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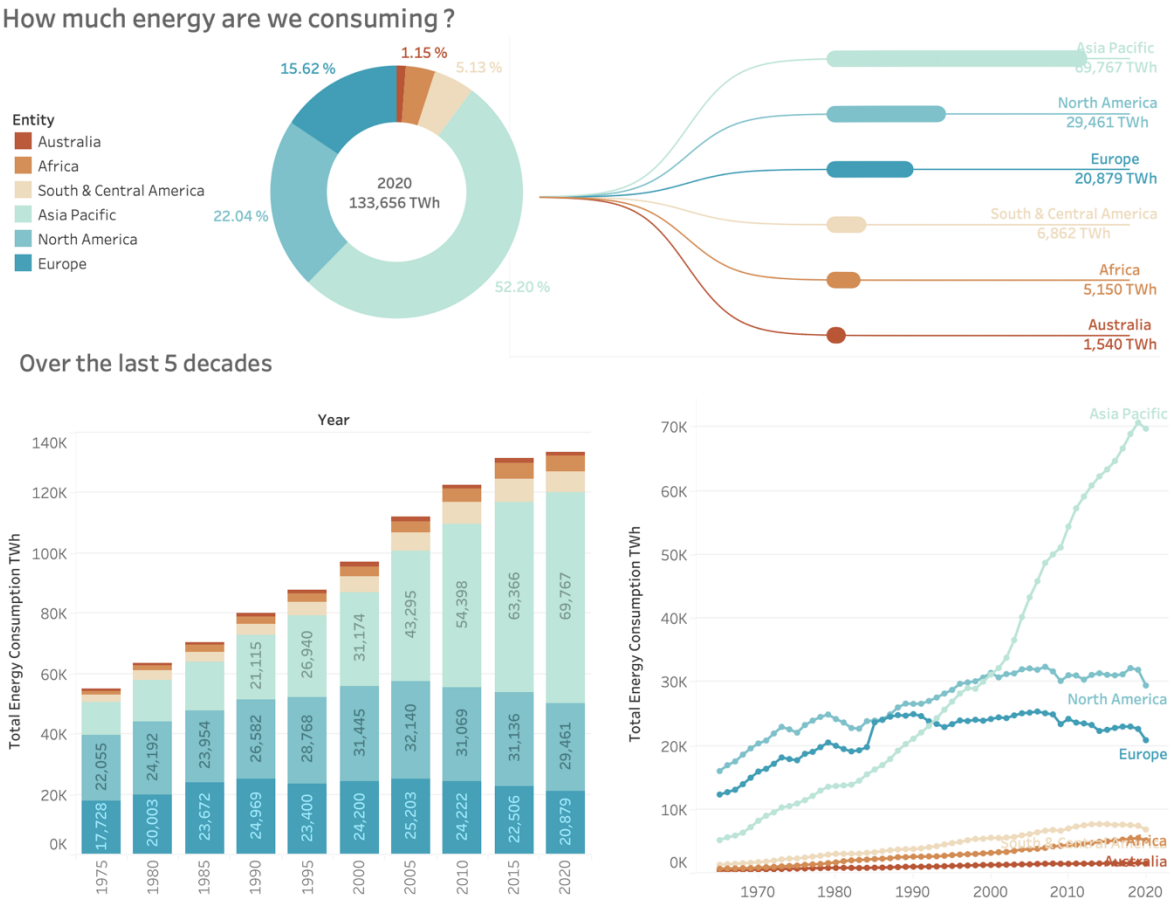
Visualization Topic - Energy consumption in the world

Energy is a basic part of economic activity and powers businesses worldwide. Today, we consume a truly vast amount of energy, with demand continuing to skyrocket. Producing this energy has significant environmental impacts and emitting so much carbon dioxide into the atmosphere could cause climate change. In this project, we look at some world energy consumption datasets from https://ourworldindata.org/energy to see at what rate the consumption is growing and its's consequences on the environment.

Technical approach – We used Tableau for rendering visuals, Microsoft Excel for data cleaning, manipulation and merging, Python for TSNE clustering.

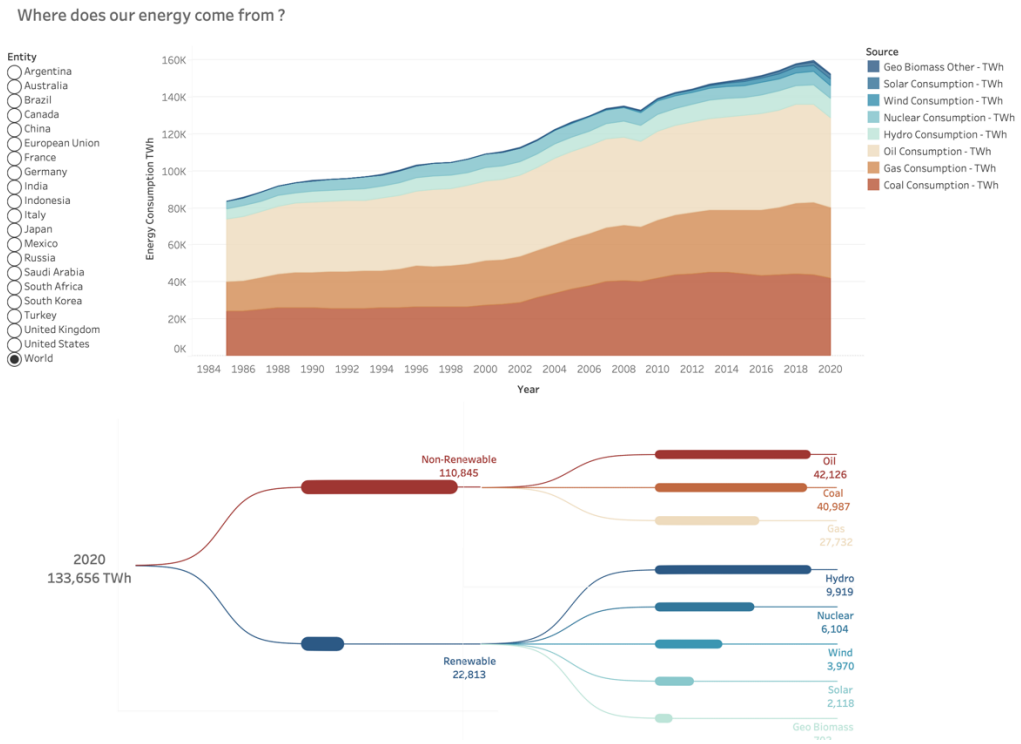
How much energy is the world consuming?



Insights :

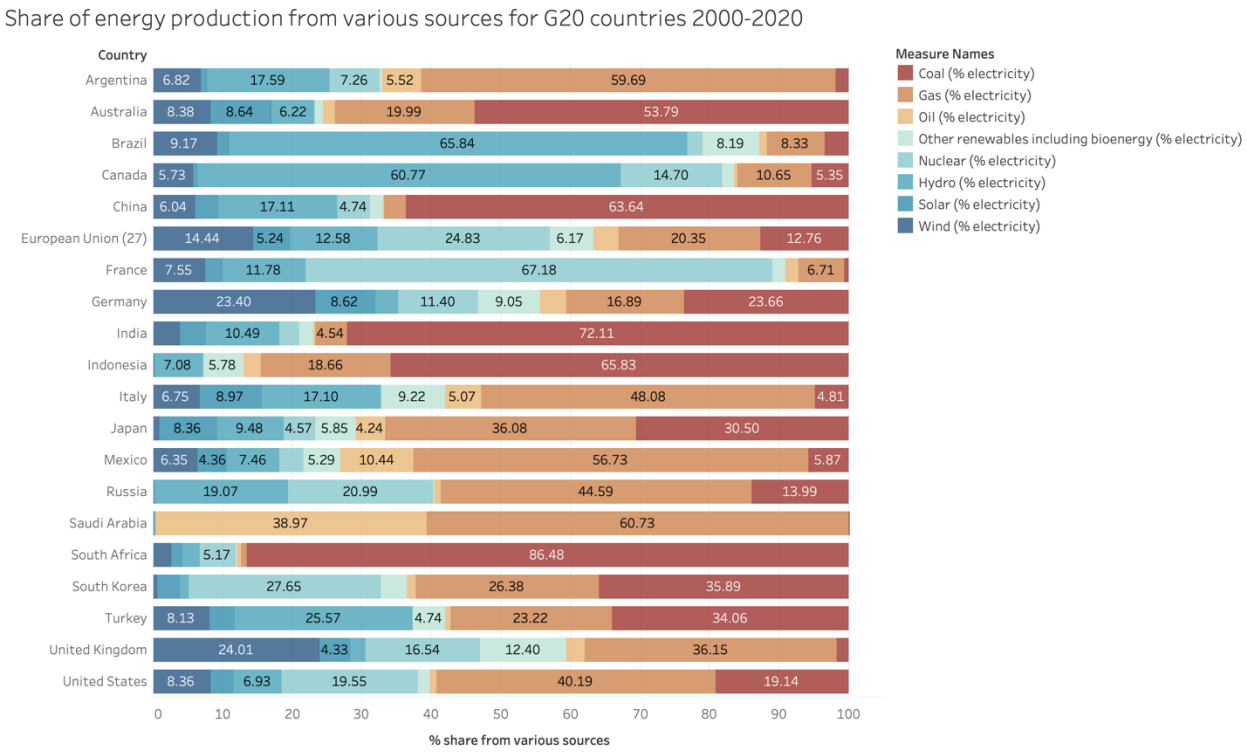
- Over the last 5 decades there has been a huge increase in the consumption, noticeably since 2000, when there has been a nearly 30% increase.
- There is noticeable growth in consumption in continents with many developing countries (Africa, Asia, South America), with the largest rate in Asia Pacific where numbers have more than doubled.
- Interestingly, since 2010, there is a small decrease in consumption numbers in Europe and North America, probably due to more awareness and action towards climate change and environment conservation.
- Most recently, Asia pacific is the largest consumer at over 50%.
- While the bar chart shows the overall magnitude of consumption in the world well, the line chart makes it easier to study the trend in every continent over the last 5 years.

Where does our energy come from ?



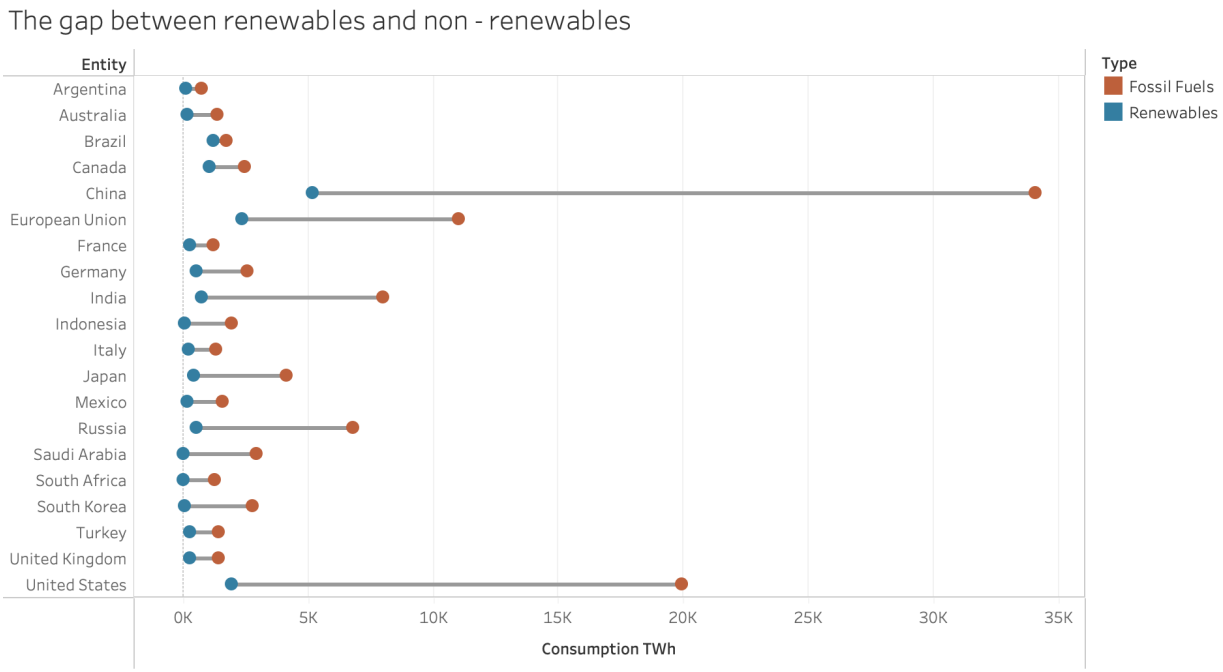
Insights :

- As we can see from above visualizations, over 80 % of our energy still comes from fossil fuels.
- Over 50% of that comes from China, United States and the Persian States of Gulf.
- The area chart in the dashboard is interactive and allows us to study the consumption from various sources for different countries selectable from the entity list. The list currently contains G20 countries, which are some of the biggest consumers from the data studied.
- The trend has been similar over the last 50 years. There has been a significant increase in energy from renewable & nuclear sources since 2000, but the numbers are still small compared to fossil fuels.
- Saudi Arabia, China, Russia and the United states are some big users of fossil fuels through the years. Noticeably, the European Union and Canada show a rise in consumption from renewable sources.



This stacked bar allows us to study the proportion from various sources more clearly, and the divide among various sources. It is animated to show the change over the last 20 years, a period when there is a growth in use of renewables.

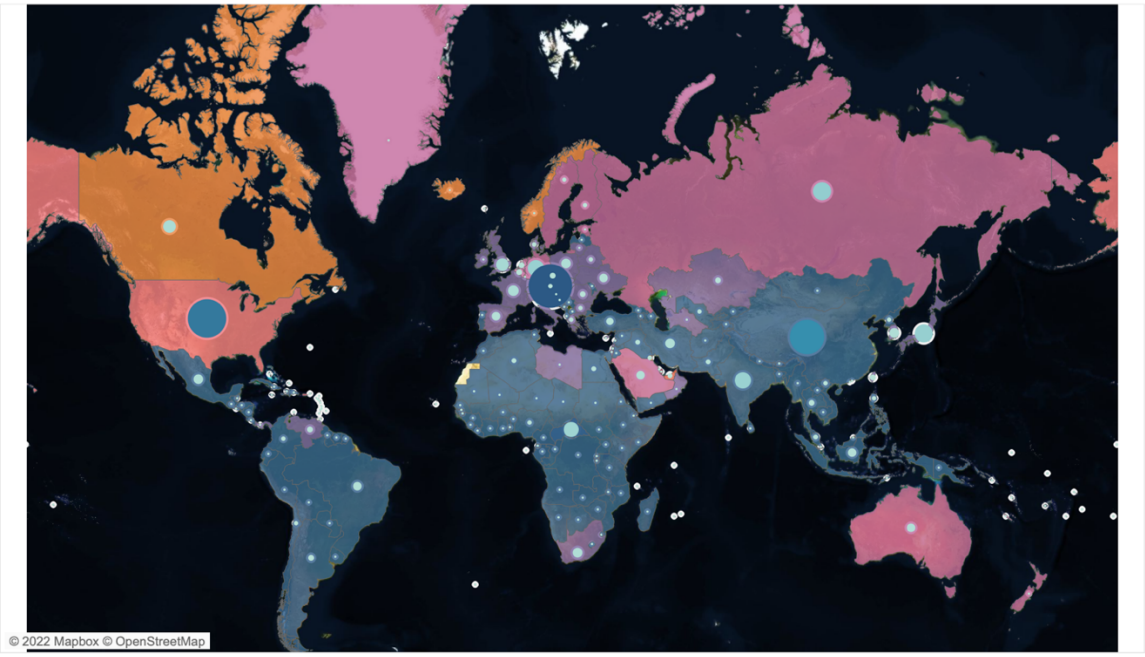
We also created a dumbbell chart to study how big the gap is between 3 sources – renewables, nuclear and fossil fuel sources. A list allows us to select any 2 entities to compare. Consistent with previous observations, China, Russia, United States and EU have huge differences.



How is the energy consumption affecting the environment?

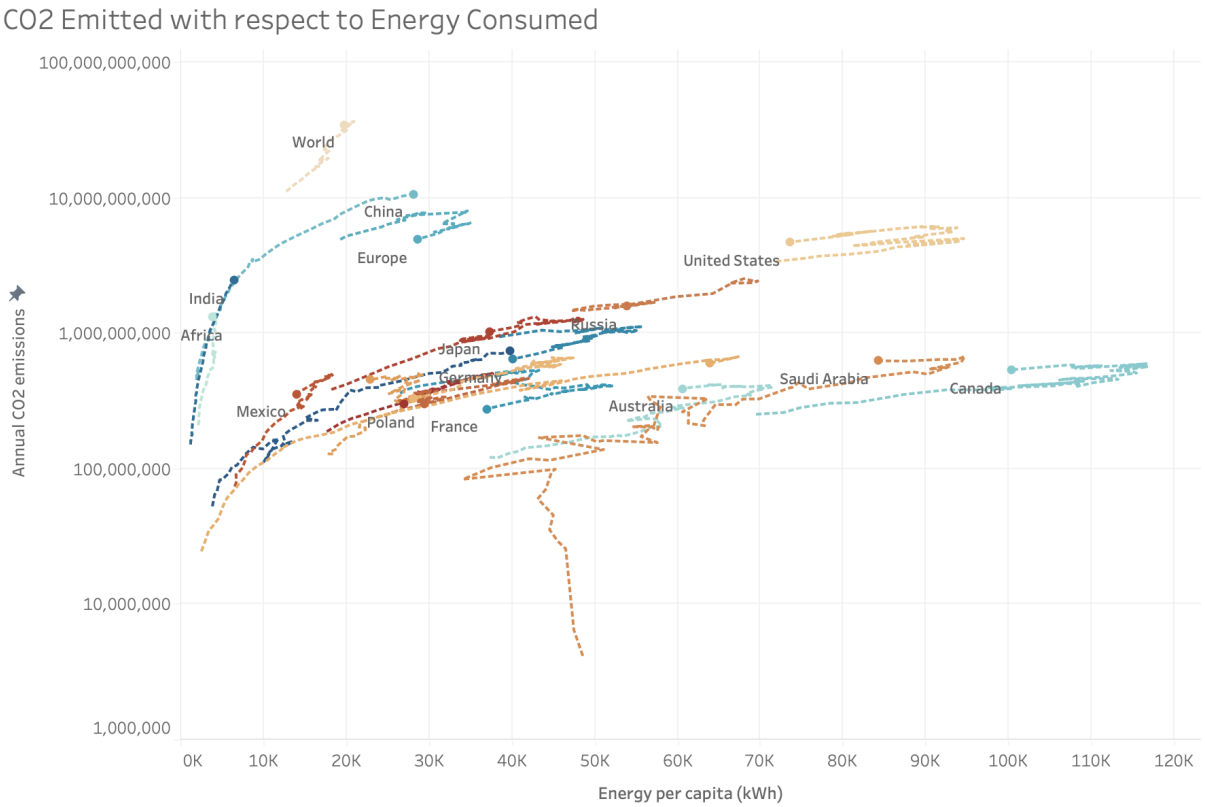
This map is an interesting visualisation which gives a graphical representation of the magnitude of energy consumed per capita as well as how much of this energy is emitted in the form of CO2. The diverging colour scale is based on per capita consumption of energy. The size of bubbles on the map depict the CO2 emissions for every country w.r.t to energy that is being utilised. As seen in the map the USA, Russia have a higher energy consumption per capita and a high rate of emission.

CO2 Emitted with respect to Energy Consumed

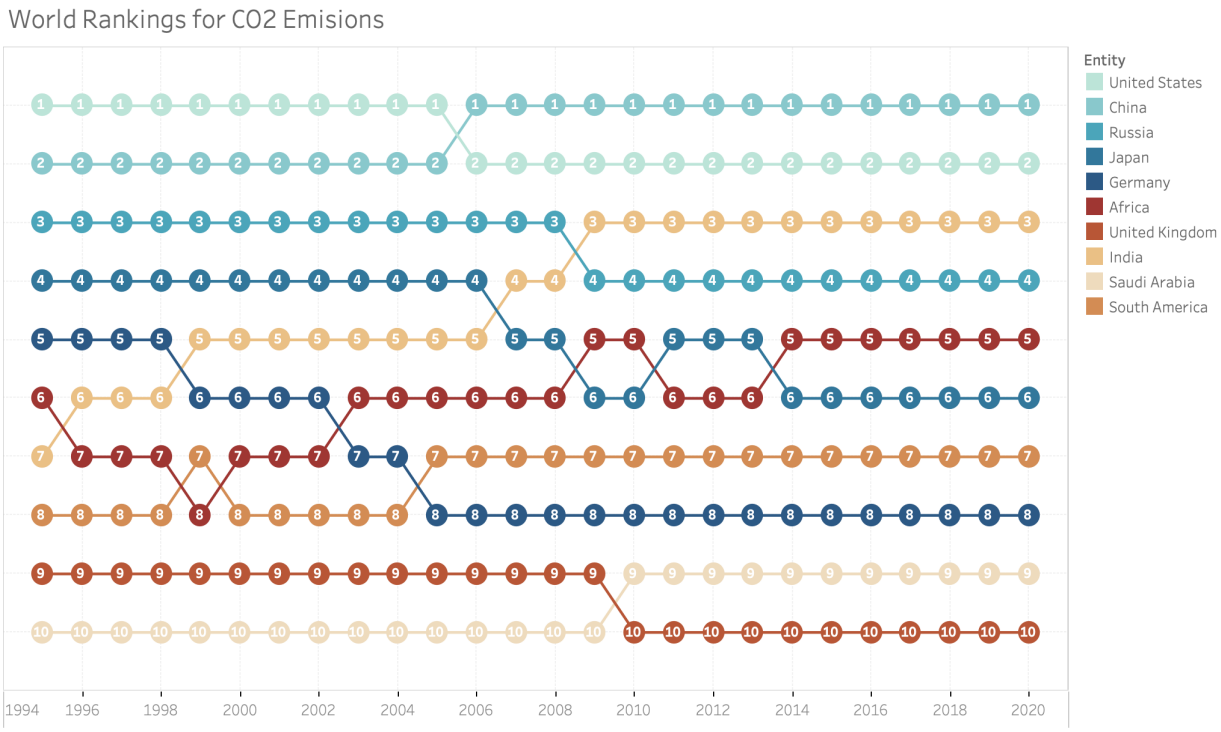


CO2 emissions as a result of energy

The connected scatterplot shows the change in emission rates w.r.t consumption for the Top 20 countries in the world.
The trail left behind on the connected scatterplot helps us to see the progression of the top emitting countries over the course of 55 years.
Again this connected scatterplot concludes that the USA, Russia, Europe are some of the top CO2 emitters and consumers over the course of 55 years.
Japan, UK, India have closely followed the top 5 countries.
Overall, there is an increase in both consumption of energy & CO2 emissions in the world.



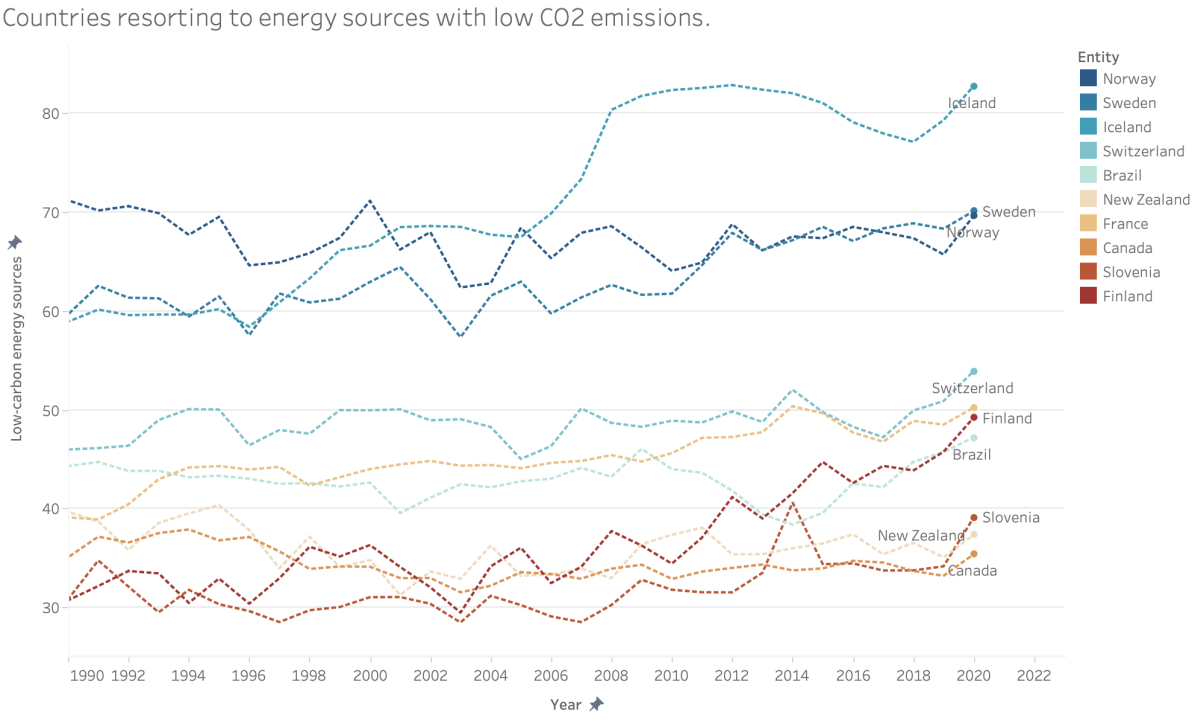
Which countries are the least environment friendly with their energy?



Who emits the most CO2 each year? We are trying to find the answer to this question by using Bump chart. This chart shows the Annual CO2 emissions in the world caused by consumption of energy resources from a period of 1990 to 2020. The energy resources taken into consideration are renewable, non-renewable and nuclear energy. United States ranks number one in the table of emissions for a good 10 years before surrendering the position to China. Russia, Japan and Germany closely follow. There is a sudden shift towards early 2000 where India is emerging as one of the top emitters. Saudi Arabia, though one of the largest producers of fossil fuels, has lower CO2 emissions.

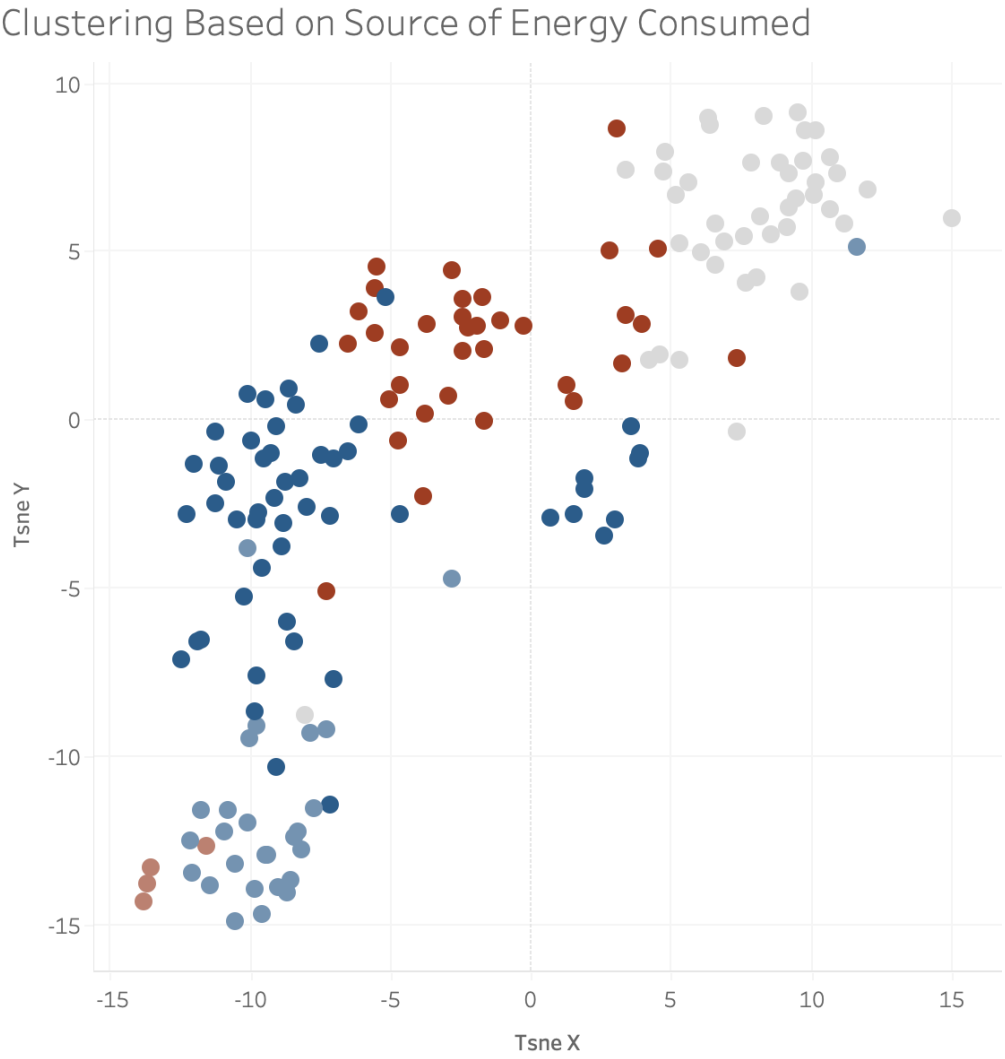
Low carbon energy users

In this chart we look at countries that consume energy from sources that are low carbon.
Countries in Europe are increasing the usage of energy sources which lessens the CO2 emissions.
Iceland, Sweden, and Norway have achieved this feat as compared to other countries.
They are closely followed by other European countries. We selected only the largest low carbon users for this chart to avoid clutter.



Clustering

We tried to study which countries are similar in terms of their energy consumption from various sources. We used TSNE to perform high dimensional visualization & clustering based on consumption from the 3 main categories of energy – fossil fuels, nuclear and renewable sources. There are no obvious patterns in the resulting cluster based on consumption magnitude, population or GDP. However, most European countries, which have consumption from similar sources (more renewables), are more carbon friendly and have lower CO2 emissions occur in the same cluster (cluster 1 & 3).



Challenges we faced with the data sets:

a. We wanted to compare consumption of different sources of energy. Some of these were available as separate datasets per source and needed to be merged correctly for visualizations.
b. Renewable sources of energy are relatively new. The available data for these sources are more recent, mostly from the 1970s, and some data just from 2000 which is not particularly an extensive timeline to study change.
c. Datasets have entries very long back in time with numbers like -1000, -2000 for the year field and these do not contain complete information. We had to spend time removing these entries that don't come into scope for our visualizations.
d. Nulls - Datasets contain rows for almost every country in the world but sometimes don’t have corresponding energy values or continent information for categorizing.
e. The range of values ion the data set is huge. This lead to some challenges choosing scale, and especially while attempting clustering as it lead to a lot of NaN errors.