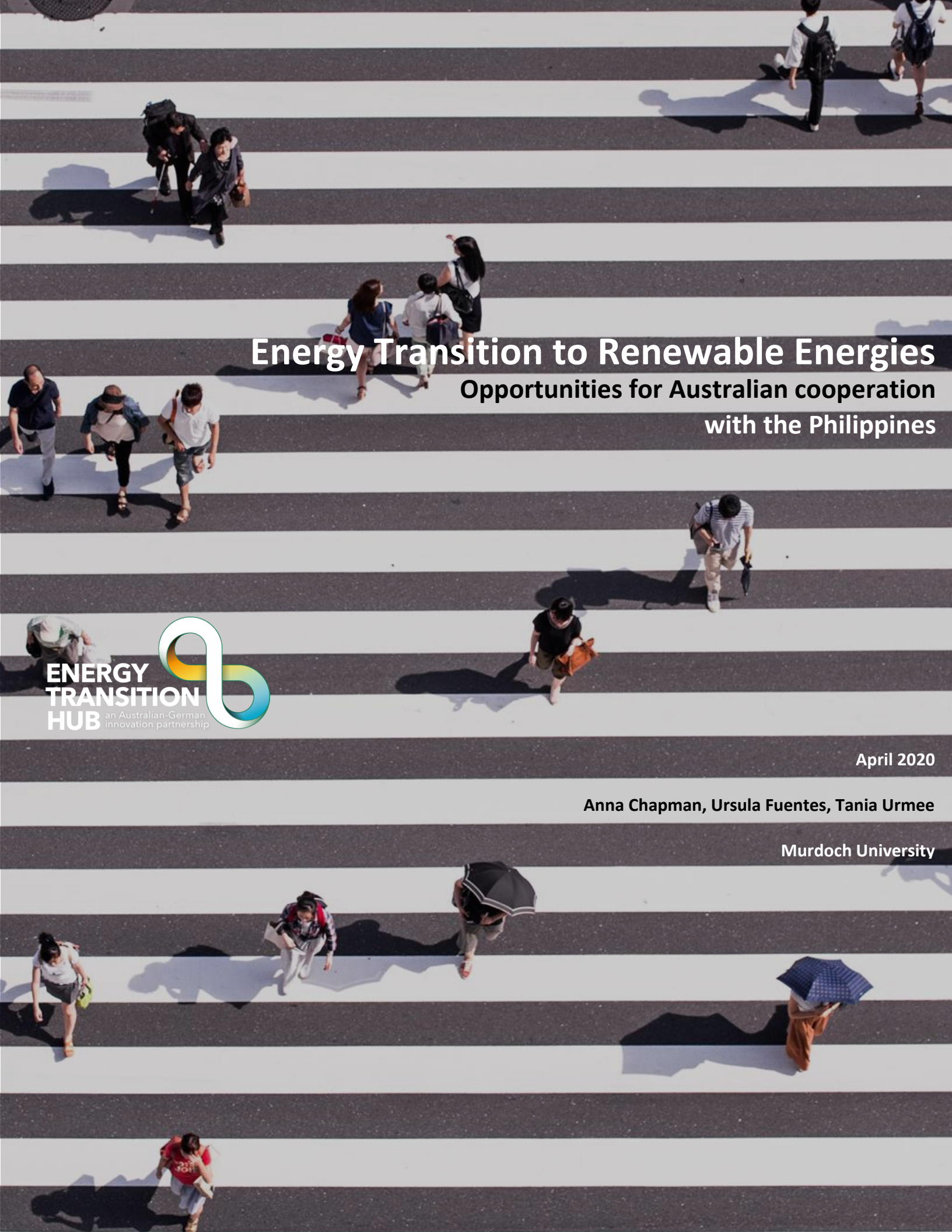

Energy Transition to Renewable Energies

Opportunities for Australian cooperation with the Philippines

ENERGY TRANSITION HUB
an Australian-German innovation partnership

April 2020

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Summary/Key messages

Vulnerability to climate change, power outages, numerous islands and increasing energy demand create an inherent need to diversify and decentralise the Philippines power system with a transition to renewable energy and storage. The COVID-19 health and economic crisis further highlight the importance of ensuring access to secure and affordable energy.

A transition to renewable energy can spur the Philippines, a country highly vulnerable to climate change, in meeting and updating its Paris Agreement Intended Nationally Determined Contribution (INDC), coupled with the benefits of meeting the sustainable development goals (SDGs). The Philippines has seen government support for renewable energy expansion, but the government intends to meet the increasing energy demand with a technology neutral approach, including fossil fuels. Renewable energy and a low carbon economy can complement the President's "Dutertenomics" agenda for developing infrastructure and industry. Developing infrastructure focused on a low carbon economy, for example with a green economic stimulus package, can set the future path for the Philippines to transition to meeting SDGs and climate targets.

Currently, the Philippines is not on track to meet its Paris Agreement target. Fossil fuel, and in particular coal production and coal fired power generation plans are far from Paris Agreement compatible. The Philippines' Paris target is conditional on financial, technological and capacity building support. Australia is well placed to support the Philippines on a pathway to a 100% renewable energy transition. However, barriers to renewable energy must be removed and investments towards fossil fuels must be redirected.

This paper explores Australia - Philippine collaborative opportunities to a renewable energy transition, which include:

- Working together to meet the Philippines' energy demand throughout the islands with technology, grid infrastructure as well as microgrid or off-grid stand-alone solutions for remote regions, removal of policy barriers and policy upgrades for electrification, renewable energy and energy efficiency taking into account high climate vulnerability and linkages between climate mitigation, climate adaptation, and sustainable development.

- Research opportunities for Australia to export renewable energy through hydrogen to meet the Philippines' energy demand and how the energy can be best received for different economic sectors.

Contents

1. Introduction

Energy security is of high importance as the Philippines has experienced numerous outages in 2019, and coal fired generation has not coped with the intensifying energy demand (CAT 2019b). The amount of coal production is targeted to increase by 170% from 2017 to 2040 (DoE 2017a). This target is not compatible with the Paris Agreement objectives[1] and will lock the Philippines into an emissions intensive future and create expensive stranded assets.

Climate and environmental vulnerabilities continue to wreak havoc on the Philippines energy system. Climate change leads to increased demand for air conditioning, and lower hydro energy supply, while earthquakes and typhoons knock out power infrastructure. Environmental hazard vulnerabilities and the goal for electrification across the many islands underscores the necessity to decentralize and diversify to renewable energy, energy storage and increase energy efficiency to improve the capacity for supply to meet demand. In addition, the Covid-19 crisis underscores the need for secure and affordable energy, as the workforce shifts to working from home. The transition to renewables offers an opportunity to meet energy needs, reducing dependence on fossil fuel imports, decarbonise and reduce climate impacts while making progress to meeting Paris Agreement commitments and Sustainable Development Goals.

In his fourth State of the Nation address, President Duterte (2019) called for renewable energy to be fast-tracked to reduce coal dependence. There has been several policies implemented to support the uptake of renewables, although, as will be shown in the next section, renewable energy expansion has not kept up with overall energy demand, causing the renewable energy share to decline in the energy mix.

The Philippines has two major electricity grids connecting the islands of Luzon, Visayas and Mindanao (IRENA 2017). Another 132 small isolated island grids (SIIG) are powered by diesel generators (Bertheau and Cader 2019). There are still some islands with no electricity supply and many without access to 24-hour electricity. In addition, the Philippines has the third most expensive electricity in Asia (IEEFA 2020). With so many islands, electrification is still a massive task underway, and electricity needs to be affordable. The Philippines aims

[1] Reducing coal dependence is crucial for meeting the Paris Agreement Long-Term Temperature goal as it – to a large extent -contributes to the country's emissions, and other sectors such as land use, land use change and forestry are highly uncertain (CAT 2019b).

to achieve 100% electrification by 2022 to grid accessible areas and 2040 for off-grid areas (DoE 2017e).

In this briefing, we summarise the current situation and future projections for the energy system of the Philippines and explore the potential for transitioning to renewable energy as well as related challenges. The briefing draws conclusions on how the future collaboration between the Philippines and Australia can address these challenges and seize opportunities to enhance and accelerate a clean energy transition to achieve Sustainable Development goals and the Paris Agreement objectives.

2. Philippines' energy system at crossroads: Targets, investment needs, projections

Philippines: tackling power outages and securing energy

The Philippines energy system power outages and vulnerabilities to climate change highlight the need for an overhaul of the current energy structure (Bertheau and Cader 2019; IRENA 2017). Fossil fuels make up the majority of the Philippines total primary energy supply accounting for 63% and renewables account for 37% (DoE 2017c) which are mostly geothermal and biomass. Specifically, the primary energy supply is comprised of oil (34.8 %), coal (21.9%) and natural gas (6.1%), as well as renewable energy sources including hydro (3.8%), geothermal (17.9%), biomass (14.1%), and a small amount of biofuels (0.6%), solar and wind (0.3%) (see 1). In 2016, the total primary energy supply equated to over 53 million tons of oil equivalent (MTOE) (DoE 2017c).

Coal represents a 38.5% share of electricity generation in 2016, with natural gas representing 11.6%, oil 4.6%, hydro 7.6%, geothermal 35.8%, solar 0.4%, wind 0.3%, and biomass 1.1% (DoE 2016a).

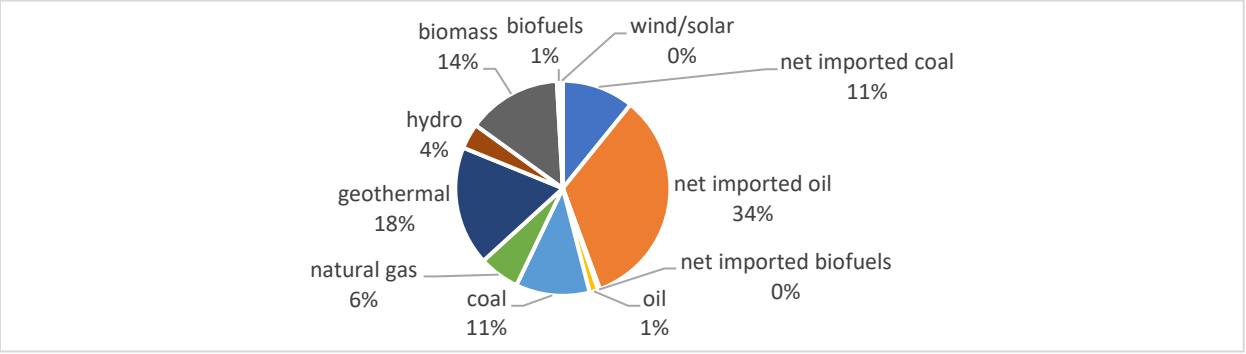


Figure 1 : Philippines total primary energy supply (TPES) in 2016 as a percentage. All indigenous energy sources unless stated 'imported'. Data from : (DoE 2017c).

The Philippines is a net fossil fuel importer and energy imports cover nearly half (44%) the primary energy supply (see figure 1). While natural gas comes from domestic reserves, the

country is dependent on imports of oil for transport and coal for power (see Figure 2 and 3). Energy imports create energy dependence on global markets and prices.

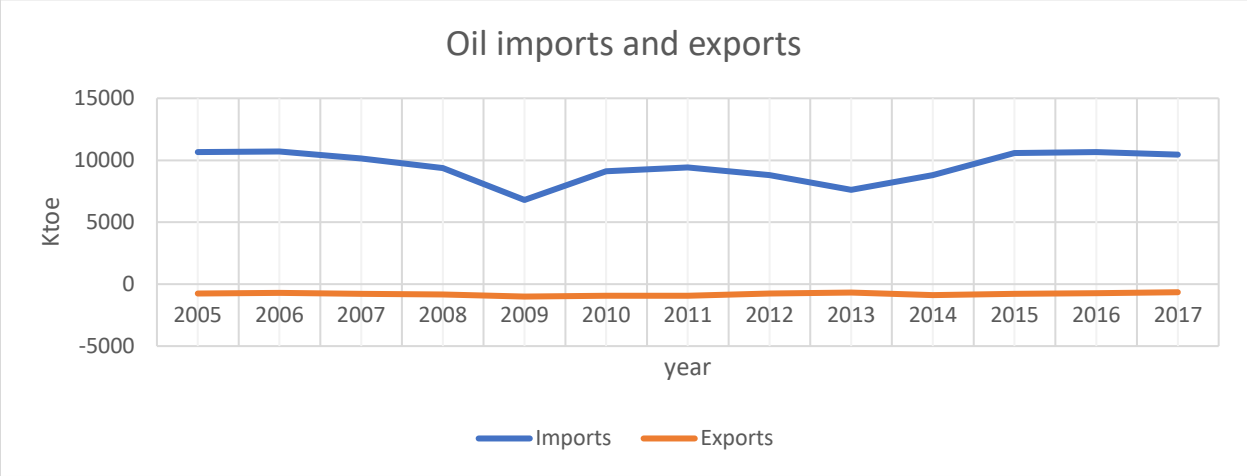


Figure 2: Oil imports and exports in the Philippines. Exports are shown with negative values. Data from: (IEA 2019).

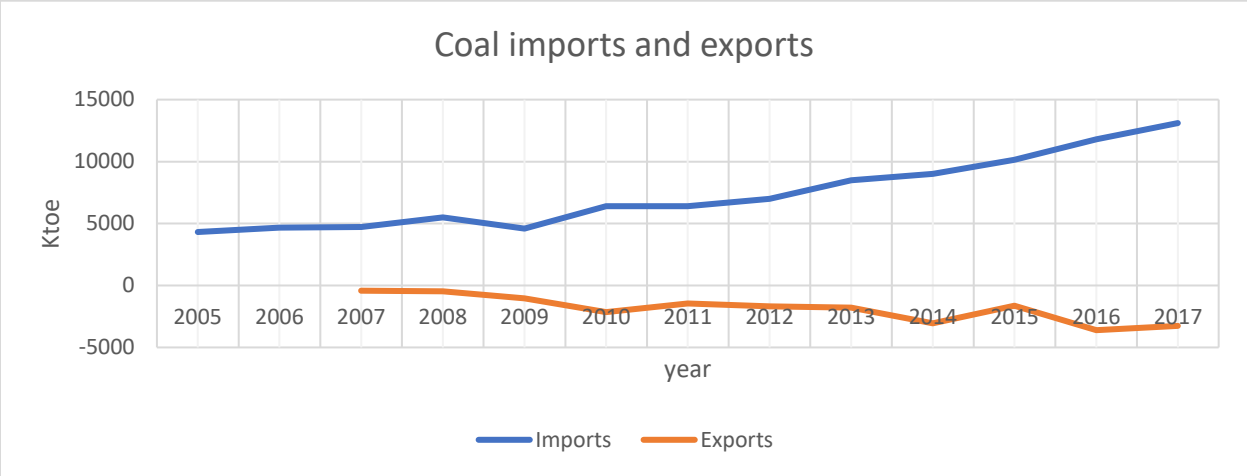


Figure 3: Coal imports and exports in the Philippines. Exports are shown with negative values. Data from: (IEA 2019).

All sectors of the Philippines economy have growing rates of energy consumption from 2015 to 2016 (DoE 2017e). Transport is responsible for the largest share of the energy consumption representing 37.2% in 2016 (DoE 2017e). The second largest sector share is the residential sector accounting for 27.3% of the total final energy consumption, followed by industry with 22.5%, commercial 11.7% and agriculture, fishery and forestry 1.4% (DoE 2017e).

The main source of natural gas in the Philippines is the Malampaya field which supports 2,880 MW of generation in Luzon, but production levels are expected to decline from 2024 (ADB 2018). Two gas plants have been designed to switch to LNG imports when the Malampaya field is depleted (ADB 2018). Although, without the discovery and commercialisation of indigenous natural gas, the Philippines would need significant capital investment for an LNG terminal, floating storage, regasification units and pipelines (ADB 2018). Declining costs of solar may reduce the need for gas fired generation for peaking, as has been the case for oil fired peaking plants (ADB 2018).

Figure 4 shows the installed electricity generation capacity in the Philippines in 2018. The total renewable energy capacity amounts to 7,227 MW amounting to a 30% share of the total capacity (DoE 2018).

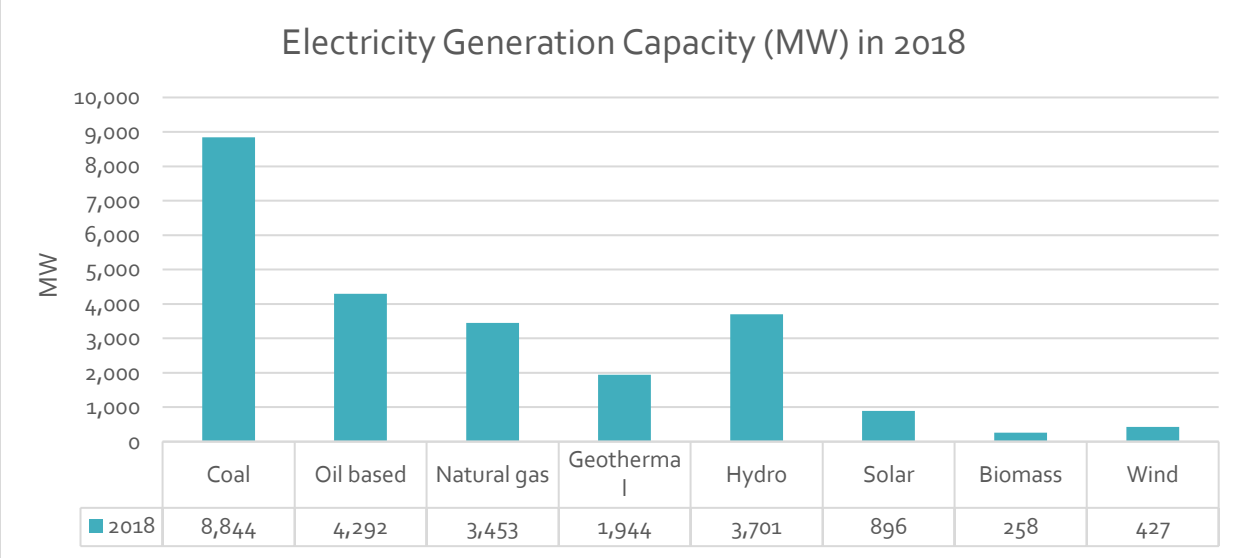
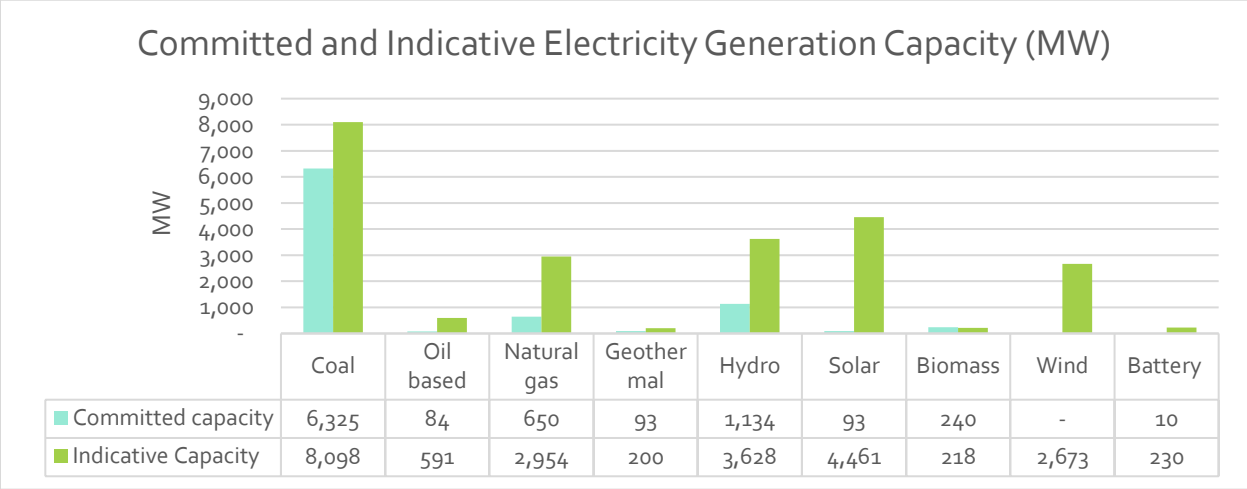


Figure 4: Philippines' electricity generation capacity (MW) in 2018. Data from: (DoE 2018). Total Renewable energy capacity adds up to 7,227 MW, a 30% share of total capacity.

Official data for future additional capacity levels is divided into committed capacity and indicative capacity. Committed capacity is defined as the generation projects that have secured financial closing and have a definite timeline for commercial operations (DoE 2017d). Indicative capacity refers to projects that are still acquiring permits, licenses and approvals, and may not have a timeline for commercial operation (DoE 2017d). The committed capacity of projects in the pipeline for coal between 2018 and 2025 amounts to 6,325 MW (73% of committed projects), and there are 8,098 MW worth of indicative

capacity coal projects (35% of all indicative projects) (DoE 2017d) (See Figure 5).[2] Oil based generation projects amount to 84 MW (1% of all committed projects) over 2018 to 2025, with 591 MW of indicative capacity (3% of all indicative projects), whereas natural gas amounts to 650 MW (8%) and 2,954 MW (13%), respectively (see Figure 5 for details).



	Coal	Oil based	Natural gas	Geothermal	Hydro	Solar	Biomass	Wind	Battery
Committed capacity	6,325	84	650	93	1,134	93	240	-	10
Indicative Capacity	8,098	591	2,954	200	3,628	4,461	218	2,673	230

Figure 5: Committed and indicative energy capacity from 2018 (MW). Committed capacity projects have secured financial closing and have a definite timeline for commercial operations between 2018 and 2025 (DoE 2017d). Indicative capacity refers to projects that are still acquiring permits, licenses and approvals, and may not have a timeline for commercial operation (DoE 2017d). Figures relate to grid generation only. Data from: (DoE 2017d).

The Department of Energy has recognised there is excess coal plant capacity creating grid instability by displacing peaking plants that should balance supply (IEEFA 2020a). Bloomberg New Energy Finance forecast that the last coal capacity addition, if any at all, in the Philippines will be in 2023 (the 1,200 MW Atimonan facility) (BNEF 2019). Further coal fired power plants risk stranded assets and increased emissions. Climate Analytics (2019b) find that the current and planned coal fired power plants are largely sub critical, with large emissions intensity, and emissions are likely to peak as late as 2035.

The Philippines has expanded its renewable energy generation in recent years (see Figure 6). Yet, in comparison to fossil fuels, the committed capacity to renewable energy and battery technology is low, totalling 1,570 MW (18% of all committed capacity) and is dominated by hydro projects (see Figure 5).

[2] Recent data from the Global Energy Monitor (2020) suggests a higher total coal capacity of coal in the pipeline at 10,531 MW.

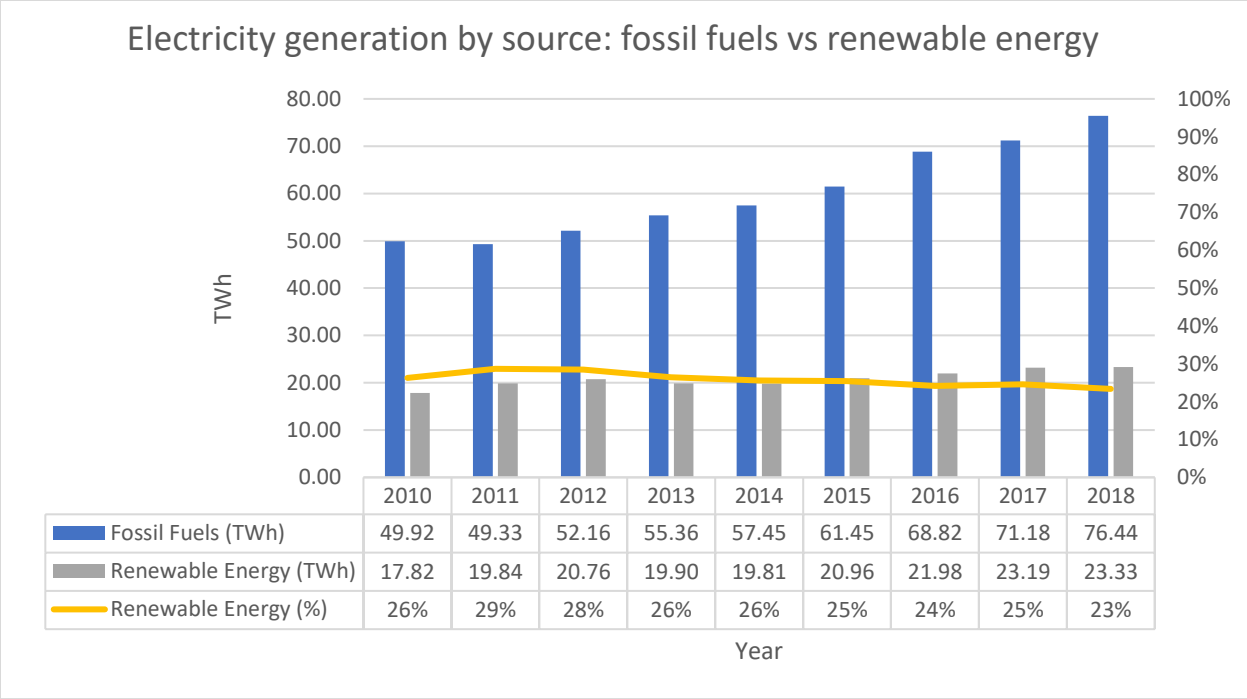


Figure 6: Electricity generation by source, comparing fossil fuels to renewable energy. Data from (DoE 2018). Renewable energy generation has increased since 2014 but renewable energy share of electricity generation has fallen overall.

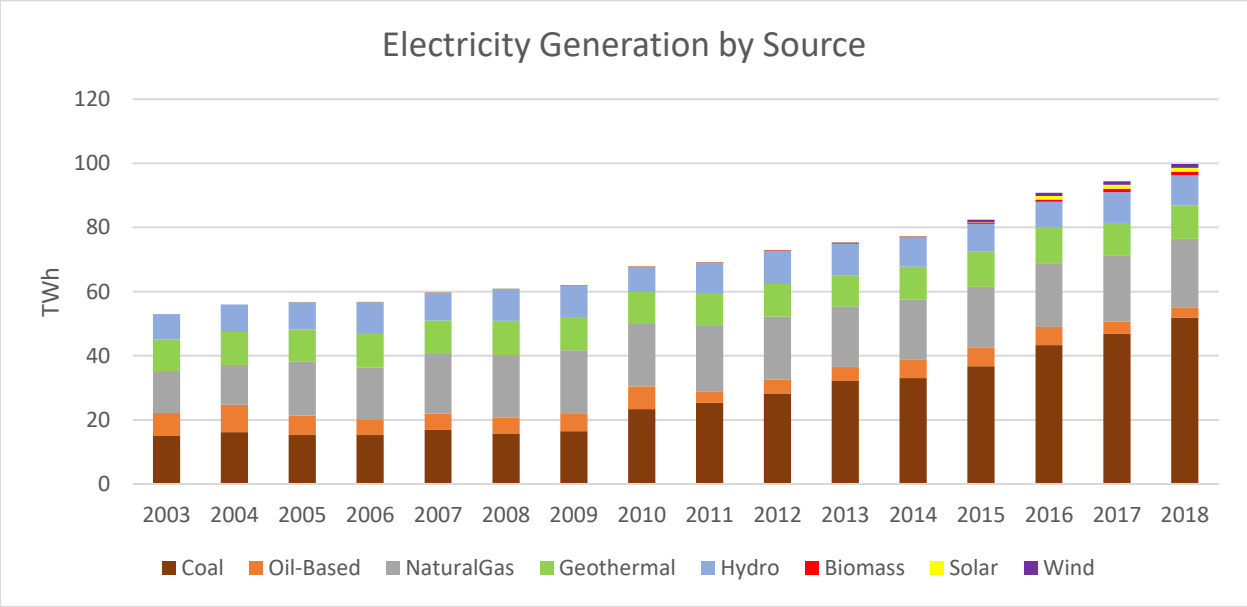


Figure 7: Electricity generation by source. Data from: (DoE 2018). Electricity generation has increased, and fossil fuels dominate power generation.

Renewable energy represents the highest share of an indicative capacity with 11,340 MW (49%). These projects remain in the bureaucracy process acquiring permits, licenses and approvals (DoE 2017d). The uptake of renewable energy is hindered by these processes, and the increasing demand for energy is currently being met by a larger share of fossil fuel projects leading to the share of renewable energy generation decreasing. Figure 7 shows how electricity generation has increased over several years. Figure 6 demonstrates how renewable energy generation has increased year on year since 2014, but the percentage share of renewables in electricity generation has a decreasing trend. Reliance on fossil fuels to meet the energy demand is creating lock-in conditions that enforce a fossil fuel path dependency, rather than a renewable energy transition.

Projections and scenarios

The Department of Energy conducted scenario projections for the energy sector for the period from 2020 to 2040. The business-as-usual (BAU) scenario depicts the energy sector without further policy intervention and clean energy scenario (CES) depicts a ramp up of renewables (see the assumptions table in the annex for further details).

In both the BAU and the CES, oil and coal supply the lion's share of the energy in every year (Figure 8). Both BAU and CES scenarios depict a projected growth in natural gas, 6.7% growth in BAU, and a higher rate of growth in the CES at 7.1% (DoE 2017c). In the CES, oil and coal have a lower rate of growth compared to the BAU scenario (DoE 2017c).

Renewables would have a lower rate of growth than fossil fuels not only in the BAU but also in the CES. The BAU scenario projected biomass will have an average growth of 2.2% and hydropower 1.9%. Biomass and geothermal will account for the most renewable energy supplied in the BAU scenario for 2040, 12.5 MTOE and 10.5 MTOE respectively. Similarly, in the CES, biomass and geothermal are projected to supply the larger shares of renewable energy, 12.3% and 11.7% respectively. In the CES, solar and wind are ramped up with a 3.5% growth rate but they are only projected to supply 0.4 MTOE in 2030. By 2040, in both the BAU and CES, renewables will represent a lower share of the energy mix compared to the historical levels in 2016 (Figure 8) following current trends of a decreasing share.

The Asia-Pacific Economic Cooperation's (APEC) Target (TGT) and 2 Degrees Celsius (2DC) scenarios are more ambitious showing higher rates of renewable energy percentages in the total primary energy supply for all years and scenarios (see Figure 8). The TGT scenario was developed to show a pathway for the aspirational target of APEC of tripling

renewable energy generation capacity by 2030, and reducing energy demand by 10% by 2030. Meeting this target would require policy changes, for example increasing the stringency of fuel efficiency regulations, building and appliance standards and increasing renewables support. The 2DC (or 2 Degrees Celsius) scenario aims to increase renewable energy to reduce energy intensity and CO_2 emissions, sufficient to provide a 50% chance of limiting the average global temperature warming to 2 degrees by 2050, in combination with worldwide efforts (APERC 2019). This is not consistent with the Paris Agreement Long-Term Temperature goal of keeping warming well below 2 degrees and efforts to limit it to 1.5 degrees. The 2DC scenario still has less than 50% renewable energy share in 2030.

High rates of renewables are not shown in the Department of Energy BAU scenario, which reflects the current energy system. All scenarios show the Philippines remaining highly dependent on fossil fuels, with fossil fuels representing over 60% of the total primary energy supply to 2030 and 50% or over to 2040, in stark contrast to the need to decarbonise energy systems globally by 2050 (Climate Analytics 2019a).

If all the coal fired power plants in the pipeline come to fruition, then coal capacity would expand to 160% above 2016 levels (CAT 2019b). The Philippines Coal Roadmap 2017 to 2040 plans to ramp up production of coal from 23 million metric tonnes (MMMT) in 2017/8 to 282 MMMT in 2040 representing an increase of 1126% (DoE 2017a). The scale of the coal ramp up is at odds with the Philippines INDC (70% emissions reduction below business as usual levels by 2030 target, conditional on international support) and the Paris Agreement goal with coal fired power needed to be phase out by 2040.

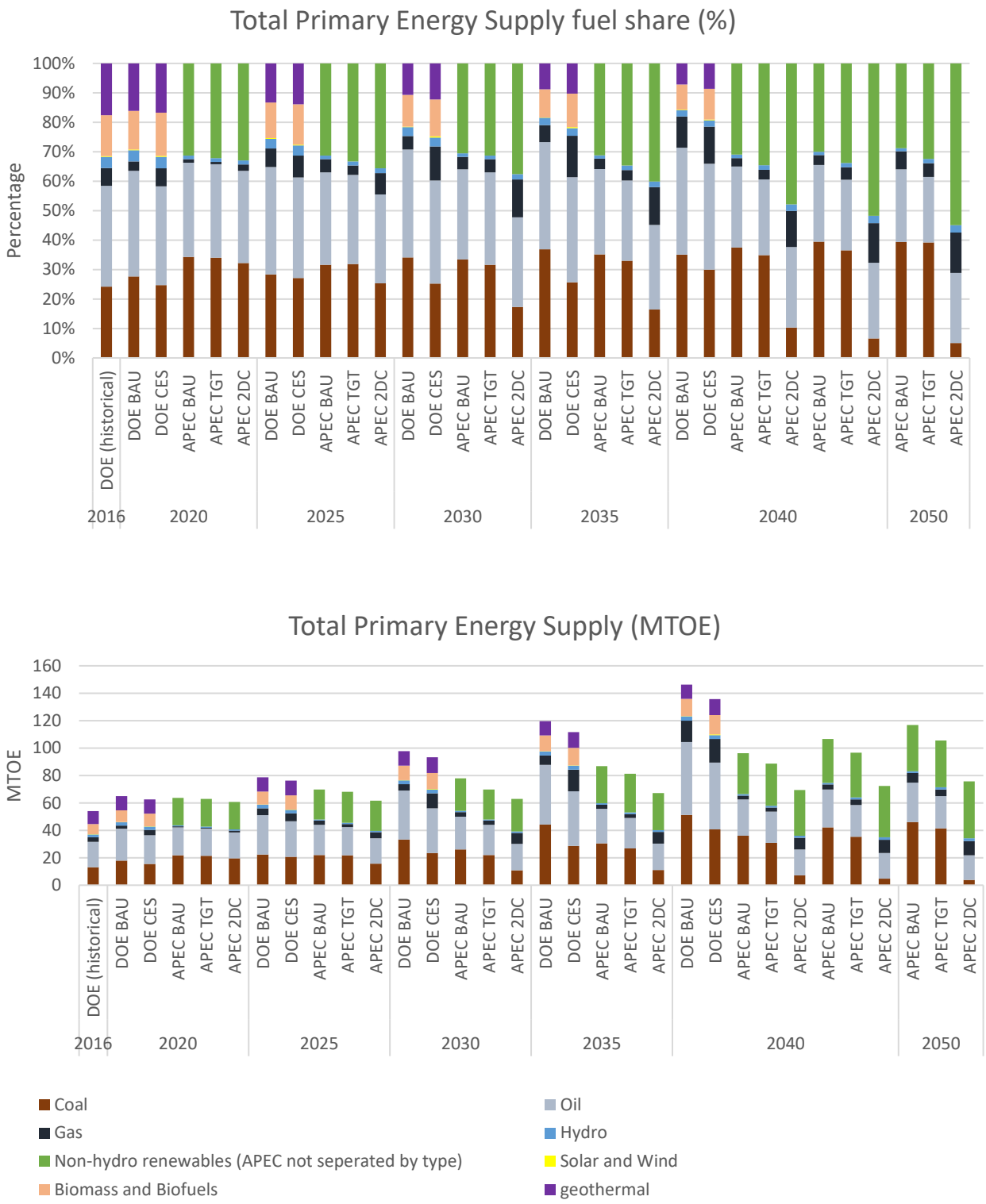


Figure 8: Total Primary Energy Supply and Fuel Share Percentages - Current and Projected Scenarios. See annex for scenario assumptions. (DOE= Philippines Department of Energy, APEC= Asia Pacific Economic Cooperation, CES= Clean energy scenario, BAU= Business as usual, TGT= Target, 2DC= 2 degrees scenario). Data from: (APERC 2019; DoE 2016b)

Figure 8 also demonstrates that Department of Energy assumes the level of total primary energy supply to be a lot higher than the assumptions by APEC for 2025 to 2040. The Department of Energy BAU scenario reflects no further policy intervention, similarly, the APEC BAU reflects current policies and trends (see assumptions section for further details). This suggests the Department of Energy total primary energy supply projection might be inflated and lead to overinvestment in fossil fuel infrastructure. Conclusions can also be drawn from inflated projection data that make policies appear more effective. For example, lower than projected levels of total primary energy supply can infer less supply was needed to meet a reduced demand due to energy efficiency measures, whereas the true cause of achieving lower than projected levels can be due to inflated data projections.

Figure 9 and 10 provide an overview of APEC's business as usual projections of the fossil fuel intensive electricity generation mix and capacity under current policies and trends to 2050 (see assumptions in annex for scenario details). The Department of Energy data (DoE 2016a) does not provide projections for electricity generation BAU or CES scenarios. The APEC BAU scenario provides an idea of the increasing electricity generation needed to meet demand and how renewable energy is not on track to scale at the same rate as energy demand under current policy. The share for renewable energy electricity generation would decrease from 24.2% today (2016), to 23.9% in 2030 and 19.9% in 2050.

The TGT scenario focuses on tripling renewable energy generation capacity by 2030. This is also a national renewable energy target, to triple renewable energy capacity from the 2010 level by 2030, i.e. 5.4GW to 15.3GW (DOE 2011). The APEC BAU projection reaches 11.9 GW renewable energy capacity in 2030, whereas the TGT surpasses the renewable energy target, reaching 16.5 GW renewables capacity in 2030. The 2DC scenario projections reach 22.2 GW renewable energy capacity in the same year, overachieving the renewable energy target by 6.9 GW.

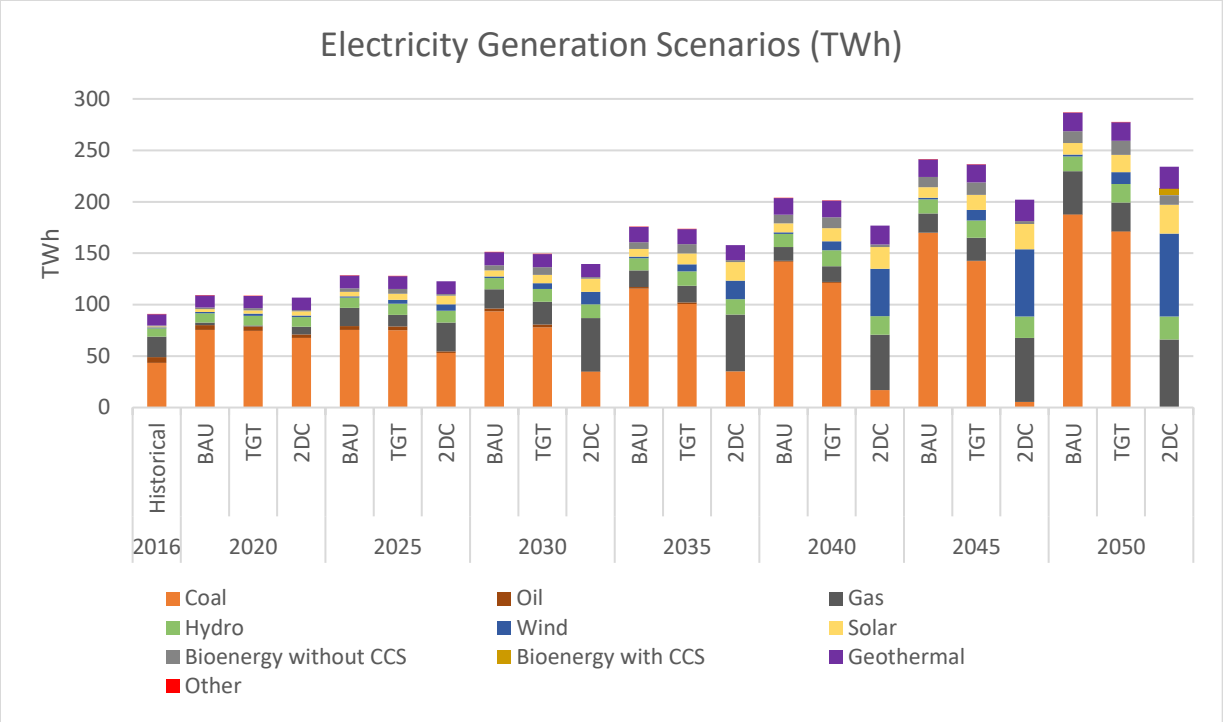


Figure 9: Electricity generation scenarios, see assumptions in annex for scenario details. (BAU= Business as usual, TGT= Target, 2DC= 2 degrees scenario). Data from: (APERC 2019).

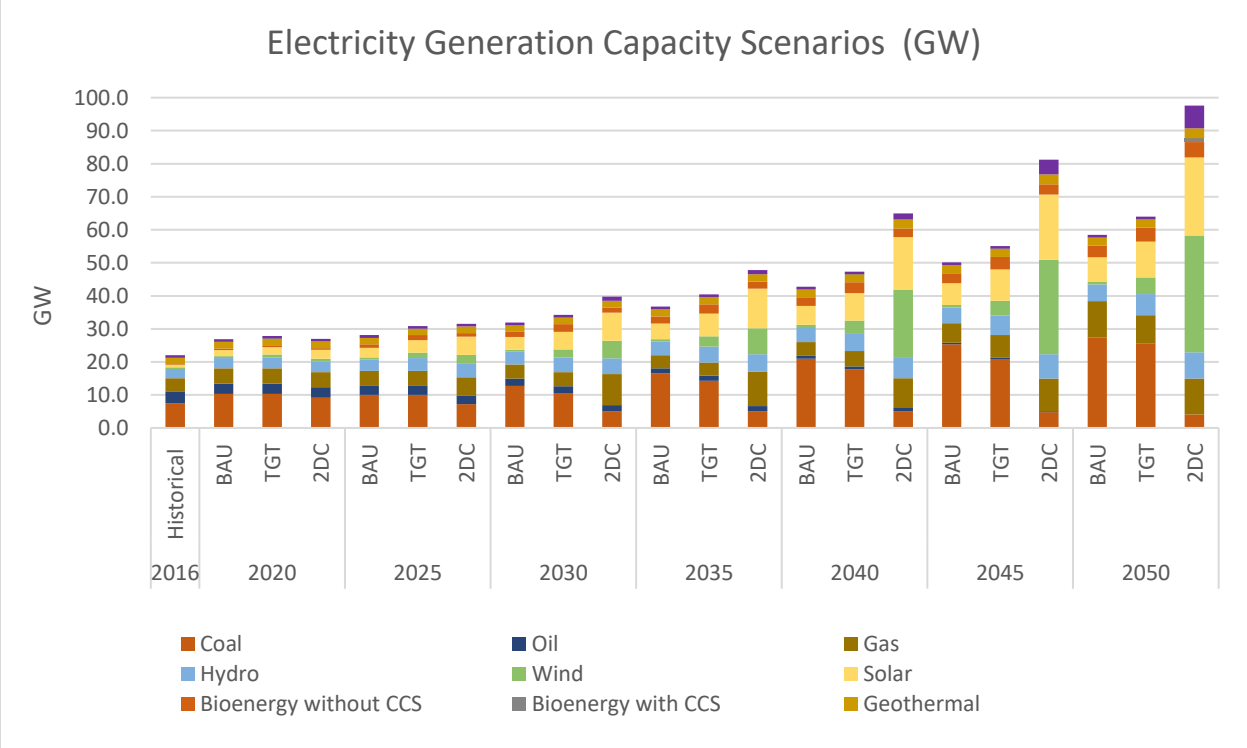


Figure 10: Electricity generation capacity scenarios, see assumptions in annex for scenario details. (BAU= Business as usual, TGT= Target, 2DC= 2 degrees scenario). Data from: (APERC 2019)

The following sections demonstrate the potential for the Philippines to improve its policy efforts in transitioning to renewable energy and decarbonising the energy sector. This section is followed by a discussion on how Australia can support the Philippines in its renewable transition and in meeting its targets.

Energy and climate governance, targets, and policies

The Philippines has several quantified energy and greenhouse gas emissions targets (see Table).

Electrification:	• Achieve 100% electrification by 2022 for targeted households (accessible to the grid) and 2040 for off grid areas (DoE 2017e).
Renewable energy:	• Triple renewable energy capacity from the 2010 level by 2030, i.e. 5.4GW to 15.3GW Milestone targets: 12.8 GW renewable energy by 2020 15.2 GW renewable energy by 2025 (DOE 2011) • Increase renewable energy capacity to at least 20 GW by 2040 (DoE 2017b).
Efficiency:	• Reduce aggregate energy intensity by 25% in 2030, and 45% by 2035 from 2005 levels (DoE 2016b).
Greenhouse gas emissions	• Paris Agreement Intended Nationally Determined Contribution: 70% below BAU by 2030 conditional on international support.

Table 1: Philippines energy and climate targets

Electrification

A major focus of the Department of Energy is electrification as some islands do not have 24-hour electricity supply. The Department of Energy aims to achieve 100% electrification by 2022 for grid accessible households and 2040 for off grid households (DoE 2017e). Electrification is hampered by the archipelago's many islands, terrain, weather and climate factors. Renewable energy, microgrid or off-grid stand-alone can offer a solution for electrifying remote regions.

Renewable Energy

The Philippines has an aspirational goal of supplying 100% of its power with renewable energy, as part of a commitment by the Climate Vulnerable Forum countries (CVF 2016, 2018), but have not pursued this goal actively through their energy policy.

The renewable energy target aims to almost triple renewable energy capacity from 2010 to 2030, i.e. 5.4GW to 15.3GW in the National Renewable Energy Program (NREP) (DOE 2011). The APEC TGT and 2DC scenarios would meet the NREP 2030 target, with renewable energy accounting for 16.5 GW (48% of total electricity capacity) and 22.2 GW (56% of total electricity capacity) respectively in 2030 (APERC 2019).

The Department of Energy recorded 7.1 GW of renewable energy in 2017, mostly from hydroelectricity and geothermal energy (Figure 4), with 1.6 GW (committed) and 11.4 GW (indicative) renewable energy projects capacity in the pipeline (see Figure 5). Altogether, this amounts to over 20 GW, and the Philippines will meet the target if these projects are operational by 2030 and assuming the indicative capacity project attain their approvals and licenses.

A further target is to increase renewable energy capacity to at least 20 GW by 2040 (DoE 2017b). Similarly, this target will be met under the same assumptions. Both the APEC TGT and 2DC scenarios meet the 2040 target, with projections for 23.3 GW and 48.1 GW renewable energy capacity in 2040, respectively (APERC 2019). The Philippines has set renewable energy targets that are attainable with the projects in the current pipeline. They are not ambitious enough for a pathway consistent with the Paris Agreement.

The Renewable Energy Act 2008 aimed to increase the development and utilization of renewable energy sources (Republic of the Philippines 2008). The Act included the Renewable Portfolio Standards (RPS), the feed-in-tariff (FiT), a Green Energy Options Program and Net Metering.

The Renewable Portfolio Standards (RPS) mechanism requires the electricity industry to source a specified fraction of their energy from renewables for on-grid energy (DoE 2017b). The Renewable Energy Act mandates a Renewable Energy Market (REM) to facilitate RPS.

The FiT intends to accelerate renewable energy by reducing the risk of buying solar PV or other renewable energy by offering a fixed price for renewable energy to be fed back to the grid. The FiT is used in compliance with RPS (Republic of the Philippines 2008). Farias-Rocha et al (2019) found that FiT solar projects are profitable. However, Agaton (2017) concludes that a higher rate is needed to spur renewable energy investment.

Net metering is when distribution utilities can enter agreements with end users who install renewable energy. It is aimed at small scale PV generation as a deduction from electricity bills (Farias-Rocha et al. 2019). Farias-Rocha et al (2019) found net-metering to be profitable, as it avoids the high retail costs of electricity.

The Green Energy Option Program (GEOP) aims to empower energy users to choose renewable energy. End users are have the option of choosing renewables as their energy source (Republic of the Philippines 2008).

Although the FiT and net metering were mandated in the Renewable Energy Act in 2008, implementation was delayed until 2012 for the FiT and 2013 for net metering (IRENA 2017). Media reports suggest delays in renewable energy implementation has resulted in the NREP renewable energy milestone target (12.8 GW) for 2020 to not be met (PhilStar 2019). Official statistics shows there was only 7.2 GW of renewable energy capacity by 2018 (table 4). Media reports from September 2019 indicate the Department of Energy intend to update renewable energy targets by October 2019 as renewable energy capacity targets had fallen short (PhilStar 2019). Although no updates have arisen in the first quarter of 2020.

The Department of Energy aims to move away from the FiT with a new Green Energy Tariff Program (GETP) (BusinessMirror 2020). The Green Energy Tariff Program is due for release in 2020. The GETP has a price cap determined by the Energy Regulatory Commission. The green energy auction facilitates competition for the procurement of renewable energy under the RPS (IEEFA 2020b). The GETP addresses the competition shortfalls of the other renewable energy policies ensuring renewable energy supported by existing policies are subject to competition (IEEFA 2020b). Auctions can lead to lower electricity prices, and streamlined fast tracked procurement processes (IEEFA 2020b).

Energy Efficiency

The Philippines Energy Plan adheres to Asia-Pacific Economic Cooperation's (APEC) target to reduce the aggregate energy intensity of APEC economies by 25% in 2030, and 45% by 2035 from 2005 levels (DoE 2016b).

The Inter-Agency Energy Efficiency and Conservation Committee (IAEECC) was created as part of the Energy Efficiency and Conservation Act to reduce energy costs in state owned or occupied buildings (CAT 2019b). There were a number of initiatives under the National Energy Efficiency and Conservation Program (NEECP) 2011 to 2030 (DoE 2016b). The

Department of Energy found that the NEECP measurements resulted in different interpretations of whether 10% reduction was needed each year or cumulatively (DoE 2016b). The Department of Energy created the Energy Efficiency and Conservation Roadmap for 2014 to 2020 and action plan for 2016 to 2020 with recommendations for each sector (DoE 2016b).

Transport

The transport sector has the largest share (over 37%) of total final energy consumption (DoE 2017c). Despite this, there are few policies to decarbonise the transport sector. The biofuels blending policy mandates minimum percentages of fuels for motors and engines to be blended with biofuels, and the blending percentage increases over time (Republic of the Philippines 2006). The Executive Order No. 488 ensures there are no tariffs imposed on parts for the assembly of hybrid, electric or flexible fuel, or compressed natural gas (CNG) vehicles (Tariff Commission n.d.). The order targets a 5% reduction in fuel consumption by road transport users. The Department of Energy has replaced some government vehicles with hybrid cars and introduced information, education and communication campaigns (DoE 2017b).

Climate Policy

The Philippines ratified the Paris Agreement and set a target of reducing emissions 70% below business-as-usual (BAU) levels by 2030 conditional on financial, technological and capacity building support. The Philippines did not define BAU levels making it a difficult target to quantify (CAT 2019b). The Climate Action Tracker[3] has developed a BAU scenario that includes policies up to the end of 2015, and rates the target as 2 degrees compatible, rather than 1.5 degrees Paris Agreement compatible, although this score may change pending the release of a revised NDC due before 2020, in particular, if the NDC also includes an unconditional target (CAT 2019b).

The Climate Change Act 2009 (Republic Act No. 9729) integrates climate change considerations into government policy and created a Climate Change Commission (CCC). A governance assessment by the Climate Action Tracker (CAT) found the CCC has a moderate level of effective coordination across government agencies (CAT 2019a). The CCC developed the National Climate Change Action Plan (NCCAP), which provides non-mandatory measures for climate change mitigation and adaptation (CCC 2011).

[3]The Climate Action Tracker (2019b) assessment is largely based on APERC (2019) scenario data.

A further option to reduce emissions is the possibility of nuclear power which is currently not used in the Philippines. The Philippines has conducted feasibility studies (DoE 2017e) although this technology may not fare well for a country prone to typhoons, earthquakes and floods.

There are some taxes imposed on coal via the Tax Reform for Acceleration (TRAIN) Act of 2018. The act periodically increases taxes on metric tonnes of coal, from 19 US cents in 2017 to 2.85 USD in 2020 (CAT 2019b).

The Climate Action Tracker suggests that current or planned policies will not meet the INDC target (CAT 2019b). Emissions[4] are projected to increase from the latest historical emissions (2015) of 177 MtCO2e per annum to 220 MtCO2e by 2020 and 263 MtCO2e by 2030 under current policies. Emissions could further decrease under planned policies to 227 MtCO2e, i.e. a 10% reduction compared to the current policy projections, following the renewable and energy efficiency targets (CAT 2019b). Installations and expansions of coal power plants jeopardize meeting the INDC target and increase the risk of stranded assets (CAT 2019b).

Investments, trade and international relations

President Duterte signed Executive Order 30 establishing the Energy Investment and Coordinating Council to simplify approvals and permit processes. The order allows the Department of Energy to stimulate large investment in the energy sector through identifying "energy projects of national significance", where projects worth over USD70 million are processed in 30 days (DoE 2017f). The Department takes a technology neutral approach to investment, with LNG projects listed as a priority as the Malampaya gas facility is set to be depleted by 2024 (DoE 2017f).

Investments in renewable energy are marred by the low prices of fossil fuels, the expensive start-up costs and low renewable energy feed-in tariffs (Agaton 2017). Agaton (2018) evaluated the investment environments in the Philippines for switching diesel power plants to renewable energy generation, considering the price volatility of diesel. The study found a positive net present value for investments in renewables, and delaying investment may incur costs depending on the price of oil (Agaton 2018).

[4] Total Greenhouse gas emissions without the uncertain and variable land use, land-use change and forestry (LULUCF) sector.

Investment in (non-hydro) renewable energy is growing, with an estimated compound annual growth rate of 11.2% from 2018 to 2030 (GlobalData 2019). The committed and indicative renewable energy projects (See Figure 5) amount to capacities that exceed the reported 'potential capacity' from the Department of Energy National Renewable Energy Program developed in 2011. Committed and indicative solar projects in the pipeline are exceeded by 12%, biomass by 40% and wind by 157% (own calculations based on DoE 2017d, 2017e).

There is evidence that businesses are seeing the need to divest away from coal. Recently, the Philippines oldest and largest conglomerate, Ayala Corporation announced it would offload all coal fired power development investments by 2030 (PhilStar 2020).

The Green Energy Tariff Program (GETP) planned for 2020 is expected to spur further renewable investment. The initial phase includes a 2,000 MW, USD 2 billion auction (IEEFA 2020b). The IEEFA (2020b) provides opportunities to improve the competitive auction framework on the GETP and conservatively estimates an investment opportunity in power generation assets through the Green Energy Tariff Program to be worth USD 7.6 billion (7.6 GW) by 2023 and USD 20 billion (20 GW) by 2030 (excluding investment in storage, transmission and distribution). If the program was to achieve this investment potential (20 GW) in addition to APEC's BAU current projected levels by 2030 it takes the Philippines on a pathway that is more ambitious than APEC's TGT and 2DC scenarios.

In addition, in response to Covid-19, the Philippine Finance Secretary has proposed an economic stimulus plan, with Pillar Four (valued at P830.47 billion) aimed at economic recovery to invest in social and infrastructure programs (Business Inquirer 2020). If appropriately directed, this plan could spur renewables investment and renewables infrastructure programs.

3. Renewable Energy potential and benefits for sustainable development

The Philippines has abundant renewable energy resources, and solar in combination with battery storage with microgrid or stand-alone off-grid solutions are key for remote locations.

The Department of Energy estimates hydro potential at 10,000 MW, geothermal 4,000 MW, wind 76,600 and ocean 170,000 MW, biomass 500 MW, and solar 5 kWh/m2/day (DoE 2019). Climate Analytics (2019b) found similar potential for geothermal but notes the locations are mainly in national parks and protected by the Indigenous People's Rights Act. IRENA (2016) estimates REmap Options (the additional potential of renewables) could reduce energy system costs by 0.5 billion USD per year in the Philippines.

Decarbonising the energy system: Scenarios towards 100% renewable energy

Mondal et al (2018) compared different scenarios for the Philippines power sector and found that the cost of the 'renewable-target scenario' from 2014 to 2040 modelling increases the total system cost by 2.6% in comparison to a reference scenario of US 69.7 billion. The scenario assumes 30% renewable generation by 2025 and 50% by 2040 based on the NREP commitment to promoting renewables in electricity generation (Mondal et al 2018). If renewable subsidies[5] replaced the current FiT, then there is a decrease in the total system cost by 22% compared to the reference scenario (Mondal et al. 2018).

A study by USAID and DoE (2018) found that 30% and 50% renewable energy is achievable in the planned power system for 2030 for the Visayas and Luzon grids. System flexibility, coordination of generation and transmission development planning, reserve

[5] The subsidies considered are US$0.04/kWh for hydro/biomass, US$0.05/kWh for wind, and US$0.06/kWh for solar in 2020. US$0.03/kWh for hydro/ biomass, US$0.04/kWh for wind/solar in 2030.

provisions and sharing of ancillary services between Visayas and Luzon are likely needed for cost effective renewable integration (USAID & DoE 2018).

The Meschede et al (2019) study analysed the potential for smart energy systems for 502 Philippine off-grid islands, and PV-battery systems are the favourable backbone of the energy systems for most islands (Meschede et al. 2019). Most off-grid islands do not have access to electricity, however, the majority of the islands that do have electricity are powered by diesel generators (Meschede et al. 2019). The islands also have varying levels of feasibility for wind power (Meschede et al. 2019).

Bertheau and Cader (2019) considered centralised and decentralised electricity options for 132 of the archipelago's many islands (Bertheau and Cader 2019). The study compares the feasibility of submarine cable interconnection and renewable energy based hybrid systems. They assessed the least cost power generation option considering diesel generators, solar PV, battery storage, and electricity demand. Submarine cables offered the cheapest solution for 35 islands (Bertheau and Cader 2019). Renewable energy based hybrid systems proved the best option financially for most islands (Bertheau and Cader 2019).

Thiesen (2016) reviews whether the Philippines can transition to 100% renewable energy and concludes that the levels of system inefficiencies and development of major coal power stations will dwarf efforts of renewable installations, and the lack of political commitment is a barrier to renewables.

The One Earth Climate Model developed decarbonization pathways to limit global warming to 1.5˚C above pre-industrial levels, through 100% renewable energy by the mid century (Teske et al. 2019). This scenario is in line with the Philippines aspirational 100% renewable energy power generation goal, as part of the Climate Vulnerable Forum (CVF 2016, 2018). The One Earth model demonstrates the feasibility of renewables increasing to 78% by 2030 and to 87% by 2050 (Teske et al. 2019). In the non-OECD Asia region, renewable electricity generation will mainly be sourced from solar PV, with some additional wind power, the increase in use of efficient heat pumps and solar heating, with biomass for heat decreasing, and the transport sector will move from fossil fuel based transport to electrification and biofuels (Teske et al. 2019).

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 (Climate Analytics 2019b).

Benefits of a transition to renewable energy

Investing in alternative policy options to propel the transition to renewable energy offers numerous benefits, particularly creating a diversified energy supply, higher levels of energy security, and a lower carbon society. Renewables also has implications for meeting the sustainable development goals (SDGs).

Clean and affordable energy

Renewable energy offers the opportunity for the Philippines' many islands to provide clean and affordable energy (relating to SDG7) in microgrid or stand-alone off-grid systems. Bertheau (2020) assesses the impact of energy on local development and SDGs, focusing on a small island case study on Cobrador island. Results found a positive impact of solar and battery technology with access to education (SDG 4), information, health services (SDG3) and perceived safety, but found that poor households need programs to ensure they equally profit from sustainable energy compare to above average income households (Bertheau 2020).

Energy security and costs

The Philippines faces the issues of high energy demand and limited capacity to meet domestic energy needs with indigenous energy supply. The Philippines is dependent of fuel imports. Renewable energy and battery technology can offer a cheaper reliable electricity supply (Meschede et al. 2019). The Philippines has high electricity prices for consumers compared to other countries in the ASEAN region (ERIA 2018, IEEFA 2020b). Electricity prices are volatile as the Philippines relies on a high portion of imported fossil fuels (Koebrich, and Speer 2019). Renewable energy can secure a domestic energy supply with lower prices. Renewable energy offers an alternative to the volatile prices of diesel. The price and transportation costs of diesel to islands make diesel generators expensive to run, and transport can increase prices up to 60 times more than the average, causing a limited service (IRENA, 2017:38).

Reduced air pollution and impacts

SDG 3 relates to health and wellbeing. Renewable energy can reduce air pollution and reduce the health impacts associated with conventional fossil fuel energy. Diesel creates issues of pollution and oil spill risks in the Philippines (Bertheau & Cader, 2019).

Society benefits

Transitioning to renewable energy brings the community together and social mobilisation can facilitate the energy transition. For example, two communities in the municipalities of Nara and Aborlan in the Province of Palawan resisted the construction of coal fired power plants (Marquardt and Delina 2019). The communities pay double the price of electricity compared to Manila and suffer from energy scarcity (Marquardt & Delina, 2019). Over half of Palawan does not have a stable electricity supply, but the community holds a 100% renewable energy vision for the area (Marquardt & Delina, 2019). The battle against coal also represented much larger battles against corrupt politicians, unemployment, and other issues (Marquardt & Delina, 2019).

4. Policy gaps and barriers

The transition to renewable energy in the Philippines faces gaps and barriers in policy making and implementation.

- *Political commitment:* There is limited leadership and buy-in from President Duterte, with some support for renewables and to reduce coal dependence but action from the Department of Energy to fast track renewables is yet to be seen (CAT 2019a). Some progress in political commitment to renewable energy is evident in the Renewable Energy Act in 2008 and more recently the Green Energy Tariff Program. Yet the government calls for increased renewable energy investment but then expresses concerns on high capital costs of renewable energy and its variability (IRENA, 2017). The government needs to relay consistent support, rather than mixed signals to stakeholders.

- *Government support for coal:* Support for coal invites investor uncertainty for renewable energy projects. The government plans to increase the capacity of coal fired power plants is a barrier for renewables. Increasing the capacity for coal locks the Philippines into a fossil fuel intensive future, and increases the growing risk of stranded coal assets, which can lead to higher electricity prices for consumers and losses for investors (IEEFA & ICSC 2017).

- *Institutional framework:* The Department of Energy and the electricity sector's institutional framework lacks effective coordination with the Climate Change Commission (the national entity dedicated towards decarbonization) (CAT 2019a).

- *Grid challenges:* Sustained interest from investors and developers creates a challenge for grid operators to manage areas where the grid is weak or has low demand (IRENA, 2017).

- *Regulatory instability and uncertainty:* The priorities of each administration changes creating investor uncertainty for renewables. For example, the Department of Energy focused on the optimal energy mix in 2014, but after the 2016 national election, the

priority moved towards capacity requirements and energy security (Mondal et al. 2018). In addition, there are a number of energy plans, with a lack of a coherent strategy (Mondal et al. 2018, DoE 2016b, 2017d).

- *Policy framework issues:* The existing policy framework does not allow for easy private sector investment. Distribution utilities control the renewable energy certificates for net metering and FiT programs, but multinational corporations may wish to retain ownership (Koebrich, and Speer 2019). The distribution utilities need a high awareness of the renewable portfolio standards (RPS), and there are difficulties meeting the renewable portfolio standards targets when the percentage for compliance changes yearly (Koebrich, and Speer 2019). A study by Barroco and Herrera (2019) found that project finance can unlock capital for renewable energy projects, but uncertainty relating to the FiT adversely affected project finance and small investor participation, but were utilised by well capitalised investors and power and financial companies. Policies need to be designed to reduce revenue uncertainty and broaden the investor base for full effect (Barroco and Herrera 2019).

- *Permit issues:* Investors face lengthy and complex procedures to acquire permits for renewable energy facing multiple government agencies, at different levels of government (barangay, municipal, provincial, regional, and departmental authorities) for approval with different timelines creating repetition and requirement variations (Mondal et al. 2018; Watson Farley & Williams 2018). Although the government has approved an "Energy Virtual One-Stop Shop" bill to improve these procedures (Senate 2018).

- *Foreign ownership:* Renewable energy projects are subject to foreign ownership restrictions, whereas thermal power plants are not (Watson Farley & Williams 2018). Only 40% of a renewable energy company can be foreign owned (Watson Farley & Williams 2018).

- *Lack of capabilities and resources:* The Philippines suffers from a lack of capabilities and resources (IRENA, 2017). Project installations do not match the capacity available within government institutions (IRENA, 2017).

- *Keeping up with innovation:* Policy makers struggle to determine how technology advancement will affect the policy landscape, creating restrictive policies or an absence of policy altogether (Mondal et al. 2018). Mondal et al (2018) give an example of the lack of policies relating to distributed energy generation, battery storage, floating solar, microgrids, and community renewable energy.

- *Perception:* Interviewees at the Department of Energy highlighted that Filipinos perceive coal as the cheap and reliable source of energy, whereas renewables are perceived as unaffordable and unreliable, delaying the renewable transition (Marquardt and Delina 2019:97), despite the prices of solar and wind energy decreasing globally. The public exhibits a strong influence on political commitment, therefore public awareness of renewable energy benefits as a cost effective option would improve and sustain political commitment (IRENA, 2017). The incentive of lowering the cost of bills would appeal to many Filipinos.

5. Options for collaboration between Australia and Philippines

There is little evidence of collaboration in the energy sector between Australia and the Philippines. The major donors in the Philippines energy sector from 2010 to 2018 are from the Asian Development Bank (ADB), the World Bank, Japan International Cooperation Agency (JICA), the European Union and USAID (ADB 2018).

International support is required as a conditionality of the Philippines' Paris Agreement INDC target. Policies can be scaled up to meet the target with the help of international support. Australia is well positioned to help deliver renewable energy projects due to its vast experience and current aligning strategies. In particular, industry, researchers and governments of the two countries could:

- Develop further research to determine a 100% renewable energy pathway for the Philippines with international support and opportunities for renewable energy imports. Further studies should be led by researchers with support and input from government and industry to consider how renewable energy can be integrated and complement the Philippines industrialization agenda, following a path for sustainable low emissions based economic growth in line with the Paris Agreement and the Sustainable Development Goals.
- Governments and industry can work together to remove barriers to renewable energy uptake and investment, and develop options for further renewable energy supportive policies based on research. A particular focus should be to revise fossil fuel expansion plans to prevent investment losses, stranded assets, to reduce the energy price for consumers and meet the sustainable development goals and the Paris Agreement objectives. Australian government and industry can share its experience and lessons learnt in creating a just transition for fossil fuel industries.
- Develop together grid infrastructure and renewable energy capacity building programs. There are opportunities for Australia to collaborate with the Philippines on grid infrastructure and renewable energy capacity building programs as well as microgrid and off-grid standalone solutions. IRENA (2017) recommended a grid infrastructure, institutional capacity, and renewable energy micro grid assessments. Researcher led

assessments would determine further support required, such as capacity building and technical assistance programs. Australia has experience in applying renewable energy, battery technology, microgrid, and offgrid solutions in remote locations and the lessons learnt, skills and knowledge can be transferred to the Philippines.

- Work jointly on issues related to climate vulnerability and resilient energy systems, given the high exposure in Australia and the very high vulnerability of the Philippines to climate change. Researchers can explore these issues, informed by governments and industry from both countries.
- The Philippines increasing energy demand can be reduced with further energy efficiency measures. The Australian government can support research and implementation to help reduce the energy demand via researcher led programs.
- Renewable energy based green hydrogen offers a collaborative opportunity for a new Australian export that aligns with the global shift to decarbonize, particularly as Australia has released a National Hydrogen Strategy. The strategy takes a technology neutral approach (COAG Energy Council 2019). However, only renewable hydrogen offers the Philippines an opportunity to shift its fossil fuel imports dependence to a renewable source. Renewable hydrogen offers a new industry for Australia with multiple benefits including economic growth, and job creation for a low emissions economy (Acil Allen 2018). Researchers, with the support of industry and government, can explore how hydrogen can be used in remote locations suited to the Philippine archipelago, for dispatchable electricity, transport fuel, heat and industrial feedstocks and avoid investments locking in a continued fossil fuel dependency.

6. Conclusion

The economic stimulus package to respond to Covid-19 offers an unprecedented opportunity to combine recovery programmes with the urgent need to shift investments towards a clean energy transition. Regional cooperation between the Philippines and Australia offers solutions to both deal with the immediate crisis but also set the foundations for the energy systems of the future.

Current plans in the Philippines energy sector depict a future with large shares of fossil fuels to meet their energy needs, and a carbon intensive economy. The Philippines can move away from its dependence on fossil fuels imports and transition to a diversified and decentralized renewable based power system to meet its energy demand, but can benefit from international support in the region to address challenges and seize opportunities of an accelerated transition to renewable energy.

The Philippines has made international commitments towards decarbonisation but also has a strong national agenda for economic development and industrialisation. These two commitments can be complementary to research and planning. Ensuring infrastructure development is focused on a low carbon economy can set the future path for the Philippines to transition to renewables and meet its climate targets.

Many studies demonstrate the potential for renewable energy in the Philippines. Australia can help support this transition through assisting in the undertaking of further studies, grid infrastructure, renewable energy capacity building and energy efficiency programs, and through renewable energy exports.

Developing a partnership between the Philippines and Australia in line with the 2030 Agenda for Sustainable Development and the Paris Agreement, Australia can support the Philippines in transitioning to renewables through exploring:

- Opportunities for collaboration between the two countries to meet the Philippines energy demand throughout the islands with technology, grid infrastructure, microgrids and off-grid solutions, removal of policy barriers and policy upgrades for electrification and renewable energy, taking into account high vulnerability to climate change.

- Opportunities for Australia to export renewable energy, including through hydrogen to meet the Philippines energy demand and reduce its fossil fuel import dependence.
- Opportunities for the best use cases in the Philippines for renewable hydrogen imports in different economic sectors.

Annex

Assumptions for scenarios

Department of Energy (DoE 2016b)

The BAU scenario:
The BAU represents the energy system without further policy intervention (DoE 2016b).
In relation to energy supply it assumes:

- the continuation of current development trends,
- completion of committed projects, including the interconnection of Min-Vis by 2020,
- The development of renewable energy based on the National Renewable Energy Programme
- Rehabilitation of current renewable energy capacity to extend its operational lifespan.
- 25% reserve margin

Clean Energy Scenario (CES):
The CES represents a view of the energy mix with "aggressive implementation" of policies including ramping up renewable energy and natural gas, and the addition of unspecified "new technology" (DoE 2016b).
In relation to energy supply it assumes:

- The same as the BAU with increased renewable energy and LNG utilisation.
- "Entry of other technology"
- Aggregated capacity of 10,000 MW for power generation.

Both BAU and CES scenarios have the same energy demand assumptions:

- Electricity savings for all sectors of 10 % by 2040.
- 24% cumulative increase of alternative fuel vehicles in the transport sector
- 2% biodiesel and 10% ethanol blend by 2040

APEC (APERC 2019)

The BAU scenario:
reflects current policies and trends.
Key assumptions and policy drivers include:

- Current levels of minimum energy performance standards and labelling for household appliances.
- Limited numbers of low emissions vehicles.

- Maintained current levels of biofuels blended.
- No new major natural gas fields.
- Least cost options for power generation utilized.
- Plans for nuclear generation are assumed unconfirmed.
- Renewable energy target of 30% generation.
- Continuing the policy supporting improving domestic energy resources, energy self-sufficiency and reducing import dependency.
- Paris Agreement target is not met.

The TGT scenario:
This scenario was developed to show a pathway for the aspirational target of APEC of tripling renewable energy generation capacity by 2030, and reducing energy demand by 10% by 2030. Meeting this target would require policy changes, for example increasing the stringency of fuel efficiency regulations, building and appliance standards and increasing renewables support.

The 2DC scenario:
The 2DC (or 2 Degrees Celsius) scenario aims to increase renewable energy to reduce energy intensity and CO_2 emissions, sufficient to provide a 50% chance of limiting the average global temperature warming to 2 degrees by 2050, in combination with worldwide efforts.

Acknowledgements

We would like to acknowledge the discussions and valuable insights from the following people.

Niccolò Manych, MCC

Rebecca Burdon, University of Melbourne

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