



CO2 and Greenhouse Gas Emissions

Group- 6
By- Aniket Ghole
Chitransh Joshi
Deep Mehta
Rashmi Bajwan
Utsavi Waingankar

MSIS 670 Enterprise Business Intelligence
Professor: One Ki Daniel Lee
Spring 2022 Date: 4th May 2022

INDEX

| Topic | Page Number |
|-------------------------------------|-------------|
| Introduction | 3 |
| Data set description | 4 |
| Storytelling and data visualization | 6 |
| Conclusion | 12 |
| References | 15 |

Introduction

We have a single mission: to protect and hand on the planet to the next generation – Francois Hollande. Today there is a huge debate about the climate change, and the main reason is enormous number of gases are emitted in the air every day. From past thousand years ago most of the one thing remained the same, is the amount of carbon dioxide in the atmosphere. In late 18th century the level began to climb and then in 20th century it went through the roof. The increase in atmospheric carbon is the biggest contributor to climate change.

The way carbon moves around the earth are called as carbon cycle. The way humans have changed the carbon cycle is one of the reasons as per the scientist, they say the earth has entered the Anthropocene. Today fossil fuel adds extra 95 billion tons of carbon into the atmosphere. Think about all the petrol that's poured into the car in all the cities of the world, think about the coal that goes into the power plant, all the gases that has been burned on all the burners of stoves of the whole world. Plants photosynthesis is more if there is more carbon dioxide, we think it as a good, but plants photosynthesis is less if they are dead. If the climate changes, large number of plants die.

Roughly half of the carbon from fossil fuels is absorbed by the earths sinks, rest makes to the atmosphere which traps heat warming the planet. This has had the devastating effect on the world's climate. We need to reduce human emissions as quickly as we can. Our main purpose of selecting this topic is to discuss about the gas emission throughout the world, we are more focused to the higher emitting countries. We will be discussing about types of different gases that countries are emitting and ways to limit them. Also, we have focused on the current state of covid 19 crises, to discuss the effects on gases during that time. To know whether the effect will continue to remain same or again the gases will continue emitting the way when covid 19 was not there.

Data Set Description

According to the main and sub-questions, the data cannot be extracted from one data set only. The amount of information about covid 19 crisis, emissions per capita, sectors contributing to gas emissions, and historic results of the world. We have chosen several data sets which relate to one another and let us answer our questions smoothly. For the data sets, we are referring to, we did not need to clean the data as the data was available clearly in its ready form. Let us discuss them one by one, first, we have a data set, which covers most of the information about different types of CO₂ gases, their consumption, about their share globally, according to the population and GDP of all the countries around the world. In our project, we are focused on the highest CO₂ gas emitting countries. This data set also includes cumulative gas and energy consumed per capita. The data is from the year the 1740s to 2020. For some countries the emission of gases began in the late 90s so according to that data has been organized by default. This data set is useful for us to extract the information about historic data of the gas emissions, the gases emitted based on their per capita, it also mentions the information about the contributors of different types of gases and lastly the reason which has caused an increase in the emission of those gases.

The second data set is mainly focused to find the average emission per capita by countries over the world from the year 1990 to 2018. This dataset includes various section such as aviation and shipping, land-use change and forestry, agriculture, building and industry per capita. The emission caused by human usage such as electricity, heat, transport & waste by each person.

We got this data set and relevant information from Our World in Data (1).

The third data set, specifically center the attention to various sectors such as power, industry, ground transport, residential, domestic aviation, and international aviation of the countries such as Brazil, China, UK, France, Germany, India, Italy, Japan, Russia, Spain, UK, and US. It has an additional row of World data for the mentioned sector which covers the other gas emitting countries as a whole. This data is given for the year 2019 and 2022. For the given countries given by sector, MtCO₂ or Metric tons of carbon dioxide per day is represented in the data set. This data set gave us the excessive information about most of the gas emitting countries by their sectors.

We got this data set and relevant information from Carbon Monitor (2).

The other 3 data sets are combined to answer few questions from our question set. It gives us knowledge about the various policy regulations by sector which helps to reduce the emission of CO₂ gases. It is about different types of emission such as CH₄ emission, CO₂ emission, and N₂O emission of all the countries around the world from 1990 to 2018. These datasets comprise of the agriculture rate, waste, land-use change and forestry, transport, electricity and heat, building, fugitive emission and about the number of industries built in those country. It gives clarification about the number of industries in a country in specific year, for which the number of gases were emitted. Whether there is excess use of gas per industry or increased number of industries were causing more amount of emission.

Then there is a dataset which compares CO₂ emission with GDP per capita of countries around the world. It helps to track appropriate comparison of the CO₂ emission gases of GDP per capita and annual CO₂ emission per capita based on the population of the countries (population is hint at by the historic estimation). Additionally, to reduce the greenhouse gas emission or to ensure that ongoing emissions are balanced by removals, to reduce global warming, it is necessary that global carbon emission should reach net zero. To trace net zero target, it is mentioned about the countries who has achieved net-zero and other countries who are in still in progress and has made the future estimation by year. Along with that, this dataset provides knowledge about the way to limit the emission by their sectors based on policy regulations implemented on those countries.

Furthermore, a dataset to track the covid 19 data of the countries around the world. It is about the temporary reduction in daily global CO₂ emissions during the Covid-19 crisis. We know there was a strict lockdown over the countries. Due to which some gas emitting industries were shut, offices and other things were closed so travelling was reduced, petrol consumption was reduced. This caused reduction in gas emission. For that temporary period of time this data sheet is designed to trace the changes in greenhouse gases emitted with respect to their sectors. This data set help us find whether this will continue and how much it benefitted our earth with these reduced emissions. Different gases with different countries can be compared and a wise solution can be framed. So, we used this data set of the year 2020.

Moreover, in addition to the previous paragraph, one more datum is used to estimate the effect of confinement post covid-19. It includes UNFCCC countries which were affected post covid19 by their total CO₂ emission per day, power, and industry. Also, the effect on surface transport, gases emitted by public each day, residential and aviation by their region. Further, these senarios are elaborated more by each sector based on their level of data for low section, median section, and high section. This data is of the year 2020. It helped us gather the information about various sectors which has helped to reduce the emission during covid19 crises. To know whether it was beneficial in a way to reduce the emission or there is a need to revise pre covid policies to make sure whether the tracking of emission over the world was benefitting or not.

We got this dataset and information related to this data set from ICOS.

Storytelling by Data Visualizations (using Tableau)

Main Question and their sub-questions:

1. Is the population of countries directly proportional to higher emissions?
 - 1.1 How much does each country historically contribute to the emission each year?
 - 1.2 What is the average emission by each person/ per capita?
 - 1.3 What has caused the increase in emissions?
 - 1.4 What are the ways to limit the emission quickly?
2. Does Covid 19 crisis helped in reduction of global emissions?
 - 2.1 How much Covid 19 crises has helped to reduce the emissions and which sectors?
 - 2.2 Will the Covid 19 continue to contribute to the reduction of emissions?
 - 2.3 Is there a need to revise pre Covid 19 current policies scenarios?
3. Who is the source of global gas emissions?
 - 3.1 Which sector contributes the most of gas emissions?
 - 3.2 How much policy regulations in each sector helping to limit the emissions?
 - 3.3 Will each sector emission affect the consumption and marketing opportunities cum strategy?

Visualizations for the first question and their interpretations (findings)

We only have one earth. If we do not protect the earth, then we will not have a place to stay, to live. Before the Industrial Revolution there were blue skies and white clouds, everything was clean. But, in the 18th century, England began the Industrial Revolution which spread to other countries and began to change the environment. Environmental issue became a big problem. It was because of the people who started overusing the fossil fuels. By 1700s there were 2.5 million tons of coal mined, by 1800s it rose to 10 million tons and later reached till 57 million tons of coal. If they mined this much coal, people burned it in same amount.

When we burn coal, it releases lot of carbon dioxide into the atmosphere. Increased carbon dioxide has led to global warming and cause greenhouse effect. This is causing climate change throughout the countries. The polar ice caps have started melting faster in the last 20 years than in 10,000 years.

Let us visualize the historic data of the highest CO₂ emitting countries for the reason discussed above about United Kingdom, the first emission started in United Kingdom by 1750s, increased till 420 tons by year 1900. After 20 years, from 1920 to 2020 the emission kept on fluctuating between 400 to 500 tons of CO₂ gas. In 1902 china was at zero emission of CO₂ gases, since then it gradually started increasing and reached till 10,668 tons emission of CO₂ gases which represents as the highest contributor of CO₂ emitting country. This is the reason every year, hundreds of thousand people die because of air pollution in China. These gases

emitted in china comprises mainly from coal burning, including coal-fired power stations, coal mining and blast furnaces which produces iron and steel.

United States started emitting 1ton of CO₂ by the year 1826, it peaked up by 4000 tons by 1969 and then onwards it started rising significantly without any limit due to the development of country, a high standard westernize culture was trending. Every person in family uses individual transportation. The whole goods transportation is by roads. So, the largest sources of greenhouse gas emission are produced by the human activities, mostly are by burning fossil fuels for electricity, transportation, and heat. By 2020 emission in United States reached around 5000 tons of emission of CO₂ gases, US is the second highest country after china for emitting CO₂ gas. India is the world's third largest emitter of CO₂ gases after china and US. Coal power plants, rice paddies and cattle grazing are major sources of emission which continue to rise over the period of time. The emission reached till 1000 tons in 2000 and continued to grow and in 2020 it reached till 2442 tons of CO₂.

Emission in Russia started in 1861 after 100 years it rose till 911 tons of CO₂. As we know Russia is the major contributors of weapon. Tons of fuels are burned to make weapons which becomes harmful for the environment. The increase of emission was not too fast in Russia, but the trading of weapons was not even decreasing. In 2007, it was around 1602 tons, after two years it decreased by 100 tons and again increased after 1 years that is in 2010 it again went to approximately 1600 tons of CO₂.

To measure the emission based on per capita we have made four visualizations, showing countries with the highest and lowest emissions of greenhouse gases, methane, and nitrous oxide which are most relevant to our case project.

In the initial part of the visualization, we'll talk of countries that contribute the most and least per capita concerning different emissions. Countries like Brunei, Qatar, Bahrain, UAE, etc. contribute the highest GHG per capita while Bhutan and Fiji are the only two countries that have negative consumption per capita. In Bhutan, the government has taken national steps based on Gross National Happiness rather than Gross Income which is related to their focus on them becoming carbon negative. Methane plays a huge part in emissions but smaller countries like Grenada, Libya, Equatorial Guinea, etc. play a huge part in emission contribution. Similarly, Burundi, Kiribati, and the Maldives make up smaller countries, and Japan and Yemen make for surprisedly larger countries with lower methane emissions per capita. The third and last gas responsible is nitrous oxide. Countries like the Central African Republic, Australia, Mongolia, New Zealand, and Cameroon realize huge amounts of gases. And Countries Equatorial Guinea, Maldives, Solomon Islands, Bahrain, and Seychelles contribute to lowest nitrous production per capita.

The highest emission of CO₂ gases and greenhouse gases is caused by electricity and heat which includes excessive use of burning fossil fuels, mostly coal and natural gas. We have had more heatwaves; most glaciers are melting, and the lowest amount of ice is ever recorded at the North pole. The second highest is agriculture which is farm-related emissions comes come from methane and nitrous oxide Cattle belching (CH₄) and the addition of natural or synthetic fertilizers and wastes to soils (N₂O) repress most sectors for emission globally. Emission Caused

by transportation is nearly equal to agriculture. Transportation emission is caused by burning fossil fuels like gasoline and diesel for our car, truck, ships, trains, and airplanes. For the use of agriculture, humans are clearing the forest. When the forest is converted into other land uses, it releases carbon as carbon oxide, which is an important greenhouse gas. An increase in the emission of CO₂ and other greenhouse gases causes climate change globally. Emission Caused by manufacturing and construction and fugitive emission is almost the same which ranks 5th and 6th globally. These emissions are caused by groundwater which results from oil and gas and coal mining activity, manufacturing emission is caused by burning fossil fuel in car, trucks, and other modes of transportation. This includes gasoline and diesel. Approximately, 15% of the emission is caused by waste, aviation, and shipping. As the countries are developing the construction of new towers, factories and raspatories have become the main cause of emissions. The lowest of all the emissions is the emission caused by buildings and industries.

Development and rapid infrastructure are hallmark of fast progressing countries. For such paced development of infrastructure, there was huge amount Cement needed causing release of carbon dioxide. This was possible because of a process called carbonation curing which meant mixing limestone and clay at very high temperatures along with hot air causing the release of carbon dioxide. Since cement very sturdy and has massive qualities in building of infrastructure, many countries pushed for its growth. Among many countries that stood out the most are China, United States, Japan, Russia, and India. China and India have pushed for infrastructure development because of their huge populations. While US, Russia and Japan which spend most it on military and disaster redevelopment. China surprisingly amounts to 45% of global cement carbon dioxide emissions.

The burning of natural gas in the process of extracting oil is known as gas flaring. The practice has persisted since the beginning of oil production over 160 years ago and is caused by a variety of factors, including market and economic constraints, a lack of appropriate regulation, and a lack of political will. Flaring is a massive waste of a valuable natural resource that should either be used productively, such as for power generation, or conserved. Flaring is still practiced today because it is a relatively safe, albeit wasteful and polluting, method of disposing of the associated gas produced by oil production. Using associated gas frequently necessitates economically viable markets for companies to make the necessary investments to capture, transport, process, and sell the gas. The United States, Venezuela, Nigeria, Saudi Arabia, and Iran are the top five contributors to flaring carbon dioxide emissions. They account for approximately seventy-five percent of flaring pollution. Out of these the United States and Iran are top producers of natural gas which understandably is the reason why they are also top polluters. Saudi Arabia which has an abundant quantity of fossil resources makes it easier and cheaper to waste it causing it to be on the list. Poorer countries like Nigeria and Venezuela use it as a trading option mainly for monetary purposes.

Coal is a readily combustible carbon material. It is found all over the world and especially is produced largely in India and China which depends on it for their daily energy needs. Coal use is associated with various types of air pollution. Many compounds are produced during the incomplete burning or conversion of coal, some of which are carcinogenic. Coal combustion also produces sulfur and nitrogen oxides, which react with atmospheric moisture to form sulfuric and nitric acids, resulting in acid rain. China leads in carbon emissions related to coal with twenty-six

percent followed by India, Russia, Germany, and United Kingdom. In these countries, Coal is primarily used for power generation in thermal power plants and Steel production with help of coking coal. It is also used as a commodity for fertilizers, chemicals, plastics, medicines, and road surfaces.

In our data, we have taken Greenhouse Gases (GHG) as consideration for measurement in carbon dioxide emissions. The difference between GHG and carbon dioxide is that CO₂ refers to Carbon Dioxide, while CO₂e stands for "Carbon Dioxide Equivalent" which includes CO₂ and other greenhouse gases. Here, to notice that top four countries that produce high greenhouse gases also have highest population. The countries that top the charts are China, India, United States, Russia, Indonesia, and Brazil.

Carbon footprints can be reduced if humans take it seriously by making simple lifestyle changes. The best way to reduce emission of CO₂ is to address the root causes, so the carbon is not extracted in the first place. It should start with planting a greater number of trees as much as possible, if one person plants only one tree only then also it will benefit the earth 100 times in a better way. Cutting trees and cleaning forest should be restricted. The westerners are nowadays so much engrossed in material happiness that they forget that their movements are causing emission. Such as 2-4 family member staying in mansion or villa will cause usage of maximum electricity, more heat. Instead, if they choose to live in a space which is comfortable yet sufficient for family members, this will improve insulating heat, use of less electricity. People should have more of electricity produced from renewable energy. Eating beef, generates lot of carbon dioxide. People should start travelling more often by public transport such as bus, train and sharing vehicles. If one wants to use personal car for emergency then instead of burning fossil fuel per car, using electric cars are more efficient to nature. People should start recycling if they are not already, keeping their recycles like plastic and papers separately from their regular trash. Also, using reusable bags are more efficient to use rather than using plastic bags or one time use bags which causes mission of greenhouse effect.

Visualizations for the second question and their interpretations (findings)

All these years even after implementation of the Paris Climate Agreement, the global CO₂ emissions continue to sit on the fence. The extensive turmoil from the Covid19 crises has dramatically affected the course of global Co₂ gas emissions.

The data in [Figure 2.2](#) reveals the temporary reduction in daily emissions during Covid19 crisis. In 2020, the daily global carbon outflow declined in Public Sector by approximately -19% for China, -38% for Europe and USA, -26% for India. The total variation can be noticed due to changes in surface transport during lock down during covid19 crisis. Additionally, Industry Sector Co₂ outpouring slashed by more than -250% for USA and then followed by half of these emissions by India and Europe by approximately -100%. In as much as, the Power Sector Co₂ effusion have taken the edge off by 145% in India and lowest in USA by only -25%. In contrast, the contamination from Residential Sector has soared by 7.2% in Europe and 2% in India. The annual carbon discharge during Covid19 have cut down by -27% on average in 2020, reflecting the perseverance of restrictions in different countries during the year.

The restrictions during Covid19 pandemic will not cause long term to decrease in Co2 emissions because these provisional courses of action have little impact on the different industries and infrastructures that sustain the world economy at a larger scale. Wherein, policy makers can change the course of global emissions at national level and introduce policies that can help in consistent reduction in emissions. The fading path of strategies due to Covid19 era will curtail the recovery and strengthen cuts in global emissions eventually.

The restrictions in 2020 affecting transportation, indicates the benefits to accelerate the sweeping deployment of diesel vehicles and to encourage manufacturing of electric and hybrid vehicles. The pliability of renewable energy production during the covid crisis had resulted in proven track records of reduced emissions with better air quality. Further that braces the implementation of renewable energy sources like Solar Panels, providing at subsidized rates. From Figure 2.3 we can predict that the root cause of emissions reoccurs in due course of duration. With many countries to yet achieve the net zero emissions benchmark, this gap provides a need for revised substantial strengthening of climate goals. The biggest emitters China, the United States, and the Europe, and India were already faltering before Covid19 with enough evidence from least to no reduction in Co2 emissions in the past.

This report highlights the increasing emissions down the line after covid19 restrictions. Therefore, data interpretations in this report are an eye opener to policy makers to endorse new ambitions beyond Covid19 Recovery Plan. The growing pledge by countries to reduce their emissions to net zero within decades provides a substantial strengthening of climate goals. The paradoxical impacts of the post Covid19 investments in gas emissions, fuel-based infrastructure, and the recent reinforcement of climate agendas brings attention of policy makers to rewrite new policies to unfaltering decline in global emissions in the post Covid19 age.

Visualizations for the third question and their interpretations (findings)

Since the dawn of the industrial revolution, carbon dioxide emissions have always been concerning because of the damage it causes to the environment. Human activity is one of the most contributors to pollution and as per the data that we discussed above, we will be specifically focusing on emissions related to carbon dioxide, nitrous oxide, and methane. We will be talking about sectors that contribute to major factors releasing these emissions.

As we go on in this report, carbon dioxide has been the largest and most encouraging cause of global warming. It is largely produced because of electricity and heat production. Although countries with a high population play a huge part in this, smaller countries like Qatar, Iceland, Norway, Canada, etc. also play a huge part because of their geographical location which makes them consume more electricity per capita wise. Electricity usage rose from 19 billion in 1990 to 32 billion in 2018. Other sectors that contribute to carbon dioxide are transportation and manufacturing. There has been a total increase of 13 billion and is reaching a peak in till we find alternative methods for fossil fuels. The other sectors that up the carbon dioxide emissions are industrial waste, Land-use change like forests are torn down to build new houses, and emissions released by day-to-day activities.

Methane is a gas that is produced and transported as a by-product of the mining and transportation of coal, natural gas, and oil. Methane emissions are also caused by livestock and other agricultural practices, land use, and the decomposition of organic waste in municipal solid waste landfills. Enteric Fermentation is a digestive process that causes livestock to exhale methane through their bodies. Waste is the third largest source of methane caused by organic decomposition. Over the first 20 years, after it enters the atmosphere, methane has more than 80 times the warming power of carbon dioxide. Despite having a longer-lasting effect than CO₂, methane sets the pace for warming in the short term. Methane from human activity is responsible for at least 25% of today's warming. The oil and gas industry which releases fugitive emissions is a major source of methane. This refers to gas leaks that occur unintentionally as a result of techniques like fracking as well as more traditional oil and gas extraction and transportation.

Nitrous oxide is naturally present in the atmosphere as part of the Earth's nitrogen cycle and comes from a variety of sources. Nitrous oxide molecules linger in the atmosphere for an average of 114 years before being removed by a sink or destroyed chemically. One pound of N₂O has nearly 300 times the warming effect of one pound of carbon dioxide. Globally, about 40% of total N₂O emissions come from human activities. Nitrous oxide is emitted from agriculture, land use, transportation, industry, and other activities. Nitrous oxide can be produced by a variety of agricultural soil management activities, including the application of synthetic and organic fertilizers and other cropping practices, manure management, and agricultural residue burning. Agricultural soil management is the most significant source of N₂O emissions in the United States, accounting for roughly 74% of total N₂O emissions in 2020. Globally nitrous oxide emissions shot up from 3.78 billion in 1993 to 4.77 billion in 2018. This sector saw the largest increase in emissions. In industry, Nitrous oxide is produced as a byproduct during the manufacture of chemicals such as nitric acid, which is used to make synthetic commercial fertilizer, and adipic acid, which is used to manufacture fibers such as nylon and other synthetic products. The emission in this sector has remained approximately constant throughout the years. When fuels are burned, nitrous oxide is produced. The amount of N₂O emitted by burning fuels is determined by the type of fuel and combustion technology used, as well as maintenance and operating practices. Lastly, waste disposal also results in Nitrous oxide is also produced during the nitrification and denitrification of nitrogen present in domestic wastewater, which is typically in the form of urea, ammonia, and proteins.

The United Nations Framework Convention on Climate Change was established in 1994 to tackle the increase in global greenhouse gas emissions. It was signed by 154 countries that are members of the United Nations Conference on Environment and Development (UNCED). In 1997 Kyoto protocol was adopted and ran till 2015. In 2016, The infamous Paris Agreement was signed by 197 states in which countries pledged to different targets like net-zero, carbon and GHG neutral, and zero emissions by a set year. In our data, we will refer to Net-Zero targets set by different countries and our views on how they may make changes in their policies to achieve that. The science clearly shows that to avoid the worst effects of climate change and preserve a livable planet, global temperature rise should be limited to 1.5°C above pre-industrial levels. The Earth is already about 1.1°C warmer than it was in the late 1800s, and emissions are still increasing. To limit global warming to 1.5°C, as called for in the Paris Agreement, emissions must be cut by 45 percent by 2030 and reach net zero by 2050. It is an early step to limit emissions to meet their target, but as we can see in the graphic, numerous countries have already

established policies to limit emissions. We also could examine the individual countries' target years for achieving net-zero emissions in the future. The graph, we can see some countries like Cambodia, Madagascar, Guyana, Liberia, etc. have already achieved their net-zero targets. While countries like India, China, Brazil, Iceland, Turkey, Finland, Chile, etc. had adopted their policies to achieve that in a certain period. The United States, Australia, Russia, Saudi Arabia, etc. have made pledges to meet their goals. Other countries in Europe, the United Kingdom, South Korea, and Japan have adopted their target goals in law.

Lastly, to analyze whether there will be an effect on emission based on the consumption and marketing opportunities combined with their strategy. Most of the gases consumed by ICEV or Internal combustion engine vehicles it uses fuel which combust inside a combustion chamber with help of oxidizer. To get more power, ICEVs literally burn more fuel. This is causing more emission and these types of cars are planned to ban in future. Nowadays a world is moving towards hybrid nature, so electric cars such as BEV and PHEV are in more demand their emission of CO₂ gases is lesser as compared to ICEV vehicles. Although, these will not have ban or for few it may have. These types of cars, if used excessively will cause emission. PHEV vehicles use batteries to power an electric motor and another fuel, such as gasoline, to power an internal combustion engine (ICE). Difference between PHEV and BEV is only that PHEV can be charged using wall outlet and charging equipment and BEV are electric vehicles which run on pre-charged batteries. Regulation of carbon footprints for new vehicles or batteries may be motivated. Prospective lifecycle assessment and vehicle fleet turnover simulations are used. Regardless, the use of ICEV is more and they are much cheaper than other two.

Conclusion

Summary of your visuals and new insights found

To save earth we must stop using coal and produce less carbon dioxide. Instead of using fossil fuels, we need to use clean energy resources. Also, we can follow the four R's: Reuse, Reduce, Recycle and Replace. According to the visualization of the data set we were appropriately able to track the highest CO₂ emitting countries. Which was based on per capital and other resources such as transportation, electricity, fugitive, heat and other co₂ emitting resources. We were able to track the reason and the cause behind the increase in the emission by forming a chart of all the co₂ emitting resources such as agriculture, transport, manufacturing, industries, construction based by their highest usage. By this visualization we were able to think about the solutions to reduce greenhouse gases.

According to the data displayed on tableau about the consumption of energy, we were able to come to a point, that to conserve energy we can replace any incandescent light box by compact fluorescent bulb as they are more efficient. Planet should be greener in order to fight back with these resources, by to their consumption level. We were able to create a new insight that the population of the country is not directly proportional to the higher emission of CO₂ gases, whereas it is based on the usage of resources which causes greenhouse gas emission.

By visualizing the graph of highest CO₂ emitting causes we were able to understand those types such as electricity, transportation, industries are all run by humans and concluded. We as a human are the main cause of CO₂ gas emission, most of the gases emitted are by burning fossil

fuel. Industries are increased rapidly; developments are everywhere around the world. The highest emission globally is because of the electricity used by human in various forms.

Then, by tracking and visualizing the data of covid 19, about how it affected the global emission. The restrictions during Covid19 pandemic will not cause long term to decrease in Co2 emissions because these provisional courses of action have little impact on the different industries and infrastructures that sustain the world economy at a larger scale. Wherein, policy makers can change the course of global emissions at national level and introduce policies that can help in consistent reduction in emissions. The fading path of strategies due to Covid19 era will curtail the recovery and strengthen cuts in global emissions eventually. It has also benefitted the nature with the decreased amount of emission of gases during that period. The ways this was achieved for few years of pandemic should be the appropriate way it should continue in order to save earth by increase of emission.

What did you learn about data visualization concepts and lessons, especially to address the questions?

When we began working on the visualization aspect of our project, we began to understand data and the complexities that it entails. There is a popular saying that "a picture is worth a thousand words," and we can now claim that this quote now makes more sense to us.

We learned that strong data visualization can help us better understand the data because it is presented in a visual style; visualization also aids policymakers in making faster decisions and avoiding inefficiencies. As we learnt from our questions, countries that have previously made decisions or established a target to achieve Net Zero Emissions will do so within the specified time frame, but not those countries that have still not pledged to do so.

We also learned numerous patterns and trends when visualizing the largest CO2 emissions by different countries, not only by adhering to them but also by comparing them across sectors and per capita. We also discovered some data errors and inaccuracies, which we were able to quickly identify and correct. Not only did we understand the importance of storytelling and the key elements in it, such as knowing your audience and communicating the right message to them, but it also enabled us to analyze real-time data and find out important information, as we did in our Global emissions amidst COVID-19 worksheet, which concluded that emissions were low because there was nationwide lockdown among countries and the post upliftment of that the emissions were rising again.

Data visualization aided us all in comprehending many concepts related to the most effective use of data, as well as the value of excellent storytelling and visualization.

What did you learn about the data visualization software application - Tableau?

Tableau helped us analyze the data more quickly. By looking at the data set file it was difficult to come up with the exact conclusion, huge amount of data cannot be tracked by just looking and analyzing it. In tableau, we were able to work with unordered dataset and create variety of visualization with the help of tableau in-built features. We were also able to explore our visualizations and observe the data in various approach. It

was not tricky to use this software as we found it as user-friendly without any technical knowledge. Any fresher who is introduced to tableau for first time can use it without any hesitation, data is well organized. We just must drag and drop the dimensions and measures according to our requirement. Data visualization helped us all understand distinct concepts of optimal Tableau usage and different ends of the essential variables that go into successful storytelling and visualization.

References

1. Ritchie, H. (2020, May 11). CO₂, CH₄, and Greenhouse Gas Emissions. Our World in Data. <https://ourworldindata.org/co2-and-other-greenhouse-gas-emissions>
2. <https://carbonmonitor.org/>
3. <https://www.icos-cp.eu/gcp-covid19>