Energy Policy Studies

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ENERGY POLICY STUDIES

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Foreword

The year 2020 brought a lot of challenges to the country which led to the energy sector facing issues on energy security. We started the year with the eruption of the Taal Volcano that significantly affected the country's economy leading to shutdowns of the key manufacturing industries along the area. While recuperating with the aftermath of this natural disaster came a bigger event that struck the world – the COVID19 pandemic!

The energy sector was not spared from the impact of these events. The COVID19 pandemic led to depressed energy demand due to shutdowns and closure of energy-consuming industries. Because of this, we experienced an oversupply of energy during the first half of 2020, but this was compensated with the resumption of the economy in the second half. However, in between these events, we experienced the impending threat of the lack of supply due to the restriction and movement of goods and people in and out of the country, as well its resulting impact on economic activity.

The first major impact in the sector was the announcement of PSPC to temporarily close its refinery. Not long after was the announcement of Petron to shut down also its refinery. This has threatened us with energy security or availability of supply because these happened when the country is transitioning to reopening the economy. The event led us to analyze the oil trends and look at the availability of the petroleum supply in the country amidst the restriction of movement of supply internationally.

However, amid the pandemic, we made sure that the threatening heat index in the summer will not affect the supply of electricity for the household, which became the major user in this period with the limited movement of the people due to pandemic.

The limited economic activity during the period necessitated the government to look for additional funding to combat the pandemic. The IATF identified imposing additional 10% tariff in petroleum products under Executive Order 113. It has prompted to analyze the trends of Dubai crude price as well as Mean of Platts Singapore (MOPS) prices of diesel and

gasoline and its impact on the domestic pump prices upon the imposition of the tariff; how long will it be imposed at when will it be lifted.

We, in the energy sector as well as the government is hopeful that this pandemic will be over soon. After the issuance of the Bayanihan Act I known as We Heal as One Act or Republic Act (RA) 11469 it was extended to Bayanihan Act II known as We Recover as One Act or RA 11494. The government has outlined its plans on the road to recovery from this pandemic. We, also in the energy sector did our homework to plan the equivalent energy requirements for this recovery, prompting us to formulate the short-term outlook 2020-2024, which summarizes the impact of the challenges brought by the pandemic.

Indeed, for as long as there is economic activity, the energy sector will continue to do its part in shaping the future of the country!

Mabuhay!

Special Issue on Oil Trend Analysis
(As of April 2020)

This issue presents an analysis of trends of oil demand considering the immediate impact of COVID-19 pandemic and its ensuing community quarantines in March 2020. Actual oil demand data for January 2018 to December 2019 was used, while the January-March 2020 data is based on four (4) major importers and their share to the total industry (57.2% as of 1H2019). All basic data were provided by OIMB.

Product demand for comparative periods showed an abrupt decline in March 2020 vis-à-vis March 2019, and against the increasing trend for the months of January-March observed in 2018 and 2019 (Figure 1). Aggregate oil demand dropped to 8.4 MMB (1,336 million liters) in March 2020, 37% lower than its year-ago level and down by 43% from Feb 2020. Except for kerosene, **all products showed downtrends during the same period, particularly gasoline and diesel, which registered a sharp drop in demand for March 2020, both month-on-month and year-on-year**. Restricting public transportation, as well as other modes of travel due to ECQ, had an immediate impact on these fuels' demand levels for March 2020 *(Figure 1)*.

Kerosene demand, used primarily by the residential sector for cooking, increased between February and March 2020, attributing to the utilization of the low-income class in the urban and rural vis-à-vis declining consumption of LPG. On the other hand, higher demand for Jet A-1 can be interpreted as a leveraging approach of airline companies in anticipation of a robust tourism sector for 2020, not yet considering the looming restriction in air travel due to the COVID19 pandemic. *(Figure 1)*

Figure 1: **Product Demand, Jan-March 2018, 2019 and 2020 (million liters)**

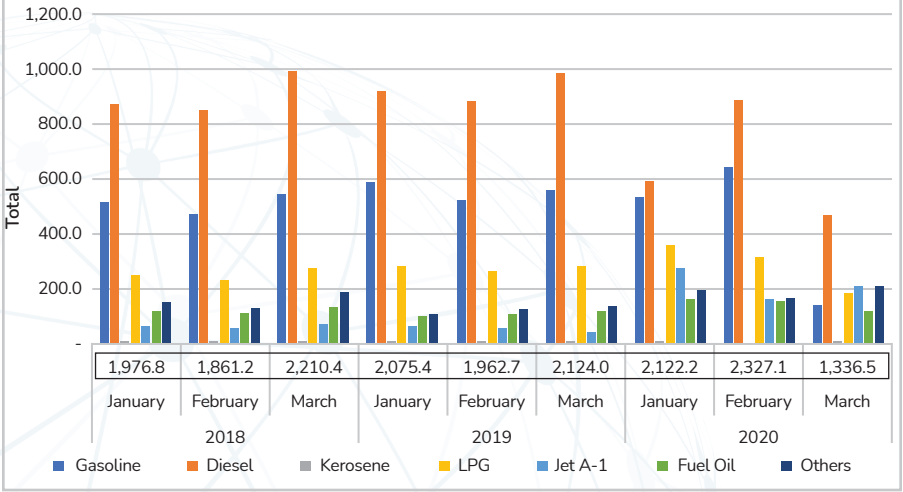
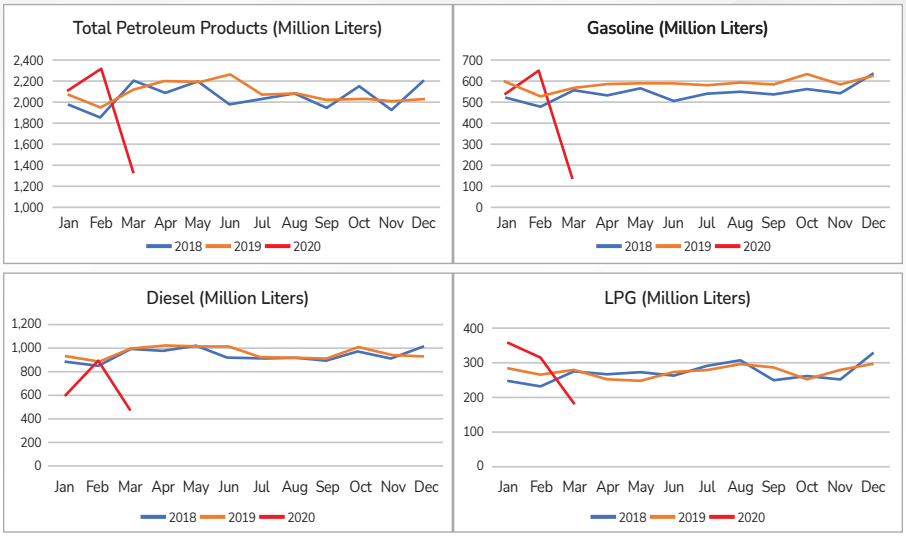
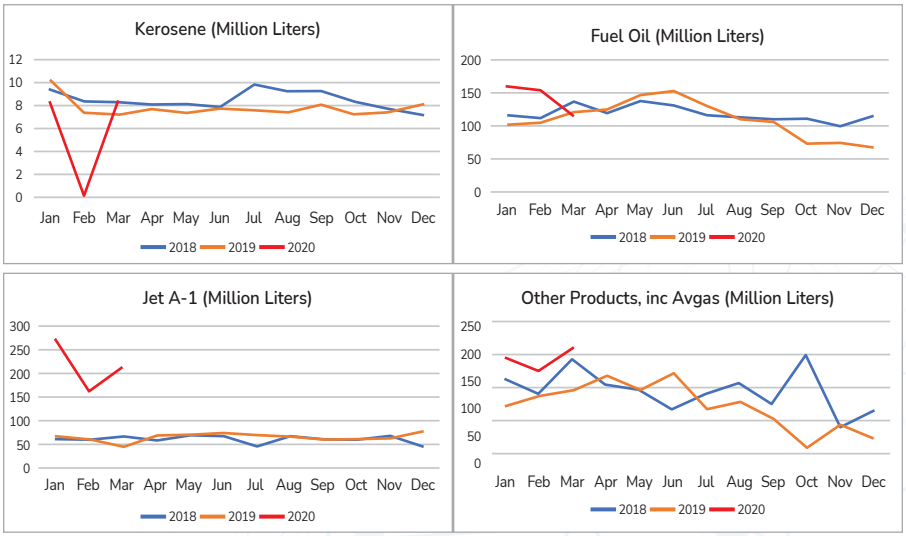


Figure 2. **Trends of Oil Demand: Total and by Product, January 2018-March 2020**



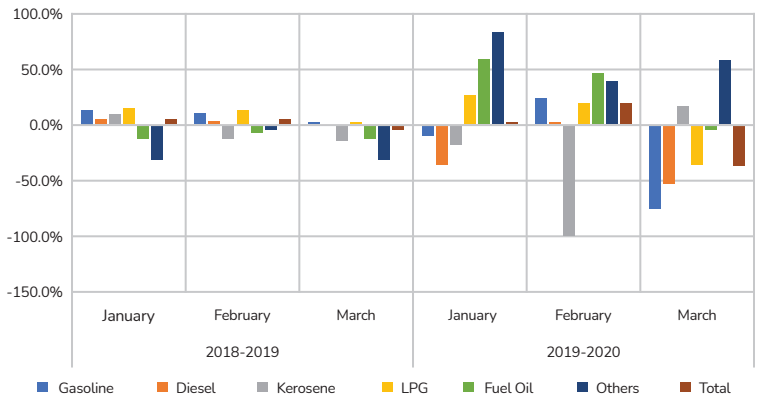
Restricting public transportation, as well as other modes of travel due to ECQ, had an immediate impact on gasoline and diesel demand levels for March 2020.



Major petroleum products registered substantial reductions in March 2020, except for kerosene, jet A-1 and other products *(Figure 3*).

Levels for gasoline and diesel, primarily used in the transport sector, dropped by around 60% - both year-on-year (March 2019-2020) and month-on-month (Feb 2020-Mar 2020).

Figure 3: **YOY Growth of Demand, by Petroleum Product and Total January-March 2018-2020**



Despite record rollbacks in domestic pump prices between January and March 2020 *(Figure 4a)* attributable to the slump in international crude prices *(Figure 4b)*, demand remains depressed mainly due to restrictions in the land, air, and water transport under the enhanced community quarantine (ECQ).

Figure 4a: **Net Adjustments in Pump Prices (Peso/Liter)**
Source: DOE Oil Monitor

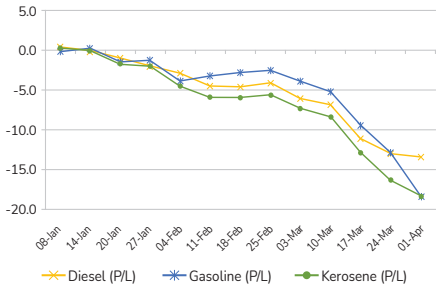
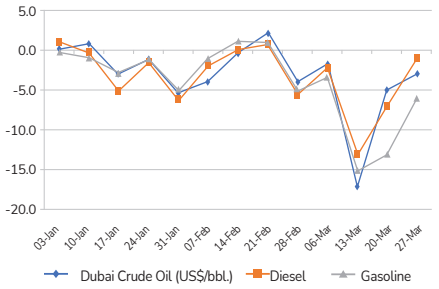


Figure 4b: **Changes in International Oil Prices (US$)**
Source: DOE Oil Monitor

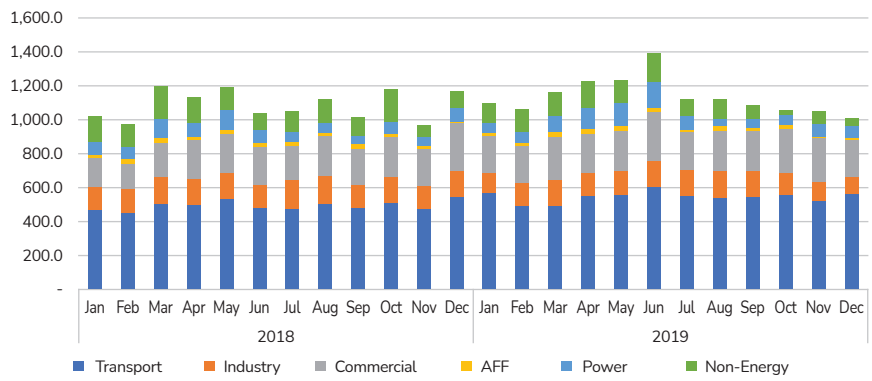


Based on the oil sales by industrial classification or Schedule 4B, **total oil demand for 2019 was at 1,136.5 million liters per month compared to 1,091.9 million liters per month in 2018**[1]. The transport sector consistently accounts for more than 40% of the total

[1] Average level for twelve (12) months, January to December.

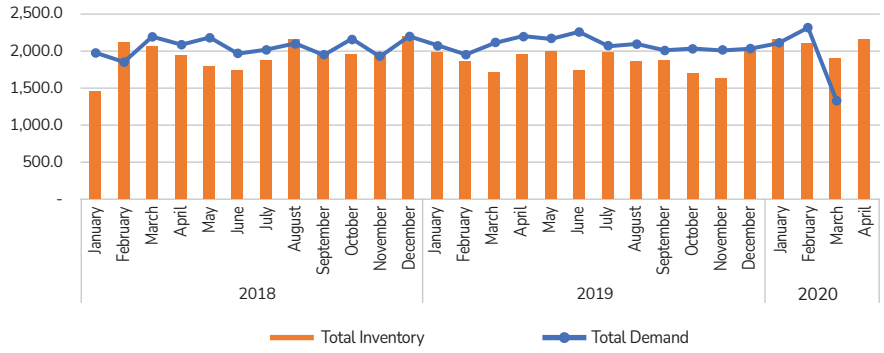
demand per month, followed by the commercial sector with 20% share, industry with 13% share and the rest are contributed by AFF, power, and non-energy (oil used as raw materials in manufacturing processes) *(Figure 4)*. Industry and AFF sectors registered reduced consumption of oil in 2019 vis-à-vis 2018, while the other sectors showed increased consumption, particularly in the transport sector, during the same period.

Figure 5: **Total Oil Demand, by Industrial Classification (million liters)**



In terms of inventory, the DOE ensures that the oil players comply with the Minimum Inventory Requirement (MIR), which are as follows: - a combination of a 30-day supply of crude oil and finished product for refiners; 15-day supply of finished products for oil importers and 7-day supply for LPG importers. Looking at the trend of inventory vis-à-vis demand from January 2018 to 20 April 2020 *(Figure 5)*, it is evident that oil companies are compliant with the above regulation. However, **it is notable that the depressed demand seen in March 2020 translates to an increase in inventory levels of April 2020 vis-à-vis March 2020**, which may indicate that some portion of the import volume for Q1 2020 became an addition to stocks that are stored in storage facilities (oil depots).

Figure 5: **Total Demand vs Total Inventory of Petroleum Products (million liters)**



Energy Brief:
Analyzing the Relationship between Peak Demand and Maximum Temperatures
(As of May 2020)

Using ordinary least squares (OLS) regression of the log-transformations of peak demand and maximum temperature elasticity of peak demand vis-à-vis maximum temperatures of 0.7% each for Luzon and Visayas, and 0.5% for Mindanao. These values imply that peak demand responds positively to proportionate changes in maximum temperature. Moreover, maximum temperatures account for around 18% and 21% of the variability in peak demand for Luzon and Visayas, respectively, while only 7% of peak demand variability in Mindanao. Restrictions in major economic activities due to the Luzon-wide enhanced community quarantine (ECQ) caused peak demand to drop by around 20% in March – April 2020, which contributed to the volatility in peak demand levels. However, if the ECQ period were to be excluded, maximum temperatures account for around 30% of the variability in the Luzon grid alone.

I. Rationale / Background

Studies showed how energy demand is driven by weather and a variety of socio-economic factors[2]. One of this is the paper published by the Fondazione Eni Enrico Mattei[3], which pointed out that the link between temperature and energy demand is easily verifiable. Increasing temperature, particularly in summer, affects energy demand in two (2) ways – it lowers energy demand needed for heating purposes, while more energy (in particular, electricity) will be needed to run air conditioners and other cooling devices, while converse holds during winter season. As such, the seasonal pattern of energy and electricity consumption typically exhibits two peaks, in winter and summer, with the summer peak becoming progressively higher in many countries, in recent years. This suggests that temperature interplays with other factors, like income, since the demand for air conditioners has a relatively high-income elasticity, and different income elasticities are also associated with different fuels[4]. Apart from temperatures, the dynamics of energy demand involves the concept that the timing of energy demand is determined by the way practices are ordered in time – or what we can call as patterns of consumption that result in variability in peak demand for weekdays, weekends and holidays. For example, temperatures and other factors may be the same at any given time, and that the substantial change between weekday and weekend is in terms of people's activities.

In the Philippines, peak power periods in Luzon normally occur in April and May, with the rising temperatures, prompting a spike in demand. Specifically, the highest demand for power occurs between 10:00 am to 2:00 pm. The reason for this is that economic activities using electricity have already started; also, at noontime commercial offices which use most of the electricity have their lunch break at noontime, hence lesser electricity used.

Patterns of energy consumption result in variability in peak demand for weekdays, weekends and holidays.

[2] The role of temperature in the variability and extremes of electricity and gas demand in Great Britain https://iopscience.iop.org/article/10.1088/1748-9326/11/11/114015#erlaa46b7s1

[3] A nonprofit, nonpartisan research institution devoted to the study of sustainable development and global governance located in Milan, Italy

[4] De Cian, et. Al "The Impact of Temperature Change on Energy Demand: A Dynamic Panel Analysis", Fondazione Eni Enrico Mattei

II. Available Data

This briefer analyzes the relationship between peak demand and maximum temperatures in the country's main grids (Luzon, Visayas and Mindanao) using peak demand from the National Grid Corporation of the Philippines (NGCP) and maximum temperatures from DOST-PAGASA specified as follows:

1. Daily Hourly Load, in mega-watt (MW): January 2018 – March 2020 for Visayas and Mindanao; until April 2020 for Luzon
2. Daily Peak Load, in mega-watt (MW): January 2018 – March 2020 for Visayas and Mindanao; until April 2020 for Luzon
3. Daily Maximum Temperatures (in Celsius degree): January 2018 to April 2020 for Science Garden, Quezon City (Luzon), Mactan International Airport, Cebu (Visayas) and Davao City (Mindanao)

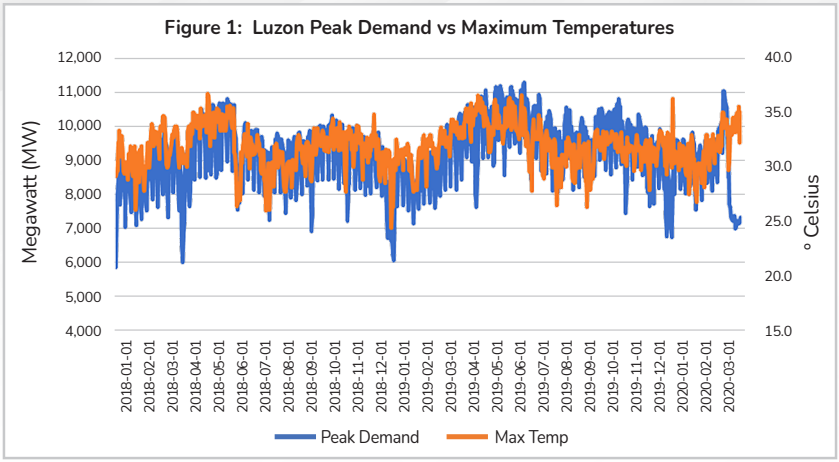
III. Methodology, Statistics and Applications Used

The study uses descriptive statistics and Pearson's correlation coefficient to analyze the relationship between peak demand and maximum temperatures while Ordinary Least Squares (OLS) Regression determines the impact of the temperature on the electricity demand pattern with the use of MS Excel Data Analysis and MATLAB tools.

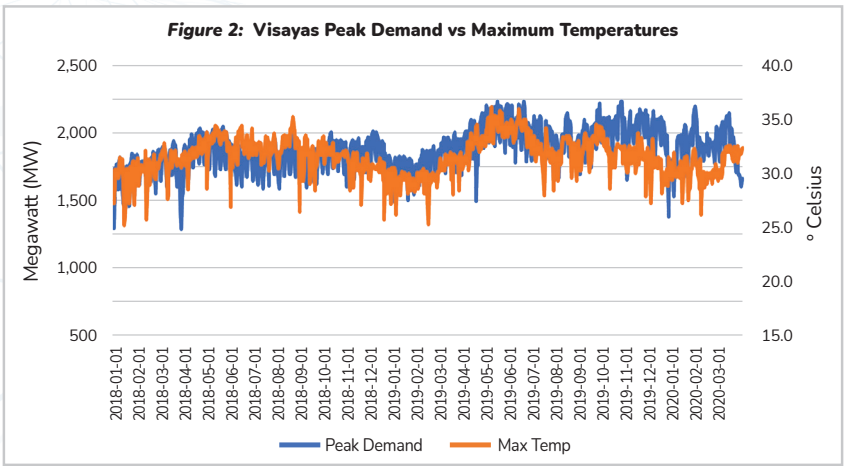
IV. Empirical Results

Based on matched data of peak demand and temperatures (January 2018 to March 2020) for Luzon, Visayas and Mindanao, the following trends were evident:

The highest peak demand registered in the Luzon grid was 11,301 MW on 2:00 PM of Friday, 21 June 2019, which is consequently the summer solstice or longest day of 2019. The maximum temperature for the same day was 35.4° Celsius around 12:00 noon. On the other hand, the hottest day was recorded on Thursday, 02 May 2018, as temperatures rose to 36.8° during the middle of the day, as electricity demand peaked at 10,571 MW around 2:00 PM *(Figure 1)*.

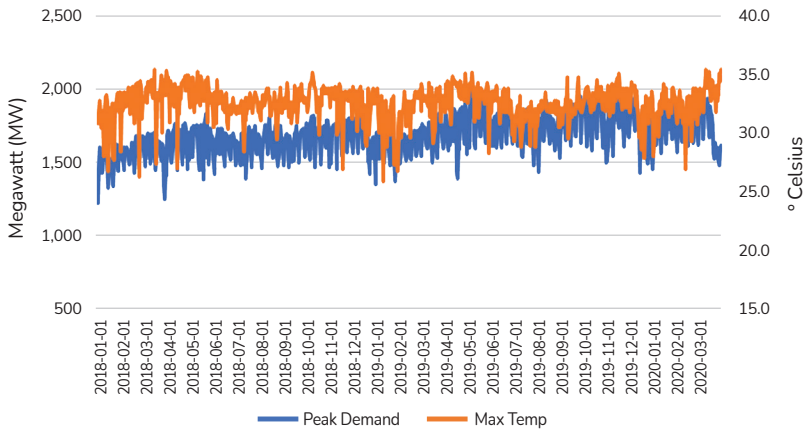


The Visayas grid coincident peak demand registered at 2,224 MW on Thursday, 16 May 2019 and on 25 October 2019, that took place both at 2:00 PM with the maximum temperature reaching 35.7° Celsius at around lunchtime. Meanwhile, its highest maximum temperature was 36° Celsius on Wednesday, 08 May 2019 at around noontime, with a peak demand of 2, 175 MW *(Figure 2)*. The region celebrates other historical and vibrant festivals every May, a summer season and the height of domestic tourism.



The Mindanao coincident peak demand was reported at 2:00 PM on 08 May 2019 with 2,013 MW coinciding with a maximum temperature of 35.4° Celsius. The area's highest maximum temperature of 35.7° Celsius occurred on 16 March 2018 along with a peak demand of 1,718 MW *(Figure 3)*.

Figure 3: **Mindanao Peak Demand vs Maximum Temperatures**



Summary statistics *(Table 1)* likewise point to the following:

- The average peak demand for Luzon was 9,267 MW, 1,903 MW for the Visayas and 1,704 MW for Mindanao. The average maximum temperatures were 32.0° Celsius for Luzon, 31.8° Celsius for the Visayas and 32.7° Celsius for Mindanao.

Luzon's temperature varies more than Visayas and Mindanao. This may be the case since Baguio and other locations up north are experiencing extremely low or high temperatures across the year.

- Luzon grid has the highest variability in daily peak demand with a standard deviation of 969 MW or about seven (7) times the variability of the Visayas and Mindanao grid. Luzon seats at the economic hub of the country, it also has diversified users of electricity (i.e. low income to high income cities and provinces) with different consumption patterns vis-à-vis other grids and in part, due to its geographical size.

Summary Statistics	Peak Demand			Maximum Temperatures		
	Luzon	Visayas	Mindanao	Luzon	Visayas	Mindanao
Mean	9,267	1,903	1,704	32.0	31.8	32.7
Median	9,423	1,906	1,706	32.0	31.9	33.0
Mode	10,288	1,834	1,765	32.0	32.0	33.0
Standard Deviation	969	145	133	2.0	1.6	1.5
Minimum	5,889	1,363	1,230	24.5	26.1	26.0
Maximum	11,301	2,224	2,013	36.8	36.0	35.7
No. of Observations	821	821	821	821	821	821

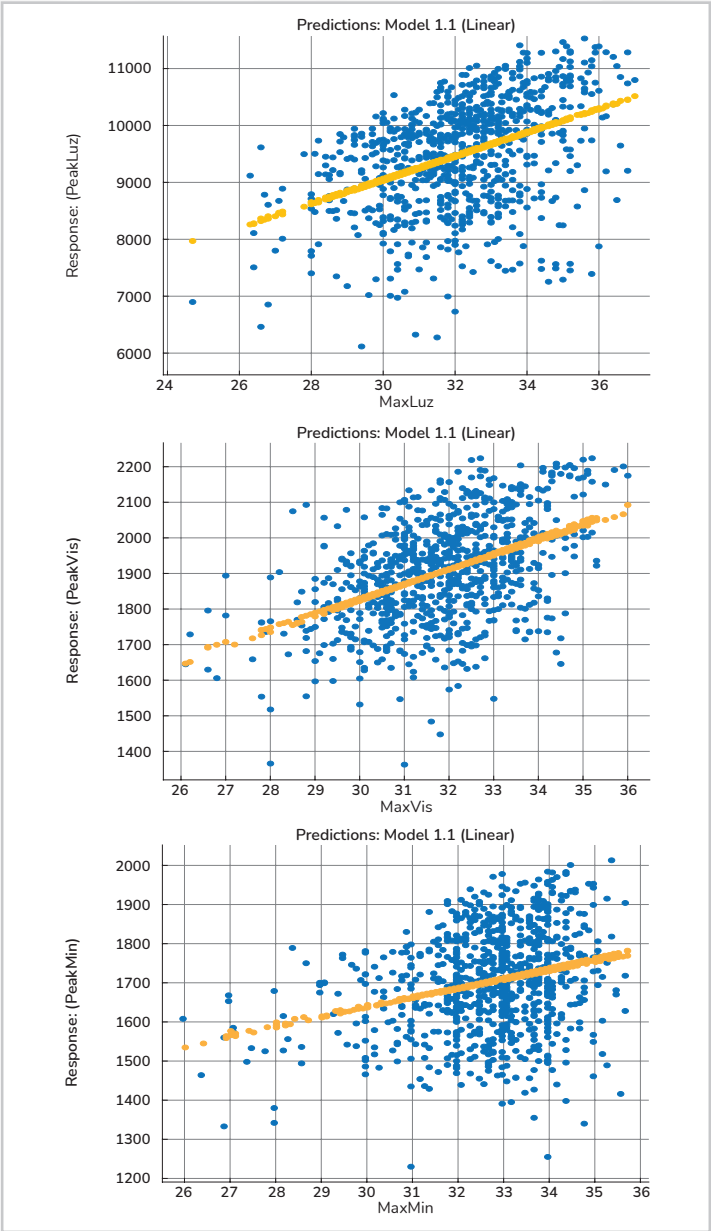
Table 1. Summary Statistics for Peak Demand (MW) and Maximum Temperatures (°C)

Correlation values between peak demand and maximum temperature point to a positive but moderate relationship for Luzon and Visayas, while a positive but weak relationship for Mindanao *(Table 2)*. Since the associated probability value (p-value) for each pairing is less than the significance level of 0.05, this leads to the rejection of the null hypothesis that no correlation exists between peak demand and maximum temperature. This also implies that as maximum temperature increases, peak demand also tends to increase. This linear relationship is easily seen in the scatterplot of peak demand versus maximum temperatures *(Figure 4)*.

	Correlation	
	Rho	P-Value
2018	0.419	0.000
2019	0.462	0.000
2020	0.269	0.000

Table 2. Correlation for Maximum Temperature vs Peak Demand

Figure 4: Luzon, Visayas and Mindanao: Level Regression Plots of Actual (blue) vs Predicted (yellow)



The scatterplot of peak demand vs maximum temperatures in Luzon, Visayas and Mindanao easily show the positive linear relationship between these variables.

A simple OLS with peak demand as the dependent variable and maximum temperature as the independent variable likewise confirms the positive correlation between these two (2) variables *(Table 3a and 3b)*. **The adjusted R^2 of around 18% and 21% represents the amount of variability in peak demand for Luzon and Visayas, respectively, that can be attributed to changes in maximum temperatures, while only 7% of peak demand variability in Mindanao** is caused by changes in maximum temperatures. However, if the ECQ period were to be excluded, maximum temperatures account for **around 30% of the variability in the Luzon grid alone** *(Table 3c)*.

	Luzon		Visayas		Mindanao	
	Stat	P-Value	Stat	P-Value	Stat	P-Value
Multiple R	0.219		0.462		0.269	
R Square	0.176		0.214		0.072	
Adjusted R Square	0.175		0.213		0.071	
Standard Error	879.288		128.347		127.878	
Observations	821		821		821	
ANOVA F	174.85	0.0000	223.11	0.0000	63.74	0.0000
Coefficients						
Intercept	2,619.01	0.0000	560.02	0.0000	917.58	0.0000
Max Temp	207.99	0.0000	42.23	0.0000	24.01	0.0000

Table 3a. **Regression Statistics for Maximum Temperature vs Peak Demand (Level)**

	Luzon		Visayas		Mindanao	
	Stat	P-Value	Stat	P-Value	Stat	P-Value
Multiple R	0.405		0.456		0.266	
R Square	0.164		0.208		0.071	
Adjusted R Square	0.163		0.207		0.070	
Standard Error	0.043		0.030		0.033	
Observations	821		821		821	
ANOVA F	160.90	0.0000	215.29	0.0000	62.56	0.0000
Coefficients						
Intercept	2.893	0.0000	2.231	0.0000	2.550	0.0000
Max Temp	0.713	0.0000	0.697	0.0000	0.449	0.0000

Table 3b. **Regression Statistics for Maximum Temperature vs Peak Demand: Log-Log**

	Luzon		Visayas		Mindanao	
	Stat	P-Value	Stat	P-Value	Stat	P-Value
Multiple R	0.405		0.456		0.266	
R Square	0.164		0.208		0.071	
Adjusted R Square	0.163		0.207		0.070	
Standard Error	0.043		0.030		0.033	
Observations	821		821		821	
ANOVA F	160.90	0.0000	215.29	0.0000	62.56	0.0000
Coefficients						
Intercept	2.893	0.0000	2.231	0.0000	2.550	0.0000
Max Temp	0.713	0.0000	0.697	0.0000	0.449	0.0000

Table 3c. **Regression Statistics for Maximum Temperature vs Peak Demand, January 2018-June 2019**

The maximum temperature as a predictor variable is likewise significant for all grids. The regression equation and coefficients are as follows:

Equation 1:
LUZ_PEAK DEMAND=2,619+ 207.99*LUZ_MAXTEMP

This means that for every 1°C increase in maximum temperature, peak demand increases by 208 MW.

Equation 2:
LOG (LUZ_PEAK DEMAND) = 2.527 + 0.713*LOG(LUZ_MAXTEMP)

Alternatively, Equation 2 tells us that for every 1% increase in maximum temperature, peak demand in Luzon increases by 0.71%.

Equation 3:
VIS_PEAK DEMAND = 560 + 42.23*VIS_MAXTEMP

Equations 3 means that for every 1°C increase in maximum temperature, peak demand in Visayas increases by 42 MW.

Equation 4:
LOG (VIS_EAK DEMAND)= 2.231 + 0.697*LOG(VIS_AXTEMP)

Alternatively, Equation 4 implies that for every 1% increase in maximum temperature, peak demand in Visayas increases by 0.70%.

Equation 5:
MIN_PEAK DEMAND = 917.58 + 24.01*MIN_MAXTEMP

Equation 5 means that for every 1°C increase in maximum temperature, peak demand in Mindanao increases by 24 MW.

Equation 6:
MIN_PEAK DEMAND = 917.58 + 24.01*MIN_MAXTEMP

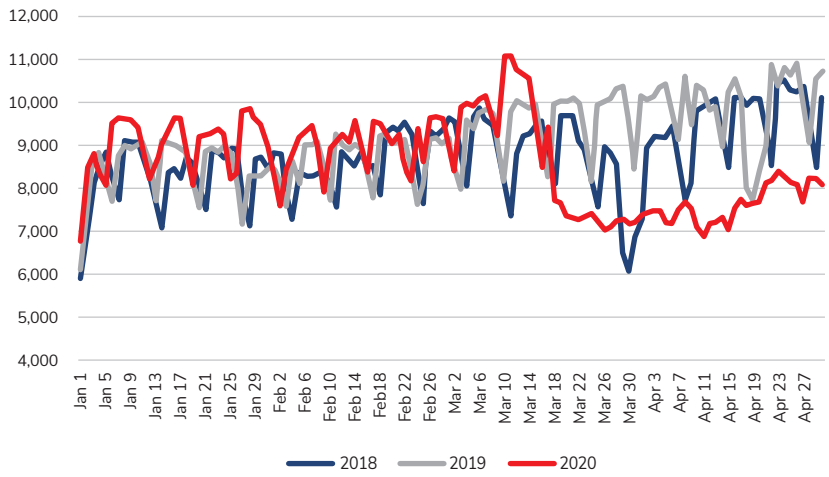
In Equation 6, it shows that for every 1% increase in maximum temperature, peak demand in Mindanao increases by 0.45%.

Note that the log-regression gives us the elasticity of peak demand vis-à-vis maximum temperatures. Values obtained indicate that ***peak demand responds positively to proportionate changes in maximum temperature****.*

Regression analysis was likewise conducted to closely inspect the Luzon grid's peak demand and its maximum temperature for the period **January to April for 2018, 2019 and 2020**. This was done in oder to determine if the Luzon-wide enhanced community quarantine (ECQ) affected the long-run positive linear correlation between the two (2) variables. The results show the following:

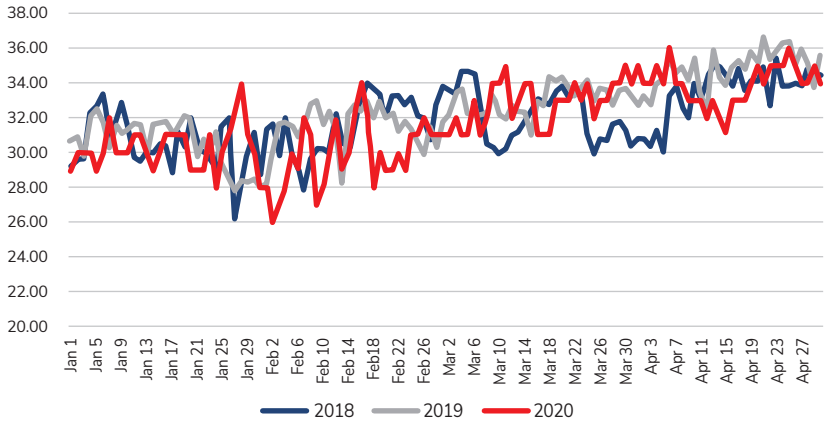
- Highest peak demands occurred on 24 April 2018 at 10,511 MW, 26 April 2019 at 10,898 MW and 10 March 2020 at 11,050 MW. The highest peak demand for 2020 occurred prior to the implementation of the Luzon-wide enhanced community quarantine (ECQ), which brought down demand levels by an average of 22% since March 15, 2020 *(Figure 6). This would mean that other factors aside from temperature impact peak demand particularly the pattern of consumption.*

Figure 6: **Peak Demand (MW): Jan to Apr 2018-2020**



- In terms of maximum temperatures, the increasing trend from January to April is preserved from 2018 to 2020. However, the early summer rains contributed to the reduction in temperatures during the first two (2) weeks of April 2020, before ascending to impact its 2018-2019 levels moving towards May. The hottest days occurred on 23 April 2018 (35.4° Celsius), 21 April 2019 (36.6° Celsius) and 06 April 2020 (36.0° Celsius) *(Figure 7)*.

Figure 7: **Maximum Temperatures (Celsius): Jan to Apr 2018-2020**



Summary statistics show that peak demand for January-April 2020 has become more volatile compared to 2018 and 2019 as consumption patterns were affected by the ECQ. However, 2020 has the highest modal peak demand, which implies that level-wise, **peak demand would have trended higher compared to previous years if not for the restrictions on business and movement due to COVID19** *(Table 4)*.

Summary Statistics	Peak Demand (MW)			Maximum Temperatures (Celsius)		
	2018	2019	2020	2018	2019	2020
Mean	8,753	9,133	8,573	31.9	32.5	31.7
Median	8,816	9,034	8,516	32.0	32.3	32.0
Mode	8,816	10,553	11,050	33.8	33.0	31.0
Standard Deviation	918.3	920.8	1,034.2	1.9	2.0	2.2
Minimum	5,889	6,097	6,780	26.2	27.8	26.0
Maximum	10,511	10,898	11,050	35.4	36.6	36.0
Count	120	120	120	120	120	120

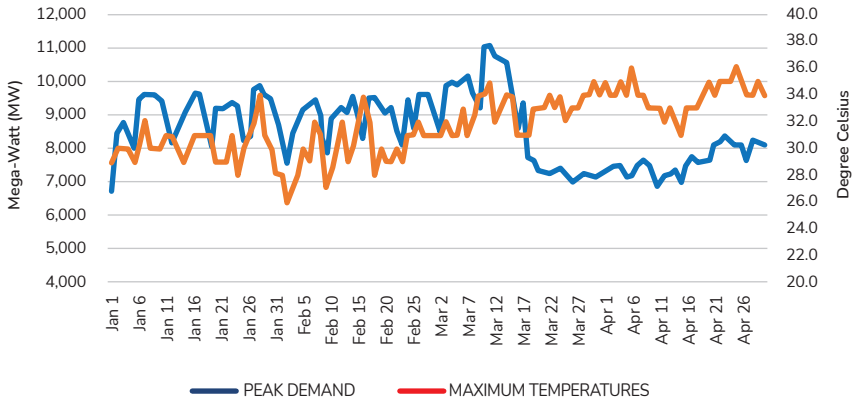
Table 4. **Summary Statistics for Peak Demand and Maximum Temperature in Luzon: January to April 2018, 2019 and 2020**

The effect of the ECQ is largely felt in the correlation coefficients for maximum temperatures and peak demand *(Table 4)*. Correlation coefficients 2018 and 2019 point to a moderate positive relationship (Rho > 0.5), higher than its value from the longer series (January 2018-April 2020), as one variable increases, the other also tends to increase. However, for 2020, the correlation coefficient is negative 0.287 – a negative and low degree of relationship between the variables, albeit still significant. This disjoint relationship is evident in Figure 8, implying that while maximum temperatures are increasing, peak demand is declining *(Figure 8)*.

	Correlation	
	Rho	P-Value
2018	0.594	0.000
2019	0.550	0.000
2020	-0.287	0.002

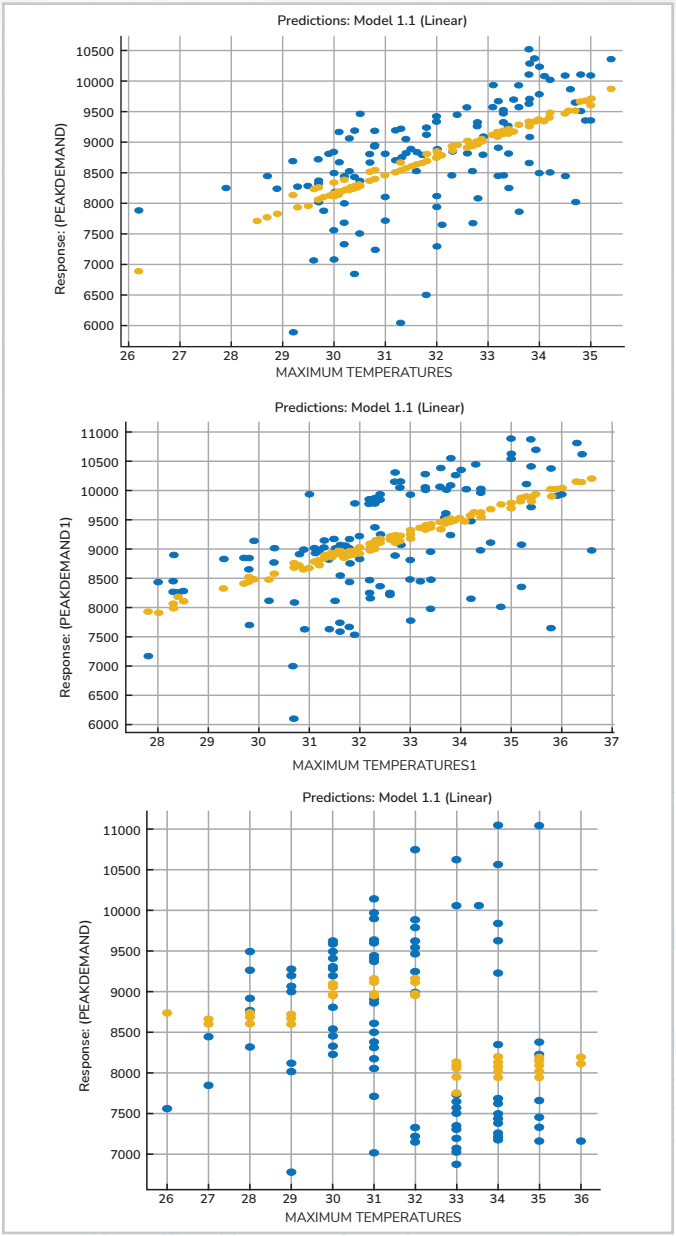
Table 5. **Correlation for Maximum Temperature vs Peak Demand, Jan-Apr 2018-2020**

Figure 8: **Peak Demand vs Maximum Temperature**



The reduction in peak demand due to ECQ affected its positive linear relationship with maximum temperature in contrast to 2018 and 2019. This is easily verifiable from the scatterplot of maximum temperatures versus peak demand *(Figure 9)*.

Figure 9: **2018, 2019 and 2020: Scatterplot of Actual (blue) vs Predicted (yellow) Observations for Maximum Temperature vs Peak Demand**



The scatterplot of peak demand vs maximum temperatures in Luzon for 2020 vis-à-vis 2018 & 2019 shows the lack of positive linear relationship between variables due to impact of ECQ.

Moreover, regression coefficients for 2018 and 2019 point **to an increase in peak demand of around 295 MW and 255 MW, respectively, for every 1°C increase in maximum temperatures, or an increase of 1.1% and 0.89% for every 1% increase in maximum temperature.** ***But for 2020, the coefficient implies a reduction of 0.52% in peak demand for every 1% increase in maximum temperature*** *(Table 6)*. Since the OLS model is unfit for 2020, the Medium Tree model gives the lowest error measure based on fit (or the root mean square error, RMSE) at 994.71 vis-à-vis OLS's RMSE of 1,003.9.

	2018		2019		2020	
	Stat	P-Value	Stat	P-Value	Stat	P-Value
Multiple R	0.594		0.550		0.287	
R Square	0.353		0.302		0.083	
Adjusted R Square	0.347		0.296		0.075	
Standard Error	742.016		772.490		994.711	
Observations	120		120		120	
ANOVA F	64.25	0.0000	51.06	0.0000	10.63	0.0015
Coefficients						
Intercept	-648.2	0.6	858.9	0.5	12,844.5	0.0000
Max Temp	294.6	0.0	254.9	0.0	-134.7	0.0015

	2018		2019		2020	
	Stat	P-Value	Stat	P-Value	Stat	P-Value
Multiple R	0.568		0.532		0.300	
R Square	0.323		0.283		0.090	
Adjusted R Square	0.317		0.277		0.082	
Standard Error	0.039		0.038		0.050	
Observations	120		120		120	
ANOVA F	56.31	0.0000	46.50	0.0000	11.65	0.0009
Coefficients						
Intercept	2.339	0.000	2.615	0.000	4.702	0.000
Max Temp	1.065	0.000	0.889	0.000	-0.515	0.001

Table 6. **Regression Statistics for Maximum Temperature vs Peak Demand, Jan-Apr 2018, 2019 and 2020, Level *(upper)* and Log *(lower)***

V. Key Take-Aways

1. At **normal** condition, **maximum temperatures and peak demand** exhibit a **positive long-run and moderate linear relationship**. Significant shocks and phenomena, such as COVID-19, affects this assertion.

2. One can assume as peak demand returns to its pre-ECQ levels, the **long-run** linear relationship, and thus regression models, for maximum temperature and peak demand will remain valid. For this case, the period of ECQ will be treated as an **outlier**. It can be done as a separate case for Jan to June 2020. The findings can be used once economic operations can be normalized.

3. Univariate regression model, which means that the only predictor variable is maximum temperature, can be **expanded** to include other climate and socio-economic data to capture at least 90% of the variability in peak demand. These may include relative humidity, solar radiation, wind-speed and other derived variables, energy prices, consumer behavior, income, gross domestic product (GDP), manufacturing, population and building characteristics[5].

VI. Policy Implications and Recommendations

1. **Consider the impact of temperature in the peak demand projections.** The positive and moderate linear relationship of maximum temperatures and peak demands is likely to mitigate the risk or the uncertainty of the demand estimates.

2. **Adopt time of use for those sectors with tendency to spike their demand through efficient utilization of energy.** With ECQ, consumption pattern shows that it has a significant role in the demand trends.

[5] The role of temperature in the variability and extremes of electricity and gas demand in Great Britain https://iopscience.iop.org/article/10.1088/1748-9326/11/11/114015#erlaa46b7s1

3. **Use the long-run relationship without the impact of the pandemic for a normal economic condition** as the demand trend is expected to revert to its previous shape.

Energy Brief:
Analyzing the Impact of the One-Month Shutdown of Petron and Shell Refineries
(As of May 2020)

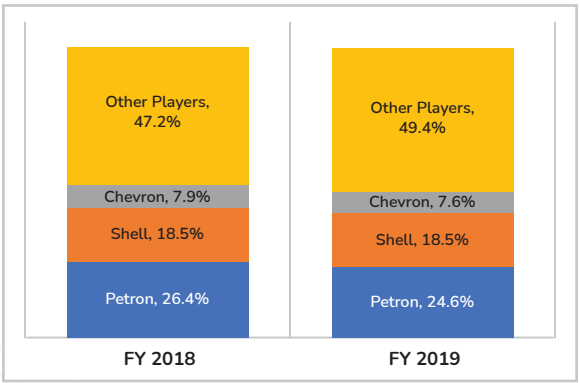
This Energy Brief seeks to analyze the potential impact of the one-month refinery shutdown of Petron and Shell for the months of May to June 2020 on the downstream oil industry's refinery production, product demand, inventory, and its ensuing effect on consumers.

I. Rationale

The Pilipinas Shell Petroleum Corp (PSPC) announced a month-long shutdown of its Tabangao refinery starting from mid-May to avoid any potential losses due to the drastic decline in local product demand that led to a drop-in refining margins during the ECQ.[6] In the same period, Petron will be on a maintenance shutdown. Petron and PSPC guaranteed that there will be no supply disruption during the refinery shutdown by complying with the government's minimum inventory requirement and by importing refined products, if necessary. The refineries will retain their flexibility to do a start-up immediately when the market and demand conditions improve and stabilize.

II. Market Shares

Figure 1: **"Big 3" Oil Companies Market Share, 2018-2019**



The Philippines' downstream oil industry has been traditionally dominated by the "Big Three" oil companies namely Petron, Shell, and Chevron[7]. FY 2018 and 2019 market shares show that oil majors accounted for more than 50% of the market *(Figure 1)*, with Petron Corporation leading with close to one-fourth shares, followed by PSPC and Chevron Philippines. In recent years, the emergence of new oil players had contributed to declining shares of oil majors[8].

Presently, there are only two (2) operational refineries – Petron's Limay, Bataan plant with a production capacity of 180,000 barrels per day and expected to increase to 270,000 to 300,000 barrels per day. The company

[6] https://www.reuters.com/article/us-health-coronavirus-philippines-pilipi/shells-philippines-unit-to-suspend-refinery-operations-for-one-month-idUSKBN22H048

[7] https://business.mb.com.ph/2019/01/01/big-3-oil-firms-sustain-market-leadership/

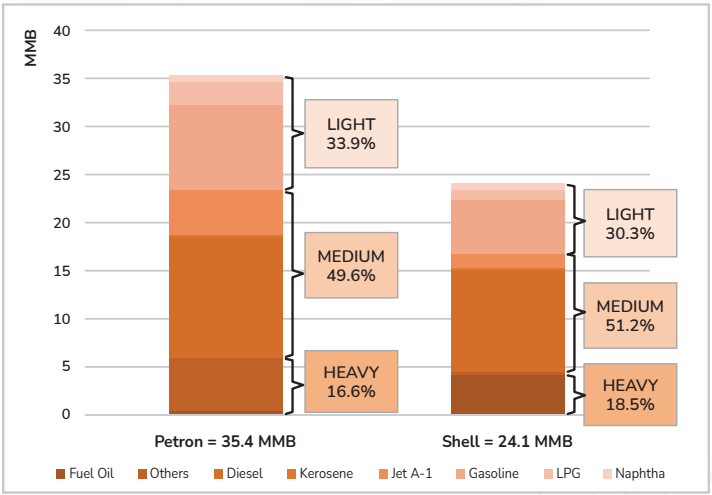
[8] DOE-Oil Industry Management Bureau (OIMB) Comprehensive Report FY 2018 and FY 2019

accounts for around 60% of the total refinery output and has the largest network of service stations nationwide[9]. Next to Petron is PSPC's refinery in Tabangao, Batangas with a capacity of 110,000 barrels per day[10].

III. Refinery Production

In 2019, the combined refining output from the country's two (2) refineries reached 61.2 million barrels of oil (MMB), a sharp decline of 29.3%, from its year-ago level of 86.6 MMB *(Figure 2)*.

Figure 2: **2019 Total Marketable Products, in MMB. Petron vs Shell**



As such, the level of total marketable products posted a double-digit reduction of 30.8% from 89.0 MM in 2018 to 59.5 MMB in 2019. The reduction is attributable to Petron's maintenance shutdown from April to August 2019 as its refinery suffered damages from the 6.1 magnitude earthquake in Central Luzon provinces. Despite its 5-month shutdown, Petron accounted 59.5 % vis-à-vis PSC's 40.5 % of the total marketable products for 2019.

Petron's average monthly refinery production is 3.0 MMB for 2019, while that of PSPC is at 2.0 MMB *(Table 1)*.

[9] Petron Corporation's "A Force for Change" 2018 Annual Report

[10] PSPC Financial Report FY 2019

	2019		January – April			
	Full Year	Monthly Average	2019	Monthly* Average	2020**	Monthly** Average
Petron	35.4	3.0	13.4	3.4	13.9	3.7
Shell	24.1	2.0	8.3	2.1	8.8	2.2
Total	59.5	5.0	21.7	5.5	22.7	5.7

*based on January to April only
**estimated based on refinery shares for Jan-March 2020

Table 1. **Refinery Production by Company (in MMB)**

Meanwhile, the latest available data on refinery production for January to April 2020 for the total oil industry points to a 9.9% reduction to 22.7 MMB compared to January-April 2019 level of 21.7 MMB. This is attributable to the depressed demand for oil products as public transportation and movement of people remain restricted or limited under the continuing community quarantine (enhanced, modified, and general).

> *Based on 2019 data, January to April cumulative level represents around 42% of the full-year refinery production.*

Petron and Shell's refinery capacity for 2019 was at 180 MBSD and 105 MBSD, respectively. Petron holds the bulk of the January to April 2020 refinery production, estimated at 13.9 MMB vis-à-vis Shell's 8.8 MMB. This also puts Petron's average monthly refinery production to 3.7 MMB against Shell's 2.2 MMB for the same period.

Hence, the refineries' one (1) month shutdown will entail volume loss of approximately 5.7 MMB or around 9.6 % of the full-year refinery production output (based on FY 2019 level). This volume may be significant at the industry level but can be met by the required inventories, excluding petroleum supply from crude stock/inventory.

We also assumed that Petron and PSPC would have prepared their stock/inventory levels and adjusted their importations to compensate for the 5.7 MMB "loss" in refinery production. Moreover, we expect the product demand to remain at levels lower than 2019 due to restrictions under community quarantines.

IV. Demand vs. Inventory

The estimated total product demand for the 2nd quarter of 2020 is at 30.6 MMB, lower than its 1Q 2020 demand as public transportation is still restricted until June 2020. Given the estimated total product demand, total industry inventory as of 18 May 2020 at 13.3 MMB. Of this value, the combined inventories of Petron and PSPC in the same period accounted for 30.5% of the total inventory. The product inventory, if maintained up to the operation of the full capacity of the two refineries, could supply the one-month demand of the country *(Table 2)*.

Product Type	Total Industry Demand (MMB)						Inventory (MMB) *as of 18 May 2020*	
	1Q 2020*	Average Monthly*	2Q 2020**	Average Monthly**	3Q 2020**	Average Monthly**	Total Industry	Petron and PSPC
Diesel	13.97	4.66	11.90	3.97	15.53	5.18	6.03	1.99
Gasoline	8.73	2.91	7.96	2.65	9.59	3.20	3.89	1.19
Kerosene	0.12	0.04	0.12	0.04	0.13	0.04	0.06	0.03
LPG	4.72	1.57	5.13	1.71	5.00	1.67	1.18	0.13
Jet A1 / Avturbo	3.70	1.23	2.94	0.98	2.89	0.96	0.09	0.47
Fuel Oil	1.89	0.63	1.43	0.48	1.72	0.57	0.94	0.13
Others	1.26	0.42	1.15	0.38	1.80	0.60	1.04	0.09
Total	**34.40**	**11.47**	**30.63**	**10.21**	**36.66**	**12.22**	**13.23**	**4.03**
**actual; **estimated*								

Table 2. **Estimated 2Q and 3Q Demand vs. Inventory as of 18 May 2020**

V. Impact of Shell Shutdown to Refinery Production

Refineries shutdown starting mid-May to June (1 month) due to the following reason(s): lockdowns and COVID-19 pandemic that led to drastic low demand and losses of Shell[11]; and scheduling of maintenance shutdown of Petron as maybe also attributed to the reduced demand since it has been on shutdown for 5 months in 2019. The shutdown may lead to the following probable impacts and possible alternatives/solutions:

- No refinery production output during the shutdown period may be compensated by the inventory and product importation of all the players. Table 2 shows that total industry inventory as of

[11] https://oilprice.com/Latest-Energy-News/World-News/Shell-Halts-Philippines-Oil-Refinery-As-Demand-Collapses.html

18 May 2020 at 13.23 MMB provides at one-month supply[12] of finished petroleum products. Of the total, 30.5% is held by Petron and Shell before their scheduled shutdown.

- Oil prices may rise once ECQ is lifted in the transition to MECQ to GCQ (new normal), considering that the refineries have no production. This may signal a lack of supply which may lead to a price increase of petroleum products. Three days after the announcement of refinery shutdown came a news advisory on 16 May 2020 says there will be an oil price hike effective 19 May 2020 (Tuesday) on the following fuels and estimates:

Fuel	Estimates on ↑ per liter*
Gasoline	P 1.40-1.60
Diesel	P 0.50-0.70
Kerosene	P 2.30-2.50

- National Capital Region's Modified Enhanced Community Quarantine (MECQ) is expected to end on 31 May. NCR has a dense population and congested roads. By 01 June it is expected that all cities of the country will shift to General Community Quarantine (GCQ) where 70% of the workforce in permitted/ allowed sectors will be open and this will lead to high demand for oil – not just in highly urbanized cities, but across the areas of the country[13].

- By the second week of June, we expect the refineries to be on their normal operations, ensuring that their operations will be back to normal once the economic situation eases.

- The country's current maximum working crude distillation capacity is 285.2 thousand barrels per stream day (MBSD)[14] implies a strong performance before the shutdown and dependability of the refineries from January to April, which could mitigate the impact of one-month economic shutdowns in mid-May to mid-June 2020.

- With this, we expect Petron and PSPC's total country petroleum product imports to rise much higher than FY 2019, with their assurance of maintaining their inventories of refined petroleum products equivalent to 30 days' supply[15] by importing, if necessary.

[12] https://news.abs-cbn.com/business/05/16/20/oil-price-hike-sasalubong-sa-mga-motorista-sa-pagluwag-ng-lockdown-sa-ilang-lugar

[13] https://news.mb.com.ph/2020/05/14/entire-ph-under-gcq-effective-may-16-except-for-ncr-laguna-cebu-city/

[14] OIMB, Oil Situationer 2019

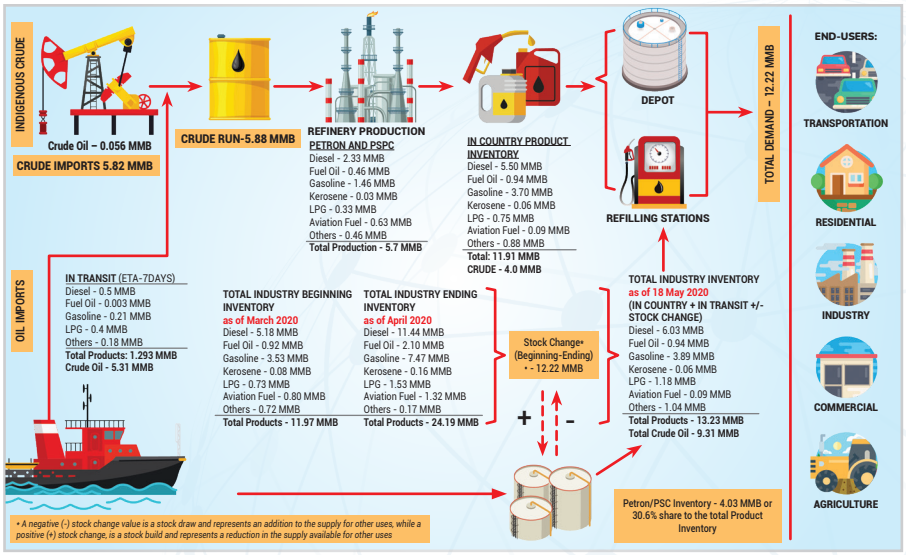
[15] DC No. 2003-01-001 under EO 134

VI. Conclusions

Figure 3 exhibits the summary of average one-month oil supply chain with the actual inventories as of 18 May 2020. Based on the oil supply chain, we can conclude the following:

- The estimated average monthly refinery production from Petron and PSPC of 5.7 MMB covers 47% of the average monthly demand for petroleum products in the country.
- The product inventory as 18 May 2020 could supply one month's demand in the country. Petron and PSPC cover 30.5% of the total product inventory.
- The resumption of operation of the refineries will take 6-10 days to produce products. Total crude inventories at 9.31 MB as of 18 May 2020 will sustain about three-fourths of the average monthly demand of the country.
- The Assessment of COVID-19 Impact in the Energy Sector expects the demand for petroleum products to be lower than the previous year's demand due to restrictions under community quarantines and the new normal scheme to combat the COVID-19 pandemic.
- Thus, we expect no supply disruption if we sustain the current product inventory till mid-June 2020, along with the in-transit deliveries reaching the country within the allotted time of arrival.

Figure 3: **One-month Oil Supply Chain**



VII. Recommendations

The DOE needs to closely monitor the:

(1) Compliance of oil companies with the government's Minimum Inventory Requirement (MIR) during the shutdown period.

(2) Resumption of refineries operation should be ensured at mid-June 2020 as declared.

(3) Coordination with the Bureau of Customs to prioritize the processing of import documents for refined petroleum products.

Given the significant contribution of the refineries to the country's petroleum demand, the DOE needs to ensure that there is available supply by closely monitoring the compliance of companies, resumption of operation of refineries and coordination with the Bureau of Customs (BOC).

DOE may also need to consider increasing the minimum required inventory for petroleum products to sustain the supply during disruptions, i.e., refinery shutdowns, necessary considering the current capacity of oil depots.

For long-term mitigation, DOE needs to look at the possibility of putting up Strategic Petroleum Reserves (SPR) in the country. However, given the current situation on the refineries, it may also be necessary to look at stockpiling of refined products other than crude oil.

Three days after the declared economic shutdown of the refineries came the announcement of the pump price hike. Although, this brief did not look at the deeper analysis of the impact of shutdowns on prices, it may be necessary for the DOE to continue monitoring the price of petroleum products as the announcement may be an avenue to signal price increases, which may motion a lack of supply.

Energy Brief:
Assessment of the 10% Tariff Increase under EO 113 on Domestic Pump Prices

This energy brief looks at the empirical evidence on the behavior of oil international prices and its corresponding domestic prices to determine if the tariff would stay longer than expected. While oil companies placed the price adjustment for gasoline with the additional 10% tariff at Php 1.6 per liter, the estimated adjustment with inclusion of 12% VAT is approximately Php 1.3 per liter – slightly less than estimated price adjustment. When Dubai crude prices reach the ceiling of US$64 per barrel (trigger price at which tariff reverts to zero), the pump price of gasoline reaches PhP74.42 per liter. This energy brief was prepared by the Policy Formulation and Research Division – Energy Policy and Planning Bureau (PFRD-EPPB), in cooperation with the Oil Industry Management Bureau (OIMB).

I. Introduction

President Duterte signed on 02 May 2020 the Executive Order No. 113 series of 2020 entitled, "Temporarily Modifying the Rates of Import Duty on Crude Petroleum Oil and Refined Petroleum Products under Section 1611 Of Republic Act No. 10863, otherwise known as the Customs Modernization and Tariff Act", to help finance government programs addressing the COVID19 pandemic. EO 113 provides a temporary additional 10% import duty, on top of the existing Most Favoured Nation (MFN) and preferential import duties levied on crude and refined petroleum products regardless of country of origin. This will remain in force until Republic Act 11469 or the Bayanihan to Heal as One Act, is in effect or upon reversion of the modified rates of import duty to 0% pursuant to EO 113, whichever is earlier. The 10% tariff reverts to 0% when it reaches a trigger price in the international market identified under the EO 113 implementing guidelines duly certified by the Department of Energy (DOE) and Department of Finance (DOF) notified. This will be implemented by Bureau of Customs (BOC) by issuing a corresponding a memorandum ordering the effect of the reversion.

This Energy Brief provides clarifications to some of the salient points of EO 113, as follows:

- When to impose the tariff increase?
- When is the additional tax lifted?
- What is the impact of EO 113 on domestic pump prices?

This energy brief looks at the empirical evidence on the behavior of oil international prices and its corresponding domestic prices to determine if the tariff would stay longer than expected.

II. When to impose the tariff increase?

The imposition of the new round of tariff increases under EO 113 will take place as inventory is depleted from the time of cut-off. The depletion of product inventory depends on product demand. Under the normal (pre-COVID19) situation, inventory of diesel is usually depleted after 15 to 25 days, while gasoline inventory is exhausted after 15 to 30 days. However, due to depressed demand, there is excess days' supply of both products in the domestic oil market.

Several oil companies have already notified the OIMB of its scheduled price adjustments in its petroleum products as early as June 17, 2020 *(Table 1)* to reflect the increase in tariff effective per effectivity date. Meanwhile, *Table 2* details the days-supply of gasoline and diesel for two (2) major local refiners – Petron and Shell, based on average daily demand for March 2020. For Shell, stock level of gasoline and diesel as of 18 May were expected to be depleted after 40 days and 21 days, respectively, Hence, its scheduled price adjustment for diesel last 17 June 2020 signals fresh withdrawal from stocks after approximately 30 days; while it has not announced any price adjustment for gasoline. Meanwhile, Petron's days-supply of diesel for the same cut-off date is 33 days, with its pump prices adjusting by 20 June 2020 to reflect the 10% additional tariff.

Oil Company	Dates	Fuel	Estimated Tariff (Peso/Liter)	Remarks
Petron	20-Jun-20	Diesel	1.60	Different retail outlets are scheduled to implement tariff adjustment per indicated date
	21-Jun-20			
	22-Jun-20			
	23-Jun-20			
	24-Jun-20			
	25-Jun-20			
	26-Jun-20			
	28-Jun-20			
	30-Jun-20			
Shell	17-Jun-20	Diesel	1.45	
Caltex	20-Jul-20	Gasoline	1.61	
	25-Jul-20	Gasoline	1.57	
	28-Jul-20	Kerosene	1.56	
Phoenix	23-Jun-20	Diesel	1.23-1.48	
		Gasoline	1.23-1.31	

Table 1. **Schedule of Price Adjustment due to EO113 with estimated tariff as provided by oil companies to the DOE-OIMB**

Fuel	As of 18 May 2020 Inventory Days Supply		Earliest Price Adjustment		Amount of Adjustment (Peso/Liter)	
	Petron	Shell	Petron	Shell	Petron	Shell
Diesel	33.9	20.7	20-Jun-20	17-Jun-20	1.60	1.45
Gasoline	32.3	39.9				

Table 1. **Days-Supply and Schedule of Price Adjustments due to EO113 for Petron and Shell**

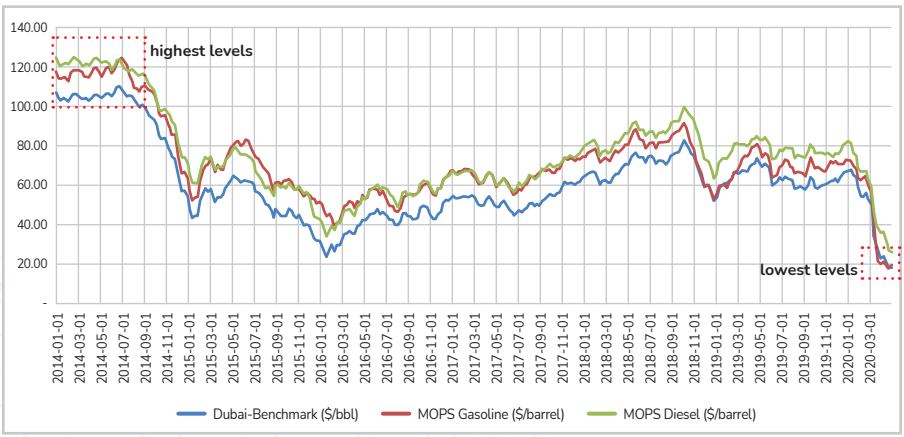
III. When is the additional tax lifted?

Under EO 113, 10% tariff reverts to 0% when: (1) the effectivity of RA 11469 ends or (2) Dubai crude price reaches a trigger price level that automatically signals the reversion to 0% import duty. The ceiling price for Dubai crude, currently pegged at US$64 per barrel, is the basis of the lifting of the 10% tariff on crude oil and petroleum products. Identifying the trigger prices leads to an imperative of analyzing the trends of international prices and domestic prices to look into the applicability of US$64 as the trigger price level.

International Crude vs. Product Prices

Weekly data from 01 January 2014 to 28 April 2020 (Figure 1) of Dubai benchmark crude price and Mean of Platts Singapore (MOPS) show the following trends:

Figure 1: Weekly International Prices, US$/barrel from 01 June 2014 to 28 April 2020



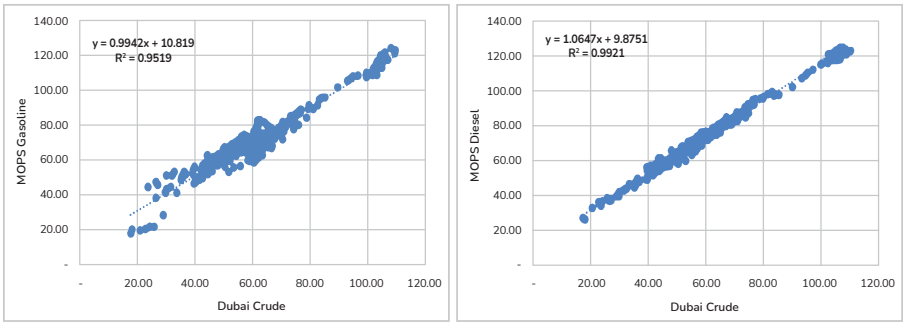
- The average prices per barrel for the period were US$61.5 for Dubai crude, US$71.9 for gasoline and US$ 75.3 for diesel.
- The highest recorded prices per barrel were: (1) the week 24 June 2014 at US$110.1 for crude oil, (2) the week of 01 July 2014 at US$125 for gasoline, and (3) the week of 01 January 2014 at US$125 for diesel.
- Lowest prices per barrel registered on: (1) the week of 21 April 2020 as both Dubai crude and MOPS gasoline were at US$18, while (2) the week of 28 April 2020 at US$26 diesel.

Table 2. **Correlation Matrix, MOPS vs Dubai**

	Var1	Crude	Gasoline	Diesel
1	'crude'	1.0000	0.9960	0.9757
2	'gasoline'	0.9960	1.0000	0.9712
3	'diesel'	0.9757	0.9712	1.0000

Based on the price data series, Dubai crude price and MOPS prices for gasoline and diesel are perfectly and positively correlated - as the international prices of crude oil increase, their domestic prices also tend to increase. The correlation value for Dubai crude and MOPS gasoline is 0.996, while 0.976 for diesel *(Table 2)*. Even the correlation between MOPS gasoline and diesel is high at 0.971. The scatterplot of these variables also shows an almost perfect linear trend. The resulting regression equation shows a high R2, indicating the variability in MOPS gasoline and diesel are entirely due to changes in Dubai crude prices *(Figure 2)*.

Figure 2: **Scatterplot and Trendline, MOPS vs Dubai**



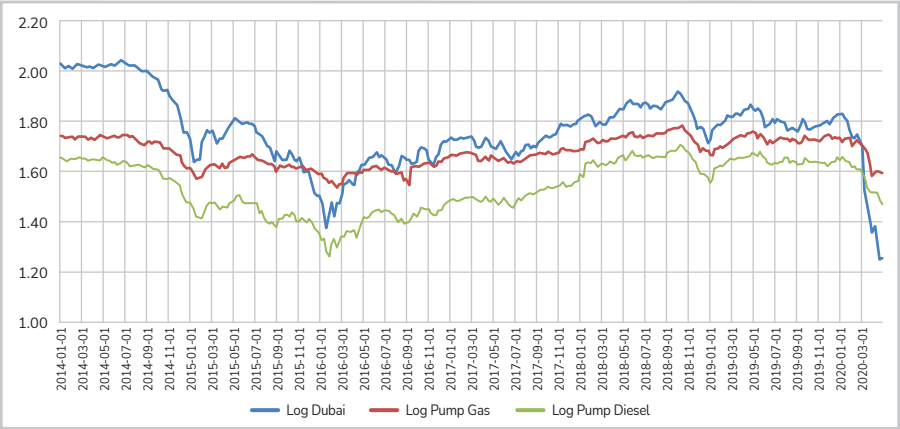
International Prices (crude) vs. Pump Prices

Seeing the international product and international crude prices closely follows each other leads to using the latter to compare with pump prices. For an apple-to-apple comparison, we use the log-transformation of international crude prices with domestic pump prices for the gasoline and diesel *(Figure 3)*[1]. We can observe the following trends for the weekly prices from 01 January 2014 to 28 April 2020:

- Gasoline pump price was highest in the week of 15 October 2018 at PhP 61 per liter, while for diesel, prices peaked in the week of 09 October 2018 at Php 51/liter.

[1] Log-transformation eliminates the effect of comparing dollar to peso as the price values are normalized as logarithm of base 10.

Figure 3: Log-transformed Dubai Price and Pump Prices of Gasoline and Diesel



- Across the time series, hikes in Dubai crude prices happened 162 times, while price drops occurred 168 times. These movements resulted in the pump price of gasoline to increase 166 times and drop 146 times, while there were 148 hikes and 165 rollbacks in the pump price of diesel.
- Domestic pump prices mirror the movements in international prices, albeit with a lag of approximately 1-4 weeks, at the most.
- These trends suggest that gasoline prices tend to vary more erratic than diesel prices, suggesting that the latter tends to remain sticky amidst pending increases. The reason behind this is that diesel is used primarily in the transport sector and by grassroots level groups (farmers, etc.) such that abrupt changes in price cannot be implemented without arousing public interests.

Given the near-perfect correlation between Dubai crude prices and MOPS prices for gasoline and diesel, we can approximate the level of MOPS prices for a given forecast of Dubai. The resulting estimated MOPS prices of gasoline and diesel are plugged into the price build-up model to determine an approximate pump price considering local components such as taxes (including the proposed 10% tariff) and industry take.

The Dubai Crude Price ceiling of US$64/barrel approximately corresponds to MOPS price per barrel of gasoline and diesel at US$74.45 and US$78.02, respectively, given the regression equation from *Figure 2*[2]. *Table 3* and *Table 4* present different pump price scenarios for gasoline and diesel, respectively.

[2] Equation for MOPS gasoline: MOPSGas = 10.819+0.9942*Dubai; equation for MOPS diesel: MOPSDsl = 9.8751 +1.0647*Dubai

Table 3: **Gasoline Pump Price Scenarios**

	Base Scenario		**Scenario 1**		**Scenario 2**		**Scenario 3**		**Scenario 4**		**Scenario 5**		**Scenario 6**	
	Based on Prices as of 09 June 2020		*Base Scenario + 10% Tariff on Landed Cost*		*Scenario 1 + No Bioethanol Blend*		*Dubai Ceiling Price of US$64+10% Tariff*		*Scenario 3 + No Bioethanol Blend*		*Dubai Price is at US$53.43 + Tariff*		*Scenario 5 + No Bioethanol Blend*	
	Php	**%**	**Php**	**%**	**Php**	**%**	**Php**	**%**	**Php**	**%**	**Php**	**%**	**Php**	**%**
FOB MOPS/CP, $/bbl (ave for 8-12 June)	42.45	95%	42.45	95%	42.95	95%	74.45	97%	74.45	97%	63.94	96%	63.94	96%
Ave. Freight	2.00	4%	2.00	4%	2.00	4%	2.00	3%	2.00	3%	2.00	3%	2.00	3%
Ocean Loss (0.5%)	0.22	0%	0.22	0%	0.22	0%	0.38	0%	0.38	0%	0.33	0%	0.33	0%
Total Import Cost	**44.68**	**100%**	**44.68**	**100%**	**44.68**	**100%**	**76.83**	**100%**	**76.83**	**100%**	**66.27**	**100%**	**66.27**	**100%**
Exchange Rate	49.93		49.93		49.93		49.93		49.93		49.93		49.93	
Peso Landed Cost, P/bbl	2,230.75		2,230.75		2,230.75		3,836.24		3,836.24		3,308.90		3,308.90	
Peso Landed Cost, P/liter	12.63	26%	12.63	25%	12.63	28%	21.71	29%	21.71	31%	18.73	28%	18.73	30%
Tariff**		0%	1.26	3%	1.26	3%	2.17	3%	2.17	3%	1.87	3%	1.87	3%
Excise tax	10.00	21%	10.00	20%	10.00	22%	10.00	13%	10.00	14%	10.00	15%	10.00	16%
VAT	5.82	12%	5.82	12%	5.49	12%	8.93	12%	8.46	12%	7.96	12%	7.49	12%
Biofuel Cost	3.94	8%	3.94	8%		0%	3.94	5%		0%	3.94	6%		0%
Total Cost before industry take	**32.39**	**67%**	**33.65**	**68%**	**29.38**	**64%**	**46.76**	**63%**	**42.34**	**60%**	**42.51**	**64%**	**38.09**	**61%**
Industry take	16.08	33%	16.08	32%	16.41	36%	27.66	37%	28.13	40%	23.86	36%	24.33	39%
Pump Price, P/liter	**48.47**	**100%**	**49.73**	**100%**	**45.79**	**100%**	**74.42**	**100%**	**70.48**	**100%**	**66.37**	**100%**	**62.42**	**100%**
+/- vs Original Pump Price (%)			*2.6%*		*-5.5%*		*53.5%*		*45.4%*		*36.9%*		*28.8%*	

Note: Industry Take covers the costs and mark up for the whole industry chain

Table 4: **Diesel Pump Price Scenarios**

	Base Scenario		Scenario 1		Scenario 2		Scenario 3		Scenario 4		Scenario 5		Scenario 6	
	Based on Prices as of 09 June 2020		*Base Scenario + 10% Tariff on Landed Cost*		*Scenario 1 + No Biodiesel Blend*		*Dubai Ceiling Price of US$64+10% Tariff*		*Scenario 3 + No Biodiesel Blend*		*Dubai Price is at US$53.43 + Tariff*		*Scenario 5 + No Biodiesel Blend*	
	Php	**%**	**Php**	**%**	**Php**	**%**	**Php**	**%**	**Php**	**%**	**Php**	**%**	**Php**	**%**
FOB MOPS/CP, $/bbl (ave for 8-12 June)	45.81	95%	45.81	95%	45.81	95%	78.02	97%	78.02	97%	66.76	97%	66.76	97%
Ave. Freight	2.00	4%	2.00	4%	2.00	4%	2.00	2%	2.00	2%	2.00	3%	2.00	3%
Ocean Loss (0.5%)	0.24	0%	0.24	0%	0.24	0%	0.40	0%	0.40	0%	0.34	0%	0.34	0%
Total Import Cost	**48.05**	**100%**	**48.05**	**100%**	**48.05**	**100%**	**80.42**	**100%**	**80.42**	**100%**	**69.11**	**100%**	**69.11**	**100%**
Exchange Rate	49.93		49.93		49.93		49.93		49.93		49.93		49.93	
Peso Landed Cost, P/bbl	2,399.36		2,399.36		2,399.36		4,015.50		4,015.50		3,450.56		3,450.56	
Peso Landed Cost, P/liter	14.79	43%	14.79	41%	14.79	42%	24.75	48%	24.75	31%	21.27	46%	21.27	47%
Tariff**		0%	1.48	4%	1.48	4%	2.47	5%	2.47	3%	2.13	5%	2.13	5%
Excise tax	10.00	29%	10.00	28%	10.00	29%	10.00	19%	10.00	14%	10.00	22%	10.00	22%
VAT	4.14	12%	4.14	12%	4.19	12%	6.24	12%	6.11	12%	5.58	12%	5.45	12%
Biofuel Cost	1.07	2%	1.07	2%		0%	1.07	2%		0%	1.07	2%		0%
Total Cost before industry take	**30.00**	**87%**	**31.48**	**87%**	**30.46**	**87%**	**44.54**	**86%**	**43.34**	**85%**	**40.04**	**86%**	**38.84**	**86%**
Industry take	4.52	13%	4.52	13%	4.47	13%	7.48	14%	7.48	15%	6.43	14%	6.56	14%
Pump Price, P/liter	**34.52**	**100%**	**36.00**	**100%**	**34.93**	**100%**	**52.02**	**100%**	**50.95**	**100%**	**46.47**	**100%**	**45.40**	**100%**
+/- vs Original Pump Price (%)			*4.3%*		*1.2%*		*50.7%*		*47.6%*		*34.6%*		*31.5%*	

Note: Industry Take covers the costs and mark up for the whole industry chain

Below are the approximate domestic pump prices of gasoline in various scenarios estimated straightforwardly:

- Average pump price for week of 8-12 June 2020 for gasoline is PhP48.47/liter and PhP34.52/liter for diesel.
  - ❍ With the imposition of a 10% tariff on landed cost, gasoline and diesel pump prices increase by 2.6% and 4.3%, respectively.
  - ❍ A 10% tariff but without the mandated biofuel blending (10% bioethanol and 2% biodiesel) leads to a 5.5 percent drop in gasoline pump prices to PhP45.79/liter, while diesel sustains a 1.2% increase to PhP36.00/liter.
- From Table 1, the estimated price adjustment for both gasoline and diesel with the additional 10% tariff is Php 1.6 per liter. In Table 3 & 4, the estimated tariff pushes gasoline and diesel pump prices by as much as PhP1.26 and PhP1.48 per liter, respectively. Despite the inclusion of 12% VAT, the price adjustment due to tariff slightly less than estimated price adjustment given by oil companies.
- At Dubai price ceiling of US$64 per barrel (trigger price at which tariff reverts to zero), the pump price of gasoline reaches PhP74.42/liter; while if without the mandated bioethanol blend, price with tariff per liter of gasoline is PhP70.48. For diesel, the US$64/barrel price of crude oil results in pump price of PhP52.02/liter; the exclusion of biodiesel blending puts prices at PhP50.95/liter.
- It also observed from the table that industry take for gasoline (around 30-40%) is higher than diesel (around 13-14%). Moreover, since the mandated bioethanol blending is five (5) times that of biodiesel, exclusion of the former as a component of gasoline leads to greater reduction in pump prices vis-à-vis diesel.

IV. Conclusion

The Dubai Crude Price ceiling of US$64/barrel at which the tariff reverts to zero approximately corresponds to MOPS price per barrel of gasoline and diesel at US$74.45 and US$78.02, respectively. The highest pre-COVID19 price of Dubai Crude was recorded at US$ 110 per barrel (June 2014), while gasoline and diesel prices each reached US$ 125 per barrel in July 2014 and January 2014, respectively, as peak levels.

In 2014, the world GDP at US$2010 prices was recorded at US$73.9 trillion, while the crude price elasticity is at 2.7 units. The GDP elasticity of Dubai prices peaks during the global financial and economic crisis as observed in 2009, 2011 and 2015. These years mark the global events of the 2009 Financial Crisis, the 2011 Fukushima nuclear incident and the 2015 record-slump in oil prices due to oversupply. As of 2020, the average GDP elasticity of Dubai prices is at 7.7, indicating that the level of crude prices remains responsive to changes in aggregate economic output.

The results also show that domestic pump prices of gasoline and diesel exhibit price stickiness as they do not easily respond to changes in Dubai prices. Gasoline prices are sticky-down, which means that hikes take effect faster vis-à-vis upward movements in Dubai prices, compared to rollbacks when Dubai prices are declining. The opposite holds for diesel prices which are sticky-up, i.e., Dubai crude price increases take some time to impact pump prices, while rollbacks are implemented relatively quicker. Inevitably, higher biofuel blending likewise contributes to higher pump prices for both gasoline and diesel.

V. Recommendation

Since the 10% additional tariff levied on crude and refined petroleum products under EO 113 has been lifted effective 25 June 2020, the government was able to collect an accumulated revenue amounting to Php 2.789 billion based on data provided by the Bureau of Customs (BOC) to the DOE[3]. Said amount has contributed to government resources for COVID-19 pandemic response.

[3] As of 06 September 2021, data from the BOC; said amount includes collection after the EO was lifted, i.e., from post modification entries (additional) lodged or assessed during the implementation and are still subject to payment of duties and taxes.

This brief recommends conducting a study of tariff imposition for hydrocarbons for the purpose of transitioning towards to a clean energy fuel

The study notes that while EO 113 led to a 2.6% increase in domestic prices this has not been felt by majority of consumer since the government has been proactive on its seeming impact on consumer prices by taking precautionary initiatives to keep watch over the price of essential commodities. Since its implementation amidst the pandemic, there was no clamor for oil price hikes due to the restriction of movement. Grassroots commuters were provided transport services by their employers. It is also worthy to note that industry take applied to diesel is close 1/3 that of gasoline. This reveals the presence of cross-subsidy measures between the two products. Diesel being used by grassroots and public transport gets a lower industry mark-up. In terms of demand, economy-wide diesel to gasoline ratio is **1.9**[4], i.e., every liter of diesel corresponds to two (2) liters of gasoline, since the former is much cheaper compared to the latter. Given the volume of diesel demand, it accounts for half (50.0%) of the transport sectors total utilization, while it contributes 20.2% to over-all greenhouse gas (GHG) emission in 2020. Thus, policy interventions are needed to disincentivize diesel consumption. These can be energy efficiency and conservation (EE&C) measures that will contribute to reduction in diesel demand and effectively lower the fuel's carbon footprint. EE&C can also help mitigate the associated price increases in both gasoline and diesel that stems from higher biofuel blending.

Lastly, the implementation of E0 113 can be viewed as a prudent move of the government to augment its COVID19 resources. Moreover, the policy of imposing a tariff on imported fuels also promotes alternative fuels by removing the incentives for hydrocarbons and reduced dependence on imported fuels, and at the same time, maybe a source of additional funds for the government in transitioning to clean energy fuel.

[4] Per 2020 Energy Balance Table (EBT)

Energy Study:
Assessing the Impact of COVID-19 on the Energy Supply and Demand for Full-Year 2020 in the Philippines
(As of June 2020)

The Department of Energy (DOE) seeks to assess the impact of COVID19 in terms of energy supply and demand for the FULL-YEAR 2020, as well as the risks that will crucially impact the energy supply. This simulation also considers the analysis and recommendations of the University of the Philippines' (UP) COVID-19 Pandemic Response Team published on 13 April 2020. As such, the scenarios used in this Energy Study were built upon the studies of the NEDA and UP Pandemic Response Team and in consideration of the timeline of the Luzon-wide ECQ (until April 30). The effect of the scenarios was then applied to FULL YEAR 2020 considering that many sectors were affected by the Luzon-wide ECQ that lasted until April 30.

I. Background

The 2019–20 coronavirus pandemic is an ongoing pandemic of coronavirus disease 2019 (COVID-19), caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2). The outbreak was first identified in Wuhan, Hubei, China, in December 2019, and was recognized as a pandemic by the World Health Organization (WHO) on 11 March 2020. As of 14 April 2020, nearly 2 million cases of COVID-19 have been reported in more than 210 countries and territories, resulting in approximately 126,812 deaths and 494,368 recoveries[i]. In the Philippines, there have been 5,223 confirmed cases – out of which 335 have died and 295 have recovered, while more than a thousand await confirmation of their COVID19 swab tests[ii].

Along with the declaration of a State of Public Health Emergency, the whole of Luzon was placed under an Enhanced Community Quarantine (ECQ) for forty-give (45) days, initially covering 17 March to 15 April, then extended further to 30 April 2020. The ECQ restricted land, air, and sea travel; suspended mass transportation and imposed a "stay-at-home" directive for non-essential personnel. In its 19 March 2020, the National Economic and Development Authority (NEDA) assessed the economic and social impact of the pandemic in the Philippines[iii]. The NEDA report stated that without mitigating measures, the impact of the pandemic will imply a reduction in the Philippines' real GDP growth to -0.6 to 4.3% in 2020.

Some salient points from the NEDA report are the following:

Given the simultaneous adverse effects on the supply and the demand side of the economy, we expect a cumulative loss of PhP428.7 to PhP1,355.6 billion in gross value added (in current prices), equivalent to 2.1 to 6.6% of nominal GDP in

	Forgone Gross-Value Added	% of 2020 nominal GDP	Impact on Employment
	(in billion)		(no. of persons)
Via transport and tourism	Php 77.5 - 156.9	0.4 - 0.8	33,800 - 56,600
Exports	Php 4.9 - 9.8	0.02 - 0.05	3,000 - 6,700
Remittances	Php 3.9 - 8.5	0.02 - 0.04	1,700 - 4,500
Consumption	Php 45.1 - 93.6	0.2 - 0.5	16,500 - 62,500
Luzon ECQ	Php 298 - 1,086.9	1.5 - 5.3	61,000 - 1,000,000
TOTAL	**Php 428.7 - 1,355.6**	**2.1 - 6.6**	**116,000 - 1,800,000**

Table 1. **COVID Impact, by Sector** *(NEDA Report)*

2020. Without mitigating measures, this would imply a reduction in the Philippines' real GDP growth to -0.6 to 4.3% in 2020.

To reiterate, the estimates assume that the adverse impact will be felt until June, though the brunt will be felt during the one-month ECQ. External trade, however, is expected to recover beginning March, though it will still be affected by the ECQ.

It also bears emphasizing that attaining the upper bound of 4.3% growth rate for 2020 is possible only if we can stem the impact of COVID-19 and the enhanced community quarantine to the rest of the economy. By extension, if the ECQ is extended beyond one month, or if the spread of COVID-19 is unabated even after the ECQ, then even the low-end of the estimate is still too high.

II. Rationale

The Department of Energy (DOE) seeks to assess the impact of COVID19 in terms of energy supply and demand for the FULL-YEAR 2020 with the consideration of the above-stated points and the risks that will crucially impact the energy supply. This simulation also considers the analysis and recommendations of the University of the Philippines' (UP) COVID-19 Pandemic Response Team published on 13 April 2020.

The studies of NEDA and the UP-Pandemic Response Team serve as the basis of the scenarios in this brief, taking into account the timeline of the Luzon-wide ECQ until 30 April 2020. The study applies the results to FULL YEAR 2020, considering that many sectors were affected by the Luzon-wide ECQ that lasted within the period.

III. 2019 Energy Situation[18] and 2020 Outlook before ECQ

A. Energy Demand

Energy Consumption in 2019

Based on preliminary data, total final energy consumption (TFEC) for 2019 stands at 36.9 million tons of oil equivalent (MTOE) or 3.2% higher than its 2018 level. Transport and industry account for the bulk, as their respective energy consumption went up by 3.7% and 5.5% during the year. The AFF sector registered the fastest increase in

[18] 2019 figures cited herein are taken from the preliminary Energy Balance Table (EBT), as of 13 April 2020

energy utilization at 7.8%, while commercial establishments and households reported increments in energy consumption of 5.3% and 2.5%, respectively. These trends in sectoral energy consumption are consistent with the 5.9% hike in the country's aggregate economic output in 2019, as measured by the gross domestic product (GDP). On a per fuel basis, oil remains the most consumed fuel with a 50.2% share, followed by electricity and biomass, with a 40.3% combined share to TFEC. Coal consumption, used primarily as a fuel in cement manufacturing, went up by as much as 11.4% in response to the higher demand for building materials in public and private infrastructure projects in 2019. Non-energy demand for coal and oil as raw materials in industrial processes declined by 16.4%. *(Table 2)*.

Sector	2018		2019		18-19 GR (%)
	MTOE	%Share	MTOE	%Share	
AFF	0.44	1.2	0.47	1.3	7.8
Industry	7.52	21.1	7.94	21.5	5.5
Commercial	4.67	13.1	4.92	13.3	5.3
Residential	9.43	26.4	9.66	26.2	2.5
Transport	12.24	34.3	12.69	34.4	3.7
Non-Energy	1.42	4.0	1.19	3.2	-16.4
TOTAL	**35.72**	**100.0**	**36.87**	**100.0**	**3.2**

Fuel	2018		2019		18-19 GR (%)
	MTOE	%Share	MTOE	%Share	
Coal	2.57	7.2	2.87	7.8	11.4
Natural Gas	0.06	0.2	0.06	0.2	3.6
Oil	18.17	50.9	18.51	50.2	1.9
Biofuels	0.52	1.5	0.56	1.5	6.6
Electricity	7.10	19.9	7.54	20.4	6.1
Biomass	7.29	20.4	7.33	19.9	0.5
TOTAL	**35.72**	**100.0**	**36.87**	**100.0**	**3.2**

Table 2. **Total Final Energy Consumption (TFEC): by Sector and Fuel, 2018 vs 2019**

Pre-COVID-19 Energy Consumption Estimate in 2020

The 2020 Business as Usual (BAU) or the pre-COVID-19 estimate of TFEC is at 38.5 million tons of oil equivalent (MTOE), up by 4.5% from its 2019 level. Note that in this scenario the economy will expand by 7.3% consistent with the growth target initially set by the government when the COVID19 pandemic was not yet in place. In this scenario, we expect all economic sectors to register an increase in energy consumption (industry at 5.4%, AFF at 8.0%, commercial at 5.0%, transport at 5.4%), with the residential sector having the slowest growth at 2.1% in 2020. The hike in energy utilization of end-use in all the sectors is consistent with their target expansions in 2020, particularly that of manufacturing, AFF and services; while for the transport sector, there is an expected increase in the volume of vehicles coupled with improvements in mass transportation for the same period. Oil remains the most consumed fuel, followed by electricity and natural gas. Electricity registers the fastest increase in utilization at 7.2% in 2020 *(Table 3)*.

Sectors	LEVELS (MTOE)			GROWTH RATES (%)	
	Actual		2020 BAU	2018-2019	2019-2020 BAU
	2018	2019			
AFF	0.44	0.47	0.51	7.8	8.0
Industry	7.52	7.94	8.36	5.5	5.4
Commercial	4.67	4.92	5.16	5.3	5.0
Residential	9.43	9.66	9.87	2.5	2.1
Transport	12.24	12.69	13.37	3.7	5.4
Non-Energy	1.42	1.9	1.25	-16.4	4.9
TOTAL	**35.72**	**36.87**	**38.52**	**3.2**	**4.5**

Fuel	LEVELS (MTOE)			GROWTH RATES (%)	
	Actual		2020 BAU	2018-2019	2019-2020 BAU
	2018	2019			
Coal	2.57	2.87	2.98	11.4	3.9
Natural Gas	0.06	0.06	0.06	3.6	0.4
Oil	18.17	18.51	19.45	1.9	5.1
Biofuels	0.52	0.56	0.59	6.6	5.5
Electricity	7.10	7.54	8.08	6.1	7.2
Biomass	7.29	7.33	7.36	0.5	0.4
TOTAL	**35.72**	**36.87**	**38.52**	**3.2**	**4.5**

Table 3. **Total Final Energy Consumption (TFEC): by Sector and Fuel, 2018, 2019 vs 2020 BAU**

B. Energy Supply

Energy Supply in 2019

Preliminary total primary energy supply (TPES) level for 2019 is at 60.4 MTOE, up by 1.3% from its year-ago level of 59.7 MTOE. Self-sufficiency improves to 51.7%, which means that around 31.2 MTOE out of TPES is from indigenous energy sources, while 29.2 MTOE is net imported energy. The sluggish growth is attributed to the lower crude oil imports due to the prolonged refinery shutdown by Petron and declining production from domestic oil sources because of the near depletion of Matinloc and Nido oil fields. The impact of the el-Nino phenomenon slowed down the electricity production from hydro and geothermal sources during the year, with coal and solar energy compensating for the reduction. *(Table 4)*

Source	2018		2019		18-19 GR (%)
	MTOE	%Share	MTOE	%Share	
Indigenous Energy	**29.92**	**50.2**	**31.24**	**51.7**	**4.4**
Oil	0.59	1.0	0.52	0.9	-12.0
Natural Gas	3.60	6.0	3.63	6.0	0.7
Coal	6.20	10.4	7.25	12.0	16.9
Hydro	2.34	3.9	2.40	4.0	2.9
Geothermal	8.97	15.0	9.16	15.2	2.1
Biomass	7.67	12.9	7.71	12.8	0.5
Wind	0.10	0.2	0.10	0.2	1.9
Solar	0.11	0.2	0.11	0.2	6.6
Biodiesel	0.17	0.3	0.18	0.3	6.0
Bioethanol	0.17	0.3	0.17	0.3	-0.5
Net Imported Energy	**29.74**	**49.8**	**29.18**	**48.3**	**-1.9**
Oil	19.40	32.5	18.79	31.1	-3.2
Coal	10.14	17.0	10.17	16.8	0.3
Bioethanol	0.19	0.3	0.22	0.4	13.3
Total Primary Energy	**59.66**	**100.0**	**60.42**	**100.0**	**1.3**

Table 4. **Total Primary Energy Supply (TPES): By Fuel, 2018, vs 2019**

Pre-COVID-19 Energy Supply Estimate in 2020

TPES for 2020 before COVID-19 estimates reaches 62.3 MTOE or 3.1% higher from its 2019 level to meet the energy requirement under the BAU scenario/ pre-COVID19 *(Table 5)*. Under this scenario, oil continues to be the country's primary fuel, reversing its year-ago decline of 3.4% to an increase of 3.9% at 20.1 MTOE or 32.2% share to the TPES for 2020. Next to oil, the following fuels contribute significantly to TPES: coal, geothermal and biomass at 18.0 MTOE (28.8% share), 9.2 MTOE (14.8% share), and 7.9 MTOE (12.7% share), respectively. Power generation uses the bulk of coal supply and the rest for the industrial sector requirement, specifically the cement industry. Meanwhile, the estimates for the aggregate share of renewable energy (RE) stand at 32.9%.

Table 5. **Total Primary Energy Supply (TPES): By Fuel, 2018, 2019 vs 2020 BAU**

Fuel	LEVELS (MTOE)			SHARES (%)			GROWTH RATES (%)	
	Actual		2020 BAU	Actual		2020 BAU	2018-2019	2019-2020 BAU
	2018	2019		2018	2019			
Coal	16.35	17.42	17.95	27.4	28.8	28.8	6.6	3.0
Natural Gas	3.60	3.63	3.76	6.0	6.0	6.0	0.7	3.6
Oil	19.99	19.31	20.07	33.5	32.0	32.2	-3.4	3.9
Renewable	19.72	20.06	20.49	33.0	33.2	32.9	1.7	2.2
Hydro	2.34	2.40	2.52	3.9	4.0	4.1	2.9	4.9
Geothermal	8.97	9.16	9.20	15.0	15.2	14.8	2.1	0.4
Solar	0.11	0.11	0.15	0.2	0.2	0.2	6.6	26.9
Wind	0.10	0.10	0.12	0.2	0.2	0.2	1.9	19.8
Biomass	7.67	7.71	7.91	12.9	12.8	12.7	0.5	2.7
Biofuels	0.53	0.57	0.59	0.9	0.9	0.9	6.6	4.1
TPES	**59.66**	**60.42**	**62.27**	**100.0**	**100.0**	**100.0**	**1.3**	**3.1**

C. Environmental Impact

In 2019, greenhouse gas (GHG) emission reached 134.0 metric tons of CO_2 equivalent ($MTCO_2e$). Emissions from power generation and the transport sector account for 47.7% and 25.3%, respectively. Under the BAU scenario, the level of GHG emission is expected to increase by 5.7%. Coal accounts for the bulk of the emission for 2019 and 2020 BAU. Particulate matter (PM)[19] level for 2019 was at 39.5 metric tons (MT), which is projected to reach 40.9 MT in the 2020 BAU scenario due to increased economic activity during the period *(Table 6)*. Particulate matter from end-use sectors is at 14.7 MT, with the transport sector accounting for the bulk at 48% under the BAU *(Annex 1 Table 20)*.

[19] Particulate matter is the sum of all solid and liquid particles suspended in air many of which are hazardous. This complex mixture includes both organic and inorganic particles, such as dust, pollen, soot, smoke, and liquid droplets. These particles vary greatly in size, composition, and origin (Source: https://www.greenfacts.org/en/particulate-matter-pm/level-2/01-presentation.htm)

Table 6. **GHG emission by Fuel *(upper)* and PM Emissions by Fuel *(lower)*: 2018, 2019 2019 vs 2020 BAU**

Fuel Source	LEVELS ($MTCO_2e$)			GROWTH RATES (%)	
	Actual		2020 BAU	2018-2019	2019-2020 BAU
	2018	2019			
Natural Gas	8.43	8.15	8.67	-3.3	6.3
Coal	63.16	69.06	73.22	9.3	6.0
Oil	51.73	56.82	59.75	9.8	5.2
Total GHG	**123.32**	**134.03**	**141.63**	**8.7**	**5.7**

Fuel Source	LEVELS (MT)			GROWTH RATES (%)	
	Actual		2020 BAU	2018-2019	2019-2020 BAU
	2018	2019			
Natural Gas	0.71	0.73	0.79	2.6	8.3
Coal	27.11	28.85	29.73	6.4	3.0
Oil	9.60	9.93	10.36	3.5	4.2
Total PM	**37.42**	**39.51**	**40.87**	**5.6**	**3.4**

D. Impact of COVID-19 on Full-Year 2020 Energy Outlook: Post-ECQ Analysis

Effects on energy consumption of COVID-19 in 2020 were simulated under two scenarios:

COVID Scenario 1: The Luzon ECQ is lifted as scheduled and economic activity gradually resumes after 30 April 2020 *(coincides with the upper limit of the NEDA GDP target for 2020 considering impact of COVID-19)* and with modified community quarantine based on the level of risk;

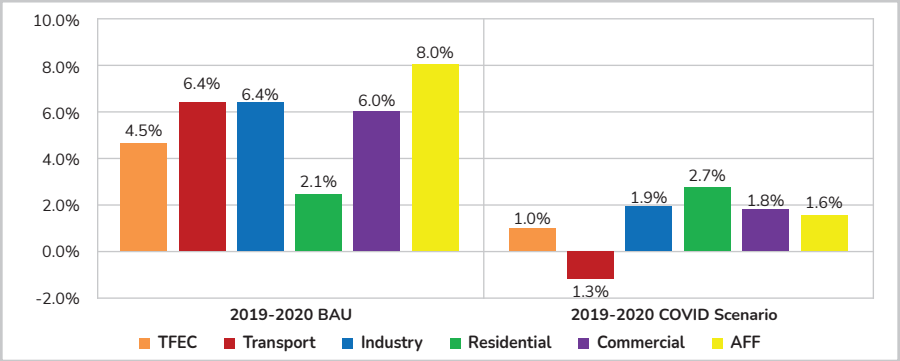
COVID Scenario 2: The Luzon-wide ECQ is extended beyond 30 April and COVID-19 remains unabated *(coincides with the lower limit of the NEDA GDP target for 2020 considering impact of COVID-19)*

1. COVID Scenario 1 (CS1): The ECQ is lifted as scheduled and economic activity gradually resumes after 30 April 2020.

1.1 Energy Demand

If the country stems the impact of COVID-19 and lifts the enhanced community quarantine as scheduled (April 30), economic output increases by 4.3% 2020, lower than its pre-COVID/BAU target of 7.3%. This translates to a sluggish increase in TFEC of 1.0%, down by 3.5 percentage points from the projected growth under BAU *(Figure 1)*.

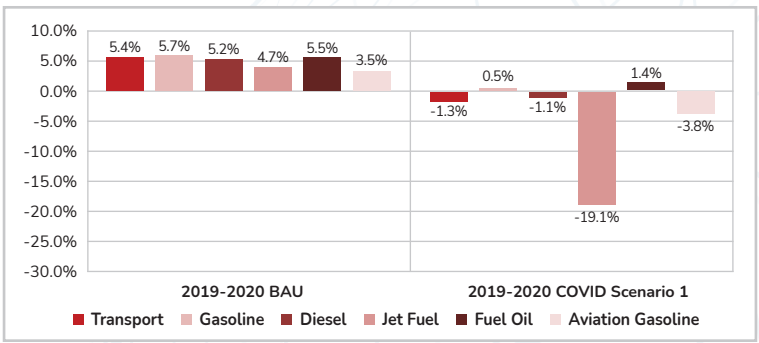
Figure 1: **Comparison of Growth Rates TFEC, by Sector: (%): 2020 BAU vs 2020 CS1**



The transport sector bears the brunt of ECQ implemented from 17 March to 30 April 2020 as consumption levels declines by 1.3% vis-à-vis 2019. Other economic sectors register higher energy consumption than in 2019 at a slower rate than their BAU levels. Alternative work from home (WFH) schemes and strict "stay-at-home" practices push residential energy consumption to increase by 2.7%, slightly faster than its BAU trend *(Annex 1 Table 6)*.

- The localized or modified community quarantine in certain areas imposed despite the lifting of the Luzon-wide ECQ may result in a 1.3% contraction in energy consumption of the transport sector vis-à-vis 2019 levels. In this scenario, utilization of fuels for transport slows down due to the suspension of land, air and water travel in Luzon and urban cities in Visayas and Mindanao placed under ECQ, which may continue depending on the level of risk per region or province *(Figure 2)*.

Figure 2: Comparison of Growth Rates (%): 2020 BAU vs 2020 CS1 in the Transport Sector and its Major Fuels



- The modified community quarantines may still limit traveling that may push down the transport sector's aggregate consumption of petroleum products by 1.3%. Among petroleum products, diesel declines by 1.1% due to the suspension of public transportation in certain regions. Gasoline registers a meager 0.5% increase owing to the use in private transport. The consumption of fuels for air (aviation gas and jet) is still on the downtrend compared to their 2019 levels, as domestic tourism may take some time to recover from the virus scare *(Annex 1-Table 11)*.

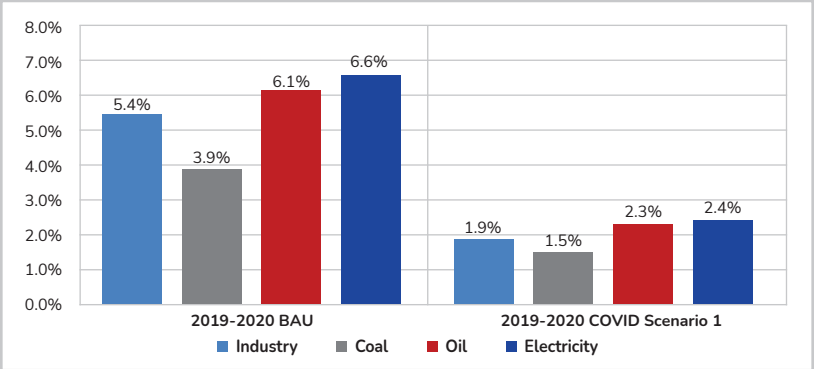
Depressed demand for oil may have been cushioned by declining pump prices of petroleum products.

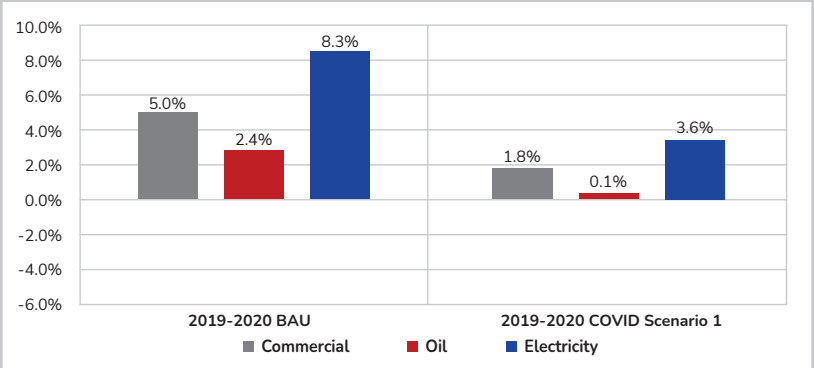
- These reductions in consumption may have been cushioned in part by declining pump prices of petroleum products. *As of 24 March 2020, gasoline and diesel prices have dropped by as much as PhP 7/liter and PhP 9/liter from January 2020 (Annex 1-Figure 15 and 16)* as crude oil prices in the international market continue to decline due to dual effect of the oil price war between Saudi Arabia and Russia and the impact of COVID-19[v]. The decline in crude prices persists with both the US Energy Information Administration (EIA) *(Annex 1-Figure 17)* and International Monetary Fund (IMF) predicting that future prices are unlikely to return to pre-coronavirus levels[vi].

The energy consumption in the Industry and Commercial increases by 1.9% and 1.8%, respectively, albeit slower (and levels lower) than BAU *(Figure 2)* with the "new normal", partial reopening of factories, and resumption of industrial processes, service establishments (banks, malls, call centers, restaurants, hotels and the like) and work in the public and private sector. *(Figure 3)*.

- The industry sector will rely on coal, oil, and electricity to revive manufacturing output, despite the consumption levels of these fuels slowing down to 1.5%, 2.3% and 2.4%, respectively *(Table 8)*. The slowdown in consumption of coal is attributed to the suspended operation of cement factories, particularly that of Holcim and Cemex[vii] in areas under ECQ. The same trend is exhibited by oil and electricity as both fuels are used across all industries and business establishments,

Figure 3: **Comparison of Growth Rates (%): 2020 BAU vs 2020 CS1 in the Industry Sector and its Major Fuels *(upper graph)* and Commercial Sector and its Major Fuels *(lower graph)***



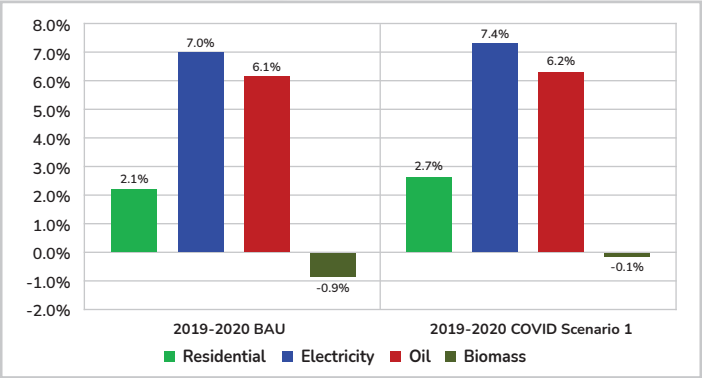


which have stopped operations during the ECQ, and have re-opened but with limitations to operations and manpower services post-ECQ *(Annex 1-Table 9 & 10)*.

- Household energy consumption reverts close to its BAU level and registers a 2.7% increase over its 2019 levels, the fastest among sectors under CS1 *(Figure 4)*.

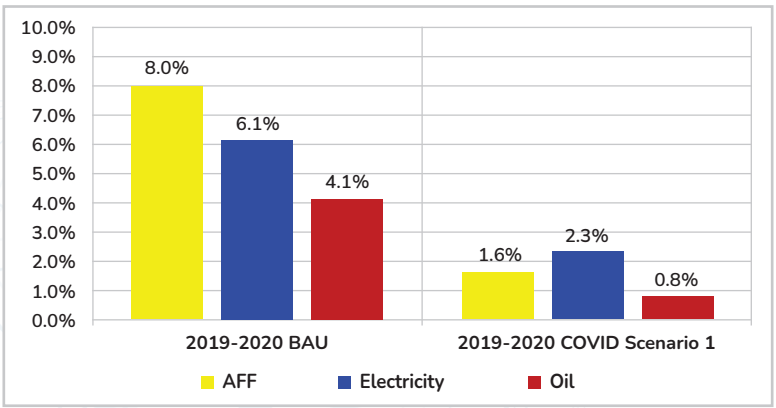
  Owing to the adoption of a "new normal" approach to prevent the spread of COVID-19 post ECQ, work-from-home (WFH) is considered the next-best alternative for the country's workforce. In addition, cooking fuels, particularly LPG and biomass, will register increased consumption under CS1 *(Annex 1-Table 12)*.

Figure 4: **Comparison of Growth Rates (%): 2020 BAU vs 2020 CS1 in the Residential Sector and its Major Fuels**



- AFF registers a meager 1.6% energy utilization under CS1 *(Figure 5)*. Farm activity slowly recovers post ECQ given the stimulus package targeted for the sector. As such, oil and electricity consumption, the main fuels of the sector, exhibit a slowdown like the industry and commercial sectors *(Annex 1 Table 13)*.

Figure 5: **Comparison of Growth Rates (%): 2020 BAU vs 2020 CS1 AFF Sector and its Major Fuels**



- Aggregate oil demand (including non-energy and fuel input to power generation) under CS1 will be 1.0% lower than in 2019, indicating a slowdown from its 4.3% hike under BAU. The slowdown may be attributable to the deceleration in oil consumption in all sectors, except households, while there is an 18.8% contraction in fuel input to power generation *(Annex 1 Table 14)*.

- The total electricity consumption registers a 4.5% increase under CS1, down by 2.7 percentage points from its growth under BAU, as all economic sectors, except households will have lower consumption due to ECQ *(Annex 1 Table 16)*.

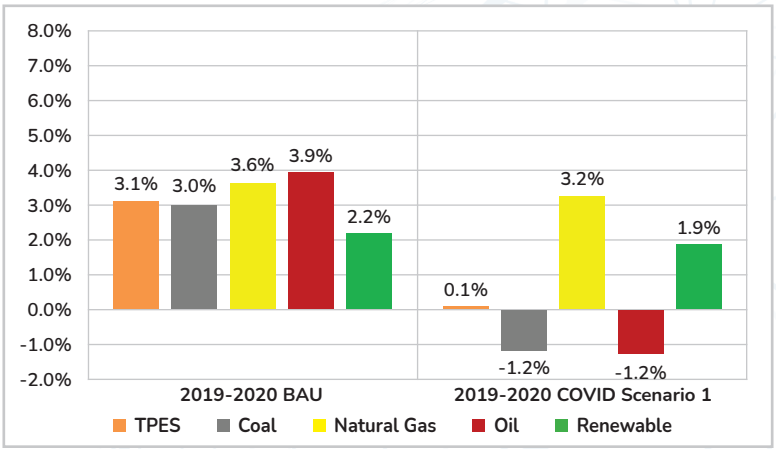
1.2 Energy Supply

If the country stems the impact of COVID-19 and lifts the enhanced community quarantine as scheduled (April 30), economic output increases by 4.3% 2020, lower than its pre-COVID/BAU target of 7.3%. This translates to a sluggish increase in TFEC of 1.0%, down by 3.5 percentage points from the projected growth under BAU *(Figure 1)*.

Importation of oil and coal is expected to decline vis-à-vis the BAU to cushion the impact of (1) impending supply cuts from the Organization of Petroleum Exporting Countries (OPEC) as a strategy to stabilize the oil price. Oil prices decreased to 60% since January of 2020 *(Annex 1 Figure 17)* resulting from the oil war between Saudi Arabia and Russia); and (2) possible restrictions in both importations and exportations of these fuels amidst the risk associated with the COVID-19 pandemic.

Imported supply are at a risk due to the high probability of manpower exposure to COVID-19 prompting the country to require quarantine on personnel in vessels. There is also a threat of receiving port

Figure 6: **Comparison of Growth Rates (%): 2020 BAU vs 2020 CS1 in the TPES**



closure and of exporting countries to hold onto their respective fuel supplies. These risks and threats can hamper the delivery of fuel to coal power plants that leads to load curtailment and rotational brownout; and may hike up electricity rates through increased utilization of indigenous fueled power plants with higher generation rate i.e., natural gas among others.

The impending threats for reduction of coal and oil will pave the way for higher utilization of renewables in power generation as they are considered a must and priority dispatch plants in the Wholesale Electricity Spot Market (WESM) per Department Circular No. 2015-03-001. RE is also an indigenous supply that is readily available in the country, which may exclude variable RE considering the intermittency of its energy source. Thus, the share of renewables is expected to increase at 33.8% compared to 32.9% under the BAU and compensating for the reduction in oil and coal. The said circular is meant to integrate RE sources into the electricity market to lower power rates for the country and increase utilization of RE in the power generation which is the main purpose of the implementation of RE Act of 2008.

1.3 Environmental Impact

GHG emission under the COVID19 Scenario 1 (CS1) is estimated to be at 136.8 $MTCO_2e$ representing a 2.0% increase from its 2019 level albeit slower compared to the BAU. This is due to the reduction in oil demand and coal utilization for power generation *(Annex 1 Table 19)*.

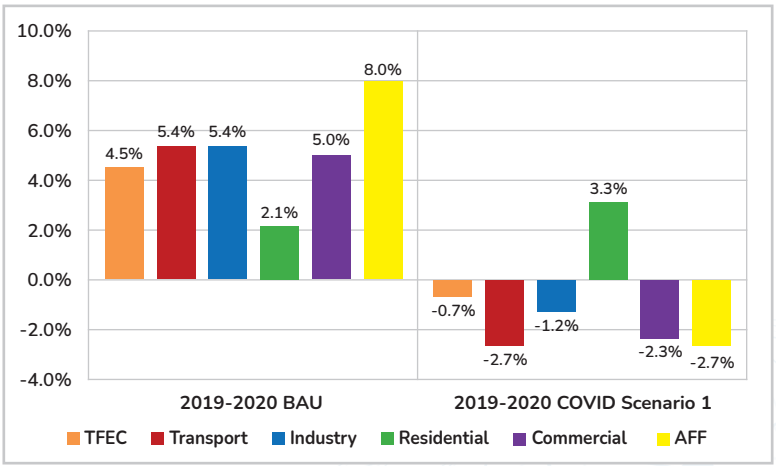
Given the restrictions imposed on mass transportation and the movement of people/vehicles, particulate matter (PM) under the CS1 scenario is estimated to be at 39.1 metric tons (MT) lower than both its 2019 and 2020 BAU levels *(Annex 1 Table 20)*. PM from the transport sector under this scenario is down by 1.3%. For Metro Manila alone, data from the Department of Environment and Natural Resources (DENR) shows air quality has improved during the enhanced community quarantine to contain the spread of COVID-19 and that "air pollution poses little or no risk" among the cities in Metro Manila areas[viii].

2. COVID Scenario 2 (CS2): Luzon-wide ECQ is extended beyond 30 April and COVID-19 remains unabated.

2.1 Energy Demand

The possible contraction in economic output of 0.6% leads to a 0.7% reduction in TFEC for 2020, *down by 5.2 percentage points from the projected growth under BAU (Figure 7)*. Output producing sectors – AFF, industry, commercial, and transport register declines in consumption levels vis-à-vis 2019 and as compared to the BAU. The household energy consumption registers the fastest growth at 3.3% under this scenario *(Annex 1 Table 7)*.

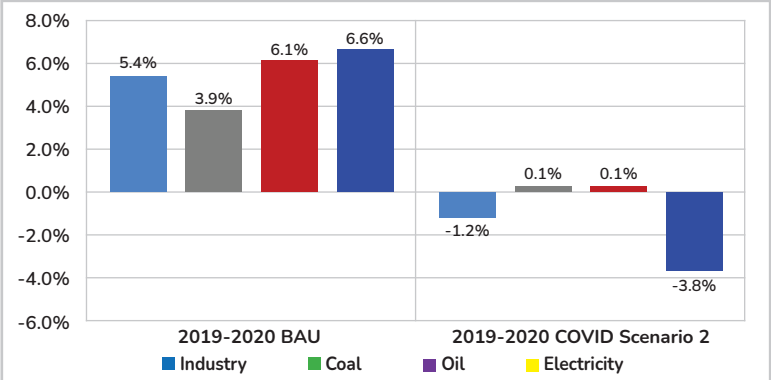
Figure 7: **Comparison of Growth Rates TFEC, by Sector: (%): 2020 BAU vs 2020 CS2**

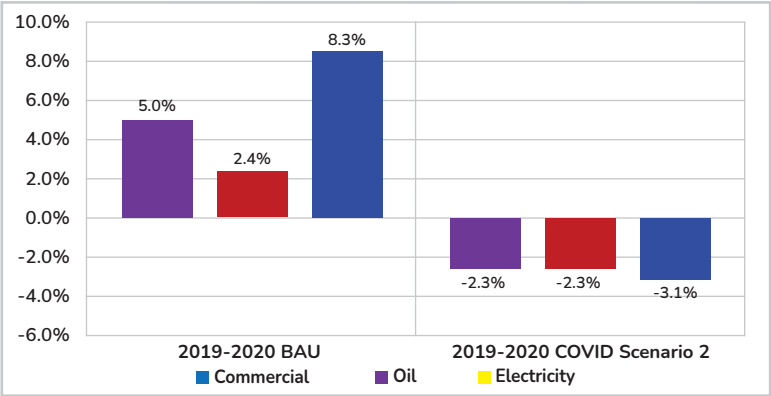


The aggregate energy consumption of economic sectors (industry, commercial, transport, and AFF) contracts by 2.2%, losing the momentum of 7.5 percentage points as the economy bears the brunt of COVID19 than the 5.3% growth under the BAU. *(Annex 1 Table 7)*

- The energy consumption in the industry and commercial sector shrinks by 1.2% and 2.3%, respectively, since only establishments engaged in the provision of basic needs and services are allowed to operate with halted operations of nonessential establishments and factories due to work restrictions imposed under the ECQ *(Figure 8)*.

Figure 8: Comparison of Growth Rates: 2020 BAU vs 2020 CS2 in the Industry Sector and its Major Fuels *(upper graph)* and Commercial Sector and its Major Fuels *(lower graph)*



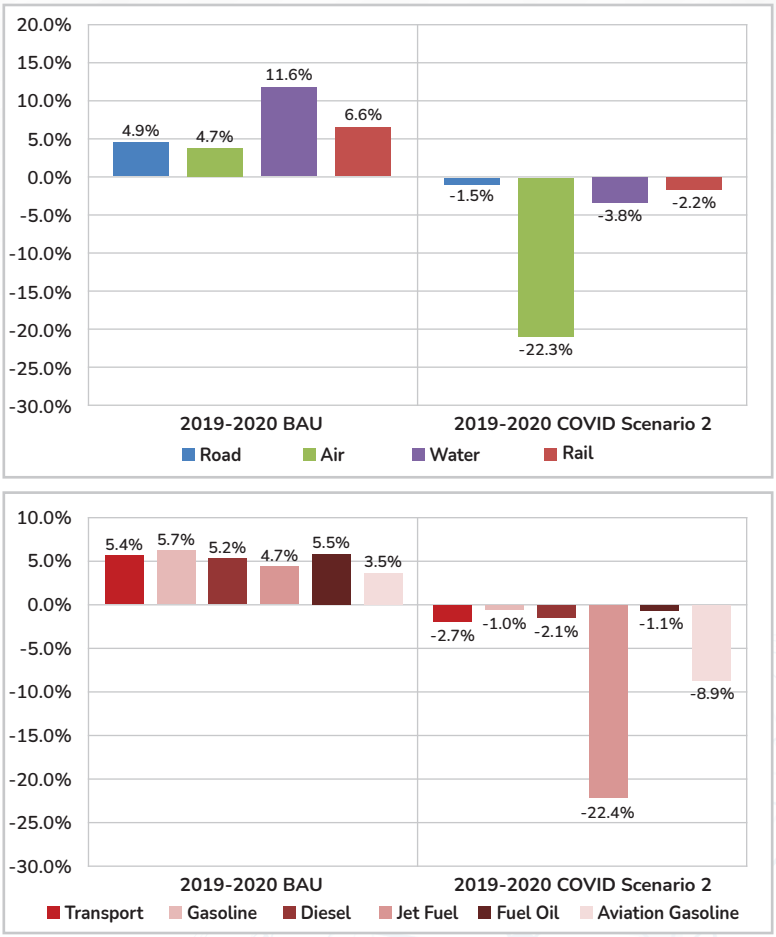


- The extended lockdown brings down industrial output. The closure of factories not engaged in the production of essentials results in a 3.8% drop in electricity consumption of the industry sector. Similarly, the prolonged closure of business establishments and offices spaces brings down the commercial sector's electricity consumption by 3.1%. Coal utilization for cement manufacturing is at a standstill as cement plants ceased production under the ECQ. LPG consumption in the industry. The commercial sectors post increments of 3.4% and 4.8%, respectively, to meet the demand for food products and food deliveries, while other petroleum products will register stunted growths *(Annex 1 Table 9 & 10)*

- The impact of restrictions on public transport further depresses energy consumption in the transport sector to 2.7%. Domestic air and water transport are projected to decline by 22.3% and 3.8%, as inter-island

travel is highly restricted to contain community transmission. Rail transport will also drop by 2.2% due to reduced operating hours of mass rail transport systems (MRT, LRT, etc.). *(Figure 9)*.

Figure 9: **Comparison of Growth Rates: 2020 BAU vs 2020 CS2 for Transport Sub-sectors** *(upper)* **and Major Fuels in the Transport Sector** *(lower)*

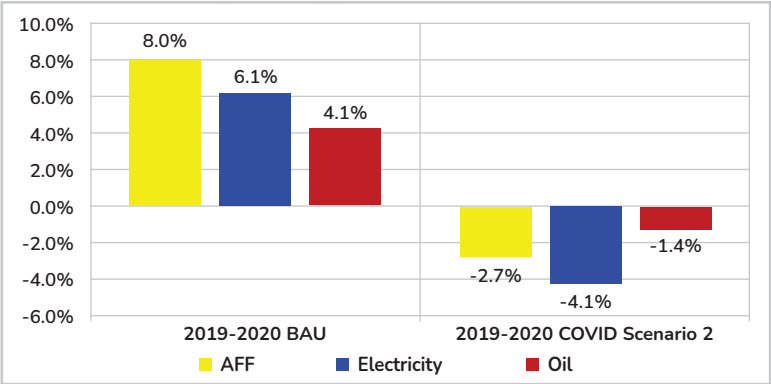


- The sector's aggregate oil consumption drops by 2.7%, as all products register depressed demand due to restrictions on public transportation and other modes of travel. Major transport fuels - gasoline and diesel declines by 1.0% and 2.1%, respectively, albeit manageable compared to other fuels given their inelastic demand due to lack of substitute fuels in the sector *(Figure 9 & Annex 1 Table 11)*.

- Consumption of fuels for air (aviation gas and jet), water (fuel oil) and rail (electricity) are expected to drop due to heightened limitation to the movement of people and non-essential personnel.

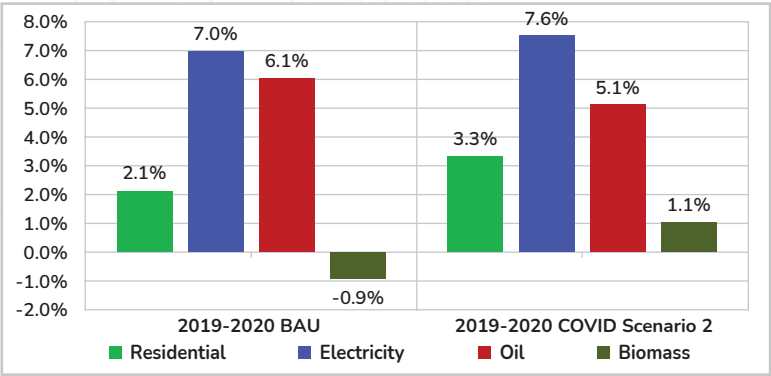
  Worsening bottlenecks in the transporting of agriculture harvests due to municipal/regional lockdowns may contribute to the 2.7% reduction in energy consumption in the AFF sector. Restrictions of movement and an impending shortage of fertilizers, veterinary medicines and other input could affect agricultural production. Farm output is also expected to drop as farmers are constrained by low farm gate prices. *(Figure 10)*

Figure 10: **Comparison of Growth Rates 2020 BAU vs 2020 CS2 in the AFF Sector and its Major Fuels**



- Household energy consumption will increase the fastest at 3.3% under CS2 *(Figure 11)* as a large portion of the working population shall be or are already relegated to work-from-home (WFH) scheme due to ECQ.

Figure 11: **Comparison of Growth Rates: 2020 BAU vs 2020 CS2 in Residential Sector and its Major Fuels**



- The hike in the consumption of **petroleum products (or oil)**, particularly LPG and kerosene, and that of electricity in the residential sector at **5.1% and 7.6%**, respectively, tends to be higher compared to other sectors. This may be attributable to the shift on household energy consumption patterns where work-from-home arrangements and staggered working hours are encouraged; with children and elders forced to stay at home *(Annex 1 Table 12)*.

- The changes in the use of electric appliances for work, recreation, and space cooling, in which the spike in electricity demand from the residential sector results in the only growth in demand among the sectors. Waning household income due to prolonged ECQ may cause the return to cheaper alternatives such as biomass. Although, the declining prices of LPG and kerosene prices still guarantee the utilization of these fuels for cooking.

- Aggregate oil demand *(including non-energy and fuel input to power generation)* under CS2 is lower by 2.5% than in 2019, reversing its 4.3% hike under BAU, attributing to the contraction in oil consumption in the transport, commercial, and AFF sectors and in power plants, combined with further deceleration in other end-use sectors *(Annex 1 Table 14)*.

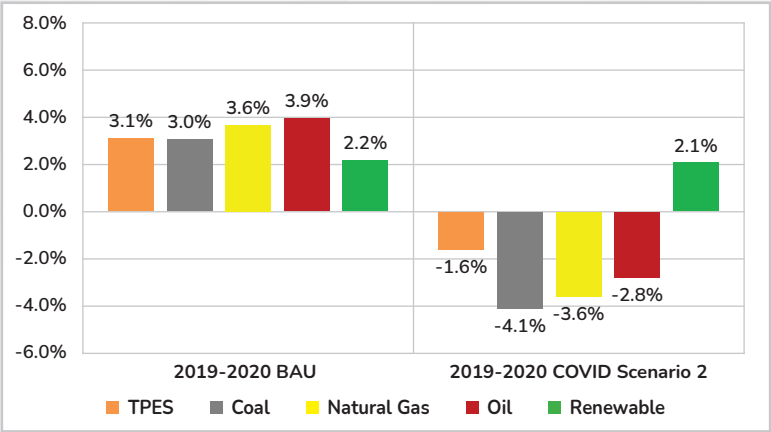
- Electricity consumption registers a meager 0.3% increase vis-à-vis 2019, shelving off 6.9 percentage points from its growth under the BAU. The residential sector registers the fastest and only positive increment of 7.6% under CS2 *(Annex 1 Table 16)*.

2.2 Energy Supply

- Under CS2 scenario, the country's TPES shrinks by 1.6% or *4.7 percentage points lower than the BAU (Figure 12)* due to lower energy requirement in the transformation sector as an impact of the continued restriction in the operation of non-essentials which relies heavily in electricity. Self-sufficiency improves to 56.9% as importation of coal for power plants dops during the same period *(Annex 1 Table 17)*.

- The energy mix for CS2 scenario shifts to renewable vis-à-vis the BAU having a share of at 34.4% due to the mechanism provided for under the WESM that prioritizes RE in the market and also in response to the declining supply levels in fossil fuels cause by the risk of COVID 19 infection associated with the delivery of supply. Renewables are also expected to augment supply cuts on imported fuels such as coal and oil.

Figure 12: **Comparison of Growth Rates: 2020 BAU vs 2020 CS2 in TPES Fuels**



2.3 Environment Impact

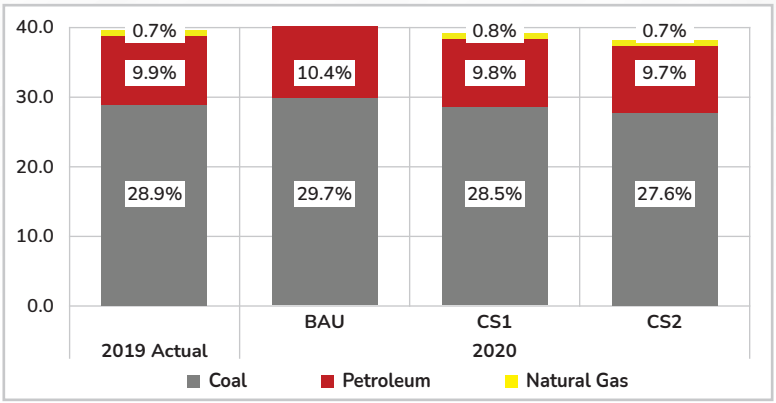
- GHG emission under the COVID Scenario 2 drops by 0.7% to 133.1 $MTCO_2e$ from its 2019 level due to the reduction in the utilization of coal for power generation and oil in the transport sector *(Annex 1 Table 19)*.

- Particulate matter (PM) emission under the CS2 scenario results in at 38.1 metric tons (MT) relatively lower than its 2019 level and its 2020 BAU *(Figure 13 and Annex 1 Table 20)*. Lower PM levels are expected under CS2 with the prolonged restrictions imposed on mass transportation, limited movement of people/vehicles and halted operations of industries and establishments. Among end-use sectors, transport accounts for close to half of the PM, albeit registering reductions of 1.3% and 2.7% under the CS1 and CS2, respectively.

- According to the Environmental Management Bureau (EMB) of the Department of Environment and Natural Resources (DENR), the air quality in Metro Manila is "improving", recording "good" or "moderate/fair" levels of PM10 (inhalable particles 10 micrometers or smaller in diameter) in various cities. Meanwhile, according to the Environmental Pollution Studies Laboratory of the Institute of Environmental Science and Meteorology at the University of the Philippines-Diliman, data gathered from airtoday.ph stations shows that the levels of PM2.5 (2.5 micrometers or smaller) decreased by 80% to 180% at the Lung Center of the Philippines compound, and by 70% to 90% as measured

along EDSA Muñoz, from two weeks to days prior the ECQ[ix]. Despite the negative impact of COVID-19 to the country, it cannot be denied that it has positive impacts to health and the environment as well.

Figure 13: **Particulate Matter (PM) Emissions from fossil fuels, in Metric Tons under 2019 and 2020 Scenarios**



E. Risk Analysis on Energy Supply

The energy sector is one of the affected sectors due to the implementation of the Luzon-wide lockdown in response to COVID-19. The lockdown has caused major economic sectors to suffer revenue losses from forced closures and halted activities, resulting in a reduction in energy consumption. Despite depressed energy demand, a stable energy supply is not guaranteed. The country is heavily reliant on imported fuels, specifically coal and oil. As of December 2019, energy supply amounted to 60.4 MTOE. Indigenous resources stood at 31.2 MTOE, which translates to a self-sufficiency level of 51.7%. Local resources comprised of coal at 7.3 MTOE (12.1% share), natural gas at 3.6 MTOE (6.0% share), oil at 0.5 MTOE (0.9 % share, and a combined RE resources of around 19.9 MTOE (32.9% share) from renewables. Net imported coal and oil accounts for 16.9% and 31.1% of TPES, respectively. Coal is highly used for the baseload in power generation while oil is the primary fuel in the transport sector. (Table 4). Meanwhile, at the end of 2019, the country had the following volume of indigenous reserves - 7.1 million barrels of oil (MMBBL), 982.2 billion cubic feet of gas (BCF) and 33.3 MMBBL of condensate.

Under DC No. 2010-03-0003[20] dated 26 February 2010, *power plants are required to have a stock of fuel equivalent to one (1) month*. Similarly, oil companies are required under Department Circular No. 2003-01-001[21] *dated 20 January 2003 to sustain an inventory level of fifteen (15) days' supply of petroleum products, except LPG, which shall maintain seven (7) days of supply for all Oil Companies and Bulk Suppliers*. On the other hand, refiners are obliged to maintain a minimum inventory equivalent to thirty (30) days supply consisting of petroleum crude oil and refined petroleum products. Under the DC, required minimum inventories shall include petroleum crude oil and product stock, on shore and en-route to stock points within the country, but shall exclude importations still in-transit to the country.

The vulnerability assessment of the energy sector to COVID-19 shows that coal and oil are highly susceptible fuels due to increased probability of manpower exposure to COVID-19. Imposition of quarantine requirements by both the exporting and importing country could cause delays to supply delivery. Aside from this, energy security is threatened should a source country limits its export volume and/or the risk of receiving port closures.[22] These situations can hamper supply to coal power plants which will result in baseload curtailment, or consequently, may lead to rotational power interruption in some areas should there be no alternative source to coal.

Aside from the impact of quarantine measures, there is also a global deal to cut oil production by more than 10% or about 10 million barrels per day among OPEC+ countries in a bid to help erase the imbalance between falling demand and excessive supply that has plunged crude prices by around 60%[x]. Amidst the planned supply cuts, if the price will continue to fall, producing countries might be forced to stop production. Stockpiles continue to build owing to the crash in demand caused by the COVID-19 pandemic[xii], which may pose a threat to refinery capacities and may require reduction in importation.

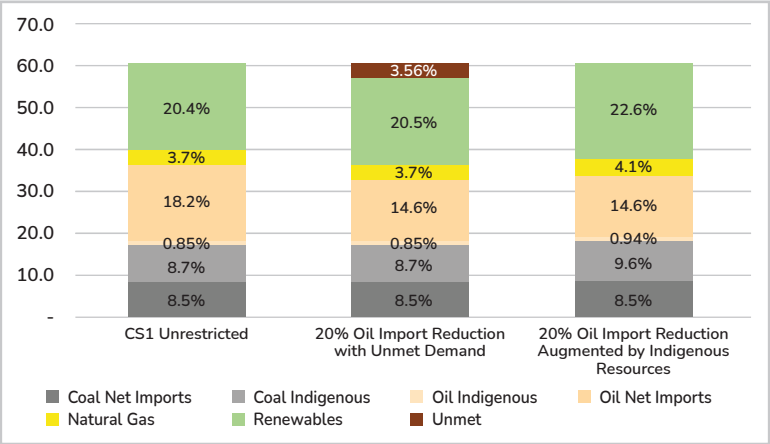
[20] Rules and Procedures for Implementing Department Circular No. 2010-03-0003 and Creating the Grid Reliability Task Force

[21] Guidelines Implementing the Minimum Inventory Requirements of Oil Companies and Bulk Suppliers as Provided under Executive Order No. 134

[22] The Philippines's energy security will be adversely affected should Indonesia, its top coal supplier for power generation, limit coal exports.

For these reasons, a new energy mix is needed to meet demand while mitigating the risk of decreased imports caused by the impact of COVID19. Consequently, there is a need to determine how long the country's own energy resources can meet demand. To answer these queries, a sensitivity analysis was conducted for coal and oil as follows: a 10% reduction applied separately on either import volume of coal or oil, a 10% reduction applied on the aggregate volume of coal and oil, and, increasing the reduction percentage from 10% to 20% *(Figure 14)*.

Figure 14: Comparative TPES (Net Imports and Indigenous) under CS1 unrestricted, with 20% Reduction in Oil Imports and Augmented by Indigenous Resources



- Under the BAU or normal condition, TPES is expected to reach 62.3 MTOE with a self-sufficiency level of 54.3%. Restricting imports by 10% to 20% will result in unmet demand ranging from 1.6 MTOE to 3.8 MTOE. Any reduction in the volume of coal imports affects the level of power generation since coal accounts for 47.2% of the total fuel input to it. On the other hand, any possible reduction in oil imports will be felt in end-use sectors, particularly the transport sector as the fuel accounts for 95.9% of its requirements under the BAU.

- From a TPES level of 60.5 MTOE under CS1, this may be reduced by external shocks to importations (production cuts by OPEC, restrictions by source countries, etc.) resulting to unmet demand ranging between 1.4 MTOE to 3.6 MTOE – the latter figure being equal to half the size

of the industry sector's energy consumption in 2020 under the same scenario. Indigenous production can be expected to augment this reduction - when there is a 20% reduction in oil imports, aggregate domestic resources must ramp up their production by as much as 10%.

- Among indigenous resources, renewable sources and natural gas are expected to compensate for the reduction in imports, including improvements in domestic production of oil and coal. Equivalently, with lower import volume and ramped up domestic production, self-sufficiency is expected to increase vis-à-vis an unrestricted CS1 *(Annex 1 Table 21)*.

- Depressed energy demand under the CS2 due to the unabated impact of COVID-19 leads to a TPES level of 59.4 MTOE. Resulting restrictions in importations as cited previously leads to unmet demand that is slightly lower than CS1. Again, it is expected that indigenous resources will increase their share in the energy mix to compensate for the reduction in imports, hence self-sufficiency will likely improve *(Annex 1 Table 21)*.

Since the Philippines is largely dependent on imported coal and oil to meet its domestic requirements, a drastic reduction with 20% and above will be infeasible. Thus, maximizing indigenous resources is necessary to sustain the country's energy requirement by taking *full advantage of targeted production and utilizing the proven reserves of coal, oil, and natural gas as well as tapping renewable resources to reduce reliance on imported coal particularly for power generation*. Coal indigenous production which is usually exported can be tapped for our own requirement as in the case of the 300 MW unit of Sem-Calaca coal power plant which is designed to use brown coal as a fuel. For end-use sectors, it is important to look at alternative sources that can diversify the fuel demand mix, such as using electric vehicles in the transport sector.

Aside from maximizing our natural resources and fuel diversification on end-use, there is never more need than now to intensify the energy sector's campaign on energy efficiency and conservation as well as implement the provisions of the Energy Efficiency and Conservation Law.

F. Conclusions

1. Energy Demand

✓ Under the COVID Scenario 1 (CS1), the TFEC would register a sluggish increase of 1.0%, down by 3.5 percentage points from the projected growth under BAU as economic output is expected to register a 4.3% increase in 2020 – lower than its pre-COVID/BAU target of 7.3% assuming that ECQ will be lifted by 30 April 2020.

- The transport sector is expected to bear the brunt of ECQ implemented from 17 March to 30 April 2020 as consumption levels are expected to decline by 1.3% vis-à-vis 2019. On the other, other economic sectors projected to register higher energy consumption than 2019 although at a slower rate compared to their BAU levels. Alternative work from home (WFH) schemes and strict "stay-at-home" practices is seen to push residential energy consumption to increase by 2.7%, slightly faster than its BAU trend.
- Aggregate oil demand (including non-energy and fuel input to power generation) under CS1 will be 1.0% lower than 2019, indicating a slowdown from its 4.3% hike under BAU attributable to the deceleration in oil consumption in all sectors, except households, while here is an 18.8% contraction in fuel input to power generation.
- Electricity consumption is expected to register a 4.5% increase under CS1, down by 2.7 percentage points from its growth under BAU as all economic sectors, except households, are expected to have lower usage due to ECQ. On the other hand, *strict adherence to stay at home directive, as well as setting up of work-from-home (WFH) scheme due to ECQ, will push electricity consumption in the residential sector to increase the fastest among sectors.*

✓ With prolonged ECQ beyond April 30, a possible contraction of the economic output by 0.6% leads to a 0.7% reduction in TFEC for 2020, down by 5.2 percentage points from the projected growth under BAU.

- Output producing sectors – AFF, industry and commercial and transport register declines in consumption levels vis-à-vis 2019. On the other hand, household energy consumption is expected to register the fastest growth at 3.3% under the CS2 scenario.

- With the prolonged ECQ, aggregate oil demand (including non-energy and fuel input to power generation) under CS2 will be 2.5% lower than 2019 (6.8 percentage points), reversing its 4.3% hike under BAU attributable to the contraction in oil consumption in the commercial sector and in power plants, combined with further deceleration in other end-use sectors.

- Electricity consumption registers a meager 0.3% increase vis-à-vis 2019, shelving off 6.9 percentage points from its growth under the BAU. The residential sector registers the fastest and only positive increment of 7.6% under CS2.

2. Energy Supply

✓ Under this CS1 scenario, the country's TPES grows moderately at 0.1% or *3.0 percentage points lower than the BAU*. The country's primary energy requirement will be supported by oil (31.5% share), followed by coal (28.5% share), geothermal (15.2%) and biomass (13.1%). The impending threats for the reduction of coal and oil imports due to the risk associated with it will pave the way for higher utilization of indigenous supply i.e., oil, coal, gas, and, renewable energy for power generation. Thus, the share of renewables is expected to increase at 33.8% compared to 32.9% under the BAU compensating for the anticipated reduction in oil and coal imports.

✓ Under the CS2 scenario, the country's TPES shrinks by 1.6% or *4.7 percentage points lower than the BAU* due to the continued restriction in the operation of non-essentials which relies heavily on electricity.

3. Environmental Impact

- ✓ The GHG emission is expected to reach 136.8 $MTCO_2e$ under the CS1 and 133.1 $MTCO_2e$ under CS2 with growth rates of 2.0% and negative 0.7%, respectively, as compared to the 2019 levels. The positive impact on GHG emission under both the COVID19 Scenarios could be attributed to the decreased energy demand and preference for indigenous supply due to the risk associated with imported fuels.

- ✓ Despite the negative impact of COVID-19 in the country, it cannot be denied that it has positive impacts on health and the environment as well. The ambient air quality has improved given the restrictions imposed on mass transportation and the limited movement of people/ vehicles as particulate matter (PM) under the CS1 is estimated to be at 39.1 MT and 38.1 MT under CS2 – levels that are relatively lower than the 2019 and 2020 BAU.

- ✓ Among end-use sectors, transport accounts for close to half of the PM, albeit registering reductions of 1.3% and 2.7% under the CS1 and CS2, respectively.

4. Risk Analysis for Coal and Oil Imports

- ✓ The country is a net importer of coal and oil. The supply of coal and oil is at risk with the increased probability of personnel exposure to COVID-19, which entails the imposition of quarantine requirements by both the exporting and importing country, causing a delay in supply delivery. Aside from this, there is also a threat of receiving port closure, limiting of source country's export volume, and increasing energy security concerns. There is also a global deal to cut oil production by more than 10% or about 10 million barrels per day among OPEC+ countries to help ease the imbalance between falling demand and excessive supply. The risk associated with the delivery of coal supply to power plants may lead to load curtailment and rotational power interruptions while low demand and falling prices challenge oil storage capacity.

G. Summary of COVID-19 Impacts to Energy Supply and Consumption for 2020

Table 22 below presents the summary of COVID19 Impacts on Energy Supply and Consumption.

	COVID Scenario 1 vis-à-vis BAU	COVID Scenario 2 vis-à-vis BAU
Changes in Total Final Energy Consumption, by Sector		
Industry	↓ **3.3% or 279.0 kTOE** • Energy consumption declines caused by suspended work and operation of non-essential industries.	↓ **6.3% or 523.0 kTOE** • Prolonged closure of factories forces industrial output to drop, and energy consumption follows; electricity registers reduction of 3.8%
Commercial	↓ **3.0% or 156.9 kTOE** • Reduced operating hours for commercial establishments of nonessentials slows down energy consumption.	↓ **7.0% or 359.3 kTOE** • Extended lockdown caused major commercial establishments to close, makes electricity and oil drop by 3.1% and 2.3%, respectively.
Transport	↓ **6.3% or 842.5 kTOE** • Limited travel via land, air, and water in Luzon and large cities in the Visayas and Mindanao; air transport contracts significantly by 19%.	↓ **7.6% or 1,020 kTOE** • Continued Luzon-wide ECQ restrictions on travel and on mass transportation; air transport contracts by more than 20%.
Agri., Fishery and Forestry	↓ **5.9% or 30.4 kTOE** • Restricted movement of agricultural products and limited distribution markets	↓ **10.0% or 51.0 kTOE** • Heightened limitations in the transporting of agriculture harvests, including farm inputs such as fertilizers.
Residential	↓ **0.6% or 57.9 kTOE** • Increase in consumption due to implementation of work-from-home (WFH) scheme.	↓ **1.2% or 116.7 kTOE** • Extended lockdown under ECQ hikes residential demand; residential sector becomes the biggest consumer of electricity.
TFEC	↓ **3.4% or 1,304.4 kTOE**	↓ **5.0% or 1,912.2 kTOE**
Changes in Total Primary Energy Supply		
	↓ **2.9% or 1.8 MTOE** • Reduced imports due to global restriction of movements increase indigenous supply, i.e., natural gas, RE, among others. • Stoppage in the operation of non-essential establishments lowers supply requirement in the transformation.	4.6% or 2.8 MTOE • Increased share of indigenous resources, particularly RE to augment supply cuts on imported fuels such as coal and oil. • Continued non-operation of energy-intensive sectors relying heavily on electricity lowers supply requirement in the transformation sector.

H. Recommendations

Short-term (2020-2021)

✓ **Strengthen institutional arrangement with relevant agency for the timely delivery of imported fuels.**

Coordinate with the Bureau of Customs to expedite the process of energy-related imports during an impending crisis on energy or other issues that will impact the reduction of energy imports, address the possible delays in the delivery of coal and oil due to the imposition of quarantine requirements upon the arrival of goods at the port area.

✓ **Monitor the implementation of the Energy Efficiency and Conservation Law and consider the new pattern of sectoral energy consumption.**

Encourage efficient use of oil in the demand-side specifically transport sector and electricity consumption to cushion the impact of the threats of supply cuts on imports from the producing countries.

✓ **Explore other alternative fuels in the transport sector to lessen the dependence on imported oil.**

The transport sector consumes the bulk of the oil supply. The only alternative fuel for the transport sector is electricity, gas, and biofuels for now. Hence, it is difficult to mitigate the adverse effect of oil imports disruptions.

✓ **Consider allocating a bigger portion for finished petroleum products in the country's oil imports**

Importing more petroleum products rather than crude is more efficient in terms of output energy as this will reduce the losses in the refining process. It will also reduce the risk of COVID-19 infection in its manpower due to lesser activity.

✓ **Conduct a study for oil stockpiling.**

After the COVID19 pandemic, the government is drafting a recovery program that will lead to the development of the countryside through the "Balik Probinsya Program" and the Stimulus Package for the Recovery Program proposals. These programs will spur the economy in the countryside, leading to an increase in the demand for oil in the transport sector. A study is necessary to look for an alternative way to

address the adverse impact of disasters and threats of supply cuts.

✓ **Promote an efficient mass transportation that allows for social distancing measures.**

Public mass transports (i.e., PUBs, LRT/MRT, etc.) reduce the number of vehicles on the road and effectively cuts oil consumption with consideration of strict social distancing should be implemented in these transport modes to combat the spread of the COVID-19 pandemic.

✓ **Improve the standards of gasoline and diesel to improve the ambient air quality.**

A very clear indication of the positive impact of the ECQ is the improvement of ambient air quality brought by the restriction of people and vehicle movement which drastically decreased pollutants in the atmosphere. According to the Environmental Pollution Studies Laboratory of the Institute of Environmental Science and Meteorology at the University of the Philippines-Diliman, data gathered from airtoday.ph stations shows that the levels of PM2.5 (2.5 micrometers or smaller) decreased by 80% to 180% at the Lung Center of the Philippines compound, and by 70% to 90% as measured along EDSA Muñoz, from two weeks to days prior the ECQ. This will lead to positive impacts to health and the environment. To sustain this positive impact, there is a need to improve the standards of the gasoline and diesel by reducing the hazardous substance. This may warrant revisiting the current maximum sulfur content of gasoline and diesel as % mass, which are 0.05% and 0.005%, respectively, based on PNS/DOE QS 008:2018[xiii].

Long-term (2022-2040)

✓ **Tap the indigenous resources by exploring more of our potential coal, oil, and gas resources.**

The country needs to continue tapping its resources by exploring potential resources of fossil fuel and renewable energy source technology to mitigate the adverse impact of impending cuts in coal and oil supply. During the oil embargo in the 1970s, the country was highly dependent on imported oil in transport and power generation. It was during this period that gave birth to exploring indigenous resources like geothermal, coal and oil.

Until now, the country continues to benefit from the blueprint of energy security and diversification by tapping its indigenous resources, i.e., a geothermal source in Bicol and Leyte. While current production targets for 2020 (based on data submitted by Bureaus) fall slightly below the aspirational indigenous production considered under the BAU, CS1 and CS2, there is still room for an increase since there are available and viable reserves.

✓ **Consider increasing the fuel inventory of oil and coal for both the power and non-power**

Power plants are required to have a stock of fuel equivalent to one (1) month while oil companies are required to sustain a minimum inventory level of fifteen (15) days' supply of petroleum products, except LPG, which shall maintain seven (7) days of supply for all Oil Companies and Bulk Suppliers. On the other hand, refiners are obliged to maintain a minimum inventory equivalent to thirty (30) days supply consisting of petroleum crude oil and refined petroleum products. However, there may be a limitation on the storage capacity of energy infrastructure. Thus, this could be applied to new-build infrastructure.

✓ **Explore other baseload technology to replaced coal such as RE and nuclear.**

Coal is mostly used as fuel for baseload Coal is used for baseload generation power plants since it cannot be readily start-up and shut down. There is a need to look for alternative baseload with abundant fuel, which is not vulnerable to supply disruptions and price hikes. Nuclear power may be an alternative technology for this purpose. Uranium which fuels a nuclear power plant is stored for a longer period and does not require large-scale storage space.

✓ **Encourage the construction of new power plants with alternative fuels that are domestically sourced such as RE, i.e., hybrid technology**

Hybrid technology reduces the risk of power interruption, especially for variable sourced energy such as solar and wind, where the source of energy is intermittent. Adoption of hybrid alternatives will cushion the impact of supply disruption from an imported source of energy.

✓ **Implement fully the Energy Efficiency and Conservation Law**

The COVID-19 impact will drastically reduce the energy consumption under the prolonged ECQ scenario or CS2. It seems ironic to push for the conservation of energy in this situation. However, the impending cuts of oil and coal imports from the source country may compromise the domestic energy supply. Thus, one remedy is to drive the implementation of EE&C Law to cushion the impact of reduced supply of coal and oil while promoting energy independence.

Limitations of the Energy Study

The study makes use of the GDP and GVA assumptions of NEDA in its 19 March 2020 report. Any update made by NEDA implies a reassessment of the energy demand and supply.

- The impact assessment accounts for the fullest extent possible the recommendation made by the UP COVID19 Pandemic Response Team regarding the implementation of modified community quarantine after the lifting of the Luzon-wide ECQ on 30 April 2020. In addition, the results have likewise incorporated the effect of partial resumption of operations in several industries and establishments.
- The study uses 2019 as the base year with the preliminary Energy Balance Table (EBT) for 2019 as of 13 April 2020. Changes in the EBT due to the availability of more updated and final data from DOE bureaus may affect base year comparisons.
- The study estimates the Particulate matter (PM) via direct conversion using the following factors: 0.00054 ton/TOE for oil, 0.00021 ton/TOE for natural gas and 0.00167 for coal.
- The study uses the 2020 TPES production targets and reserves of indigenous energy resources as a reference point/level in the estimation. As such, the estimates themselves tend to be higher than targets and may be subject to further review and validation.

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[xi] Alvin P. Ang 1 and Jeremaiah M. Opiniano, Policy Brief, Possible Economic Impacts of Falling Oil Prices, the Pandemic, and the Looming Global Recession onto Overseas Filipinos and their Remittances, 4 April 2020, Ateneo De Manila University

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[xiii] Philippine National Standards (PNS) Catalogue: Petroleum products – E-Gasoline fuel – Specification PNS DOE QS 008:2018

ANNEXES for the Energy Study:

Assessing the Impact of COVID-19 on the Energy Supply and Demand for Full-Year 2020 in the Philippines

(As of April 2020)

Table 7. Total Final Energy Consumption (TFEC): By Sector, 2018, 2019 vs 2020 BAU and COVID19 Scenarios

Sectors	LEVELS (MTOE)					SHARES (%)				GROWTH RATES (%)			
	Actual		2020 Projection			Actual	2020 Projection			2018-2019	2019-2020 Projection		
			Pre-COVID19: BAU	With COVID19			Pre-COVID19: BAU	With COVID19			Pre-COVID19: BAU	With COVID19	
	2018	2019		Scenario 1	Scenario 2	2019		Scenario 1	Scenario 2			Scenario 1	Scenario 2
AFF	0.44	0.47	0.50	0.48	0.46	1.3	1.3	1.3	1.3	7.8	5.2	1.6	-2.8
Industry	7.52	7.94	8.38	8.08	7.84	21.5	21.7	21.7	21.4	5.5	5.5	1.9	-1.2
Commercial	4.67	4.92	5.16	5.00	4.80	13.3	13.4	13.4	13.1	5.3	5.0	1.8	-2.3
Residential	9.43	9.66	9.87	9.93	9.99	26.2	25.6	26.7	27.3	2.5	2.1	2.7	3.3
Transport	12.24	12.69	13.37	12.53	12.35	34.4	34.7	33.7	33.7	3.7	5.4	-1.3	-2.7
Non-Energy	1.42	1.19	1.25	1.19	1.17	3.2	3.2	3.2	3.2	-16.4	4.9	0.4	-1.5
Total	**35.72**	**36.87**	**38.52**	**37.22**	**36.61**	**100.0**	**100.0**	**100.0**	**100.0**	**3.2**	**4.5**	**1.0**	**-0.7**

Table 8. Total Final Energy Consumption (TFEC): By Fuel, 2018, 2019 vs 2020 BAU and COVID19 Scenarios

Fuel	LEVELS (MTOE)					SHARES (%)				GROWTH RATES (%)			
	Actual		2020 Projection			Actual	2020 Projection			2018-2019	2019-2020 Projection		
			Pre-COVID19: BAU	With COVID19			Pre-COVID19: BAU	With COVID19			Pre-COVID19: BAU	With COVID19	
	2018	2019		Scenario 1	Scenario 2	2019		Scenario 1	Scenario 2			Scenario 1	Scenario 2
Coal	2.57	2.87	2.98	2.91	2.87	7.8	7.7	7.8	7.8	11.4	3.9	1.7	0.1
Natural Gas	0.06	0.06	0.06	0.06	0.06	0.2	0.2	0.2	0.2	3.6	0.4	0.4	0.3
Oil	18.90	19.25	20.07	19.06	18.76	52.2	52.1	51.2	51.2	1.9	4.3	-1.0	-2.5
Biofuels	0.52	0.56	0.59	0.56	0.55	1.5	1.5	1.5	1.5	6.6	5.5	0.3	-1.8
Electricity	7.10	7.54	8.08	7.87	7.56	20.4	21.0	21.2	20.6	6.1	7.2	4.5	0.3
Biomass	7.29	7.33	7.36	7.34	7.39	19.9	19.1	19.7	20.2	0.5	0.4	0.2	0.8
Total	**35.72**	**36.87**	**38.52**	**37.22**	**36.61**	**100.0**	**100.0**	**100.0**	**100.0**	**3.2**	**4.5**	**1.0**	**-0.7**

Table 9. Total Final Energy Consumption (TFEC) in INDUSTRY: By Fuel, 2018, 2019 vs 2020 BAU and COVID19 Scenarios

Fuel	LEVELS (MTOE)					SHARES (%)				GROWTH RATES (%)			
	Actual		2020 Projection			Actual	2020 Projection			2018-2019	2019-2020 Projection		
			Pre-COVID19: BAU	With COVID19			Pre-COVID19: BAU	With COVID19			Pre-COVID19: BAU	With COVID19	
	2018	2019		Scenario 1	Scenario 2	2019		Scenario 1	Scenario 2			Scenario 1	Scenario 2
Coal	2.41	2.67	2.78	2.71	2.68	33.7	33.2	33.6	34.1	10.9	3.9	1.5	0.1
Natural Gas	0.06	0.06	0.06	0.06	0.06	0.8	0.7	0.8	0.8	3.6	0.4	0.4	0.3
Petroleum	1.47	1.46	1.55	1.50	1.47	18.5	18.6	18.5	18.7	-0.3	6.1	2.3	0.1
LPG	0.20	0.17	0.20	0.18	0.18	2.2	2.3	2.3	2.3	-12.1	13.1	6.7	3.4
Kerosene	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	0.0	-5.1	28.0	5.0	-2.0
Diesel	0.69	0.75	0.79	0.76	0.75	9.5	9.4	9.4	9.5	8.8	5.0	1.1	-0.9
Fuel Oil	0.58	0.54	0.57	0.55	0.54	6.8	6.7	6.8	6.9	-7.2	5.5	2.5	0.6
Biodiesel	0.01	0.01	0.02	0.02	0.01	0.2	0.2	0.2	0.2	8.3	7.4	3.4	1.4
Electricity	2.37	2.52	2.68	2.58	2.42	31.7	32.0	31.9	30.9	6.1	6.6	2.4	-3.8
Biomass	1.20	1.21	1.29	1.22	1.20	15.2	15.3	15.1	15.3	0.7	6.5	1.1	-0.4
Total Industry	**7.52**	**7.94**	**8.38**	**8.08**	**7.84**	**100.00**	**100.00**	**100.00**	**100.00**	**5.5**	**5.5**	**1.9**	**-1.2**

Table 10. Total Final Energy Consumption (TFEC) in COMMERCIAL: By Fuel, 2018, 2019 vs 2020 BAU and COVID19 Scenarios

Fuel	LEVELS (MTOE)					SHARES (%)				GROWTH RATES (%)			
	Actual		2020 Projection			Actual	2020 Projection			2018-2019	2019-2020 Projection		
			Pre-COVID19: BAU	With COVID19			Pre-COVID19: BAU	With COVID19			Pre-COVID19: BAU	With COVID19	
	2018	2019		Scenario 1	Scenario 2	2019		Scenario 1	Scenario 2			Scenario 1	Scenario 2
Petroleum	2.22	2.34	2.39	2.34	2.29	47.6	46.4	46.8	47.6	5.2	2.4	0.1	-2.3
LPG	0.51	0.50	0.52	0.52	0.52	10.1	10.1	10.5	10.8	-2.3	5.3	5.7	4.8
Diesel	1.57	1.71	1.73	1.68	1.64	34.7	33.5	33.5	34.1	8.8	1.1	-1.7	-4.2
Fuel Oil	0.15	0.14	0.15	0.14	0.13	2.8	2.9	2.8	2.8	-7.2	7.7	1.3	-3.8
Biodiesel	0.03	0.03	0.03	0.03	0.03	0.7	0.7	0.7	0.7	8.3	3.5	0.7	0.1
Electricity	2.07	2.19	2.37	2.27	2.12	44.6	46.0	45.4	44.2	6.1	8.3	3.6	-3.1
Biomass	0.35	0.35	0.36	0.36	0.36	7.2	6.9	7.2	7.5	0.7	1.7	1.7	1.6
Total Commercial	**4.67**	**4.92**	**5.16**	**5.00**	**4.80**	**100.00**	**100.00**	**100.00**	**100.00**	**5.3**	**5.0**	**1.8**	**-2.3**

Table 11. **Total Final Energy Consumption (TFEC) in TRANSPORT: By Fuel, 2018, 2019 vs 2020 BAU and COVID19 Scenarios**

Fuel	LEVELS (MTOE)					SHARES (%)				GROWTH RATES (%)			
	Actual		2020 Projection			Actual	2020 Projection			2018-2019	2019-2020 Projection		
			Pre-COVID19: BAU	With COVID19			Pre-COVID19: BAU	With COVID19			Pre-COVID19: BAU	With COVID19	
	2018	2019		Scenario 1	Scenario 2	2019		Scenario 1	Scenario 2			Scenario 1	Scenario 2
Petroleum	11.75	12.17	12.83	12.01	11.85	95.9	95.9	95.9	95.9	3.6	5.4	-1.3	-2.7
LPG	0.01	0.01	0.01	0.01	0.01	0.1	0.1	0.1	0.1	-12.1	6.9	-0.6	-3.8
Aviation Gasoline	0.00	0.01	0.01	0.01	0.00	0.0	0.0	0.0	0.0	5.6	3.5	-3.8	-8.9
Gasoline	4.50	4.87	5.15	4.90	4.82	38.4	38.5	39.1	39.0	8.1	5.7	0.5	-1.0
Jet Fuel	0.58	0.62	0.65	0.50	0.48	4.9	4.9	4.0	3.9	7.3	4.7	-19.1	-22.4
Diesel	6.45	6.48	6.81	6.41	6.34	51.1	51.0	51.2	51.4	0.4	5.2	-1.1	-2.1
Fuel Oil	0.20	0.19	0.20	0.19	0.19	1.5	1.5	1.5	1.5	-7.2	5.5	1.4	-1.1
Biodiesel	0.13	0.13	0.13	0.13	0.12	1.0	1.0	1.0	1.0	0.2	5.2	-1.1	-2.1
Ethanol	0.35	0.38	0.40	0.38	0.37	3.0	3.0	3.0	3.0	8.6	5.7	0.5	-2.0
Electricity	0.01	0.01	0.01	0.01	0.01	0.1	0.1	0.1	0.1	1.0	9.0	4.1	-1.0
Total Transport	**12.24**	**12.69**	**13.37**	**12.53**	**12.35**	**100.00**	**100.00**	**100.00**	**100.00**	**3.7**	**5.4**	**-1.3**	**-2.7**

Table 12. **Total Final Energy Consumption (TFEC) in RESIDENTIAL: By Fuel, 2018, 2019 vs 2020 BAU and COVID19 Scenarios**

Fuel	LEVELS (MTOE)					SHARES (%)				GROWTH RATES (%)			
	Actual		2020 Projection			Actual	2020 Projection			2018-2019	2019-2020 Projection		
			Pre-COVID19: BAU	With COVID19			Pre-COVID19: BAU	With COVID19			Pre-COVID19: BAU	With COVID19	
	2018	2019		Scenario 1	Scenario 2	2019		Scenario 1	Scenario 2			Scenario 1	Scenario 2
Petroleum	1.25	1.31	1.39	1.39	1.38	13.6	14.1	14.0	13.8	4.6	6.1	6.2	5.1
LPG	1.18	1.24	1.32	1.32	1.30	12.8	13.4	13.3	13.1	5.4	6.6	6.2	5.2
Kerosene	0.08	0.07	0.07	0.08	0.07	0.7	0.7	0.8	0.8	-8.1	-4.0	5.3	3.7
Electricity	2.43	2.58	2.76	2.77	2.77	26.7	28.0	27.9	27.8	6.1	7.0	7.4	7.6
Biomass	5.75	5.77	5.72	5.76	5.83	59.7	57.9	58.1	58.4	0.4	-0.9	-0.1	1.1
Total Residential	**9.43**	**9.66**	**9.87**	**9.93**	**9.99**	**100.00**	**100.00**	**100.00**	**100.00**	**2.5**	**2.1**	**2.7**	**3.3**

Table 13. Total Final Energy Consumption (TFEC) in AFF: By Fuel, 2018, 2019 vs 2020 BAU and COVID19 Scenarios

Fuel	LEVELS (MTOE)					SHARES (%)				GROWTH RATES (%)			
	Actual		2020 Projection			Actual	2020 Projection			2018-2019	2019-2020 Projection		
			Pre-COVID19: BAU	With COVID19			Pre-COVID19: BAU	With COVID19			Pre-COVID19: BAU	With COVID19	
	2018	2019		Scenario 1	Scenario 2	2019		Scenario 1	Scenario 2			Scenario 1	Scenario 2
Petroleum	208.03	227.58	236.97	229.40	224.43	48.0	47.6	47.7	48.7	9.4	4.1	0.8	-1.4
Kerosene	0.40	0.38	0.35	0.35	0.35	0.1	0.1	0.1	0.1	-5.1	-7.8	-7.8	-7.8
Diesel	199.88	217.53	226.91	219.34	214.38	45.9	45.5	45.6	46.5	8.8	4.3	0.8	-1.5
Gasoline	7.06	9.03	9.04	9.04	9.04	1.9	1.8	1.9	2.0	28.0	0.1	0.1	0.1
Fuel Oil	0.69	0.64	0.66	0.66	0.66	0.1	0.1	0.1	0.1	-7.2	3.9	3.9	3.9
Biodiesel	3.87	4.19	4.48	4.33	4.23	0.9	0.9	0.9	0.9	8.3	6.8	3.2	0.9
Electricity	227.65	241.98	256.80	247.60	231.99	51.1	51.5	51.4	50.4	6.3	6.1	2.3	-4.1
Total AFF	**439.55**	**473.76**	**498.24**	**481.32**	**460.66**	**100.00**	**100.00**	**100.00**	**100.00**	**7.8**	**5.2**	**1.6**	**-2.8**

Table 14. Total Oil Demand, by Sector: 2018, 2019 vs 2020 BAU and COVID19 Scenarios

Sectors	LEVELS (MTOE)					SHARES (%)				GROWTH RATES (%)			
	Actual		2020 Projection			Actual	2020 Projection			2018-2019	2019-2020 Projection		
			Pre-COVID19: BAU	With COVID19			Pre-COVID19: BAU	With COVID19			Pre-COVID19: BAU	With COVID19	
	2018	2019		Scenario 1	Scenario 2	2019		Scenario 1	Scenario 2			Scenario 1	Scenario 2
AFF	0.21	0.23	0.24	0.23	0.22	1.2	1.2	1.2	1.2	9.4	4.1	0.8	-1.4
Industry	1.47	1.46	1.55	1.50	1.47	7.6	7.7	7.9	7.8	-0.3	6.1	2.3	0.1
Commercial	2.22	2.34	2.39	2.34	2.29	12.2	11.9	12.3	12.2	5.2	2.4	0.1	-2.3
Residential	1.25	1.31	1.39	1.39	1.38	6.8	6.9	7.3	7.4	4.6	6.1	6.2	5.1
Transport	11.75	12.17	12.83	12.01	11.85	63.2	63.9	63.0	63.1	3.6	5.4	-1.3	-2.7
Non-Energy	1.26	1.00	1.05	0.99	0.98	5.2	5.2	5.2	5.2	-21.0	5.1	-0.2	-1.8
Fuel Input to Power	0.73	0.74	0.62	0.60	0.58	3.8	3.1	3.1	3.1	1.0	-16.3	-18.8	-21.0
Total	**18.90**	**19.25**	**20.07**	**19.06**	**18.76**	**100.00**	**100.00**	**100.00**	**100.00**	**1.9**	**4.3**	**-1.0**	**-2.5**

Table 15. Total Oil Demand, by Product: 2018, 2019 vs 2020 BAU and COVID19 Scenarios

Product	LEVELS (MTOE)					SHARES (%)				GROWTH RATES (%)			
	Actual		2020 Projection			Actual	2020 Projection			2018-2019	2019-2020 Projection		
			Pre-COVID19: BAU	With COVID19			Pre-COVID19: BAU	With COVID19			Pre-COVID19: BAU	With COVID19	
	2018	2019		Scenario 1	Scenario 2	2019		Scenario 1	Scenario 2			Scenario 1	Scenario 2
LPG	1.89	1.92	2.05	2.03	2.01	10.0	10.2	10.7	10.7	1.4	6.9	6.1	4.9
Gasoline	4.51	4.88	5.16	4.90	4.83	25.4	25.7	25.7	25.7	8.2	5.7	0.5	-1.0
Jet Fuel	0.58	0.62	0.65	0.50	0.48	3.2	3.2	2.6	2.6	7.3	4.7	-19.1	-22.4
Aviation Gasoline	0.00	0.01	0.01	0.01	0.00	0.0	0.0	0.0	0.0	5.6	3.5	-3.8	-8.9
Kerosene	0.08	0.07	0.07	0.08	0.08	0.4	0.4	0.4	0.4	-8.0	-3.2	5.2	3.5
Diesel	9.29	9.56	9.88	9.38	9.25	49.7	49.2	49.2	49.3	3.0	3.3	-1.9	-3.3
Fuel Oil	1.28	1.19	1.20	1.16	1.13	6.2	6.1	6.1	6.0	-7.2	1.0	-2.5	-4.9
Other PP	1.26	1.00	1.05	0.99	0.98	5.2	5.2	5.2	5.2	-21.0	5.1	-0.2	-1.8
Total	**18.90**	**19.25**	**20.07**	**19.06**	**18.76**	**100.00**	**100.00**	**100.00**	**100.00**	**1.9**	**4.3**	**-1.0**	**-2.5**

Table 16. Total Electricity Demand, by Sector: 2018, 2019 vs 2020 BAU and COVID19 Scenarios

Fuel	LEVELS (MTOE)					SHARES (%)				GROWTH RATES (%)			
	Actual		2020 Projection			Actual	2020 Projection			2018-2019	2019-2020 Projection		
			Pre-COVID19: BAU	With COVID19			Pre-COVID19: BAU	With COVID19			Pre-COVID19: BAU	With COVID19	
	2018	2019		Scenario 1	Scenario 2	2019		Scenario 1	Scenario 2			Scenario 1	Scenario 2
AFF	227.65	241.98	256.80	247.60	231.99	3.2	3.2	3.1	3.1	6.3	6.1	2.3	-4.1
Industry	2,372.08	2,516.63	2,682.58	2,576.28	2,420.13	33.4	33.2	32.7	32.0	6.1	6.6	2.4	-3.8
Commercial	2,065.03	2,190.86	2,371.83	2,270.37	2,122.71	29.1	29.4	28.8	28.1	6.1	8.3	3.6	-3.1
Residential	2,429.99	2,578.06	2,758.89	2,769.53	2,773.13	34.2	34.1	35.2	36.7	6.1	7.0	7.4	7.6
Transport	9.05	9.14	9.96	9.51	9.04	0.1	0.1	0.1	0.1	1.0	9.0	4.1	-1.0
Total Electricity	**7,103.79**	**7,536.67**	**8,080.06**	**7,873.29**	**7,557.01**	**100.00**	**100.00**	**100.00**	**100.00**	**6.1**	**7.2**	**4.5**	**0.3**

Table 17. Total Primary Energy Supply, by Source: 2018, 2019 vs 2020 BAU and COVID19 Scenarios

Fuel	LEVELS (MTOE)					SHARES (%)				GROWTH RATES (%)			
	Actual		2020 Projection			Actual	2020 Projection			2018-2019	2019-2020 Projection		
			Pre-COVID19: BAU	With COVID19			Pre-COVID19: BAU	With COVID19			Pre-COVID19: BAU	With COVID19	
	2018	2019		Scenario 1	Scenario 2	2019		Scenario 1	Scenario 2			Scenario 1	Scenario 2
Coal	16.35	17.42	17.95	17.21	16.70	28.8	28.8	28.5	28.1	6.6	3.0	-1.2	-4.1
Natural Gas	3.60	3.63	3.76	3.74	3.49	6.0	6.0	6.2	5.9	0.7	3.6	3.2	-3.6
Oil	19.99	19.31	20.07	19.06	18.76	32.2	32.2	31.5	31.6	-3.4	3.9	-1.3	-2.8
Renewable	19.72	20.06	20.49	20.44	20.47	32.9	32.9	33.8	34.5	1.7	2.2	1.9	2.1
Hydro	2.34	2.40	2.52	2.52	2.52	4.1	4.1	4.2	4.2	2.9	4.9	4.9	4.9
Geothermal	8.97	9.16	9.20	9.19	9.19	14.8	14.8	15.2	15.5	2.1	0.4	0.4	0.3
Solar	0.11	0.11	0.15	0.14	0.14	0.2	0.2	0.2	0.2	6.6	26.9	26.5	26.0
Wind	0.10	0.10	0.12	0.12	0.12	0.2	0.2	0.2	0.2	1.9	19.8	19.5	19.2
Biomass	7.67	7.71	7.91	7.89	7.94	12.7	12.7	13.1	13.4	0.5	2.7	2.4	3.0
Biofuels	0.53	0.57	0.59	0.56	0.55	0.9	0.9	0.9	0.9	6.6	4.1	-1.1	-3.1
TPES	**59.66**	**60.42**	**62.27**	**60.46**	**59.43**	**100.0**	**100.0**	**100.0**	**100.0**	**1.3**	**3.1**	**0.1**	**-1.6**
Self-Sufficiency (%)	*50.2%*	*51.7%*	*54.3%*	*55.9%*	*56.9%*								

Table 18. Total Fuel Input, by Source: 2012018, 2019 vs 2020 BAU and COVID19 Scenarios

Fuel	LEVELS (MTOE)					SHARES (%)				GROWTH RATES (%)			
	Actual		2020 Projection			Actual	2020 Projection			2018-2019	2019-2020 Projection		
			Pre-COVID19: BAU	With COVID19			Pre-COVID19: BAU	With COVID19			Pre-COVID19: BAU	With COVID19	
	2018	2019		Scenario 1	Scenario 2	2019		Scenario 1	Scenario 2			Scenario 1	Scenario 2
Coal	13.78	14.55	14.97	14.30	13.83	47.2	47.0	46.0	45.5	5.7	2.9	-1.8	-5.0
Natural Gas	3.32	3.41	3.70	3.68	3.43	11.0	11.6	11.8	11.3	2.6	8.4	8.0	0.7
Oil	0.73	0.74	0.62	0.60	0.58	2.4	1.9	1.9	1.9	1.0	-16.3	-18.8	-21.0
Renewable	11.90	12.17	12.54	12.53	12.53	39.4	40.3	40.3	41.3	2.3	3.1	3.0	3.0
Hydro	2.34	2.40	2.52	2.52	2.52	7.8	8.1	8.1	8.3	2.9	4.9	4.9	4.9
Geothermal	8.97	9.16	9.20	9.19	9.19	29.7	29.6	29.6	30.3	2.1	0.4	0.4	0.3
Solar	0.11	0.11	0.15	0.14	0.14	0.4	0.5	0.5	0.5	6.6	26.9	26.5	26.0
Wind	0.10	0.10	0.12	0.12	0.12	0.3	0.4	0.4	0.4	1.9	19.8	19.5	19.2
Biomass	0.37	0.38	0.55	0.55	0.55	1.2	1.8	1.8	1.8	1.0	46.2	45.9	45.8
Biofuels	0.01	0.01	0.00	0.00	0.00	0.0	0.0	0.0	0.0	8.3	-84.9	-85.3	-85.7
Total Input	**29.72**	**30.87**	**31.82**	**31.11**	**30.38**	**100.0**	**100.0**	**100.0**	**100.0**	**3.8**	**3.1**	**0.8**	**-1.6**

Table 19. Total Greenhouse Gas (GHG) Emission, by Fuel and by Sector: 2018, 2019 vs 2020 BAU and COVID19 Scenarios

Fuel Source	LEVELS ($MTCO_2e$)					SHARES (%)				GROWTH RATES (%)			
	Actual		2020 Projection			Actual	2020 Projection			2018-2019	2019-2020 Projection		
			Pre-COVID19: BAU	With COVID19			Pre-COVID19: BAU	With COVID19			Pre-COVID19: BAU	With COVID19	
	2018	2019		Scenario 1	Scenario 2	2019		Scenario 1	Scenario 2			Scenario 1	Scenario 2
Natural Gas	8.4	8.2	8.7	8.4	8.1	6.1	6.1	6.2	6.1	-3.3	6.3	3.6	-0.5
Coal	63.2	69.1	73.2	71.7	69.7	51.5	51.7	52.4	52.3	9.3	6.0	3.8	0.9
Oil	51.7	56.8	59.7	56.6	55.3	42.4	42.2	41.4	41.6	9.8	5.2	-0.3	-2.6
Total GHG	**123.3**	**134.0**	**141.6**	**136.8**	**133.1**	**100.00**	**100.00**	**100.00**	**100.00**	**8.7**	**5.7**	**2.0**	**-0.7**

Sector	LEVELS ($MTCO_2e$)					SHARES (%)				GROWTH RATES (%)			
	Actual		2020 Projection			Actual	2020 Projection			2018-2019	2019-2020 Projection		
			Pre-COVID19: BAU	With COVID19			Pre-COVID19: BAU	With COVID19			Pre-COVID19: BAU	With COVID19	
	2018	2019		Scenario 1	Scenario 2	2019		Scenario 1	Scenario 2			Scenario 1	Scenario 2
Transformation	64.5	68.7	73.1	71.4	68.7	51.3	51.6	62.2	51.6	6.5	6.4	3.9	0.0
Industry	14.0	15.4	16.0	15.6	15.4	11.5	11.3	11.4	11.5	9.7	4.5	1.7	0.1
Transport	34.4	37.1	39.0	36.6	36.0	27.6	27.6	26.7	27.1	7.8	5.4	-1.3	-2.7
Others	10.5	12.9	13.4	13.2	13.0	9.6	9.5	9.7	9.8	23.5	4.0	2.4	0.6
Total GHG	**123.3**	**134.0**	**141.6**	**136.8**	**133.1**	**100.0**	**100.0**	**100.0**	**100.0**	**8.7**	**5.7**	**2.0**	**-0.7**

Table 20. Total Particulate Matter (PM) Emission, by Fuel and by Sector: 2018, 2019 vs 2020 BAU and COVID19 Scenarios

Fuel Source	LEVELS (MT)					SHARES (%)				GROWTH RATES (%)			
	Actual		2020 Projection			Actual	2020 Projection			2018-2019	2019-2020 Projection		
			Pre-COVID19: BAU	With COVID19			Pre-COVID19: BAU	With COVID19			Pre-COVID19: BAU	With COVID19	
	2018	2019		Scenario 1	Scenario 2	2019		Scenario 1	Scenario 2			Scenario 1	Scenario 2
Natural Gas	0.7	0.7	0.8	0.8	0.7	1.8	1.9	2.0	1.9	2.6	8.3	7.9	0.7
Coal	27.1	28.9	29.7	28.5	27.6	73.0	72.7	72.8	72.6	6.4	3.0	-1.2	-4.2
Oil	9.6	9.9	10.4	9.8	9.7	25.1	25.3	25.2	25.4	3.5	4.2	-1.0	-2.5
Total PM	**37.4**	**39.5**	**40.9**	**39.1**	**38.1**	**100.00**	**100.00**	**100.00**	**100.00**	**5.6**	**3.4**	**-1.0**	**-3.7**

Sector	LEVELS (MT)					SHARES (%)				GROWTH RATES (%)			
	Actual		2020 Projection			Actual	2020 Projection			2018-2019	2019-2020 Projection		
			Pre-COVID19: BAU	With COVID19			Pre-COVID19: BAU	With COVID19			Pre-COVID19: BAU	With COVID19	
	2018	2019		Scenario 1	Scenario 2	2019		Scenario 1	Scenario 2			Scenario 1	Scenario 2
Transformation	24.2	25.5	26.2	25.0	24.2	64.5	64.1	64.0	63.6	5.5	2.7	-1.7	-5.1
Industry	4.8	5.3	5.5	5.4	5.3	13.4	13.5	13.7	13.9	9.0	4.3	1.6	0.1
Transport	6.4	6.6	7.0	6.5	6.4	16.8	17.1	16.7	16.9	3.6	5.4	-1.3	-2.7
Others	2.0	2.1	2.2	2.2	2.1	5.3	5.4	5.5	5.6	5.2	3.7	2.2	0.3
Total PM	**37.4**	**39.5**	**40.9**	**39.1**	**38.1**	**100.0**	**100.0**	**100.0**	**100.0**	**5.6**	**3.4**	**-1.0**	**-3.7**

Table 21. Sensitivity Analysis: **Comparative Energy Mix for 2020 for CS1, Import Restricted and with Augmentation by Indigenous Resources**

Fuel Source	CS1 Unrestricted	Import Restricted Scenario with Unmet Demand						Import Restriction is Augmented by Indigenous Resources					
		10% Coal	20% Coal	10% Oil	20% Oil	10% Coal & Oil	20% Coal & Oil	10 % Coal	20% Coal	10% Oil	20% Oil	10% Coal & Oil	20% Coal & Oil
Coal Net Imports	8.51	7.10	5.70	8.51	8.51	7.81	7.10	7.10	5.70	8.51	8.51	7.81	7.10
Coal Indigenous	8.70	8.70	8.70	8.70	8.70	8.70	8.70	9.03	9.31	9.08	9.62	9.05	9.46
Oil Net Imports	18.22	18.22	18.22	16.41	16.60	17.32	16.41	18.22	18.22	16.41	14.60	17.32	16.41
Oil Indigenous	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.89	0.91	0.92	0.94	0.89	0.93
Natural Gas	3.75	3.74	3.74	3.74	0.85	3.74	3.74	3.94	4.10	3.92	4.14	3.94	4.11
Renewables	20.44	20.49	20.49	20.49	3.74	20.49	20.49	21.28	22.23	21.62	22.65	21.46	22.45
Unmet	-	1.35	2.76	1.75	20.49	1.55	3.16						
TPES	**60.46**	**60.46**	**60.46**	**60.46**	**60.46**	**60.46**	**60.46**	**60.46**	**60.46**	**60.46**	**60.46**	**60.46**	**60.46**
Self-Sufficiency	*55.79*							*58.12*	*60.45*	*58.78*	*61.77*	*58.45*	*61.11*

Fuel Source	CS2 Unrestricted	Import Restricted Scenario with Unmet Demand						Import Restriction is Augmented by Indigenous Resources					
		10% Coal	20% Coal	10% Oil	20% Oil	10% Coal & Oil	20% Coal & Oil	10 % Coal	20% Coal	10% Oil	20% Oil	10% Coal & Oil	20% Coal & Oil
Coal Net Imports	8.00	6.65	5.29	8.00	8.00	7.32	6.65	6.65	5.29	8.00	8.00	7.32	6.65
Coal Indigenous	8.70	8.70	8.70	8.70	8.70	8.70	8.70	9.03	9.31	9.16	9.62	9.10	9.46
Oil Net Imports	17.92	17.92	17.92	16.15	14.37	17.03	16.15	17.92	17.92	16.15	14.37	17.03	16.15
Oil Indigenous	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.89	0.91	0.90	0.94	0.89	0.93
Natural Gas	3.49	3.49	3.49	3.49	3.49	3.49	3.49	3.69	3.80	3.68	3.86	3.69	3.83
Renewables	20.47	20.47	20.47	20.47	20.47	20.47	20.47	21.26	22.21	21.56	22.64	21.41	22.42
Unmet	-	1.35	2.71	1.77	3.54	1.56	3.13						
TPES	**59.44**	**59.44**	**59.44**	**59.44**	**59.44**	**59.44**	**59.44**	**59.44**	**59.44**	**59.44**	**59.44**	**59.44**	**59.44**
Self-Sufficiency	*56.40*							*58.67*	*60.95*	*59.38*	*62.36*	*59.02*	*61.65*

Note: Unmet demand is included prior to summing TPES details to show the required TPES level. Rightmost table shows that unmet demand is already augmented by indigenous resources.

Figure 15. **Monthly Pump Prices (Peso/Liter)**

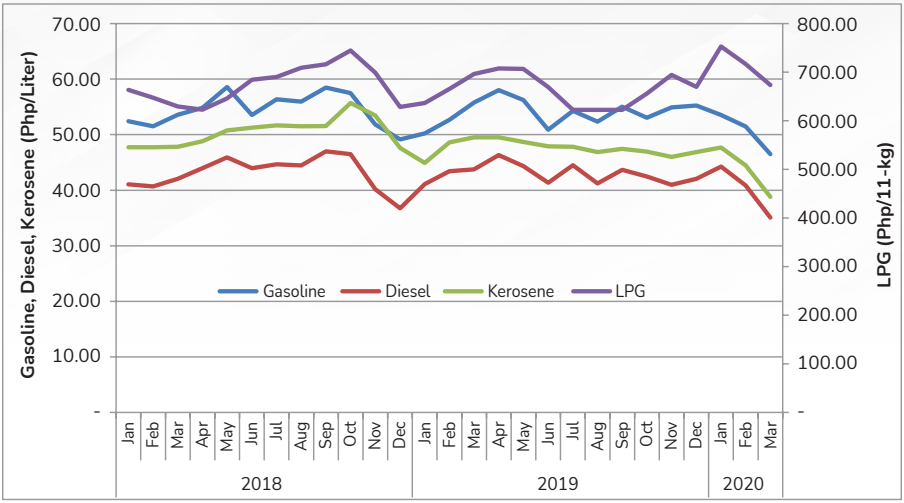


Figure 16. **Weekly Net Adjustments in Pump Prices of Petroleum Products (Pesos/Liter)**

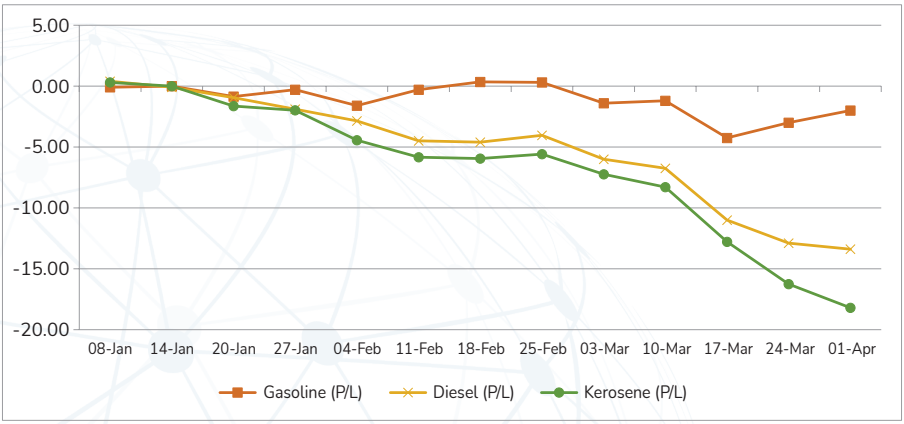
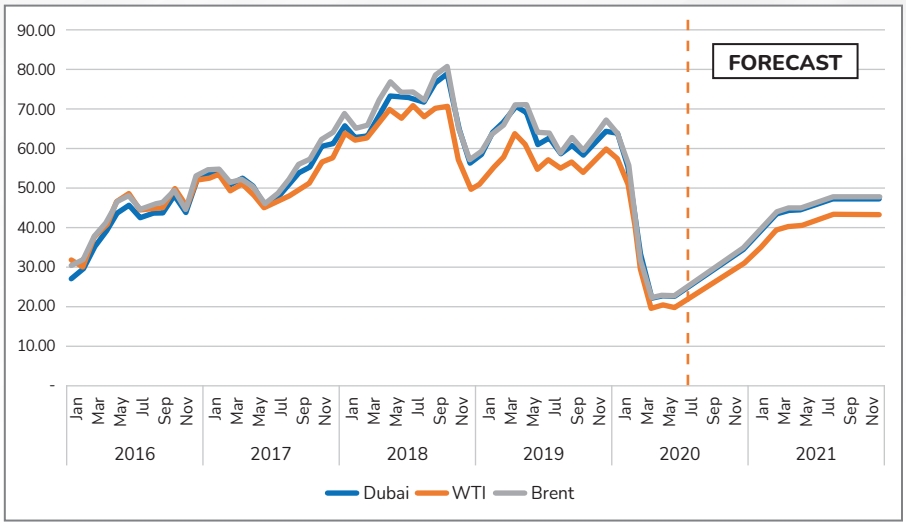


Figure 17. **Crude Spot Prices Forecast for Apr 2020-Dec 2021 by the US EIA for West Texas Intermediate and Brent (https://www.eia.gov/outlooks/steo/report/prices.php)**



Note: Jan 2016 – March 2020 for Dubai from IndexMundi, forecast based on ratio to WTI
https://www.indexmundi.com/commodities/?commodity=crude-oil-dubai&months=240

Energy Policy Studies

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