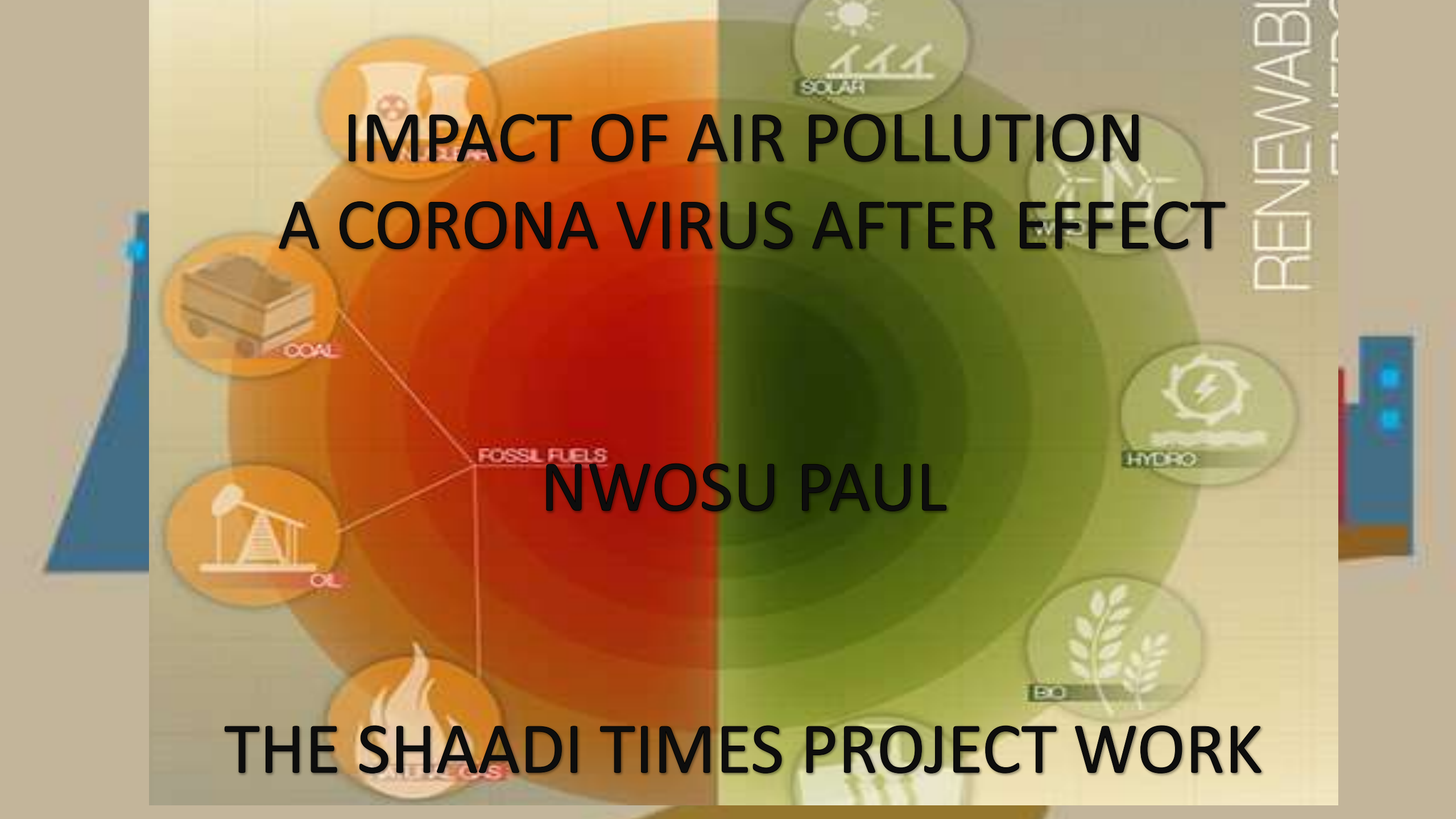
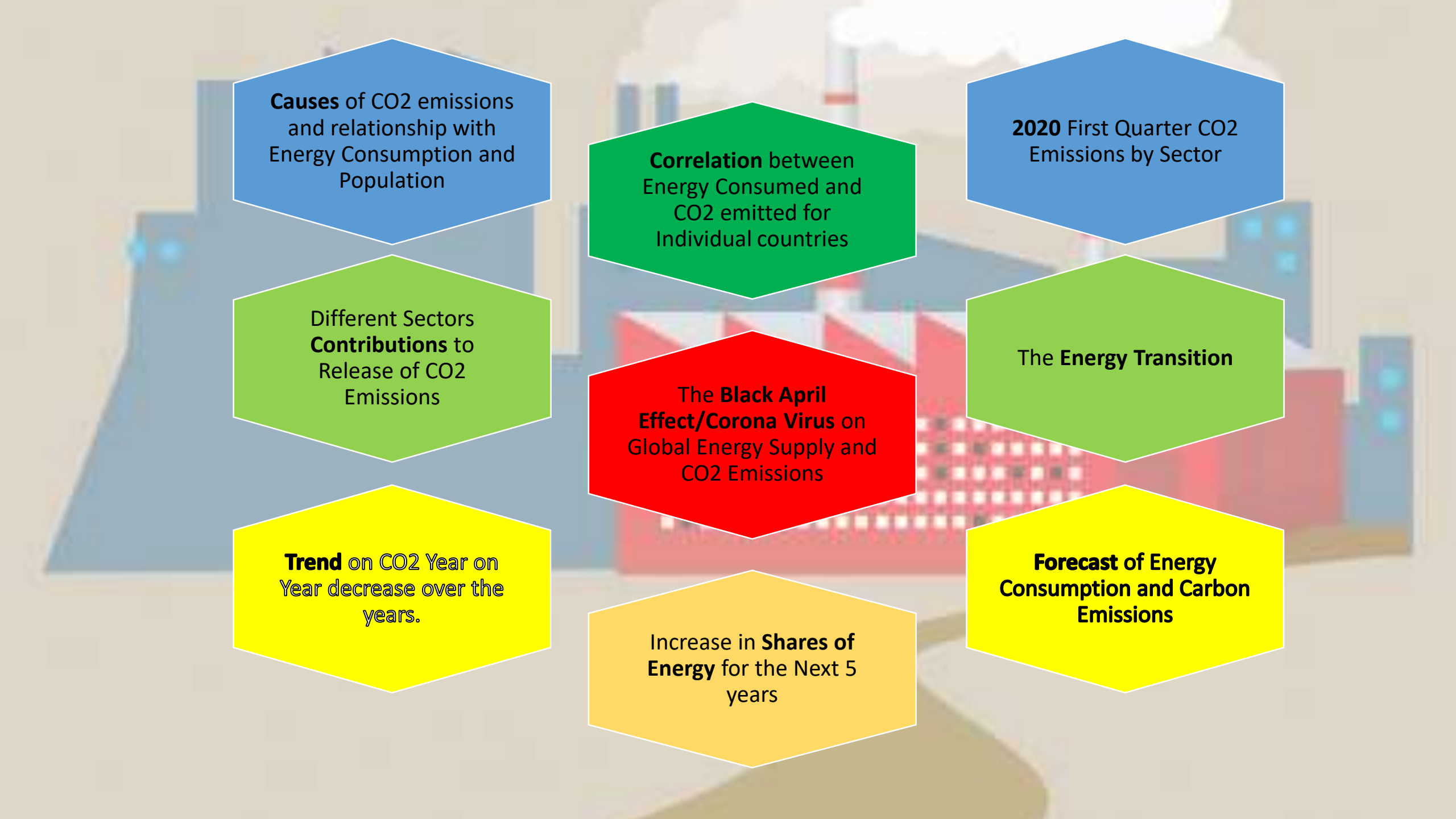


IMPACT OF AIR POLLUTION
A CORONA VIRUS AFTER EFFECT

NWOSU PAUL

THE SHAADI TIMES PROJECT WORK


Causes of CO2 emissions and relationship with Energy Consumption and Population
Correlation between Energy Consumed and CO2 emitted for Individual countries
2020 First Quarter CO2 Emissions by Sector
Different Sectors **Contributions** to Release of CO2 Emissions
The **Black April Effect/Corona Virus** on Global Energy Supply and CO2 Emissions
The **Energy Transition**
Trend on CO2 Year on Year decrease over the years.
Increase in **Shares of Energy** for the Next 5 years
Forecast of Energy Consumption and Carbon Emissions

EXECUTIVE SUMMARY

When we talk about **CO2 Emissions** and **Air Pollution**, we relate it to **CLIMATE CHANGE**, which refers to the changes in the average weather condition of a region over a long period of time, Climate change is related to Global warming, the release of Greenhouse gases such as CO2 and METHANE to the atmosphere.

This release can be natural but over the years, the main cause and rapid increase is attributed to human activities such as Industrialization and combustion of fossil fuels. This leads to the Scenario known as Global Warming.

Global warming is the release of Greenhouse Gases (GHG) to the atmosphere, this leads to the entrapment of gases like CO2 and Methane in the atmosphere. The Release of greenhouse gases caused by human activities can be attributed to fuel combustion from vehicles and airplanes, gas flaring from Oil and Gas activities, bush burning and a whole lot of activities in the manufacturing and industrial sectors. Over the past years, the issues of Climate change have been a trending topic as many people/investors have started taking things seriously, due to the rise of renewables, they are able to put pressure on companies that release a lot of C02 Emissions to the environment.

This project clearly looks how Carbon Emissions is related to Energy consumption and the impacts of Corona Virus Pandemic on carbon emissions. At the end of project, we discover that there is a strong linear relationship between Energy consumption and CO2 Emissions, we also see previous trends in the reduction of C02 Emissions, this allow us to come up with the conclusion that the effect of corona virus on carbon emissions is a temporary one but has yet again brought to our attention the need to look for new means to ‘Produce more with Less’.

MAIN CAUSES OF CO2 EMISSIONS

Air Pollution is caused by various Human Activities, from bush burning to deforestation, extraction of crude oil and also fuel combustion.

CO2 Emissions by fuel consumption is the major focus of this project since most Industry sectors such as Transportation, Aviation, Electricity Generation and Manufacturing are known to be dependent on fuel.

From Figure 0 we can see that the highest emitter of CO2 is from Coal as compared to Oil, while Gas is the lowest by far.

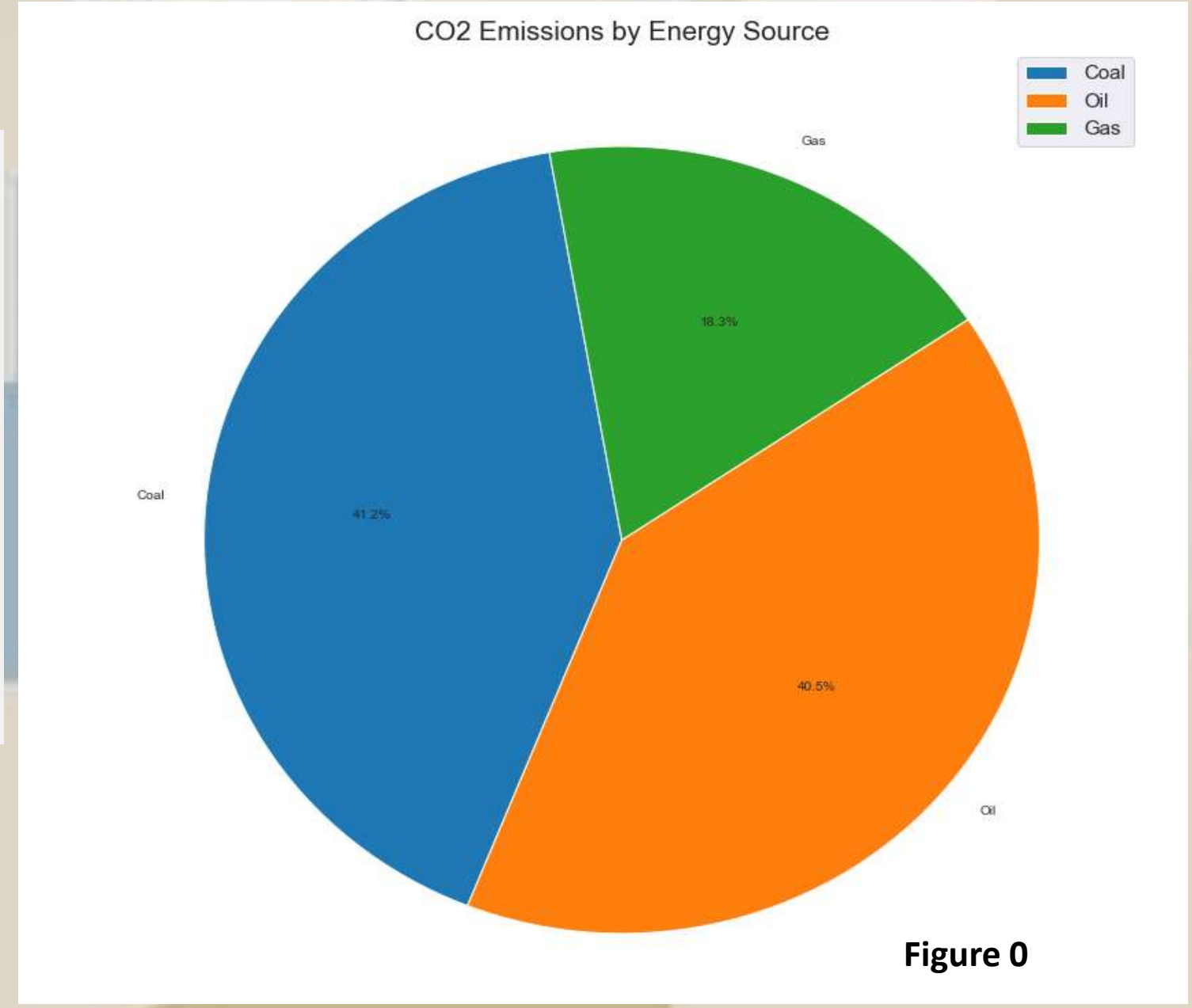


Figure 0

CORRELATION BETWEEN ENERGY CONSUMPTION AND CARBON EMISSIONS

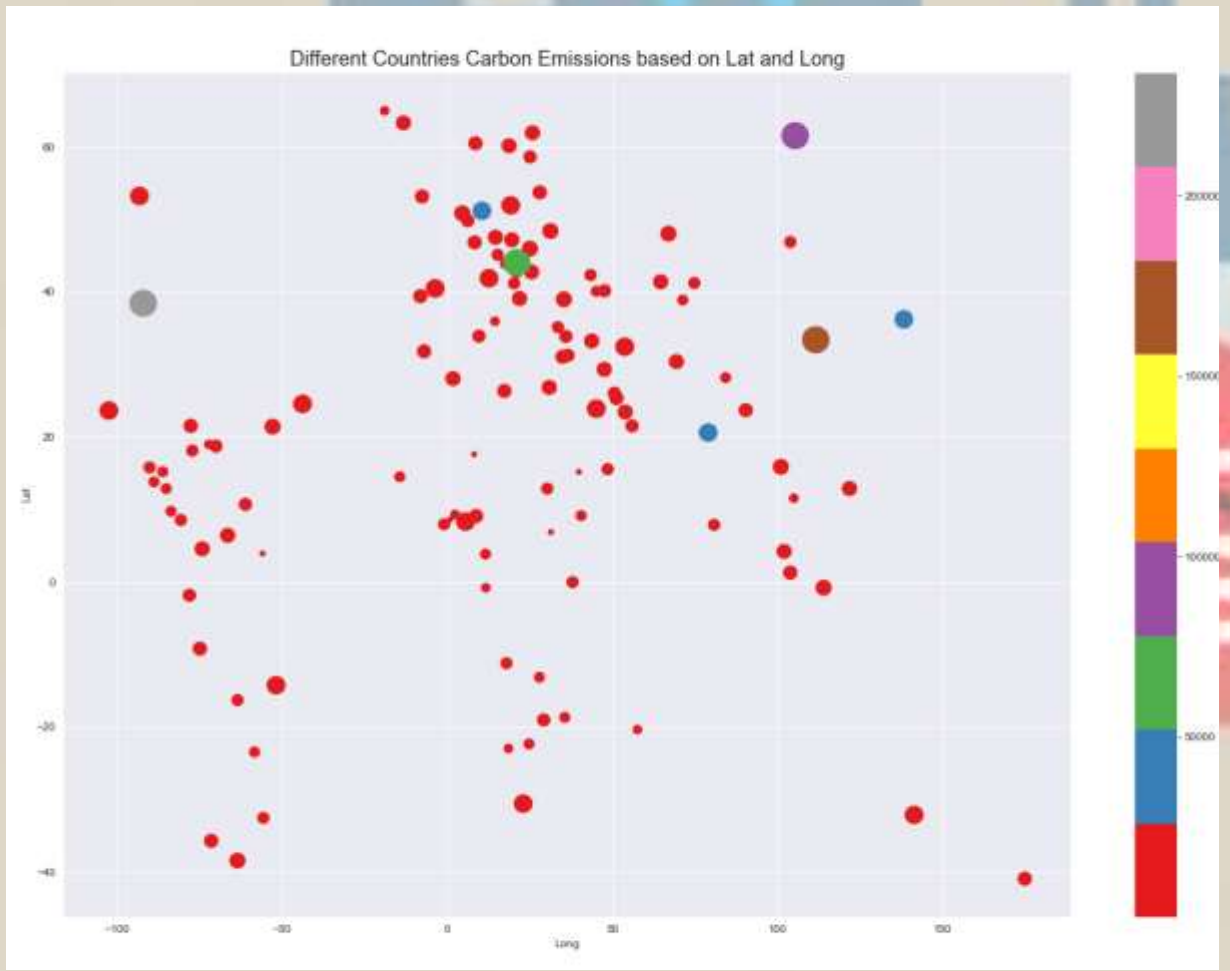


FIGURE 1

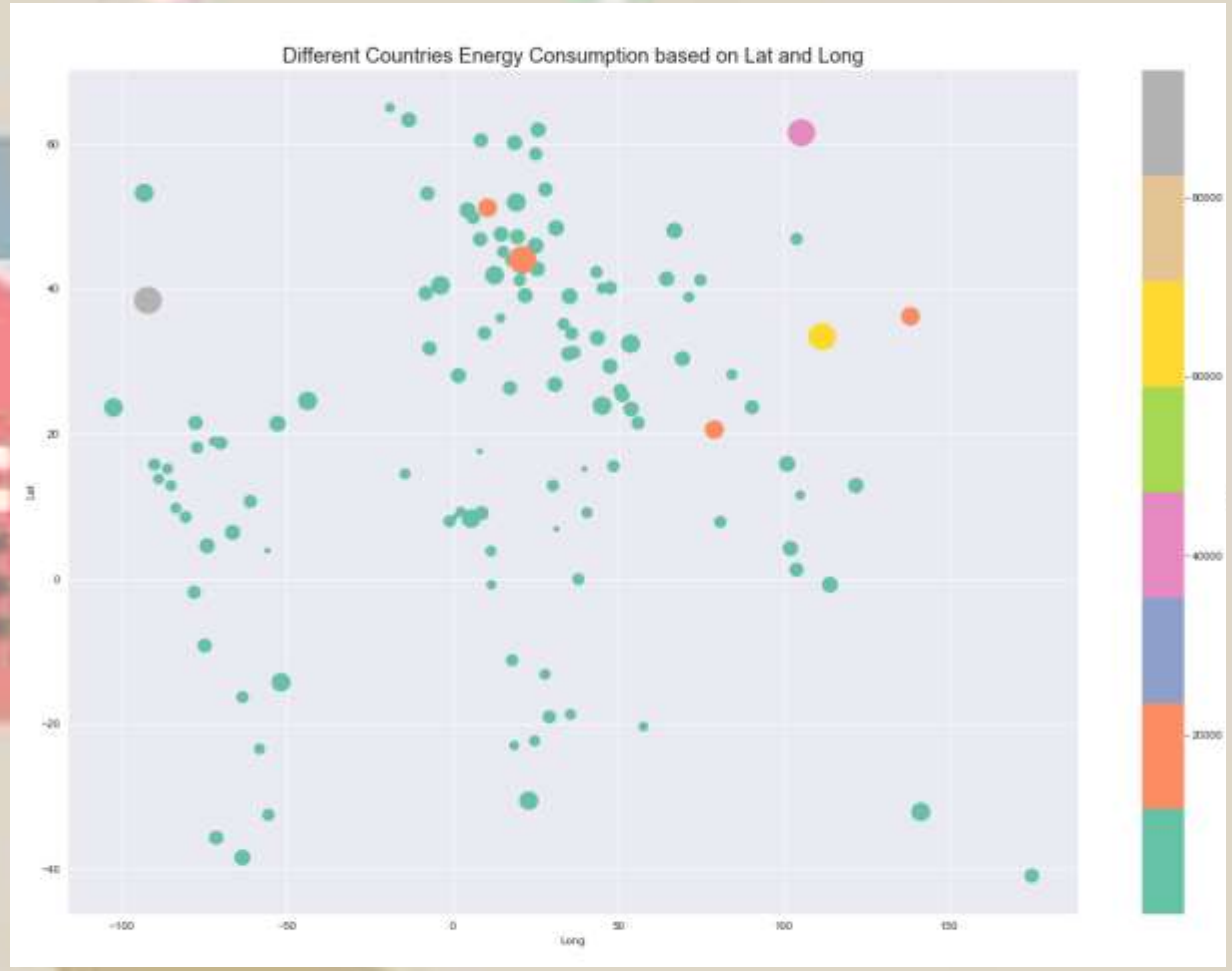


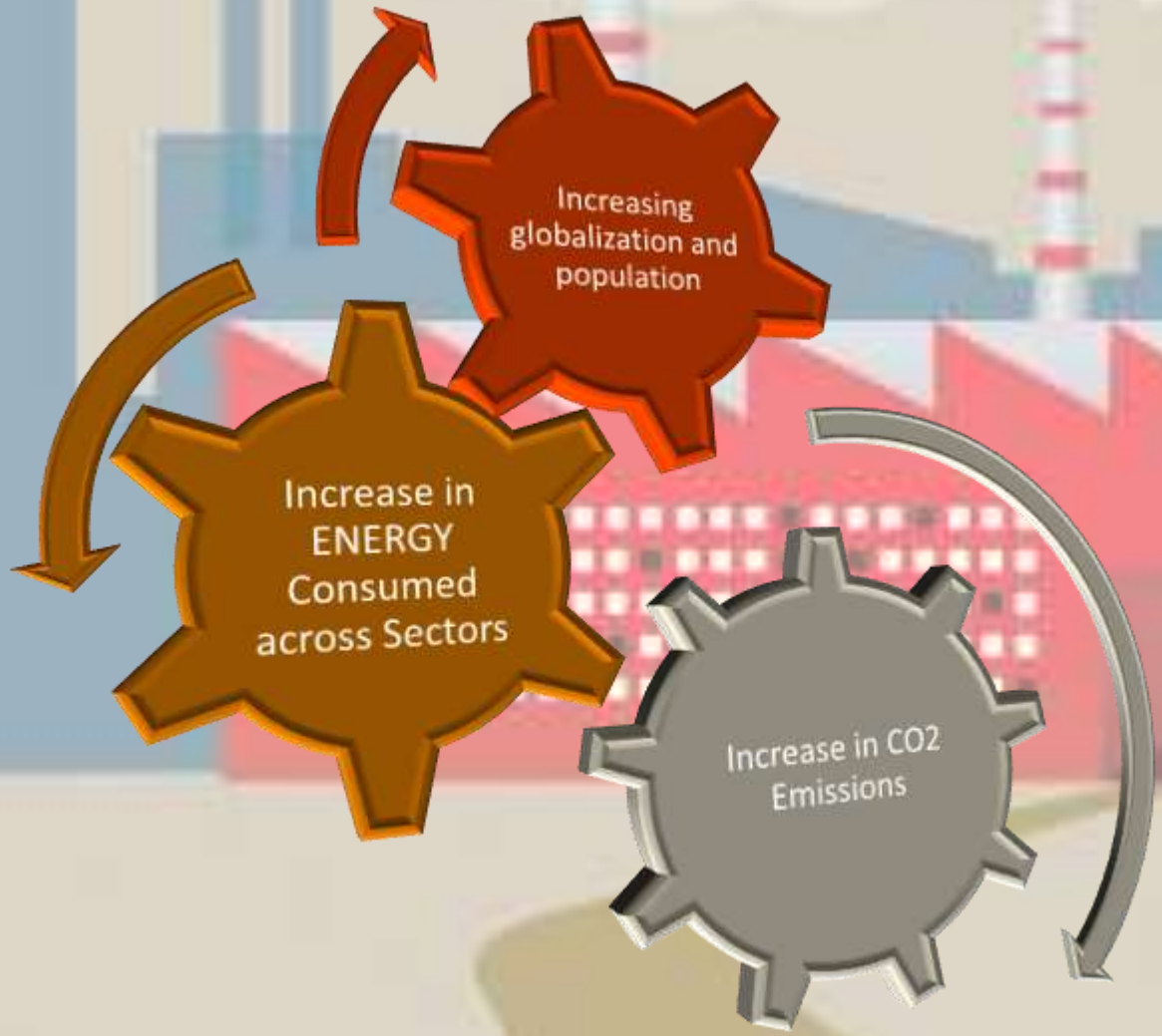
FIGURE 2

From **Figures 1 and 2**, the plots contains the coordinates of various countries showing with there respective CO2 Emissions and Energy Consumption.
The two plots are similar showing a relationship between Total Energy Consumption till date and Total CO2 Emitted so far.
There's little difference between the amount of CO2 Emissions released by individual countries and the Energy consumed by these countries.
The US has the highest Total Energy Consumed so far followed by China and Russia, the same goes for the Total CO2 emitted.

Highest Energy Consumed Till date	Highest Carbon Emitted
US	US
CHINA	CHINA
RUSSIA	RUSSIA
SERBIA	SERBIA
JAPAN	JAPAN

This shows that the biggest Air Polluters are the biggest consumers of Energy

POSSIBLE FACTORS THAT CAUSES COUNTRIES CONSUME MORE ENERGY AND RELEASE EXCESS CARBON TO THE ENVIRONMENT



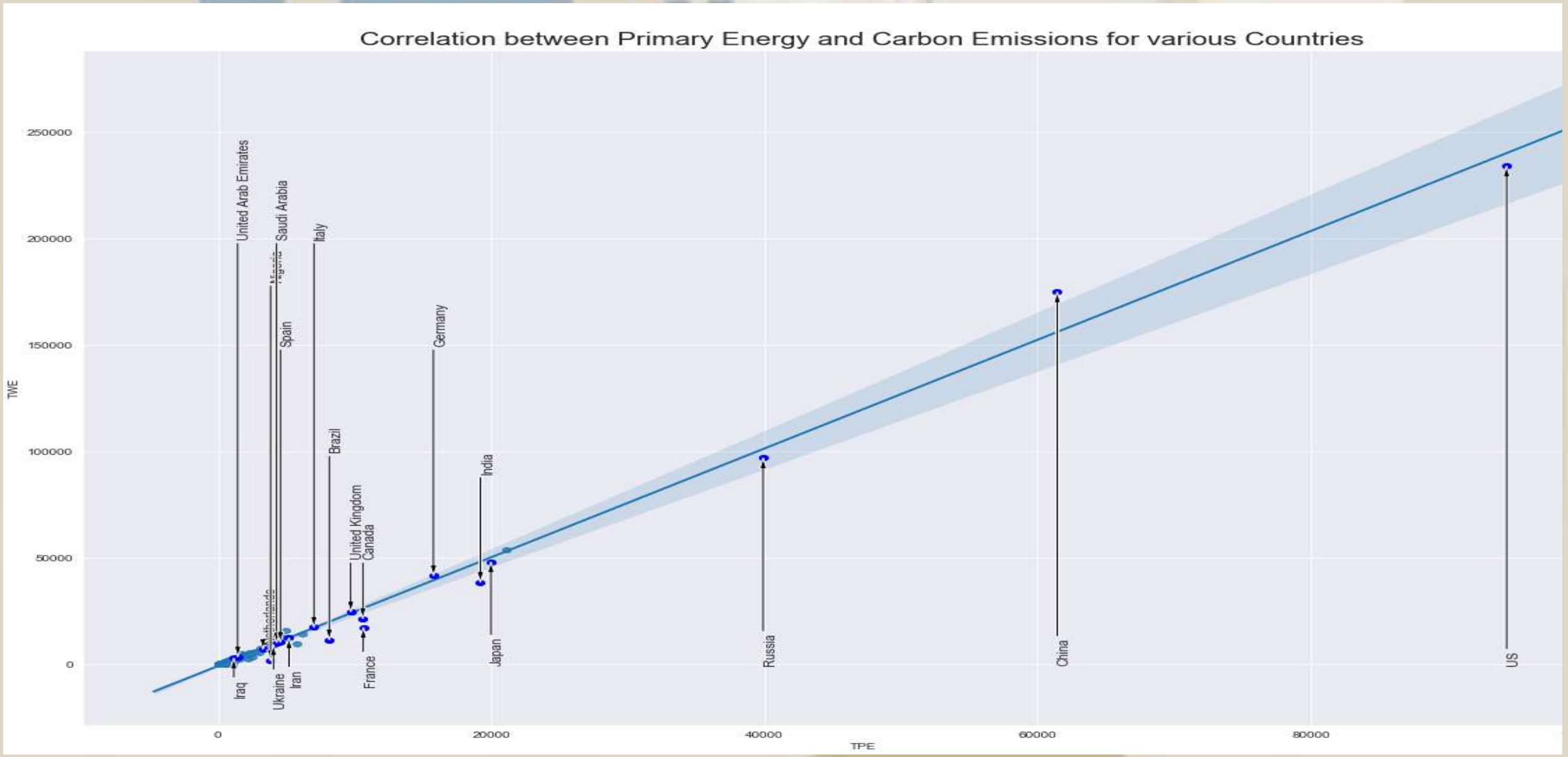

Correlation between Primary Energy and Carbon Emissions for various Countries
TWE
TPE
250000
200000
150000
100000
50000
0
0
20000
40000
60000
80000
United Arab Emirates
Saudi Arabia
Italy
Spain
Germany
Brazil
India
United Kingdom
Canada
Iraq
Ukraine
Iran
France
Japan
Russia
China
US

FIGURE 3

From **Figure 3** above, it can be seen that there is a linear relationship between Carbon Emissions and Energy consumed, the plot of which is a linear regression between the two variables shows an outlying relationship between countries Carbon emissions and Energy consumption. The US tops the list again as the greatest consumers of energy at the same time also gets the title for Largest Emitters/Polluters.

Features	Correlation with Carbon Emissions
Year	0.979569
Total Energy	0.997342
Population	0.979332

The table above is linked to **Figure 4** and shows how well population, year and Energy consumed correlates with Carbon Emission. Starting from year 1970, CO2 has seen a steady growth over the past 50 years with just few declines

Total Energy is the most correlated with Carbon Emissions and this gives a possibility of Correlation equals to Causation since we can say that an increase or decrease in Energy Consumed can lead to a decrease in Carbon Emissions.

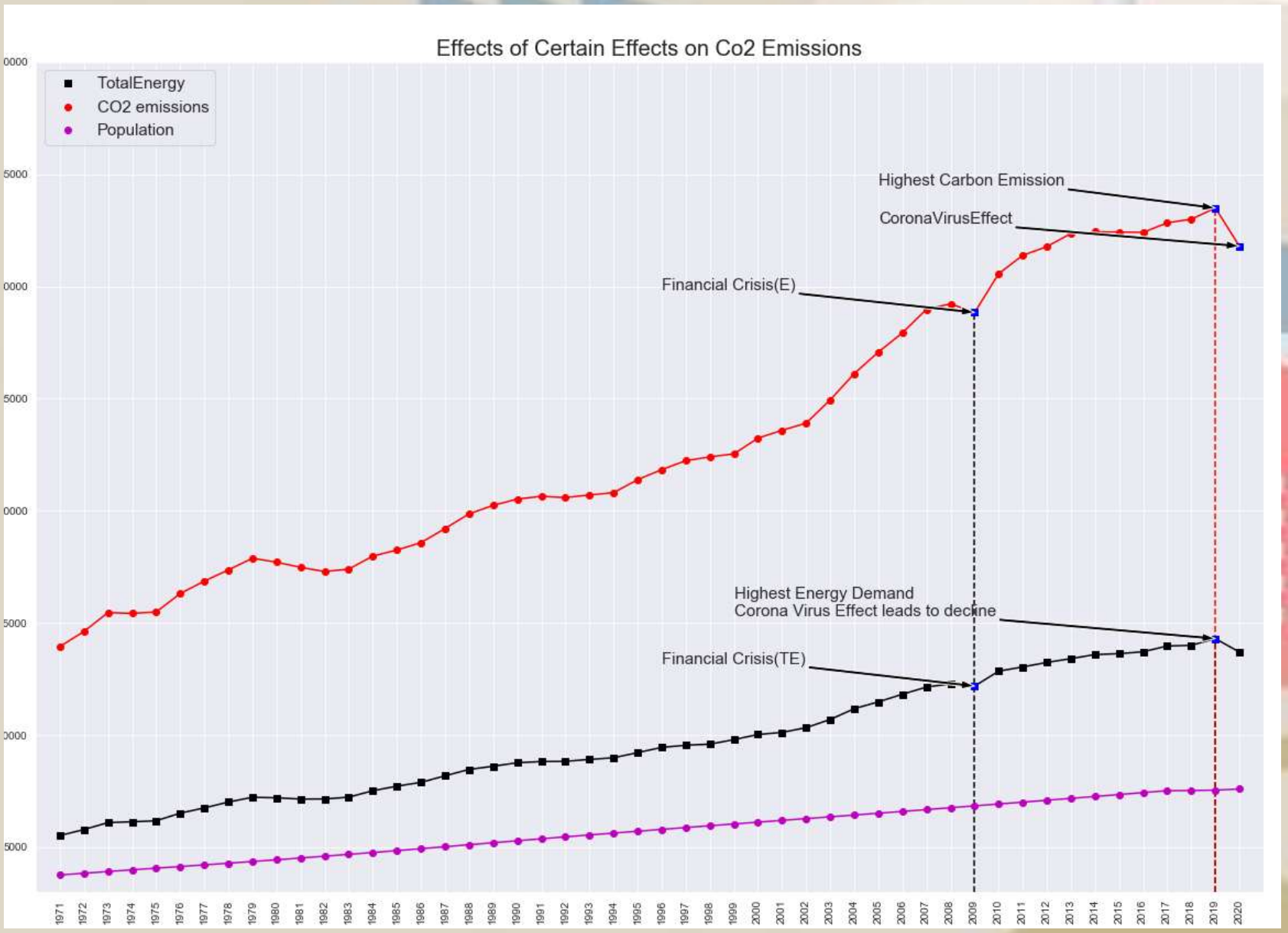


FIGURE 4

Figure 4 shows more precisely how Energy consumed affects Carbon emissions, we can also see that a decrease in Energy consumed directly leads to a decrease in CO2 emissions.

The plot also shows a steady rise in CO2 for the past 50 years alongside increase in population.

This makes sense as facts shows that an increase in population brings about an increase in Energy consumed which leads to a Rapid increase in Carbon Emissions since the primary source of energy is Fossil fuel ⛽

CO2 EMISSIONS BY SECTOR

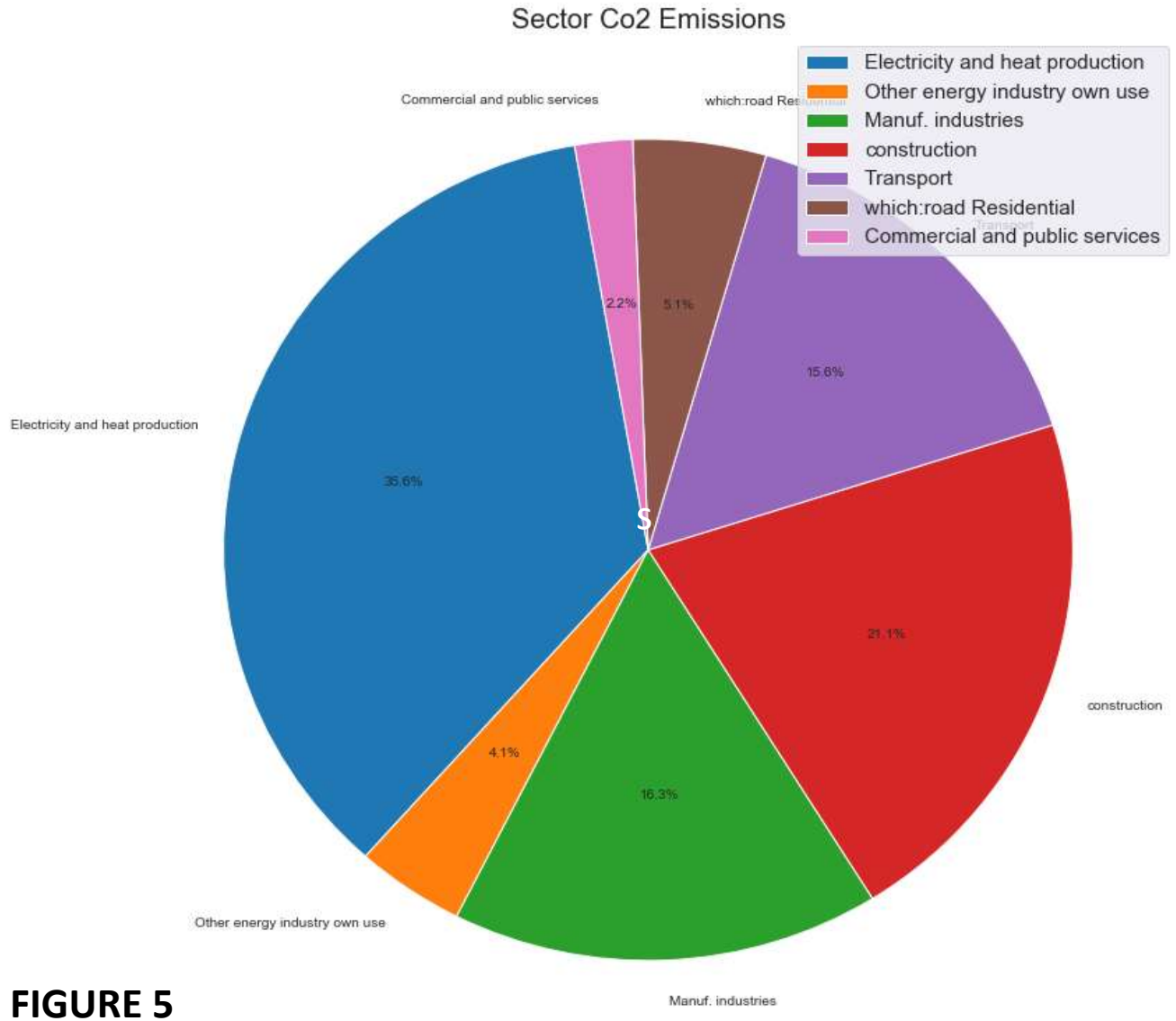


FIGURE 5

Petroleum has a lot of by-products spread across various sectors from
Electricity Generation
Transportation/Aviation
Manufacturing
Commercial Services

This makes Petroleum to be a sought after commodity that is traded globally leading to the increase in Carbon emissions since an increase In primary energy correlates to an increase in CO2.

TOTAL SHARES OF ENERGY DEMAND

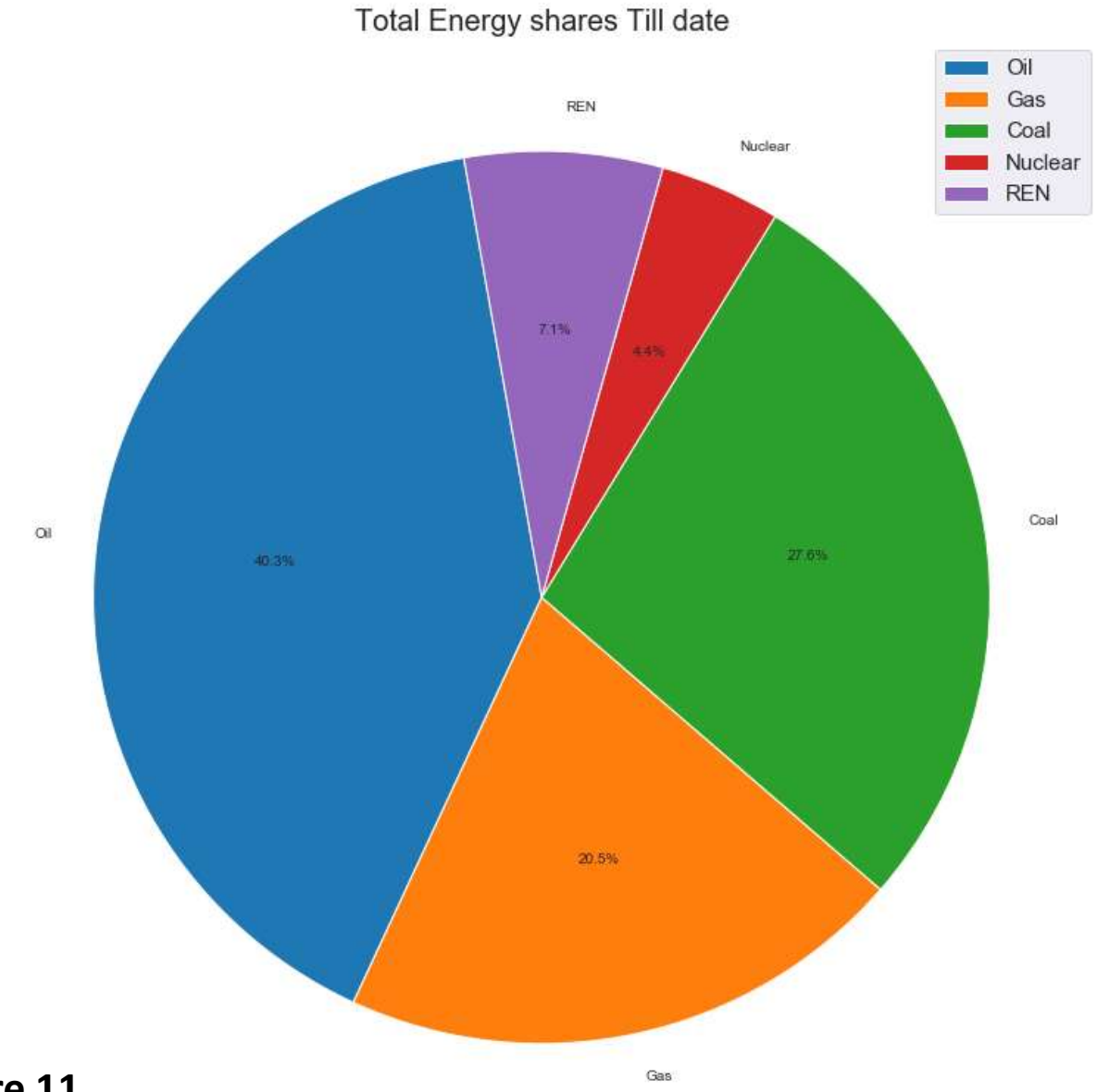


Figure 11

Figure 11 shows an accumulation of the Primary sources of Energy shares till date. The chart shows that Oil still holds a major share of the demand followed by coal, and referencing data from **Figure 0,** Coal and Oil are the two biggest CO2 emitters compared to gas which bears a lesser carbon emission and renewables that has a net zero emission.

From **Figure 12** below, we can see the variation in shares of different Energy sources over 50 years, Oil is still leading but has gradually lost market share to rising energy sources like Gas and Renewables, but the effect on Carbon Emission is still not evident as we still continue to rely on Oil and Coal has the two main sources of energy (The two biggest CO2 emitters), this offsets any impact made by renewables to lower Carbon emissions.

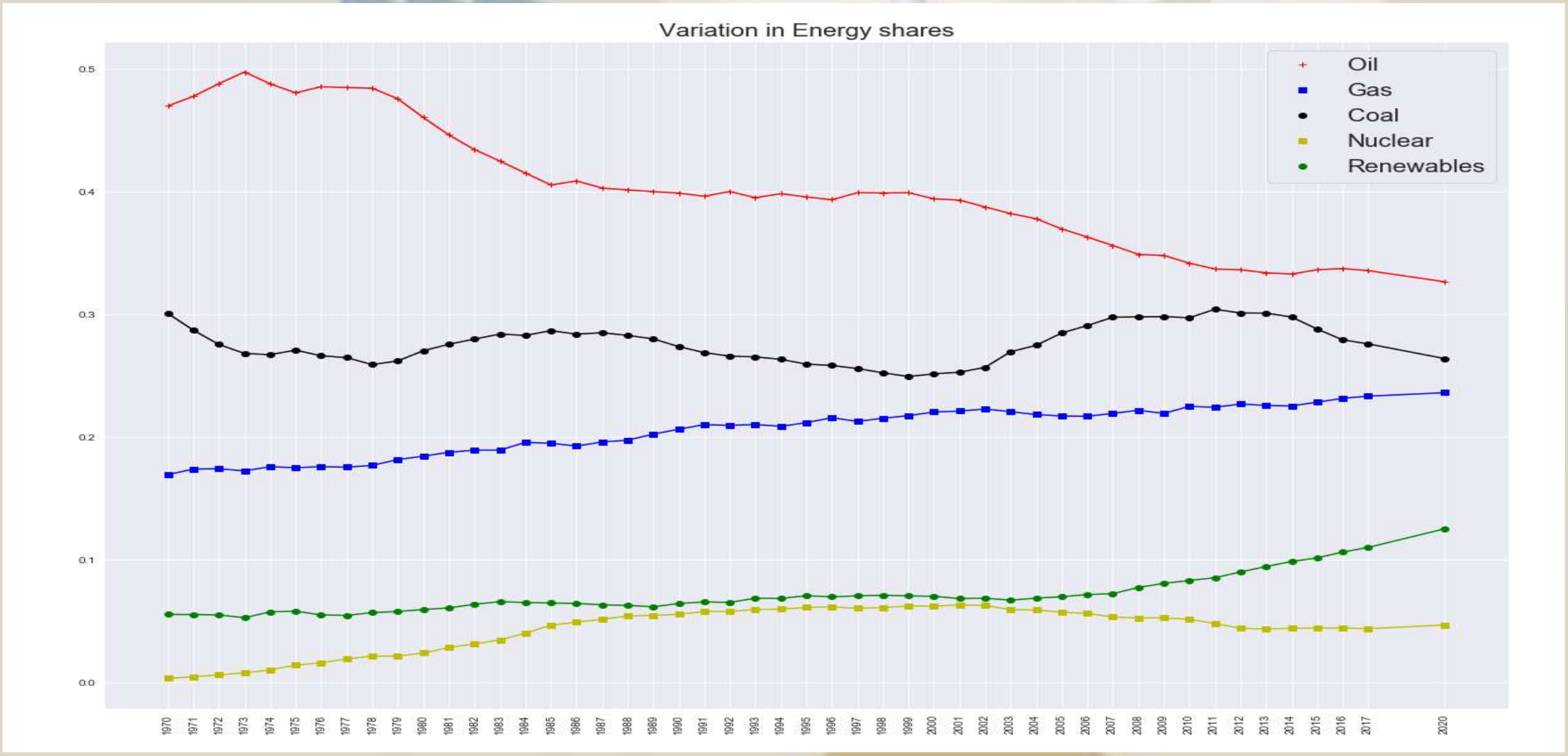

Variation in Energy shares
Oil
Gas
Coal
Nuclear
Renewables
0.5
0.4
0.3
0.2
0.1
0.0
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2020

Figure 12

From **Figure 12**, Renewables have been gaining market shares at the expense of Oil and Coal due to various factors, One of which is the High cost of buying a barrel of oil, Necessity is the mother of inventions and asides the fact that renewables offer the option of **Net Zero Emissions**, it also offers a replacement to high purchasing cost of a barrel of oil or at the best compete for market shares thereby reducing the average cost of purchasing a barrel due to lower demand . **Figure 13** shows that in 2008, Oil price reached its all time highest so far, from **Figure 12** above, it also shows that 2008 was the year Renewables started gaining more market shares.

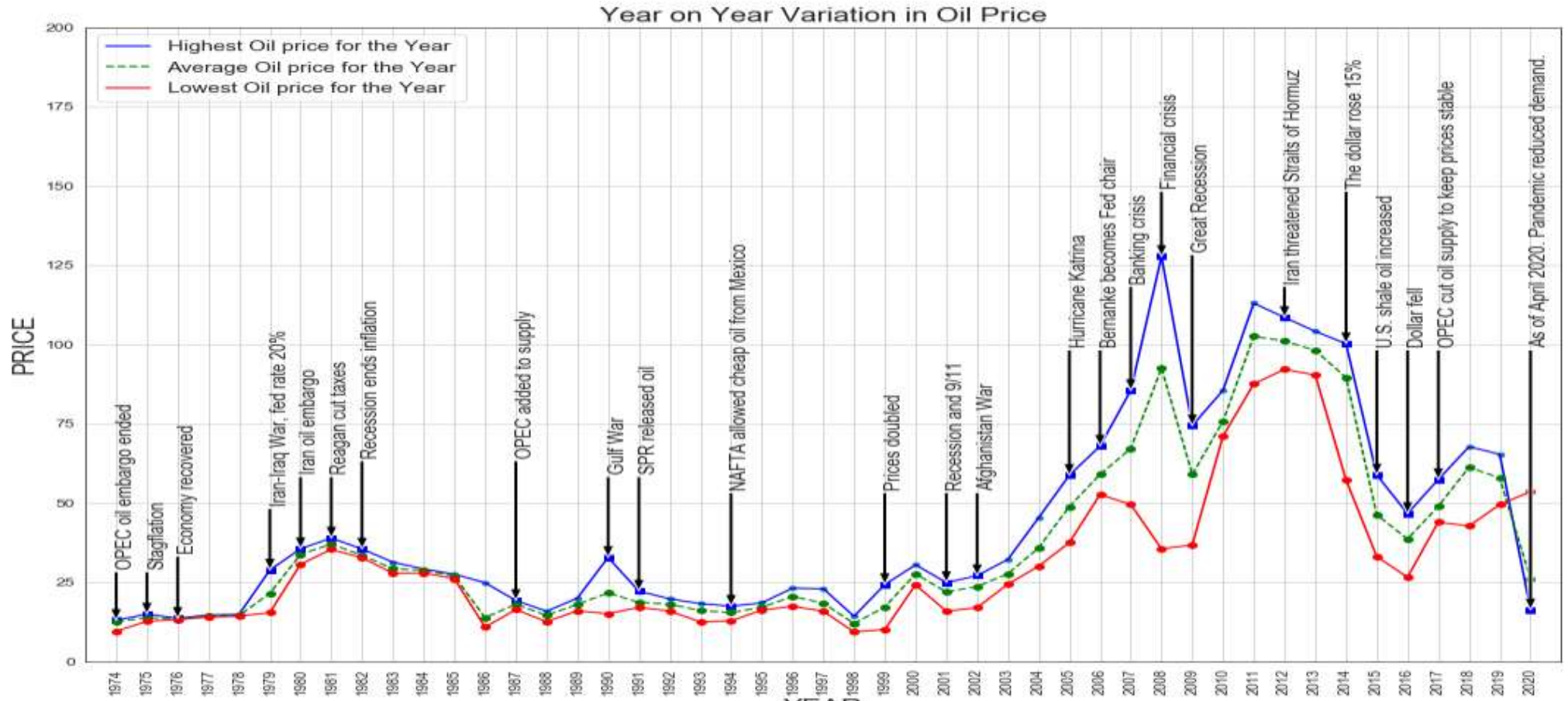


Figure 13

EFFECT OF CORONA VIRUS ON ENERGY DEMAND.

- The Corona Virus Pandemic has hit Energy Demand and Consumption across various sectors since transportation has reduced and a lot of industries have been shut down as measures were taken to limit the spread. **'Basic law of demand states that Lower Demand/Consumption leads to a lower Oil Price'** this was also fueled by high supply caused by a price war between Saudi Arabia and Russia.

- The Corona Virus alongside some Oil market forces led to the gradual decrease in Energy Consumption which affected CO2 Emissions bringing it to the lowest it had being in over 50 years in April when Lockdown measures were on full throttle.

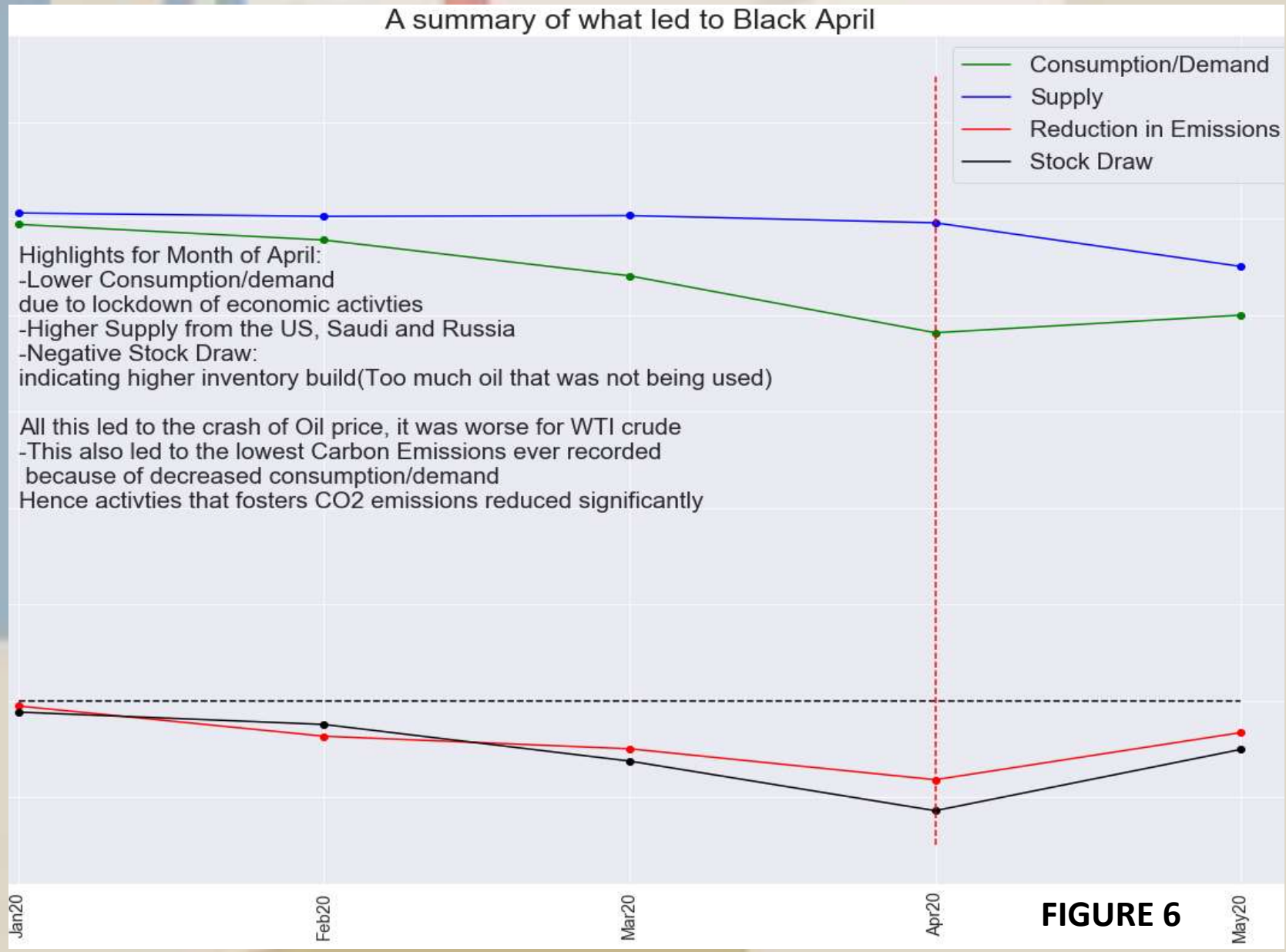


FIGURE 6

2020 FIRST QUARTER CO2 EMISSIONS BY SECTORS

There was also a decrease in CO2 emissions across various sectors with the Transportation Sector taking the major hit due to lockdown and stay at home measures, the sharp decline in CO2 emissions from the Transportation sector shows how dependent it is on Petroleum, there was also sharp decline in the Industrial sectors due to closed down Industries and Power sector as most countries started depending on Solar panels and Lower Carbon Emission sources.

Sources shows that there was a decrease in market share of Oil, Coal and Gas in the Energy Sector for the first quarter, Renewables on the other hand recorded an increase. All these factors combined led to the decrease in Global CO2 Emissions.

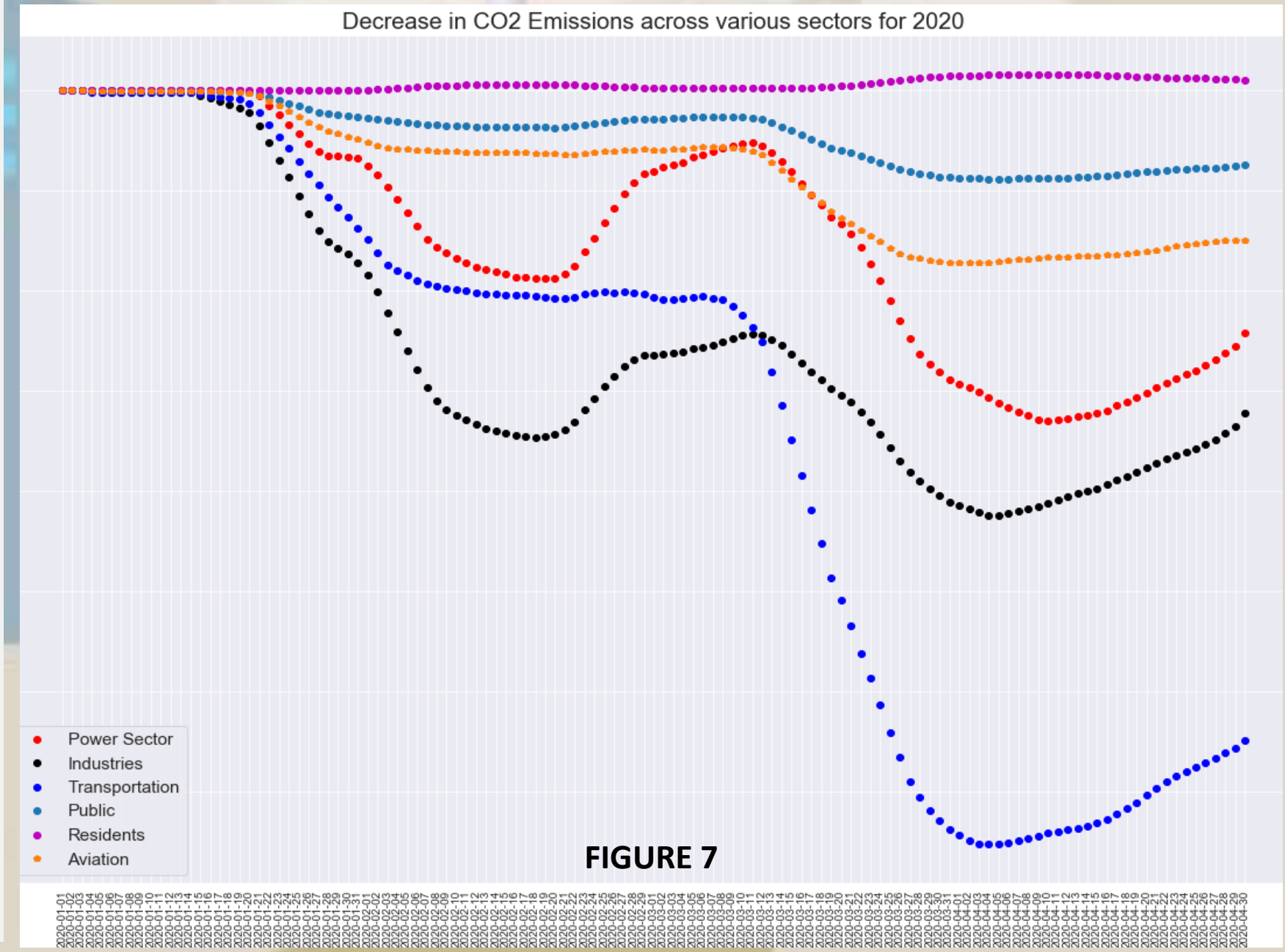


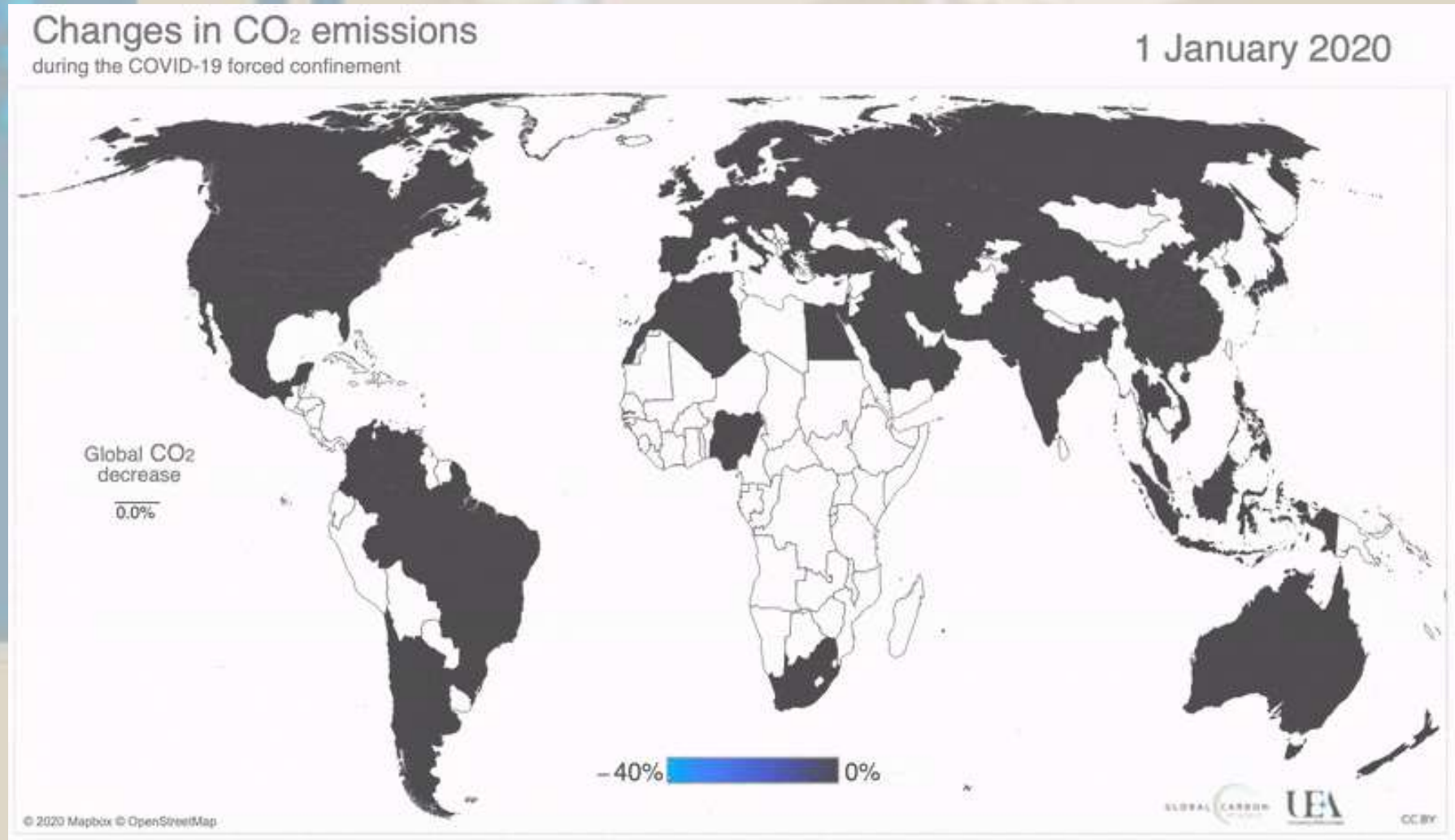
FIGURE 7

The Gif image shows the **changes in CO2 Emissions for the first quarter.**

As of May 20th, the global recorded CO2 emissions had reduced by -6.6%.

The highest recorded decrease in Global CO2 Emissions was recorded in April when lockdown measures were stringent at -18.8%

There was a steady decline in CO2 Emissions starting from January all the way to April but as lockdown measures became lighter, CO2 Emissions started to increase yet again but it is still lower when compared to previous levels.



SIGNIFICANT EVENTS THAT LED TO DECREASE IN CO2 EMISSIONS OVER THE PAST 50 YEARS

A **Year on Year Variation** of CO2 Emissions shows that there has only been an Annual decrease in CO2 emissions 7 times all the way from 1970 and this decrease is mostly attributed to Global Crisis that affected the Energy Industry/Demand and thereby led to the decrease in CO2 emissions.

This goes a long way to tell us that the reduction in Global CO2 emissions over the years have never been an intentional process from countries or sectors but rather a side effect of a Global Crisis that reduced the Production, Consumption and Manufacturing capabilities across various sectors that are related to the Energy Industry since a Lower Fuel Combustion leads to Lower Carbon Emissions.

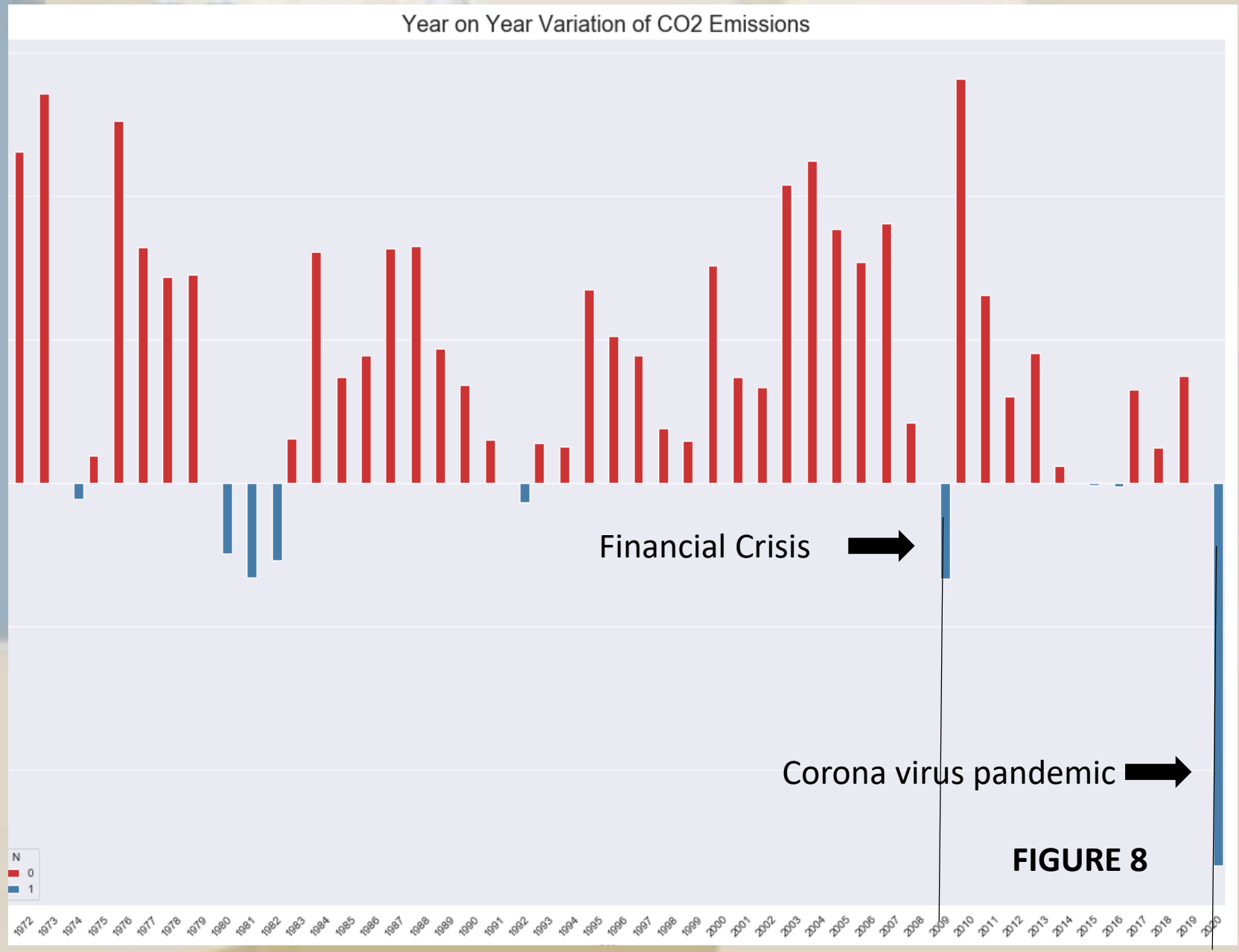


FIGURE 8

COMPARISON OF ENERGY SHARES IN 2017 VS 2025

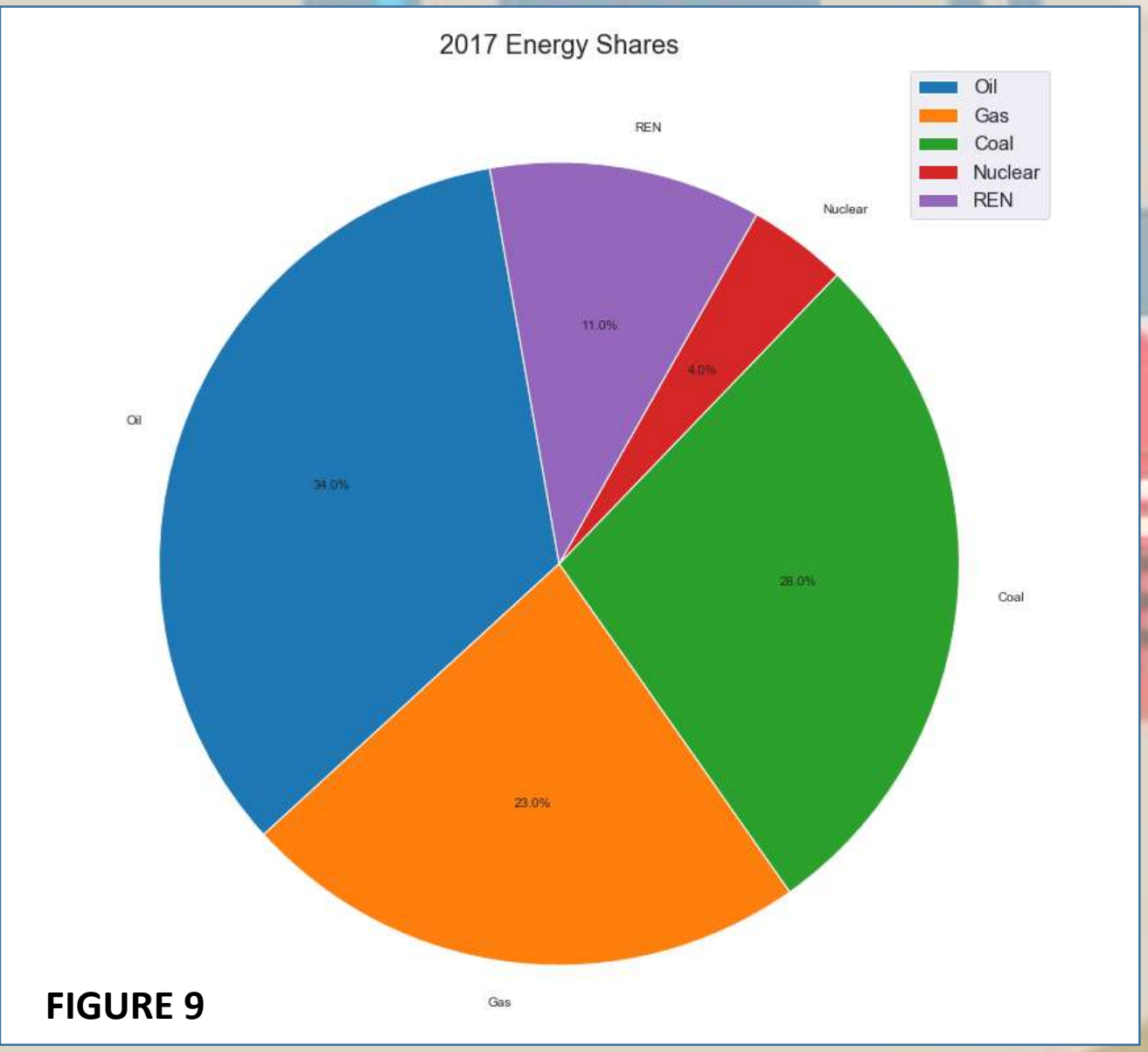


FIGURE 9

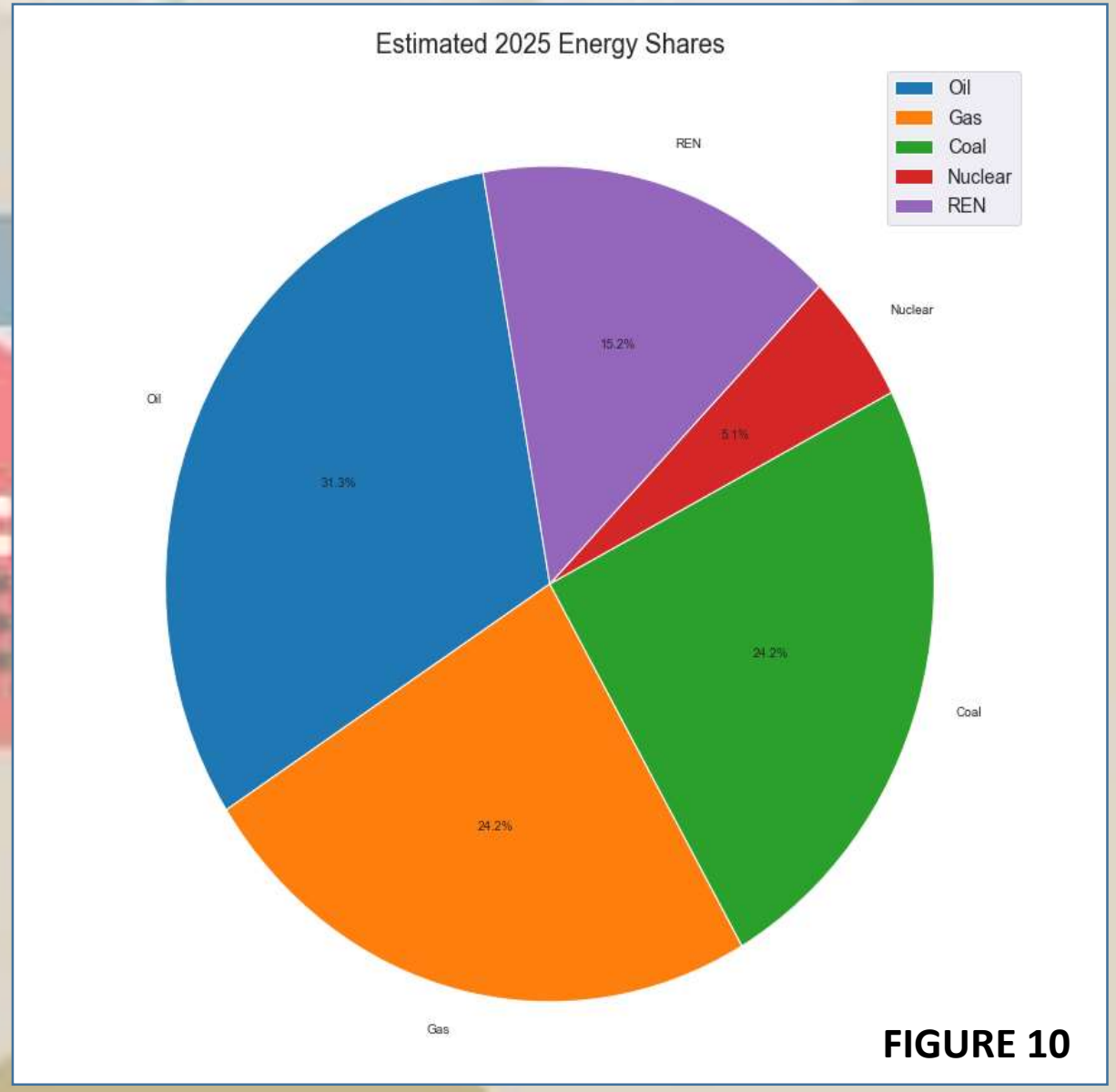


FIGURE 10

So why not go Green completely?

From **Figures 9 and 10**, we see the BP outlook estimated share price for the next 5 years and Oil is still the dominant Energy source, one might want to bring up the argument that the Corona virus pandemic has affected the way we think causing us to be more aware of our environment and make appropriate changes, that may be true but let us not forget that according to **Figure 8**, in 2008 during the financial crisis there was also a decrease in CO2 emissions, this of course did not last as we can see that CO2 Emissions reached its all time highest the following year meaning that World leaders were not able to capitalize on the reductions and enforce policies that would have maintained CO2 emissions below that level.

There are talks of Environmental, Societal and Governmental (ESG) Investments and Investors are beginning to be aware of the condition of the environment and are putting pressure on companies especially Oil and Gas companies, asking them to share their Future plans on the Energy Transition and Climate Change but these are long term goals and the effect on CO2 Emissions will not be noticed for a long period of time. So in as much as Renewables offer net zero emissions, it's not going to be easy to transition from the Oil and Gas Industry that gives more profit in the short term as compared to Renewables. Especially in a time of Economic Recovery, Government leaders and Investors are likely to abandon talks on Transitioning to a cleaner energy as everyone is preoccupied on making more money to prevent a recession

FORECAST OF PRIMARY ENERGY COMSUMPTION BY SECTORS

Energy Consumption for the next 20 years is estimated to keep on increasing, this can be attributed to increase in globalization, rapid development of some countries and an increase in population, **Figure 14** shows the estimated energy consumption across various sectors.

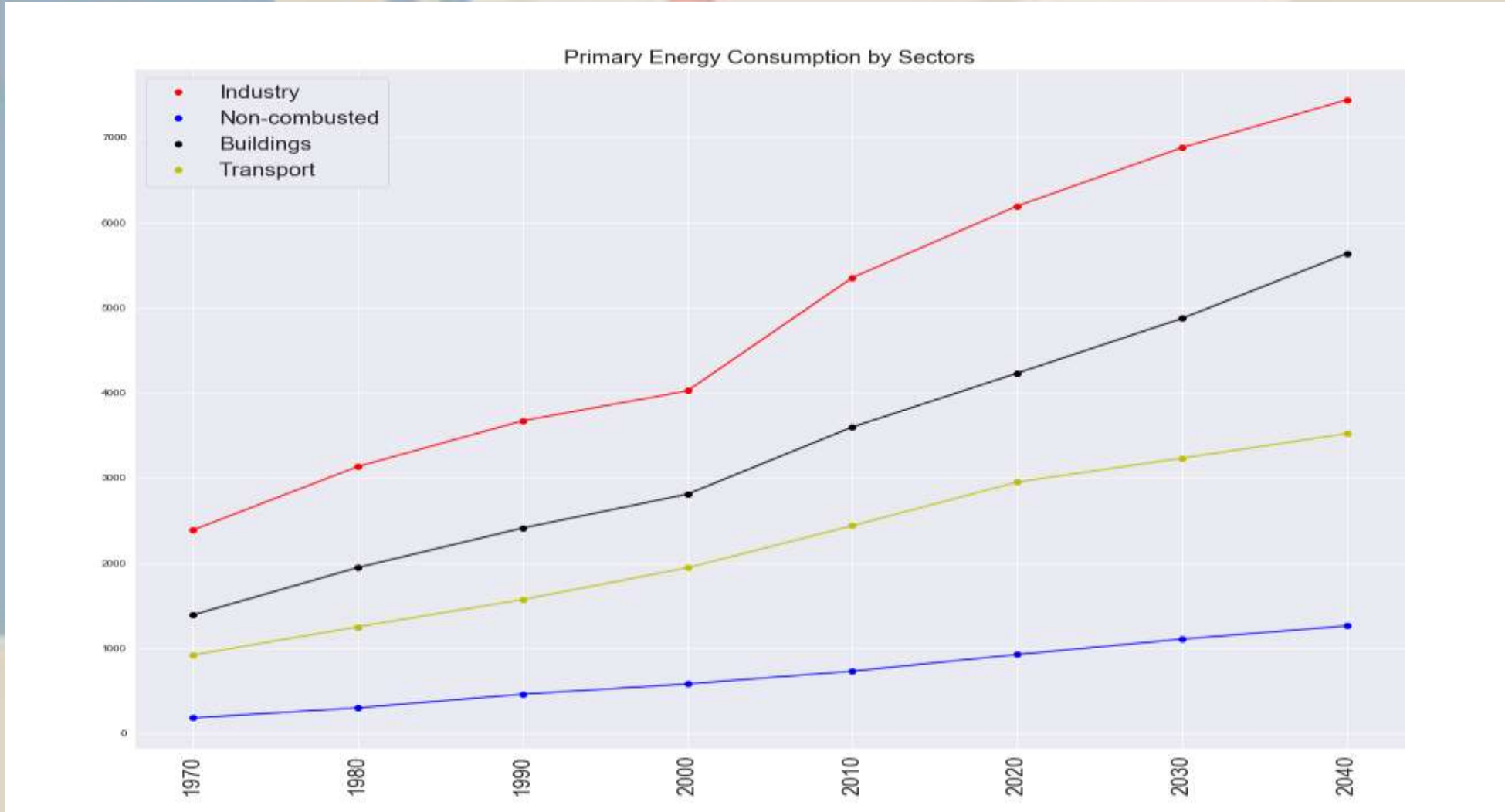


Figure 14

Energy Consumption is estimated to increase rapidly over the next 20 years, this also means that Carbon Emissions would increase over the next 20 years, but in a bid to produce '**More Energy with Less Carbon Emissions**', Humanity have to find a way to reduce the Total Carbon Emission and this will be best done by an **Energy Transition** to Energy sources that produces **Net Zero Emissions**. **Figure 15** shows how demand for various sources will increase over the next 20 years. There seems to be a rapid increase in the demand for Renewables compared to other sources.

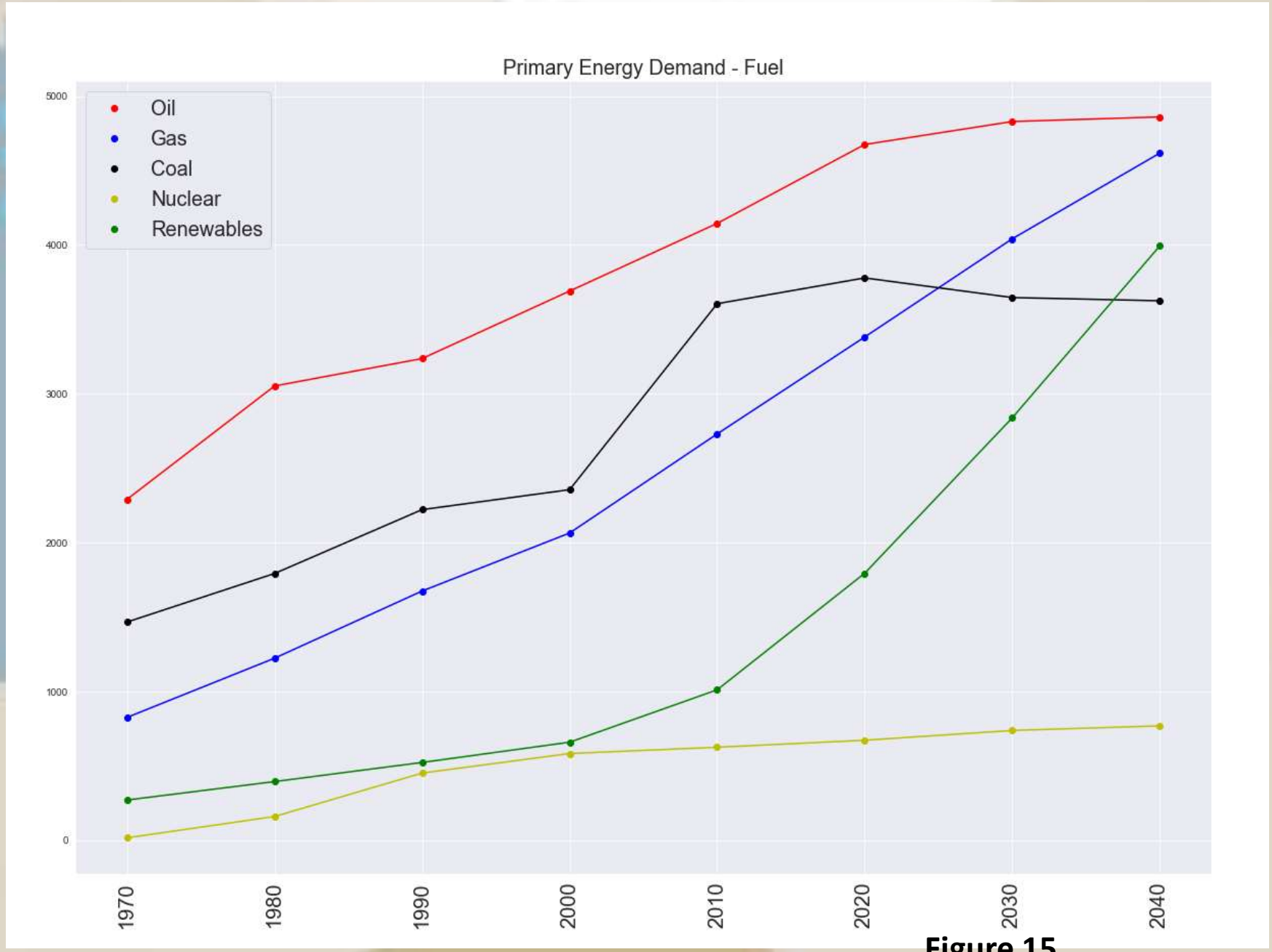


Figure 15

Figure 16 shows the Possible Energy transitions and the carbon emissions associated with each transition.
Evolving Transition: This depicts a gradual change in Oil and Coal as the primary energy to Renewables.
More Energy: This depicts a situation whereby the World focuses on industrialization and globalization thereby consuming more Energy.
Less Globalization: This is the opposite of the More Energy situation indicating lesser growth and development of countries.
Rapid Transition: This illustrates a situation whereby stringent policies are put in place and there is a swift change in the main primary energy from Oil and Coal to Gas and Renewables

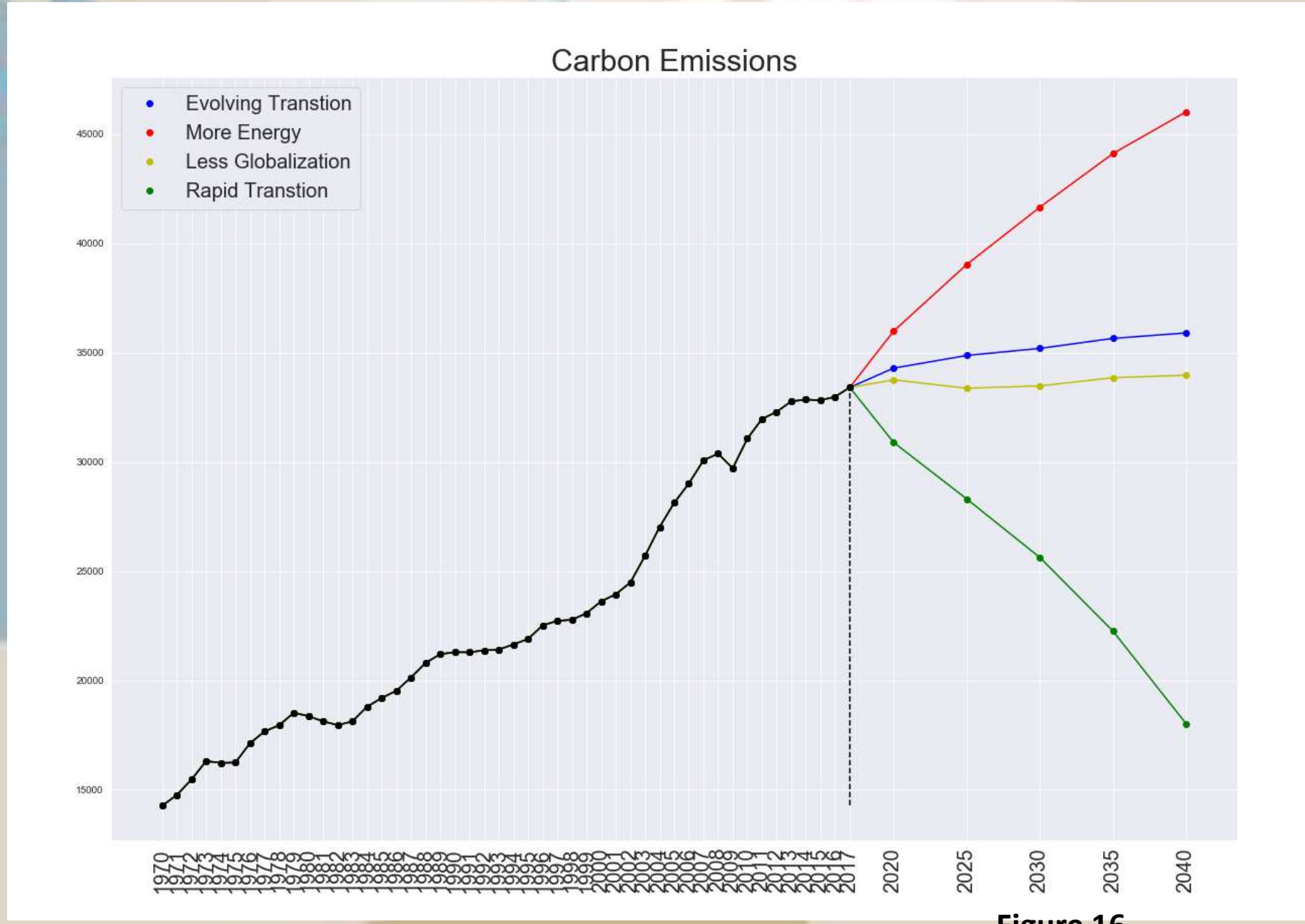


Figure 16

Key Findings:

- Developing countries that have shown growth over the past ten years have contributed significantly to the release of Carbon Emissions.
- There is a direct correlation between Carbon Emissions and Energy consumed, which is somewhat influenced by Population, because as population increases we tend to consume more energy so as to meet more needs
- Oil and Coal fossil fuels constitute greatly to the amount of CO2 Emissions that is released to the atmosphere compared to Gas which is also a fossil fuel.
- Renewables have a net zero emission, but its impact have not been felt on the Reduction of Global CO2 Emissions because of its lower %shares in the energy market.
- Reduction In Carbon Emissions over the years have never been an intentional process by sectors or countries but rather have been caused by various global events that affected demand and consumption of Energy sources like Oil and Coal, indirectly leading to a decrease in CO2 Emissions.
- The Corona virus pandemic affected the Global CO2 Emissions simply because of lockdown measures taken by world leaders, this directly affected fuel consumption in the Transportation, Aviation, Manufacturing and Industrial sectors and to sharp decline, the data shows that as lockdown measures were eased off, carbon emissions started to rise again. Data from previous global events that have reduced Carbon Emissions shows that once the World is past that crisis, CO2 Emissions increases and even passes it previous levels. Hence it is very possible that the current reduction in CO2 emissions will not last as activities are set to resume in the next 3-6 months.
- An Energy Transition is the most likely event to reduce Carbon Emissions over the coming years and this can only work if Investors and World leaders put stringent measures in place that forces Big Oil companies to transition from higher carbon sources like Oil and coal to lower carbon sources like gas or even better to Net Zero sources like Renewables.
- The best the Corona virus has done in relation to Air Pollution is to bring into awareness that the earth is suffering and we need to make a change to keep the Earth clean, hence companies and various sectors needs to start taking sustainable developmental goals more seriously by planning for the future which involves a cleaner energy that reduces Emissions.

References.

- IEA Website
- EIA Website
- Reuters Website
- Oilprice.com
- data.world
- IEA Global Energy Review

Dataset

- The IEA 2020 Global energy review
- BP Energy Outlook 2019
- EIA Short-Term Energy Outlook