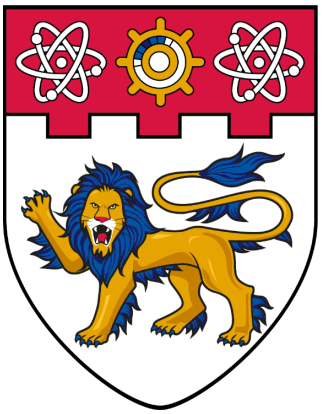

NANYANG TECHNOLOGICAL UNIVERSITY
SINGAPORE

BC2402 - Designing & Developing Databases

Title: Group Report

Seminar Group 3 Group 5

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Question 12

Open-ended question How has Singapore been performing in terms of energy consumption? Find a comparable reference(s) to illustrate changes in energy per capita, energy per GDP, and various types of energy (e.g., solar, gas, and oil) over the years.

Hint: The formal technique to identify comparable references is "matching" in econometrics (i.e., propensity score matching, see https://en.wikipedia.org/wiki/Propensity_score_matching). For this question, you may consider countries with somewhat comparable GDP and/or population).

To answer this question, we first began by looking for countries that are able to serve as comparable references to Singapore, in terms of their Gross Domestic Product (GDP) and population.

Finding Comparable References

We did this by setting a desired population and GDP range that we were going to look for.

With the intention of narrowing down to just 2 countries for comparison, we set the range for population to be within 100,000 (i.e. +100,000 & -100,000) and the range for GDP to be within 300,000,000,000 (i.e +300,000,000,000 & -300,000,000,000), while using Singapore's 2018 values as the baseline for comparison.

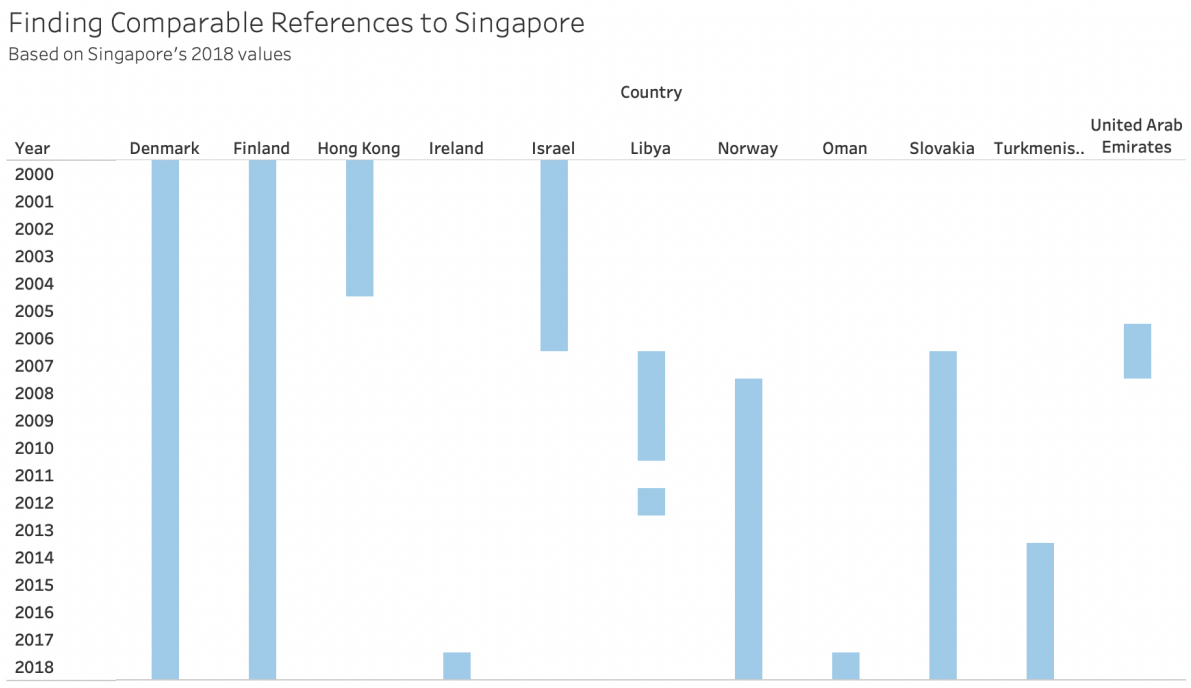

Figure 1: Graph of Years of Countries with Population and GDP falling within the specified range

As seen in Figure 1, we have identified the 2 countries of comparable reference to be Denmark and Finland. The reason for choosing these 2 countries is because they are the only 2 countries that have both their GDP and population values within range throughout from 2000 to 2018.

Now that we have identified the countries for comparison, we will be looking at the different metrics of Singapore, Denmark, and Finland: GDP per Capita, Energy per Capita, Energy per GDP, and Total Energy Consumption.

GDP per Capita

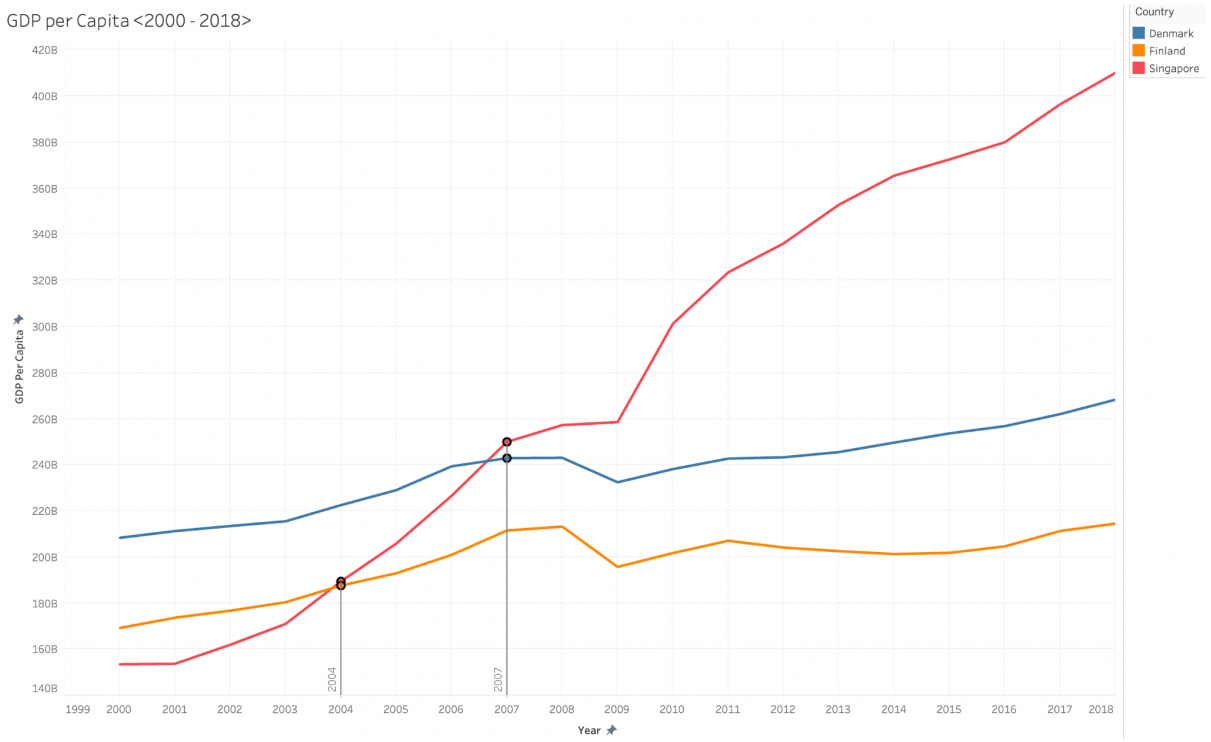

Figure 2: Graph of GDP per Capita for Singapore, Denmark, and Finland from 2000 to 2018

From Figure 2, we can identify that all 3 countries show an increasing trend in terms of their GDP per capita, with Singapore having the largest magnitude of change, where it nearly tripled in value from 153 billion in 2000 to 410 billion in 2018. Singapore started in 2000 with a GDP per capita value that is lower than Denmark and Finland. By 2004, it overtook Finland's GDP per capita, and by 2007, it surpassed Denmark's GDP per capita. This shows that Singapore's GDP growth was at a much greater rate compared to the other 2 countries, which implies that Singapore is likely to have a higher level of energy consumption, in order to support this rapid economic growth.

Energy per Capita

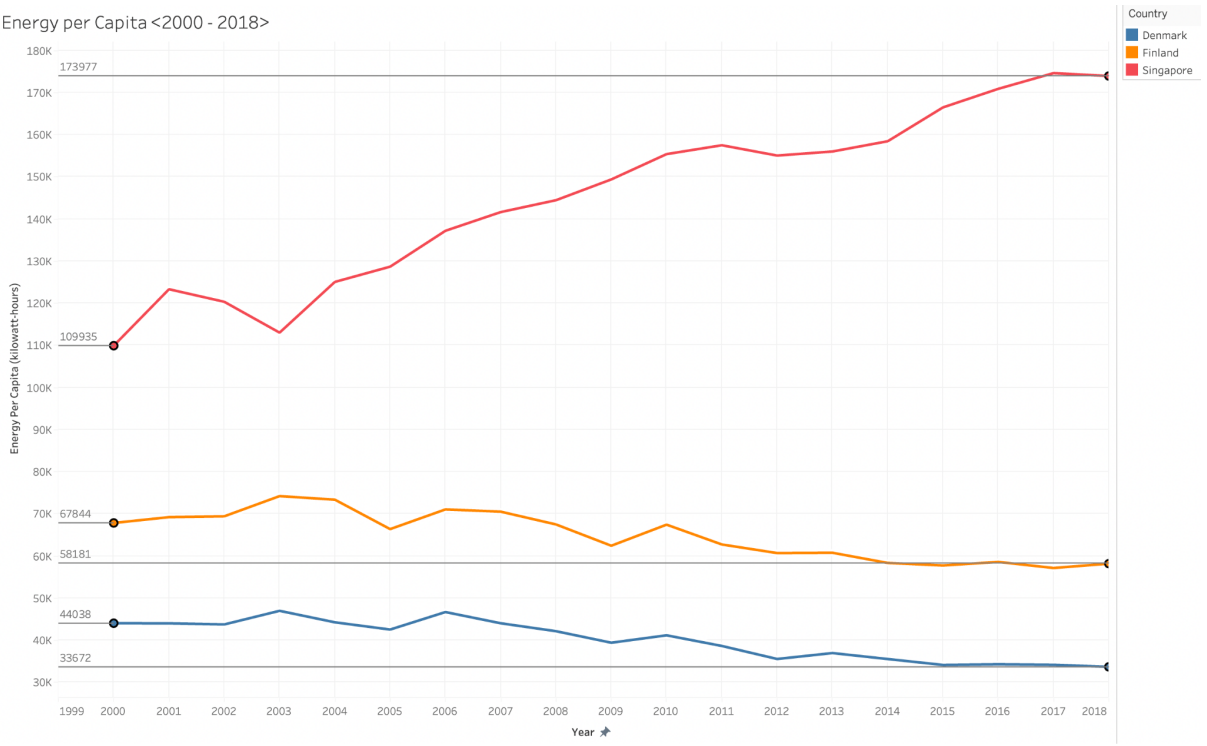

Figure 3: Graph of Energy per Capita of Singapore, Denmark, and Finland from 2000 to 2018

As seen in Figure 3, we can identify that Singapore is showing an increasing trend while Denmark and Finland are showing decreasing trends, with Denmark having a higher magnitude of decrease compared to Finland. However, Singapore's magnitude of increase is substantially larger than the decrease of Denmark, with an increase of 64,042 kilowatt-hours from 2000 to 2018, compared to Denmark's decrease of 9,663 kilowatt-hours. This supports our hypothesis that Singapore's energy consumption level is likely to be higher than Denmark and Finland.

Energy per GDP

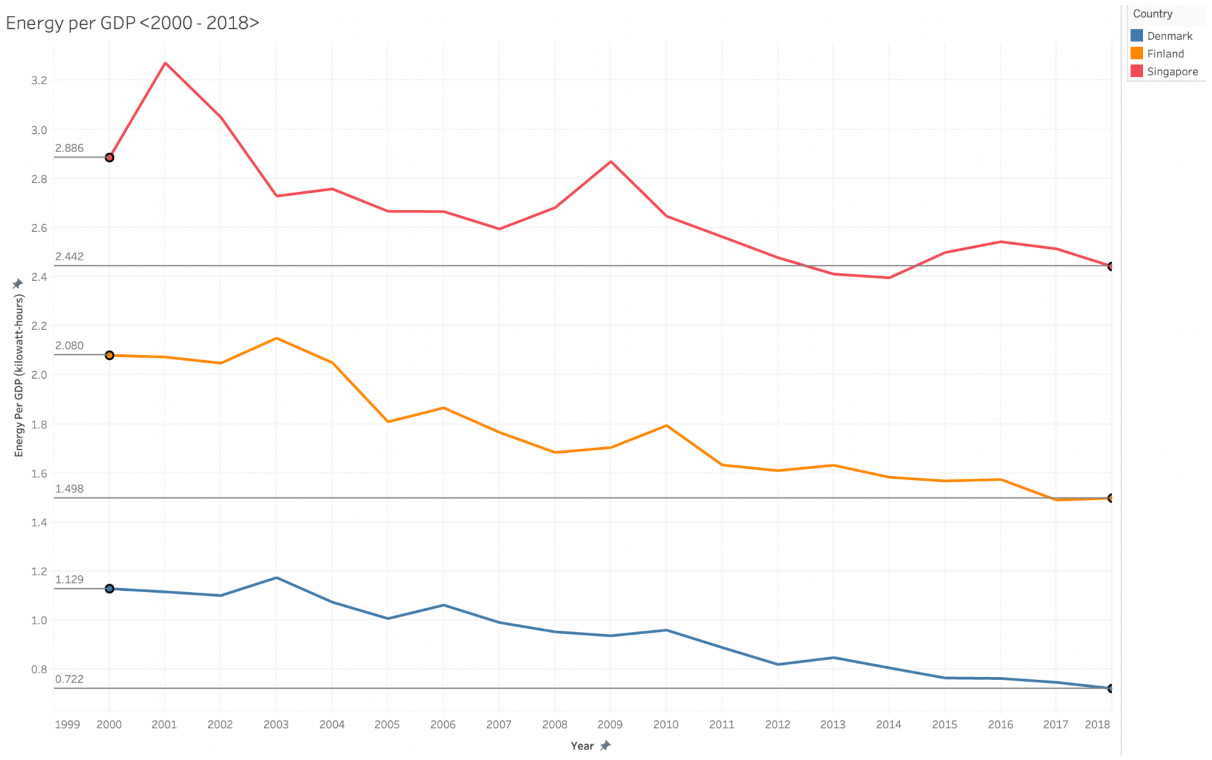

Figure 4: Graph of Energy per GDP of Singapore, Denmark, and Finland from 2000 to 2018

Looking at Figure 4, we can identify that all 3 countries are showing a decreasing trend, with Finland having the highest magnitude of decrease of 0.582 kilowatt-hours and Denmark having the lowest magnitude of decrease of 0.407 kilowatt-hours. This contradicts the findings obtained when comparing Energy per Capita, hence we will look at the Total Energy Consumption of all 3 countries to understand better.

Total Energy Consumption

In order to obtain the total energy consumption, we will first add the consumption levels of all the different energy types together.

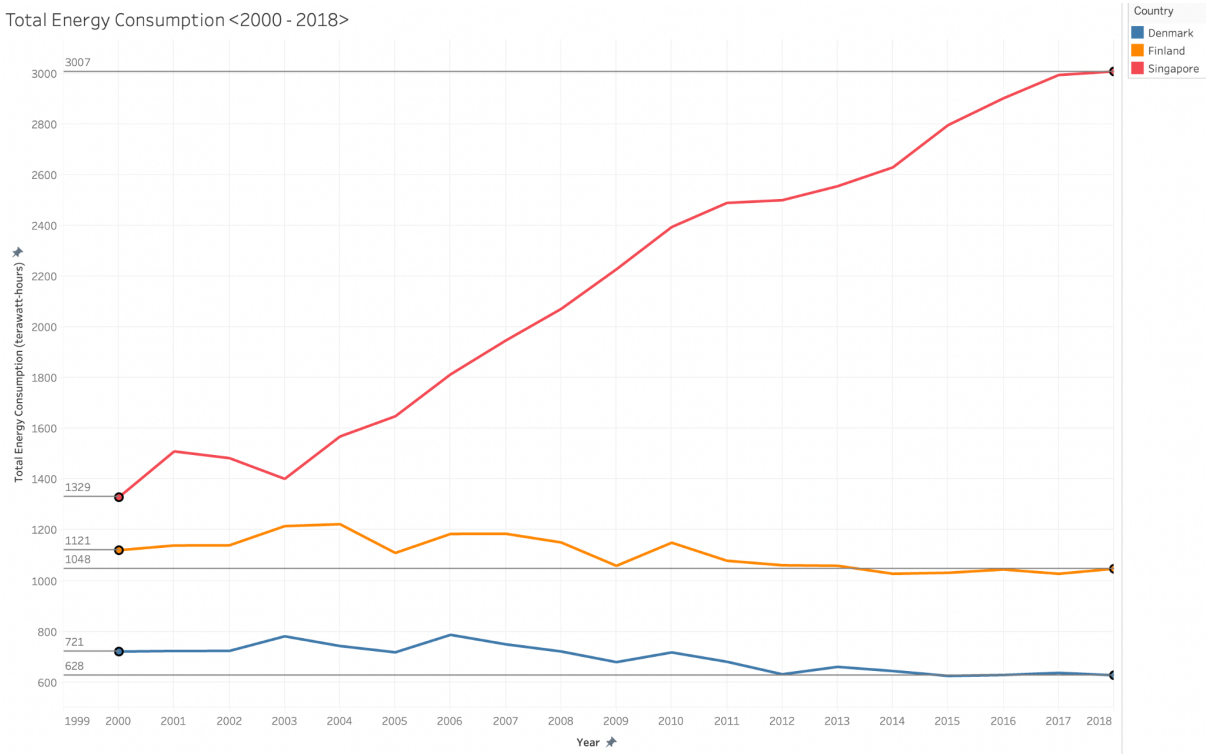

Figure 5: Graph of Total Energy Consumption of Singapore, Denmark, and Finland from 2000 to 2018

From Figure 5, we can identify that Singapore's total energy consumption has increased dramatically from 2000 to 2018, more than doubling its initial values, where it was consuming 1,329 terawatt-hours in 2000, compared to 3,007 terawatt-hours in 2018. On the contrary, Denmark and Finland decreased their total energy consumption slightly. This raises concerns that Singapore is consuming energy at a very rapid rate.

Population

As 2 of our metrics used (GDP per Capita and Energy per Capita) are affected by the country's population, we will also be investigating the population change of the 3 countries. Looking at the population for all 3 countries, we can identify that all 3 countries have an increasing trend for their population, with Singapore having the highest magnitude of increase. This suggests that the above findings regarding energy consumption is worrisome, as despite an increase in population, Singapore's energy per capita is still increasing, which suggests that Singapore's energy consumption level is increasing at a faster rate than its population.

Conclusion

In conclusion, the fact is that Singapore's total level of energy consumption is increasing at a

drastic rate, as evident from its increasing Energy per Capita and Total Energy Consumption. The plausible reason for this would be the increasing level of energy use per person, which is often associated with a higher Standard of Living, indicated by the increasing prevalence of electrical appliances such as the air conditioner and television. This would suggest a dire outlook if this trend were to continue, as the energy sources on Earth are limited, and we would eventually consume all possible energy sources on Earth if this trend were to persist. On the bright side, Singapore's Energy per GDP is decreasing, which suggests that the increase in energy consumption for Singapore is less than the increase in GDP. This implies that Singapore is using less energy to produce 1 unit of GDP in 2018, compared to 2000. This suggests that Singapore is gradually moving towards more sustainable economic growth where it uses fewer energy sources for the purposes of economic growth, which indicates a positive outlook as it could suggest an increasing level of awareness of the issue of increasing energy consumption levels.

Question 13

Open-ended question Can renewable energy adequately power continued economic growth?

According to the United Nations (United Nations, n,d), renewable energy is defined as energy sources that are coming from these sources:

1) Solar Energy
2) Wind Energy
3) Geothermal Energy
4) Hydropower
5) Ocean Energy
6) Bio Energy

To address the main question of whether renewable energy can adequately power continued economic growth, we have to identify key metrics such as how much energy each country consumes annually, throughout the different areas such as energy powered by fossil fuels and even energy powered through renewable means.

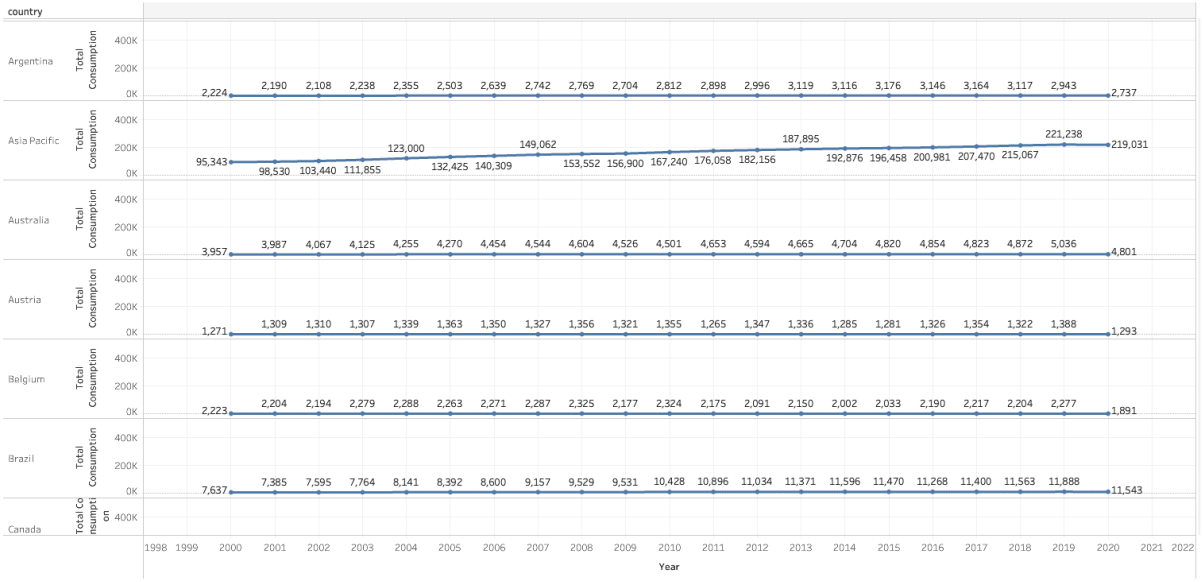

Figure 6: A graph showcasing the total consumption of countries throughout the years

From the above figure, we can see that in 2000, Argentina consumed 2224 terawatt-hours. This allows us to have a gauge of how much energy each country uses so that we can effectively determine how much energy is needed to power the country.

As a result, the next query would be to look at how much energy is generated per year for each country.

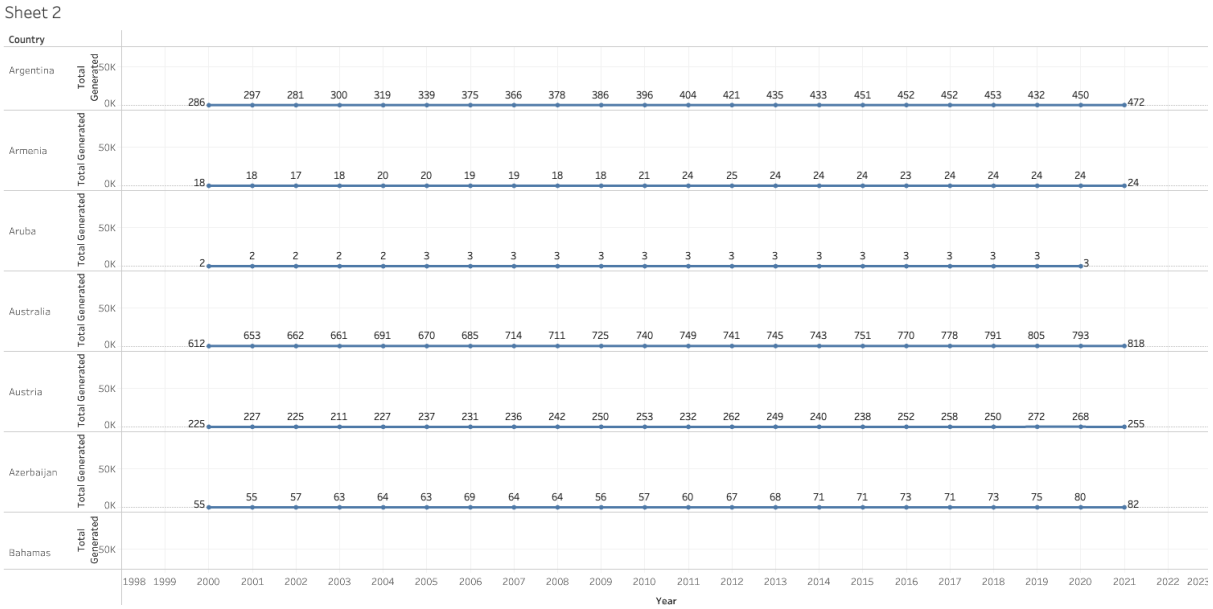

Figure 7: A graph depicting energy generation metrics for countries across the years.

Using the above figures, we are able to see an example that the country Argentina only recorded a produced generation of 286 terawatt/hour in the year 2000. This could suggest that countries like Argentina import more energy than they can produce so as to make up for the difference in energy consumed and generated.

Hence, we will now break down the specific energy share for each country and this will show us how much of each specific type of energy that country uses.

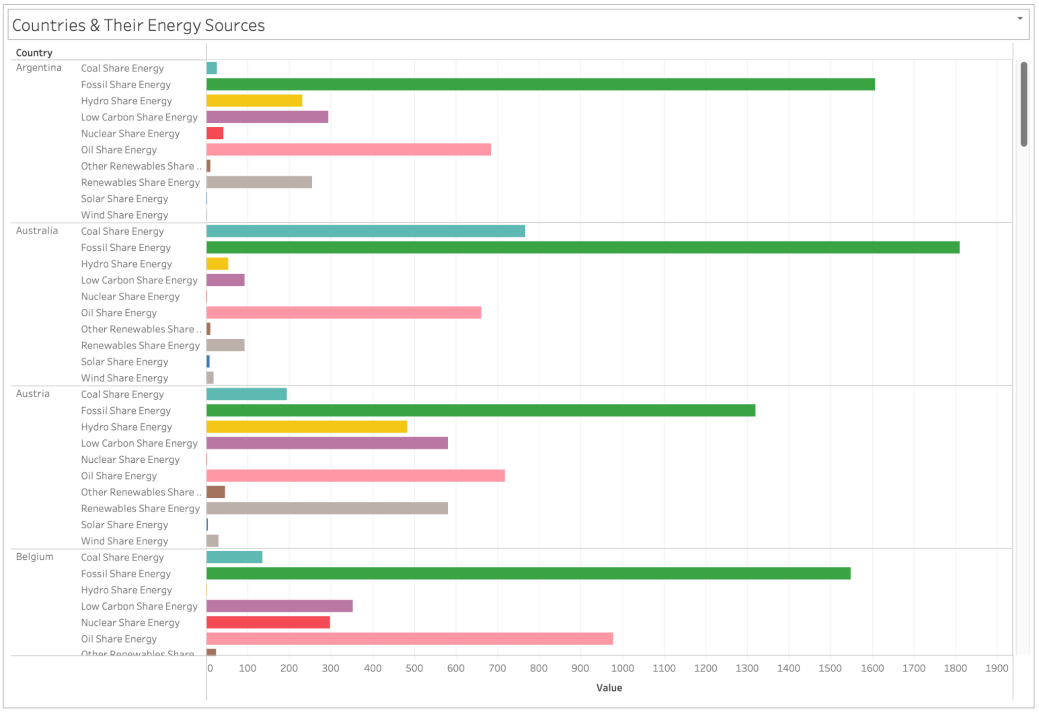

Figure 8: Global countries and their energy sources

From this selected output, we can observe that Argentina uses mainly fossil fuel and natural gas to power their country. Through data-driven analytics, we can observe that fossil fuel contributes the highest share throughout most countries. This suggests that the world is heavily reliant on fossil fuels as its main source of energy.

We can also use similar analytics to view our ASEAN neighbours as well as Singapore's own performance with regards to where we get our energy from.

Figure 9: ASEAN countries and their energy sources

Similar to global trends, Singapore as well as our ASEAN neighbours rely heavily on fossil fuel as our primary source of energy. It is also notable that Singapore is trying to develop renewable energy capabilities despite our nation's small geographical size as well.

With this in mind, we can now view the correlation between how a country's GDP changes according to whether or not the country uses less fossil fuel or more renewable energy. To observe global economic trends we can analyse the four largest nations based on GDP that shape the global economy. These nations are the United States of America, China, Germany and Japan (Investopedia, 2022). As such, we can first begin identifying if the GDP of these countries are affected by an overall change in renewable energy and fossil fuels.

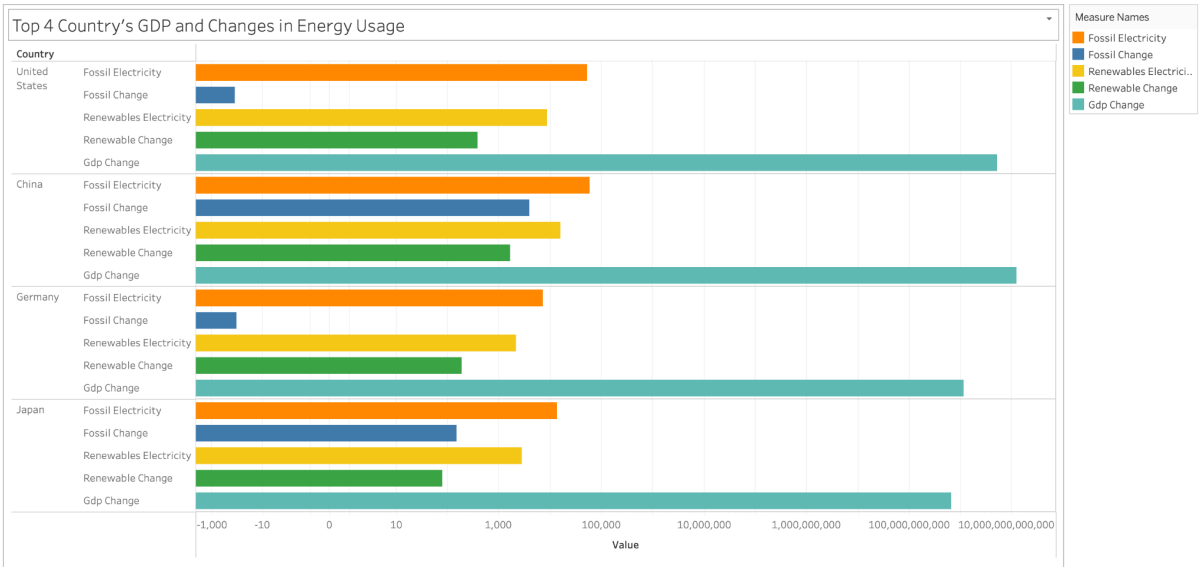

Figure 10: Global countries and their changes in renewable energy and fossil fuel reliance against changes in GDP.

This showcases that for most cases a positive change in renewable energy is accompanied with an increase in GDP. It is worth noting that countries such as the United States of America and Germany have an average of negative changes in fossil fuel which suggests that they are trying to transition away from fossil fuel. The trend for these two countries also show that their GDP increases despite a decreasing use of fossil fuel.

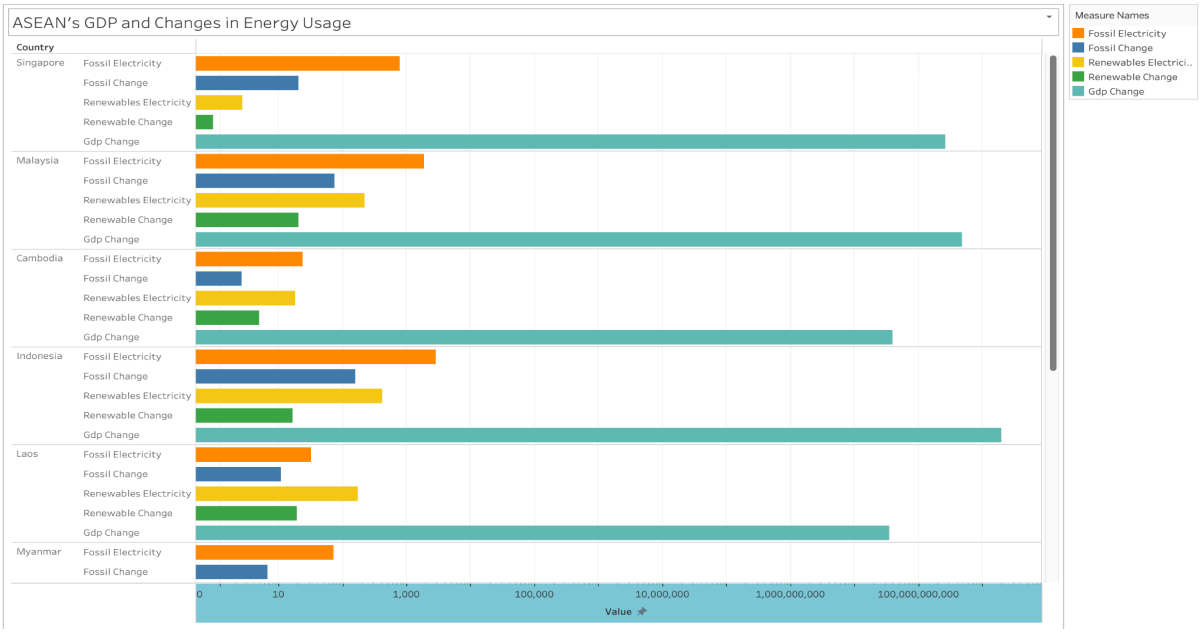

Figure 11: ASEAN countries and their changes and their changes in fossil change, renewable change and gdp change

Using the same analytics for ASEAN nations, we can see that ASEAN countries often have an increase in fossil fuel reliance as well as an increase in renewable energy usage. However, we can only observe that GDP increases when renewable energy change is positive as well as when fossil fuel change is positive as well.

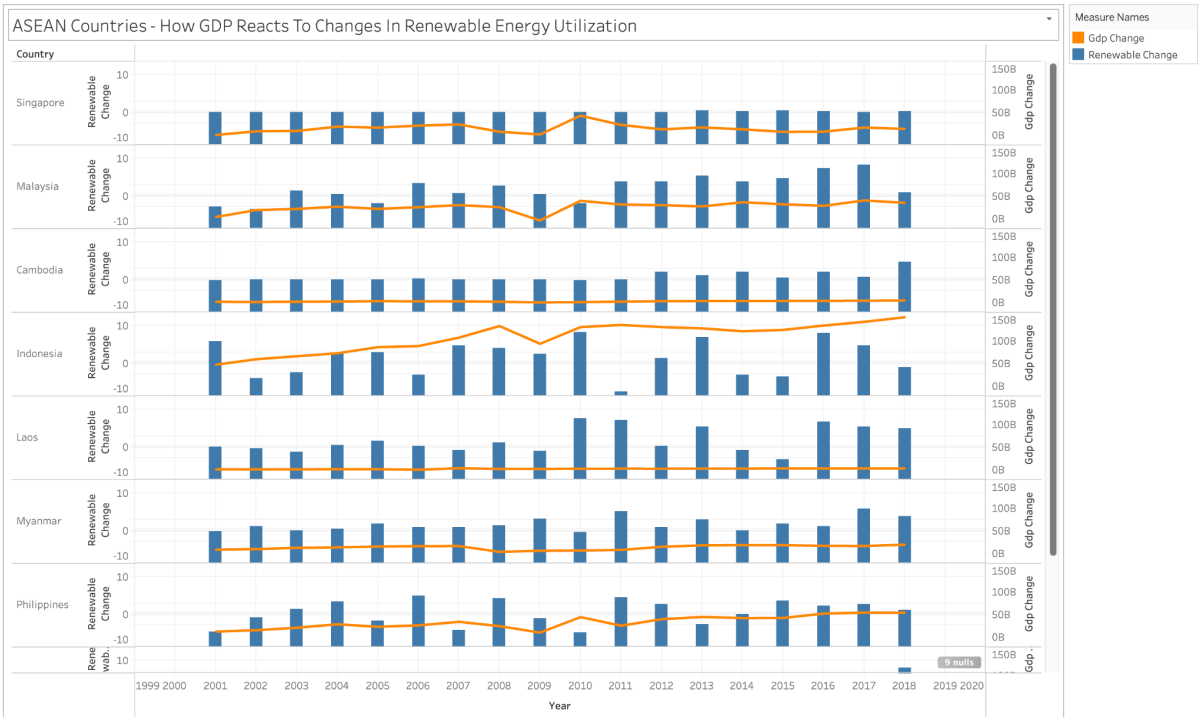

Figure 12: ASEAN countries and how their GDP reacts to renewable energy changes

This analysis shows us that for ASEAN countries there is no clear indicator that an increase in renewable energy will increase the economic output of a nation. As a result, we cannot infer that renewable energy is able to power sustainable economic growth due to the fact that a country's GDP could be affected by other factors that are not renewable energy. (Bhuiyan et al., 2001)

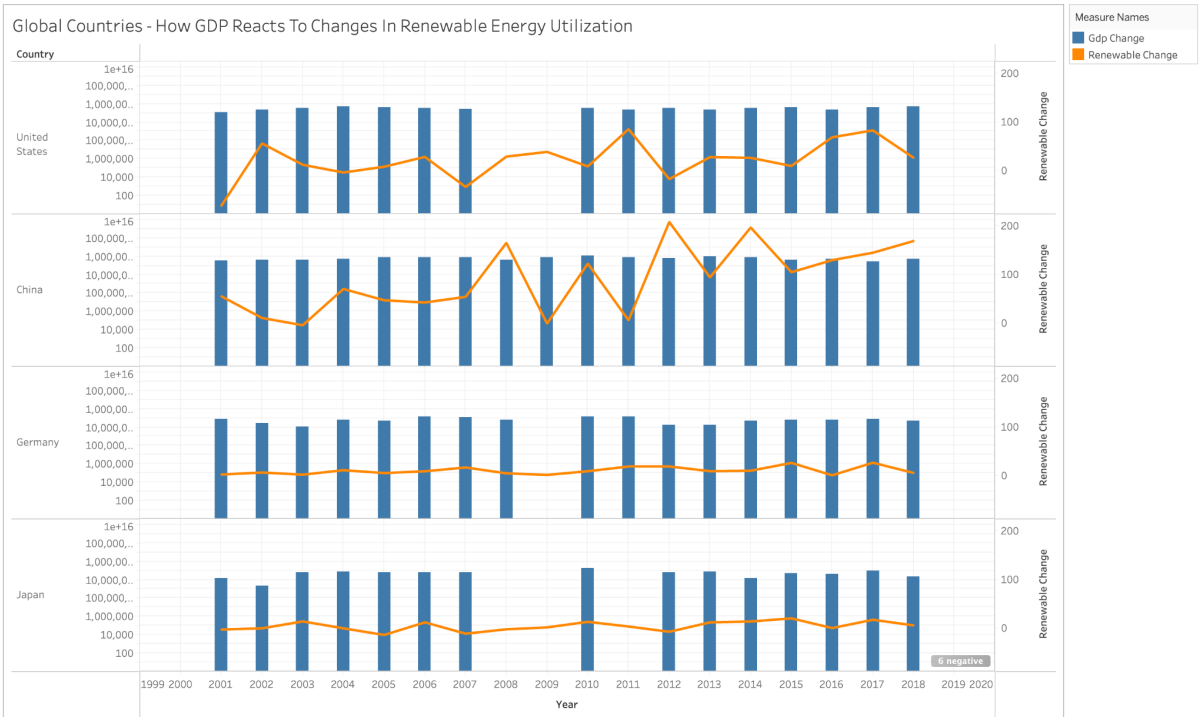

Figure 13: TOP 4 GDP nations and how their GDP reacts to changes in renewable energy utilisation.

Conclusion

As traditional means of energy such as fossil fuels are a finite resource, countries will definitely look at adopting alternative renewable energy sources to power their economy for decades to come.

Through our data-driven analytics, we can observe that on average, renewable energy is often accompanied by growth in GDP for the year. However, that being said, as correlation does not equate to causation, we cannot conclude that renewable energy is the sole cause for the increase in GDP.

Through our analytics, we can only observe that a country's GDP tends to increase on average when the change in renewable energy usage is positive.

Henceforth countries need to identify appropriate renewable energy sources. For example, countries with strong wind currents should adopt wind turbine systems that allow for greater utilisation of such renewable energy methods.

Question 14

Open-ended question Say micro-nuclear reactors (https://energypost.eu/micronuclear-reactors-up-to-20mw-portable-safer/) have become environmentally viable and economically feasible for Singapore. Shall we go nuclear? Why / why not? Substantiate your team's opinion with the data provided.

The use of nuclear reactors have been widely known by most as one to produce clean and sustainable energy. However, the events of Chernobyl in 1986 and more recently 2011 in Fukushima Daiichi has led the world to believe that it is unsafe as a source of energy. The misconceptions and fear about radiation have brought about psychological and socio-economic factors that have repelled many countries. The traditional forms of energy production through the burning of fossil fuels results in air pollution that causes 8.7 million deaths every year ("What are the effects of nuclear accidents?", n.d.). This pushes fossil fuels to be the deadliest method of electricity generation. Therefore, countries should start looking into alternative ways to produce electricity.

Nuclear energy protects air quality by producing large amounts of carbon-free electricity, eliminating the negative side effects of burning fossil fuel. With the use of micro-nuclear reactors which greatly reduces the amount of space needed for such systems, it opens the potential for land-scarce countries, such as Singapore, to explore the possibility of nuclear energy.

From owid_energy_data, we can see how Singapore is slowly transitioning away from the use of fossil fuel for energy towards more sustainable options where the Republic stopped being fully dependent on fossil energy in 1986. Taking a look at the values from the most recent logged entry (2020), we can see that Singapore has increased its percentage of renewable energy used more specifically, solar energy. Singapore has not implemented the use of nuclear energy to produce electricity yet.

country	year	fossil_share_energy	solar_share_energy	nuclear_electricity
Singapore	1985	100.0	0.0	0.0
Singapore	1986	99.857	0.0	0.0
Singapore	2020	99.747	0.077	0.0

Figure 14: A figure to showcase the years where reliance of fossil energy is high

Compared to nuclear energy which has a high capacity factor of 92.5%, renewable energy sources such as solar, 24.9%, and wind, 35.4%, produce intermittent sources of energy depending on the geographical conditions. This makes nuclear energy more than 3 times more reliable than that of wind and solar plants (“Nuclear Power is the Most Reliable Energy Source”, 2021). From our data in Q10, we can see how the energy consumption of household electricity fluctuates with the highest consumption in quarter 2. If the low energy cycle of renewable energy coincides with quarters that have higher consumption, this could lead to a deficit of energy pushing Singapore back to the consumption of fossil fuel.

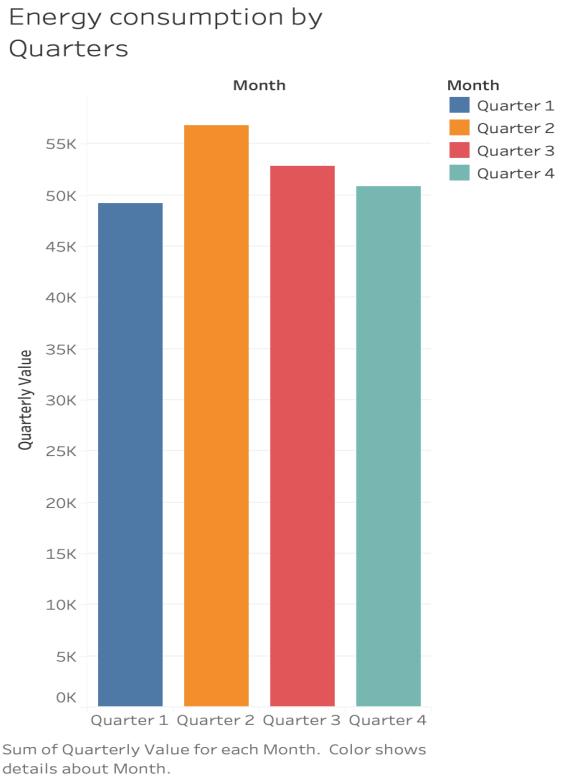

Figure 15: A figure that showcases the energy consumption by quarters

Therefore, by choosing nuclear energy, it would help provide a constant source of energy that is more reliable than both fossil fuel and renewable energy that will reduce the chances of energy shortages.

Singapore aims to reach net-zero greenhouse gas emissions by 2050 (Fogarty, 2022). They aim to do this by implementing solar panels on roofs and reservoirs as well as implementing a zero-growth policy for cars and motorcycles. The adoption of nuclear energy would be a game-changer to help boost the nation in achieving its goal. However, the implementation of such technology still needs to be further evaluated to determine its safety and efficacy in Singapore’s context.

Question 15

Blue-sky question Despite the increasing awareness of environmental issues, some remain sceptical about climate change being a problem (see https://www.bbc.com/news/science-environment-62225696). Using the data provided in this project and the individual assignment (as well as any other publicly available data, if your team shall desire), build a convincing data narrative to illustrate climate change problems associated with emissions.

For a long time, climate change has been a highly polarising topic around the world, with people lining up on opposite sides depending on their politics and worldview. On one end of the spectrum, climate deniers firmly believe that climate change is a hoax branded as a crisis to justify self-interests – or even a conspiracy created by governments (Figure 1).

Figure 16: A tweet by Donald Trump of his scepticism towards climate change (Matthews, 2017)

These individuals have also been feeding the masses with groundless claims and disinformation, planting seeds of doubt as to whether climate change is a real problem or not. While climate change may not be a directly observable phenomenon, its impacts are currently threatening the lives of all kinds. **However, how do we know climate change is really an issue?**

Here, our group will dissect the matter into nine sections and present knowledge visualisations to help communicate the issue of climate change to sceptics in a digestible manner, as well as bridge their information gap.

To interact with our data visuals on Tableau Public, access the link here.

1. **Is the world really getting warmer?**

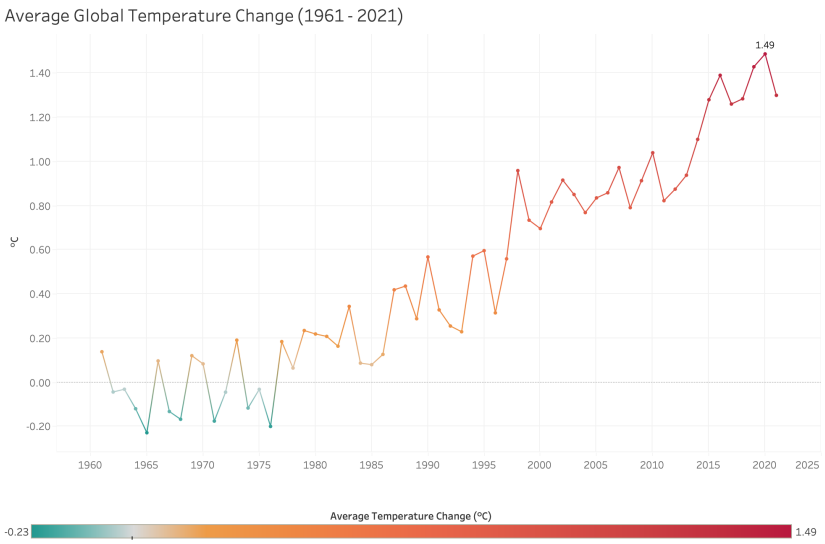

Figure 17: Average Global Temperature Change (1961 - 2021)

Analysis: For the past 61 years, the average global temperature change has increased significantly, from a change in merely less than 0.2 degree celsius, to 1.49 degree celsius in 2020. The most notable increase was from 1997 to 1998 onwards. Both years marked a turning point when the planet started to warm up faster than previous decades. In 1997, the greenhouse effect was starting to show and in 1998, the spike in global temperature was due to the El Niño effect, a weather pattern that impacts the global weather systems. Since then, temperature change has been increasing significantly, with a more constant rise from 2013 to 2015. By 2020, it has reached the highest change in global temperature.

1. **What is the relationship between global temperature change and emissions?**

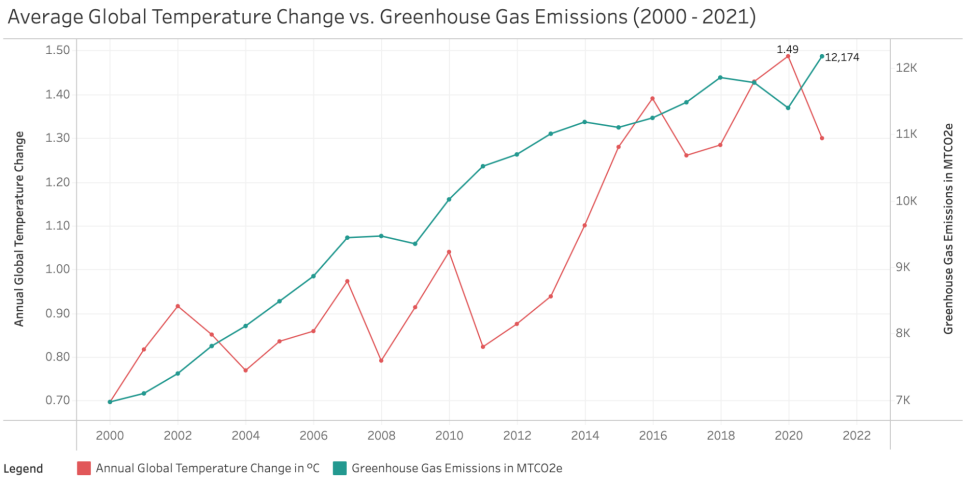

Figure 18: Average Global Temperature Change vs. Greenhouse Gas Emissions (2000 - 2021)

Analysis: As seen from the figure, the rising positive temperature change from 2000 to 2021 is positively related with the increasing greenhouse gas emissions. This is because greenhouse gases, in particular carbon dioxide, causes extra heat to be trapped, resulting in the rise in temperature. (Denchak, 2019). Greenhouse gas emissions have been increasing significantly, with a significant increase from 2009 to 2010 and from 2020 to 2021. The spike in greenhouse gas emissions in 2010 was due to economic recovery and colder winter (European Environment Agency, 2021). In 2021, the increase in greenhouse gas emissions is the highest since it was driven by increase in power-and-industry-related emissions from China and India (Davis et. al., 2022). Additionally, recovering from lockdowns in 2020, more people are able to travel in 2021, causing the increase in greenhouse gases as more vehicles and planes are used as mode of transportation.

2. Who is responsible for the high emissions

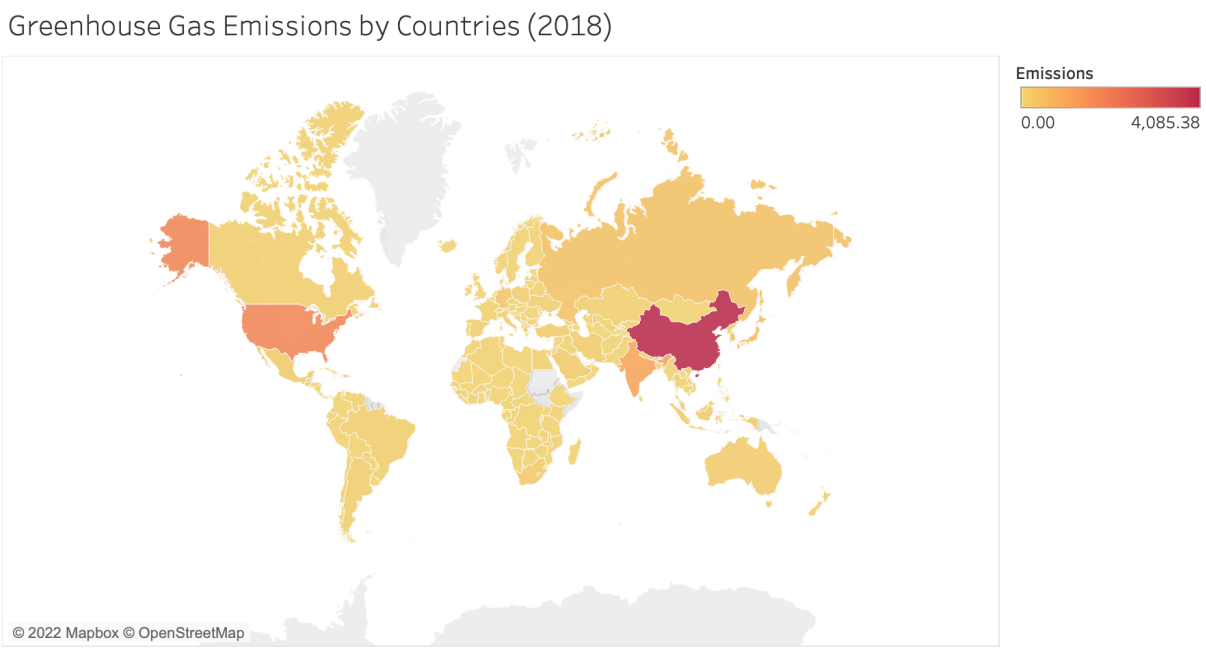

Figure 19: Distribution of Greenhouse Gas Emissions (2018)

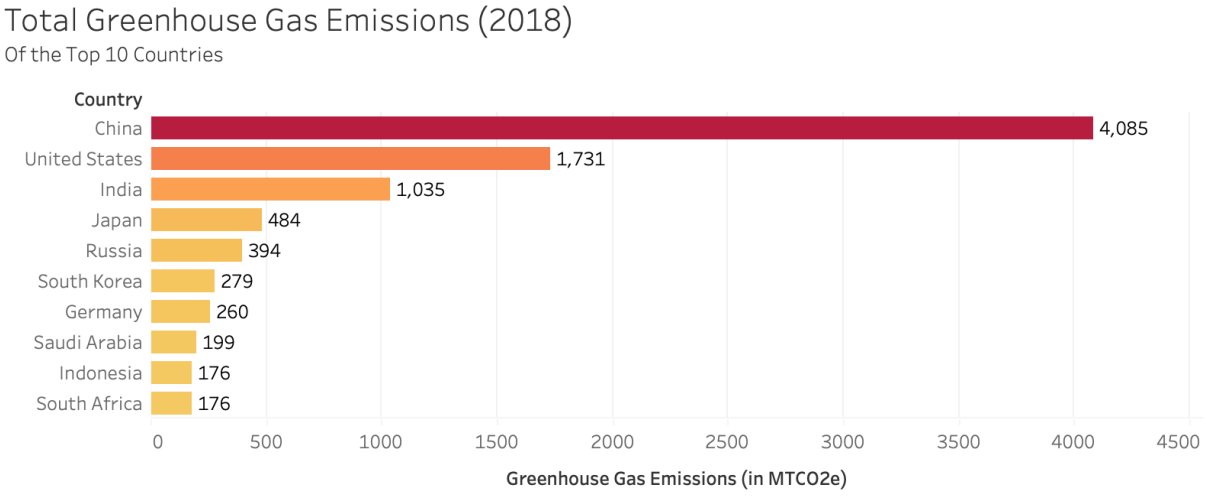

Figure 20: Total Greenhouse Gas Emissions (2018)

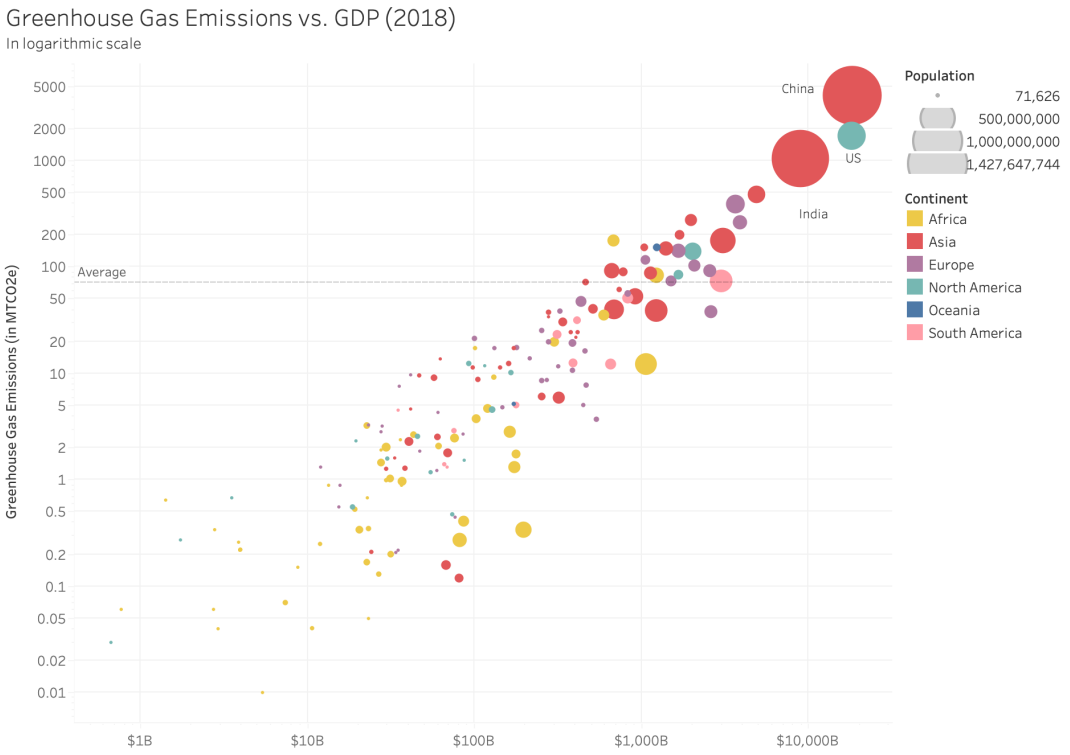

Figure 21: Greenhouse Gas Emissions (2018)

Analysis: When we consider the total greenhouse gas emissions, differences across countries often reflect differences in population size, as seen from the correlation between the two. In other words, countries with a large population inevitably emit more greenhouse gases than smaller countries which may make their impact per person smaller. Evidently, China and India – with a combined population size of almost 40% of the world's population – are a few of the biggest contributors of greenhouse gases in 2018.

Moreover, looking at the positive correlation between Gross Domestic Product (GDP) and greenhouse gas emissions in 2018, it can be noted that countries with a higher GDP (i.e. bigger economies such as China and the United States) contribute more towards emissions due to higher production within the economy.

This highlights the fact that human activities do, in fact, lead to higher greenhouse gas emissions.

Furthermore, in line with the Fourth Industrial Revolution, Asian economies, such as China, India and Japan, are making rapid strides to industrialise (Tonby et al., 2019), resulting in higher emissions in this region. This greatly contrasts with the poorer and smaller African nations that contribute little towards greenhouse gas emissions.

As a result, economic powerhouses are responsible for greenhouse gas emissions in totality.

3. Per capita: who is responsible for the high emissions?

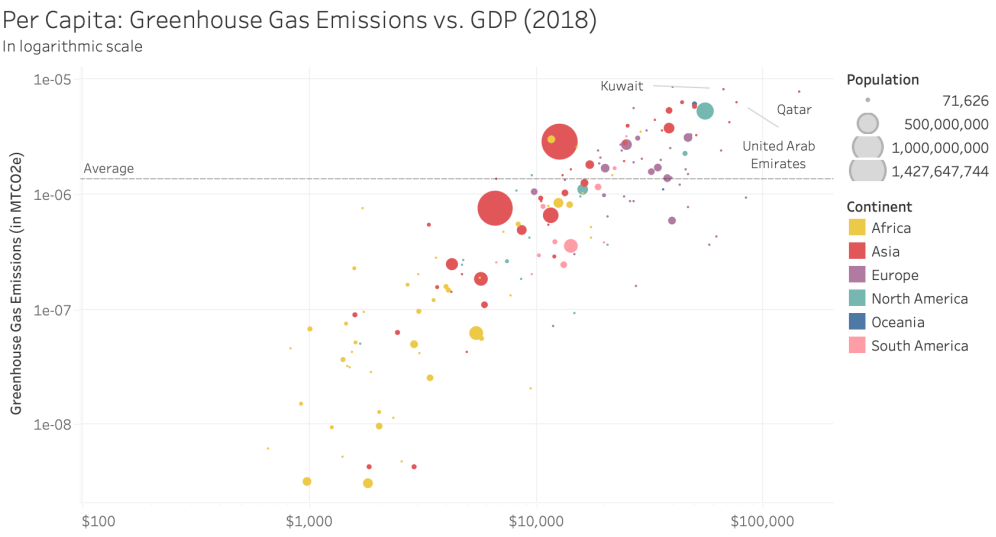

Figure 22: Per Capita: Greenhouse Gas Emissions vs GDP (2018)

Analysis: As shown before, measuring the total carbon emissions does not always paint the most accurate picture of a country's contribution, if their population is not considered. Comparing countries based on emissions per person can add nuance to the overall story.

On a per capita basis, inhabitants of petro monarchies in the Middle East, inclusive of Qatar, Kuwait and the United Arab Emirates, are the largest emitters of greenhouse gases. Furthermore, it is worth noting that the average person in these countries emits at least 6 times more greenhouse gases than the global average per person.

4. What is the cause of high emissions?

As we have observed, major oil-producing countries such as Qatar, Kuwait and the United Arab Emirates are responsible for high emissions per person. This signifies to us that one of the main sources of greenhouse gas emissions is from the burning of fossil fuels, like oil, for energy. Indeed, in recent years, almost 75% of worldwide emissions come from the energy sector which includes electricity, transportation and heat (Ritchie, 2020). Therefore, we will study trends on worldwide energy consumption next.

5. How is global energy consumption changing?

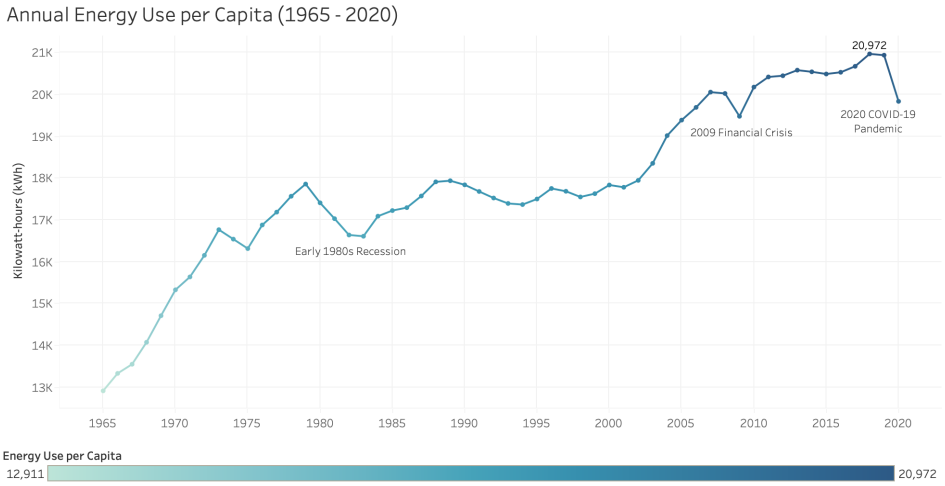

Figure 23: Annual Energy Use per Capita (1965 - 2020)

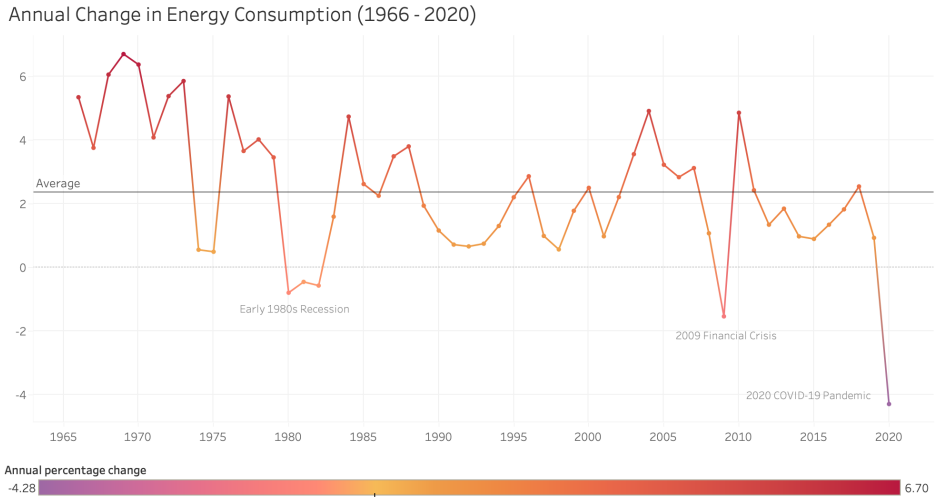

Figure 24: Annual Change in Energy Consumption (1966 - 2020)

Analysis: Demand for energy has been growing across the world, as countries get richer and populations grow. We can observe that the world's energy consumption per capita has increased by 53.6% in the last 55 years, peaking at **20,972** Kilowatt-hours (kWh) in 2018. It is also evident that global energy consumption continues to grow year-on-year, with the exceptions of the early **1980s, 2009 and 2020 following recessions, the financial crisis and COVID-19 pandemic respectively**. However, notably, the demand for energy seems to be slowing with the percentage change averaging around 1 - 2% in the past decade.

A growing demand for energy will make it challenging for economies to transit away from fossil fuels and towards low-carbon emitting sources of energy. This is because renewables and low-carbon energy have to meet this additional demand and try to displace existing fossil fuels in the world's current mix of energy sources.

6. Per capita: who is responsible for high energy use?

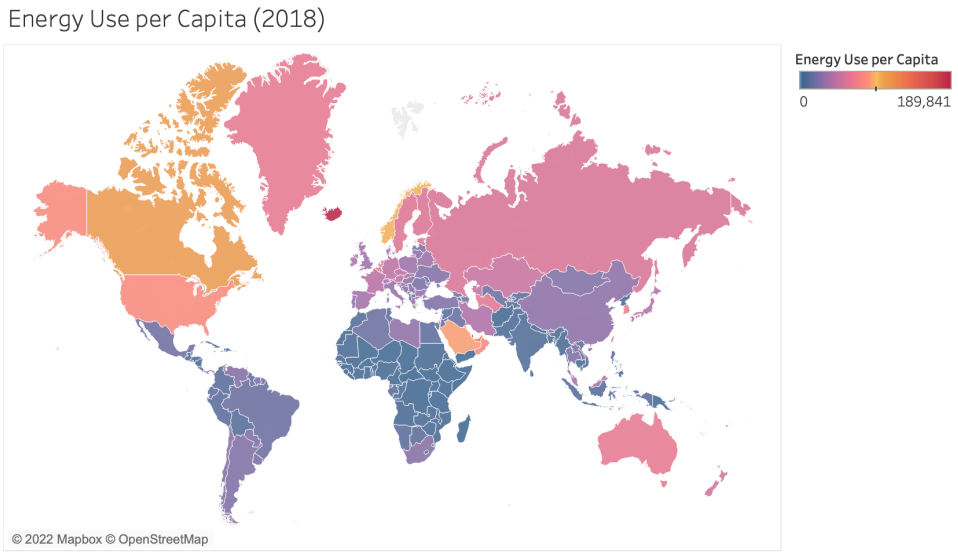

Figure 25: Energy Use per Capita (2018)

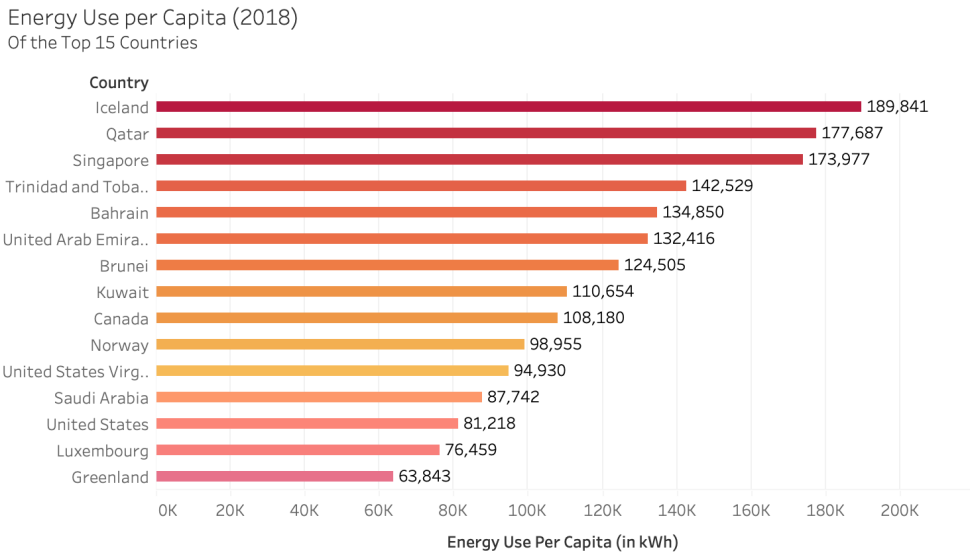

Figure 26: Energy Use per Capita (2018)

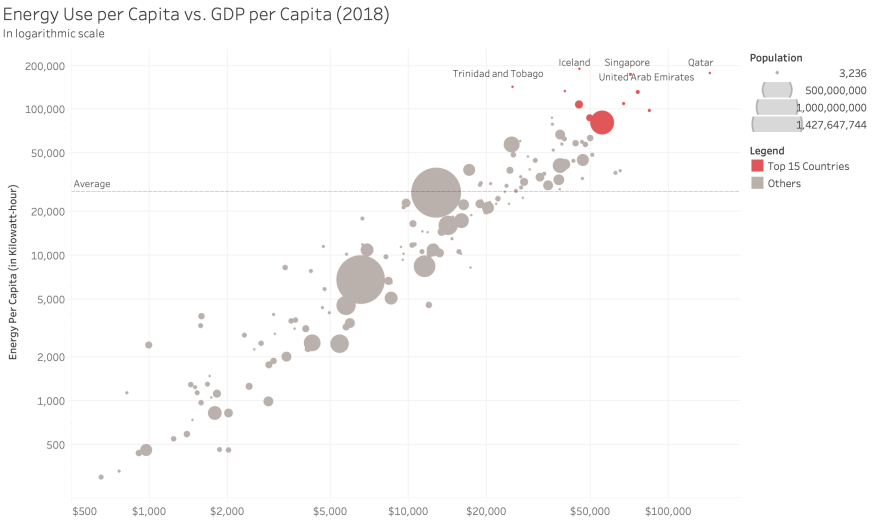

Figure 27: Energy Use per Capita vs GDP per Capita (2018)

Analysis: In 2018, there are vast differences in energy use per capita across the world. The largest energy consumers include Iceland, Canada, the United States as well as wealthy nations such as Qatar, Saudi Arabia and Kuwait. The average person in these countries consume as much as 100 times more than the average person in some of the poorest, less-developed nations.

The top 15 countries by energy consumption per capita are relatively wealthy and heavily industrialised. Many of them are large energy producers or industry-heavy economies. As evident, the United Arab Emirates, Saudi Arabia, Kuwait, Norway, Canada and the United States are among the world's 10 biggest oil producers and exporters (The World's 10 Biggest Oil Exporters, 2022).

Interestingly enough, Iceland is the leading consumer of energy per capita, instead of the inhabitants of petrol monarchies. Around half of Iceland's energy consumption can be attributed to metal manufacturing due to the high volume of electricity used by the aluminium industry (Over 50% of Energy in Iceland Used in Industry, n.d.). Similarly, Iceland is a hotspot for Cryptocurrency mining facilities – with 8% of all Bitcoins being mined there – due to its cheap electricity that comes from renewable sources (Walter, 2021).

Therefore, countries with energy-intensive industries such as oil extraction and production are significant influencers of energy consumption per capita.

7. **How much of their energy comes from fossil fuel, renewables and nuclear energy?**

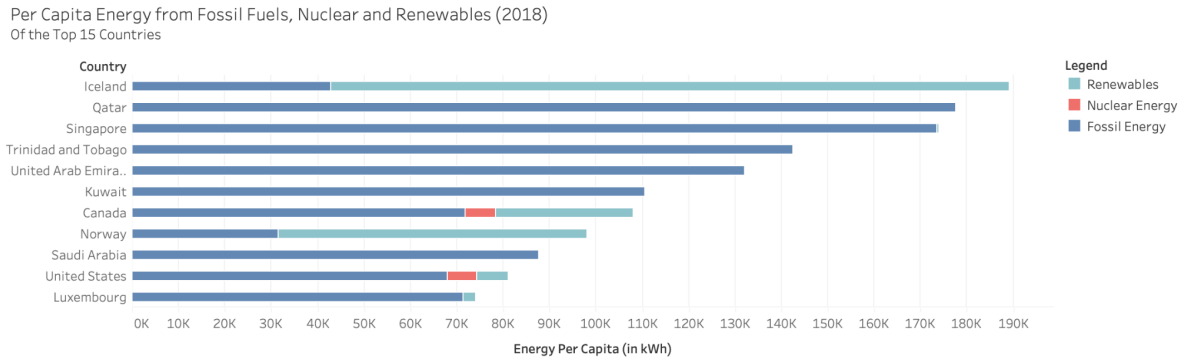

Figure 28: Per Capita Energy from Fossil Fuels, Nuclear and Renewables (2018)

Analysis: Based on the previous chart, Iceland seems to be the leading energy user per capita. However, upon delving deeper into the breakdown of the energy between renewables, nuclear, and fossil energy, it is found that Iceland mainly utilises renewables energy. Therefore, on average, each individual in Iceland is contributing lower greenhouse gas emissions as compared to other countries such as Qatar, Singapore, Trinidad and Tobago since these countries rely fully or almost fully on fossil energy. Both Canada and the States have nuclear energy. In the States, about 20% of electricity is powered by nuclear power (Energy.gov, n.d.). Meanwhile, in Canada, about 15% of the electricity is powered by nuclear power (World Nuclear, 2022). The reason why countries like Singapore do not have Nuclear energy is because of its small land size to even fit in Nuclear Plants.

8. What are the consequences of climate change?

Given the long-term upward shifts in temperatures and weather patterns, there are several consequences.

Firstly, the global population's health will be affected in many ways. Those with existing medical conditions such as high blood pressure will be more sensitive towards change in temperature, which affects blood flow to the skin and dehydration, increasing likelihood for fainting and falls (Nripen, 2020). Additionally, people might suffer from heat stress that leads to heat stroke. Currently, 30% of the global population is subjected to heat stress each year, but the Intergovernmental Panel on Climate Change estimates that the percentage will rise to as high as 76% by the end of this century (IPCC, n.d.).

Also, individuals who are displaced are more likely to be exposed to infectious disease as a result of flooding. The rise in temperature causes water bodies to be warmer and the environment to be more moist, leading to increased risk of contracting dengue. Flooding also spreads waterborne organisms that cause hepatitis and diarrheal diseases.

Food and water security will also be affected. High temperature affects crop yield, as proven by Lancet review which found that high temperatures in 2021 shortened the growing season by 9.3 days (Lichtveld, 2022). Warming water bodies can also affect marine life, which eventually affects the food supply chain.

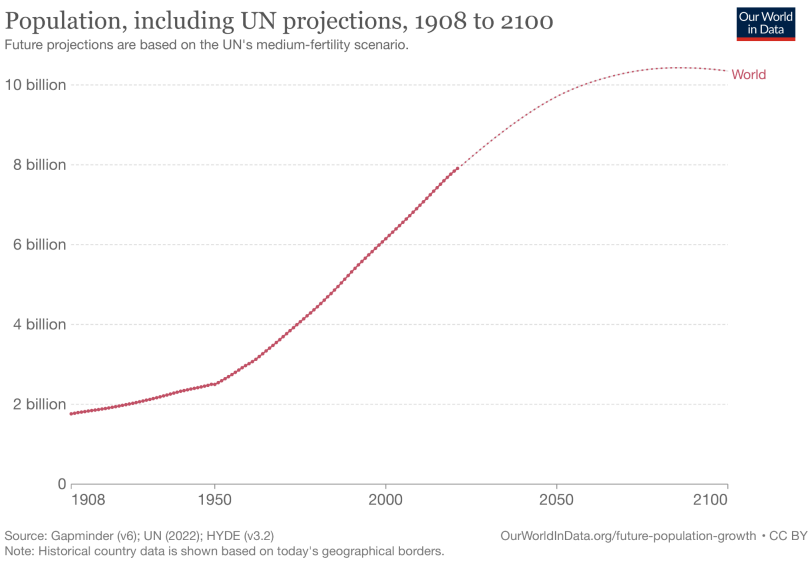

Figure 29: Population, including UN Projections (Mathieu, 2022)

The impact of climate change is exacerbated with the rising global population. Every additional person increases the carbon emission, with the rich contributing more than the poor, however, the poor are suffering far more from the impact.

Call-to-action

Governments: Currently, countries adopt the Paris Agreement to limit the rise in global temperature by 1.5%. However, countries' pledges are not ambitious enough to achieve the goal. Alternatively, a climate club can be created to penalise countries that do not meet their obligations or do not join. This avoids any form of excuses that a government may have for not joining, thus shrinking away from their responsibility to minimise greenhouse gas emissions, regardless of whether they are part of any climate change agreement.

Individuals: Although individuals may not make drastic emissions cuts, their behaviour will also influence policymakers and businesses. Individuals can consider travelling to nearby destinations with economy class instead as business class has a carbon footprint thrice that of an economy class (Bofinger and Strand, 2013). Opting out fossil fuels investment helps to lower businesses in the fossil fuel industry, improving the environment. Lastly, individuals can take the first step by consuming less meat and dairy, especially red meat which has the largest environmental impact (The Grantham Institute, n.d.).

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Appendices

Question 12

country	year	gdp	population
Denmark	2000	2083587122O1.0	5341192.0
Denmark	2001	211275272656.0	5358059.0
Denmark	2002	213475432436.0	5372798.0
Denmark	2003	215532702113.0	5386968.0
Denmark	2004	222551117434.0	5402754.0
Denmark	2005	229050958246.0	5421701.0
Denmark	2006	239379200822.0	5444293.0
Denmark	2007	242933470571.0	5469920.0
Denmark	2008	243073654298.0	5497731.0

Figure 30: Selected Output of Comparable References based on GDP and population in SQL

	_id	country	population	year	matching_result
1	63074885ff3acbe0d63c	Denmark	5,341,192 (5.3M)	2000	Array[1]
2	63074885ff3acbe0d63c	Denmark	5,358,059 (5.4M)	2001	Array[1]
3	63074885ff3acbe0d63c	Denmark	5,372,798 (5.4M)	2002	Array[1]
4	63074885ff3acbe0d63c	Denmark	5,386,968 (5.4M)	2003	Array[1]
5	63074885ff3acbe0d63c	Denmark	5,402,754 (5.4M)	2004	Array[1]
6	63074885ff3acbe0d63c	Denmark	5,421,701 (5.4M)	2005	Array[1]
7	63074885ff3acbe0d63c	Denmark	5,444,293 (5.4M)	2006	Array[1]
8	63074885ff3acbe0d63c	Denmark	5,469,920 (5.5M)	2007	Array[1]
9	63074885ff3acbe0d63c	Denmark	5,497,731 (5.5M)	2008	Array[1]
10	63074885ff3acbe0d63c	Denmark	5,526,389 (5.5M)	2009	Array[1]
11	63074885ff3acbe0d63c	Denmark	5,554,849 (5.6M)	2010	Array[1]
12	63074885ff3acbe0d63c	Denmark	5,582,980 (5.6M)	2011	Array[1]
13	63074885ff3acbe0d63c	Denmark	5,610,909 (5.6M)	2012	Array[1]
14	63074885ff3acbe0d63c	Denmark	5,638,152 (5.6M)	2013	Array[1]

Figure 31: Selected Output of Comparable References based on GDP and population in noSQL

country	year	gdp_per_capita
Denmark	2000	208358712201
Denmark	2001	211275272656
Denmark	2002	213475432436
Denmark	2003	215532702113
Denmark	2004	222551117434
Denmark	2005	229050958246
Denmark	2006	239379200822
Denmark	2007	242933470571

Figure 32: Selected Output of GDP per capita of Singapore, Denmark, and Finland from 2000 to 2018 in SQL

	_id	country	year	population	gdp	gdp_per_capita
1	63074885ff3acbe0d63c	Denmark	2000	5,341,192 (5.3M)	208,358,712,201 (0.21T)	39,009.7776 (39.0K)
2	63074885ff3acbe0d63c	Denmark	2001	5,358,059 (5.4M)	211,275,272,656 (0.21T)	39,431.3076 (39.4K)
3	63074885ff3acbe0d63c	Denmark	2002	5,372,798 (5.4M)	213,475,432,436 (0.21T)	39,732.637 (39.7K)
4	63074885ff3acbe0d63c	Denmark	2003	5,386,968 (5.4M)	215,532,702,113 (0.22T)	40,010.0209 (40.0K)
5	63074885ff3acbe0d63c	Denmark	2004	5,402,754 (5.4M)	222,551,117,434 (0.22T)	41,192.1619 (41.2K)
6	63074885ff3acbe0d63c	Denmark	2005	5,421,701 (5.4M)	229,050,958,246 (0.23T)	42,247.0657 (42.2K)
7	63074885ff3acbe0d63c	Denmark	2006	5,444,293 (5.4M)	239,379,200,822 (0.24T)	43,968.8314 (44.0K)
8	63074885ff3acbe0d63c	Denmark	2007	5,469,920 (5.5M)	242,933,470,571 (0.24T)	44,412.6186 (44.4K)
9	63074885ff3acbe0d63c	Denmark	2008	5,497,731 (5.5M)	243,073,654,298 (0.24T)	44,213.4499 (44.2K)
10	63074885ff3acbe0d63c	Denmark	2009	5,526,389 (5.5M)	232,468,682,940 (0.23T)	42,065.2044 (42.1K)
11	63074885ff3acbe0d63c	Denmark	2010	5,554,849 (5.6M)	238,176,024,487 (0.24T)	42,877.1375 (42.9K)
12	63074885ff3acbe0d63c	Denmark	2011	5,582,980 (5.6M)	242,738,383,168 (0.24T)	43,478.2828 (43.5K)
13	63074885ff3acbe0d63c	Denmark	2012	5,610,909 (5.6M)	243,290,007,585 (0.24T)	43,360.177 (43.4K)
14	63074885ff3acbe0d63c	Denmark	2013	5,638,152 (5.6M)	245,558,515,767 (0.25T)	43,553.0145 (43.6K)

Figure 33: Selected Output of GDP per capita of Singapore, Denmark, and Finland from 2000 to 2018 in noSQL

country	year	energy_per_capita
Denmark	2000	44037.943
Denmark	2001	44006.794
Denmark	2002	43746.435
Denmark	2003	46980.912
Denmark	2004	44252.394
Denmark	2005	42532.489
Denmark	2006	46688.108
Denmark	2007	44026.56

Figure 34: Selected Output of energy per capita of Singapore, Denmark, and Finland from 2000 to 2018 in SQL

	_id	country	year	energy_per_capita
1	63074885ff3acbe0d63c	Denmark	2000	44,037.943 (44.0K)
2	63074885ff3acbe0d63c	Denmark	2001	44,006.794 (44.0K)
3	63074885ff3acbe0d63c	Denmark	2002	43,746.435 (43.7K)
4	63074885ff3acbe0d63c	Denmark	2003	46,980.912 (47.0K)
5	63074885ff3acbe0d63c	Denmark	2004	44,252.394 (44.3K)
6	63074885ff3acbe0d63c	Denmark	2005	42,532.489 (42.5K)
7	63074885ff3acbe0d63c	Denmark	2006	46,688.108 (46.7K)
8	63074885ff3acbe0d63c	Denmark	2007	44,026.56 (44.0K)
9	63074885ff3acbe0d63c	Denmark	2008	42,141.057 (42.1K)
10	63074885ff3acbe0d63c	Denmark	2009	39,407.67 (39.4K)
11	63074885ff3acbe0d63c	Denmark	2010	41,164.357 (41.2K)
12	63074885ff3acbe0d63c	Denmark	2011	38,636.374 (38.6K)
13	63074885ff3acbe0d63c	Denmark	2012	35,543.896 (35.5K)
14	63074885ff3acbe0d63c	Denmark	2013	36,950.534 (37.0K)

Figure 35: Selected Output of energy per capita of Singapore, Denmark, and Finland from 2000 to 2018 in noSQL

country	year	energy_per_gdp
Denmark	2000	1.129
Denmark	2001	1.116
Denmark	2002	1.101
Denmark	2003	1.174
Denmark	2004	1.074
Denmark	2005	1.007
Denmark	2006	1.062
Denmark	2007	0.991

Figure 36: Selected Output of energy per GDP of Singapore, Denmark, and Finland from 2000 to 2018 in SQL

	_id	country	year	energy_per_gdp
1	63074885ff3acbe0d63c	Denmark	2000	1.129
2	63074885ff3acbe0d63c	Denmark	2001	1.116
3	63074885ff3acbe0d63c	Denmark	2002	1.101
4	63074885ff3acbe0d63c	Denmark	2003	1.174
5	63074885ff3acbe0d63c	Denmark	2004	1.074
6	63074885ff3acbe0d63c	Denmark	2005	1.007
7	63074885ff3acbe0d63c	Denmark	2006	1.062
8	63074885ff3acbe0d63c	Denmark	2007	0.991
9	63074885ff3acbe0d63c	Denmark	2008	0.953
10	63074885ff3acbe0d63c	Denmark	2009	0.937
11	63074885ff3acbe0d63c	Denmark	2010	0.96
12	63074885ff3acbe0d63c	Denmark	2011	0.889
13	63074885ff3acbe0d63c	Denmark	2012	0.82
14	63074885ff3acbe0d63c	Denmark	2013	0.848

Figure 37: Selected Output of energy per GDP of Singapore, Denmark, and Finland from 2000 to 2018 in noSQL

country	year	total_energy_consumption
Denmark	2000	721.123
Denmark	2001	723.5080000000002
Denmark	2002	723.7379999999999
Denmark	2003	781.259
Denmark	2004	743.032
Denmark	2005	718.192
Denmark	2006	787.063
Denmark	2007	749.711

Figure 38: Selected Output of total energy consumption of Singapore, Denmark, and Finland from 2000 to 2018 in SQL

	_id	country	year	biofuel_co	coal_consu	fossil_fuel_	gas_consi	hydro_cc	low_carbc	nuclear	oil_consum	other_re	primary_er	renewable	solar_cor	wind_cons	total_energy_consumption
1	63074	Denmark	2000	0	46.183	219.737	51.019	0.084	15.478	0	122.535	3.61	235.215	15.478	0.003	11.781	721.123
2	63074	Denmark	2001	0	48.816	219.657	53.315	0.076	16.134	0	117.526	4.172	235.791	16.134	0.003	11.884	723.508
3	63074	Denmark	2002	0	48.874	216.426	53.818	0.087	18.615	0	113.734	5.152	235.041	18.615	0.004	13.372	723.738
4	63074	Denmark	2003	0	66.683	231.081	54.409	0.058	22.004	0	109.988	6.793	253.085	22.004	0.004	15.15	781.259
5	63074	Denmark	2004	0	51.114	213.308	54.15	0.072	25.777	0	108.044	7.879	239.085	25.777	0.005	17.821	743.032
6	63074	Denmark	2005	0	43.126	204.203	52.006	0.061	26.396	0	109.071	8.538	230.598	26.396	0.006	17.791	718.192
7	63074	Denmark	2006	0	65.442	229.538	52.983	0.063	24.601	0	111.113	8.206	254.184	24.601	0.006	16.326	787.063
8	63074	Denmark	2007	0	54.108	213.377	47.49	0.075	27.378	0	111.779	8.248	240.822	27.378	0.007	19.049	749.711
9	63074	Denmark	2008	0	47.655	204.957	47.716	0.068	26.653	0	109.586	8.29	231.68	26.653	0.007	18.288	721.553
10	63074	Denmark	2009	0	46.883	191.27	45.828	0.05	26.401	0	98.559	8.711	217.782	26.401	0.01	17.631	679.526
11	63074	Denmark	2010	0	44.574	195.93	51.84	0.054	32.41	0	99.517	11.978	228.662	32.41	0.016	20.362	717.753
12	63074	Denmark	2011	0	37.66	177.457	43.474	0.044	36.75	0	96.323	11.338	215.706	36.75	0.039	25.329	680.87
13	63074	Denmark	2012	0	28.763	158.741	40.603	0.045	38.217	0	89.375	11.452	199.434	38.217	0.268	26.453	631.568
14	63074	Denmark	2013	0	37.635	164.958	38.298	0.034	40.881	0	89.025	11.044	208.333	40.881	1.325	28.478	660.892

Figure 39: Selected Output of total energy consumption of Singapore, Denmark, and Finland from 2000 to 2018 in noSQL

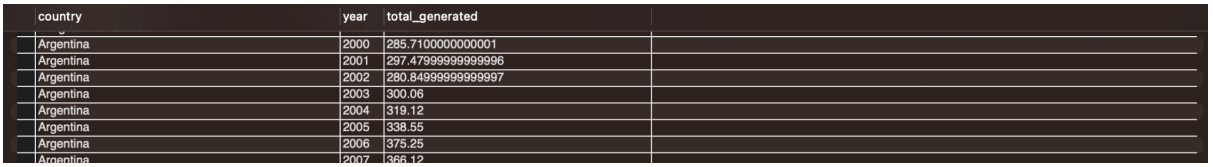
Question 13

	country	year	total_consumption
	Argentina	2000	2224
	Argentina	2001	2190
	Argentina	2002	2108
	Argentina	2003	2238
	Argentina	2004	2355
	Argentina	2005	2503
	Argentina	2006	2639
	Argentina	2007	2742

Figure 40: Selected output that showcases energy consumed by countries throughout the years using SQL

22	Argentina	2000	2,223.652 (2.2K)
23	Argentina	2001	2,189.69 (2.2K)
24	Argentina	2002	2,108.146 (2.1K)
25	Argentina	2003	2,237.531 (2.2K)
26	Argentina	2004	2,354.673 (2.4K)
27	Argentina	2005	2,503.009 (2.5K)
28	Argentina	2006	2,639.181 (2.6K)
29	Argentina	2007	2,741.885 (2.7K)
30	Argentina	2008	2,769.032 (2.8K)
31	Argentina	2009	2,704.007 (2.7K)

Figure 41: Selected output that showcases energy consumed by countries throughout the years using noSQL

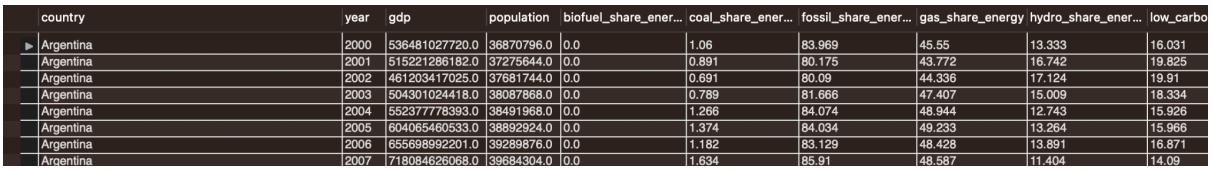


country	year	total_generated
Argentina	2000	285.7100000000001
Argentina	2001	297.47999999999996
Argentina	2002	280.84999999999997
Argentina	2003	300.06
Argentina	2004	319.12
Argentina	2005	338.55
Argentina	2006	375.25
Argentina	2007	366.12

Figure 42: Selected output that showcases how much energy each country generates in that year in terawatt-hours in SQL

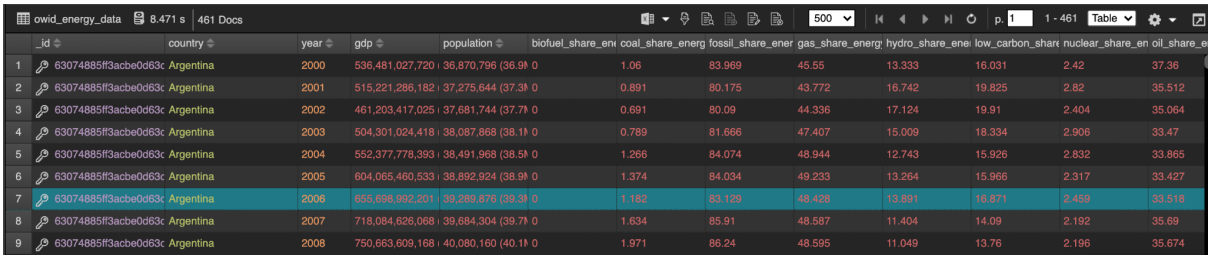
	country	year	total_generated
148	Argentina	2000	285.71
149	Argentina	2001	297.48
150	Argentina	2002	280.85
151	Argentina	2003	300.06
152	Argentina	2004	319.12
153	Argentina	2005	338.55
154	Argentina	2006	375.25
155	Argentina	2007	366.12
156	Argentina	2008	377.82
157	Argentina	2009	386.06

Figure 43: Selected output that showcases how much energy each country generates in that year in terawatt-hours in noSQL



country	year	gdp	population	biofuel_share_ener...	coal_share_ener...	fossil_share_ener...	gas_share_energy	hydro_share_ener...	low_carbo
Argentina	2000	536481027720.0	36870796.0	0.0	1.06	83.969	45.55	13.333	16.031
Argentina	2001	515221286182.0	37275644.0	0.0	0.891	80.175	43.772	16.742	19.825
Argentina	2002	461203417025.0	37681744.0	0.0	0.691	80.09	44.336	17.124	19.91
Argentina	2003	504301024418.0	38087868.0	0.0	0.789	81.666	47.407	15.009	18.334
Argentina	2004	552377778393.0	38491968.0	0.0	1.266	84.074	48.944	12.743	15.926
Argentina	2005	604065460533.0	38892924.0	0.0	1.374	84.034	49.233	13.264	15.966
Argentina	2006	655698992201.0	39289876.0	0.0	1.182	83.129	48.428	13.891	16.871
Argentina	2007	718084626068.0	39684304.0	0.0	1.634	85.91	48.587	11.404	14.09

Figure 44: Selected output that showcases how much energy each country consumes in each specific category in terawatt-hours in SQL



owid_energy_data | 8.471 s | 461 Docs

	_id	country	year	gdp	population	biofuel_share_ene	coal_share_energ	fossil_share_ener	gas_share_energ	hydro_share_ene	low_carbon_share	nuclear_share_en	oil_share_e
1	63074885ff3acbe0d63c	Argentina	2000	536,481,027,720	36,870,796 (36.9M	0	1.06	83.969	45.55	13.333	16.031	2.42	37.36
2	63074885ff3acbe0d63c	Argentina	2001	515,221,286,182	37,275,644 (37.3M	0	0.891	80.175	43.772	16.742	19.825	2.82	35.512
3	63074885ff3acbe0d63c	Argentina	2002	461,203,417,025	37,681,744 (37.7M	0	0.691	80.09	44.336	17.124	19.91	2.404	35.064
4	63074885ff3acbe0d63c	Argentina	2003	504,301,024,418	38,087,868 (38.1M	0	0.789	81.666	47.407	15.009	18.334	2.906	33.47
5	63074885ff3acbe0d63c	Argentina	2004	552,377,778,393	38,491,968 (38.5M	0	1.266	84.074	48.944	12.743	15.926	2.832	33.865
6	63074885ff3acbe0d63c	Argentina	2005	604,065,460,533	38,892,924 (38.9M	0	1.374	84.034	49.233	13.264	15.966	2.317	33.427
7	63074885ff3acbe0d63c	Argentina	2006	655,698,992,201	39,289,876 (39.3M	0	1.182	83.129	48.428	13.891	16.871	2.459	33.518
8	63074885ff3acbe0d63c	Argentina	2007	718,084,626,068	39,684,304 (39.7M	0	1.634	85.91	48.587	11.404	14.09	2.192	35.69
9	63074885ff3acbe0d63c	Argentina	2008	750,663,609,168	40,080,160 (40.1M	0	1.971	86.24	48.595	11.049	13.76	2.196	35.674

Figure 45: Selected output that showcases how much energy each country consumes in each specific category in terawatt-hours in noSQL

country	fossil_electric...	renewables_electric...	gdp	year	fossil_change	renewable_change	gdp_change
China	1113.3	225.559	5952682333616.0	2000	NULL	NULL	NULL
China	1182.59	280.734	6329737195923.0	2001	69.28999999999996	55.17499999999998	377054862307
China	1337.46	291.401	6814493761716.0	2002	154.87000000000012	10.667000000000003	484756565793
China	1579.96	287.277	7248622636565.0	2003	242.5	-4.124000000000024	434128874849
China	1795.41	357.426	7830953031578.0	2004	215.45000000000005	70.149	582330395013
China	2042.8	404.369	8602939916574.0	2005	247.38999999999987	46.94300000000004	771986884996
China	2364.16	446.726	9489543138171.0	2006	321.3599999999999	42.35699999999997	886603221597
China	2718.7	500.72	10358205936544.0	2007	354.53999999999996	53.99400000000003	868662798373

Figure 46: Selected output that showcases how much change in gdp correlates to how much fossil change and renewable change in SQL

	_id	country	fossil_electricity	renewables_electricity	gdp	year	renewable_change	fossil_change	gdp_change
1	63074885ff3acbe0d63c	China	1,113 (1.1K)	225.55	5,952,682,333,616 (6.0T)	2000	null	null	null
2	63074885ff3acbe0d63c	China	1,182.5 (1.2K)	280.73	6,329,737,195,923 (6.3T)	2001	55.18	69.5	377,054,862,307 (0.38T)
3	63074885ff3acbe0d63c	China	1,337.4 (1.3K)	291.4	6,814,493,761,716 (6.8T)	2002	10.67	154.9	484,756,565,793 (0.48T)
4	63074885ff3acbe0d63c	China	1,579.9 (1.6K)	287.27	7,248,622,636,565 (7.2T)	2003	-4.13	242.5	434,128,874,849 (0.43T)
5	63074885ff3acbe0d63c	China	1,795.4 (1.8K)	357.42	7,830,953,031,578 (7.8T)	2004	70.15	215.5	582,330,395,013 (0.58T)
6	63074885ff3acbe0d63c	China	2,042 (2.0K)	404.36	8,602,939,916,574 (8.6T)	2005	46.94	246.6	771,986,884,996 (0.77T)
7	63074885ff3acbe0d63c	China	2,364.1 (2.4K)	446.72	9,489,543,138,171 (9.5T)	2006	42.36	322.1	886,603,221,597 (0.89T)
8	63074885ff3acbe0d63c	China	2,718 (2.7K)	500.7	10,358,205,936,544 (10.4T)	2007	53.98	353.9	868,662,798,373 (0.87T)
9	63074885ff3acbe0d63c	China	2,762.2 (2.8K)	665.07	10,799,148,330,075 (10.8T)	2008	164.37	44.2	440,942,393,531 (0.44T)
10	63074885ff3acbe0d63c	China	2,980 (3.0K)	664.39	11,572,543,696,066 (11.6T)	2009	-0.68	217.8	773,395,365,991 (0.77T)

Figure 47: Selected output that showcases how much change in gdp correlates to how much fossil change and renewable change in noSQL

country	fossil_electricity	renewables_electric...	gdp	year	fossil_change	renewable_change	gdp_change
Singapore	43.32	0.01	32357984786...	2011	0.6099999999999994	0.01	223042561...
Singapore	44.19	0.01	33610841380...	2012	0.8699999999999974	0	125285659...
Singapore	45.02	0.16	35291569916...	2013	0.8300000000000054	0.15	168072853...
Singapore	46.23	0.28	365521147155.0	2014	1.2099999999999937	0.12000000000000002	126054479...
Singapore	47.08	0.41	37258583152...	2015	0.8500000000000014	0.12999999999999995	7064684365
Singapore	48.16	0.52	38002719971...	2016	1.0799999999999983	0.11000000000000004	7441368192
Singapore	48.8	0.55	39650747790...	2017	0.6400000000000006	0.030000000000000027	164802781...

Figure 48: Selected output that showcases how much change in gdp correlates to how much fossil change and renewable change in SQL in ASEAN countries

	_id	country	fossil_electricity	renewables_electricity	gdp	year	renewable_change	fossil_change	gdp_change
1	63074885ff3acbe0d63c	Cambodia	0.4	0	20,441,457,984 (20.4G)	2000	null	null	null
2	63074885ff3acbe0d63c	Cambodia	0.4	0	21,596,243,896 (21.6G)	2001	0	0	1,154,785,912 (1.2G)
3	63074885ff3acbe0d63c	Cambodia	0.6	0	22,487,645,150 (22.5G)	2002	0	0.2	891,401,254 (0.89G)
4	63074885ff3acbe0d63c	Cambodia	0.6	0	23,847,375,436 (23.8G)	2003	0	0	1,359,730,286 (1.4G)
5	63074885ff3acbe0d63c	Cambodia	0.7	0	25,709,399,080 (25.7G)	2004	0	0.1	1,862,023,644 (1.9G)
6	63074885ff3acbe0d63c	Cambodia	0.8	0	28,450,984,911 (28.5G)	2005	0	0.1	2,741,585,831 (2.7G)
7	63074885ff3acbe0d63c	Cambodia	0.9	0.1	30,787,632,700 (30.8G)	2006	0.1	0.1	2,336,647,789 (2.3G)
8	63074885ff3acbe0d63c	Cambodia	1.2	0.1	33,155,623,330 (33.2G)	2007	0	0.3	2,367,990,630 (2.4G)
9	63074885ff3acbe0d63c	Cambodia	1.2	0.1	34,556,531,284 (34.6G)	2008	0	0	1,400,907,954 (1.4G)
10	63074885ff3acbe0d63c	Cambodia	1	0.1	34,483,415,774 (34.5G)	2009	0	-0.2	-73,115,510

Figure 49: Selected output that showcases how much change in gdp correlates to how much fossil change and renewable change in noSQL in ASEAN countries

Code Base Compilation

SQL

Data Cleaning

```
## Creating a common cleaning method
SET SQL_SAFE_UPDATES = 0;
## Will be closing this at the end of the ENTIRE codebase

## Modifying table contents

## Altering Table For owid_energy_data
update owid_energy_data
set gdp = NULL
where gdp = "";
#To not affect calculations of the average GDP as well as GDP per capita below

update owid_energy_data
set oil_consumption = NULL
where oil_consumption = ""; #Updating of blank values to NULL
#To not affect calculations of average_oil_consumption below


## Altering Table For householdelectricityconsumption

alter table householdelectricityconsumption
modify column year int;
## modify column month int;
## Seems like the month column cannot be recoded as int because they have the "annual"
summary count.
## Should remove it from the Database
## Checking for string or text values now
select count(kwh_per_acc)
from householdelectricityconsumption
where NOT REGEXP_LIKE(kwh_per_acc, '^-?[0-9.]+$');
## There are 906 instances where there are non-numeric values
-- Okay try and count how many rows there are in total first
select count(kwh_per_acc)
from householdelectricityconsumption;
-- There is only a 1.15% of data which has the non numeric value. Could drop it
## Deleting the data given that it is only a 1.15% loss in data
delete from householdelectricityconsumption
where NOT REGEXP_LIKE(kwh_per_acc, '^-?[0-9.]+$');
## Altering Table for importsofenergyproduct
#Checking for NULL values
```

```
SELECT *
FROM importsofenergyproducts
WHERE value_ktoe IS NULL OR value_ktoe = "";
# No empty values found

## Altering Table for exportsofenergyproduct
SELECT *
FROM exportsofenergyproducts
WHERE value_ktoe IS NULL OR value_ktoe = "";
# No empty values found
```

Question 1

```
## Will be counting the countries by ISO_code
select count(distinct(iso_code))
from owid_energy_data
where length(iso_code) = 3;
## Checked and returned 217 countries

-- Checking individual countries
select distinct(iso_code)
from owid_energy_data
where length(iso_code) = 3;

## Checking for countries that are not in the list:
select distinct(iso_code), country
from owid_energy_data
where length(iso_code) !=3;

select distinct(country)
from owid_energy_data
where iso_code like "";

## Greenland is a country, just that the country itself has two records, one with ISO_code
and the other without ISO_code
## Kosovo was recognized as a country by Singapore on 1 Dec 2016

## If we count by ISO_Code, we will have a total of 217 countries with ISO_code =3 and 1
country that were excluded but recognized by Singapore
## Therefore total = 218 countries after adding kosovo;
```

Question 2

```
select min(year) from owid_energy_data
; -- min:1900
select max(year) from owid_energy_data
; -- max:2021
-- total number of years from 1900 to 2021 is 122
```

```
select country, count(country) as records from owid_energy_data
where country in
(select distinct(country) from owid_energy_data
where length(iso_code) = 3
or country like "Kosovo")                    #additional countries identified from q1 that were
omitted from using iso_code = 3
group by country
having count(country) = (select max(year) - min(year) + 1 from owid_energy_data)
        #difference between year 2021 and year 1900 is 2021-1900+1 = 122
;
```

Question 3

```
select country, year, fossil_share_energy
from owid_energy_data
where country = "Singapore" and cast(fossil_share_energy as float) < 100
order by year
limit 1;

select iso_code, country, year, fossil_share_energy, oil_share_energy, coal_share_energy,
gas_share_energy, low_carbon_share_energy, nuclear_share_energy,
renewables_share_energy, other_renewables_share_energy, biofuel_share_energy,
hydro_share_energy, solar_share_energy, wind_share_energy
from owid_energy_data
where country = "Singapore" and year in (1985,1986);
```

Question 4

```
SELECT country, (SUM(CAST(gdp AS FLOAT)) / COUNT(DISTINCT(year))) AS avgGdp
FROM owid_energy_data
WHERE year BETWEEN 2000 AND 2021
AND country IN ("Brunei", "Cambodia", "Indonesia", "Laos", "Malaysia", "Myanmar",
"Philippines", "Singapore", "Thailand", "Vietnam")
GROUP BY country
ORDER BY avgGdp DESC;
```

Question 5

```
UPDATE owid_energy_data
SET oil_consumption = NULL
WHERE oil_consumption = ""; #Updating of blank values to NULL
#To not affect calculations of average_oil_consumption below

#First Part: 3-year Moving Averages
SELECT country, year, AVG(oil_consumption+0.0) #oil_consumption is text column
OVER(
PARTITION BY country
```

```
ORDER BY year
ROWS BETWEEN 2 PRECEDING AND CURRENT ROW) AS average_oil_consumption
FROM owid_energy_data
WHERE country IN ("Brunei", "Cambodia", "Indonesia", "Laos", "Malaysia", "Myanmar",
"Philippines", "Singapore",
"Thailand", "Vietnam") AND (year BETWEEN 2002 AND 2021) #Do I start from 2002 or
2000? --> 2002 if using Partition
ORDER BY year, country;
#Brunei, Cambodia, Laos and Myanmar is 0 throughout --> Discuss how to clean during
meeting --> Make NULL
#Second Part: Identifying instances of negative changes and corresponding 3-year moving
averages in GDP
#Can compute country by country instead - Prof's Comment
SELECT *
FROM
(SELECT country, year, average_oil_consumption - LAG(average_oil_consumption,1)
OVER(
PARTITION BY country
ORDER BY year) AS change_in_moving_average, AVG(gdp+0.0)
OVER(
PARTITION BY country
ORDER BY year
ROWS BETWEEN 2 PRECEDING AND CURRENT ROW) AS average_gdp
FROM
(SELECT country, year, AVG(oil_consumption+0.0)
OVER(
PARTITION BY country
ORDER BY year
ROWS BETWEEN 2 PRECEDING AND CURRENT ROW) AS average_oil_consumption,
gdp
FROM owid_energy_data
WHERE country IN ("Brunei", "Cambodia", "Indonesia", "Laos", "Malaysia", "Myanmar",
"Philippines", "Singapore",
"Thailand", "Vietnam") AND (year BETWEEN 2002 AND 2021) #Do I start from 2002 or
2000? --> 2002 if using Partition
ORDER BY year, country) AS table1) AS table2
WHERE change_in_moving_average < 0;
```

Question 6

```
#Overall Average for importsofenergyproducts
SELECT energy_products, sub_products, AVG(value_ktoe+0.0) AS average_value
FROM importsofenergyproducts
GROUP BY sub_products, energy_products;

#Overall Average for exportsofenergyproducts
SELECT energy_products, sub_products, AVG(value_ktoe+0.0) AS average_value
FROM exportsofenergyproducts
```

```
GROUP BY sub_products, energy_products;
```

Question 7

```
SELECT x.year, x.energy_products, x.sub_products, CAST(x.value_ktoe AS FLOAT) -
CAST(m.value_ktoe AS FLOAT) AS yearlyDiff
FROM exportsofenergyproducts x
INNER JOIN importsofenergyproducts m
ON x.year = m.year
WHERE x.energy_products = m.energy_products
AND x.sub_products = m.sub_products;

SELECT x.year
FROM exportsofenergyproducts x
INNER JOIN importsofenergyproducts m
ON x.year = m.year
WHERE x.energy_products = m.energy_products
AND x.sub_products = m.sub_products
AND CAST(x.value_ktoe AS FLOAT) > CAST(m.value_ktoe AS FLOAT)
GROUP BY x.year
HAVING COUNT(x.year) > 4;
```

Question 8

```
select region, year, avg(cast(kwh_per_acc as float)) as yearly_avg_kwh
from householdelectricityconsumption
where dwelling_type = "Overall" and month = "Annual" and Region not in ("Overall") and
Description not like '%Region%' #use overall to avoid overlapping
group by Region, year
order by Region, year;
```

Question 9

```
select region, count(kwh_per_acc_MA) as count
from
(select year, region,
case when convert(year, signed int) = 2005 then 0 -- since 2005 is the first year, no 2 year
MA diff
else avg_kwh_per_acc - lag(avg_kwh_per_acc) over(order by region, convert(year, signed
int))
end as kwh_per_acc_MA
from
        (select year, region, avg(convert(kwh_per_acc, double)) avg_kwh_per_acc
        from householdelectricityconsumption
        where dwelling_type = "Overall"
        and month = "Annual"
        and region != "Overall"
        and description not like "%Region%"
        group by year, region
        order by year, region) as a) as b
```

```
where kwh_per_acc_MA < 0
group by region
order by -count
limit 3;
```

Question 10

```
select * from householdelectricityconsumption;

delete from householdelectricityconsumption
where month like "%annual%";

## Altering Table
alter table householdelectricityconsumption
modify column month int;

## Grouping by QuarterlyValue
SELECT year, region,
ROUND(AVG(CASE WHEN month IN ("1","2","3") THEN kwh_per_acc+0.0 END),4) AS Q1,
ROUND(AVG(CASE WHEN month IN ("4","5","6") THEN kwh_per_acc+0.0 END),4) AS Q2,
ROUND(AVG(CASE WHEN month IN ("7","8","9") THEN kwh_per_acc+0.0 END),4) AS Q3,
ROUND(AVG(CASE WHEN month IN ("10","11","12") THEN kwh_per_acc+0.0 END),4) AS
Q4
FROM householdelectricityconsumption
GROUP BY year, region
ORDER BY year, region;

#Checking for Quarterly Effects
SELECT
AVG(CASE WHEN month IN ("1","2","3") THEN kwh_per_acc+0.0 END) AS Q1,
AVG(CASE WHEN month IN ("4","5","6") THEN kwh_per_acc+0.0 END) AS Q2,
AVG(CASE WHEN month IN ("7","8","9") THEN kwh_per_acc+0.0 END) AS Q3,
AVG(CASE WHEN month IN ("10","11","12") THEN kwh_per_acc+0.0 END) AS Q4
FROM householdelectricityconsumption;
## Electrical consumption is on average highest during Q2 followed by Q3, followed by Q4
and lastly Q1
```

Question 11

```
SELECT year, sub_housing_type,
ROUND(AVG(CASE WHEN month IN ("1","2","3") THEN avg_mthly_hh_tg_consp_kwh+0.0
END),4) AS Q1,
ROUND(AVG(CASE WHEN month IN ("4","5","6") THEN avg_mthly_hh_tg_consp_kwh+0.0
END),4) AS Q2,
ROUND(AVG(CASE WHEN month IN ("7","8","9") THEN avg_mthly_hh_tg_consp_kwh+0.0
END),4) AS Q3,
```

```
ROUND(AVG(CASE WHEN month IN ("10","11","12") THEN
avg_mthly_hh_tg_consp_kwh+0.0 END),4) AS Q4
FROM householdtowngasconsumption
WHERE sub_housing_type != "Overall" AND month NOT LIKE "%Region%"
GROUP BY sub_housing_type, year
ORDER BY sub_housing_type, year;

#Checking for Quarterly Effects
SELECT
AVG(CASE WHEN month IN ("1","2","3") THEN avg_mthly_hh_tg_consp_kwh+0.0 END) AS
Q1,
AVG(CASE WHEN month IN ("4","5","6") THEN avg_mthly_hh_tg_consp_kwh+0.0 END) AS
Q2,
AVG(CASE WHEN month IN ("7","8","9") THEN avg_mthly_hh_tg_consp_kwh+0.0 END) AS
Q3,
AVG(CASE WHEN month IN ("10","11","12") THEN avg_mthly_hh_tg_consp_kwh+0.0 END)
AS Q4
FROM householdtowngasconsumption
WHERE sub_housing_type != "Overall";
#Not much difference generally, but can see that Q1, Q2, Q3 is slightly higher, while Q4 is
slightly lower
```

Question 12

```
#Exploring Current Data Sets
SELECT *
FROM owid_energy_data;
#Noteworthy Columns: gdp, population, energy_per_gdp, energy_per_capita + Different
types of energy consumption

#Finding Comparable References to Singapore
SELECT country, year, gdp, population
FROM (
	SELECT country, year, gdp, population
	FROM owid_energy_data
	WHERE (population BETWEEN ((
		SELECT population
		FROM owid_energy_data
		WHERE country = "Singapore" AND (year = 2018)) - 1000000.0) AND ((
		SELECT population
		FROM owid_energy_data
		WHERE country = "Singapore" AND (year = 2018)) + 1000000.0)) AND
	gdp BETWEEN ((
		SELECT gdp
		FROM owid_energy_data
		WHERE country = "Singapore" AND (year = 2018)) - 300000000000.0) AND
((
		SELECT gdp
```

```
                FROM owid_energy_data
                WHERE country = "Singapore" AND (year = 2018)) + 300000000000.0)) AS
table2
WHERE year BETWEEN 2000 AND 2018
ORDER by country, year;
#For multiple years: Subquery returns more than 1 row, is there any way to do this to obtain
countries?
#Cannot do that, need to set 1 year's value as baseline for comparison --> 2018
#Based on this, nearest reference for gdp + population is Denmark and Finland
#Reasoning: Only 2 countries to have all 19 years in range

#Extracting GDP per capita for Singapore, Denmark and Finland
SELECT country, year, (gdp+0.0/population+0.0) AS gdp_per_capita
FROM owid_energy_data
WHERE country IN ("Singapore", "Denmark", "Finland") AND year BETWEEN 2000 AND
2018
ORDER BY country, year;
#Analysis 1: Singapore started lower than Denmark and Finland in 2000, but overtook
Denmark in 2007, Finland in 2003
#Analysis 2: All 3 show increasing trend, but SG has the highest magnitude of change
(Nearly tripled)

#Extracting energy per capita for Singapore, Denmark and Finland
SELECT country, year, energy_per_capita
FROM owid_energy_data
WHERE country IN ("Singapore", "Denmark", "Finland") AND year BETWEEN 2000 AND
2018
ORDER BY country, year;
#Analysis 1: Singapore increasing trend, while Denmark and Finland decreasing trend
#Analysis 2: Denmark has higher magnitude of decrease

#Comparing energy per gdp for Singapore, Denmark and Finland
SELECT country, year, energy_per_gdp
FROM owid_energy_data
WHERE country IN ("Singapore", "Denmark", "Finland") AND year BETWEEN 2000 AND
2018
ORDER BY country, year;
#Analysis 1: All 3 experience decreasing trend
#Analysis 2: Denmark highest magnitude of decrease, Singapore lowest magnitude of
decrease

#Comparing just total energy consumption for Singapore, Denmark and Finland
SELECT country, year,
((biofuel_consumption+0.0)+(coal_consumption+0.0)+(fossil_fuel_consumption+0.0)+(gas_c
onsumption+0.0)
+(hydro_consumption+0.0)+(low_carbon_consumption+0.0)+(nuclear_consumption+0.0)+(oi
l_consumption+0.0)
```

```
+(other_renewable_consumption+0.0)+(primary_energy_consumption+0.0)+(renewables_co
nsumption+0.0)+(solar_consumption+0.0)
+(wind_consumption+0.0))
AS total_energy_consumption
FROM owid_energy_data
WHERE country IN ("Singapore", "Denmark", "Finland") AND year BETWEEN 2000 AND
2018
ORDER BY country, year;
#Analysis: Singapore increased drastically (More than double), Denmark and Finland
decreased slightly
```

Question 13

```
-- Big level overview
select *
from owid_energy_data
order by country;

-- Seems like the data is quite unreliable in the sense that some countries flat out don't
provide any data for all years

-- Forcing it to show only columns where not null
select distinct(country), year, biofuel_consumption, coal_consumption,
fossil_fuel_consumption,
gas_consumption, hydro_consumption, low_carbon_consumption,
nuclear_consumption, oil_consumption, other_renewable_consumption,
primary_energy_consumption, renewables_consumption, solar_consumption,
wind_consumption
from owid_energy_data
where biofuel_consumption not like ""
and coal_consumption not like ""
and fossil_fuel_consumption not like ""
and gas_consumption not like ""
and hydro_consumption not like ""
and low_carbon_consumption not like ""
and nuclear_consumption not like ""
and oil_consumption not like ""
and other_renewable_consumption not like ""
and primary_energy_consumption not like ""
and renewables_consumption not like ""
and solar_consumption not like ""
and wind_consumption not like ""
and year >= 2000
order by country;

-- Important to note that the blank values are actually an empty string.
```

```
-- Now that we can view all the consumption throughout, the next step is to create a column
with all the values summed together
-- to see the yearly values required for each "country".
-- How much each country requires a year
select distinct(country), year,
round(biofuel_consumption+coal_consumption+fossil_fuel_consumption+
gas_consumption+hydro_consumption+low_carbon_consumption+
nuclear_consumption+oil_consumption+other_renewable_consumption+
primary_energy_consumption+renewables_consumption+solar_consumption+wind_consum
ption) as total_consumption
from owid_energy_data
where biofuel_consumption not like ""
and coal_consumption not like ""
and fossil_fuel_consumption not like ""
and gas_consumption not like ""
and hydro_consumption not like ""
and low_carbon_consumption not like ""
and nuclear_consumption not like ""
and oil_consumption not like ""
and other_renewable_consumption not like ""
and primary_energy_consumption not like ""
and renewables_consumption not like ""
and solar_consumption not like ""
and wind_consumption not like ""
and year >= 2000
order by country;

-- Similarly looking at the numbers of electricity generated as a total
select distinct(country), year, biofuel_electricity+coal_electricity+electricity_generation+
fossil_electricity+gas_electricity+hydro_electricity+low_carbon_electricity+nuclear_electricity
+
oil_electricity+other_renewable_electricity+other_renewable_exc_biofuel_electricity+
renewables_electricity+solar_electricity+ wind_electricity as total_generated
from owid_energy_data
where biofuel_electricity not like ""
and coal_electricity not like ""
and fossil_electricity not like ""
and electricity_generation not like ""
and gas_electricity not like ""
and hydro_electricity not like ""
and low_carbon_electricity not like ""
and nuclear_electricity not like ""
and oil_electricity not like ""
and other_renewable_electricity not like ""
and other_renewable_exc_biofuel_electricity not like ""
and renewables_electricity not like ""
and solar_electricity not like ""
```

```
and wind_electricity not like ""
and year >= 2000
order by country;

-- Looking at other high level metrics of energy share
select country, year, gdp, population, biofuel_share_energy, coal_share_energy,
fossil_share_energy
, gas_share_energy, hydro_share_energy, low_carbon_share_energy,
nuclear_share_energy,oil_share_energy,
other_renewables_share_energy, renewables_share_energy, solar_share_energy,
wind_share_energy
from owid_energy_data
where year not like ""
and gdp not like ""
and population not like ""
and biofuel_share_energy not like ""
and coal_share_energy not like ""
and fossil_share_energy not like ""
and gas_share_energy not like ""
and hydro_share_energy not like ""
and low_carbon_share_energy not like ""
and nuclear_share_energy not like ""
and oil_share_energy not like ""
and other_renewables_share_energy not like ""
and renewables_share_energy not like ""
and solar_share_energy not like ""
and wind_share_energy not like ""
and year >= 2000
order by country;


## Looking at ASEAN nations
select country, year, gdp, population, biofuel_share_energy, coal_share_energy,
fossil_share_energy
, gas_share_energy, hydro_share_energy, low_carbon_share_energy,
nuclear_share_energy,oil_share_energy,
other_renewables_share_energy, renewables_share_energy, solar_share_energy,
wind_share_energy
from owid_energy_data
where country in ("Singapore", "Malaysia", "Brunei",
"Cambodia","Indonesia","Laos","Myanmar","Philippines","Thailand","Vietnam")
and gdp not like "";

-- Global Economy Trend
-- Looking at big countries that affect global shifts in renewable energy perspectives
-- AKA( USA, China, Russia, India )
select country, fossil_electricity, renewables_electricity, gdp, year,
```

```
(fossil_electricity+0.0 - lag(fossil_electricity+0.0,1) over(partition by country order by year))
as fossil_change,
(renewables_electricity+0.0 - lag(renewables_electricity+0.0,1) over(partition by country
order by year)) as renewable_change,
(gdp+0.0 - lag(gdp+0.0,1) over(partition by country order by year)) as gdp_change
from owid_energy_data
where country in ("United States", "China", "Japan", "Germany")
and renewables_electricity not like ""
and fossil_electricity not like ""
and gdp not like ""
and year >= 2000
order by country, year;

-- ASEAN Economic Trend
select country, fossil_electricity, renewables_electricity, gdp, year,
(fossil_electricity+0.0 - lag(fossil_electricity+0.0,1) over(partition by country order by year))
as fossil_change,
(renewables_electricity+0.0 - lag(renewables_electricity+0.0,1) over(partition by country
order by year)) as renewable_change,
(gdp+0.0 - lag(gdp+0.0,1) over(partition by country order by year)) as gdp_change
from owid_energy_data
where country in ("Singapore", "Malaysia", "Brunei",
"Cambodia","Indonesia","Laos","Myanmar","Philippines","Thailand","Vietnam")
and renewables_electricity not like ""
and fossil_electricity not like ""
and gdp not like ""
and year >= 2000
order by fossil_change asc, country, year;
```

Question 14

```
# table showing the transition away from fossil fuel to renewable energy more specifically
solar energy
select country, year, fossil_share_energy, solar_share_energy, nuclear_electricity
from owid_energy_data
where country = "Singapore" and year in (1985,1986, 2020);

(select year, "Quarter 1" as month, avg(kwh_per_acc) as QuarterlyValue, region
        from householdelectricityconsumption
   where month in("1","2","3")
   group by year,region)
union
(select year, "Quarter 2" as month, avg(kwh_per_acc) as QuarterlyValue, region
        from householdelectricityconsumption
   where month in("4","5","6")
   group by year,region)
union
(select year, "Quarter 3" as month, avg(kwh_per_acc) as QuarterlyValue, region
```

```
        from householdelectricityconsumption
    where month in("7","8","9")
    group by year, region)
union
(select year, "Quarter 4" as month, avg(kwh_per_acc) as QuarterlyValue, region
        from householdelectricityconsumption
    where month in("10","11","12")
    group by year,region)
order by year asc;

#Grouping by QuarterlyValue
# Table to show quarterly consumption
(select year, "Quarter 1" as month, round(avg(kwh_per_acc),3) as QuarterlyValue, region
        from householdelectricityconsumption
    where month in("1","2","3")
    group by year,region)
union
(select year, "Quarter 2" as month, round(avg(kwh_per_acc),3) as QuarterlyValue, region
        from householdelectricityconsumption
    where month in("4","5","6")
    group by year,region)
union
(select year, "Quarter 3" as month, round(avg(kwh_per_acc),3) as QuarterlyValue, region
        from householdelectricityconsumption
    where month in("7","8","9")
    group by year, region)
union
(select year, "Quarter 4" as month, round(avg(kwh_per_acc),3) as QuarterlyValue, region
        from householdelectricityconsumption
    where month in("10","11","12")
    group by year,region)
order by QuarterlyValue;
```

Question 15

```
-- 1. globalTempChange
CREATE TABLE globalTempChange
AS SELECT 'World' AS area, year, AVG(avgValueChange) AS Average_Value
FROM
    (SELECT area, year, AVG(value) AS avgValueChange
    FROM sustainability2022.temperaturechangebycountry
    GROUP BY area , year
    ORDER BY area , year) AS World_average
GROUP BY year;

-- 2. globalTempChange_GHGemissions
CREATE TABLE globalTempChange_GHGemissions
```

```
AS SELECT area, globalTempChange.year, Average_Value AS tempChange,
greenhouse_gas_emissions, (greenhouse_gas_emissions/population) AS
emissions_per_capita
FROM globalTempChange, owid_energy_data
WHERE country = "World"
AND globalTempChange.year = owid_energy_data.year
AND greenhouse_gas_emissions IS NOT NULL;

SET SQL_SAFE_UPDATES = 0;

UPDATE owid_energy_data
SET population = NULL
WHERE population = "";

-- 3. gdp_emissions_cap
CREATE TABLE gdp_emissions_cap
AS SELECT iso_code, country, year, gdp, population, (gdp/population) AS
gdp_per_capita,greenhouse_gas_emissions, (greenhouse_gas_emissions/population) AS
emissions_per_capita
FROM owid_energy_data
WHERE greenhouse_gas_emissions IS NOT NULL
AND (LENGTH(iso_code) = 3 OR country = "World")
OR country LIKE "Greenland"
OR country LIKE "Kosovo";

-- 4. energy
CREATE TABLE energy
AS SELECT iso_code, country, year, gdp, population, (gdp/population) AS
gdp_per_capita,greenhouse_gas_emissions, (greenhouse_gas_emissions/population) AS
emissions_per_capita, energy_cons_change_pct, energy_per_capita,
fossil_fuel_consumption, fossil_energy_per_capita, renewables_consumption,
renewables_energy_per_capita, nuclear_consumption, nuclear_energy_per_capita
FROM owid_energy_data
WHERE greenhouse_gas_emissions IS NOT NULL
AND (LENGTH(iso_code) = 3 OR country = "World")
OR country LIKE "Greenland"
OR country LIKE "Kosovo";


## Closing safe update
SET SQL_SAFE_UPDATES = 1;
```

noSQL

Question 1

```
db.owid_energy_data.aggregate([
   {$group : {_id: "$iso_code"}},
   {$count : "Amount of countries in Owid_Energy_data"}])
// This shows that there is a total of 223 countries in the second collection

// Need to only show those with an ISO code = 3
db.owid_energy_data.aggregate([
   {$project:
      {iso_check:
         {$substr: ["$iso_code", 0, 4]}}}, // Project iso_codes and extract from string iso_code
from 1st char to 3rd char
   {$match:{
      "$and":
         [{"iso_check": {$ne: ""}},
         {"iso_check": {$ne: "OWID"}}]
   }}, // Removing iso_codes that are empty and displaying country code that are OWID
   {$group:
      {_id: "$iso_check"}}
   ]).count()
// This shows us that there are 217 countries with isocode = 3

// Will do a check to see countries and ISO_code that
// is not inside the query above

// Check for countries that do not have iso_code =3
db.owid_energy_data.aggregate([
   {$project:
      {_id:0, country:1, iso_code:1}},
   {$match:
      {"iso_code": {$eq:""}}},
   {$group:
      {_id:{groupByCountry: "$country"}}}
   ])

// Add  in country Kosovo
// Total country : 217 + 1:Kosovo
```

Question 2

```
db.owid.aggregate([         // find minimum year and maximum year
   {$group:{_id: {}, minyear: {$min: "$year"}, maxyear: {$max: "$year"}}}
   ])                  // to display the min and max year
```

```
db.owid.aggregate([         // find countries with 122 years of record
   {$project: {iso_code: {$substr: ["$iso_code", 0, 3]}, year: {$toInt: "$year"}}},
   {$group: {_id: "$iso_code", yearscount: {$sum: 1}}},
   {$match:{"$or": [{
      "$and":[{"country": "Kosovo"}]}, // to consider "Kosovo" which was left out using
iso_code as a filter
      {"$and":[{_id: {$ne: ""}}, {_id: {$ne: "OWID"}}, {yearscount: 122}]}]}},
   ])
```

Question 3

```
db.owid_energy_data.aggregate([
   {$project: {_id: 0, "country": 1, "year": 1, "fossil_share_energy": {$convert: { input:
"$fossil_share_energy", to: "double"}}}},
   {$match: {"country": "Singapore"}},
   {$match: {"fossil_share_energy": {$lt: 100}}},
   {$sort: {"year":1}},
   {$limit: 1},
   ])

db.owid_energy_data.aggregate([
   {$match: {"country": "Singapore"}},
   {$match: {"year": "1986"}},
   {$project: {iso_code: 1, country: 1, year: 1, fossil_share_energy: 1, oil_share_energy: 1,
coal_share_energy: 1, gas_share_energy: 1, low_carbon_share_energy: 1,
nuclear_share_energy: 1, renewables_share_energy: 1, other_renewables_share_energy:
1, biofuel_share_energy: 1, hydro_share_energy: 1, solar_share_energy: 1,
wind_share_energy: 1}}
   ])
```

Question 4

```
db.owid_energy_data.aggregate([
 {
    $project: {
       'gdp': {$convert: { input: "$gdp", to: 1, onError: null, onNull: null}},
       'country': 1,
       'year': {$toInt: '$year'}
    }
 },
 {
    $match: {
       'country': {
          $in: [
             "Brunei",
             "Cambodia",
             "Indonesia",
```

```
            "Laos",
            "Malaysia",
            "Myanmar",
            "Philippines",
            "Singapore",
            "Thailand",
            "Vietnam"
        ]
      },
      'gdp': {$ne: null},
      'year': {$gte: 2000, $lte: 2021},
   }
},
{
   $group: {
      _id: '$country',
      avgGdp: {$avg: '$gdp'}
   }
},
{
   $sort: {
      avgGdp: -1
   }
}
])
```

Question 5

```
db.owid_energy_data.aggregate( [
   //Data conversions and keeping relevant fields + Cleaning of NULL values
   {$project: {country: 1, year: {$toInt: "$year"},
            oil_consumption: {$convert:{input: "$oil_consumption", to: 1, onError: null, onNull:
null}},
            gdp:{$convert:{input: "$gdp", to: 1, onError: null, onNull: null}}}}, //1 for double
  //ASEAN countries from 2000 to 2021 --> Start from 2002 because of window frame set
below
   {$match: {country: {$in: ["Brunei", "Cambodia", "Indonesia", "Laos", "Malaysia",
"Myanmar", "Philippines", "Singapore",
   "Thailand", "Vietnam"]}, year: {$gte: 2002, $lte: 2021}}},
   //Create new fields of oil & gdp 3-year moving average
   {$setWindowFields: {partitionBy: "$country" ,
                  sortBy: {year:1},
                  output: {oil_moving_avg: {$avg: "$oil_consumption", window: {documents:
[-2, 0]}} ,
                           gdp_moving_avg: {$avg: "$gdp", window: {documents: [-2, 0]}}}}},
   //Create new fields of previous year's 3-year moving averages for oil and gdp
   {$setWindowFields: {partitionBy: "$country",
```

```
                    sortBy: {year:1},
                    output: {pre_oil_moving_avg: {$avg: "$oil_moving_avg", window:
{documents: [-1, -1]}} ,
                                pre_gdp_moving_avg: {$avg: "$gdp_moving_avg", window:
{documents: [-1, -1]}}}}},
  //Create new field of moving_avg_diff for oil & gdp
  {$addFields: {moving_avg_oil_diff: {$subtract: ["$oil_moving_avg",
"$pre_oil_moving_avg"]},
            moving_avg_gdp_diff: {$subtract: ["$gdp_moving_avg",
"$pre_gdp_moving_avg"]}}},
  //Only show years where moving oil average difference < 0
  {$match: {moving_avg_oil_diff: {$lt: 0}}},
  {$sort: {"country":1,"year":1}
] )
```

Question 6

```
db.importsofenergyproducts.aggregate([
   {$project: {sub_products: 1, value_ktoe: {$convert: {input: "$value_ktoe", to: 1, onError:
null, onNull: null}}}},
   {$group: {_id: "$sub_products", avg_value_ktoe: {$avg: "$value_ktoe"}}}
   ])

db.exportsofenergyproducts.aggregate([
   {$project: {sub_products: 1, value_ktoe: {$convert: {input: "$value_ktoe", to: 1, onError:
null, onNull: null}}}},
   {$group: {_id: "$sub_products", avg_value_ktoe: {$avg: "$value_ktoe"}}}
   ])
```

Question 7

```
db.importsofenergyproducts.aggregate([
 {
    $group: {
       "_id": {
          year: '$year',
          energy_products: '$energy_products',
          sub_products: '$sub_products',
       },
       count: {$count: {}}
    }
 },
 {
    $sort: {'count': -1}
 }
])
```

Yearly Difference

```
db.importsofenergyproducts.aggregate([
 {
    $lookup:
       {
          from: "exportsofenergyproducts",
          let: {
             energy_products: "$energy_products",
             sub_products: "$sub_products",
             year: "$year",
          },
          pipeline: [
             {
                $match: {
                   $expr: {
                      $and: [
                         {$eq: ["$energy_products", "$$energy_products"]},
                         {$eq: ["$sub_products", "$$sub_products"]},
                         {$eq: ["$year", "$$year"]},
                      ]
                   }
                }
             },
             {
                $project: {
                   energy_products: 1, sub_products: 1, year: 1, value_ktoe: {$toDouble:
"$value_ktoe"}, _id: 0
                }
             }
          ],
          as: "exportsdata"
       }
 },
 {
    $project: {
       energy_products: 1,
       sub_products: 1,
       import_ktoe: {$toDouble: "$value_ktoe"},
       export_ktoe: {$first: "$exportsdata.value_ktoe"},
       year: 1
    }
 },
 {
    $addFields: {
       export_sub_import: {$subtract: ['$export_ktoe', '$import_ktoe']},
    }
 },
```

])

Question 8

```
db.householdelectricityconsumption.aggregate([

    {$match: {"dwelling_type": "Overall"}},

    {$match: {"month": "Annual"}},

    {$match: {"Region": {$not : /Overall/}}},

    {$match: {"Description": {$not: /.*Region.*/}}},

    {$match: {"kwh_per_acc": {$ne: "s\r"}}},

    {$project: {year: {$toInt: "$year"}, Region: 1, kwh_per_acc: {$convert: {input: {$substr:
["$kwh_per_acc", 0, {$subtract: [{$strLenCP: "$kwh_per_acc"}, 1]}]}, to: 1, onError: null,
onNull: null}}}},

    {$group: {_id: {year: "$year", region: "$Region"}, avg_kwh: {$avg: "$kwh_per_acc"}}},

    {$sort: {"_id.region": 1, "_id.year": 1}}

    ])
```

Question 9

```
db.householdelectricityconsumption.aggregate([

    {$match: {"dwelling_type": "Overall"}},

    {$match: {"month": "Annual"}},

    {$match: {"Region": {$not : /Overall/}}},

    {$match: {"Description": {$not: /.*Region.*/}}},

    {$project: {year: {$toInt: "$year"}, Region: 1, kwh_per_acc: {$convert: {input: {$substr:
["$kwh_per_acc", 0, {$subtract: [{$strLenCP: "$kwh_per_acc"}, 1]}]}, to: 1, onError: null,
onNull: null}}}},

    {$group: {_id: {year: "$year", region: "$Region"}, avg_kwh: {$avg: "$kwh_per_acc"}}},

    {$setWindowFields: { partitionBy: "$_id.region",

                        sortBy: { "_id.year":1},
```

```
                output: { prev_year_avg_kwh: {$avg: "$avg_kwh", window: { documents: [-1, -1] } } } } },

   {$addFields: {mvg_diff: {$cond: {if: {$gte: [{$subtract: ["$avg_kwh", "$prev_year_avg_kwh"]}, 0]}, then: 0, else: 1}}}},

   {$match: {"_id.year":{$ne: 2005}}},

   {$group: {_id: "$_id.region", count: {$sum: "$mvg_diff"}}},

   {$sort: {count: -1}}

   ]).limit(3)


// Output: E8, W8 , N7, C6, NE6
```

Question 10

```
db.household_electricity_consumption.aggregate([

   {$match:

      {"$and":

      [{Region: {$ne:"Overall"}}, {month:{$ne: "Annual"}}, // This essentially removes documents where Region is Overall and Month is recorded as annual

      {kwh_per_acc: {$ne: "s\r"}}]}},//This line removes all instances where there is a "s" value

   {$project:

      {year: {$toInt: "$year"}, month: {$toInt: "$month"},

      Region: 1, kwh_per_acc: {$convert: {input :{$substr: ["$kwh_per_acc", 0, {$subtract: [{$strLenCP: "$kwh_per_acc"},1]}]}, to: 1, onError: null, onNull:null}}}},

   {$addFields: {quarter: { $switch: { branches: [ {case: {$lte: ["$month", 3]}, then: 1},

                                                   {case: {$lte: ["month",6]}, then: 2},

                                                   {case: {$lte:["month",9]}, then: 3},

                                                   {case: {$lte: ["$month", 12]}, then: 4},],

                                                   default: 4 }}}},
```

```
        {$group: {_id: {year: "$year", region : "$Region", quarter: "quarter"}, avg_kwh: {$avg:
"$kwh_per_acc"}}},

        {$sort: {"_id.region":1, "_id.year": 1,  "id_quarter":1}}

        ])
```

Question 11

```
db.householdtowngasconsumption.aggregate([

   {$match: {sub_housing_type: {$ne: "Overall"}}},

   {$project:{year: {$toInt: "$year"},month:{$convert:{input:"$month", to:16, onError:null,
onNull:null}}, //16 for integer

   sub_housing_type:"$sub_housing_type",

   avg_mthly_hh_tg_consp_kwh: {$convert: {input: {$trim:{input:
"$avg_mthly_hh_tg_consp_kwh"}}, to: 1, onError: null, onNull: null}}}},

   {$addFields:{quarter: {$switch: {branches:[{case:{$gte:["$month",10]}, then:4},

                                        {case:{$gte:["$month",7]}, then:3},

                                        {case:{$gte:["$month",4]}, then:2},

                                        {case:{$gte:["$month",1]}, then:1}],

                                        default:0}}}},

   {$group:{_id:{year: "$year",quarter:
"$quarter",sub_housing_type:"$sub_housing_type"},quarter_avg:{$avg:
"$avg_mthly_hh_tg_consp_kwh"}}},

   {$match:{"_id.quarter":{$ne: 0}}},

   {$sort:{"_id.sub_housing_type": 1, "_id.year": 1, "_id.quarter": 1}}

   ])
```

Question 12

```
//Exploring Current Data Sets

db.owid_energy_data.find()
```

```
//Noteworthy Attributes: gdp, population, energy_per_gdp, energy_per_capita + Different types of energy consumption


//Finding Comparable References to Singapore

//Creating new collection, population_range, for desired population range

db.owid_energy_data.aggregate([
    {$project: {country: 1, year:{$toInt: "$year"},
                population: {$convert:{input: "$population", to: 1, onError: null, onNull: null}}}},
    {$match:{$and:[{country:"Singapore"},{year:2018}]}},
    {$addFields:{
        population_lower_limit:{$add:["$population",-1000000]},
        population_upper_limit:{$add:["$population",1000000]}
    }},
    {$out:{db:"group_project",coll:"population_range"}}
    ])


//Checking that population_range was created correctly

db.population_range.find()


//Creating new collection, gdp_range, for desired gdp range

db.owid_energy_data.aggregate([
    {$project: {country: 1, year:{$toInt: "$year"},
                gdp: {$convert:{input: "$gdp", to: 1, onError: null, onNull: null}}}},
    {$match:{$and:[{country:"Singapore"},{year:2018}]}},
    {$addFields:{
        gdp_lower_limit:{$add:["$gdp",-300000000000]},
```

```
    gdp_upper_limit:{$add:["$gdp",300000000000]}
  }},
  {$out:{db:"group_project",coll:"gdp_range"}}
  ])

//Checking that gdp_range was created correctly
db.gdp_range.find()

//Creating a collection of countries within population_range, called
countries_in_population_range
db.owid_energy_data.aggregate([
  {$project: {country: 1, year:{$toInt: "$year"},
        population: {$convert:{input: "$population", to: 1, onError: null, onNull: null}}}},
  {$lookup:{
    from:"population_range",
    let:{target_population:"$population"},
    pipeline:[
      {
        $match:{
          $expr:{$and:[
            {$gte:["$$target_population","$population_lower_limit"]},
            {$lte:["$$target_population","$population_upper_limit"]}
            ]
        }
      }
      },
```

```
        {$project:{country:1,year:1,population:1}}
        ],
      as:"population_result"}},
  {$match:{$and:[{year:{$gte:2000}},{year:{$lte:2018}},{"population_result":{$size:1}}]}},
  {$out:{db:"group_project",coll:"countries_in_population_range"}
  ])

//Creating a collection of countries within gdp_range, called countries_in_gdp_range
db.owid_energy_data.aggregate([
  {$project: {country: 1, year:{$toInt: "$year"},
          gdp: {$convert:{input: "$gdp", to: 1, onError: null, onNull: null}}}},
  {$lookup:{
      from:"gdp_range",
      let:{target_gdp:"$gdp"},
      pipeline:[
        {
          $match:{
            $expr:{$and:[
              {$gte:["$$target_gdp","$gdp_lower_limit"]},
              {$lte:["$$target_gdp","$gdp_upper_limit"]}
              ]
          }
        }
        },
        {$project:{country:1,year:1,gdp:1}}],
      as:"gdp_result"}},
```

```
    {$match:{$and:[{year:{$gte:2000}},{year:{$lte:2018}},{"gdp_result":{$size:1}}]}},
    {$out:{db:"group_project",coll:"countries_in_gdp_range"}
    ])

//Joining countries_in_population_range and countries_in_gdp_range
db.countries_in_population_range.aggregate([
    {$project:{country:1, year:{$toInt: "$year"}, population:1}},
    {$lookup:{
        from:"countries_in_gdp_range",
        let:{country_match:"$country",year_match:"$year"}
        pipeline:[
            {
                $match:{
                    $expr:{$and:[
                        {$eq:["$$country_match","$country"]},
                        {$eq:["$$year_match","$year"]}
                        ]}
                }
            }],
        as:"matching_result"
    }},
    {$match:{"matching_result":{$size:1}}}
    ])

/*
Based on this output, nearest reference for gdp + population is Denmark and Finland
```

Reasoning: Only 2 countries to have all 19 years in range

*/

//Extracting GDP per capita for Singapore, Denmark and Finland

```
db.owid_energy_data.aggregate([
   {$project:{country:1, year:{$toInt: "$year"},
   population: {$convert:{input: "$population", to: 1, onError: null, onNull: null}},
   gdp: {$convert:{input: "$gdp", to: 1, onError: null, onNull: null}}}},
   {$match:{$and:[
      {year:{$gte:2000, $lte:2018}},
      {country:{$in:["Singapore", "Denmark", "Finland"]}}
      ]}},
   {$addFields:{
      gdp_per_capita:{$divide:["$gdp","$population"]}
   }}
   ])
```

/*

Analysis 1: Singapore started lower than Denmark and Finland in 2000, but overtook Denmark in 2007, Finland in 2003

Analysis 2: All 3 show increasing trend, but SG has the highest magnitude of change (Nearly tripled)

*/

//Extracting energy per capita for Singapore, Denmark and Finland

```
db.owid_energy_data.aggregate([
   {$project:{country:1, year:{$toInt: "$year"},
```

```
    energy_per_capita: {$convert:{input: "$energy_per_capita", to: 1, onError: null, onNull:
null}}}},
    {$match:{$and:[
        {year:{$gte:2000, $lte:2018}},
        {country:{$in:["Singapore", "Denmark", "Finland"]}}
        ]}}
    ])
/*
Analysis 1: Singapore increasing trend, while Denmark and Finland decreasing trend
Analysis 2: Denmark has higher magnitude of decrease
*/

//Comparing energy per gdp for Singapore, Denmark and Finland
db.owid_energy_data.aggregate([
    {$project:{country:1, year:{$toInt: "$year"},
    energy_per_gdp: {$convert:{input: "$energy_per_gdp", to: 1, onError: null, onNull: null}}}},
    {$match:{$and:[
        {year:{$gte:2000, $lte:2018}},
        {country:{$in:["Singapore", "Denmark", "Finland"]}}
        ]}}
    ])
/*
Analysis 1: All 3 experience decreasing trend
Analysis 2: Denmark highest magnitude of decrease, Singapore lowest magnitude of
decrease
*/
```

```
//Comparing just total energy consumption for Singapore, Denmark and Finland

db.owid_energy_data.aggregate([

   {$project:{country:1, year:{$toInt: "$year"},

   biofuel_consumption: {$convert: {input: "$biofuel_consumption", to: 1, onError: 0, onNull:
0}},

   coal_consumption: {$convert: {input: "$coal_consumption", to: 1, onError: 0, onNull: 0}},

   fossil_fuel_consumption: {$convert: {input: "$fossil_fuel_consumption", to: 1, onError: 0,
onNull: 0}},

   gas_consumption: {$convert: {input: "$gas_consumption", to: 1, onError: 0, onNull: 0}},

   hydro_consumption: {$convert: {input: "$hydro_consumption", to: 1, onError: 0, onNull:
0}},

   low_carbon_consumption: {$convert: {input: "$low_carbon_consumption", to: 1, onError:
0, onNull: 0}},

   nuclear_consumption: {$convert: {input: "$nuclear_consumption", to: 1, onError: 0, onNull:
0}},

   oil_consumption: {$convert: {input: "$oil_consumption", to: 1, onError: "0", onNull: 0}},

   other_renewable_consumption: {$convert: {input: "$other_renewable_consumption", to: 1,
onError: 0, onNull: 0}},

   primary_energy_consumption: {$convert: {input: "$primary_energy_consumption", to: 1,
onError: 0, onNull: 0}},

   renewables_consumption: {$convert: {input: "$renewables_consumption", to: 1, onError:
0, onNull: 0}},

   solar_consumption: {$convert: {input: "$solar_consumption", to: 1, onError: 0, onNull: 0}},

   wind_consumption: {$convert: {input: "$wind_consumption", to: 1, onError: 0, onNull: 0}}}},

   {$match:{$and:[

      {year:{$gte:2000, $lte:2018}},

      {country:{$in:["Singapore", "Denmark", "Finland"]}}

      ]}},

   {$addFields:{
```

```
total_energy_consumption:{$add:["$biofuel_consumption","$coal_consumption","$fossil_fuel
_consumption","$gas_consumption",


"$hydro_consumption","$low_carbon_consumption","$nuclear_consumption","$oil_consumpt
ion","$other_renewable_consumption",


"$primary_energy_consumption","$renewables_consumption","$solar_consumption","$wind
_consumption"]}

    }}

    ])

/*

Analysis: Singapore increased drastically (More than double), Denmark and Finland
decreased slightly

*/
```

Question 13

```
db.owid_energy_data.find()


// First step is to only show the documents where there are no blank values

db.owid_energy_data.aggregate([

    {$match:

        {"$and":

            [{biofuel_consumption: {$ne: ""}}, {coal_consumption: {$ne: ""}},
{fossil_fuel_consumption: {$ne: ""}}, {gas_consumption: {$ne: ""}},

            {hydro_consumption: {$ne: ""}}, {low_carbon_consumption: {$ne: ""}},
{nuclear_consumption: {$ne: ""}}, {oil_consumption: {$ne: ""}},

            {other_renewable_consumption:{$ne: ""}}, {primary_energy_consumption:{$ne: ""}},
{renewables_consumption: {$ne: ""}},

            {solar_consumption: {$ne: ""}}, {wind_consumption:{$ne: ""}}
```

```
        ]}

    },

    {$project:

        {_id:0,

        country:1, year:1,
biofuel_consumption:1,coal_consumption:1,fossil_fuel_consumption:1,gas_consumption:1,

        hydro_consumption:1,low_carbon_consumption:1,nuclear_consumption:1,
oil_consumption:1,other_renewable_consumption:1,

        primary_energy_consumption:1,renewables_consumption:1,solar_consumption:1,
wind_consumption:1, total_consumption:1

        }},

    {$sort:

        {country:1}}}

        ])



// Next step is to sum up all the consumption based on the country and the year

// How much each country requires / Year



db.owid_energy_data.aggregate([

    {$match:

        {"$and":

            [{biofuel_consumption: {$ne: ""}}, {coal_consumption: {$ne: ""}},
{fossil_fuel_consumption: {$ne: ""}}, {gas_consumption: {$ne: ""}},

            {hydro_consumption: {$ne: ""}}, {low_carbon_consumption: {$ne: ""}},
{nuclear_consumption: {$ne: ""}}, {oil_consumption: {$ne: ""}},

            {other_renewable_consumption:{$ne: ""}}, {primary_energy_consumption:{$ne: ""}},
{renewables_consumption: {$ne: ""}},

            {solar_consumption: {$ne: ""}}, {wind_consumption:{$ne: ""}},
```

```
        {year: {$gte: "2000"}}

        ]}

    },

    {$project:

        {country:1, year:1

        biofuel_consumption: {$convert: {input: "$biofuel_consumption", to: 1, onError: null,
onNull: null}},

        coal_consumption: {$convert: {input: "$coal_consumption", to: 1, onError: null, onNull:
null}},

        fossil_fuel_consumption: {$convert: {input: "$fossil_fuel_consumption", to: 1, onError:
null, onNull: null}},

        gas_consumption: {$convert: {input: "$gas_consumption", to: 1, onError: null, onNull:
null}},

        hydro_consumption: {$convert: {input: "$hydro_consumption", to: 1, onError: null,
onNull: null}},

        low_carbon_consumption: {$convert: {input: "$low_carbon_consumption", to: 1,
onError: null, onNull: null}},

        nuclear_consumption: {$convert: {input: "$nuclear_consumption", to: 1, onError: null,
onNull: null}},

        oil_consumption: {$convert: {input: "$oil_consumption", to: 1, onError: null, onNull:
null}},

        other_renewable_consumption: {$convert: {input: "$other_renewable_consumption", to:
1, onError: null, onNull: null}},

        primary_energy_consumption: {$convert: {input: "$primary_energy_consumption", to: 1,
onError: null, onNull: null}},

        renewables_consumption: {$convert: {input: "$renewables_consumption", to: 1,
onError: null, onNull: null}},

        solar_consumption: {$convert: {input: "$solar_consumption", to: 1, onError: null, onNull:
null}},

        wind_consumption: {$convert: {input: "$wind_consumption", to: 1, onError: null, onNull:
null}}}},

    {$addFields:{
```

```
        total_consumption: {$add:
["$biofuel_consumption","$coal_consumption","$fossil_fuel_consumption","$gas_consumptio
n","$hydro_consumption","$low_carbon_consumption",


"$nuclear_consumption","$oil_consumption","$other_renewable_consumption","$primary_en
ergy_consumption","$renewables_consumption","$solar_consumption",

        "$wind_consumption"]

        }}},

    {$project:{

        _id:0, country:1, year:1,total_consumption:1

    }}

])




// The above query tells us how much each country uses per year

// Hence to better understand how much energy is needed, we should look at energy
generated per country as well this includes renewable and non-renewable

db.owid_energy_data.aggregate([

    {$match:

        {"$and":

            [{biofuel_electricity: {$ne: ""}}, {coal_electricity: {$ne: ""}}, {electricity_generation:
{$ne: ""}}, {fossil_electricity: {$ne: ""}},

            {gas_electricity: {$ne: ""}}, {hydro_electricity: {$ne: ""}}, {low_carbon_electricity: {$ne:
""}}, {nuclear_electricity: {$ne: ""}},

            {oil_electricity:{$ne: ""}}, {other_renewable_electricity:{$ne: ""}},
{other_renewable_exc_biofuel_electricity: {$ne: ""}},

            {renewables_electricity: {$ne: ""}}, {solar_electricity:{$ne: ""}}, {wind_electricity:{$ne:
""}},

            {year: {$gte: "2000"}}

            ]}
```

```
    },

    {$project:

        {country:1, year:1,

        biofuel_electricity: {$convert: {input: "$biofuel_electricity", to: 1, onError: null, onNull:
null}},

        coal_electricity: {$convert: {input: "$coal_electricity", to: 1, onError: null, onNull: null}},

        electricity_generation: {$convert: {input: "$electricity_generation", to: 1, onError: null,
onNull: null}},

        fossil_electricity: {$convert: {input: "$fossil_electricity", to: 1, onError: null, onNull: null}},

        gas_electricity: {$convert: {input: "$gas_electricity", to: 1, onError: null, onNull: null}},

        hydro_electricity: {$convert: {input: "$hydro_electricity", to: 1, onError: null, onNull:
null}},

        low_carbon_electricity: {$convert: {input: "$low_carbon_electricity", to: 1, onError: null,
onNull: null}},

        nuclear_electricity: {$convert: {input: "$nuclear_electricity", to: 1, onError: null, onNull:
null}},

        oil_electricity: {$convert: {input: "$oil_electricity", to: 1, onError: null, onNull: null}},

        other_renewable_electricity: {$convert: {input: "$other_renewable_electricity", to: 1,
onError: null, onNull: null}},

        other_renewable_exc_biofuel_electricity: {$convert: {input:
"$other_renewable_exc_biofuel_electricity", to: 1, onError: null, onNull: null}},

        renewables_electricity: {$convert: {input: "$renewables_electricity", to: 1, onError: null,
onNull: null}},

        solar_electricity: {$convert: {input: "$solar_electricity", to: 1, onError: null, onNull: null}},

        wind_electricity: {$convert: {input: "$wind_electricity", to: 1, onError: null, onNull: null}}}},



    {$addFields:{

        total_generated: {$add:
["$biofuel_electricity","$coal_electricity","$electricity_generation","$fossil_electricity","$gas_el
ectricity","$hydro_electricity",
```

```
"$low_carbon_electricity","$nuclear_electricity","$oil_electricity","$other_renewable_electricit
y","$other_renewable_exc_biofuel_electricity","$renewables_electricity",
        "$solar_electricity","$wind_electricity"]
        }}},
    {$project:{
        _id:0, country:1, year:1,total_generated:1
    }}
])

// High Level Overview of Energy Share amongst different countries
db.owid_energy_data.aggregate([
    {$project: {country: 1,
        year: {$convert: {
            input: "$year", to: "int", onError: 0, onNull: 0}},
        gdp: {$convert: {
            input: "$gdp", to: "double", onError: "remove", onNull: "remove"}},
        population: {$convert: {
            input: "$population", to: "double", onError: "remove", onNull: "remove"}},
        biofuel_share_energy: {$convert: {
            input: "$biofuel_share_energy", to: "double", onError: "remove", onNull: "remove"}},
        coal_share_energy: {$convert: {
            input: "$coal_share_energy", to: "double", onError: "remove", onNull: "remove"}},
        fossil_share_energy: {$convert: {
            input: "$fossil_share_energy", to: "double", onError: "remove", onNull: "remove"}},
        gas_share_energy: {$convert: {
            input: "$gas_share_energy", to: "double", onError: "remove", onNull: "remove"}},
```

```
    hydro_share_energy: {$convert: {
        input: "$hydro_share_energy", to: "double", onError: "remove", onNull: "remove"}},
    low_carbon_share_energy: {$convert: {
        input: "$low_carbon_share_energy", to: "double", onError: "remove", onNull:
"remove"}},
    nuclear_share_energy: {$convert: {
        input: "$nuclear_share_energy", to: "double", onError: "remove", onNull: "remove"}},
    oil_share_energy: {$convert: {
        input: "$oil_share_energy", to: "double", onError: "remove", onNull: "remove"}},
    other_renewables_share_energy: {$convert: {
        input: "$other_renewables_share_energy", to: "double", onError: "remove", onNull:
"remove"}},
    renewables_share_energy: {$convert: {
        input: "$renewables_share_energy", to: "double", onError: "remove", onNull:
"remove"}},
    solar_share_energy: {$convert: {
        input: "$solar_share_energy", to: "double", onError: "remove", onNull: "remove"}},
    wind_share_energy: {$convert: {
        input: "$wind_share_energy", to: "double", onError: "remove", onNull: "remove"}}}},
  {$match:
    {$and: [
        {gdp: {$ne: "remove"}},
        {population: {$ne: "remove"}},
        {biofuel_share_energy: {$ne: "remove"}},
        {coal_share_energy: {$ne: "remove"}},
        {fossil_share_energy: {$ne: "remove"}},
        {gas_share_energy: {$ne: "remove"}},
```

```
            {hydro_share_energy: {$ne: "remove"}},
            {low_carbon_share_energy: {$ne: "remove"}},
            {nuclear_share_energy: {$ne: "remove"}},
            {oil_share_energy: {$ne: "remove"}},
            {other_renewables_share_energy: {$ne: "remove"}},
            {renewables_share_energy: {$ne: "remove"}},
            {solar_share_energy: {$ne: "remove"}},
            {wind_share_energy: {$ne: "remove"}},
            {year: {$gte: 2000}}

        }
    ])

// Looking at the trend of previous years versus current years for big players AKA China, Russia, USA, India

db.owid_energy_data.aggregate([
    {$match:
        {$and:[
            {country: {$in:['China','United States','Japan', 'Germany']}},
            {renewables_electricity: {$ne: " "}},
            {fossil_electricity: {$ne: " "}},
            {gdp: {$ne: " "}},
            {year:{$gte: "2000"}}
              ]}},
    {$addFields:{
        renewables_electricity: {$convert: {
```

```
        input: {$substr: ["$renewables_electricity", 0, {$subtract: [{$strLenCP:
"$renewables_electricity"}, 1]}]}, to: 1, onError: null, onNull: null}},

      fossil_electricity: {$convert: {

        input: {$substr: ["$fossil_electricity", 0, {$subtract: [{$strLenCP: "$fossil_electricity"},
1]}]}, to: 1, onError: null, onNull: null}},

      gdp: {$convert: {

        input: {$substr: ["$gdp", 0, {$subtract: [{$strLenCP: "$gdp"}, 1]}]}, to: 1, onError: null,
onNull: null}}

   }},

   {$setWindowFields: {

    partitionBy: '$country',

    sortBy: {'country': 1, 'year': 1},

    output: {

      'renewable_prev': {$avg: "$renewables_electricity",window: {documents: [-1, -1]}},

      'fossil_energy_prev': {$avg: "$fossil_electricity",window: {documents: [-1,-1]}}

      'gdp_prev': {$avg: "$gdp",window: {documents: [-1,-1]}}

    }

   }},

   {$project:{

      country: 1,

      year: {$toInt: "$year"},

      renewables_electricity: 1,

      renewable_change: {$subtract: ["$renewables_electricity", "$renewable_prev"]},

      fossil_electricity: 1,

      fossil_change: {$subtract: ["$fossil_electricity","$fossil_energy_prev"]},

      gdp: 1

      gdp_change: {$subtract: ["$gdp","$gdp_prev"]
```

```
    }}

        ])


// Looking at the trend of previous years versus current years for ASEAN Players

db.owid_energy_data.aggregate([

    {$match:

        {$and:[

            {country: {$in:['Singapore','Malaysia','Brunei', 'Cambodia', 'Indonesia', 'Laos',
'Myanmar', 'Philippines', 'Thailand', 'Vietnam']}},

            {renewables_electricity:{$ne: ""}},

            {fossil_electricity: {$ne: ""}},

            {gdp: {$ne: ""}},

            {year:{$ne: ""}}

              ]}},

    {$addFields:{

        renewables_electricity: {$convert: {

            input: {$substr: ["$renewables_electricity", 0, {$subtract: [{$strLenCP:
"$renewables_electricity"}, 1]}]}, to: 1, onError: null, onNull: null}},

        fossil_electricity: {$convert: {

            input: {$substr: ["$fossil_electricity", 0, {$subtract: [{$strLenCP: "$fossil_electricity"},
1]}]}, to: 1, onError: null, onNull: null}},

        gdp: {$convert: {

            input: {$substr: ["$gdp", 0, {$subtract: [{$strLenCP: "$gdp"}, 1]}]}, to: 1, onError: null,
onNull: null}}

    }},

    {$setWindowFields: {

     partitionBy: '$country',

     sortBy: {'country': 1, 'year': 1},
```

```
    output: {
        'renewable_prev': {$avg: "$renewables_electricity",window: {documents: [-1, -1]}},
        'fossil_energy_prev': {$avg: "$fossil_electricity",window: {documents: [-1,-1]}}
        'gdp_prev': {$avg: "$gdp",window: {documents: [-1,-1]}}
    }
   }},
   {$project:{
      country: 1,
      year: {$toInt: "$year"},
      renewables_electricity: 1,
      renewable_change: {$subtract: ["$renewables_electricity", "$renewable_prev"]},
      fossil_electricity: 1,
      fossil_change: {$subtract: ["$fossil_electricity","$fossil_energy_prev"]},
      gdp: 1
      gdp_change: {$subtract: ["$gdp","$gdp_prev"]
   }}}
      ]])
```

Question 14

```
db.owid.aggregate([
   {$match: {"country": "Singapore"}},
   {$match: {"$or": [{"year": "1985"}, {"year": "1986"},{"year": "2020"}]},
   {$project: {country: 1, year: 1, fossil_share_energy: 1, solar_share_energy: 1,
nuclear_electricity: 1}}
   ])
db.household_electricity_consumption.aggregate([
```

```
{$match:

{"$and":

[{Region: {$ne:"Overall"}}, {month:{$ne: "Annual"}}, // This essentially removes documents where Region is Overall and Month is recorded as annual

{kwh_per_acc: {$ne: "s\r"}}]}},//This line removes all instances where there is a "s" value

{$project:

{year: {$toInt: "$year"}, month: {$toInt: "$month"},

Region: 1, kwh_per_acc: {$convert: {input :{$substr: ["$kwh_per_acc", 0, {$subtract: [{$strLenCP: "$kwh_per_acc"},1]}]}, to: 1, onError: null, onNull:null}}}},

{$addFields: {quarter: { $switch: { branches: [ {case: {$lte: ["$month", 3]}, then: 1},

{case: {$lte: ["month",6]}, then: 2},

{case: {$lte:["month",9]}, then: 3},

{case: {$lte: ["$month", 12]}, then: 4},],

default: 4 }}}},

{$group: {_id: {year: "$year", region : "$Region", quarter: "quarter"}, avg_kwh: {$avg: "$kwh_per_acc"}}},

{$sort: {"_id.region":1, "_id.year": 1,  "id_quarter":1}}

])
```

Question 15

Table 1: globalTempChange

```
db.temperaturechangebycountry.find()


db.temperaturechangebycountry.aggregate([

{$project: {Area:1, Year:1, Value:{$convert:{input: "$Value", to: 1, onError: null, onNull: null}}}},

{$project: {Area:1, Year:1, avgValueChange:{$avg: "$Value"}}}
```

```
    {$group: {_id:{"Area": "World", "Year" : "$Year"}, "Average_Value": {$avg:
"$avgValueChange"}}},

    {$sort:{"_id.Year":1}},

    {$out: "globalTempChange"}

    ])


db.globalTempChange.find({})
```

Table 2: globalTempChange_GHGemissions

```
// Document 1: globalTempChange


db.globalTempChange.find({})


db.globalTempChange.aggregate([

    {$project:{"_id.Area":1, "_id.Year":1, "tempChange" :"$Average_Value"}},

    {$out: "globalTempChangeTEMP"}

    ])


db.globalTempChangeTEMP.find()


// Document 2: owid_energy_data


db.owid_energy_data.find({"country": "World"})


db.owid_energy_data.aggregate([
```

```
    {$project:{

    population:{$convert:{input: "$population", to: 1, onError: null, onNull: null}},

    greenhouse_gas_emissions:{$convert:{input: "$greenhouse_gas_emissions", to: 1,
onError: null, onNull: null}},

    year: 1, country: 1

    }},

    {$project:{ greenhouse_gas_emissions: 1,"greenhouse_gas_emissions_per_capita":
{$divide: ["$greenhouse_gas_emissions", "$population"]}, year: 1, country: 1}},

    {$match: {$and: [{"country": "World"}, {"greenhouse_gas_emissions": {$ne: null}}]}},

    {$out: "owid_energy_dataTEMP"}])




db.owid_energy_dataTEMP.find()



// Combine:

db.owid_energy_dataTEMP.aggregate([

    {$lookup:

        {

            from: "globalTempChangeTEMP",

            localField:"year",

            foreignField:"_id.Year",

            as: "globalTempChange_GHGemissions"

        }

    }}

])
```

Table 3: gdp_emissions_cap

```
db.owid_energy_data.aggregate([

    {$project:{_id:0, iso_code:1, country:1, year:1,

    gdp:{$convert:{input: "$gdp", to: 1, onError: null, onNull: null}},

    population:{$convert:{input: "$population", to: 1, onError: null, onNull: null}},

    greenhouse_gas_emissions:{$convert:{input: "$greenhouse_gas_emissions", to: 1,
onError: null, onNull: null}}}},

    {$project:{_id:0, iso_code:1, "isox":{$strLenCP:"$iso_code"}, country:1, year:1, gdp: 1,
population : 1,

    "gdp_per_capita": {$divide: ["$gdp", "$population"]}, greenhouse_gas_emissions : 1,

    "greenhouse_gas_emissions_per_capita": {$divide: ["$greenhouse_gas_emissions",
"$population"]}}},

    {$match: {"greenhouse_gas_emissions": {$ne: null}}},

    {$match: { $or: [ {isox: 3}, {"country": "World"}, {"country": "Greenland"}, {"country":
"Kosovo"}]}},

    {$out: "gdp_emissions_cap"}])



db.gdp_emissions_cap.find()
```

Table 4: energy

```
db.owid_energy_data.aggregate([

    {$project:{_id:0, iso_code:1, country:1, year:1,

    gdp:{$convert:{input: "$gdp", to: 1, onError: null, onNull: null}},

    population:{$convert:{input: "$population", to: 1, onError: null, onNull: null}},

    greenhouse_gas_emissions:{$convert:{input: "$greenhouse_gas_emissions", to: 1,
onError: null, onNull: null}},

    energy_cons_change_pct:1, energy_per_capita:1, fossil_fuel_consumption:1,
fossil_energy_per_capita:1, renewables_consumption:1,renewables_energy_per_capita:1,
nuclear_consumption:1, nuclear_energy_per_capita:1}},
```

```
    {$project:{_id:0, iso_code:1, "isox":{$strLenCP:"$iso_code"}, country:1, year:1,
"gdp_per_capita": {$divide: ["$gdp", "$population"]}, greenhouse_emissions_per_capita:
{$divide: ["$greenhouse_gas_emissions", "$population"]}, energy_cons_change_pct:1,
energy_per_capita:1, fossil_fuel_consumption:1, fossil_energy_per_capita:1,
renewables_consumption:1,renewables_energy_per_capita:1,  nuclear_consumption:1,
nuclear_energy_per_capita:1}},

    {$match: { $or: [ {isox: 3}, {"country": "World"}, {"country": "Greenland"}, {"country":
"Kosovo"}]}},

    {$out: "energy"}])



db.energy.find()
```

Code Base Output

SQL

Question 1

count(distinct(iso_co...
217

SQL Output 1a

iso_code
AFG
ALB
DZA
ASM
AGO
ATG
ARG
ARM
ABW
AUS
AUT
AZE
BHS

SQL Output 1b

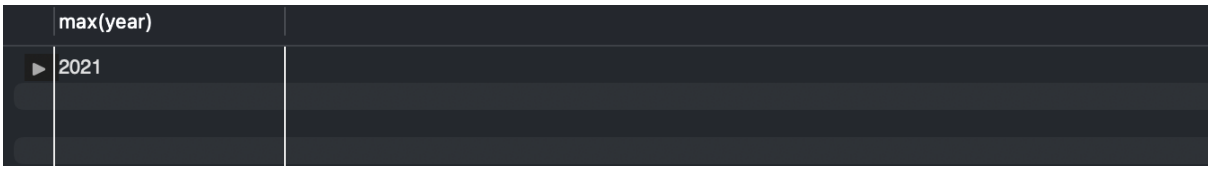
country
Antarctica
Asia Pacific
CIS
Czechoslovakia
East Germany
Eastern Africa
Europe
European Union (27)
Greenland
Hawaiian Trade Zone
Kosovo
Middle Africa
Middle East

SQL Output 1c

Question 2

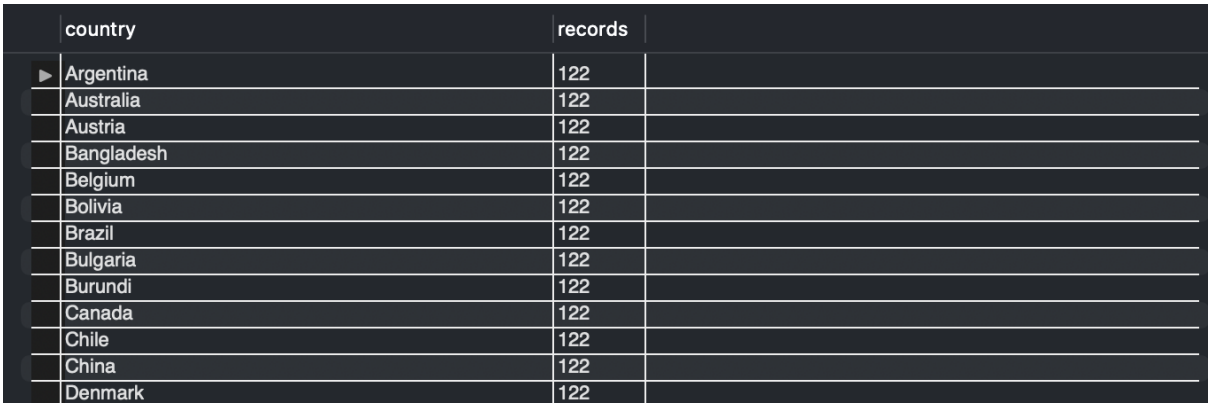
min(year)
1900

SQL Output 2a



max(year)
2021

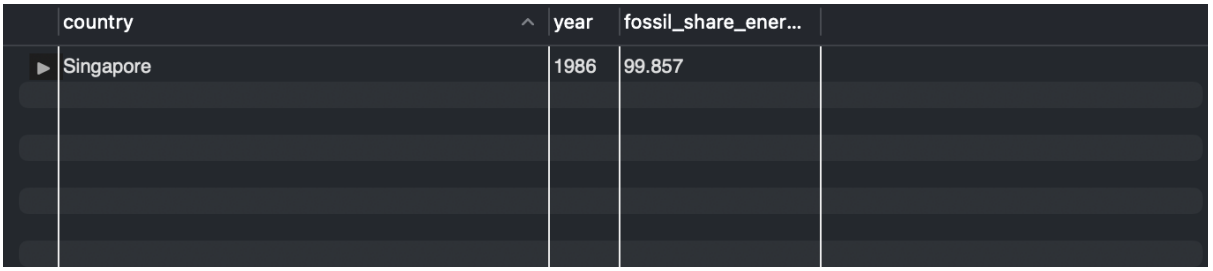
SQL Output 2b



country	records
Argentina	122
Australia	122
Austria	122
Bangladesh	122
Belgium	122
Bolivia	122
Brazil	122
Bulgaria	122
Burundi	122
Canada	122
Chile	122
China	122
Denmark	122

SQL Output 2c

Question 3



country	year	fossil_share_ener...
Singapore	1986	99.857

SQL Output 3a

iso_code	country	year	fossil_share_ener...	oil_share_energy
SGP	Singapore	1985	100.0	99.907
SGP	Singapore	1986	99.857	99.807

SQL Output 3b

Question 4

country	avgGdp
Indonesia	1782642734937.4285
Thailand	734647228291.6818
Philippines	484712138799.9091
Malaysia	459662487551.4286
Vietnam	349375789745.63635
Singapore	239388843051.86365
Myanmar	171131908481.85715
Cambodia	32800018008.142857
Laos	23599811989
Brunei	NULL

SQL Output 4

Question 5

country	year	average_oil_consumpti...
Brunei	2002	NULL
Cambodia	2002	NULL
Indonesia	2002	686.184
Laos	2002	NULL
Malaysia	2002	317.513
Myanmar	2002	NULL
Philippines	2002	187.244
Singapore	2002	445.566
Thailand	2002	454.143
Vietnam	2002	118.187
Brunei	2003	NULL
Cambodia	2003	NULL
Indonesia	2003	690.371

SQL Output 5a

country	year	change_in_moving_avera...	average_gdp
Indonesia	2015	-25.372333333333245	2527840615714.3335
Indonesia	2016	-30.407333333333327	2653406947698.3335
Indonesia	2017	-8.875	2785879843874.3335
Indonesia	2020	-74.88900000000012	3075456084370
Malaysia	2010	-5.39766666666668	489133234422.6667
Malaysia	2015	-1.5596666666667147	636911028203.3334
Malaysia	2017	-3.0920000000000414	702434988315.6666
Malaysia	2019	-0.10133333333340033	756149085729
Malaysia	2020	-12.364000000000033	773658537411
Philippines	2003	-0.46649999999999636	363805036246.5
Philippines	2005	-3.029666666666685	400276583075
Philippines	2006	-8.685666666666634	425701480481
Philippines	2007	-8.400666666666694	452927712537

SQL Output 5b

Question 6

energy_products	sub_products	average_value
Coal and Peat	Coal and Peat	239.16875
Crude Oil	Crude Oil	50975.975
Crude Oil	Other Crude Oil	1755.14375
Petroleum Products	Fuel Oil	56357.3
Petroleum Products	Gas/Diesel Oil	12571.96875
Petroleum Products	Gasoline	13715.550000000001
Petroleum Products	Jet Fuel Kerosene	2391.43125
Petroleum Products	Naphtha	6430.506249999999
Petroleum Products	Other Petroleum Products	2030.0437499999998
Natural Gas (NG)	Pipeline NG	6940.34375
Natural Gas (NG)	Liquefied NG	1246.2625
Other Energy Pro...	Other Energy Products	35.925

SQL Output 6a

energy_products	sub_products	average_value
Coal and Peat	Coal and Peat	0.9499999999999998
Crude Oil	Crude Oil	60.15
Crude Oil	Other Crude Oil	1031.1312500000001
Petroleum Products	Fuel Oil	23343.7625
Petroleum Products	Gas/Diesel Oil	22540.906250000004
Petroleum Products	Gasoline	22908.562500000004
Petroleum Products	Jet Fuel Kerosene	6116.337500000001
Petroleum Products	Naphtha	1184.625
Petroleum Products	Other Petroleum Products	7785.74375

SQL Output 6b

Question 7

year	energy_products	sub_products	yearlyDiff
2005	Coal and Peat	Coal and Peat	-7.8999999999999995
2005	Crude Oil	Crude Oil	-58707.299999999996
2005	Crude Oil	Other Crude Oil	-602.8
2005	Petroleum Products	Fuel Oil	-13484.5
2005	Petroleum Products	Gas/Diesel Oil	11209.099999999999
2005	Petroleum Products	Gasoline	7563.5
2005	Petroleum Products	Jet Fuel Kerosene	4774.6
2005	Petroleum Products	Naphtha	-1624.8000000000002
2005	Petroleum Products	Other Petroleum Products	5882.9
2006	Coal and Peat	Coal and Peat	-3.8000000000000003
2006	Crude Oil	Crude Oil	-56536.4
2006	Crude Oil	Other Crude Oil	-867.0000000000001
2006	Petroleum Products	Fuel Oil	-17796.199999999997

SQL Output 7a

year
2014

SQL Output 7b

Question 8

region	year	yearly_avg_kwh
Central Region	2005	701.8611111111112
Central Region	2006	676.9578947368421
Central Region	2007	691.6578947368421
Central Region	2008	705.9842105263158
Central Region	2009	711.4263157894736
Central Region	2010	719.4842105263158
Central Region	2011	684.5684210526315
Central Region	2012	686.8368421052631
Central Region	2013	687.8421052631579
Central Region	2014	683.9999999999999
Central Region	2015	684.6
Central Region	2016	697.5736842105263
Central Region	2017	642.1842105263158

SQL Output 8a

Question 9

region	count
East Region	8
West Region	8
North Region	7

SQL Output 9a

Question 10

year	region	Q1	Q2	Q3	Q4
2005	Central Region	604.1359	721.7387	687.0657	667.9499
2005	East Region	482.4545	574.2068	544.4879	519.5894
2005	North East Re…	484.0572	556.9748	544.4069	517.5925
2005	North Region	535.219	621.5079	572.2294	576.5512
2005	Overall	488.9259	576.7852	555.463	533.5741

SQL Output 10a

Q1	Q2	Q3	Q4
513.2139702690966	592.85524490681	586.8391951107046	564.8501174948499

SQL Output 10b

Question 11

year	sub_housing_type	Q1	Q2	Q3	Q4
2005	1 Room and 2 Room	64.5667	62.8333	61.3667	61.3333
2006	1 Room and 2 Room	61.7667	59.1667	59.3333	61.0667
2007	1 Room and 2 Room	61.0667	59.8	58.7	59.8667
2008	1 Room and 2 Room	60.6	61.3	60.6333	60.6333
2009	1 Room and 2 Room	60.9333	59.3	59.4333	60.6333
2010	1 Room and 2 Room	59.2	57.5333	58.1	59.0667
2011	1 Room and 2 Room	58.8667	57.5667	57.8667	57.9667
2012	1 Room and 2 Room	58.1	57	56.8333	56.4667
2013	1 Room and 2 Room	56.2	55.2333	56.7667	55.6333
2014	1 Room and 2 Room	56.5333	53.5333	54.5667	53.2667
2015	1 Room and 2 Room	55.1333	53.3333	54.7333	54.1667
2016	1 Room and 2 Room	53.4667	52.5	54.1667	52.2667
2017	1 Room and 2 Room	53	52.0333	52.4	50.1

SQL Output 11a

Q1	Q2	Q3	Q4
85.5534313725491	85.89975490196073	85.67135416666677	84.62343749999997

SQL Output 11b

Question 12

iso_code	country	year	coal_prod_change_...	coal_prod_change_t...	gas_prod_change_pct	gas_prod_char
AFG	Afghanistan	1900				
AFG	Afghanistan	1901		0.0		
AFG	Afghanistan	1902		0.0		
AFG	Afghanistan	1903		0.0		
AFG	Afghanistan	1904		0.0		

SQL Output 12a

country	year	gdp	population
Denmark	2000	208358712201.0	5341192.0
Denmark	2001	211275272656.0	5358059.0
Denmark	2002	213475432436.0	5372798.0
Denmark	2003	215532702113.0	5386968.0
Denmark	2004	222551117434.0	5402754.0

SQL Output 12b

country	year	gdp_per_capi...
Denmark	2000	208358712201
Denmark	2001	211275272656
Denmark	2002	213475432436
Denmark	2003	215532702113
Denmark	2004	222551117434

SQL Output 12c

country	year	energy_per_gdp
Denmark	2000	1.129
Denmark	2001	1.116
Denmark	2002	1.101
Denmark	2003	1.174
Denmark	2004	1.074

SQL Output 12d

country	year	energy_per_gdp
Denmark	2000	1.129
Denmark	2001	1.116
Denmark	2002	1.101
Denmark	2003	1.174
Denmark	2004	1.074

SQL Output 12e

country	year	total_energy_consumpti...
Denmark	2000	721.123
Denmark	2001	723.5080000000002
Denmark	2002	723.7379999999999
Denmark	2003	781.259
Denmark	2004	743.032

SQL Output 12f

Question 13

iso_code	country	year	coal_prod_change_...	coal_prod_change_t...	gas_prod_change_pct	gas_prod_ch
AFG	Afghanistan	1900				
AFG	Afghanistan	1901		0.0		
AFG	Afghanistan	1902		0.0		
AFG	Afghanistan	1903		0.0		
AFG	Afghanistan	1904		0.0		

SQL Output 13a

country	year	biofuel_consumpti...	coal_consumpti...	fossil_fuel_consumpt...	gas_consumpti...	hydro_consumpti...	low_carbon_consu
Africa	2000	0.0	963.274	2941.614	556.822	209.016	251.979
Africa	2001	0.0	975.588	3045.207	634.636	223.164	260.379
Africa	2002	0.491	934.101	3071.925	670.605	233.562	274.466
Africa	2003	0.541	1016.713	3235.96	711.507	225.775	269.476
Africa	2004	0.637	1118.29	3458.685	783.068	236.607	283.637

SQL Output 13b

country	year	total_consumption
Africa	2000	9797
Africa	2001	10148
Africa	2002	10281
Africa	2003	10751
Africa	2004	11474

SQL Output 13c

country	year	total_generated
Afghanistan	2000	1.72
Afghanistan	2001	2.27
Afghanistan	2002	2.63
Afghanistan	2003	3.4499999999999997
Afghanistan	2004	3.23

SQL Output 13d

country	year	gdp	population	biofuel_share_ener...	coal_share_ener...	fossil_share_ener...	gas_share_energy	hydro_share_e
Argentina	2000	536481027720.0	36870796.0	0.0	1.06	83.969	45.55	13.333
Argentina	2001	515221286182.0	37275644.0	0.0	0.891	80.175	43.772	16.742
Argentina	2002	461203417025.0	37681744.0	0.0	0.691	80.09	44.336	17.124
Argentina	2003	504301024418.0	38087868.0	0.0	0.789	81.666	47.407	15.009
Argentina	2004	552377778393.0	38491968.0	0.0	1.266	84.074	48.944	12.743

SQL Output 13e

country	year	gdp	population	biofuel_share_ener...	coal_share_ener...	fossil_share_ener...	gas_share_energy	hydro_share_ene
Cambodia	1980	9092187720.0	6693759.0					
Cambodia	1981	9211223110.0	6749849.0					
Cambodia	1982	9905037436.0	6919803.0					
Cambodia	1983	10619108380.0	7170004.0					
Cambodia	1984	11330466768.0	7447844.0					

SQL Output 13f

country	fossil_electricity	renewables_electric...	gdp	year	fossil_change	renewable_change	gdp_change
China	1337.46	291.401	6814493761716.0	2002	154.87000000000012	10.66700000000003	484756565793
China	1579.96	287.277	7248622636565.0	2003	242.5	-4.124000000000024	434128874849
China	1795.41	357.426	7830953031578.0	2004	215.45000000000005	70.149	582330395013
China	2042.8	404.369	8602939916574.0	2005	247.38999999999987	46.94300000000004	771986884996
China	2364.16	446.726	9489543138171.0	2006	321.3599999999999	42.35699999999997	886603221597

SQL Output 13g

country	fossil_electricity	renewables_electric...	gdp	year	fossil_change	renewable_change	gdp_change
Cambodia	0.42	0.05	20441457984.0	2000	NULL	NULL	NULL
Indonesia	78.43	14.888	1138300077496.0	2000	NULL	NULL	NULL
Laos	0.35	3.28	12209285533.0	2000	NULL	NULL	NULL
Malaysia	58.02	7.87	305415976532.0	2000	NULL	NULL	NULL
Myanmar	2.88	2.01	84093543261.0	2000	NULL	NULL	NULL
Philippines	24.29	19.37	326462616360.0	2000	NULL	NULL	NULL

SQL Output 13h

Question 14

country	year	fossil_share_ener...	solar_share_energy	nuclear_electric...
Singapore	1985	100.0	0.0	0.0
Singapore	1986	99.857	0.0	0.0
Singapore	2020	99.747	0.077	0.0

SQL Output 14a

year	month	QuarterlyValue	region
2005	Quarter 1	604.1358974358975	Central Region
2005	Quarter 1	482.4545454545453	East Region
2005	Quarter 1	484.05723270440245	North East Region
2005	Quarter 1	535.2190476190476	North Region
2005	Quarter 1	488.9259259259259	Overall

SQL Output 14b

year	month	QuarterlyValue	region
2018	Quarter 1	384.942	West Region
2015	Quarter 1	400.885	West Region
2020	Quarter 1	402.223	West Region
2018	Quarter 4	404.256	West Region
2019	Quarter 1	405.275	West Region

SQL Output 14c

noSQL

Question 1

	Amount of countries in Owid_Energy_data
1	223

noSQL Output 1a

1	"217"

noSQL Output 1b

	_id
1	{ groupByCountry : "Antarctica" }
2	{ groupByCountry : "Asia Pacific" }
3	{ groupByCountry : "CIS" }
4	{ groupByCountry : "Czechoslovakia" }
5	{ groupByCountry : "East Germany" }
6	{ groupByCountry : "Eastern Africa" }
7	{ groupByCountry : "Greenland" }
8	{ groupByCountry : "Hawaiian Trade Zone" }
9	{ groupByCountry : "Kosovo" }
10	{ groupByCountry : "Middle Africa" }
11	{ groupByCountry : "Middle East" }

noSQL Output 1c

Question 2

	_id	minyear	maxyear
1	{ }	1900	2021

noSQL Output 2a

	_id	yearscount
1	BEL	122
2	TWN	122
3	BRA	122
4	DNK	122
5	JPN	122
6	IRL	122
7	AUS	122
8	IND	122
9	BGD	122
10	ROU	122
11	TUN	122

noSQL Output 2b

Question 3

	country	year	fossil_share_energy
1	Singapore	1986	99.857

noSQL Output 3a

	_id	iso_code	country	year	biofuel_share_energy	coal_share_energy	fossil_share_energy	gas_share_energy	hydro_share_energy	low_carbon_share_energy
1	63074887	SGP	Singapore	1986		0.05	99.857	0.0	0.0	0.143

noSQL Output 3b

Question 4

	_id	avgGdp
1	Indonesia	1,970,289,338,615.0527 (2.0T)
2	Thailand	850,644,159,074.579 (0.85T)
3	Philippines	561,245,634,399.8948 (0.56T)
4	Malaysia	508,048,012,556.8421 (0.51T)
5	Vietnam	404,540,388,126.5263 (0.40T)
6	Singapore	277,187,081,428.4737 (0.28T)
7	Myanmar	189,145,793,585.2105 (0.19T)
8	Cambodia	36,252,651,482.6842 (36.3G)
9	Laos	26,084,002,724.6842 (26.1G)

noSQL Output 4

Question 5

	_id	country	year	oil_consumption	gdp	oil_moving_avg	gdp_moving_avg	pre_gdp_moving_	pre_oil_moving_av	moving_avg_oil_c	moving_avg_gdp_diff
1	6307	Indonesia	2015	847.61	2,650,203,478,697 (2.7T)	887.841	2,527,840,615,714	2,404,351,577,13	913.2133	-25.3723	123,489,038,579.3335 (0.1
2	6307	Indonesia	2016	823.012	2,783,164,797,711 (2.8T)	857.4337	2,653,406,947,698	2,527,840,615,71	887.841	-30.4073	125,566,331,984 (0.13T)
3	6307	Indonesia	2017	875.054	2,924,271,255,215 (2.9T)	848.5587	2,785,879,843,874	2,653,406,947,69	857.4337	-8.875	132,472,896,176 (0.13T)
4	6307	Indonesia	2020	650.387	null	808.044	3,075,456,084,370	2,999,863,669,79	882.933	-74.889	75,592,414,577.5 (75.6G)
5	6307	Malaysia	2010	359.007	514,171,988,796 (0.51T)	358.8683	489,133,234,422.6	468,794,830,234	364.266	-5.3977	20,338,404,188.6667 (20.3
6	6307	Malaysia	2015	397.144	670,135,292,796 (0.67T)	418.0033	636,911,028,203.3	605,262,962,087.	419.563	-1.5597	31,648,066,115.6667 (31.6
7	6307	Malaysia	2017	419.665	738,639,634,047 (0.74T)	420.0263	702,434,988,315.6	669,024,648,017.	423.1183	-3.092	33,410,340,298 (33.4G)
8	6307	Malaysia	2019	442.966	null	427.84	756,149,085,729 ((	736,942,736,520.	427.9413	-0.1013	19,206,349,208.3334 (19.2
9	6307	Malaysia	2020	382.573	null	415.476	773,658,537,411 ((	756,149,085,729	427.84	-12.364	17,509,451,682 (17.5G)
10	6307	Philippines	2003	186.311	374,041,679,199 (0.37T)	186.7775	363,805,036,246.5	353,568,393,294	187.244	-0.4665	10,236,642,952.5 (10.2G)
11	6307	Philippines	2005	178.155	424,650,338,562 (0.42T)	185.395	400,276,583,075 ((	376,582,601,319	188.4247	-3.0297	23,693,981,756 (23.7G)

noSQL Output 5

Question 6

	_id	avg_value_ktoe
1	Other Crude Oil	1,755.1438 (1.8K)
2	Gas/Diesel Oil	12,571.9688 (12.6K)
3	Fuel Oil	56,357.3 (56.4K)
4	Other Petroleum Products	2,030.0438 (2.0K)
5	Naphtha	6,430.5063 (6.4K)
6	Pipeline NG	6,940.3438 (6.9K)
7	Other Energy Products	35.925
8	Crude Oil	50,975.975 (51.0K)
9	Jet Fuel Kerosene	2,391.4313 (2.4K)
10	Gasoline	13,715.55 (13.7K)
11	Liquefied NG	1,246.2625 (1.2K)

noSQL Output 6a

	_id	avg_value_ktoe
1	Crude Oil	60.15
2	Jet Fuel Kerosene	6,116.3375 (6.1K)
3	Gasoline	22,908.5625 (22.9K)
4	Coal and Peat	0.95
5	Gas/Diesel Oil	22,540.9063 (22.5K)
6	Other Crude Oil	1,031.1313 (1.0K)
7	Fuel Oil	23,343.7625 (23.3K)
8	Other Petroleum Products	7,785.7438 (7.8K)
9	Naphtha	1,184.625 (1.2K)

noSQL Output 6b

Question 7

	_id			count
	year	energy_products	sub_products	
1	2006	Coal and Peat	Coal and Peat	1
2	2009	Petroleum Products	Fuel Oil	1
3	2011	Natural Gas (NG)	Liquefied NG	1
4	2016	Petroleum Products	Gas/Diesel Oil	1
5	2007	Petroleum Products	Fuel Oil	1
6	2018	Petroleum Products	Gasoline	1
7	2019	Natural Gas (NG)	Pipeline NG	1
8	2014	Natural Gas (NG)	Pipeline NG	1
9	2017	Natural Gas (NG)	Pipeline NG	1
10	2008	Petroleum Products	Gasoline	1

noSQL Output 7a

	_id	year	energy_products	sub_products	import_ktoe	export_ktoe	export_sub_import
1	63074E	2005	Coal and Peat	Coal and Peat	8.2	0.3	-7.9
2	63074E	2005	Crude Oil	Crude Oil	58,884.6 (58.9K)	177.3	-58,707.3
3	63074E	2005	Crude Oil	Other Crude Oil	1,315.6 (1.3K)	712.8	-602.8
4	63074E	2005	Petroleum Products	Fuel Oil	29,551.2 (29.6K)	16,066.7 (16.1K)	-13,484.5
5	63074E	2005	Petroleum Products	Gas/Diesel Oil	3,999.7 (4.0K)	15,208.8 (15.2K)	11,209.1 (11.2K)
6	63074E	2005	Petroleum Products	Gasoline	7,619.5 (7.6K)	15,183 (15.2K)	7,563.5 (7.6K)
7	63074E	2005	Petroleum Products	Jet Fuel Kerosene	2,180.7 (2.2K)	6,955.3 (7.0K)	4,774.6 (4.8K)
8	63074E	2005	Petroleum Products	Naphtha	4,095 (4.1K)	2,470.2 (2.5K)	-1,624.8
9	63074E	2005	Petroleum Products	Other Petroleum Products	1,845.8 (1.8K)	7,728.7 (7.7K)	5,882.9 (5.9K)
10	63074E	2005	Natural Gas (NG)	Pipeline NG	5,571.1 (5.6K)		null
11	63074E	2005	Natural Gas (NG)	Liquefied NG	0		null

noSQL Output 7b

Question 8

	_id		avg_kwh
	year	region	
1	2005	Central Region	701.8611
2	2006	Central Region	676.9579
3	2007	Central Region	691.6579
4	2008	Central Region	705.9842
5	2009	Central Region	711.4263
6	2010	Central Region	719.4842
7	2011	Central Region	684.5684
8	2012	Central Region	686.8368
9	2013	Central Region	687.8421
10	2014	Central Region	684

noSQL Output 8

Question 9

	_id	count
1	West Region	8
2	East Region	8
3	North Region	7

noSQL Output 9

Question 10

	_id	dwelling_type	year	month	Region	Description	kwh_per_acc
1	63074882ff3acbe0d63c	1 room and 2 room	2005	1	Central Region	Bishan	104.9\r
2	63074882ff3acbe0d63c	1 room and 2 room	2005	1	Central Region	Bukit Merah	140.7\r
3	63074882ff3acbe0d63c	1 room and 2 room	2005	1	Central Region	Central Region	136.5\r
4	63074882ff3acbe0d63c	1 room and 2 room	2005	1	Central Region	Geylang	148.5\r
5	63074882ff3acbe0d63c	1 room and 2 room	2005	1	Central Region	Kallang	115.6\r
6	63074882ff3acbe0d63c	1 room and 2 room	2005	1	Central Region	Marine Parade	165.3\r
7	63074882ff3acbe0d63c	1 room and 2 room	2005	1	Central Region	Novena	136.1\r
8	63074882ff3acbe0d63c	1 room and 2 room	2005	1	Central Region	Outram	114.2\r
9	63074882ff3acbe0d63c	1 room and 2 room	2005	1	Central Region	Queenstown	148.6\r
10	63074882ff3acbe0d63c	1 room and 2 room	2005	1	Central Region	Rochor	164.4\r
11	63074882ff3acbe0d63c	1 room and 2 room	2005	1	Central Region	Toa Payoh	137.2\r

noSQL Output 10a

	_id			avg_kwh
	year	region	quarter	
1	2005	Central Region	1	604.1359
2	2005	Central Region	4	692.2893
3	2006	Central Region	4	699.9743
4	2006	Central Region	1	619.7231
5	2007	Central Region	1	591.7594
6	2007	Central Region	4	701.5646
7	2008	Central Region	4	691.171
8	2008	Central Region	1	615.6254
9	2009	Central Region	4	703.9729
10	2009	Central Region	1	606.7127

noSQL Output 10b

Question 11

	_id			quarter_avg
	year	quarter	sub_housing_type	
1	2005	1	1 Room and 2 Room	64.5667
2	2005	2	1 Room and 2 Room	62.8333
3	2005	3	1 Room and 2 Room	61.3667
4	2005	4	1 Room and 2 Room	61.3333
5	2006	1	1 Room and 2 Room	61.7667
6	2006	2	1 Room and 2 Room	59.1667
7	2006	3	1 Room and 2 Room	59.3333
8	2006	4	1 Room and 2 Room	61.0667
9	2007	1	1 Room and 2 Room	61.0667
10	2007	2	1 Room and 2 Room	59.8

noSQL Output 11

Question 12

	_id	iso_code	country	year	coal_prod_change_pct	coal_prod_change_twh	gas_prod_change_pct
1	63074885ff3acbe0d63c	AFG	Afghanistan	1900			
2	63074885ff3acbe0d63c	AFG	Afghanistan	1901		0.0	
3	63074885ff3acbe0d63c	AFG	Afghanistan	1902		0.0	
4	63074885ff3acbe0d63c	AFG	Afghanistan	1903		0.0	
5	63074885ff3acbe0d63c	AFG	Afghanistan	1904		0.0	
6	63074885ff3acbe0d63c	AFG	Afghanistan	1905		0.0	
7	63074885ff3acbe0d63c	AFG	Afghanistan	1906		0.0	
8	63074885ff3acbe0d63c	AFG	Afghanistan	1907		0.0	
9	63074885ff3acbe0d63c	AFG	Afghanistan	1908		0.0	
10	63074885ff3acbe0d63c	AFG	Afghanistan	1909		0.0	
11	63074885ff3acbe0d63c	AFG	Afghanistan	1910		0.0	

noSQL Output 12a

	_id	country	year	population	population_lower_limit	population_upper_limit
1	6307	Singapore	2018	5,757,503 (5.8M)	4,757,503 (4.8M)	6,757,503 (6.8M)

noSQL Output 12b

	_id	country	year	gdp	gdp_lower_limit	gdp_upper_limit
1	6307	Singapore	2018	410,139,845,598 (0.41T)	110,139,845,598 (0.11T)	710,139,845,598 (0.71T)

noSQL Output 12c

	_id	country	year	population	population_result
1	630	Burundi	2000	6,378,871 (6.4M)	Array[1]
2	630	Burundi	2001	6,525,546 (6.5M)	Array[1]
3	630	Burundi	2002	6,704,118 (6.7M)	Array[1]
4	630	Congo	2015	4,856,093 (4.9M)	Array[1]
5	630	Congo	2016	4,980,996 (5.0M)	Array[1]
6	630	Congo	2017	5,110,701 (5.1M)	Array[1]
7	630	Congo	2018	5,244,363 (5.2M)	Array[1]
8	630	Costa Rica	2014	4,795,390 (4.8M)	Array[1]
9	630	Costa Rica	2015	4,847,805 (4.8M)	Array[1]
10	630	Costa Rica	2016	4,899,336 (4.9M)	Array[1]
11	630	Costa Rica	2017	4,949,955 (4.9M)	Array[1]

noSQL Output 12d

	_id	country	year	gdp	gdp_result
1	6307	Algeria	2000	208,554,150,226 (0.21T)	Array[1]
2	6307	Algeria	2001	223,420,295,817 (0.22T)	Array[1]
3	6307	Algeria	2002	245,360,882,457 (0.25T)	Array[1]
4	6307	Algeria	2003	273,568,648,245 (0.27T)	Array[1]
5	6307	Algeria	2004	296,773,599,327 (0.30T)	Array[1]
6	6307	Algeria	2005	326,854,481,209 (0.33T)	Array[1]
7	6307	Algeria	2006	345,705,351,663 (0.35T)	Array[1]
8	6307	Algeria	2007	371,665,201,209 (0.37T)	Array[1]
9	6307	Algeria	2008	395,658,551,735 (0.40T)	Array[1]
10	6307	Algeria	2009	418,247,682,283 (0.42T)	Array[1]
11	6307	Algeria	2010	450,705,877,335 (0.45T)	Array[1]

noSQL Output 12e

	_id	country	population	year	matching_result
1	63074	Denmark	5,341,192 (5.3M)	2000	Array[1]
2	63074	Denmark	5,358,059 (5.4M)	2001	Array[1]
3	63074	Denmark	5,372,798 (5.4M)	2002	Array[1]
4	63074	Denmark	5,386,968 (5.4M)	2003	Array[1]
5	63074	Denmark	5,402,754 (5.4M)	2004	Array[1]
6	63074	Denmark	5,421,701 (5.4M)	2005	Array[1]
7	63074	Denmark	5,444,293 (5.4M)	2006	Array[1]
8	63074	Denmark	5,469,920 (5.5M)	2007	Array[1]
9	63074	Denmark	5,497,731 (5.5M)	2008	Array[1]
10	63074	Denmark	5,526,389 (5.5M)	2009	Array[1]
11	63074	Denmark	5,554,849 (5.6M)	2010	Array[1]

noSQL Output 12f

	_id	country	year	population	gdp	gdp_per_capita
1	63074	Denmark	2000	5,341,192 (5.3M)	208,358,712,201 (0.21T)	39,009.7776 (39.0K)
2	63074	Denmark	2001	5,358,059 (5.4M)	211,275,272,656 (0.21T)	39,431.3076 (39.4K)
3	63074	Denmark	2002	5,372,798 (5.4M)	213,475,432,436 (0.21T)	39,732.637 (39.7K)
4	63074	Denmark	2003	5,386,968 (5.4M)	215,532,702,113 (0.22T)	40,010.0209 (40.0K)
5	63074	Denmark	2004	5,402,754 (5.4M)	222,551,117,434 (0.22T)	41,192.1619 (41.2K)
6	63074	Denmark	2005	5,421,701 (5.4M)	229,050,958,246 (0.23T)	42,247.0657 (42.2K)
7	63074	Denmark	2006	5,444,293 (5.4M)	239,379,200,822 (0.24T)	43,968.8314 (44.0K)
8	63074	Denmark	2007	5,469,920 (5.5M)	242,933,470,571 (0.24T)	44,412.6186 (44.4K)
9	63074	Denmark	2008	5,497,731 (5.5M)	243,073,654,298 (0.24T)	44,213.4499 (44.2K)
10	63074	Denmark	2009	5,526,389 (5.5M)	232,468,682,940 (0.23T)	42,065.2044 (42.1K)
11	63074	Denmark	2010	5,554,849 (5.6M)	238,176,024,487 (0.24T)	42,877.1375 (42.9K)

noSQL Output 12g

	_id	country	year	energy_per_capita
1	630748	Denmark	2000	44,037.943 (44.0K)
2	630748	Denmark	2001	44,006.794 (44.0K)
3	630748	Denmark	2002	43,746.435 (43.7K)
4	630748	Denmark	2003	46,980.912 (47.0K)
5	630748	Denmark	2004	44,252.394 (44.3K)
6	630748	Denmark	2005	42,532.489 (42.5K)
7	630748	Denmark	2006	46,688.108 (46.7K)
8	630748	Denmark	2007	44,026.56 (44.0K)
9	630748	Denmark	2008	42,141.057 (42.1K)
10	630748	Denmark	2009	39,407.67 (39.4K)
11	630748	Denmark	2010	41,164.357 (41.2K)

noSQL Output 12h

	_id	country	year	energy_per_gdp
1	63074	Denmark	2000	1.129
2	63074	Denmark	2001	1.116
3	63074	Denmark	2002	1.101
4	63074	Denmark	2003	1.174
5	63074	Denmark	2004	1.074
6	63074	Denmark	2005	1.007
7	63074	Denmark	2006	1.062
8	63074	Denmark	2007	0.991
9	63074	Denmark	2008	0.953
10	63074	Denmark	2009	0.937
11	63074	Denmark	2010	0.96

noSQL Output 12i

	_id	country	year	biofuel_co	coal_consumption	fossil_fuel_consur	gas_consumption	hydro_consumptic	low_carbon_cor
1	63074	Denmark	2000	0	46.183	219.737	51.019	0.084	15.478
2	63074	Denmark	2001	0	48.816	219.657	53.315	0.076	16.134
3	63074	Denmark	2002	0	48.874	216.426	53.818	0.087	18.615
4	63074	Denmark	2003	0	66.683	231.081	54.409	0.058	22.004
5	63074	Denmark	2004	0	51.114	213.308	54.15	0.072	25.777
6	63074	Denmark	2005	0	43.126	204.203	52.006	0.061	26.396
7	63074	Denmark	2006	0	65.442	229.538	52.983	0.063	24.601
8	63074	Denmark	2007	0	54.108	213.377	47.49	0.075	27.378
9	63074	Denmark	2008	0	47.655	204.957	47.716	0.068	26.653
10	63074	Denmark	2009	0	46.883	191.27	45.828	0.05	26.401
11	63074	Denmark	2010	0	44.574	195.93	51.84	0.054	32.41

noSQL Output 12j

Question 13

	_id	iso_code	country	year	coal_prod_change_pct	coal_prod_change_twh	gas_prod_change_pct
1	63074	AFG	Afghanistan	1900			
2	63074	AFG	Afghanistan	1901		0.0	
3	63074	AFG	Afghanistan	1902		0.0	
4	63074	AFG	Afghanistan	1903		0.0	
5	63074	AFG	Afghanistan	1904		0.0	
6	63074	AFG	Afghanistan	1905		0.0	
7	63074	AFG	Afghanistan	1906		0.0	
8	63074	AFG	Afghanistan	1907		0.0	
9	63074	AFG	Afghanistan	1908		0.0	
10	63074	AFG	Afghanistan	1909		0.0	
11	63074	AFG	Afghanistan	1910		0.0	

noSQL Output 13a

	country	year	biofuel_consumption	coal_consumption	fossil_fuel_consumption	gas_consumption	hydro_consumption	low_carbon_consumption
1	Africa	1990	0.0	877.81	2421.581	398.645	159.041	184.755
2	Africa	1991	0.0	853.195	2403.493	401.636	168.476	196.165
3	Africa	1992	0.0	858.301	2451.311	421.27	160.723	188.896
4	Africa	1993	0.0	871.615	2465.769	412.644	157.452	180.22
5	Africa	1994	0.0	894.169	2547.541	431.828	159.989	189.265
6	Africa	1995	0.0	921.803	2648.019	461.243	166.025	200.269
7	Africa	1996	0.0	934.552	2715.229	484.192	173.101	209.33
8	Africa	1997	0.0	958.321	2764.456	474.476	177.368	216.376
9	Africa	1998	0.0	936.307	2799.416	499.337	185.153	227.717
10	Africa	1999	0.0	965.481	2883.659	504.02	196.345	236.77
11	Africa	2000	0.0	963.274	2941.614	556.822	209.016	251.979

noSQL Output 13b

	country	year	total_consumption
1	Africa	2000	9,796.613 (9.8K)
2	Africa	2001	10,147.55 (10.1K)
3	Africa	2002	10,280.755 (10.3K)
4	Africa	2003	10,751.281 (10.8K)
5	Africa	2004	11,474.418 (11.5K)
6	Africa	2005	11,580.164 (11.6K)
7	Africa	2006	11,782.317 (11.8K)
8	Africa	2007	12,215.353 (12.2K)
9	Africa	2008	12,943.167 (12.9K)
10	Africa	2009	13,179.639 (13.2K)
11	Africa	2010	13,623.914 (13.6K)

noSQL Output 13c

	country	year	total_generated
1	Afghanistan	2000	1.72
2	Afghanistan	2001	2.27
3	Afghanistan	2002	2.63
4	Afghanistan	2003	3.45
5	Afghanistan	2004	3.23
6	Afghanistan	2005	3.38
7	Afghanistan	2006	3.16
8	Afghanistan	2007	3.6
9	Afghanistan	2008	2.73
10	Afghanistan	2009	3.6
11	Afghanistan	2010	3.57

noSQL Output 13d

	_id	country	year	gdp	population	biofuel_share_ene	coal_share_energ	fossil_share_ener	gas_share_energ	hydro_share_ener	low_carbon_
1	630748	Argentina	2000	536,481,027	36,870,796 (36.9M	0	1.06	83.969	45.55	13.333	16.031
2	630748	Argentina	2001	515,221,286	37,275,644 (37.3M	0	0.891	80.175	43.772	16.742	19.825
3	630748	Argentina	2002	461,203,417	37,681,744 (37.7M	0	0.691	80.09	44.336	17.124	19.91
4	630748	Argentina	2003	504,301,024	38,087,868 (38.1M	0	0.789	81.666	47.407	15.009	18.334
5	630748	Argentina	2004	552,377,778	38,491,968 (38.5M	0	1.266	84.074	48.944	12.743	15.926
6	630748	Argentina	2005	604,065,460	38,892,924 (38.9M	0	1.374	84.034	49.233	13.264	15.966
7	630748	Argentina	2006	655,698,992	39,289,876 (39.3M	0	1.182	83.129	48.428	13.891	16.871
8	630748	Argentina	2007	718,084,626	39,684,304 (39.7M	0	1.634	85.91	48.587	11.404	14.09
9	630748	Argentina	2008	750,663,609	40,080,160 (40.1M	0	1.971	86.24	48.595	11.049	13.76
10	630748	Argentina	2009	709,525,643	40,482,784 (40.5M	0	1.113	84.598	48.414	12.382	15.402
11	630748	Argentina	2010	784,986,270	40,895,752 (40.9M	0.659	1.5	84.888	46.855	11.768	15.112

noSQL Output 13e

	_id	country	fossil_electricity	renewables_	gdp	year	renewable_	fossil_change	gdp_change
1	630748	China	1,113 (1.1K)	225.55	5,952,68	2000	null	null	null
2	630748	China	1,182.5 (1.2K)	280.73	6,329,73	2001	55.18	69.5	377,054,862,
3	630748	China	1,337.4 (1.3K)	291.4	6,814,49	2002	10.67	154.9	484,756,565,
4	630748	China	1,579.9 (1.6K)	287.27	7,248,62	2003	-4.13	242.5	434,128,874,
5	630748	China	1,795.4 (1.8K)	357.42	7,830,95	2004	70.15	215.5	582,330,395,
6	630748	China	2,042 (2.0K)	404.36	8,602,93	2005	46.94	246.6	771,986,884,
7	630748	China	2,364.1 (2.4K)	446.72	9,489,54	2006	42.36	322.1	886,603,221,
8	630748	China	2,718 (2.7K)	500.7	10,358,2	2007	53.98	353.9	868,662,798,
9	630748	China	2,762.2 (2.8K)	665.07	10,799,1	2008	164.37	44.2	440,942,393,
10	630748	China	2,980 (3.0K)	664.39	11,572,5	2009	-0.68	217.8	773,395,365,
11	630748	China	3,326.1 (3.3K)	786.38	12,858,8	2010	121.99	346.1	1,286,263,90

noSQL Output 13f

	_id	country	fossil_electricity	renewables_	gdp	year	renewable_	fossil_change	gdp_change
1	630748	Cambodia	0.4	0	20,441,4	2000	null	null	null
2	630748	Cambodia	0.4	0	21,596,2	2001	0	0	1,154,785,91
3	630748	Cambodia	0.6	0	22,487,6	2002	0	0.2	891,401,254
4	630748	Cambodia	0.6	0	23,847,3	2003	0	0	1,359,730,28
5	630748	Cambodia	0.7	0	25,709,3	2004	0	0.1	1,862,023,64
6	630748	Cambodia	0.8	0	28,450,9	2005	0	0.1	2,741,585,83
7	630748	Cambodia	0.9	0.1	30,787,6	2006	0.1	0.1	2,336,647,78
8	630748	Cambodia	1.2	0.1	33,155,6	2007	0	0.3	2,367,990,63
9	630748	Cambodia	1.2	0.1	34,556,5	2008	0	0	1,400,907,95
10	630748	Cambodia	1	0.1	34,483,4	2009	0	-0.2	-73,115,510
11	630748	Cambodia	0.8	0.1	34,988,6	2010	0	-0.2	505,210,462

noSQL Output 13g

Question 14

	_id	country	year	nuclear_electricity	fossil_share_energy	solar_share_energy
1	630748	Singapore	1985	0.0	100.0	0.0
2	630748	Singapore	1986	0.0	99.857	0.0
3	630748	Singapore	2020	0.0	99.747	0.077

noSQL Output 14a

	_id			avg_kwh
	year	region	quarter	
1	2005	Central Region	4	692.2893
2	2005	Central Region	1	604.1359
3	2006	Central Region	1	619.7231
4	2006	Central Region	4	699.9743
5	2007	Central Region	4	701.5646
6	2007	Central Region	1	591.7594
7	2008	Central Region	1	615.6254
8	2008	Central Region	4	691.171
9	2009	Central Region	4	703.9729
10	2009	Central Region	1	606.7127

noSQL Output 14b

Question 15

	_id	DomainCode	Domain	AreaCode	Area	ElementCode	Element	MonthsCode	Months
1	637668c5	ET	Temperature change	2	Afghanistan	7271	Temperature change	7001	January
2	637668c5	ET	Temperature change	2	Afghanistan	7271	Temperature change	7001	January
3	637668c5	ET	Temperature change	2	Afghanistan	7271	Temperature change	7001	January
4	637668c5	ET	Temperature change	2	Afghanistan	7271	Temperature change	7001	January
5	637668c5	ET	Temperature change	2	Afghanistan	7271	Temperature change	7001	January
6	637668c5	ET	Temperature change	2	Afghanistan	7271	Temperature change	7001	January
7	637668c5	ET	Temperature change	2	Afghanistan	7271	Temperature change	7001	January
8	637668c5	ET	Temperature change	2	Afghanistan	7271	Temperature change	7001	January
9	637668c5	ET	Temperature change	2	Afghanistan	7271	Temperature change	7001	January
10	637668c5	ET	Temperature change	2	Afghanistan	7271	Temperature change	7001	January
11	637668c5	ET	Temperature change	2	Afghanistan	7271	Temperature change	7001	January

noSQL Output 15a

	_id		Average_Value
	Area	Year	
1	World	1961	0.1409
2	World	1962	-0.0433
3	World	1963	-0.0306
4	World	1964	-0.1176
5	World	1965	-0.228
6	World	1966	0.0972
7	World	1967	-0.1331
8	World	1968	-0.1677
9	World	1969	0.1212
10	World	1970	0.0856

noSQL Output 15b

	_id		tempChange
	Area	Year	
1	World	1961	0.1409
2	World	1962	-0.0433
3	World	1963	-0.0306
4	World	1964	-0.1176
5	World	1965	-0.228
6	World	1966	0.0972
7	World	1967	-0.1331
8	World	1968	-0.1677
9	World	1969	0.1212
10	World	1970	0.0856

noSQL Output 15c

	_id	iso_code	country	year	coal_prod_change_pct	coal_prod_change_twh	gas_prod_change_pct
1	63074887ff3acbe0d63c	OWID_WRL	World	1900			
2	63074887ff3acbe0d63c	OWID_WRL	World	1901	1.808	96.707	10.817
3	63074887ff3acbe0d63c	OWID_WRL	World	1902	2.42	131.829	9.761
4	63074887ff3acbe0d63c	OWID_WRL	World	1903	9.122	508.837	8.893
5	63074887ff3acbe0d63c	OWID_WRL	World	1904	0.509	30.981	8.167
6	63074887ff3acbe0d63c	OWID_WRL	World	1905	7.809	477.761	7.55
7	63074887ff3acbe0d63c	OWID_WRL	World	1906	5.601	369.474	7.02
8	63074887ff3acbe0d63c	OWID_WRL	World	1907	10.617	739.536	6.56
9	63074887ff3acbe0d63c	OWID_WRL	World	1908	-4.964	-382.441	6.156
10	63074887ff3acbe0d63c	OWID_WRL	World	1909	4.493	328.97	5.799
11	63074887ff3acbe0d63c	OWID_WRL	World	1910	5.366	410.572	8.138

noSQL Output 15d

	_id	country	year	greenhouse_gas_emissions	greenhouse_gas_emissions_per_capita
1	630748	World	2000	6,969.64 (7.0K)	0
2	630748	World	2001	7,097.5 (7.1K)	0
3	630748	World	2002	7,397.38 (7.4K)	0
4	630748	World	2003	7,811.07 (7.8K)	0
5	630748	World	2004	8,112.86 (8.1K)	0
6	630748	World	2005	8,485.61 (8.5K)	0
7	630748	World	2006	8,862.72 (8.9K)	0
8	630748	World	2007	9,442.85 (9.4K)	0
9	630748	World	2008	9,467.59 (9.5K)	0
10	630748	World	2009	9,350.67 (9.4K)	0
11	630748	World	2010	10,018.95 (10.0K)	0

noSQL Output 15e

	_id	country	year	greenhouse_gas_emissions	greenhouse_gas_emissions_per_capita	globalTempChange_GHGemissions
1	630748	World	2000	6,969.64 (7.0K)	0	Array[1]
2	630748	World	2001	7,097.5 (7.1K)	0	Array[1]
3	630748	World	2002	7,397.38 (7.4K)	0	Array[1]
4	630748	World	2003	7,811.07 (7.8K)	0	Array[1]
5	630748	World	2004	8,112.86 (8.1K)	0	Array[1]
6	630748	World	2005	8,485.61 (8.5K)	0	Array[1]
7	630748	World	2006	8,862.72 (8.9K)	0	Array[1]
8	630748	World	2007	9,442.85 (9.4K)	0	Array[1]
9	630748	World	2008	9,467.59 (9.5K)	0	Array[1]
10	630748	World	2009	9,350.67 (9.4K)	0	Array[1]
11	630748	World	2010	10,018.95 (10.0K)	0	Array[1]

noSQL Output 15f

	_id	iso_code	country	year	gdp	population	greenhouse_gas_	isox	gdp_per_capita	greenhouse_gas_
1	63774	AFG	Afghanistan	2000	11,283,79	20,779,958 (20	0.12	3	543.0133	0
2	63774	AFG	Afghanistan	2001	11,021,27	21,606,992 (21	0.07	3	510.079	0
3	63774	AFG	Afghanistan	2002	18,804,87	22,600,774 (22	0.1	3	832.0455	0
4	63774	AFG	Afghanistan	2003	21,074,34	23,680,872 (23	0.24	3	889.9311	0
5	63774	AFG	Afghanistan	2004	22,332,57	24,726,690 (24	0.24	3	903.1768	0
6	63774	AFG	Afghanistan	2005	25,397,68	25,654,274 (25	0.25	3	989.9983	0
7	63774	AFG	Afghanistan	2006	28,704,40	26,433,058 (26	0.16	3	1,085.9281 (1.1K)	0
8	63774	AFG	Afghanistan	2007	34,507,52	27,100,542 (27	0.16	3	1,273.3151 (1.3K)	0
9	63774	AFG	Afghanistan	2008	36,561,04	27,722,282 (27	0.14	3	1,318.8324 (1.3K)	0
10	63774	AFG	Afghanistan	2009	44,358,71	28,394,806 (28	0.13	3	1,562.2125 (1.6K)	0
11	63774	AFG	Afghanistan	2010	47,399,42	29,185,512 (29	0.15	3	1,624.0738 (1.6K)	0

noSQL Output 15g

	_id	iso_code	country	year
1	63774a36905577f00e7	AFG	Afghanistan	1900
2	63774a36905577f00e7	AFG	Afghanistan	1901
3	63774a36905577f00e7	AFG	Afghanistan	1902
4	63774a36905577f00e7	AFG	Afghanistan	1903
5	63774a36905577f00e7	AFG	Afghanistan	1904
6	63774a36905577f00e7	AFG	Afghanistan	1905
7	63774a36905577f00e7	AFG	Afghanistan	1906
8	63774a36905577f00e7	AFG	Afghanistan	1907
9	63774a36905577f00e7	AFG	Afghanistan	1908
10	63774a36905577f00e7	AFG	Afghanistan	1909
11	63774a36905577f00e7	AFG	Afghanistan	1910

noSQL Output 15h