CATEGORY:

Data analytics with tableau

PROJECT TITLE:

Unearthing The Environmental Impact Of Human Activity: A Global CO_2 Emission Analysis

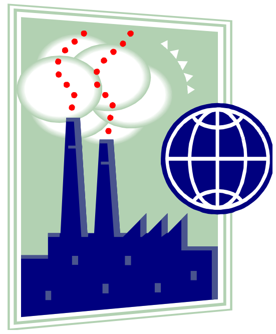
1 INTRODUCTION:

1.1 Overview: A brief description about your project.

1.2 Purpose: The use of this project. What can be achieved using this.

1.1 OVERVIEW :

The CO_2, or the carbon dioxide, is a kind of Greenhouse gases, which means that its emissions contribute to the global warming. In the nature, there exists a circulation called the Global Carbon Cycle which can prevent the CO_2 in the air from being excessive to influence the global temperature. However, as CO_2 emissions from human activities such as fuel burning keep increasing, the cycle becomes less effective to adjust the Carbon balance and as a result, the global average temperature becomes higher along with the rising CO_2 contents in the atmosphere. Hence, make it clear that how exactly does the amount of CO_2 emissions affect the temperature is important in environmental protection work. This project focus on dealing with the annual CO_2 emissions data and global average temperature change data from 1960 to 2019 separately. We try to verify an assumption that there exists a limit of Global Carbon Cycle and the global temperature will keep increasing if CO_2 in atmosphere exceeds such a limit.



Moreover, the increasing rate of temperature is defined by the increasing rate of CO_2 in atmosphere. In this project, we assume that the CO_2 produced by the nature remains stable. Then the CO_2 emissions decide the CO_2 in atmosphere and can be used to represent the CO_2 amount in atmosphere. To complete the verification, firstly, we want to construct time varying models under different approaches and find the most accurate one to describe the annual changes in CO_2 emissions and global temperature. Methods include SVR regression model, ARIMA model and Holt's Model linear trend method. Then, compare their changing trends referring to the models. If the two trends are similar, we can make a primary judgement that the two factors do have positive correlation, and the similarity decides whether the relationship is strong or not as well as whether this relationship is linear or not. Moreover, through finding the time node at which the global temperature started to have a distinguish increase with the help of models and K-means clustering method, we can roughly determine the carbon dealing ability of the nature Carbon Cycle. The results shows that if people produce more than 20,000 Mt CO_2 emissions, the global temperature will begin to have a distinguished increase. Also, by computing the correlation coefficient R between the two variables, we find that the CO_2 emissions and the global temperature change have a strong correlation. Both data have shown fitness with the Holt's linear trend model and have increasing trends with nearly stable rate, which means that the relationship between the two datasets is almost linear. Or we can explain this result as: every year, the same increase of CO_2 in the atmosphere will cause a certain amount of rise in global average temperature.

1.2 PURPOSE:

USES OF THE PROJECT:

Energy use in industry: 24.2%

Iron and Steel (7.2%): energy-related emissions from the manufacturing of iron and steel.

Chemical & petrochemical (3.6%): energy-related emissions from the manufacturing of fertilizers, pharmaceuticals, refrigerants, oil and gas extraction, etc.

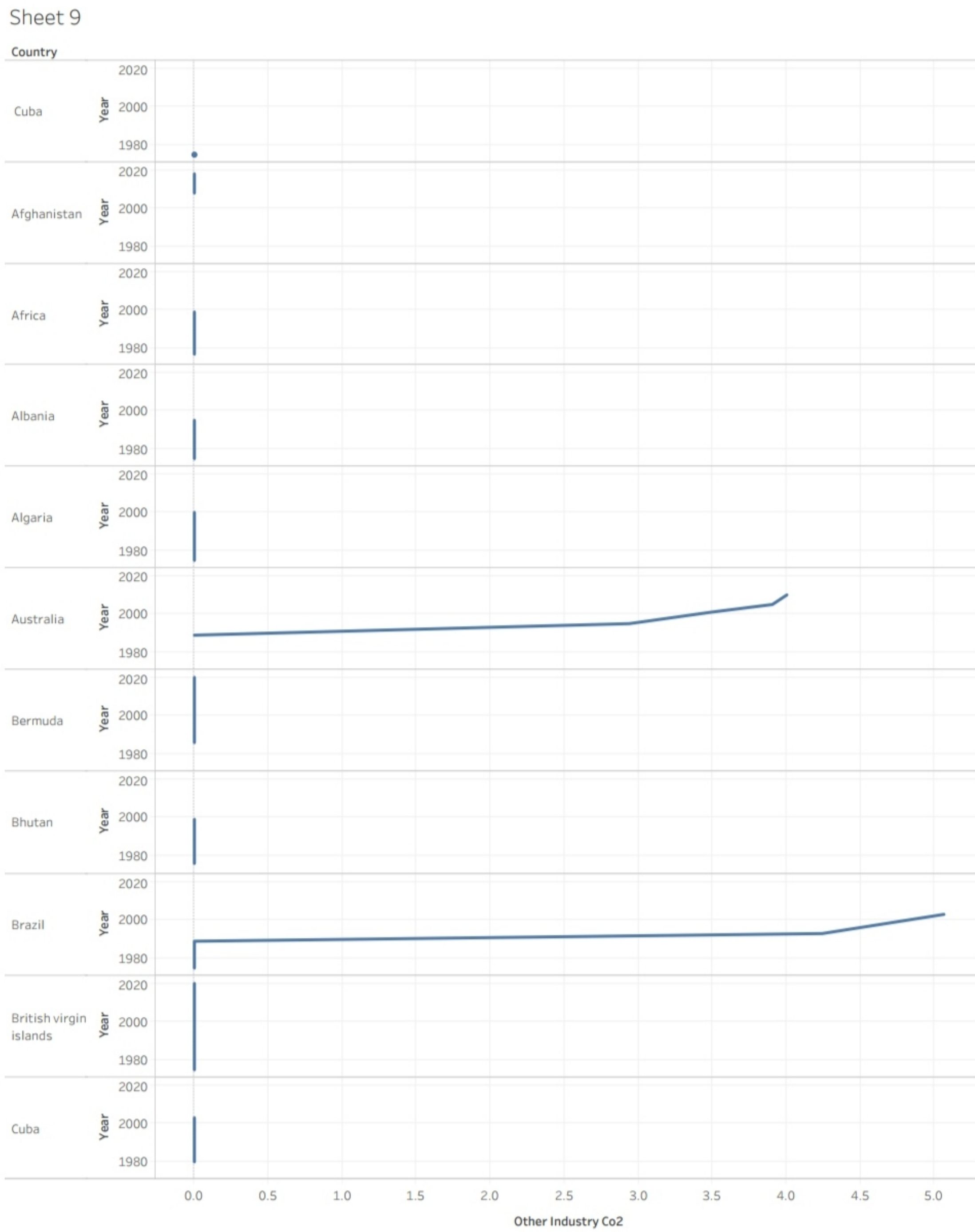
Food and tobacco (1%): energy-related emissions from the manufacturing of tobacco products and food processing (the conversion of raw agricultural products into their final products, such as the conversion of wheat into bread).

Non-ferrous metals: 0.7%: Non-ferrous metals are metals which contain very little iron: this includes aluminium, copper, lead, nickel, tin, titanium and zinc, and alloys such as brass. The manufacturing of these metals requires energy which results in emissions.

Paper & pulp (0.6%): energy-related emissions from the conversion of wood into paper and pulp.

Machinery (0.5%): energy-related emissions from the production of machinery.

Other industry (10.6%): energy-related emissions from manufacturing in other industries including mining and quarrying, construction, textiles, wood products, and transport equipment (such as car manufacturing).



Transport: 16.2%

This includes a small amount of electricity (indirect emissions) as well as all direct emissions from burning fossil fuels to power transport activities. These figures do not include emissions from the manufacturing of motor vehicles or other transport equipment – this is included in the previous point ‘Energy use in Industry’.

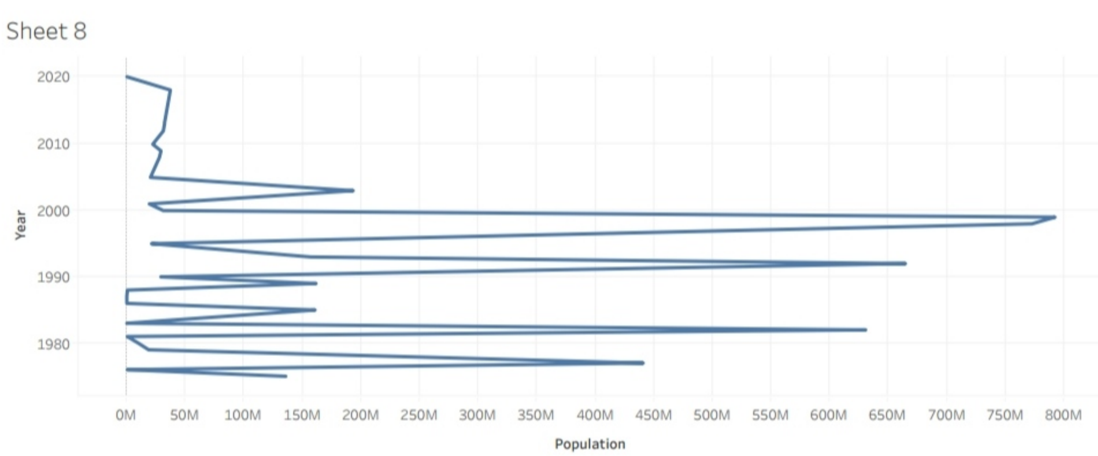
Road transport (11.9%): emissions from the burning of petrol and diesel from all forms of road transport which includes cars, trucks, lorries, motorcycles and buses. Sixty percent of road transport emissions come from passenger travel (cars, motorcycles and buses); and the remaining forty percent from road freight (lorries and trucks). This means that, if we could electrify the whole road transport sector, and transition to a fully decarbonized electricity mix, we could feasibly reduce global emissions by 11.9%.

Aviation (1.9%): emissions from passenger travel and freight, and domestic and international aviation. 81% of aviation emissions come from passenger travel; and 19% from freight.[7] From passenger aviation, 60% of emissions come from international travel, and 40% from domestic.

Shipping (1.7%): emissions from the burning of petrol or diesel on boats. This includes both passenger and freight maritime trips.

Rail (0.4%): emissions from passenger and freight rail travel.

Pipeline (0.3%): fuels and commodities (e.g. oil, gas, water or steam) often need to be transported (either within or between countries) via pipelines. This requires energy inputs, which results in emissions. Poorly constructed pipelines can also leak, leading to direct emissions of methane to the atmosphere – however, this aspect is captured in the category ‘Fugitive emissions from energy production’.



Energy use in buildings: 17.5%

Residential buildings (10.9%): energy-related emissions from the generation of electricity for lighting, appliances, cooking etc. and heating at home.

Commercial buildings (6.6%): energy-related emissions from the generation of electricity for lighting, appliances, etc. and heating in commercial buildings such as offices, restaurants, and shops.

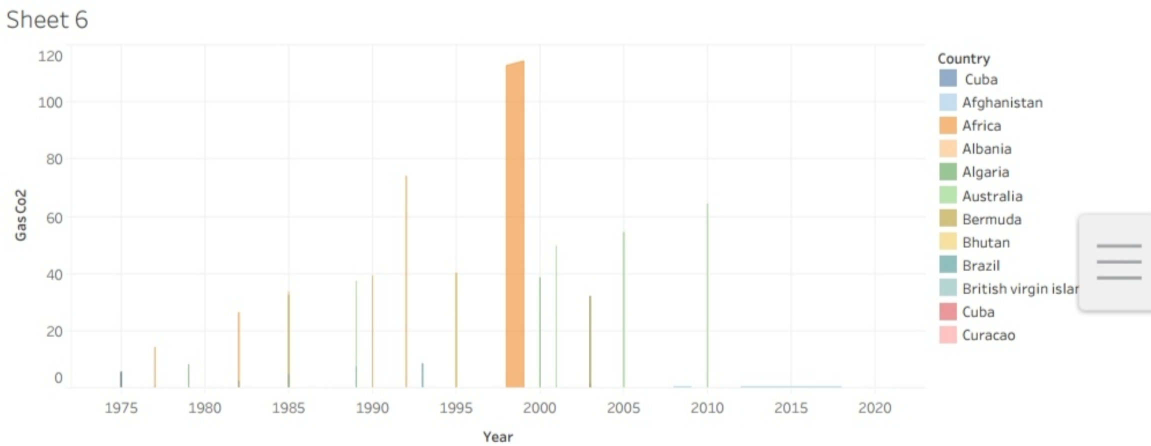
Unallocated fuel combustion (7.8%)

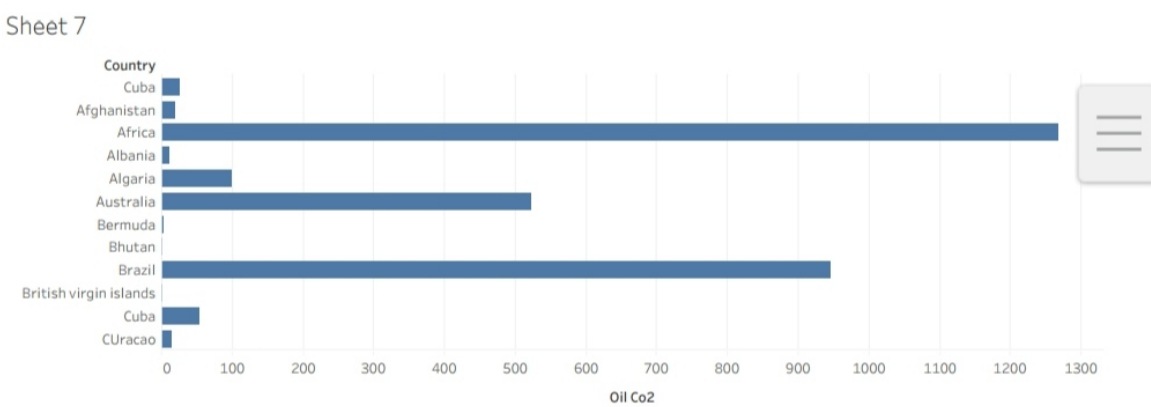
Energy-related emissions from the production of energy from other fuels including electricity and heat from biomass; on-site heat sources; combined heat and power (CHP); nuclear industry; and pumped hydroelectric storage.

Fugitive emissions from energy production: 5.8%

Fugitive emissions from oil and gas (3.9%): fugitive emissions are the often-accidental leakage of methane to the atmosphere during oil and gas extraction and transportation, from damaged or poorly maintained pipes. This also includes flaring – the intentional burning of gas at oil facilities. Oil wells can release gases, including methane, during extraction – producers often don't have an existing network of pipelines to transport it, or it wouldn't make economic sense to provide the infrastructure needed to effectively capture and transport it. But under environmental regulations they need to deal with it somehow: intentionally burning it is often a cheap way to do so.

Fugitive emissions from coal (1.9%): fugitive emissions are the accidental leakage of methane during coal mining.





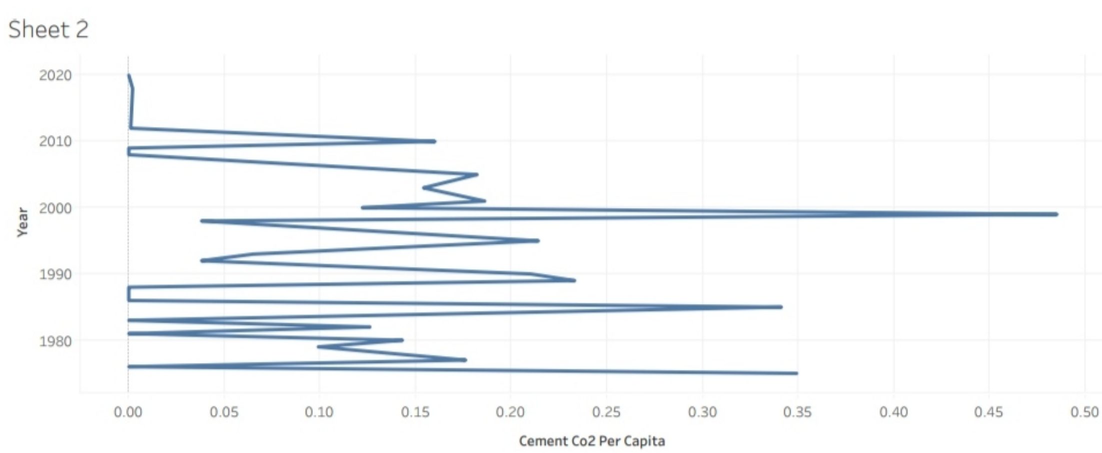
Energy use in agriculture and fishing (1.7%)

Energy-related emissions from the use of machinery in agriculture and fishing, such as fuel for farm machinery and fishing vessels.

Direct Industrial Processes: 5.2%

Cement (3%): carbon dioxide is produced as a byproduct of a chemical conversion process used in the production of clinker, a component of cement. In this reaction, limestone ($CaCO_3$) is converted to lime (CaO), and produces CO_2 as a byproduct. Cement production also produces emissions from energy inputs – these related emissions are included in 'Energy Use in Industry'.

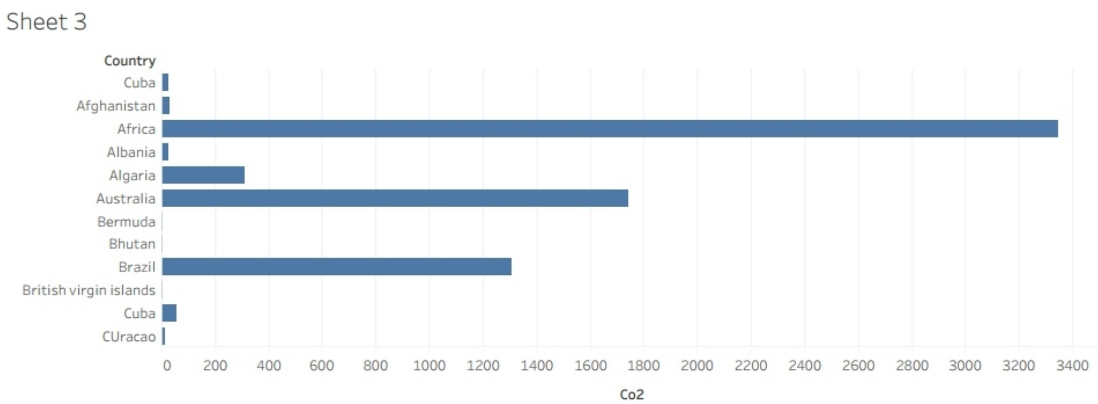
Chemicals & petrochemicals (2.2%): greenhouse gases can be produced as a byproduct from chemical processes – for example, CO_2 can be emitted during the production of ammonia, which is used for purifying water supplies, cleaning products, and as a refrigerant, and used in the production of many materials, including plastic, fertilizers, pesticides, and textiles. Chemical and petrochemical manufacturing also produces emissions from energy inputs – these related emissions are included in 'Energy Use in Industry'.



Waste: 3.2%

Wastewater (1.3%): organic matter and residues from animals, plants, humans and their waste products can collect in wastewater systems. When this organic matter decomposes it produces methane and nitrous oxide.

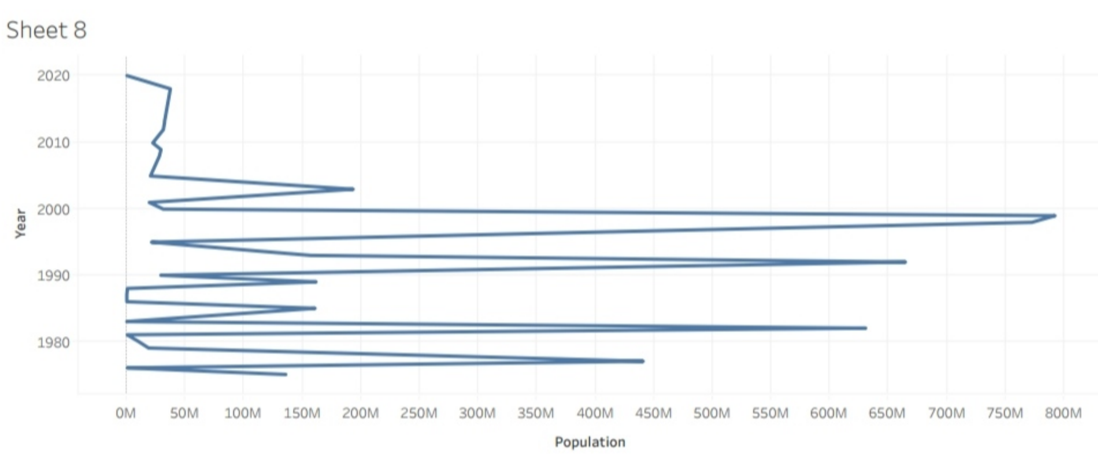
Landfills (1.9%): landfills are often low-oxygen environments. In these environments, organic matter is converted to methane when it decomposes.



Agriculture, Forestry and Land Use: 18.4%

Agriculture, Forestry and Land Use directly accounts for 18.4% of greenhouse gas emissions. The food system as a whole – including refrigeration, food processing, packaging, and transport – accounts for around one-quarter of greenhouse gas emissions.

Grassland (0.1%): when grassland becomes degraded, these soils can lose carbon, converting to carbon dioxide in the process. Conversely, when grassland is restored (for example, from cropland), carbon can be sequestered. Emissions here therefore refer to the net balance of these carbon losses and gains from grassland biomass and soils.



Cropland (1.4%): depending on the management practices used on croplands, carbon can be lost or sequestered into soils and biomass. This affects the balance of carbon dioxide emissions: CO_2 can be emitted when croplands are degraded; or sequestered when they are restored. The net change in carbon stocks is captured in emissions of carbon dioxide. This does not include grazing lands for livestock.

Deforestation (2.2%): net emissions of carbon dioxide from changes in forestry cover. This means reforestation is counted as 'negative emissions' and deforestation as 'positive emissions'. Net forestry change is therefore the difference between forestry loss and gain. Emissions are based on lost carbon stores from forests and changes in carbon stores in forest soils.

Crop burning (3.5%): the burning of agricultural residues – leftover vegetation from crops such as rice, wheat, sugar cane, and other crops – releases carbon dioxide, nitrous oxide and methane. *Farmers often burn crop residues after harvest to prepare land for the resowing of crops.*

Rice cultivation (1.3%): flooded paddy fields produce methane through a process called 'anaerobic digestion'. Organic matter in the soil is converted to methane due to the low-oxygen environment of water-logged rice fields. 1.3% seems substantial, but it's important to put this into context: rice accounts for around one-fifth of the world's supply of calories, and is a staple crop for billions of people globally.[8]

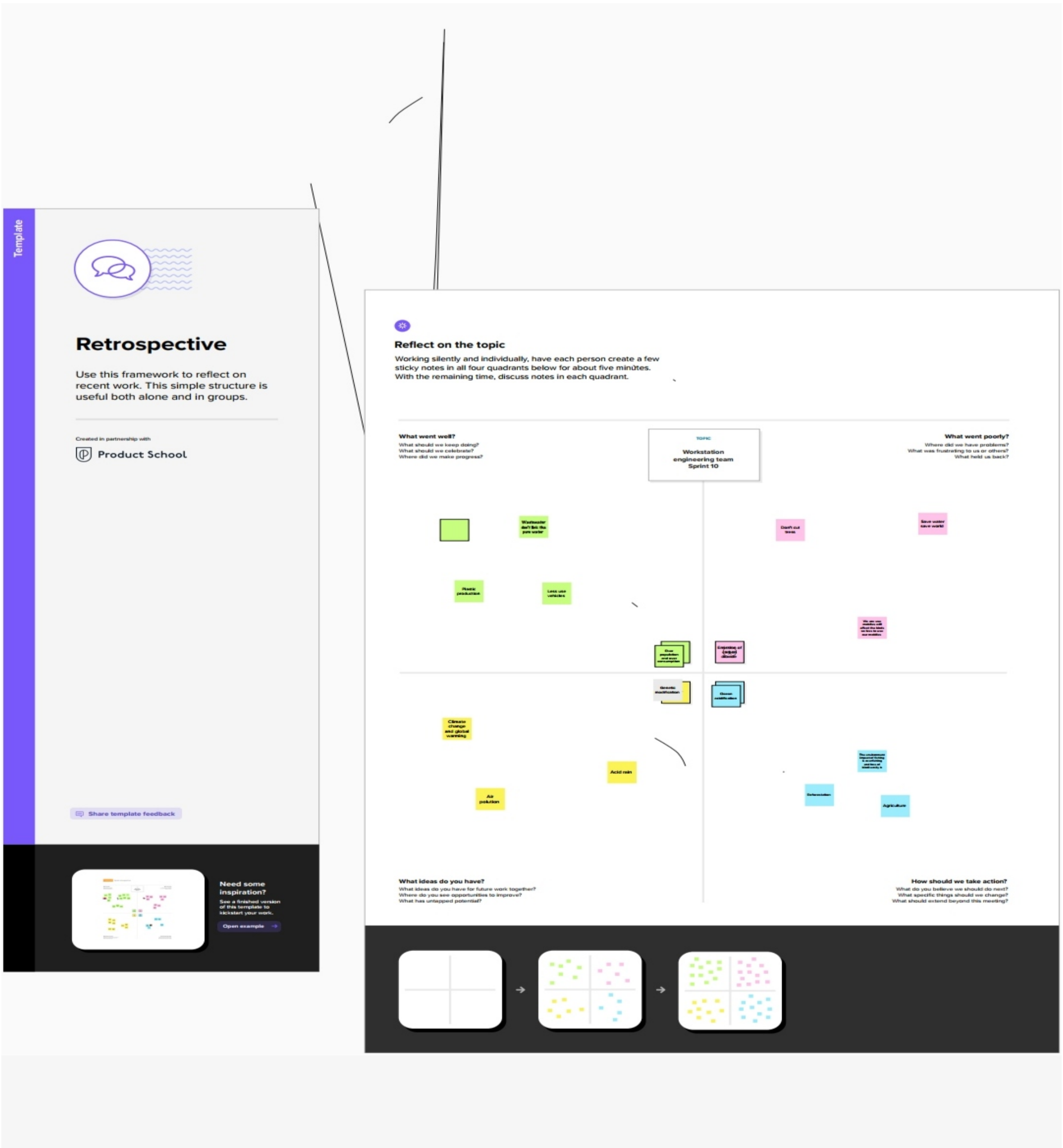
Agricultural soils (4.1%): Nitrous oxide – a strong greenhouse gas – is produced when synthetic nitrogen fertilizers are applied to soils. This includes emissions from agricultural soils for all agricultural products – including food for direct human consumption, animal feed, biofuels and other non-food crops (such as tobacco and cotton).

Livestock & manure (5.8%): animals (mainly ruminants, such as cattle and sheep) produce greenhouse gases through a process called 'enteric fermentation' – when microbes in their digestive systems break down food, they produce methane as a by-product. This means beef and lamb tend to have a high carbon footprint, and eating less is an effective way to reduce the emissions of your diet.

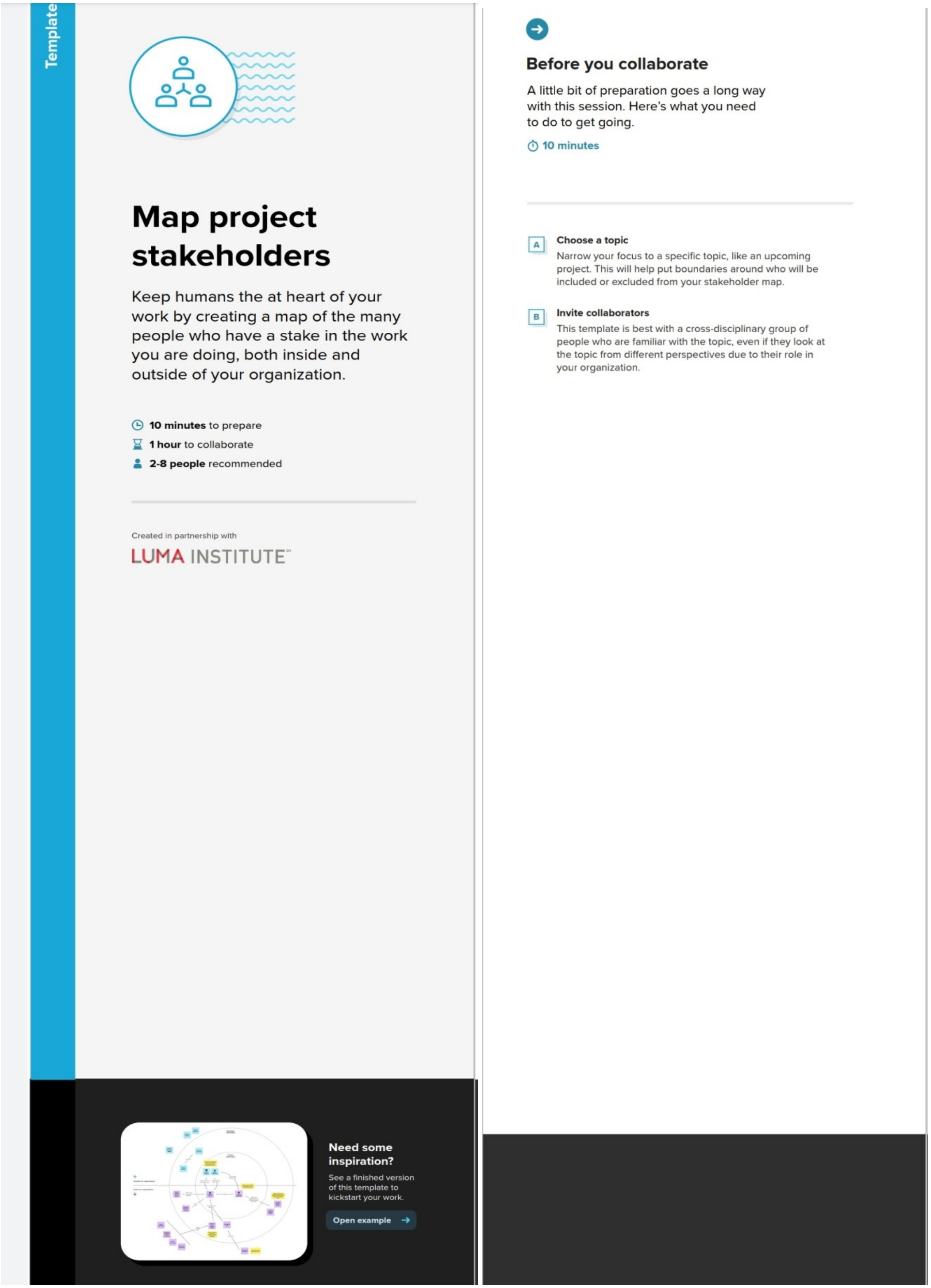
Nitrous oxide and methane can be produced from the decomposition of animal manures under low oxygen conditions. This often occurs when large numbers of animals are managed in a confined area (such as dairy farms, beef feedlots, and swine and poultry farms), where manure is typically stored in large piles or disposed of in lagoons and other types of manure management systems 'Livestock' emissions here include direct emissions from livestock only – they do not consider impacts of land use change for pasture or animal feed.

2. PROBLEM DEFINITION AND DESIGN THINKING

2.1 EMPATHYMAP:



2.2 IDEATION & BRAINSTORMING MAP:



1

Quickly list stakeholders

As a group, list individuals or groups related to the topic. Don't debate them, just write whatever comes to mind.

10 minutes

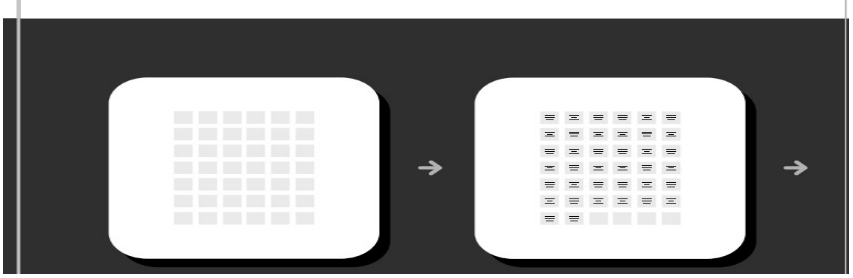
TOPIC

NextGen Workstation project stakeholders

TIP

Choose a note-taker to write stakeholders as they are mentioned by people in your group.

[Individual person]	**[Group of people]**	Agriculture	Deforestation	Over population	Over construction
Plasti product	[illegible] ion of [illegible]2	Green house gases	Destruction of the oreefs	Production of black carban	Waste management
Light polution	Over fishing	Wild life conservation	Habitat destruction	Air polution	Water polution
Over population	Fossil fuels	Climate changes	Soul erosion	Poor air quality	Undrinkable water
Asid rain	Genetic modification	Domesticated animals	Global warming	Osean ascidification	Ozone depletion
Cutting trees	Biodiversity	Environmental issues	Dessert besertification	Over harvesting	Wild fires
Damaging sensetive forest	Human induce	Marine conservation	Recycling	Plastics	Coal
Depletion of resources	Methane emission	Invasive species	Increasing livestock forming	Illegal fishing	Hunting

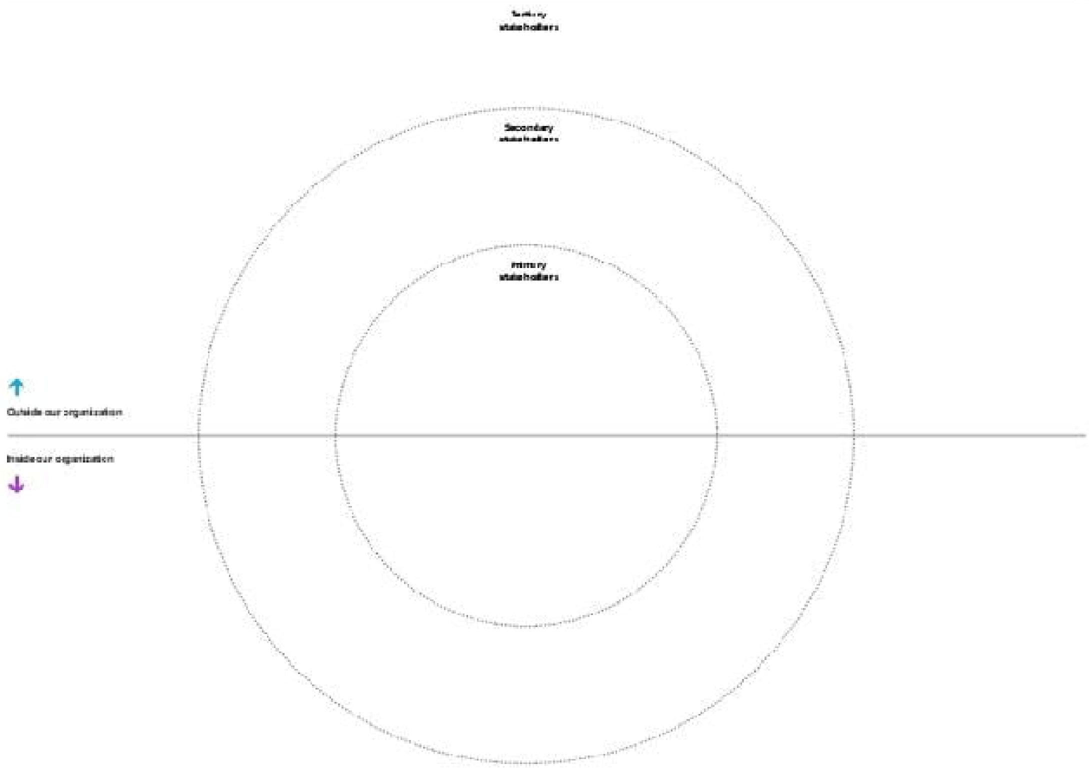


2

Discuss and group the stakeholders

Discuss each stakeholder one-by-one and drag them onto the map.
Next, add connector lines to show relationships between key people.
Label the lines with verbs to describe the relationships.

60 minutes



3

Vote to reveal key stakeholders

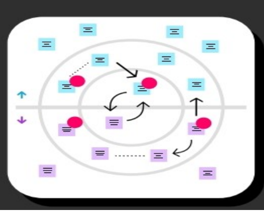
Choose a voting prompt below, then begin a **voting session**. With remaining time, have people discuss their vote.

10 minutes

VOTING PROMPT	VOTING PROMPT
Which stakeholders do we not know enough about?	Which stakeholders are the most essential for our success?
What people inside our organization should we be sure to involve?	What people outside our organization should we consult with?

TIP

Click the Voting session icon in the toolbar at the top of the screen to begin the vote. Consider giving each person 2-3 votes.



After you collaborate

Stakeholder mapping is a great way to zoom out and look at the big picture, providing scaffolding for work to come.

Quick add-ons

A **Refine the layout, lines, and labels**
Take extra time to refine the way the map is organized. Consider moving people around, visually clustering similar people together, adding more lines to show relationships, or updating labels to add clarity.

B **Add quotes the stakeholders might say**
Enliven the stakeholder map with quotes that illuminate a person's point of view. Consider quotes that start with "help me" or "help me avoid." For example, a manager might say "Help me motivate my team" or an accountant might say "Help me avoid costly mistakes." Ideally, base these quotes on interviews and observations, not uninformed assumptions.

Keep moving forward

Interview users of a product or service
Talk directly with the most voted-upon stakeholders to more deeply understand their perspective.

Open the template →

Brainstorm many ideas
Use the most voted-upon stakeholders as column headings in this brainstorming template.

Open the template →

Frame a problem to invite bold ideas
Write bold "how might we" questions about how you might impact the most voted-upon stakeholders.

Open the template →

Share template feedback

3 RESULT

FINAL FINDING (OUTPUT) OF THE PROJECT

Changes since a particular base year

The sharp acceleration in CO_2 emissions since 2000 to more than a 3% increase per year (more than 2 ppm per year) from 1.1% per year during the 1990s is attributable to the lapse of formerly declining trends in carbon intensity of both developing and developed nations. China was responsible for most of global growth in emissions during this period. Localised plummeting emissions associated with the collapse of the Soviet Union have been followed by slow emissions growth in this region due to more efficient energy use, made necessary by the increasing proportion of it that is exported. In comparison, methane has not increased appreciably, and N_2O by 0.25% y^{-1}.

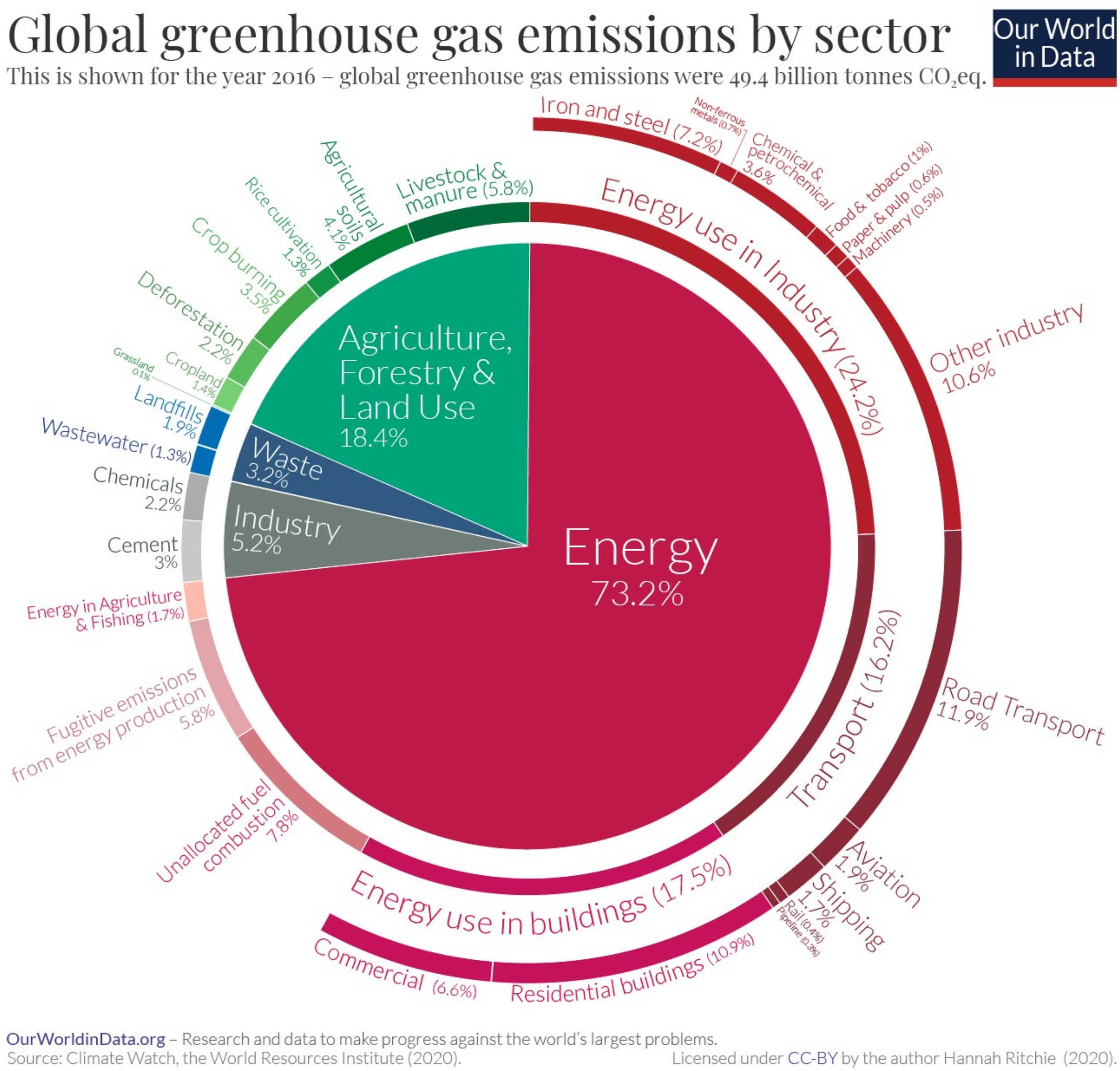
Using different base years for measuring emissions has an effect on estimates of national contributions to global warming. This can be calculated by dividing a country's highest contribution to global warming starting from a particular base year, by that country's minimum contribution to global warming starting from a particular base year. Choosing between base years of 1750, 1900, 1950, and 1990 has a significant effect for most countries. Within the G8 group of countries, it is most significant for the UK, France and Germany. These countries have a long history of CO_2 emissions .

Annual emission

Annual per capita emissions in the industrialized countries are typically as much as ten times the average in developing countries. China's fast economic development, its annual per capita emissions are quickly approaching the levels of those in the Annex I group of the Kyoto Protocol (i.e., the developed countries excluding the US) Other countries with fast growing emissions are South Korea, Iran, and Australia (which apart from the oil rich Persian Gulf states, now has the highest per capita emission rate in the world). On the other hand, annual per capita emissions of the EU-15 and the US are gradually decreasing over time.[1]Emissions in Russia and Ukraine have decreased fastest since 1990 due to economic restructuring in these countries.

Energy statistics for fast-growing economies are less accurate than those for industrialized countries.

2015 was the first year to see both total global economic growth and a reduction of carbon emissions.



TOP EMISSION COUNTRIES

In 2019, China, the United States, India, the EU27+UK, Russia, and Japan - the world's largest CO_2 emitters - together accounted for 51% of the population, 62.5% of global gross domestic product, 62% of total global fossil fuel consumption and emitted 67% of total global fossil CO_2. Emissions from these five countries and the EU28 show different changes in 2019 compared to 2018: the largest relative increase is found for China (+3.4%), followed by India (+1.6%). On the contrary, the EU27+UK (-3.8%), the United States (-2.6%), Japan (-2.1%) and Russia (-0.8%) reduced their fossil CO_2 emissions.

Types Of Carbon Capture

Pre-combustion carbon capture

Pre-combustion carbon procedures involve trapping carbon before the combustion process of fossil fuels ends. Synthesis syngas or gas is produced when oil, coal, or natural gas is heated in oxygen and steam.

The gas is composed of carbon dioxide, carbon monoxide, and hydrogen. The reaction subsequently turns water into hydrogen. During this process, carbon monoxide is converted into carbon dioxide. The final result is a gas with a mixture of carbon dioxide and carbon dioxide is produced. The mixture can be trapped, separated, and sequestered from the mixture. The hydrogen can be utilized for other energy generation operations.

Pre-combustion carbon capture is often more efficient and effective compared to post-combustion carbon capture. The equipment is more expensive than other processes.

Post-combustion carbon capture

During the combustion of fossil fuels, carbon dioxide is captured. The combustion of fossil fuels emits flue gases, which contain sulfur dioxide, nitrogen, water vapor, carbon dioxide, and nitrogen.

Carbon dioxide is collected and isolated from the flue gases generated from the combustion of fossil fuels in a post-combustion process. Post-combustion capturing is the most utilized carbon-capture technology. This is because of its ability to be utilized in both new and existing coal-fired power plants. This process does pose some challenges, namely that it requires massive equipment to function which can affect the efficiency of the turbines.

Oxy-fuel combustion carbon capture

Regular air is not utilized during the combustion of fossil fuels. Instead, a mixture of high concentrations of pure oxygen is utilized during the combustion process.

Water and carbon dioxide are the primary components of the flue gas produced during the combustion process. By compressing and cooling the flue gas, it is feasible to separate the carbon dioxide in the gas.

One of the benefits of oxy-fuel combustion capture is that it can be utilized in both new and existing coal-burning plants. The process on the whole is relatively expensive, though certain components are generally inexpensive.

4 ADVANTAGES AND DISADVANTAGES:

LIST OF ADVANTAGES AND DISADVANTAGES OF THE PROPOSED SOLUTION

Advantages of Carbon Capture

Carbon capture and storage is one of the most efficient methods of extracting carbon emissions permanently from the environment.

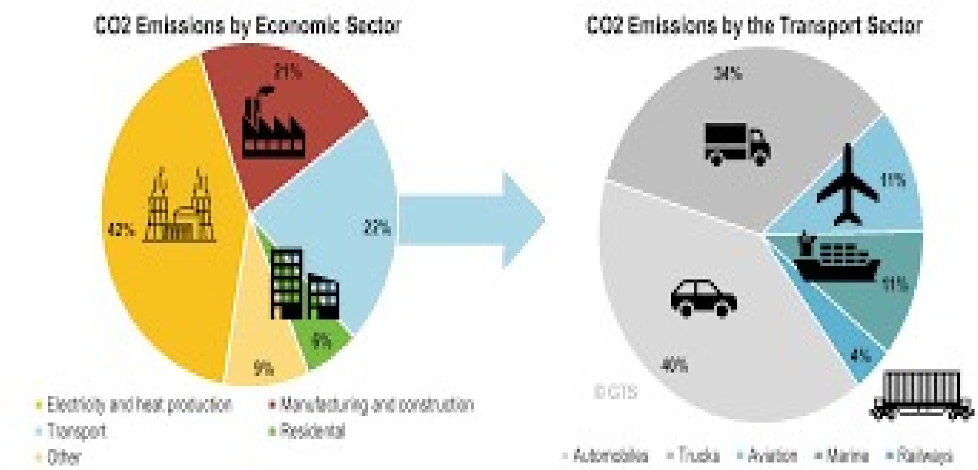
The numerous advantages of CCS include economic, social, and environmental, and a massive impact on a global and local scale.

Carbon capture can increase the power generated with carbon dioxide-based steam cycles. In this process, carbon dioxide is pressured through a supercritical fluid, which could transfer heat more effectively and require less energy to compress steam.

Geologically stored carbon dioxide might be utilized to retrieve geothermal heat from the area injected which results in the generation of sustainable geothermal energy.

Carbon dioxide captured with carbon capture can also be utilized in the manufacturing of polymers and chemicals such as polyurethanes.

The captured carbon dioxide is incorporated into concrete to reinforce it and increase the durability of the infrastructure. The carbon capture operations create employment for skilled engineers and technicians who need to operate them.



Disadvantages of Carbon Capture

Carbon capture reduces the carbon released in the atmosphere and therefore, it is recognized as one of the solutions to help address climate change and global warming. Despite this, carbon capture and storage (CCS) does not come without some disadvantages.

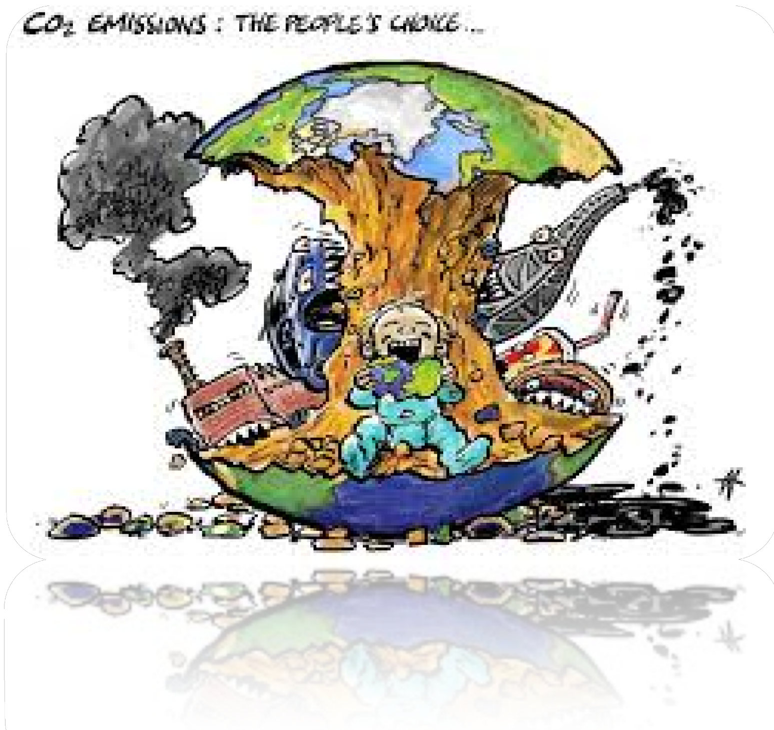
The methods and CCS technologies that are necessary for carbon capture have some cost implications attached to them. Therefore, it can be very costly for power plants to generate electricity through fossil fuels. There are several concerns with respect to the safety of the storage of carbon dioxide in huge volumes at a single location due to the possibility of leakages, which can lead to environmental contamination if not handled correctly.

The possibility of leakages could also be a result of natural disasters such as earthquakes or can be a result of human-induced incidents such as damage as a result of wars that can damage underground storage reservoirs.

Many critics have questioned the cost efficiency of basalt formation storage. For this option, 25 tons of water will be required for each ton of carbon dioxide to be buried. There is a possibility that volcanic rock microbes can also digest the carbonates and hence produce methane gas which can be another problem.

Another disadvantage of carbon capture storage is that it is not adequate to successfully deal with climate change. The emissions that come from heat and power generation as a result of using fossil fuels only account for about 25% of the total greenhouse gas (GHG) emission, while

60% of all greenhouse gas emissions come from transportation, agriculture, and other related industrial activities. These emissions are currently not being captured by carbon capture and storage.



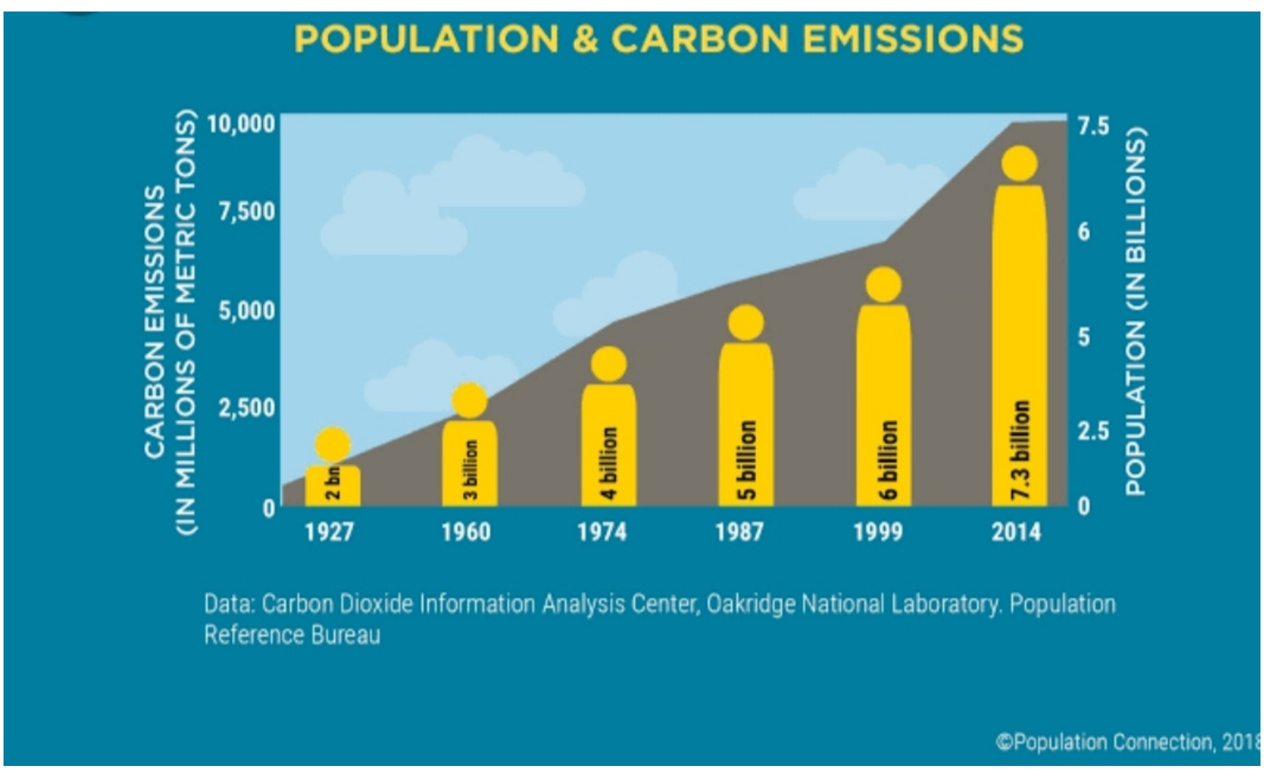
5 APPLICATIONS:

New opportunities to use carbon dioxide (CO_2) in the development of products and services are capturing the attention of governments, industry and the investment community interested in mitigating climate change as well as in other factors, including technology leadership and supporting a circular economy. This analysis considers the near-term market potential for five key categories of CO_2-derived products and services: fuels, chemicals, building materials from minerals, building materials from waste, and CO_2 use to enhance the yields of biological processes. All five categories could individually be scaled-up to a market size of at least 10 $MtCO_2$/yr – almost as much as the current CO_2 demand for food and beverages – but most face commercial and regulatory barriers. CO_2 use can support climate goals where the application is scalable, uses low-carbon energy and displaces a product with higher life-cycle emissions. Some CO2-derived products also involve permanent carbon retention, in particular building materials. A better understanding and improved methodology to quantify the life-cycle climate benefits of CO2 use applications are needed. The market for CO2 use is expected to remain relatively small in the short term, but early opportunities could be developed, especially those related to building materials. Public procurement of low-carbon products can help to create an early market for CO2-derived products and assist in the development of technical standards. In the long term, CO2 sourced from biomass or the air could play a key role in a net-zero CO2 emission economy, including as a carbon source for aviation fuels and chemicals.

6 COUNCLUSION:

Discussion and Conclusions:

With all the work done above, we have an elementary proof of our assumption that the ability of Global Carbon Cycle is limited to some certain value, and when CO2 contents in the atmosphere exceed this limit, it will cause global warming. This project have roughly proved the assumption proposed at the beginning, meanwhile it still remains some limitations. Firstly, this project simply draws a conclusion by merely comparing the changing trends of CO2 emissions and global temperatures. It lacks a strict and scientific test-and-prove process along with controlling variables. This makes the conclusion not quite rigorous. Secondly, the size of the database we choose in this project is quite narrow since data in 19th century and before are not comprehensive and even not accessible. Then the project cannot eliminate the interference of special circumstances or special periods, and cannot draw a fine and extensive conclusion. Also, the limited size of the data may make the models we constructed in this project not accurate enough, which can also influence the conclusions we get from comparing models. Last but not least, except CO2, there still exist other greenhouse gases produced from human activities that can influence the climate, but this project ignored the effects caused by these gases.



Then the conclusion may magnify the effect of CO_2 emissions to global temperature. In future research, we may manufacture environments simulating the atmosphere in laboratory. Then we can control variables through changing the amount of CO_2 merely in the simulation environments. Then compare the models of simulation environments and the natural atmosphere, we can clarify the influences of CO_2 emissions to temperature changes.

7 FUTURE SCOPE

The Future of Carbon Capture

The transit to energy sources that generate minimal or no greenhouse gases must be made. However, we should address the ever-increasing carbon emission industries.

Sequestered carbon can become a vital instrument of global climate strategy if the carbon capture sectors continue to innovate and expand. Carbon capture technologies should be developed and scaled up to make them commercially feasible.

OFFSETTING
CO2 EMISSIONS
Emissions
Result from land use change (for example by converting forests into arable land) and from deforestation
Removals
CO2 absorbed by existing and new forests
The European Parliament proposes that when EU countries cut down their forests, they are required to compensate for it by planting new forest or by improving the sustainable management of their existing forest, croplands and grasslands.