Fossil fuel share in total energy	Share in total primary energy (%)	WB-WDI	78.74	79.99	79.84	2014
Electricity use	Electric power consumption (kWh per capita)	WB-WDI	1,448	2,307	2,540	2014
Fossil fuel share in electricity production	Electricity production from oil, gas and coal sources (% of total)	WB-WDI	93.19	94.39	91.46	2015
Share of coal in electricity production	Electricity production from coal sources (% of total)	WB-WDI	18.52	18.84	19.45	2015
Modern RE share in electricity production	Electricity production from renewable sources, excluding hydroelectric (% of total)	WB-WDI	0.53	2.14	5.87	2015
Renewable energy capacities	Installed RE capacity (in MW)	IRENA				
	Wind (onshore)		-	-	628	2017
	Wind (offshore)		-	-	-	-
	Solar (Concentrated)		-	-	5	2017
	Solar (Photovoltaic)		-	49	2,697	2017
	Biogas		-	103	475	2017
	Bioenergy (Solid Biomass)		598	1,663	3,349	2017
	Hydropower		2,388	2,393	2,544	2017
	Geothermal		-	-	-	-

*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).

Energy use (total) in Thailand has increased by over 85% between 2000 and 2014 (The World Bank, 2019). Thailand's per capita energy use has increased by 71% between 2000 and 2014 and was above the world average in 2014 and close to 90% of the average upper middle income country energy use (The World Bank, 2019).

The energy intensity of Thailand's economy remained more or less constant between 2000 and 2017, varying between 5.2 (2001) and 5.56 (2013) MJ/$2011 PPP GDP. Also carbon intensity of energy remained almost constant between 2000 and 2014, decreasing only slightly. Likewise, Thailand's share of fossil fuel sources in total energy consumption has remained on a constant level of around 80% in the last 15 years.

Thailand's per capita CO_2 emissions[6] have increased from 2.7 to 3.9 metric tons of CO_2 between 2000 and 2016 (see Table 5), but remained below the world's average of 4.8 tCO_2/capita (JRC, 2016).

Between 2000 and 2014, per capita electricity consumption has increased substantially to 2,540 kWh but remains below the world's average (3,127 kWh/capita) and also below the average of upper middle income countries (3,517 kWh/capita) in 2014 (The World Bank, 2019). The CIA World Factbook estimates that Thailand's electricity consumption has risen to 2,726 kWh/capita in 2016 (CIA, 2019).

The share of fossil fuels in electricity production has decreased slightly from 93% to 91.5% between 2000 and 2015, yet remained on a comparably high level; the average share for upper middle-income countries in 2014 was 71% (The World Bank, 2019). Also the share of coal in electricity production has stayed constant around 19% between 2000 and 2015. At the same time, the share of electricity produced from renewable sources (excluding hydro) has increased from 0.5% in 2000 to almost 6% in 2015, with substantial added capacities in wind (onshore), solar PV and solid biomass. Including hydro, the share of RE in total electricity output was 8.5% in 2015 (The World Bank, 2019).

Between 2000 and 2014, Thailand decreased the share of electric output lost due to transmission and distribution losses from around 8% to about 6% (The World Bank 2019).

[6] Excluding carbon emissions from land-use, land-use change and forestry.

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) (Thailand)

Indicators for co-benefits potential		Source	Most recent	
			Value	Year
Fuel import dependency	Share of national income (GDP) spent on fuel imports (%)	WB-WDI+	6.2	2016
	Public expenditures spent on fuel imports (in billion current US$)	WB-WDI+	25.5	2016
Reliability of electricity supply	Share of firms experiencing electrical outages (%)	WB WDI	8.6	2016
	Power outages in firms in a typical month (number)	WB WDI	0.2	2016
	Share of sales lost for firms subject to power outages (%)	WB WDI	4.1	2016
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	99.9	2016
	Share of primary schools with access to electricity (in %)	SDG-database	100.0	2011
	Share of population with access to clean fuels or technologies for cooking (in %)	WB WDI	74.4	2016
Indoor air pollution and health impacts	Number of deaths attributed to indoor air pollution* (per 100 000 inhabitants)	SDG-database	32	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).

Energy security has been a top priority for Thailand's government. According to IRENA, more than half of Thailand's energy supply depend on imported energy and known national oil and gas reserves are expected to be depleted in less than a decade (IRENA, 2017). This has increasing implications for energy-related expenditures. In 2016, it spent about 6.2% of its GDP **on fuel imports**, amounting to public expenditures of about 25.5 billion USD (see Table 6). In 2008, expenditures on energy imports peaked at 12% of GDP due to an oil price hike (IRENA, 2017), illustrating Thailand's susceptibility to international market price volatility. In addition to fuel imports, Thailand imports ever more electricity from neighboring countries, and while these imports are expected to increase further, they are being capped at 15% for energy security reasons (IRENA, 2017). A transition to renewable energy could contribute to reducing energy security concerns and lowering public expenditures on fossil fuel imports, thus freeing resources for other investments.

Overall, Thailand exhibits a well-established electric power grid structure (IRENA, 2017). However, there is still room for improving the **reliability of electricity**. While the share of businesses affected by power outages (about 8.6%) and also the average number of outages (0.2 per month) reported in 2016 is low compared with neighboring countries, these firms are estimated to have lost about 4.1% of their sales due to the outages (see Table 6).

Regarding **access to modern energy** Thailand has achieved virtually full access to electricity in rural and urban areas. Moreover, all primary schools in Thailand had access to electricity in 2011 (see Table 6).

However, in 2016, the share of people with access to clean cooking fuels was still only 74.4%, leaving more than one quarter of the population exposed to health hazards from **indoor air pollution** due to the burning of traditional biomass inside of dwellings. Accounting for age structure, about 32 out of every 100 000 inhabitants in Thailand die due to indoor air pollution. The World Health Organisation (WHO) estimated the number of deaths attributed to indoor air pollution to amount to almost 30 000 in 2016 (World Health Organisation, 2018).

Outdoor air pollution is also a serious health concern, especially in urban areas. In 2016, Thailand's entire population was exposed to fine particulate matter concentration levels higher than WHO recommended limits. The number of deaths attributed to outdoor air pollution is estimated to amount to about 33 000 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, Thailand pledged to reduce its GHG emissions by 20% by 2030 compared with BAU scenario. Conditional on financial and technical assistance, this could be increased to 25% (Office of Natural Resources and Environmental Policy and Planning, 2015b). This would result in emissions in 2030 amounting to 416-444 MtCO2e compared with 228 MtCO2e in 2011 (excl. LULUCF) (Office of Natural Resources and Environmental Policy and Planning, 2015a).

In 2016, Thailand's electrification rate was 100% in both rural and urban areas (ESMAP, 2019). Its energy consumption is predicted to increase at a rate of 2.5% annually from 2017 to 2036. To slow down the increase in energy consumption in 2015 Thailand adopted 20-Year Energy Efficiency Development Plan with the goals of reducing energy intensity by 30% and saving nearly 90 TWh by 2036. As a result, energy consumption would decrease from 187 Mtoe in BAU scenario to 131 Mtoe if the goals are achieved (Ministry of Energy, 2015b).

Also in 2015, Thailand's Ministry of Energy adopted Alternative Energy Development Plan (AEDP2015) with the goals of increasing the share of renewables in the electricity sector to 15-20% in 2036. The share of heat coming from renewables should be between 30-35%. On average 30% of all energy was to come from renewables. It also set a target of 19.68GW of installed renewable energy capacity by 2036. The Plan listed a number of measures to achieve these goals, such as support of research and development, support of communities in production of renewables, or capacity building (Ministry of Energy, 2015a).

According to a recent report, the 2036 goals may be met much sooner, with almost 15 GW of renewable electricity, equivalent to 21% power generation capacity, to be installed by 2028 (Fitch Solutions, 2019). Therefore the Power Development Plan (2018-2037) adopted in early 2019 included more ambitious targets for 2037: by then the installed renewable energy capacity should total almost 21 GW (The Diplomat, 2019).

BOX: relevant key policies related to energy supply sector

- **Nationally Determined Contribution:** An unconditional 20% reduction in GHG by 2030, as well as a conditional reduction of 25%. The country also pledges to investigate and promote market mechanisms at various multilateral levels (Office of Natural Resources and Environmental Policy and Planning, 2015b).
- **Alternative Energy Development Plan (AEDP2015) and Power Development Plan:** goal to increase share of renewable energy in electricity to 15-20% in 2036, and in heat to 30-35%, overall: 30%. Revised target for 2037: 21 GW renewable energy capacity in 2037.
- **Feed-in Tariffs for renewable energy:** Introduced in 2013, the Feed-in Tariffs led to the development of 3 GW of solar energy by 2016. The tariffs are available to small generation unit and guarantee a fixed price for 25 years (Pugnatorius Ltd., 2019).
- **Green bonds:** subscribed by the ADB, the green bonds finances development of renewable energy projects in the country (The Nation, 2018).

4 Projections on planning for coal

Thailand's power generation relies mainly on natural gas, but domestic gas production is falling behind demand, necessitating gas imports. In order to diversifying its energy mix, Thailand has promoted the use of renewable energy over the past ten years but it is also expanding its coal fleet and is expected to increase the share of electricity generated by coal in the future. Due to the high environmental, health, and socioeconomic impacts associated with coal use, in a country where renewable energy is price-competitive and largely available, many of the new coal power plants under development face opposition from the local population. This has created delays in construction and cancellation of many projects. In this context, the future of the planned coal generation capacity is very uncertain.

Focus: Power Development Plan

After facing massive public opposition and delays in projects, the Electricity Generating Authority Thailand (EGAT) has revised downwards its projections for coal power generation in its 2018 Power Development Plan for 2018-2037 (PDP 2018), which sets out the country's energy goals and was approved by Thailand's National Energy Policy Council (NEPC) in January 2019. Compared with the previous PDP released in 2015, some key differences stand out: the share of gas in the fuel mix is significantly higher while the coal share is much lower.

Thailand's coal-fired expansion plans amount to nearly 57% of the current capacity[7] in the country (**Figure 1**). This expansion accounts for nearly 1% of the global coal-fired expansion plans. Nearly all of the existing capacity is sub-critical, with higher emission intensity. However, all the coal power plants under construction or planned are ultra super-critical, with a lower emission intensity.

[7] 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.

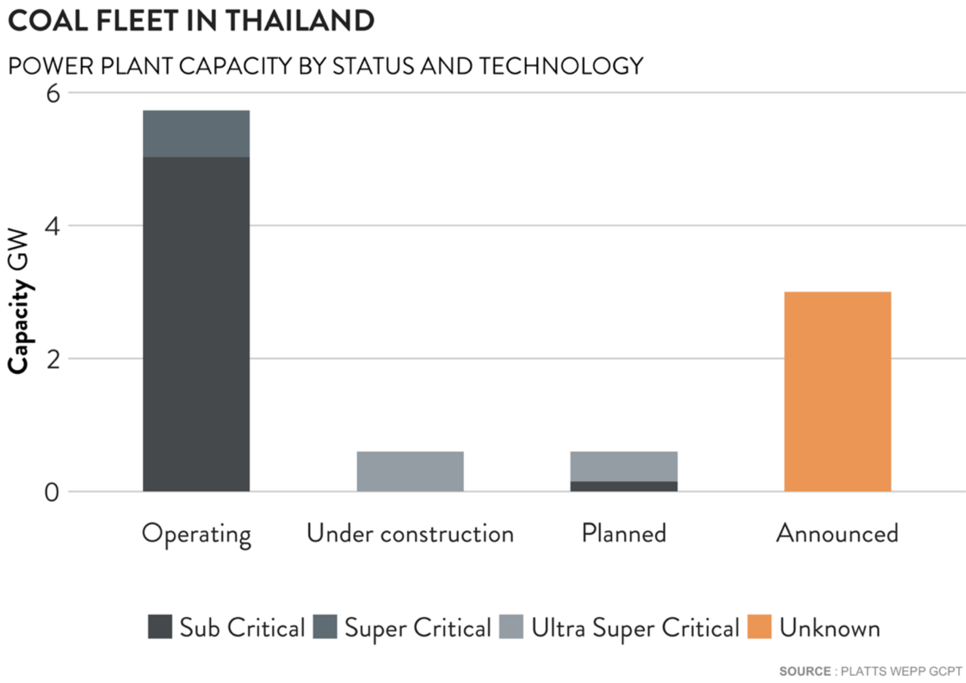

Figure 1: Thailand's coal fired power generation capacity

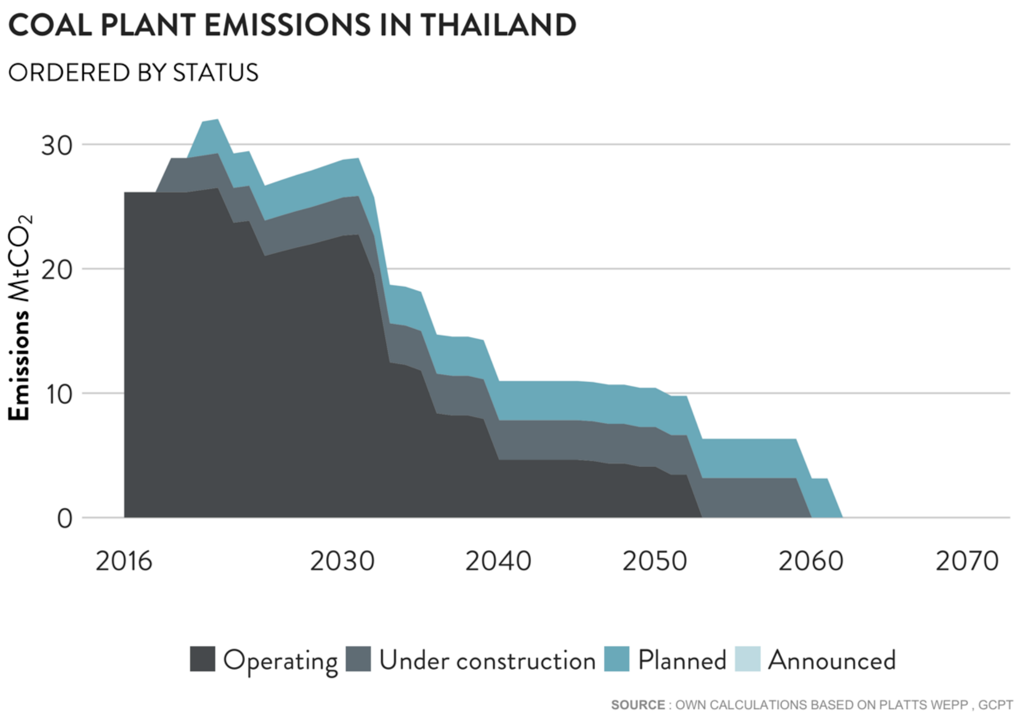

Figure 2: Committed emissions from Thailand's coal plants

The planned coal fleet expansions would represent substantial additions to the emissions profile of Thailand and delay the peaking and phase-out of emissions by more than ten years. If all the plants in the pipeline are built, the committed emissions from coal-fired power plants are likely to peak between 2021 and 2032, with an eventual phase-out only by 2069 (**Figure 2**). This far exceeds the phase-out date derived from regional benchmarks, which is 2040 for the ASEAN region.

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

5.1 Potential and technology options for renewable energy

Thailand has modest solar potential in the eastern region, with average daily Global Horizontal Irradiance values greater than 5 kWh/m2. Covering 1.5% of Thailand's land area with optimally oriented PV panels could potentially generate 1557 TWh of electricity, which eight times the total consumption of electricity in 2016 (BP, 2018; NREL, 2014).

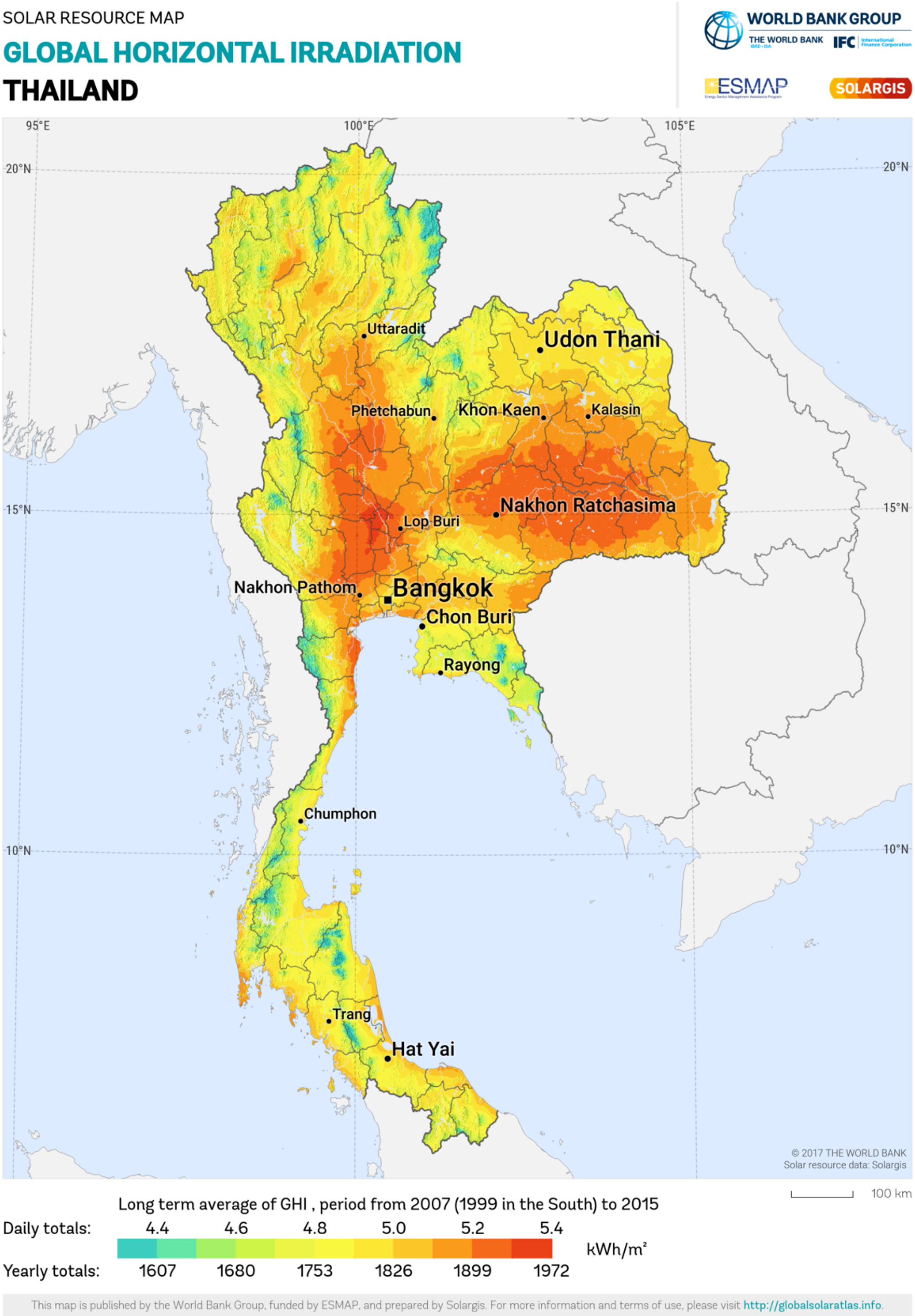

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Figure 3. Global horizontal irradiation based on Global Solar Atlas (The World Bank Group, 2016)

Thailand also has modest wind potential with a mean wind power density of 290 W/m^2 in the top 10% windiest regions in the country. The windiest regions are in the west, but their mountainous character makes it more challenging to utilise these resources (World Bank Group, 2018).

Due to its large agricultural sector, Thailand also has significant bioenergy potential, only a small share of which is currently utilised. Rice straw could provide up to 3.1 Mtoe, but only 10% of this potential is currently utilised. Only 20% of the potential of rice husk estimated at 1.5 Mtoe is utilised. Sugar cane leaves and tops could provide 2.9 Mtoe, but only 10.4% of this potential has been utilised. Combined, all forms of residual biomass could generate 8 Mtoe (Ministry of Energy, 2019a), corresponding to 6.2% of total primary energy used in 2017 (BP, 2018).

Geothermal resources in Thailand are more limited, however an assessment from 2006 found 112 hot brine sources in every region, except North-eastern, with surface water temperatures ranging between 40 and 100 degrees (Ministry of Energy, 2019b).

The existing hydro energy potential in Thailand is estimated at around 15.2 GW, a quarter of which has so far been utilised. Further 1.5 GW can be generated in 25 river areas for small scale hydropower plants (Aroonrat & Wongwises, 2015). However, especially in the case of the large hydropower plants, the further utilisation is limited by environmental considerations (IRENA, 2017).

In a scenario towards 100% renewable energy (Teske et al., 2019) Thailand is in a sub-region together with Myanmar and Bangladesh. By 2030 renewable sources make up two-thirds of electricity supply, and rise to 80% by 2050, with a decarbonisation of end use sectors.

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

Thailand can benefit substantially from a rollout of renewable energy. IRENA (IRENA, 2017) has estimated following benefits:

- **Reducing air pollution and related health impacts.** Thailand could benefits from external costs from air pollution implementing the REmap Options, with annul air pollution cost savings amounting to about 2.2 billion USD for oil, 2.3 billion USD for coal and 0.1 billion USD for gas.
- **Contribute to energy security.** The share of modern renewable energy in total primary energy supply in the REmap Scenario in 2036 is 37% compared to 28% in the reference case, contributing to Thailand’s aim to become more energy independent.
- **Contributing to reducing energy system costs.** IRENA estimates by 2036, REmap options could result in reducing energy system costs in Thailand by around 1.2 billion USD per year, equivalent to savings of 9.2 USD per MWh.

Beyond these benefits of a transition to modern renewable energy, Thailand could benefits form creating local job opportunities in the RE sector.

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

- In its NDC, Thailand commits to a 20% reduction in GHG emissions compared with Business-as-Usual by 2030. This can rise to 25%, conditional on international support.
- In 2015 Thailand's Ministry of Energy adopted an Alternative Energy Development Plan (AEDP2015) with the goal of increasing the share of renewables in final energy consumption to 30% by 2036, and in the electricity sector to between 15-20% in 2036.
- The renewables target for the electricity sector is expected to be achieved earlier, and in the target has been increased to aim for 21 GW in 2037.
- A Paris Agreement consistent pathway shows a share of 50% of decarbonised electricity by 2030 and full decarbonisation by 2050 for the ASEAN region. Other regional scenarios show that Thailand could achieve a share of more than 60% by 2030, including a role in decarbonising end use sectors.
- The planned coal fleet expansions would represent substantial additions to the emissions profile of Thailand and delay the peaking and phase-out of emissions by more than 10 years. If all the plants in the pipeline are built, the committed emissions from coal-fired power plants are likely to peak between 2021 and 2032, with an eventual phase-out only by 2069 (Figure 2). This far exceeds the phase-out date derived from regional benchmarks, which is 2040 for the ASEAN region.

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