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COVID-19 - Environment, Economy, And Energy: Note from South Africa

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Abstract
The coronavirus disease (COVID-19) started in Wuhan, China in December 2019 and quickly spread to other parts of the world at lightning speed leaving devastating effects in its tracks. As a result,governments in different countries imposed several contingency measures such as lockdown, stay at home, work from home, study and meet virtually, quarantine and closure of international borders to curtail the spread of the virus and to flatten the curve of infection in their respective countries. Even though the containment measures had positive effects in curtailing the spread and flattening the curve of the COVID-19 pandemic there are also negative aspects such as the closure of businesses, loss of jobs, economic uncertainty and depression. Many articles have been written in the medical field related to the pandemic,however, there has been no study on the impact of the pandemic with respect to the environment, energy, and economy in South Africa. Thisinitial study uses COVID-19 data collected from social media and network services in South Africa to evaluate the impact of COVID-19 on the environment, economy and energy.
Keywords: COVID-19; Energy; Environment; Economy

1. *Introduction*

The novel coronavirus disease (COVID-19) which started at the end of 2019 in Wuhan China (Sheraton et al. 2020; Atalan 2020; Mackenzie and Smith 2020; Singhal 2020; Novel 2020; Wang, Zhou, and Liu 2020; Zu et al. 2020; Bedford et al. 2020; Lango 2020; Liu et al. 2020; Cucinotta and Vanelli 2020; Lachenal and Thomas 2020; Zipfel and Dembskey 2020)has affected about 19 million people worldwide with more than 700 thousand confirmed death casesbyearly August 2020(Paudel 2020). The number of infections has increased to over 114 million and 2.5 million deaths as March 2021(WHO 2021).Specifically, the USA leads countries with confirmed cases of the virus with over 28 million cases and over 510 thousandconfirmed deaths(Sheraton et al. 2020; WHO 2021).In the same vein, the African continent has not been spared of the deadly coronavirus. To put this into perspective, by the end of July 2020 every country in Africa has reportedly being affected by the COVID-19 pandemic.Evidently, the first case was reported on February 14 in Egyptwhereas Lesotho became the last country to be affected by the virus pandemic in Africa(Abdur Rahman 2020).Globally, South Africa is in the top 20 countries worldwide and 1st in Africa(Fig. 1) with the largest confirmed cases(Worldometer 2021).

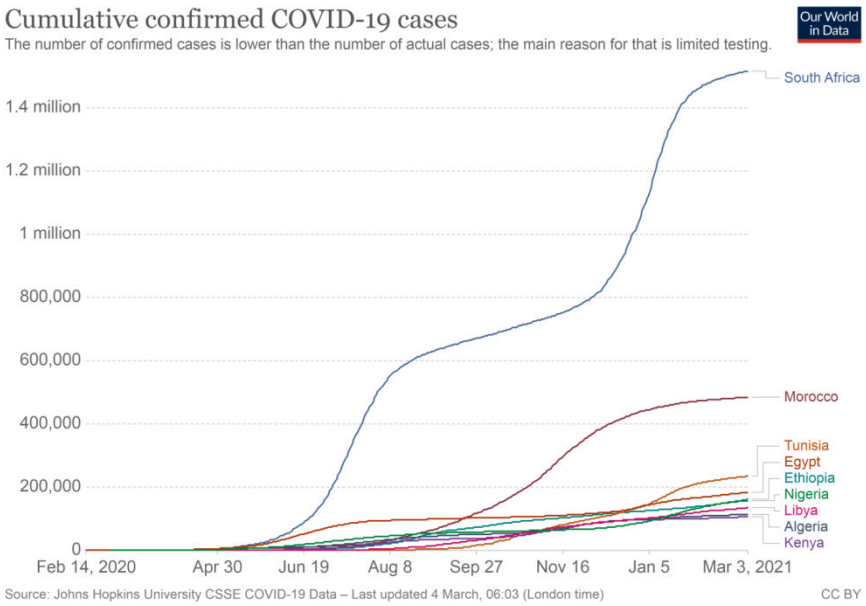

Fig. 1: Statistics of COVID-19 Cases in Africa(MilkenInstitute 2021)

ISSN- 2394-5125 VOL 08, ISSUE 03, 2021

Accordingly, the resulting anxiety generated by the fast rate of the spread of the COVID-19 pandemic due to its high rate of infection has led to the temporary closure of businesses in most economies across the world(Okorie and Lin 2020). Majorly, restrictions e.g. lockdown, working from home, quarantine and travel ban have been imposed to slow down the spread of the virus. However, these restrictions haveinadvertent psychological, environmental and economic effects on the society (Atalan 2020).It is estimated that the measures taken by different countries to prevent the spread of the virus will lead to an unprecedented global economic disaster of monumental proportion. Already, 90% of the world economy is shut down either due to social isolation, flight ban, closure of factories due to working from home rules. Also, many businesses have folded upand many people have been dismissed from their jobs(Donthu and Gustafsson 2020). Therefore, there is a need to use COVID-19 data to determinethe extent of the destruction in the economy as well asthe effects of COVID-19 restrictions on the environment. Besides,the impact of these restrictionson the risk of transmission of COVID-19 needs to be investigated. For example, there isenough evidence to link air pollution with early deaths and deteriorating health conditions (Xu et al. 2020).Studies have shown that particle matter (PM) with an aerodynamic diameter less than 5 μmcan remain suspended in the air for an extended period. Therefore,a virus can be transported directly into the respiratory system by inhalinga PM that has bound with a virus. Similarly, certain meteorological conditions like temperature, humidity and dry conditions have been directly linked with the spread of viruses in the same virus family as the COVID-19, e.g., SARS, MERS, and MERS-COV (Xu et al. 2020). Conversely, there is little evidence to show how the behavioural changes induced by government-imposed restrictions on individuals such as lockdowns, travel restrictions etc. have influenced the environment, as well as the economic impact especially in developing countries(Paudel 2020).Similarly, what arethe short and long terms effects of the COVID-19 pandemic on the transition to renewable energy from fossil fuel as an alternative source of energy?The energy sector has been identified as the main source of anthropogenic greenhouse gases(GHGs)(Change 2014). The combustion of fossil fuels for different economic activities releases GHGs into the atmosphere which in turn contributes to climate change (Masson-Delmotte et al. 2018).Moreover, research has associated increased incidence rates of pulmonary and cardiovascular disease with a rising level of nitrogen oxides and PM concentrations. Similarly, there is significant evidence thatcorrelates air quality and virus-induced diseases like influenza, acute lower respiratory infections and pneumonia (Xu et al. 2020). Conversely, the lockdown restrictions, social isolation, and working from home rules imposed to control the spread of the COVID-19 pandemic may have improved the quality of airas a result oflowered industrial/organization energy consumptionalbeit with increased electricity consumption due to increased digital and domestic (work from home) activities, including increase in waste.

1.1. Motivation of paper

As the world continues to battle with the effects of the virus, the extent of the macro-economic impact of the COVID-19-induced uncertainty is already being imagined. For example, the peak value of financial volatilityin March 2020 has been recorded as the highest in recent history including during the Great Recession(Caggiano, Castelnuovo, and Kima 2020). Similarly, due to reduced human activities, closure of factories, reduced air travels, as well as the reduction of both private and public vehicles on the roads owing to lockdown restrictions the quality of air in most countries have reportedly improved(Atalan 2020). For example, the quality of air has been reported to have improved due to lockdown restrictions in Almaty, Kazakhstan (Kerimray et al. 2020), in Delhi(Mahato, Pal, and Ghosh 2020) and Rio de Janeiro (Dantas et al. 2020). In a related study, Yunus, Masago, and Hijioka (2020)showed by using remote sensing method that the quality of water increased by 15.6% in Venbanad Lake in India.Furthermore, we envisioned the growth of renewable energy post-COVID-19 era as a fallout of the COVID-19 pandemic and the need for cleaner air and environment.On the other hand, many people have been able to digitally work from home and stay connected through digital applications such as Zoom, Google meet, Netflix etc. during the COVID-19 pandemic. Generally people working from home have had to pay more electricity bills that could have been incurred by their organizations due to increased use of electricity because of the lockdown, stay-at-home, study-from-home and work-from-home measures. Other studies on the impact of COVID-19 on the air quality and forecasting economy (Bashir, Ma, and Shahzad 2020; Rupani et al. 2020), increase in medical waste (Saadat, Rawtani, and Hussain 2020).We, therefore, see a need to put together an article that uses COVID-19 data to determinethe extent of the destruction in the economy, includingthe effects of COVID-19 restrictions on the environment as well as its the short term and long terms impact of renewable energy sourcein Africa. Consequently, this study is undertaken in South Africawhich is the most affected by the COVID-19 pandemic in Africa. To the best of our knowledge, no article has done a survey on the effects of COVID-19 on the economy, environment and energy in South Africa.

1.2. Outline of paper

The rest of this paper is organized as follows:In Section 2 a survey of the literature is carried out to examine the effects of COVID-19 on the environment, economy and energy. In Section 3, we present a description of the method employed in the study while in Section 4, the results of the data collection are presented and explained.

2. *Literature review: effects of COVID-19 on the environment, economy and energy*

This section summarizes the impact of COVID-19 on the environment, economy and energy in countries most affected by the global pandemic in Europe and Asia based on available literature. Itfurther highlights and reinforces the need to use COVID-19 data to investigate the effects of COVID-19 on the environment, economy and environment in Africa.

ISSN- 2394-5125 VOL 08, ISSUE 03, 2021

2.1. COVID-19 and the environment

The outbreak of COVID-19 in late 2019 and the subsequent contingency measures put in place by Governmentto curtail the spread of the global pandemic in different countries affected the environment in diverse ways with several consequences.Some studies (Saadat, Rawtani, and Hussain 2020; Dantas et al. 2020; Manuel A. Zambrano-Monserrate, Ruano, and Sanchez-Alcalde 2020b; Xu et al. 2020; Paudel 2020; Kerimray et al. 2020; Berman and Ebisu 2020; Yunus, Masago, and Hijioka 2020; Muhammad, Long, and Salman 2020; Mahato, Pal, and Ghosh 2020; Eroğlu 2020; Atalan 2020) have highlighted the impact of the pandemic on the environment. Manuel A Zambrano-Monserrate, Ruano, and Sanchez-Alcalde (2020a) investigated the positive and negative indirect effects of COVID-19 on the environment in countries which are mostly affected by the global pandemic comprising China, USA, Italy and Spain.Their research shows that there is an improvement in the quality of air, reduction in the level of impurity in beaches and in environmental noiseas a result of the contingency measures taken to prevent the spread of COVID-19 pandemic. Conversely, they further showed that the lockdown measuresduring the COVID-19 pandemic havereduced recycling and increased waste which in turn contaminates water, land and air. Similarly, by taking into account the extreme changes in human behaviour due to the COVID-19 global pandemicBerman and Ebisu (2020) evaluated air quality in the USA with respect to the level of PM and nitrogen dioxide in the air during the pandemic. They compared results during the global COVID-19 pandemic period (March 13-April 21 2020) with historic data pre-COVID-19 period (January 8 –March 12 2017-2019) to assess the level of air pollution.According to their result, there was a significant decrease in nitrogen dioxide and 25.5% reduction in PM during the COVID-19 pandemic. In a related study (Muhammad, Long, and Salman 2020), the data released recently by NASA and ESA showed that air pollution in Wuhan, Italy, Spain and the USA reduced by 30% during the COVID-19 pandemic.For instance, in Wuhan, nitrogen dioxide emission reduced by 30% during 2019 and 2020. Also, in Spain, due to lockdown measures nitrogen dioxide emission has reduced by about 20% to 30%. Furthermore, a similar trend of nitrogen dioxide emission reduction was observed in France, Italy, and the USA during the COVID-19 pandemic. On the other hand, the study conducted by Silva, Prata, Walker, Duarte, et al. (2020)however, showed that the excessive use of personal protective equipment (PPE) e.g. gloves and facemask during the COVID-19 pandemic poses a global macro-plastic-pollution threat to natural ecosystems and environment.Nonetheless, understanding the effects of COVID-19 pandemic in relation to air and environmental pollution will provide important clues on health safety, control of emission and plastic waste management. Therefore, it is essential to begin to find alternatives such as bio-based plastics in preference to single-use plastics to stimulate and promote sustainable green economies. For example, Silva, Prata, Walker, Campos, et al. (2020), the authors provide an overviewof plastic policiesandproposeda readjustment of the policies during the COVID-19 pandemic taking into account the potential environmental implications of plastic waste.

2.2. COVID-19 and the economy

The effects of the COVID-19 pandemic on the economy of affected countries around the globe arecatastrophic(di Mauro 2000; Boone et al. 2020; Beck 2020; Mamun and Ullah 2020; Baker et al. 2020; Bonaccorsi et al. 2020; Fernandes 2020; McKibbin and Fernando 2020; Baldwin and Weder di Mauro 2020; Saadat, Rawtani, and Hussain 2020; Chetty et al. 2020; Brodeur et al. 2020; Guerrieri et al. 2020; Béland, Brodeur, and Wright 2020; Nicola et al. 2020a, 2020b; Baldwin and Tomiura 2020). This is due to the contingency measures taken to prevent the spread of the COVID-19 infection such as lockdown, ban on travels, stay at home, work from home, study from home (virtually) and quarantine which resulted to the closure of factories, businesses, schools and international borders. It is envisioned that economic activities willreturn to normal only when a COVID-19 vaccine is developed and administered to the extent in which herd immunity is achieved. To achieve this herd immunity in South Africa, at least 67 % of the population needs to be inoculated (NICD 2021). However, the discovery of a new vaccine commenced at about December 2020 and only arrived in South Africa in February 2021. The rollout of the vaccine in South Africa has since commenced, however, priority has been given to the frontline health workers(SAcoronavirus 2021a, 2021b).Therefore, at the moment, affected economies around the world are expected to continue to decline due to the regulations taken to manage the spread of COVID-19 infections.In the book ‘Economics in the times of COVID-19’by Baldwin and Weder di Mauro (2020)for example, the authors stated that the COVID-19 pandemic is undeniably spreading economic suffering around the world.However, it could be argued that those that have manufactured the PPEs, sanitizers, vaccines, ventilators etc could have benefited. Nonetheless, experts have warned that caution should be applied when assessing the economic consequences of COVID-19 pandemic since the situation is still evolving. Moreover, according to experts, there is no certainty on how widely the virus will spread or how long the containment measuresto manage the spread of the viruswill remain in place (di Mauro 2000). Therefore, at this moment, we can only imaginethe best-case and worst-case scenariosof the implications of the COVID-19 pandemic on the global economic outlook (Boone et al. 2020). In the best-case scenario, for instance, assuming the virus remains largely in China, with pockets of infections elsewhere. Still, China accounts for 17% of the world supply and demand (GDP), 11% of global trade, 9% of world tourism, and over 40% of global demand for certain products(Boone et al. 2020).Therefore, a slight economy depression in China still affects the globaleconomy considerably. On the other hand,to put this into perspective, 8 out of 10 most affected countries by the COVID-19 pandemic constitute 60% of world GDP, 65% of the world manufacturing and 50% of the world manufacturing exports

ISSN- 2394-5125 VOL 08, ISSUE 03, 2021

(Baldwin 2020; Baldwin and Tomiura 2020). Therefore, what this implies is that a slight economy depression in these countries will produce a supply-chain contagion in every single country in the world.In the worst-case scenario, it is anticipated that the repercussions of COVID-19 pandemic on the global financial system would be shattering (Beck 2020). To give an insight,Baker et al. (2020)applied real-time forward-looking uncertainty indicator to assess the macroeconomic impact of the COVID-19 pandemic on the economy of the USA which is the worst-hit nation by the COVID-19 pandemic(Baker et al. 2020).To achieve this, COVID-19-induced first-moment and uncertainty shocks were fed into the Baker, Bloom and Terry estimated model of disaster effects. The outlook shows that the US GDP contracted by about 11% as of 2020 Q4 with a 90% confidence interval extending to about 20% contraction. Evidently, when the deflationary effects of both scenarios are combined consumer price inflation will be pushed further down globally by 0.6% in 2020 (Boone et al. 2020). Furthermore, global trade has weakened and declined by 3.7% in 2020 (from the baseline when the pandemic started). The economic impact of the COVID-19 is not limited to countries only. The impact of this virus is also felt by ordinary people. Saadat, Rawtani, and Hussain (2020) reported that different people are affected differently, as people with low socioeconomic status are the most adversely hit by the impact of the virus.

2.3. COVID-19 and energy

There is no better time with convincing reasons to begin the discussion on alternative sources of energy to fossil fuel than the COVID-19 era as well suggested by (di Mauro 2000; Kuzemko et al. 2020; Graff and Carley 2020; Akrofi and Antwi 2020; Jin 2020; Eroğlu 2020; Steffen et al. 2020). This is because there is enough evidence to link air pollution with an increased incidence of pulmonary and cardiovascular diseases e.g.SARS, MERS, and MERS-COV which are in the same virus family as COVID-19.Moreover, today, about 80% of the world primary energy supply is from fossil fuels (IEA 2019). The combustion of fossil fuels for different economic activities releases greenhouse gases (GHGs) into the atmosphere which in turn contributes to climate change. The energy sector has been identified as the main source of anthropogenic GHGs which is the major sources of environmental and air pollution and pollutants(IPCC 2014). As a result, the COVID-19 pandemic has presented the opportunity for sustainability scientists and researchers to start to investigate the implications of COVID-19 crisis for the politics of sustainable energy transitions. Kanda and Kivimaa (2020) explored the different ways which the restriction placed on mobility due to the measure imposed to manage the COVID-19 infections affect electricity and sustainability transition researches in Finland and Sweden. They envisioned that we may see a reduction in mobility and fossil-energy consumption in the long-term due to the changes caused by COVID-19 which results in the digitalization of work and other daily activities. In a related study Kuzemko et al. (2020) investigate the impact of the lockdown on fossil and sustainable sources of energy. Additionally, they consider the likely effects of the economic stimulus packages and social practices on the growth of energy demand, the speed of transition and carbon-intensity of the energy system. The study by Chen et al. (2020) among other things, investigatesthe dynamics in the pattern of energy usage and the acceptance and willingness of residents to pay for home energy during the COVID-19 pandemic in New York.Their results showed that the morning and evening usage peak periods on weekdays no longer exist as most residents observedhigher electricity usage than average during the lockdown. Additionally, they found out that residents who have a moderate perceived risk of contracting the COVID-19 infection are willingto pay for energy more than the low-risk and high-risk groups.Sovacool, Del Rio, and Griffiths (2020), examined the emerging relationship between COVID-19 and energy supply and demand, the future low-carbon transitions and energy governance. Additionally, they investigated the likely and known impact of COVID-19 crisis on energy demand. The study of Akrofi and Antwi (2020), examines the responses of the energy sector in Africa to the COVID-19 pandemic. They found out that the majority of the responses were short-term and mostly in sub-Sahara Africa which include VAT exemption on electricity bills, waiver/suspension of bills or provision of free electricity. Additionally, that economic stimulus packages did not include the energy sector especially the renewable energy sector with exception of Nigeria, Kenya and Burkina Faso. Therefore, the COVID-19 pandemic presents a great opportunity for African government to provide a conducive environment for doing business in the clean and renewable energy technologies (Gebreslassie 2020).

The COVID-19 has had impact on the global greenhouse gas emissions no doubt. A recent publication by the International Energy Agency (IEA)(IEA 2021a) on the energy-related emission of CO_2 into the atmosphere found the highest drop in CO_2 emissions globally was recorded during the early months of the COVID-19 pandemic. This drop was about 6% depending on region. This was reported to be the largest CO_2 emission drop since World War II.This reduction has brought the fore the influence of government restrictions and regulations during these early months and more importantly low energy demand during the early restriction months of COVID-19. The restriction led many high energy consumers and manufacturing companies that depend largely on the use of fossil fuel to shutdown operations, it also led to the 10% reduction in road transportation (Fig. 2), while reduction attributed to the restriction in international was about 14% in the year 2020 as compared with the year 2019(IEA 2021b), thus leading to low energy demand. Fossil fuel demand reduced by 8.6%, while the demand for coal reduced by 4%. From the report, as soon as government restrictions were eased and economic activities started bouncing back towards the end of the year 2020, the CO_2 emissions significantly increased by 2% (60 million tonnes). This increase was reportedly higher than same period in the year 2019. The increase in emission after the restriction means many organizations and governments have not done enough in the implementation of Paris Agreement geared towards reducing greenhouse gas emission by the transitioning to clean energy generation, supply and consumption.In the 2020, the global percentage of clean energy technologies such as solar

ISSN- 2394-5125 VOL 08, ISSUE 03, 2021

PV and wind in the global energy mix increased by more than 1%, thus making the use of these clean technologies reach over 20% in the global energy mix.

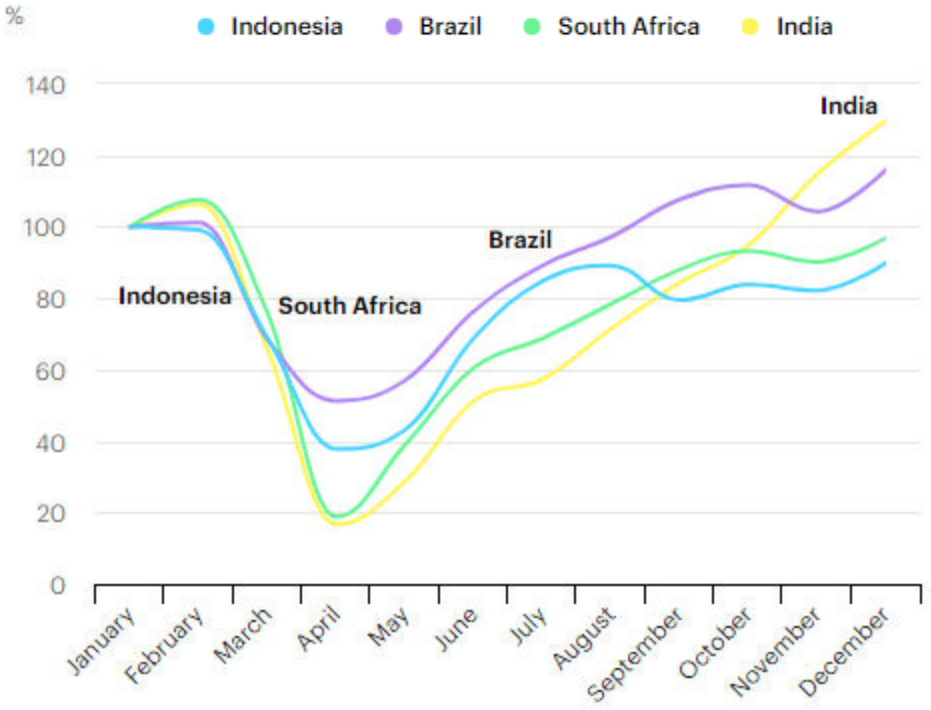

Fig. 2 Road transport activity for some developing countries in 2020 (IEA 2021b)

The high demand in energy in most of the months in the year 2020 did not only occur in the industrial sector but also in the residential sector as well. Snow et al. (2020) found from their study conducted in Australia, significant increase in energy consumption in about 491 residential houses investigated. The reason for this was that demand for cooking, reheating, digital devices and entertainment increased as more people were staying, studying or working from home. It was also found from the same study that some residential houses investigated had their energy consumption reduced because adoption of some energy conservation measures such as turning off air conditioning units and other energy consuming appliances when not in use. While many individuals are still recovering from the damage done by the impacts of COVID-19, all energy users are encouraged to consume energy wisely by using energy efficiency appliances, where possible make you natural lighting, schedule the use of appliances, install energy meters that could assist in regular monitoring of energy consumption, record and report energy consumption readings to the appropriate energy providers (should they have stopped taking the readings because of COVID-19 restrictions, failure to this could lead to issuance estimated billings that could further increase energy cost and reduce energy conservation best practices) and practice behaviors that contribute to energy saving (Abolarin et al. 2015; Abolarin et al. 2013; Abolarin et al. 2011).

These impacts of COVID-19 have further emphasized the importance of reducing energy consumption at the local and global level as well as brought the fore the urgency needed to transition to low-carbon economy. While governments around the world are making efforts to bounce back on the economy through vaccination of the people, more investment should be channeled to the clean energy transition.Increasing the integration of clean energy technologies (energy efficiency, conservation, renewable energy etc) into the local and global energy mix will no doubt further lead to the reduction in greenhouse gas emissions and low-carbon economy.

3. *Method*

To evaluate the impact of COVID-19 pandemic on the environment, economy and energy in South Africa. A descriptive analysis was conducted based on some COVID-19 questions. These questions were distributed electronically to 3500 residents of the Johannesburg area in South Africa between July 18 and August 17, 2020. This period coincided with the peak of the first wave of the pandemic in the country. However, only 2154 responses (representing a response rate of 62%) werereceived. The data collected from the respondents were first stored on the Qualtrics (an experience management software whose company has co-headquarters in Provo, Utah and Seattle, Washington, in the United States) and questions were divided based on demography, impact of COVID-19 on environment, impact of COVID-19 on economy, impact of COVID-19 on energy usage.

4. *Results*

In this section, we present the results of the survey that was carried out to gauge the impact of COVID-19 pandemic on the average South African with respect to the environment, their economic situation, and renewable energy based on collected COVID-19 data.

ISSN- 2394-5125 VOL 08, ISSUE 03, 2021

Q1 - What is your gender?

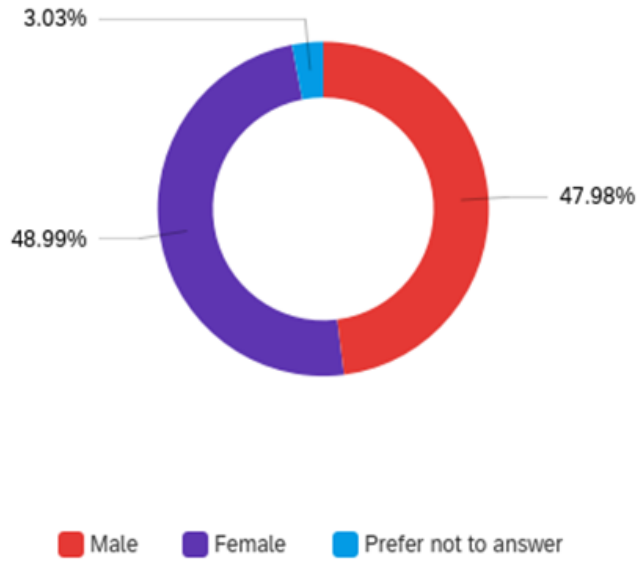

Fig. 3: Gender distribution of participants

From Fig. 3, it can be seen that the number of female respondents was more than the male respondents. This was expected because according to STATS SA (2020), the population of women in the Republic is about 52%.

Q2 - What is your educational qualification?

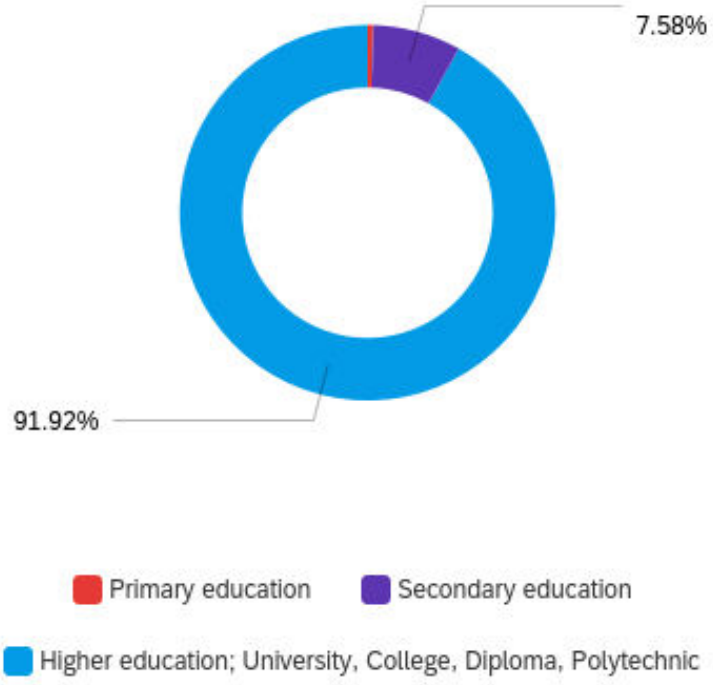

Fig. 4: Educational level of the participants

From Fig. 4, it is evident that the majority of the respondents had a university education. This was expected because the target audience for this mini-survey was young working professionals with access to internet facilities.

ISSN- 2394-5125 VOL 08, ISSUE 03, 2021

Q3 - Employment status before COVID-19

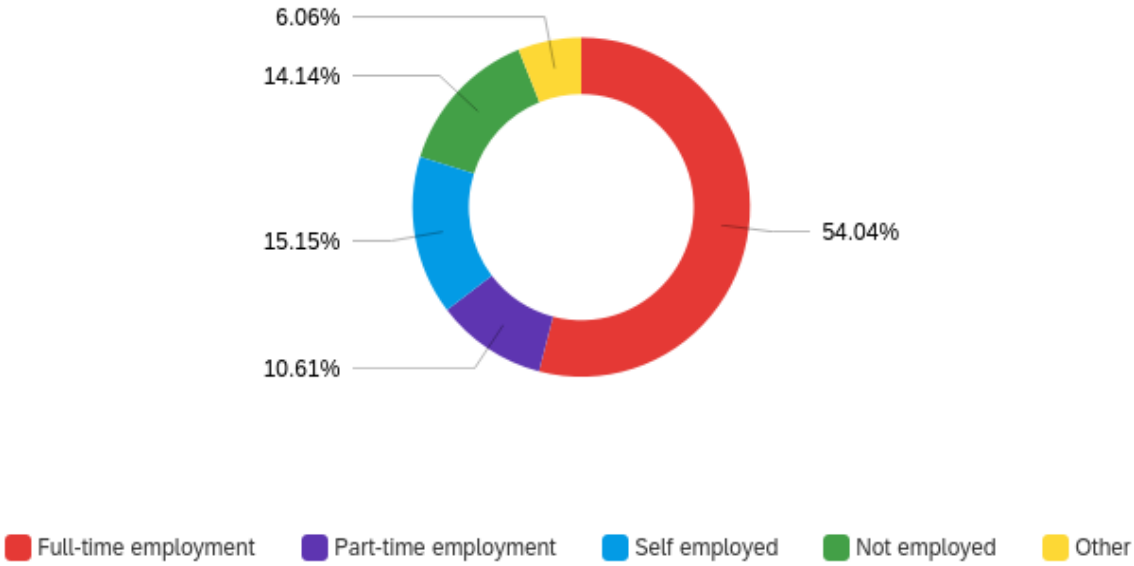

Fig. 5: Employment status of participants before COVID-19

Fig. 5 shows that the 54% of the participants were in full-time employment, 10.61% were in part-time employment, 15.15% were self-employed, 14.14% were unemployed and 6.06% were engaged in other activities.

Q4 - Employment status during COVID-19

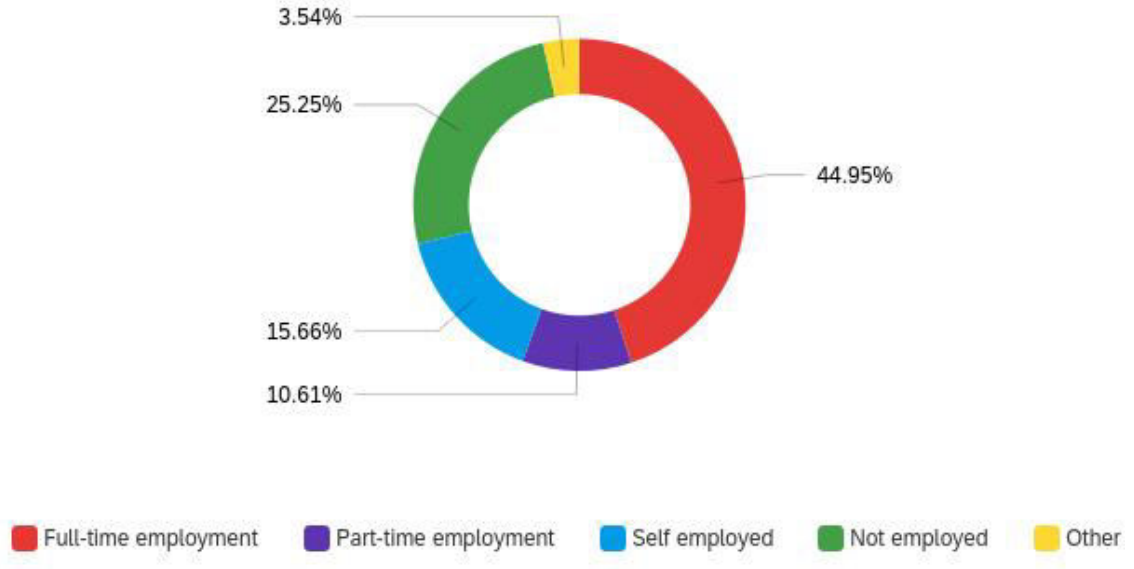

Fig. 6 : Employment status during COVID-19

It can be seen from Fig. 6 that about 10% of the people lost their jobs during COVID-19 thus highlighting the economic effects of COVID-19. In a country where black tax (Mangoma and Wilson-Prangley 2019; Magubane 2017; Mhlongo 2019) is prevalent, the spiralling effect of the pandemic can only be imagined. Moreover, Fig. 6 also shows that the rate of unemployment increased. The reason for the loss of jobs can be attributed to the austerity measures embarked on by many private companies to keep afloat.For instance, comparing Fig. 5 and Fig. 6, it can be seen that the number of self-employed persons increased. Furthermore, this suggested that the pandemic made some South Africans became emergency entrepreneurs by thinking outside the box to make money from within their homes despite the government imposed lockdown to curtail the spread of the pandemic.

ISSN- 2394-5125 VOL 08, ISSUE 03, 2021

Q5 - Which sector are (were) you employed?

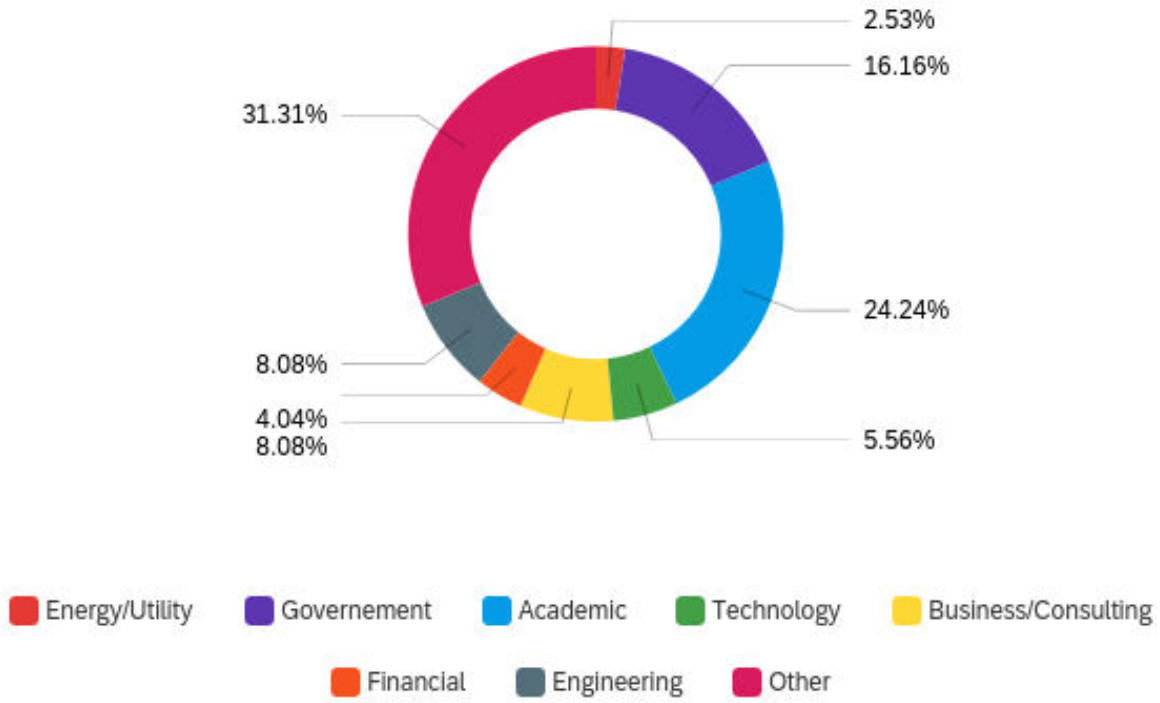

Fig. 7: Economic sector participants are employed in

Fig. 7 shows the distribution of the economic activities of the participants. It can be seen that 31% of the respondents are employed in the energy/utility industry, 24% are employed in the academia, 16% are employed in government entities while the rest are distributed between the engineering, business/consulting, financial, technology industries.

Q6 - Has the COVID-19 pandemic affected any of your planned local or foreign trip?

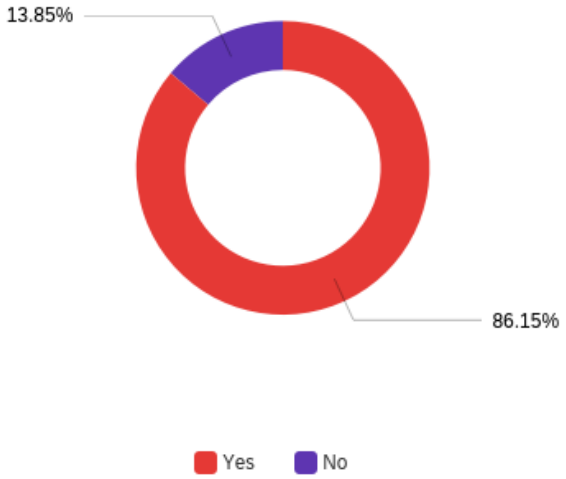

Fig. 8: Effect of COVID-19 on travel

Fig. 8 shows the percentage of respondents whose travel plans have been affected by COVID-19. It can be seen that over 86% of the respondents were affected by the flight restrictions occasioned by the pandemic. Obviously, the flight cancellations must have cost South African Airways and other carriers a lot of money. Additionally, this is coming at a time the state-owned flag carrier airline of South Africa is battling to stay afloat. Furthermore, one can only imagine the economic impact the pandemic has had on the aviation and allied industries.

ISSN- 2394-5125 VOL 08, ISSUE 03, 2021

Q7 - Did you experience load shedding during COVID-19?

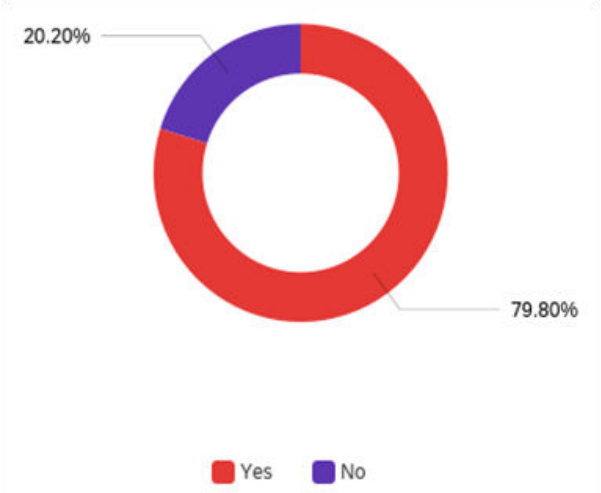

Fig. 9: Load Shedding During COVID-19

Fig. 9 indicates that about 80% of the respondents were subjected to load shedding in the peak of the pandemic. Load shedding, or load reduction, is a controlled option to respond to unplanned events to protect the electricity power system from a total blackout. Clearly,the load shedding may be attributed to delays in scheduled maintenance due to the disruption of the supply chain as a result of the pandemic. Also, it can be attributed to the ageing power plants in the country. Therefore, this highlights the electricity crisis in the country and heightens the call for the diversification of the sources of energy supply in the country. Furthermore, the pandemic exposed the deep-rooted problems facing the Electricity Supply Commission and also known as ESKOM. This result shows that the government must lead the charge to quicken energy transition and create an enabling environment to attract independent power producers to invest heavily in concentrated solar power systems and other sustainable forms of energy supply. By doing this, electricity supply may be improved, and jobs will be created for many unemployed South Africans and those that might have lost their jobs during this COVID-19 pandemic. This will most likely drive down the crime rate in the country because if people are meaningfully employed, there will bea lower likelihood that the youth will engage in all sorts of vices.

Q8 - Would you support the use of renewable energy?

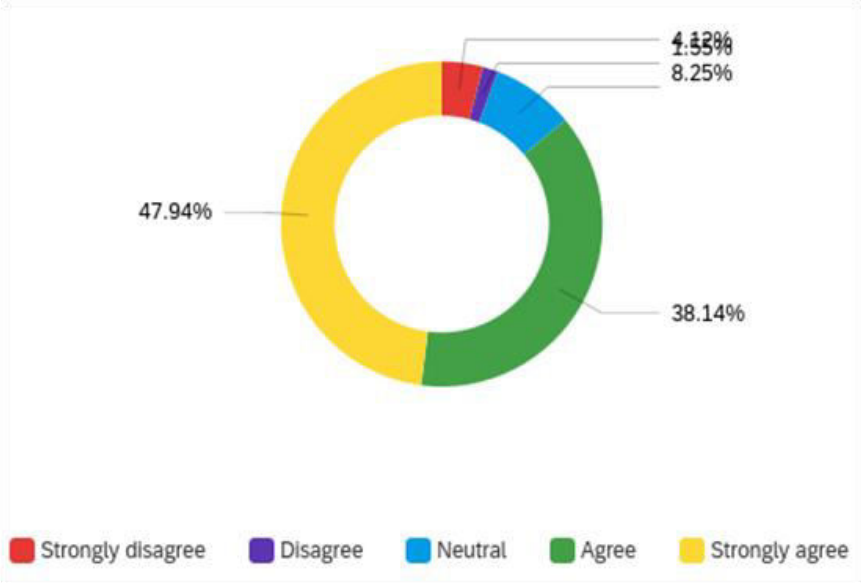

Fig. 10: Support for Renewable Energy

Fig. 10 shows that there is support for the deployment of renewable energy in the country.It must be noted that at present, the South African energy supply is dominated by coal which constitutes 69% of the total energy supply,–nextis crude oil with 14% and renewable energy and waste with 11%. While nuclear contributes 3% andnatural gas contributed 3% to the total primary supply (Africa 2019). Furthermore, it must also be noted that South Africa has a relatively infant but growing renewable energy industry and the pandemic has necessitated the call for more investment in the renewable energy sector.

ISSN- 2394-5125 VOL 08, ISSUE 03, 2021

Q9 - More money was spent on electricity during COVID-19

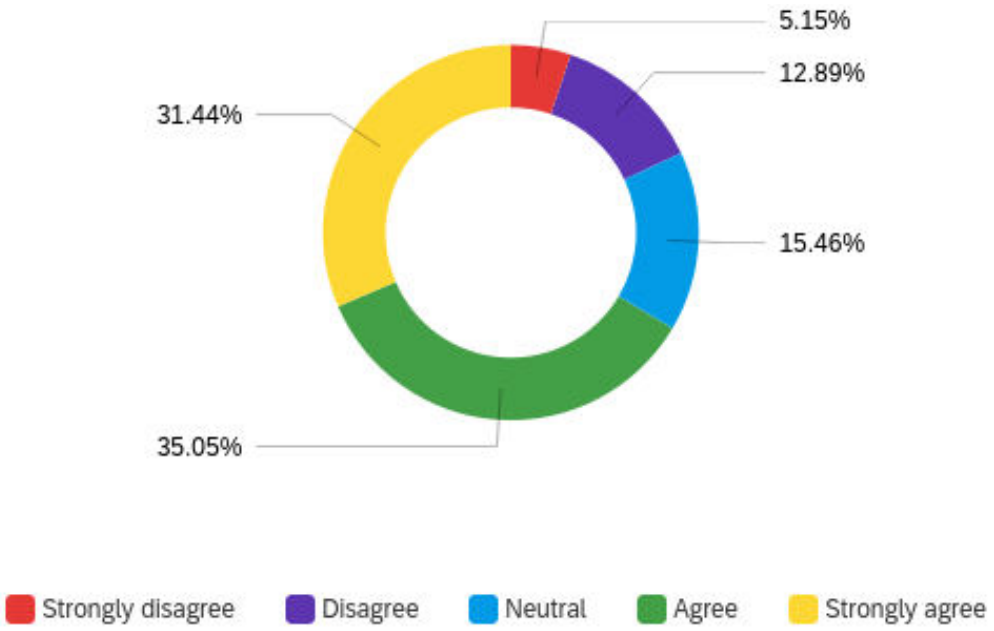

Fig. 11: Electricity consumption and cost during COVID-19

Fig. 11 shows the responses of participants to the question of whether they spent more money on electricity bills during the period under review. It can be seen that a total of 66% agreed that their electricity bills increased. This may be attributed to the fact that they were on lockdown and had to consume moreelectricity that would have been conserved if they were at work. This could also be due to the fact that the period of lockdown coincided with the winter period in South Africa where people utilised more hot water and electric heaters. While numerous people are as yet recuperating from the harm done by the effects of COVID-19, all energy consumers are urged to adopt energy efficiency and conservation best practices. These can be done by utilizing appliances that consume less energy to achieve the same purpose without reducing comfort, turn off energy consuming appliances when not in use, install energy saving light bulbs, energy use scheduling, for those utilizing HVAC system the set point temperature of the system should be set close to atmospheric temperature that can provide adequate occupancy comfort, energy meters that could assist energy users to regularly observe, monitor, record and compare energy consumption, report energy consumption readings to the suitable energy suppliers (should they have temporarily suspended house-to-house meter readings due to COVID-19 limitations, inability to this could prompt issuance of estimated bills that could add to their energy cost and lessen energy conservation consciousness and best practices).

Q10 - Did you spend extra money during COVID-19 due to working from home?

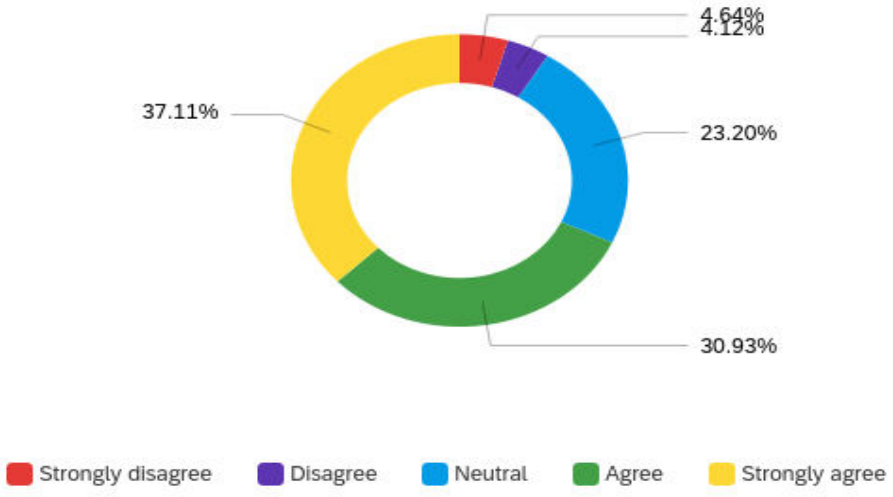

Fig. 12: Relating the increased electricity expenses to working from home

ISSN- 2394-5125 VOL 08, ISSUE 03, 2021

Fig. 12corroborates that the increased spending on electricity could not be attributed to the lockdown, working from home and the season of the year. From the Fig. 12, majority of the people agreed that their increased electricity spending was due to working from home and the weather which also coincided with the peak of the pandemic in SouthAfrica.

Q11 - The road is cleaner and has less pollution during COVID-19

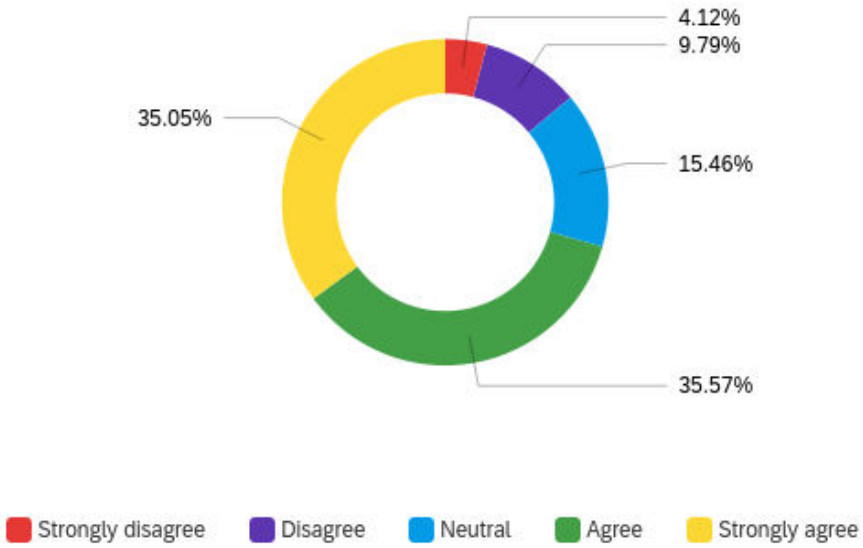

Fig. 13: Relating less pollution to the pandemic.

Fig. 13 shows that most of the respondents agreed that the air was cleaner during the peak of the pandemic. While actual measurements were not carried out to ascertain the air quality of the metropolis, the responses may be attributed to their perception of decreased emissions from both industrial plants and emissions from motor vehicles as a result of the lockdown. It this can be deduced that the pandemic may have has some positive impact on the environment.

Q12 - Any other comment

In general, participants had many other views about the pandemic such as calls to make renewable energy affordable for the common man, calls for energy alternatives, complaints of loss of business and livelihood, cries about the loss of dear ones, complaints about load shedding, inability to pay back loans and bonds, complaints about increased internet and data bills, complaints about increased cases of gender-based violence, increase in general household expenses and inflation, calls for tax relief and increased government palliatives, reduced cases of criminal activities and reduced cases of road accidents.

Conclusion

SouthAfrica is the country worst hit by the COVID-19 pandemic in Africa. In this study, a mini-survey was carried out to better understand the effect of the pandemic concerning energy, economics and the environment. It was found that majority of the respondents experienced load shedding during the peak of the pandemic due to electricity cuts by ESKOM. About 10% of the respondents reported job losses which were expected due to austerity measures taken by many companies to minimise expenses during the lockdown. Majority of the residents also reported having cancelled their local and foreign travel plans due to the restriction of movements, Furthermore, the survey showed that there is support for the deployment of renewable energy in the country. It was also found that majority of the respondents had their flights cancelled due to the travel restrictions imposed by the pandemic. In addition, 80% of the respondents were subjected to load shedding in the peak of the pandemic which highlighted the energy crisis in the country. Respondents also reported that they spent more money on electricity bills during the peak of the pandemic due to working from home policy. This study is not without limitations. The current research depended on descriptive statistics which allowed us to conclude only on the field data collected. Future research will address the issue of pandemic by using more robust techniques. While admitting this limitation, we believe that our findings will provide the foundation for the debate on the impact of COVID-19 on energy, environment, and the economy in South Africa.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

ISSN- 2394-5125 VOL 08, ISSUE 03, 2021

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