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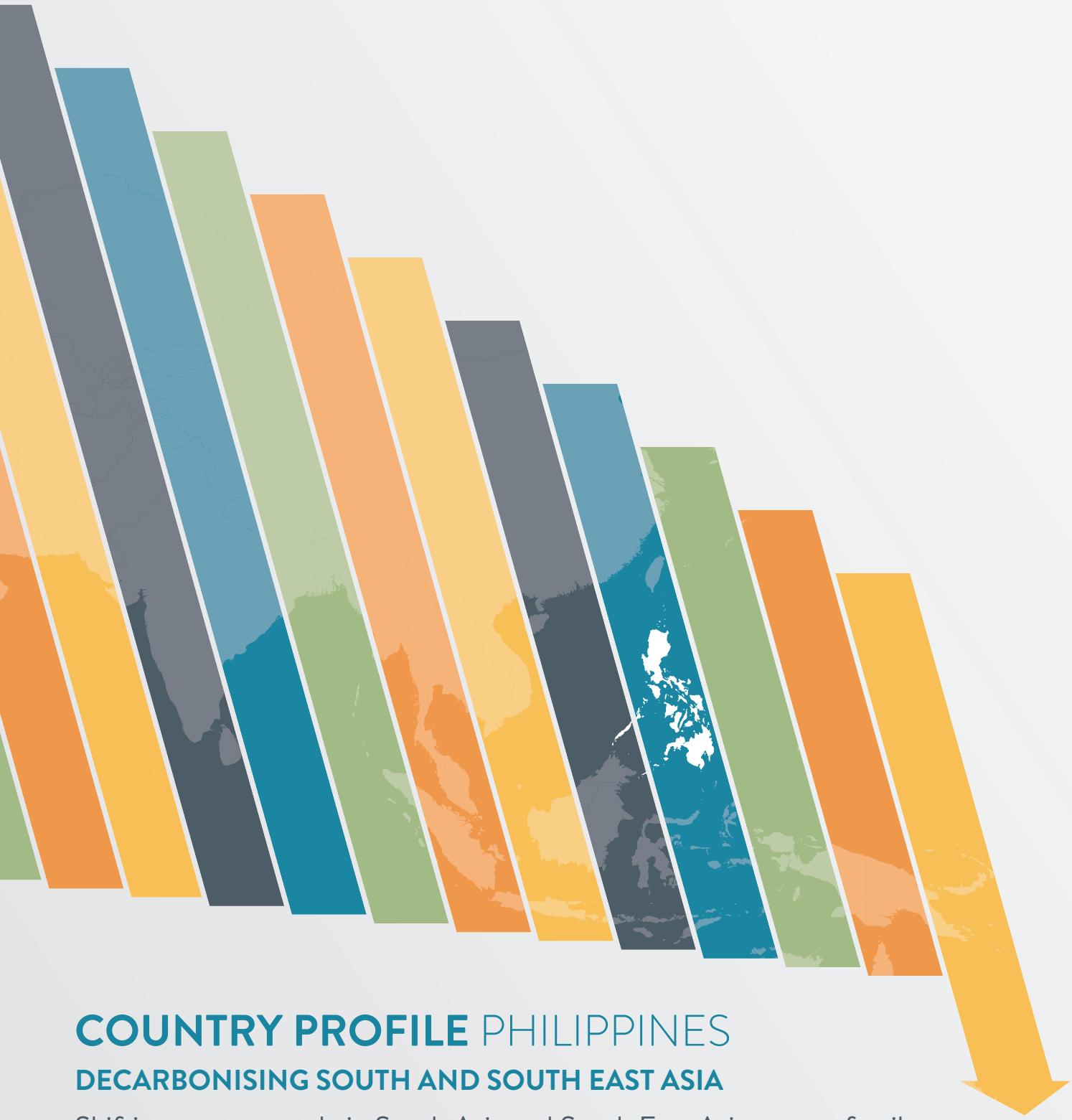


COUNTRY PROFILE PHILIPPINES

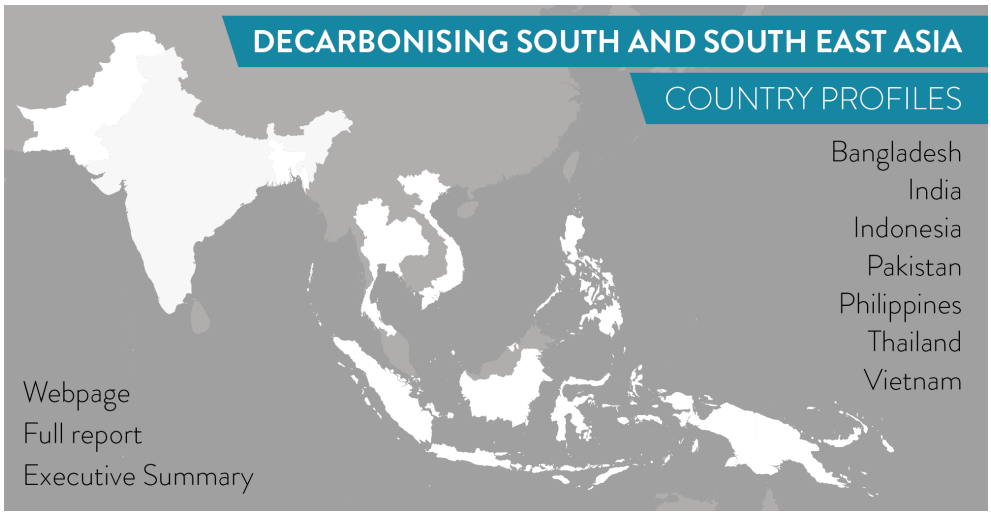
DECARBONISING SOUTH AND SOUTH EAST ASIA

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

MAY 2019

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.

Find links to other country profiles and the full report below.



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PHILIPPINES

Key Messages

Climate change impacts – Paris Agreement temperature goal matters for Philippines

- The Philippines is one of the world's most vulnerable countries to the impacts of climate change.
- The Philippines is already highly vulnerable to climate change at present level of global warming of about 1°C above pre-industrial levels.
- In a 3°C warmer world, annual precipitation is projected to increase at almost double the rate as compared to 1.5°C, greatly increasing the flooding risk by more than 7%.
- A warmer world beyond 1.5°C would commit the coastlines to more than 1m sea level rise in the long run.
-

The Philippines energy system: an increasing role of fossil fuels

- The Philippines has achieved substantial progress in reducing the energy intensity of its economy between 2000 and 2017.
- While per capita energy consumption decreased by 7% between 2000 and 2014, the potential per capita emissions reduction was outweighed by an increase in the carbon intensity of the energy sector.
- Especially worrying is the increase of coal in the supply of electricity: from 37% in 2000 to 48% in 2016.
- At the same time, the share of renewables decreased from 26% in 2000 to 15% in 2015, despite recent large capacity additions, in particular wind and solar as well as solid biomass.
- The Philippines is a net importer of fossil energy and depends strongly on oil imports for transport and coal for its power sector. On average almost half of the Philippines primary energy is imported. Energy independence is a crucial objective of the Philippines' government.
- The expansion of coal power generation as currently planned could lock in the energy system in a carbon intensive path for decades, and would be a huge missed opportunity for building a carbon-free and climate-resilient energy system that would lower oil import dependency, provide clean and reliable power, and avoid many of the externalities related to coal extraction and use.

Transition to renewable energy offers massive benefits

- The Philippines has varied renewable energy potentials, which, apart from solar, wind and bioenergy, include significant geothermal energy.
- Renewable energy is abundant and ideal for the energy needs of the country because small islands are more suitable to be provided with decentralised renewable electricity than with centralised fossil fuel based generation, which would need substantial grid investments. The competitive advantage of decentralised, carbon-free and flexible renewable energy compared with centralised and polluting coal is clear under the national circumstances of the Philippines, and would improve energy access in remote areas and isolated islands.
- IRENA estimates that by 2025 the Philippines could reduce energy system costs by around 0.5 billion USD per year, which would create local job opportunities in the renewables sector.
- A transition to renewable energy could contribute to reducing energy security concerns and public expenditures on fossil fuel imports, freeing resources for other investments. The increasing reliance on fossil fuel imports comes at a significant cost – 3.5% of the country's GDP or 11 billion USD in 2017 were spent on fuel imports.
- The Philippines can benefit substantially from a rollout of renewable energy also in terms of reducing air pollution and related health impacts. The Philippines could benefit from reducing external costs from air pollution with annual average air pollution cost savings in 2025 amounting to about 1.1 billion USD with regard to reduced outdoor air pollution.

Targets, projections, and Paris Agreement benchmarks

- The Philippines' NDC commits the country to a 70% reduction in emissions below Business-as-Usual emissions by 2030, conditional on international support. This commitment is rated 2°C C compatible by the Climate Action Tracker.
- Neither implemented nor planned policies are currently sufficient to achieve the Philippines NDC target (CAT 2018) but full implementation of the planned "National Renewable Energy Program (NREP)" and "The Energy Efficiency and Conservation Roadmap" would lower emissions by 11% compared with current policy projections.
- The NDC target is unlikely to be met if all the announced coal-fired power plant capacity (more than 10 GW announced to be constructed by 2025) were to be built.
- The massive expansion of coal-fired power plants means that emissions from coal-fired power plants are likely to peak only by 2035, with an eventual phase-out only by 2062. This far exceeds the phase-out date derived from regional benchmarks for Paris Agreement compatible scenarios, which sees coal-fired power being phased out in the ASEAN region by 2040.
- A Paris Agreement consistent pathway for the ASEAN region shows a share of 51% of decarbonised electricity generation in 2030 and full decarbonisation by 2050. Based on this and other scenario analysis, there is scope for 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.

Introduction

Due to increasing population and economic growth, energy demand in the Philippines is set to rise as well. A worrying trend is the increasing carbon intensity of energy generation, resulting from more coal use and a decreasing share of renewables. Such development is unsustainable not only due to the impact on climate change – the average CO2 emissions per capita are still significantly below the global average – but due to increasing energy dependency, which in 2017 resulted in USD 11 billion spent on fuel imports. Furthermore, outdoor and indoor air pollution lead to 206 deaths per 100 000 citizens every year.

At the same time, the country has significant renewable energy potential. While geothermal energy could replace fossil fuels for heat generation for the industry, solar energy could provide a significantly cheaper alternative to diesel generators and small power plants, especially on the islands. There is also significant, untapped wind energy and bioenergy potential. Utilisation of these sources would allow the Philippines to not only reduce the negative impact of fossil fuels on the environment, but also reduce the costs of fuels imports and energy costs.

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

1.1 Present day vulnerabilities and risks

The Philippines is one of the world's most vulnerable countries to the impacts of climate change, which include sea level rise, increased frequency of extreme weather events, rising temperatures and extreme rainfall. It has witnessed a number of climate disasters in the past 30 years including droughts, floods and storm as shown in Table 1. Storms are the most frequent and most devastating disaster type in terms of human fatalities, whereas floods incur the highest financial losses. According to the Germanwatch long-term climate risk index[1], the Philippines is 5th most vulnerable country to climate change in the world (Eckstein *et al* 2018).

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

Disaster Type	Events Count	Total Deaths	Total affected (million people)	Damage (million US$)
Drought	5	8	3.04	148.8
Floods	124	2 313	28.9	3 535.5
Storm	218	29 697	139.4	232.1

[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, which corresponds to the warming projected that would result from the current NDCs, the increase in annual precipitation is projected to double to 12% compared with a 1.5°C warmer world, which leads to an increase of more than 7% of flooding risk. Moreover, the drought days projected to decrease, while annual maximum temperature would increase in a 3°C warmer world compared with a 1.5°C world.

Table 2: Future projections of different climatic variables averaged over the Philippines, 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)	26.4	+1.1	+2.1
Precipitation	2372.2 mm	+6.7%	+12%
Extreme Events			
Drought: Consecutive drought days (Days)	20.2	+1.1	-0.37
Heat: Annual Maximum of Daily maximum Air Temperature (°C)	31	+1.0	+2.6
Flooding: Annual Maximum 5-day Consecutive Precipitation (mm)	178.48	-1.8%	+7.2%

Table 3: Future projections of Sea Level Rise (cm) as compared to today's level for the Philippines based on the data from Robert Kopp et al. (2014). Average values of 7 tide gauged stations across the Philippines 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)	30	63	93	125
RCP 4.5 (2.4°C)	33	75	117	157
RCP 8.5 (4.3°C)	35	95	156	230

The Philippines' long coastline makes it vulnerable to sea level rise (SLR) due to global warming. Paris Agreement limit of 1.5°C would result in substantially lowering sea level rise than at higher levels of warming, in particular in the long run, with a sea level rise of well over 2 meters instead of 125 cm by the end of the 22nd century in a 4.3°C world compared with a 1.6°C warmer world (Table 3)[4]. Risks posed

[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)

[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.

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%[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 (the Philippines)

Indicators on economic and human development		Source	2000	2010	Most recent (2017)
Per capita income	GDP/capita in current US$	WB-WDI	1,039	2,130	2,989
	GDP/capita adjusting for purchasing power (in PPP, constant 2011 international $)	WB-WDI	4,224	5,597	7,599
Economic growth	GDP growth rate per capita (annual, in %)	WB-WDI	2.2%	5.9%	5.1%
Human development	Human Development Index (HDI)	UNDP	0.624	0.665	0.699 *(Rank 113)*
Population	Population in millions	WB-WDI	78	94	105

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).

The Philippines has a population of more than 100 million. The World Bank has been classifying it as a "lower middle-income country" for decades, and it is expected to achieve "upper middle-income country" status in the medium term (The World Bank 2018). Since 2010, the Philippines has achieved enormous economic growth rates (per capita) of around 5% with few exceptions (The World Bank 2019). Between 2000 and 2017, the Philippines almost tripled its per capita income (in US$) and almost doubled its purchasing power (see Table 4).

The Philippines also made progress in reducing poverty and inequality. While data with regard to international poverty lines is missing, the share of the population below the national poverty line declined from 25% in 2012 to 21.6% in 2015 (The World Bank 2019).

Between 1990 and 2017, the Philippines increased its Human Development Index (HDI) value from 0.586 to 0.699, an increase of about 19% (United Nations Development Program 2018b). The Philippines' 2017 HDI is above the 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 the Philippines' 2017 HDI value is discounted for inequality, it falls to 0.574, a loss of almost 18% due to inequality (United Nations Development Program 2018b).

[5] Relative to 1986-2005 for the West Pacific 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

2.2 Energy System status and historic development

Table 5: Energy system indicators for the Philippines: 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*	5.08	3.22	3.10	2017
Carbon intensity of energy	kg CO_2 per MJ energy use	WB-WDI	76.75	87.96	92.79	2014
Carbon emissions per capita⁺	t CO_2 /population	EDGAR	0.96	0.91	1.23	2016
Fossil fuel share in total energy	Share in total primary energy (%)	WB-WDI	53.07	60.11	62.43	2014
Electricity use	Electric power consumption (kWh per capita)	WB-WDI	499.35	639.54	699.21	2014
Fossil fuel share in electricity production	Electricity production from oil, gas and coal sources (% of total)	WB-WDI	57.11	73.69	74.56	2015
Share of coal in electricity production	Electricity production from coal sources (% of total)	WB-WDI	36.79	34.40	44.51	2015
Modern RE share in electricity production	Electricity production from renewable sources, excluding hydroelectric (% of total)	WB-WDI	25.67	14.78	14.90	2015
Renewable energy capacities	Installed RE capacity (in MW)	IRENA				
	Wind (onshore)		-	33	427	2017
	Wind (offshore)		-	-	-	-
	Solar (Concentrated)		-	-	-	-
	Solar (Photovoltaic)		-	-	765	2017
	Biogas		-	9	15	2017
	Bioenergy (Solid Biomass)		-	38	233	2017
	Hydropower		2,848	3,573	3,617	2017
	Geothermal		1,931	1,966	1,916	2017

*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 the Philippines has increased by about 20% between 2000 and 2014 (The World Bank 2019). In per capita terms, however, the Philippines' energy use has even decreased by 7% between 2000 and 2014, and was only about a quarter of the world average in 2014 and about 73% of the average lower middle income country energy use (The World Bank 2019).

The Philippines has achieved substantial progress in reducing the energy intensity of its economy between 2000 and 2017, meaning that energy demand grows slower than GDP. However, the carbon intensity of energy has slightly increased between 2000 and 2014. The Philippines' share of fossil fuel sources in total energy consumption has risen from 57% in 2000 to over 74% in 2015 (see Table 5).

The Philippines' CO_2 emissions per capita[6] have increased from 0.96 to 1.23 metric tons of CO_2 per capita between 2000 and 2016 (see Table 5), but remained low compared to the world's average of 4.8 tCO_2/capita (JRC 2016).

Between 2000 and 2014, electricity consumption per capita has increased. With 699 kWh per capita, the Philippines' electricity consumption remains low compared to the world's average of 3,127 kWh/capita, and also below the average electricity consumption of lower middle income countries (767 kWh/capita) in 2014 (The World Bank 2019). The CIA World Factbook estimates that the Philippines' electricity consumption has risen to 758 kWh/capita in 2016 (CIA 2019).

The share of fossil fuels in electricity production in the Philippines has increased from close to 57% to almost 75% between 2000 and 2015. The share of coal in electricity production has also increasing from below 37% in 2000 to 44.5% in 2015 and further to 48% in 2016 (CAT 2018). At the same time, the share of electricity produced from modern renewable sources (excluding hydro) has decreased substantially from almost 26% in 2000 to close to 15% in 2015, remaining below 15% between 2010 and 2015, despite recent added capacities in wind (onshore), solar PV and also solid biomass (see Table 5). Including hydro, the share of renewables in total electricity output was 25.4% in 2015 (The World Bank 2019).

Between 2000 and 2014, the Philippines decreased the share of electric output lost due to transmission and distribution losses from 14% to about 9.4% (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) (the Philippines)

Indicators for co-benefits potential		Source	Most recent	
			Value	Year
Fuel import dependency	Share of national income (GDP) spent on fuel imports (%)	WB-WDI +	3.5	2017
	Public expenditures spent on fuel imports (in billion current US$)	WB-WDI +	11.0	2017
Reliability of electricity supply	Share of firms experiencing electrical outages (%)	WB WDI	39.9	2015
	Power outages in firms in a typical month (number)	WB WDI	0.1	2015
	Share of sales lost for firms subject to power outages (%)	WB WDI	0.8	2015
Access to modern energy	Share of population with access to electricity (in %)	WB WDI	91.0	2016
	Share of rural population with access to electricity (in %)	WB WDI	86.3	2016
	Share of urban population with access to electricity (in %)	WB WDI	96.9	201
	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	43.2	2016
Indoor air pollution and health impacts	Number of deaths attributed to indoor air pollution* (per 100 000 inhabitants)	SDG-database	134	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	72	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).

The Philippines is a net importer of fossil energy and depends strongly on imports for oil for transport and coal for its power sector. On average almost half of the Philippines primary energy is imported (IRENA - International Renewable Energy Agency 2017). In 2017, the Philippines spent about 3.5% of its GDP **on fuel imports**, amounting to public expenditures of about 11 billion USD (see Table 6). Energy independence is a crucial objective to the Philippines' government (IRENA - International Renewable

Energy Agency 2017). A transition to renewable energy could contribute to reducing energy security concerns and public expenditures on fossil fuel imports freeing resources for other investments.

Because the exposure to frequent tropical storms threatens the energy infrastructure, security of energy supply is a challenge for the Philippines (IRENA - International Renewable Energy Agency 2017). Thus, **reliability of electricity** supply remains a problem, affecting private households as well as businesses and industry. In 2015, almost 40% of businesses in the Philippines report to have been affected by power outages, with one outage every ten months on average (see Table 6). These firms are estimated to have lost about 0.8% of their sales due to the outages. In 2015, the combination of a very hot summer and El Nino, which resulted in very low precipitation, power shortages caused great concerns throughout the economy. The crisis was avoided thanks to effective demand side management, encouraging the switch to own generators (IRENA - International Renewable Energy Agency 2017).

Lack of **access to modern energy** remains a problem in the Philippines. Overall, 91% of the population had access to electricity in 2016, with about 97% in urban areas compared to only 86% in rural areas (see Table 6), leaving about 9 million people without access (ESMAP 2019b). The Philippines is an archipelago with over 7000 islands, which poses a challenge to establishing universal access to electricity. High costs for purchasing grid-based power have also been an obstacle for delivering electricity to poor people (IRENA - International Renewable Energy Agency 2017). In many regions without grid access, especially isolated islands, electricity is produced using diesel-run generator sets, which leads to high costs for electricity (IRENA - International Renewable Energy Agency 2017). Renewable powered micro- or mini-grids can provide a good alternative for these areas. The Philippines' Rural Electrification Service project has already achieved to provide electricity thanks to solar home systems to over 100 villages (IRENA - International Renewable Energy Agency 2017).

In 2016, the share of people with access to clean cooking fuels was still only 43.2%, leaving more than half 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 134 out of every 100 000 inhabitants in the Philippines die due to indoor air pollution. The World Health Organisation (WHO) estimated the number of deaths attributed to indoor air pollution in the Philippines to amount to over 86 000 in 2016 (World Health Organisation 2018).

Outdoor air pollution is also a serious health concern in the Philippines, especially in urban areas. In 2016, the whole population was exposed to fine particulate matter concentration levels exceeding recommended limits by the WHO. The number of deaths attributed to outdoor air pollution is about 4 000 in 2016 (World Health Organisation 2018) – with about 72 out of 100 000 inhabitants dying because of outdoor air pollution.

3 Policies and projections on future development

The Philippines' NDC has the stated goal to reduce GHG emissions by 70% compared with a BAU scenario in 2030, conditional on the provision of financial resources as well as technology transfer and capacity building (Government of The Philippines 2015). This would result in a 31-40% reduction on 2010 emissions levels (CAT 2018). The Philippines' Climate Change Commission is in the process of revising its Nationally Determined Contribution (NDC), which the Climate Action Tracker rates as "2˚C compatible".

Neither implemented nor planned policies are sufficient to achieve the Philippines NDC target (CAT 2018).

Full implementation of the planned "National Renewable Energy Program (NREP)" and "The Energy Efficiency and Conservation Roadmap" would lower emissions by 11% compared with current policy projections. While a Feed-In Tariffs were implemented as early as 2012, due to the delayed

implementation of other policy instruments under the Renewable Energy Act (2008) such as a Renewable Portfolio Standard (RPS), the fulfillment of the renewable energy capacity set in the NREP has been delayed significantly and it remains unclear whether the planned capacity expansion can be achieved (IRENA, 2017; CAT 2018).

The NDC target is unlikely to be met if all the announced coal-fired power plant capacity (more than 10 GW announced to be constructed by 2025) were to be built (CAT, 2018).

The country had a 91% electrification rate in 2016, with 96.2% of its urban population and 86.26% of its rural population having access to electricity (ESMAP 2019a). From 2010 to 2035, the country's electricity demand consumption is projected to increase threefold between 2010 and 2035 and amount to 187 TWh (APERC 2013).

According to the Philippine Energy Plan until 2040, by then end of that period over 35% of energy will be sourced from oil, almost 30% from coal, 12% from gas, 9% from biomass, and only 13.7% from renewable energy sources. The total energy production for 2040 is predicted to be 137.8 MTOE. To satisfy the fast growing electricity demand, the Plan assumes that almost 44 GW of new generation capacity would be needed – almost three times the existing installed capacity (Department of Energy 2017b). The government aims at satisfying a large portion of this demand with additional capacity from fossil fuels and plans to build 25 coal-fired plants in the coming years (Inquirer 2016).

BOX: relevant key policies related to energy supply sector

- **Nationally Determined Contribution:** Aims to achieve a 70% emissions reduction in comparison to BAU by 2030 (Government of The Philippines 2015). This would result in emissions 32-40% below 2010 levels (CAT 2018).
- **Plans and Roadmaps:** Coal Roadmap, Energy Plan, National Renewable Energy Program (NREP), Energy Efficiency and Conservation Roadmaps
- **House Bill on Tax Reform for Acceleration and Inclusion (TRAIN):** Introduced in 2017 it provides VAT exemptions for the sale of power or fuel generated by renewable sources (PWC 2017). It includes taxes on coal production, but at a level that is too low to spur a shift away from coal (CAT, 2018).
- **Feed-in Tariff:** for solar, wind, biomass, and run-of river hydropower, implemented in 2012.
- **Net Metering:** Allows electricity end users to feed excess of their renewable energy production back to the national grid under the condition the installed capacity is smaller than 100k (Energy Regulatory Commission 2013).

4 Projections on planning for coal

Around half of the Philippines' electricity generation is provided by the 8 GW of operating coal power plants. The government is planning to keep the dominance of coal in the energy mix and is promoting new coal exploration and development contracts, as started in Coal Roadmap 2017–2040 (Department of Energy 2017a). While energy independence has been identified as a priority for the country, most of the planned coal fleet expansion will consist of plant fueled by imported coal. In a country comprising thousands of islands, the planned expansion of centralised coal-based power generation infrastructure would need to be accompanied by substantial investments in grid expansion to be able to deliver electricity to meet the growing energy demands of the population across the entire territory. Under these circumstances overcapacity, under-utilisation and ultimately stranded assets are rapidly growing risks as the coal fleet expands, which has been confirmed in independent studies (Ahmed and Logarta 2017).

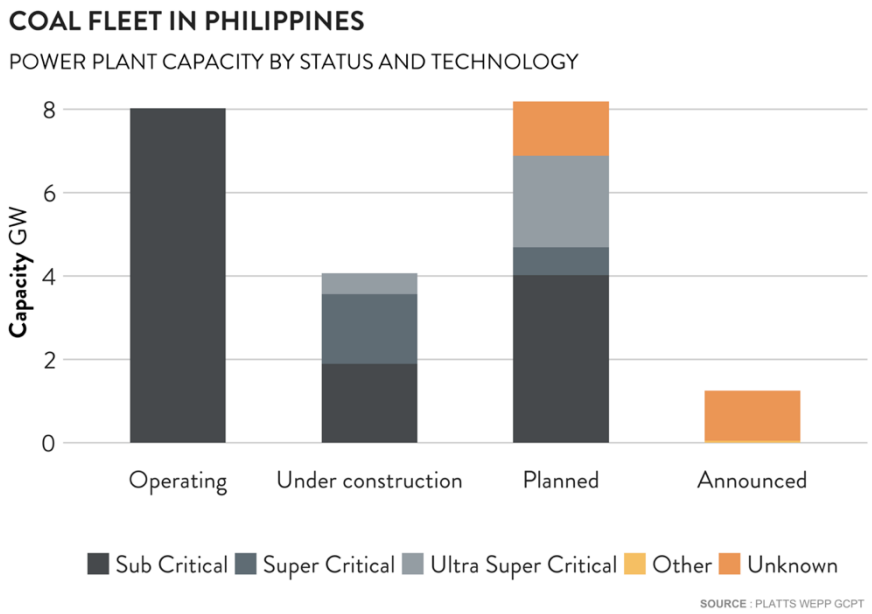

Figure 1: Philippines' coal fired power generation capacity

The Philippines' coal-fired expansion plans amount to nearly 78% of the current capacity[7] (Figure 1). This accounts for nearly 3% of the global expansion plans. All of the existing capacity, and a large proportion of the planned capacity is sub-critical. These plants have relatively high emissions intensity; despite the shift to super- an ultra super-critical power plants with low emissions intensity, the coal fired expansion has significant emission implications.

The committed emissions from the massive coal expansion mean that emissions from coal-fired power plants are likely to peak only by 2035, with an eventual phase-out only by 2062 (Figure 2). This far exceeds the phase-out date derived from regional benchmarks for Paris Agreement compatible scenarios, as discussed in Chapter 3, which sees coal-fired power being phased out in the ASEAN region by 2040.

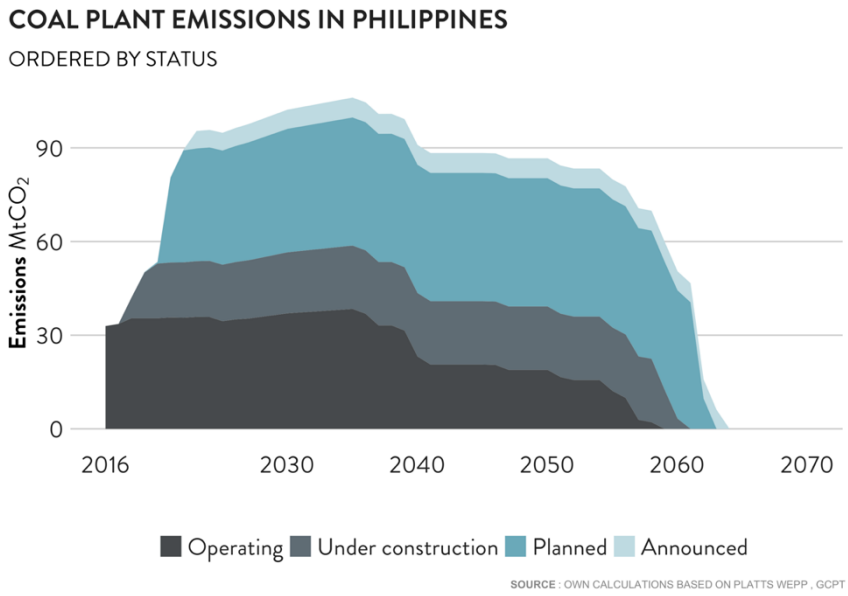

Figure 2: Committed emissions from Philippines' coal plants

[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.

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

5.1 Potential and technology options for renewable energy

Covering 1.5% of the Philippines territory with solar PV would allow generating 792 TWh of electricity – equivalent to ten times the total electricity generation in 2016 (NREL 2014, CIA 2019).

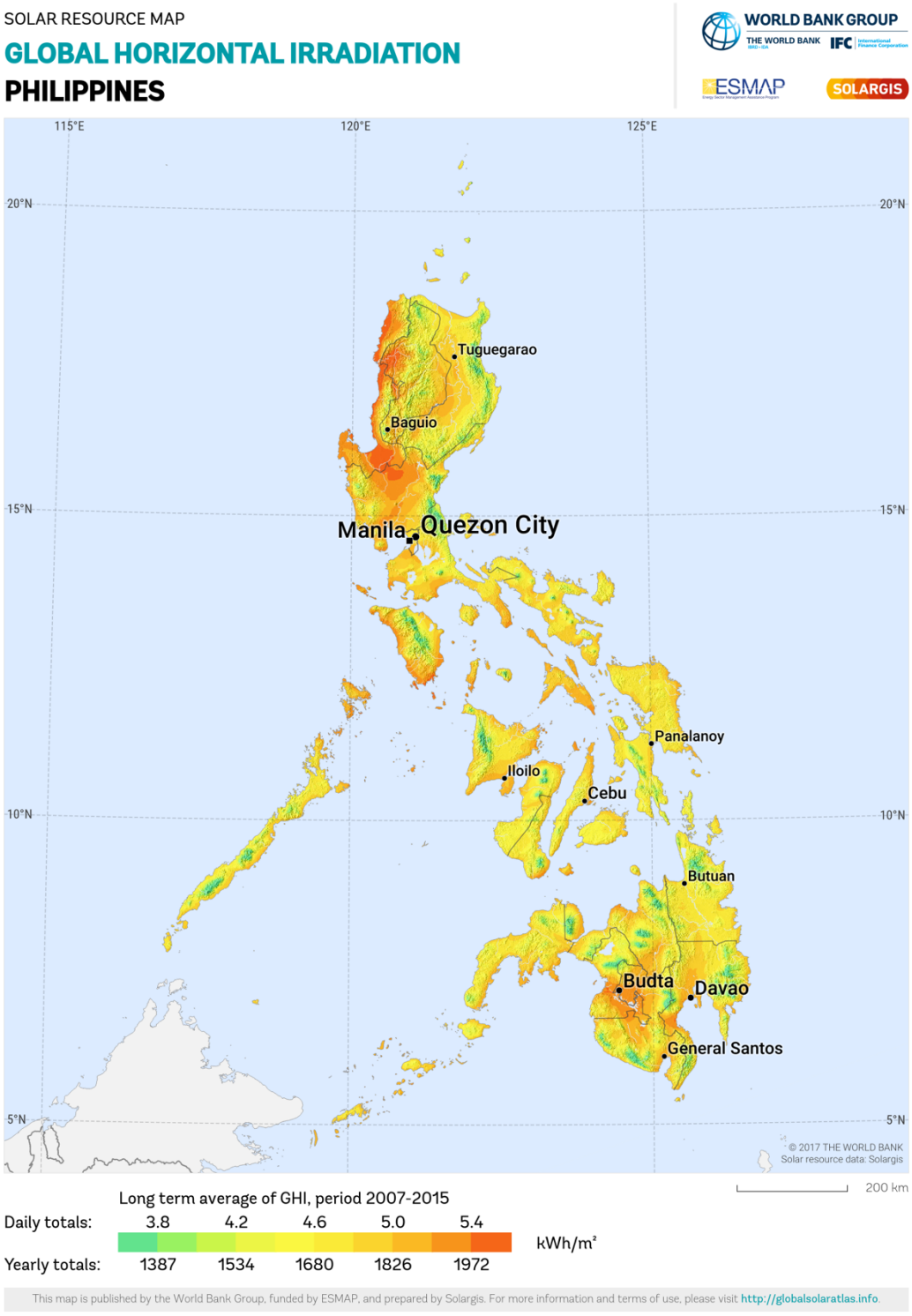

Figure 3. Global horizontal irradiation based on Global Solar Atlas (The World Bank Group 2016)

The Philippines's wind potential is higher than in many other countries in SEA, with some regions boasting 1000 Watts/m2. The mean wind power density for the 10% windiest areas at 200 m altitude is 925 Watts/m2 (World Bank Group 2018). However, the mountainous terrain makes the utilisation of this resource more difficult.

The Philippines' also has significant geothermal potential, estimated at 4.34 GW of geothermal electricity generation (Bertani 2016). However, a the untapped geothermal resources are largely located in national parks or protected by the nation-state's Indigenous People's Rights Act (Reuters 2008). The country is already utilising its bioenergy potential for steam and power generation but also agriculture and other industries (IRENA and ACE 2016).

A Paris Agreement consistent pathway for the ASEAN region shows a share of 51% of decarbonised electricity generation in 2030 and full decarbonisation by 2050.

In the OneEarth modeling under the 1.5°C scenario renewable sources increase to 78% by 2030 and to 87% by 2050. Most of the renewable electricity growth will come from variable renewables such as wind power, and especially, solar PV generation. Likewise, heating sources will increasing tend toward more efficient heat pumps and to solar heating, while absolute amounts of biomass used for heating in the non-OECD Asia region decrease somewhat, thereby making up a shrinking share of total heating energy supply. The transportation sector throughout the region makes a transition away from petroleum-based fuels and toward electrification and biofuels, whereby sustainability concerns may arise with regard to the latter (Teske et al 2019).

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

The Philippines can benefit substantially from a rollout of renewable energy. IRENA has estimated various benefits in a report on ASEAN, including the following benefits for Philippines (IRENA 2016):

- Reducing air pollution and related health impacts. The Philippines could benefit from reducing external costs from air pollution implementing the REmap Options, with annual average air pollution cost savings in 2025 amounting to about 1.1 billion USD with regard to reduced outdoor air pollution.
- Contributing to reducing energy system costs. IRENA estimates by 2025, REmap options could result in reducing energy system costs in the Philippines by around 0.5 billion USD per year.

Beyond these benefits of a transition to modern renewable energy, the Philippines could benefit from creating local job opportunities in the RE sector, improving energy access especially in remote areas and isolated islands, reducing fuel import dependency and reducing indoor air pollution and related health impacts.

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

- Philippines' NDC commits the country to a 70% reduction in emissions below Business-as-Usual emissions by 2030, conditional on international support. This commitment is rated 2°C compatible by the Climate Action Tracker (Climate Action Tracker 2018).
- Neither implemented nor planned policies are currently sufficient to achieve the Philippines NDC target (CAT 2018).
- Full implementation of the planned "National Renewable Energy Program (NREP)" and "The Energy Efficiency and Conservation Roadmap" would lower emissions by 11% compared to current policy projections.
- The NDC target is also unlikely to be met if all the announced coal-fired power plant capacity (more than 10 GW announced to be constructed by 2025) were to be built (CAT, 2018).
- The committed emissions from the massive expansion of coal-fired power plants in The Philippines mean that emissions from coal-fired power plants are likely to peak only by 2035, with an eventual phase-out only by 2062. This far exceeds the phase-out date derived from regional benchmarks for Paris Agreement compatible scenarios, as discussed in Chapter 3, which sees coal-fired power being phased out in the ASEAN region by 2040.
- A Paris Agreement consistent pathway for the ASEAN region shows a share of 51% of decarbonised electricity generation in 2030 and full decarbonisation by 2050.
- Based on this and other scenario analysis, there is scope 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 of the Climate Vulnerable Forum countries.

Literature

Ahmed S J and Logarta J J 2017 Carving out Coal in the Philippines : Stranded Coal Plant Assets and the Energy Transition

APERC 2013 APEC Energy Demand and Supply Outlook 5th Edition (Tokyo, Japan) Online: http://aperc.ieej.or.jp/publications/reports/outlook.php

Bertani R 2016 Geothermal power generation in the world 2010–2014 update report Geothermics 60 31–43 Online: https://www.sciencedirect.com/science/article/pii/S0375650515001558

BP 2018 BP Statistical Review of World Energy 2018 Online: https://www.bp.com/content/dam/bp/business-sites/en/global/corporate/pdfs/energy-economics/statistical-review/bp-stats-review-2018-full-report.pdf

CAT 2018 Pledges And Targets | Climate Action Tracker Online: https://climateactiontracker.org/countries/philippines/pledges-and-targets/

CIA 2019 The World Factbook Online: https://www.cia.gov/library/publications/the-world-factbook/geos/pp.html

Climate Action Tracker 2018 Philippines | Climate Action Tracker Online: https://climateactiontracker.org/countries/philippines/

Department of Energy 2017a Coal Roadmap 2017-2040 Online: https://www.doe.gov.ph/pep/coal-roadmap-2017-2040 [accessed on 26 October 2017]

Department of Energy 2017b Philippine Energy Plan 2017-2040 Online: https://c.ymcdn.com/sites/psme.site-ym.com/resource/resmgr/technical/REVIEW_ON_ENERGY/Dir_Aquino_PEP_2017-2040.pdf

Eckstein D, Hutfils M-L and Winges M 2018 Global Climate Risk Index 2019. Who Suffers Most From Extreme Weather Events? Weather-related Loss Events in 2017 and 1998 to 2017

Energy Regulatory Commission 2013 A Resolution adopting the rules enabling the net-metering program for renewable energy

ESMAP 2019a Tracking SDG7 Online: https://trackingsdg7.esmap.org/

ESMAP 2019b Tracking SDG7 | Progress Towards Sustainable Energy Online: http://trackingsdg7.esmap.org/

Government of The Philippines 2015 Intended Nationally Determined Contributions of the Republic of The Philippines Online: http://www4.unfccc.int/submissions/INDC/Published Documents/Philippines/1/Philippines - Final INDC submission.pdf

Inquirer 2016 Why is PH building 25 more coal-powered plants? | Inquirer News Online: https://newsinfo.inquirer.net/773681/why-is-ph-building-25-more-coal-powered-plants?utm_expid=.XqNwTug2W6nwDVUSgFJXed.1

IRENA 2019 IRENA Dashboard - RE database Online: http://resourceirena.irena.org/gateway/dashboard/

IRENA 2016 Renewable Energy Outlook for ASEAN Online: www.irena.org/publications,

IRENA - International Renewable Energy Agency 2017 Renewables Readiness Assessment: The Philippines

IRENA and ACE 2016 Renewable Energy Outlook for ASEAN

JRC 2016 EDGARv.4.3.2 - Fossil CO2 and GHG emissions of all world countries Janssens-Maenhout, G., Crippa, M., Guizzardi, D., Muntean, M., Schaaf, E., Olivier, J.G.J., Peters, J.A.H.W., Schure, K.M Online: edgar.jrc.ec.europa.eu/booklet2017/EDGARv432_FT2016_CO2_per_capita_emissions_1970-2016.csv

NREL 2014 Solar Resources by Class and Country Online: https://openei.org/doe-opendata/dataset/solar-resources-by-class-and-country/resource/3e72f32a-7de1-4e5d-a25a-76928769625f

PWC 2017 House Bill on Tax Reform for Acceleration and Inclusion Online: www.pwc.com/ph

Reuters 2008 FEATURE-Geothermal-rich SE Asia struggles to tap earth's power | Reuters Online: https://www.reuters.com/article/idUSJAK144175

Teske S, Pregger T, Naegler T, Simon S, Pagenkopf J, van den Adel B and Deniz Ö 2019 Energy Scenario Results Achieving the Paris Climate Agreement Goals (Cham: Springer International Publishing) pp 175–401 Online: http://link.springer.com/10.1007/978-3-030-05843-2_8

The World Bank 2018 Country Overview - Philippines Online: https://www.worldbank.org/en/country/philippines/overview

The World Bank 2019 World Development Indicators database Online: https://databank.worldbank.org/data/reports.aspx?source=world-development-indicators

United Nations 2019 Sustainable Development Goals database Online: https://unstats.un.org/sdgs/indicators/database/

United Nations Development Program 2018a Human Development Index database Online: http://hdr.undp.org/en/data#

United Nations Development Program 2018b Human Development Indices and Indicators: 2018 Statistical Update - Philippines Online: http://hdr.undp.org/sites/all/themes/hdr_theme/country-notes/PHL.pdf

World Bank Group 2018 Global Wind Atlas

World Health Organisation 2018 Global Health Observatory data repository Online: http://apps.who.int/gho/data/node.main.BODAMBIENTAIR?lang=en;