Covid-19 and its effect on the supply and demand of fossil fuel energy: Indonesian context.

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Abstract. Energy has a strategic contribution to the economic development of the countries. Due to Covid-19 that disrupts the demand and supply of fossil fuel energy products, thus, several sectors are also impacted. This study aims to investigate the effect of Covid-19 on the supply-demand of fossil fuel energy in Indonesia. The data in this research will be in the form of descriptive qualitative data by using secondary data analysis from several sources, the study reveals that the Covid-19 pandemic has a positive effect on Indonesian energy consumption. This result indicates that during Covid-19, 12.9% oil fuel consumption decreased, 10.8% gas use decline, 0.9% LPG gas consumption rose 7.8%, electricity power declined, and the coal consumption 14.3% reduced, consequently the reduction in fossil fuel energy use will be very beneficial for dependency on imports which causes a lot of budget deficits, also potentially decreasing intensity and elasticity of energy then finally fulfilled sustainability energy.

1. Introduction

Energy plays a significant part in human lives. Any activities need energy, like transportation, utility, telecommunication systems, etc. [1]. Consequently, the deep dependence of global demand on fossil fuel energy resources has caused declining fossil fuel reserves, then negative environmental impacts like pollution, climate change, and health risks [2].

The Coronavirus disease (Covid-19) is an infectious disease caused by a newly discovered novel coronavirus. New Covid-19 spread swiftly around the world from late 2019 since they were first identified in China, more than three million people have been reported to be infected by the novel coronavirus globally, cases have been reported in more than 210 countries and territories. (Reuters, 2020[3]). While the Covid-19 pandemic has pushed humanity toward some activities, it has decisively turned it away from others, as the coronavirus spreads around the world, it has become clear that it has the potential to derail the world economy.

The global economy under pressure by Covid-19, in short-term demand declines for fuel energy, Global energy demand fell by 3.8% compared to 2019, with more than half of the world’s population (being 60% of global GDP (Gross Domestic Product)) under lockdown policies. Primary energy demand in 2020 could decline for coal minus 8%, oil minus 9%, natural gas minus 5% [4]. Covid-19 has completely changed the way of human work. It also has a tremendous impact on accessing energy needs.

The Covid-19 pandemic has caused severe impacts on transportation, industry, commerce, and utility, in terms of supply chain activities. Much of the sudden impact of the Covid-19 virus pandemic on the energy sector is due to a reduction in the demand side, global supply chain will be at risk as
fossil fuels trade balance will struggle due to the declining price that reminds us of the price drop worst last seven decades [5].

Oil prices also fell due to concerns from traders that the OPEC deal to reduce global supply by 10% will not catch up with falling demand due to the Covid-19 outbreak. Concurrent with the outbreak, the price of Brent crude fell close to 2.5%, it almost $31.82 per barrel, shadowed by the deal of oil cartel and allies, known as OPEC plus had reached a deal that would stop a price war among Russia and Saudi Arabia that threatened to break the market with an oversupply of oil than the world could need. [6].

The slowdown production by the oil producer group is expected to cut global supplies by 10%, or 10 million barrel per day (Mbpd), to increase prices which touch the level of $22 per barrel. Due to pandemic shocks, global demand for fuel oil has fallen by 30% or 30 Mbpd. Even if OPEC plus can reduce production by 15 Mbpd, it may not be enough to raise prices while demand continues to fall. Other approaches include improving storage facilities, speeding up delivery, increasing sales, and reducing cartel efforts [6].

Fossil fuel accounts for the majority of 80% of worldwide oil supply, with conventional mineral oil, and natural gas both cover over 60% of the global demand [7]. Fossil fuels also cover over 68% of ASEAN (Association of South East Asia Nations) countries, in which Indonesia consumes over 80% of fossil fuels. Fossil fuel energy needs above are affected by the Covid-19 pandemic so that it has decreased by about 6% [8].

The impact of Covid-19 on energy has been examined by many analysts [9][10][11]. Analysts often confuse to quantify or even acknowledge the demand uncertainty in the estimates they result in [12][13]. As much as contributions to thinking focused exclusively on supply-side approaches and have featured few if any demand-side measures [14][15]. However yet, no studies have examined the effects of the Covid-19 pandemic on-deamand thoroughly, which is a critical issue for countries like Indonesia on the difficult verge of supply. In this study, we will prove that the impact of the Covid-19 which reduces energy consumption by up to 6 percent by paying attention to several sectors such as the transportation sector, commercial, industry, household, and others.

2. Method

There are several types of research related to energy demand been executed in Indonesia by the Ministry of Energy and Mineral Resources (MEMR) of Indonesia. Multiple research has been conducted by the government and agencies. The data from this report will be used in this study.

The total energy demand final (E) by industry and commercial sector is calculated by using the following equation:

\[ E = A \times I \] (1)

Where A is the number of activities, I number of Intensity energy final calculated. The total energy demand useful (E) by the household sector, is calculated by using the following equation:

\[ E = A \times U / Eff \] (2)

Where A is the number of activities, U number of Intensity energy useful, Eff number of efficiencies calculated. The total energy demand stock turnover transport (E) by the transportation sector, is calculated by using the following equation:

\[ E = S \times D / C \] (3)

Where S is the number of vehicle sum, D number of distances, C number of consumption-specific energy calculated. This descriptive analysis study the calculation of how the effects might be different among the three fossil fuel energy data, such as coal, oil, and gas, using the secondary data analysis from trusted several sources. The explanatory research results are discussed in the conclusion section, including the paper’s limitations and future research opportunities.
3. Results and discussions

3.1. Indonesia’s energy consumption

Indonesia is the major energy consumer in Asia countries, accounting for more than 4% of the region's energy use. In 2019, Indonesia’s energy consumption is growing by 3.96% annually, energy consumption per capita has increased 24% since 2010, primary energy demand increased by 4.9% last two years, 10-year average growing at 2.8%, energy production growing 3.70% annually [16].

Table 1. National energy data in the year 2019, (compiling data from ENERDATA, 2020 [17])

| Items       | Crude Oil | Oil Product | Natural Gas | Coal, Lignite | Electricity | Total Energy |
|-------------|-----------|-------------|-------------|---------------|-------------|--------------|
| Production  | 39 Mt     | 54 Mt       | 66 bcm      | 585 Mt        | 279 TWh     | 501 Mtoe     |
| (11%)       | (4%)      | (14%)       | (11%)       | (2%)          | (11%)       |              |
| Trade       | 10.9 Mt   | 19.6 Mt     | -20.4 bcm   | -449 Mt       | 1 TWh       | -235 Mtoe    |
|             | (LNG)     | (LNG)       | (LNG)       | (LNG)         | (LNG)       |              |
| Consumption | -         | -           | 40 bcm      | 136 Mt        | 245 TWh     | 269 Mtoe     |
|             |           |             | (5%)        | (2%)          | (2%)        | (4%)         |

Table 1 shows the national energy data which inform that Indonesia has a lot of energy production, but for coal and gas, it is mostly exported, while for oil products, it is a lot of imports, this is very ironic in an energy-producing country (11% in Asia) that still depends on fossil fuel energy due to high energy consumption (4% in Asia).

Figure 1. Indonesia’s fossil fuel energy consumption by the end-use sector in 2019

Figure 1 shows the share of fossil fuel energy consumption 945.8 Mboe (89%), which the majority of the fossil fuel energy consumed by the transportation sector 414.9 Mboe (43.8%), and the rest are industrial sector 346.5 Mboe (36.6%), household 129.8 Mboe (13.7%), commercial sector 42.6 Mboe (4.5%), and others 11.7 Mboe (1.2%) [18].

Energy elasticity is about 1.08 this is inelastic to GDP per capita, energy intensity level of primary energy was reported at 3.53 boe per capita, the intensity of final energy consumption per capita resulted in an increasing trend [18]. Sustainable Development Goal Index score was 65.3 (global rank 101), consist of; Population with access to electricity 98.1% (2017), Population with access to clean fuels and technology for cooking 58.4% (2016), Energy-related CO₂ emissions 1.7 tCO₂/capita (2017) [19].

Electricity absorbs around 10% of the total energy consumption (279.1 TWh), where primary energy coming from fossil fuel is about 88.09%. The consumption of electricity has been growing at
an average annual rate of 6%, fossil fuel consumption per capita is 8,590 MWh, if GDP increase by 1 percent, then energy demand will increase by 1.6 percent [20].

Indonesia has set a target to achieve an energy mix of 23% by 2025 and 31% by 2050. Meanwhile, in 2025, energy consumption is estimated at 170.8 Mtoe and around 548.8 Mtoe in 2050. Until 2019, the new national renewable energy mix has only reached 9.15% [20].

The information above shows; The high value of elasticity indicates that GDP growth still depends on large energy consumption growth, high intensity indicates the use of energy less efficiently, but energy consumption per capita in Indonesia is relatively low. On the other side, the large use of fossil fuel energy will hamper the achievement of the energy mix, so that it cannot increase the value of sustainability.

3.2. Covid-19 outbreak effect on Indonesia’s primary energy consumption.

The Covid-19 pandemic causes Indonesian energy demand in 2020 is predicted to decrease by 11.0% (optimistic scenario), 15.7% (moderate scenario), and 20.5% (pessimistic scenario) when compared to the business as a usual scenario which the total final energy demand will increase by an average of 3.9% per year. Nominal demand decreases ranged from 107–199 Mboe.

The Covid-19 pandemic will also reduce the Indonesian energy supply in 2020. Energy supply will decrease by 8.3% (optimistic scenario), 11.4% (moderate scenario), and 14.4% (pessimistic), when compared to the business as usual scenario in which the total final energy supply will increase by an average of 4.2% per year, the nominal decline was between 141-245 Mboe [21].

Indonesia’s oil sector has been adversely impacted by the regional oil market condition as, a net oil importer, the low oil prices will contribute to the economy in general, however, it will affect negatively the upstream and downstream business, the oil fuel demand significantly decreased.

Government revenues from the upstream oil sector will automatically decrease. Simultaneously, the government budget will be significantly increased due to the trade balance between oil product import and crude oil export. The dependency on the oil product import to fulfill more than half of Indonesian fuel oil demand. Another impact is declining of oil prices related to regional market conditions and the OPEC price wars with Russia, as mentioned above.

Public consumption of oil fuel has indeed decreased. Since the implementation of work from home in March 2020, in the beginning, fuel consumption has decreased by 8% from the normal daily average (from 134.87 thousand KL (Kilo Liters) to 123.74 thousand KL). Currently, the resilience of the National average oil fuel supply is at 20 days. Finally, it is recorded that national fuel from January to June 2020 was only around 117 thousand Kilolitres (KL) per day, down 13 percent compared to the same period in 2019, which was 135,000 KL per day.

Related to the oil market, the natural gas price also depends on the fluctuation of oil prices. LNG demand is depressed by large markets such as China. So far, almost 70-75% of the LNG market is still trading under long-term contracts indexed to crude oil, which is not directly affected by the decline of oil price [22]. The volatility of gas price increases due to the drop in oil price factor rather than supply and demand. Some of the gas contracts are fully committed until ten years, the rest is short-term contract or spot price, which sensitive to international oil prices [23].

Meanwhile, LPG in the household sector experienced an increase: Subsidized LPG rose 0.7% from normal daily consumption of 21.93 thousand metric tons to 22.10 thousand metric tons. Non-subsidized household LPG increased by 5.4% from the normal daily consumption of 2.05 thousand metric tons to 2.16 metric tons. This shows an increase in community awareness to use Non-Subsidized LPG for cooking needs at home. The resilience of the National oil fuel and LPG stock is still low, cause reserves are only 20 days, ideally, it should be over 60 days [24].

The pandemic has caused a decrease in electricity consumption in June 2020, minus 7.06% compared to January 2020. National electricity consumption growth year on year (YoY) in June 2019 to June 2020 still grew positively by 5.46%. The industrial sector (41%) and households (37.45%) are still the primary support in supporting the realization of electricity consumption per capita. The rest is
figured out by the business sector (15.71%) and the public sector (5.84%). Electricity consumption by December 2020 is estimated to fall by 6.25% compared to last year.

The contribution of fossil fuel energy from all Indonesian power plants reaches 60,485 MW, equivalent to 85.31 percent of the total national installed capacity. In the first position, there is coal which is the primary source of electricity in Indonesia. The total operated coal-fired power generation capacity reaches 35,216 MW, equivalent to 49.67 percent of the total national capacity of 70,900 MW. The second largest part of power generation that contributes to Indonesia's electricity is gas-based. Gas-fired power plant per May 2020 contributed 20,488 MW, equivalent to 28.90 percent of the national installed capacity. Furthermore, there is a diesel power plant which is oil-based with 4,781 MW, equivalent to 6.74 percent of the installed capacity.

Coal still dominates the energy mix portion of national electricity generation. As of May 2020, the coal mix still controls 63.92% of primary energy use to produce electricity, followed by a gas mix of 18.08%, renewable energy (EBT) 14.95%, and energy based on fossil fuel oil by 3.05%. This percentage is the realization of primary energy consumption from the total electricity production in Gigawatt per hour (GWh) of electricity generation.

The Indonesian Ministry of Energy and Mineral Resources (MEMR, 2020 [20]) said that the Covid-19 pandemic does not influence the Indonesian mining sector, particularly in coal production opinion. Although China, a coal export destination, for China power plant operation, they still require 30% coal from Indonesia. Covid-19 has caused the China industry to reduce operation, the declining operation of the China industry has led to an increment coal price. The coal price (HBA) decreases to USD 66.89 per ton or increases by 1.45% (USD 0.96 per ton). Other factors influencing the coal are the disturbing market in Australia and India considerably.

This year the Indonesian energy targets coal production to reach 550 million tons. Of this amount, 155 million tons will be distributed for domestic needs. The electricity sector consumes the most dominant portion, as much as 109 million tons for power generation needs. The remaining 16.52 million tons are for processing and refinery facilities, 1.73 million tons for fertilizer, 14.54 million tons for cement, 6.54 million tons for the textile industry, 6.64 million tons for the paper industry and 0.01 million tons for briquettes [25].

3.3. The effect of Covid-19 on fossil fuel energy consumption by the end-use sector.

Covid-19 has an impact on decreasing needs energy sector in the primary economic driving force, namely the sector commercial, transportation, industrial, and other sectors subsequently, only the household sector which experienced an increase in share because only this sector which experienced an increase in energy demand to the whole scenario, by 2020-2025 sectors the most significant energy user remains the transportation sector then followed by the commercial and household, industrial, and other sectors.

The final energy demand in 2025 in business as usual scenario 170.8 Mtoe, low carbon scenario 150.1 Mtoe, and sustainability development scenario154.7 Mtoe. In 2025, sector transportation still leading energy demand for all scenarios, which is around 35% [26].

In describing the energy consumption growth that was done previously using Million Tons of Oil Equivalent units (MTOE), we will visualize a graph of national energy consumption growth from 2018 to 2025, using Million Barrel of Oil Equivalent (MBOE) units to make evident growth per sector.

By using earlier data, filling up data into the projection graphic, total Indonesia by the end-use sector is calculated applying equation (1), (2), (3), and the results are displayed below. The figure displays that energy consumption consists of transportation, industrial, commercial, households, and other sectors.
In this figure, the disruption of the Covid-19 pandemic that occurred in early 2020 has considered, assuming economic growth, with earlier scenarios by using the basic assumption of growth in Gross Domestic Product (GDP) and the same population, namely an average GDP growth of 5.6% per year and population growth of 0.7%, from 2018 to 2025.

Figure 2 displays the history and projection of fossil fuel energy use, and the number of end-use customers in the transportation sector, commercial sector, household, industrial, and others in Indonesia. In 2018, fossil fuel energy consumption has grown significantly with a relative change of +4.9% annually. During Covid-19 pandemic, from 2019 to 2020 shows declining growth of almost -11% [21].

The restriction policies in industrial, commercial, and transportation activities were followed by decreasing energy demand in the main economic driving force. Percentage of change are sector transportation -12.8%, commercial -15%, industry -13.3% and other sectors -14.2%, meanwhile only the household sector +1.6%. These projection results follow to the results of BPPT's research with an optimistic scenario [21]. The overall result remains similar to the world energy consumption disruption during the Covid-19 pandemic, with the range -4.6 to -11.5% [27].

The decline in energy demand was also accompanied by a decrease in the use of fossil fuel. Decreased energy requirements are expected to happen together with economic conditions decline and the existence of Large-Scale Social Restrictions (PSBB). The Covid-19 outbreak affects the declining fossil fuel energy use in the sector, namely: industrial, transportation, commercial, and other sectors. Only the household energy use goes up.

4. Conclusions
This paper examines how significant the Covid-19 effect to supply and demand of fossil fuel energy is conceptualized in terms of explores the uncertainties related to demand estimation using secondary data from the Indonesian government relations.

The impact of the Covid-19 pandemic can be seen from two economic points of view, the demand side, and the supply side. From the demand side, the conditions of the Covid-19 pandemic have reduced the consumption of energy, when transportation and business activities restricted, as well as industrial and commercial activities restriction. On the supply side, it is likely to occur contraction in worker productivity, decreased operation, and logistic activities, and finally disruption of national supply chains, including the energy supply chain.

In the optimistic projection, fossil fuel energy is affected by multiple uncertainties, especially coming from the Covid-19 outbreak. Almost 12.9% of fuel oil consumption decreased, 10.8% gas use decline, LPG demand increase 0.9%, 7.8% electricity power declined, and the coal consumption 14.3% reduced by the demand decremental [21].
The decrease in energy demand hopefully is not as significant as the potential decrease in the supply chain and potential losses. However, the reduction in fossil fuel energy use will be very beneficial for dependency on imports which causes a lot of budget deficits, also potentially decreasing intensity and elasticity of energy then finally fulfilled sustainability energy.

Every forecasting of aggregate energy demand is fully dependent on assumptions create about the increased consumption of fossil fuel energy, demand forecast updating is required by all members of a supply chain, to increase the further upstream a company is in a supply chain.

What the present condition highlighted to us is the urgency of reacting time lags in a supply chain, which ultimately affects the slow accumulated demand to update forecasts. However, the significant swing in demand and supply could result in an irreversible bullwhip effect that poses challenges to companies to prepare for the future ramp up during recovery [28].

The Covid-19 outbreak events have never been classified in a situation that causes uncertainty, even though a pandemic event causes disruption of demand but cannot be categorized as an order change and demand variability. The Covid-19 outbreak has been an eye-opener for organizations and companies about uncertainty in their supply chains, which could have implications for investment and procurement strategies soon [29].

Authors suggest that fossil fuel energy-producing companies estimate their market demands quickly and accurately, as well as improve inventory efficiency and optimize production costs. The author also recommends that renewable energy producers enhance their production at affordable energy prices and recommends the Government to provide incentives to renewable energy producers and accelerate the absorption of renewable energy to support the renewable energy business ecosystem easily, and finally facilitate user access to achieve sustainable energy as soon as possible. However, we find that data limitations, these limitations need to be recognized when developing an uncertainty supply chain model and when using these to inform strategic energy policy decisions. Future research is expected to continue the analysis of pandemic as part of supply chain uncertainty that can affect supply chain strategies and organizational performance.

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