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COVID-19, Generation Fuels, and the Energy Transition in the Philippines

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ABSTRACT

The lockdown associated with COVID-19 caused a sizeable downward shock to electricity demand in the Philippines. Although coal is usually classified as a "baseload" fuel, it ironically bore the brunt of adjustment in the generation mix. The resulting upward pressure on retail prices was offset by *force majeure* contract provisions that allowed distribution utilities to pay lower fixed charges on their power purchase agreements. Coal generators thus suffered the double whammy of lower sales at lower rates. While existing coal plants will contribute to affordability during the recovery, plants in the planning stage may be reevaluated in light of the falling cost of wind and solar power and the low costs of dealing with intermittency when the percentage of intermittent generation is low. The Department of Energy's "technology neutral" policy towards the generation mix is sound so long as least cost is interpreted to include the social costs of pollution. Some changes in renewable energy policy are indicated.

Keywords:
COVID-19, electricity industry, energy transition, Philippines

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JEL: Q4, Q2, O1

I. INTRODUCTION

The Philippines Medium-Term Development Plan of 2017-2022 is anchored on *Ambisyon Natin 2040* (Clarete et al. 2018; Executive Order No. 005 s. 2016), which targets attaining high-income status by 2040. From 2010-2019, the economy was nearly on track with this ambition, growing at an average rate of 6.3 percent, having apparently conquered boom-and-bust cycles characterizing economic development in the Philippines previously (Balboa 2019; Balisacan 2018).

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In line with these rosy forecasts, electricity consumption was expected to grow to nearly four times its 2018 level by 2040, prompting concerns about attracting generation investments (Rivera 2019) to meet the growing demand. Enter the COVID-19 pandemic, and these concerns have largely disappeared. Since the first cluster of COVID-19 patients first erupted in Wuhan, China in December 2019, the pandemic has affected 140 countries, including the Philippines. In mid-March 2020, President Duterte, along with local government officials, placed Metro Manila and the surrounding provinces under a hard lockdown (Proclamation No. 929 s. 2020) known as "enhanced community quarantine" (ECQ). As operations of industrial facilities and commercial establishments slowed, especially in lockdown areas, electricity generation dropped by 20 per cent in April and by 15 per cent in May 2020. How did this negative demand shock affect the energy mix? To what extent was a transition towards cleaner energy made less costly? We focus on the immediate aftermath of the COVID-19 pandemic, two months since the first infection was detected in the country.

II. REVIEW OF RELATED STUDIES

We provide a brief review of the simple economics of generation. It is commonly believed that, due to its low fuel cost, high plant cost and high ramping inefficiencies that the least-cost generation mix involves using coal as the "baseload" fuel, meaning that it has a comparative advantage in serving the minimum load over a typical 24-shour period such that it can run at a nearly constant rate, close to maximum capacity. In contrast, the low plant costs and greater ramping flexibility of open-cycle gas turbine plants (OCGT) makes them suitable as "peaker plants," i.e., with a comparative advantage in serving peak demands. The higher plant costs but greater energy efficiency of combined cycle gas turbines (CCGT) makes them the least cost choice during the "shoulder period" of intermediate demand. By running longer hours than peaker plants, the higher fixed cost of CCGT plants is spread out over more hours.

Joskow (2006 2011) proposed using *screening curves* to determine the least-cost mix of thermal generation fuels. Screening curves plot the annual cost of a particular plant type versus number of hours per year that the plant is operating, i.e., the annualized fixed-cost plus the variable cost per hour times the number of hours used. Since minimizing cost implies choosing the fuel for each load-duration hour that has the least cost, this method determines at what load the baseload generation begins to be supplemented by the intermediate fuel type, and when those two types of generation are further supplemented by the peaking fuel-type.[1]

The COVID-19 pandemic created a worldwide shock that resulted in a drop of electricity consumption across countries resulting in changes in energy supply and demand patterns. Many countries observed a substantial decline in petro-chemical consumption (Energy Information Administration (EIA) 2020). For example, the EIA reports that US coal consumption decreased by 26 per cent in 2020. Lockdown restrictions also reduced electricity demand in Asia and the Pacific (Thomas 2020).

Adjustments on the supply side have depended on the fuel mix the country had prior to the pandemic. In Japan, two main adjustments came from traditional generation, thermal and nuclear power, and from renewable energy (Xu et al. 2021). Renewable power generation increased because of its lower marginal cost. Due to the lower flexibility of nuclear power, thermal power generation has been used to stabilize the grid against intermittency.

[1] See van Kooten et al. (2016) for an instructive application of the screening-curve methodology. Joskow (2006) notes that the method is not applicable to intermittent renewable sources, however. An alternative method would be to remove the intermittency by adding storage cost *ala* Heal (2016, 2017). Van Kooten et al. (2016) extended Joskow's (2011) model of three generation technologies (baseload, intermediate, and peaking) to include wind and nuclear energy sources in investigating the effects of carbon taxes and feed-in-tariffs on the least-cost generation mix for the case of Canada.

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III. DEMAND SHOCKS, FUEL MIX, AND ELECTRICITY PRICES

Jandoc et al. (2018) applied the screening curve analysis to Luzon (main island of the Philippines), projecting demand to 2025, and extended the model by introducing environmental costs to see how these change the fuel mix. The methodology was used to calculate the "residual load" that must be satisfied by petrochemically-fueled generation in 2025 after subtracting projected generation by renewable sources: geothermal, hydro, biomass, wind, and solar. The calculation is based on the following assumptions: a) solar and wind will together double their 2017 committed capacity[2], b) biomass will increase its 2017 committed capacity by 50 per cent, and c) any expansion of hydro and geothermal will just be sufficient to maintain current capacities (i.e., investments will be just enough to offset the reduced capacities due to depreciation or reduced generating capacity, e.g., from declining water flow and dam sedimentation). Resulting total capacity by 2025 for Luzon was accordingly projected at 17,540 MW, with 1,612 MW (9 per cent) being served by renewable sources, and the remaining 91 per cent (residual load) being supplied by non-renewable sources.

The fixed cost component for screening curves consists of the annualized overnight construction cost plus the annual fixed operating and maintenance (O&M) costs. The overnight construction cost refers to the cost of all material, labor, fuel, among others, needed to construct the facility as if that cost were incurred at a single point in time. Variable costs include fuel and O&M costs that are a function of output.

Estimating screening curves "from scratch," i.e., as if all generating capacity requires construction, coal is the least-cost generating fuel for the low-demand hours of 11 pm to 8 am. This means that CCGT should be running during the other hours. A very small supplementary capacity of OCGT is needed during the 1 and 2 pm peak hours (see Jandoc et al. 2018 for additional details).

Now consider the short run problem of adjusting to demand shocks once capacity has already been adjusted to long-run trends. In effect, the screening curves shift down absent fixed costs. Coal is now the dominant fuel, since its variable costs are lowest, even after adding pollution costs. When demand falls, however, there is excess capacity. The analysis indicates that coal should be the sole generating source for more hours of the day than before, and the burden of decreasing production would fall primarily on other plant types.

In reality, just the opposite happened. As shown in Figure 1, coal generation fell dramatically from 56 to 48 per cent (WESM-IEMOP April 23, 2020). Generation with natural gas decreased by 6 per cent, but as a share of total generation actually increased from 23 to 27 per cent. Other sources stayed about the same, with solar and biomass generation increasing slightly, reflecting new generation capacity.

The reason for this paradoxical result lies in restrictions embedded in legal rules and contracts. Since renewables are assured "must-dispatch" status as per the Renewable Energy Act (RA 9513 2008), the system operator is required to accept whatever is generated. And while generation by natural gas is usually assumed to easily adjust to varying demands, what is not flexible is the supply of gas arriving by pipeline. The take-or-pay bilateral contracts with Meralco (the utility servicing most customers in Luzon) assure that minimum purchases of natural-gas generation reflect this inflexibility in gas delivery (and the very limited gas storage capacities). This leaves the burden of adjustment falling on coal plants, a number of which had to temporarily shut down production.

Turning to the effect of the lockdown on electricity prices, average wholesale rates on the spot market fell by 55 per cent during the early lockdown period

[2] While it is assumed that solar and wind will jointly double their committed capacities, the study conjectures that most of the increase will come from solar.

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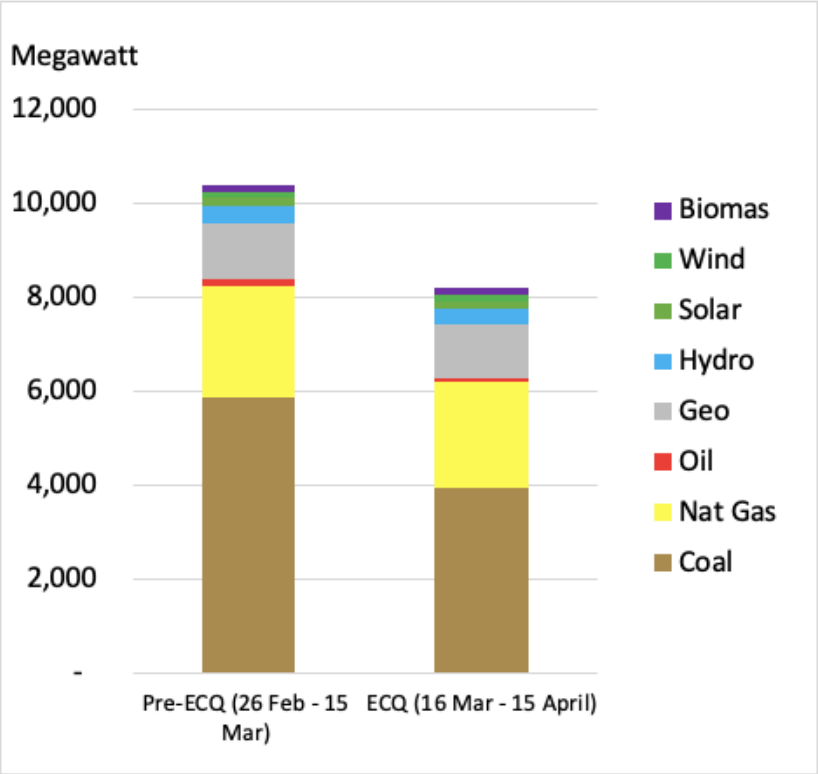
(Figure 2). Moreover, while wholesale prices used to peak around 2 pm, the peak period changed to early evening, reflecting substantial declines in commercial and industrial demand relative to residential consumers. The typically higher percentage of solar generation during the early afternoon hours also contributed to this pattern.



	Pre-ECQ	ECQ
	% Share of total	
Coal	56.5%	48.1%
Nat Gas	22.9%	27.3%
Oil	1.3%	1.0%
Geo	11.4%	14.2%
Hydro	3.8%	3.9%
Solar	1.5%	2.2%
Wind	1.2%	1.4%
Biomass	1.5%	1.9%
Total Hourly Ave. in MW	10,391	10,391

Figure 1. WESM Generation Mix Before and After Enhanced Community Quarantine. Source: Wholesale Electricity Spot Market (WESM) - Independent Electricity Market Operator of the Philippines (IEMOP) 2020.

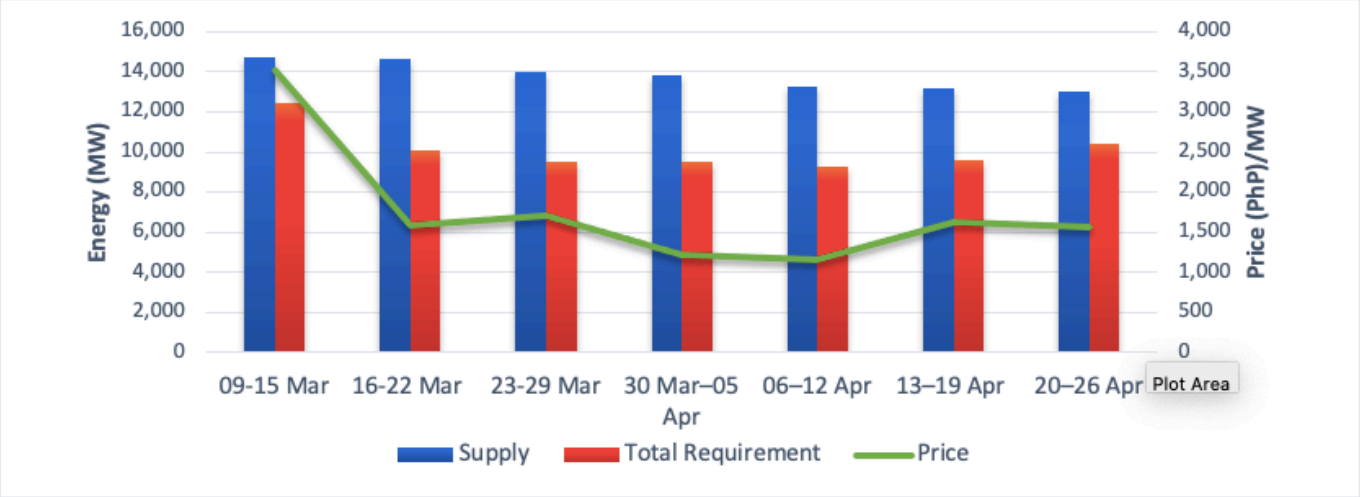


Figure 2. Average Supply and Total System Requirement (Energy + Reserve). Source of basic data: WESM - IEMOP (2020).

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As for retail prices, the rates of Meralco, the country's largest distributor, increased from ₱8.90 per kWh in March to ₱9.00 per kWh in April, 2020. The increase appears paradoxical in light of the lower WESM prices. Appearances can be deceiving, however. WESM primarily serves as a residual market for generation excesses and unexpected demand. Most generation is covered by prices set according to previously negotiated bilateral contracts. Since prices on coal contracts are typically lower than prices for natural gas and renewable sources, the shift away from coal implies that average costs to distribution utilities such as Meralco increased. In addition, the April increase reflected the Universal Charge[3] returning to its normal level following a one-time refund of P0.1453.

In May and June of 2020, Meralco rates declined to ₱8.75 and ₱8.72 per kWh, respectively in Metro Manila and its other service areas (Meralco n.d.; CNN Philippines Staff 2020a and 2020b). These decreases were due to the lower costs that Meralco paid to its suppliers. Power supply agreements (PSAs) are bilateral contracts specifying the terms on which power is supplied to the distribution utilities. The typical contract specifies a fixed monthly payment and a price per kWh. Since April, Meralco has availed of *force majeure* provisions in their PSAs allowing them to pay lower fixed charges and to suspend most of their mid-merit supply contracts.[4] In April, ERC also suspended the Feed-In-Tariff Allowance component of customer bills in light of the CoVid-19 situation (ERC 2020a).

While these provisions avoided increases in retail rates, they imposed a double whammy on coal generators—lower sales at lower prices. On the one hand, WESM prices will increase and the cost-relief measures associated with *force majeure* will come to an end. On the other hand, average generation costs will decrease as coal-fired generation comes back online.

When ECQ was extended to May 15, 2020, Meralco invoked the previous-3-months-average rule[5] of the Energy Regulatory Commission (ERC) to bill customers, resulting in widespread confusion and complaints. The average consumption from December, January, and February was used to bill customers for the summer months of March and April (Reyes 2020; Oplas 2020), even though consumption in summer is typically higher as shown in Table 1. In the months of April and May, the country also experienced an extreme heat wave, with Metro Manila recording the hottest day at 35.8 degrees Celsius (de Vera Ruiz 2020). In May, adjustments were made to reflect actual consumption, resulting in a bill shock for residential consumers. This prompted a Senate investigation (Ramos 2020) and a subsequent order from the sector regulator directing the staggered collection of payments to cushion the impact of the lockdown (ERC 2020b; Flores 2020).

Meralco retail rates were lower in 2020 than in 2019. Figure 3 shows the retail rates per kWh of consumption for residential customers with an average of 200 kWh consumption per month. The bill shock arose because initial billing was based on previous averages. Later an adjustment was added for the higher consumption in hotter weather.

Outside of Metro Manila, most electric cooperatives and private distribution utilities have struggled with collections while manual meter-reading was being prevented by the lockdown.

[3] Meralco's "Universal Charge" is an additional charge to consumers imposed for the recovery of the Stranded Debts, Costs of NPC, and Stranded Contract Costs of Eligible Contracts of Distribution Utilities and other mandated purposes, including environmental charges and all forms of cross-subsidies.

[4] As approved by the ERC.

[5] The 3-month average rule is provided in Section 3.5.4 of the Distribution Services and Open Access Rules or DSOAR (ERC Case No. 2005-10RM).

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Table 1. NGCP's Billing Determinant Energy from Distribution Utilities, in GWh

	2019				2020			
	Philippines	Luzon	Visayas	Mindanao	Philippines	Luzon	Visayas	Mindanao
January	6,098	4,535	765	798	6,482	4,805	833	844
February	6,183	4,641	770	773	6,611	4,886	861	863
March	6,095	4,621	740	734	6,341	4,698	831	812
April	7,169	5,477	848	844	5,888	4,341	782	766
May	7,303	5,555	904	845	6,371	4,789	803	780
June	7,590	5,800	932	859	7,069	5,385	855	829
July	6,983	5,309	863	811	6,729	5,129	804	796
August	6,997	5,264	888	846	6,649	5,009	829	811
September	7,026	5,225	907	894	7,102	5,381	858	863
October	7,094	5,332	896	867	6,655	5,000	817	838
November	7,030	5,284	888	858	6,502	4,802	837	863
December	6,480	4,818	835	827	6,398	4,765	813	820

Source: National Grid Corporation of the Philippines, BDE by customer type.

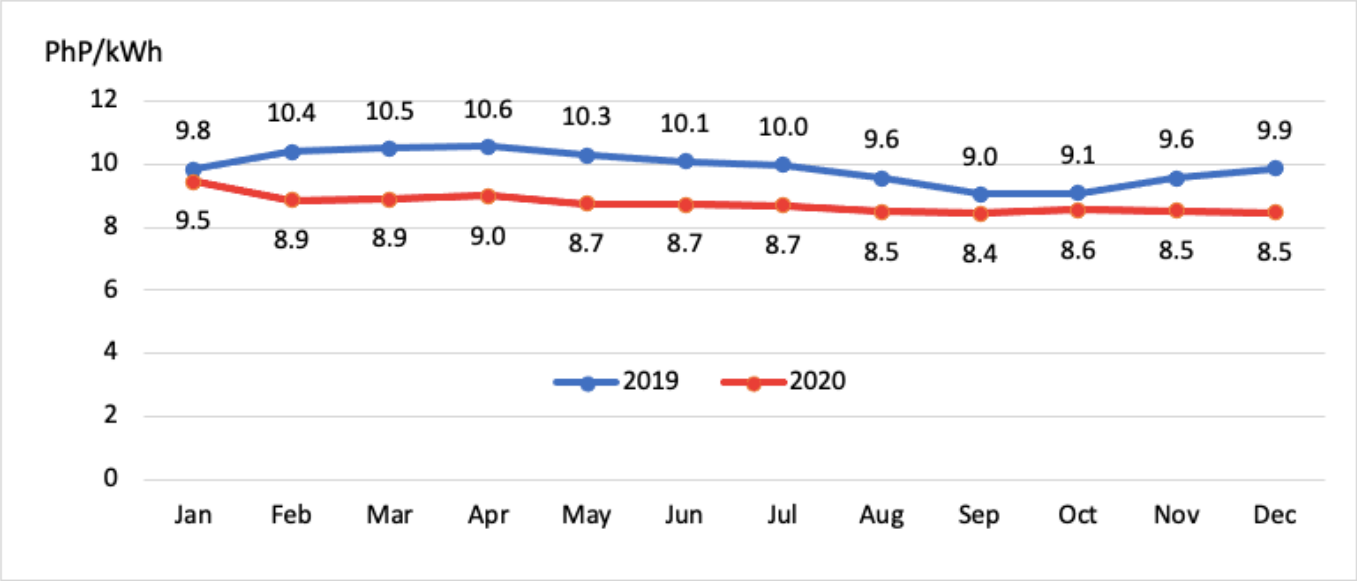

Figure 3. Meralco retail rates for residential customers with 200 kWh of consumption. Source of basic data: Meralco.

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Power outages continued to plague parts of Mindanao. When a cooperative in Zamboanga City finally billed their customers, complaints ensued due to large price increases (Jacinto 2020) and interrupted service.

IV. COVID-19 AND THE EFFICIENT ENERGY TRANSITION

Along the lines of the Machiavellian credo[6] —"never let a crisis go to waste"—some observers have advocated government measures to accelerate the transition away from coal towards renewable source of generation (EcoBusiness 2020). The implementing rules covering the Renewable Energy Act of 2008 specify an "aspirational target" of 35 per cent renewable by 2030, "subject to regular review and assessment by the DOE" (Department of Energy 2017 and 2018).

The share of renewables (RE) in dependable capacity was already 31 per cent in 2018 and 29 per cent in 2019 (Table 2), suggesting that the target of 35 per cent would be achieved much earlier than 2030. However, DOE rules (DOE 2017 and 2018) specify that the renewable portfolio standard (RPS) of 35 per cent should be attained in terms of generation, not capacity. This is somewhat more difficult since the share of renewables in generation during 2018 was only 23.4 per cent. This further went down to 20.8 per cent in 2019 as shown in Table 3.

Despite the modestly higher gap to be filled, doing so does not make subsidies necessary. The Lazard levelized costs of electricity for wind and solar for the U.S. are already below those of coal and natural gas (e.g., Marachi 2020). Even though wind and photovoltaic power are intermittent resources, the costs of intermittency are quite modest, at the indicated percentages, given the abundant opportunities for diversification, the falling costs of battery storage, pumped storage, and possibilities for demand management (Heal 2017). Solving for the optimal amount of intermittent renewables, however, will require extending the analysis here to endogenize renewable sources in the face of a rising unit cost of intermittency as a function of the percentage of intermittent sources.

Table 2. Total Installed and Dependable Capacity per Technology (in MW)

	Installed						Dependable					
	2017	**Share**	**2018**	**Share**	**2019**	**Share**	**2017**	**Share**	**2018**	**Share**	**2019**	**Share**
Coal	8,049	35%	8,844	37%	10,417	41%	7,674	37%	8,368	39%	9,743	43%
Oil based	4,154	18%	4,292	18%	4,262	17%	3,287	16%	2,995	14%	3,015	13%
Natural gas	3,447	15%	3,453	14%	3,453	14%	3,291	16%	3,286	15%	3,286	14%
Renewables	7,080	31%	7,226	30%	7,399	29%	6,263	31%	6,592	31%	6,691	29%
Geothermal	1,916	8%	1,944	8%	1,928	8%	1,752	9%	1,770	8%	1,792	8%
Hydro	3,627	16%	3,701	16%	3,760	15%	3,268	16%	3,473	16%	3,508	15%
Biomass	224	1%	258	1%	363	1%	160	1%	182	1%	227	1%
Solar	886	4%	896	4%	921	4%	700	3%	740	3%	737	3%
Wind	427	2%	427	2%	427	2%	383	2%	427	2%	427	2%
Total	22,730	100%	23,815	100%	25,531	100%	20,515	100%	21,241	100%	22,735	100%

Source of basic data: DOE (2018 and 2019) -EPIMB Power Demand and Supply Highlights

[6] The statement is commonly attributed to former Chicago Mayor Rahm Emanuel, but the original idea can be traced to Machiavelli.

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Table 3. Generation Mix, in GWh

	2017	Share	2018	Share	2019	Share
Coal	46,847	49.6%	51,978	52.1%	57,898	54.6%
Oil based	3,787	4.0%	3,192	3.2%	3,711	3.5%
Natural gas	20,547	21.8%	21,350	21.4%	22,375	21.1%
Renewables	23,189	24.6%	23,345	23.4%	22,057	20.8%
Geothermal	10,270	10.9%	10,420	10.4%	10,707	10.1%
Hydro	9,611	10.2%	9,406	9.4%	8,067	7.6%
Biomass	1,013	1.1%	1,101	1.1%	989	0.9%
Solar	1,201	1.3%	1,255	1.3%	1,217	1.1%
Wind	1,094	1.2%	1,174	1.2%	1,191	1.1%
Total	94,370	100%	99,765	100%	106,041	100%

Source of basic data: DOE (2018 and 2019) EPIMB Power Demand and Supply Highlights.

Many "clean energy" and "sustainability" devotees decry the pre-lockdown decline in the share of renewables and favor an accelerated transition to renewable energy (EcoBusiness 2020; La Viña 2020). However, greater renewable mandates and subsidies would compromise the objectives of affordability, reliability, and security as required by the Electric Power Industry Reform Act of 2001 (EPIRA) and the tax reform act of 2017 (RA 9186 2001).[7] Mandates and subsidies also put the renewability advocates at loggerheads with the DOE's declared "technology neutral" (Inquirer.net 2017) policy whereby the generation mix should satisfy the criterion of least cost.

Economics provides a clear resolution of this apparent impasse. DOE needs only to interpret least cost to include the social cost of pollution. Given the rapid reduction in the cost of renewable energy, especially solar, and improvements in storage technology, the need is to facilitate an efficient energy transition, not to force it prematurely with costly subsidies.

Projecting the efficient (least social-cost) energy transition should take into account the declining costs of wind and solar power and the low costs of managing intermittency at levels needed to meet the RPS for 2030 (Heal 2017). In order for the decisions of private investors to be consistent with least social costs, taxes should reflect the marginal damage costs of pollution (Stavins and Whitehead 1992; Tientenberg and Lewis 2014), especially from generation with coal (Ravago and Roumasset 2018). The Philippines has included coal and petroleum excise taxes as part of the 2017 tax reform (RA 10963 2017). The Renewable Energy (RE) Act of 2008 (RA 9513 2008) has put in place several programs and policy instruments that aim to accelerate the development of renewable energy. Replacing these with pollution taxes can harmonize the quest for renewability with affordability and other objectives of EPIRA.

The social cost of pollution includes both the domestic cost from carbon emissions and the costs of local pollutants (SO_2, nitrous oxides, and particulate matter) that impinge on health. The pollution cost of generation by coal is more than

[7] For a discussion of the potentially high *excess burden* cost of renewable mandates and subsidies, see Ravago and Roumasset (2018) and Roumasset et al. (2018).

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four times that for OCGT and 20 times that for CCGT (Jandoc et al. 2018). These numbers highlight the environmental benefits of transitioning away from coal towards generation by natural gas (liquefied natural gas or LNG, as the Malampaya gas fields are depleted) and by renewable sources. But mandates and subsidies to force a premature transition are unnecessary. The recent pronouncements of DOE Secretary Cusi on the removal of Feed-in-Tariff is a step towards the right direction. Cusi has proclaimed that the Philippines cannot afford to subsidize renewable energy, consistent with his advocacy of "technological neutrality" (Joint Congressional Energy Commission, April 27, 2021; Yang 2021; Dimagiba 2021). Existing subsidies can be phased out in favor of transitioning to a generation mix that minimizes social costs (including pollution costs). Inasmuch as current feed-in-tariff (FIT) rules involve several bureaucratic hurdles and *de facto* quotas, they may actually retard the energy transition. Moreover, the administration of quotas may impart market power, further inflating the cost to consumers.

In addition to pollution taxes, other policies can complement the ability of the market system to deliver energy efficiently. One of these is safeguarding competition by free entry into generation and retailing. Another is to plan investment in transmission in accordance with generation investments that minimize social cost.[8] Finally, aligning retail rates more closely with marginal costs, including real time pricing (Joskow and Wolfram 2012), can lower the costs of intermittency, lower rates, and deliver greater benefits from the power system.

The hard lockdown was lifted on 31 May 2020 in Metro Manila. In June 2020, lockdown restrictions were relaxed somewhat to move the economy towards a "new normal" in anticipation of therapies and vaccines being developed. While resilience and disaster management were incorporated in economic planning for the energy sector under *Ambisyon Natin 2040*, (EO 005 s. 2016) the economic consequences of the pandemic were greater than the effects of natural disasters. After a decade of rapid growth, the economy contracted by 9.6 percent in 2020, the lowest ebb since the Second World War. Mobility restrictions were increased again in the third quarter of 2021 due to the heightened risks associated with the delta variant. Growth assumptions for FY 2021 have been revised downwards to 4.0 to 5.0 percent from 6.0 to 7.0 percent (NEDA 2021).

The lower growth trajectory means that electricity demand targets can be reduced. On the other hand, investments already in the pipeline may be delayed and new projects may be put off. The outlook for new investments in generation, more so in coal-fired power plants, is especially bleak given the current excess capacity. In October 2020, DOE Secretary Cusi declared a moratorium on new coal plant applications (plants already in the planning stage will be allowed (Rey 2020; Flores 2021; Asian Power 2021). If and when the economy picks-up, there may again be a concern with attracting sufficient investment in generation. Accordingly, there is a need to reevaluate demand forecasts and revise investment plans. For example, "the ABC's of post-COVID-19 economic recovery" (Sheiner and Villa 2020) could be adapted to the Philippine case and mapped into demand forecasts for the different scenarios.

V. CONCLUDING REMARKS

While the average costs of power delivery have temporarily increased, there are opportunities for lowering costs and consumer rates in the near, medium, and longer terms. First, as existing coal-fired plants come back online in response

[8] The ability of the NGCP to achieve this coordination has been frustrated in the past by renewable subsidies that locate generation to surplus areas thereby bringing pressure to rationalize those investments with additional transmission capacity (see also Ravago and Roumasset 2018).

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to recovery, average costs to the distribution utilities and electricity cooperatives will decrease. Any attempt to prevent this by carrot or stick will only lead to lower welfare for consumers and/or taxpayers. Second, postponed investments in coal plants can be reevaluated in light of investments in LNG-fueled plants and falling costs of wind and solar power, especially when taxes on coal generation reflect the marginal damage costs of pollution. The DOE has already declared a moratorium on new coal investment applications and recognizes that the transition to cleaner energy should not be rushed. Third, the DOE should take action on its pronouncement of removing costly subsidies on renewables. Fourth, to level the playing field, the coal tax in the 2017 tax reform should be expanded to include other fossil fuels, according to the local pollution damages of carbon, sulfuric and nitrous oxides and particulate matter. These are promising conditions for an energy transition that is a win-win for affordability and sustainability.

Given that utility-scale wind and solar projects can be cost competitive with coal and natural gas, noting that their intermittency costs rise with their percentage of total generation, further investigation is needed to determine how much variable renewable energy is feasible and at what benchmarks in time. Rather than subsidize these programs, the government can facilitate their approval, including right-of-way arrangements for the necessary transmission.

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