Estimation of Greenhouse gas emissions and their impact on the Planet Earth

Group 2

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Background - Reasons for Choosing this Project

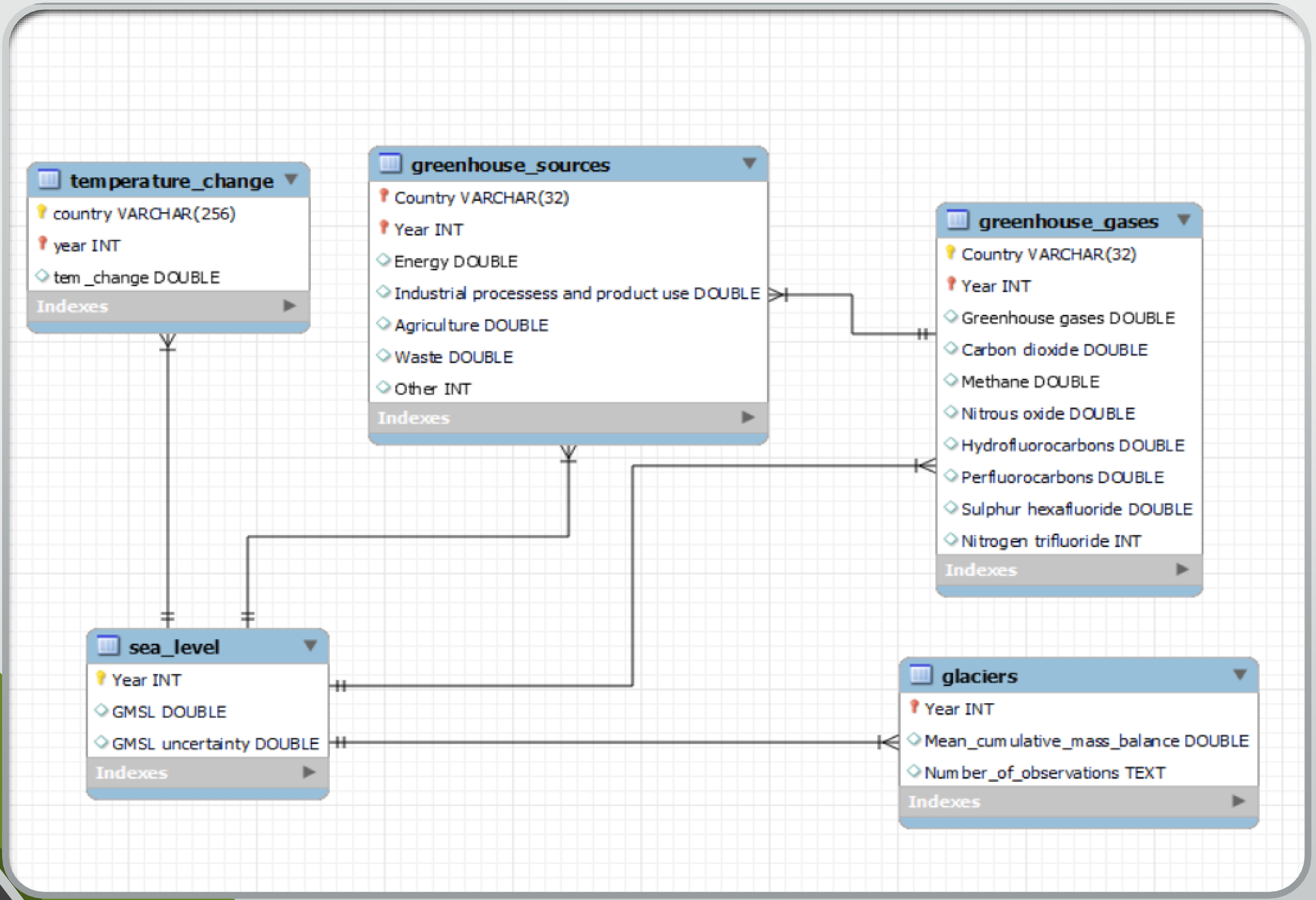
- From the beginning of the industrial revolution , the usage of fossil fuels and other natural resources has skyrocketed.
- The indiscriminate usage of these resources has led to a disastrous thing called Greenhouse Effect (Global Climate Change, 2022).
- We chose this topic in order to project the dangerous consequences of Greenhouse effect.
- Primarily, we are considering the amount of Greenhouse gasses emitted by different countries and the primary sources of these gasses too.
- Along with this analysis, we are focusing on the consequences of the effects like Temperature changes, Melting of Polar ice caps and Increase in Mean Sea levels

Methods Used

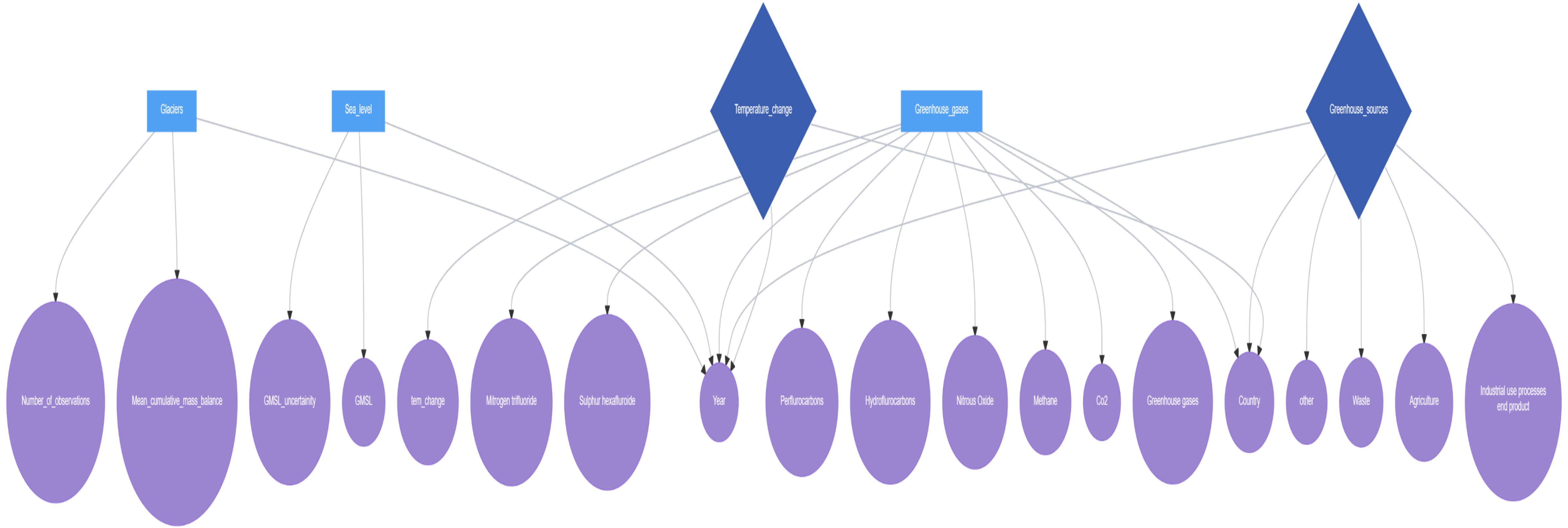
Following methods implemented while developing this project include

- Designing the ER diagram: We used the Traditional Crow's Foot notation to draw the diagram and also included Chen's notation as taught in the class.
- We used both MySQL workbench and phpMyAdmin to create the tables and to import the data from the available datasets.
- We connected our database to Tableau in order to provide a wide variety of interactive visualizations.
- Created queries, tableau dashboards and proved our research questions along with an in-depth analysis of the extent of damage Greenhouse effect is incurring.

Entity Relationship Diagram



ER Diagram Chen’s Notation



Queries to support our Research questions

Minimum and Maximum amount of constituent greenhouse gas emissions by respective countries

```sql
select country, max(Carbon_dioxide), max(Nitrous_oxide), max(Methane),
max(Perfluorocarbons), max(Hydrofluorocarbons), max(Sulphur_hexafluoride)
from greenhouse_gases group by Country;
```

country	max(Carbon_dioxide)	max(Nitrous_oxide)	max(Methane)	max(Perfluorocarbons)	max(Hydrofluorocarbons)	max(Sulphur_hexafluoride)
Argentina	201531.775	51353.292	100799.193	1562.949	613.176	1.798
Belarus	103757.549	16542.073	18852.364	0	0	6.828
Brazil	541676	177326.2	348534.9	2603.37	10232.01	814.99
Bulgaria	76698.698	8652.692	14622.996	2808.43	2252.53	20.419
Croatia	24866.343	2853.387	4305.492	1240.239	552.602	13.049
Cyprus	8714.141	343.558	889.552	0	341.741	16.391
Indonesia	628114	54668	236331.9	0	0	0

```sql
select country, min(Carbon_dioxide), min(Nitrous_oxide), min(Methane),
min(Perfluorocarbons), min(Hydrofluorocarbons), min(Sulphur_hexafluoride)
from greenhouse_gases  group by Country ;
```

country	min(Carbon_dioxide)	min(Nitrous_oxide)	min(Methane)	min(Perfluorocarbons)	min(Hydrofluorocarbons)	min(Sulphur_hexafluoride)
Argentina	100932.724	37845.763	72585.76	113.202	0	0.628
Belarus	54583.388	10659.727	13070.825	0	0	0
Brazil	213555	103561.7	231672	239.45	519.09	184.03
Bulgaria	42222.519	3576.016	6245.9	0.012	0.003	3.694
Croatia	16052.777	1579.42	3271.756	0	0	5.216
Cyprus	4651.68	229.035	660.228	0	0	2.65

Minimum and Maximum amount of greenhouse gas emissions by respective countries

```sql
select country, min(Greenhouse_gases),
max(Greenhouse_gases) from greenhouse_gases group by Country;
```

country	min(Greenhouse_gases)	max(Greenhouse_gases)
Argentina	220240.771	335854.126
Belarus	78363.789	139151.986
Brazil	552640.82	1062897.04
Bulgaria	54893.915	99978.08
Croatia	21818.718	31485.74

Average Greenhouse gasses emissions by the OECD Countries

Limit to 50000 rows

```sql
SELECT Country,round(AVG(Greenhouse_gases),2) FROM `greenhouse_gases`
WHERE Country like "%OECD%" group by Country;
```

Result Grid | Filter Rows: | Export: | Wrap Cell Content:

Country	round(AVG(Greenhouse_gases),2)
OECD - Europe	5182586.57
OECD - Total	16128880.57
OECD America	8414910

Country wise Average amount of Greenhouse gasses emissions through various sources

```sql
SELECT Country, ROUND(AVG(Energy),2) AS Average_energy, ROUND(AVG(Industrial_processess_and_product_use),2)
AS Average_industry, ROUND(AVG(Agriculture),2) AS Average_agriculture, ROUND(AVG(Waste),2) AS Average_waste
from greenhouse_sources group by Country order by Country;
```

esult Grid | Filter Rows: | Export: | Wrap Cell Content:

Country	Average_energy	Average_industry	Average_agriculture	Average_waste
Argentina	52	4.3	39.62	4.09
Belarus	65.13	5.6	23.88	5.38
Brazil	38.44	9.72	46.28	5.56
Bulgaria	73.45	10.65	9.21	6.69
China (People's Republic of)	77.36	11.28	9.45	1.91
Croatia	70.95	11.61	12.05	5.39
Cyprus	75.71	11.8	6.5	5.98
India	68.89	7.17	21.16	2.78

Average Greenhouse gasses emissions in USA, United kingdom, European Union from 1990 to 2020

```sql
SELECT Country, ROUND(avg(Greenhouse_gases),2) FROM greenhouse_gases
WHERE Country IN("European Union (28 countries)", "United Kingdom", "United States")
and Year BETWEEN 1990 AND 2020 GROUP BY Country;
```

Result Grid | Filter Rows: | Export: | Wrap Cell Content:

Country	ROUND(avg(Greenhouse_gases),2)
European Union (28 countries)	4964645.61
United Kingdom	655429.96
United States	6906367.89

Countries which are emitting higher levels of Carbon dioxide than Nitrous oxide

```sql
select distinct g1.country, g1.Carbon_dioxide, g2.Nitrous_oxide
from greenhouse_gases g1 inner join greenhouse_gases g2 on
g1.Country=g2.Country where g1.Carbon_dioxide > g2.Nitrous_oxide group by g1.country;
```

Result Grid | Filter Rows: | Export: | Wrap Cell Content:

country	Carbon_dioxide	Nitrous_oxide
Argentina	200983.616	37852.886
Belarus	61022.455	16542.073
Brazil	478123	103561.7
Bulgaria	42222.519	8652.692
Croatia	17778.838	2853.387
Cyprus	7339.882	256.468

```sql
CREATE VIEW Yearwise_temp_changes AS
SELECT greenhouse_gases.Year, ROUND(AVG(greenhouse_gases.Greenhouse_gases),2)
AS greenhouse_effect,temperature_change.tem_change FROM `greenhouse_gases`
INNER JOIN temperature_change ON greenhouse_gases.Year=temperature_change.year
GROUP BY greenhouse_gases.Year,temperature_change.year ORDER BY temperature_change.tem_change;

select * from Yearwise_temp_changes;
```

Result Grid | Filter Rows: | Export: | Wrap Cell Content:

Year	greenhouse_effect	tem_change
1992	987697.37	-0.32
1991	999782.94	-0.178
1996	1014861.98	-0.106
2012	1140489.56	0.102
1993	984947.05	0.172
1995	1008231.31	0.363
2005	1165561.41	0.386
1994	1005644.82	0.423
2014	1172204.15	0.474
1997	1031565.86	0.48
2003	1030934.31	0.598
2007	1052245.79	0.616

This query helps us in understanding the Year wise greenhouse emissions and the corresponding change in temperature

```sql
SELECT avg(temperature_change.tem_change) as Avg_Temp_change,
avg(glaciers.Mean_cumulative_mass_balance) as Avg_Cumulative_mass_balance,
avg(sea_level.GMSL) as Avg_Sea_level
FROM temperature_change INNER join sea_level ON
temperature_change.year=sea_level.Year INNER join glaciers
on glaciers.Year=temperature_change.year where
temperature_change.year > 1990;
```

Result Grid | Filter Rows: | Export: | Wrap Cell Content:

Avg_Temp_change	Avg_Cumulative_mass_balance	Avg_Sea_level
0.7995743079164609	-20.849068965516878	40.32413793103485

This query helps us in understanding the average increase in temperature will affect the decrease in cumulative mass of polar ice caps and increase in mean sea level

This query explains us the sectors that are contributing to the greenhouse effect and the percentage of emissions of the constituent gasses in each sector

```sql
select gs.country, gs.Energy, gs.Industrial_processess_and_product_use,
gs.Agriculture,gs.Waste,round(sum(gg.Carbon_dioxide)/sum(gg.Greenhouse_gases)*100,2)
as carbondioxide_trend, round(sum(gg.Methane)/sum(gg.Greenhouse_gases)*100,2)
as methane_trend, round(sum(gg.Nitrous_oxide)/sum(gg.Greenhouse_gases)*100,2)
as NO2_trend from greenhouse_sources gs inner join greenhouse_gases gg on
gs.Country=gg.country group by gs.Country order by carbondioxide_trend DESC Limit 10;
```

Result Grid | Filter Rows: | Export: | Wrap Cell Content: | Fetch rows:

country	Energy	Industrial_processess_and_product_use	Agriculture	Waste	carbondioxide_trend	methane_trend	NO2_trend
Japan	86.032	8.743	2.894	2.331	92.3	2.64	1.96
Luxembourg	80.939	12.641	5.589	0.831	91.62	5.18	2.81
Monaco	98.944	0.366	0	0.69	91.5	1.47	3.3
Korea	82.275	6.997	7.177	3.551	89.78	5.13	2.75
Estonia	90.183	2.347	6.569	0.901	89.33	6.06	4.02
Saudi Arabia	78.357	6.705	6.869	8.068	88.94	8.13	2.93
Malta	93.136	0.3	3.893	2.671	87.96	6.48	2.1
Israel	87.764	4.209	3.594	4.436	86.42	8.24	3.09
Germany	83.054	7.756	6.128	3.062	86.38	7.55	4.62
Liechtenstein	88.086	0.287	10.897	0.73	85.34	8	4.13

Average temperature change of top 10 countries before and after year 2000

```sql
select Country, round(avg(tem_change),2) as
Average_temp_change from temperature_change
where year<2000 group by Country order by
Average_temp_change desc limit 10;
```

Result Grid | Filter Rows: | Export: | Wrap Ce

Country	Average_temp_change
Mongolia	0.53
Gambia	0.52
Senegal	0.49
Mauritania	0.48
Cabo Verde	0.47
Guinea-Bissau	0.45
Western Sahara	0.41
Tunisia	0.4
Morocco	0.39
Andorra	0.35

```sql
select Country, round(avg(tem_change),2) as
Average_temp_change from temperature_change
where year>2000 group by Country order by
Average_temp_change desc limit 10;
```

Result Grid | Filter Rows: | Export: | Wrap

Country	Average_temp_change
Svalbard and Jan Mayen Islands	2.67
Kuwait	1.69
Russian Federation	1.66
Bahrain	1.66
Estonia	1.66
Belarus	1.64
Eastern Europe	1.64
Morocco	1.63
Slovenia	1.62
Finland	1.62

Percentage increase and decrease in the green house gasses emissions between 2 decades

Decade 1 - 1990 to 2000

Decade 2 - 2000 to 2020

```sql
CREATE VIEW decade1 AS SELECT Country, ROUND(avg(Greenhouse_gases),2)
AS decade1 FROM greenhouse_gases WHERE Year BETWEEN 1990 AND 2000 GROUP BY Country;

CREATE VIEW decade2 AS SELECT Country, ROUND(avg(Greenhouse_gases),2)
AS decade2 FROM greenhouse_gases WHERE Year BETWEEN 2001 AND 2020 GROUP BY Country;
```

```sql
select d1.Country,d1.decade1,d2.decade2,
ROUND(((d2.decade2-d1.decade1)/d2.decade2)*100,2)
as percentage_increase_in_Greenhouse_gasses from decade1
d1 inner join decade2 d2 on d1.Country=d2.Country where
d1.decade1<d2.decade2 order by
percentage_increase_in_Greenhouse_gasses desc limit 10;
```

Result Grid | Filter Rows: | Export: | Wrap Cell Content: | Fetch rows:

Country	decade1	decade2	percentage_increase_in_Greenhouse_gasses
China (People's Republic of)	4057617	10688574	62.04
Saudi Arabia	230664.42	536797.35	57.03
Indonesia	345573.26	682162.81	49.34
India	1369007.28	2470137.34	44.58
Turkey	255129.09	408283.97	37.51
Chile	60493.93	92153.2	34.36
Korea	413080.33	628007.97	34.22
Brazil	635051.45	897092.15	29.21
Peru	60389.94	82577.51	26.87
Costa Rica	9254.87	12532.46	26.15

```sql
select d1.Country,d1.decade1,d2.decade2,
ROUND(((d1.decade1-d2.decade2)/d1.decade1)*100,2) as
percentage_decrease_in_Greenhouse_gasses from decade1 d1
inner join decade2 d2 on d1.Country=d2.Country
where d1.decade1>d2.decade2 order by
percentage_decrease_in_Greenhouse_gasses desc limit 10;
```

Result Grid | Filter Rows: | Export: | Wrap Cell Content: | Fetch

Country	decade1	decade2	percentage_decrease_in_Greenhouse_gasses
Ukraine	622712.16	402191.74	35.41
Romania	181389.22	128291.49	29.27
Latvia	15248.95	10994.86	27.9
Lithuania	28034.02	21218.32	24.31
Denmark	78906.21	61884.95	21.57
United Kingdom	757514.32	596328.49	21.28
Estonia	24165.8	19504.53	19.29
Slovak Republic	55642.89	45440.14	18.34
Bulgaria	73082.99	60677.83	16.97
Germany	1127278.63	946887.08	16

Tableau Connection

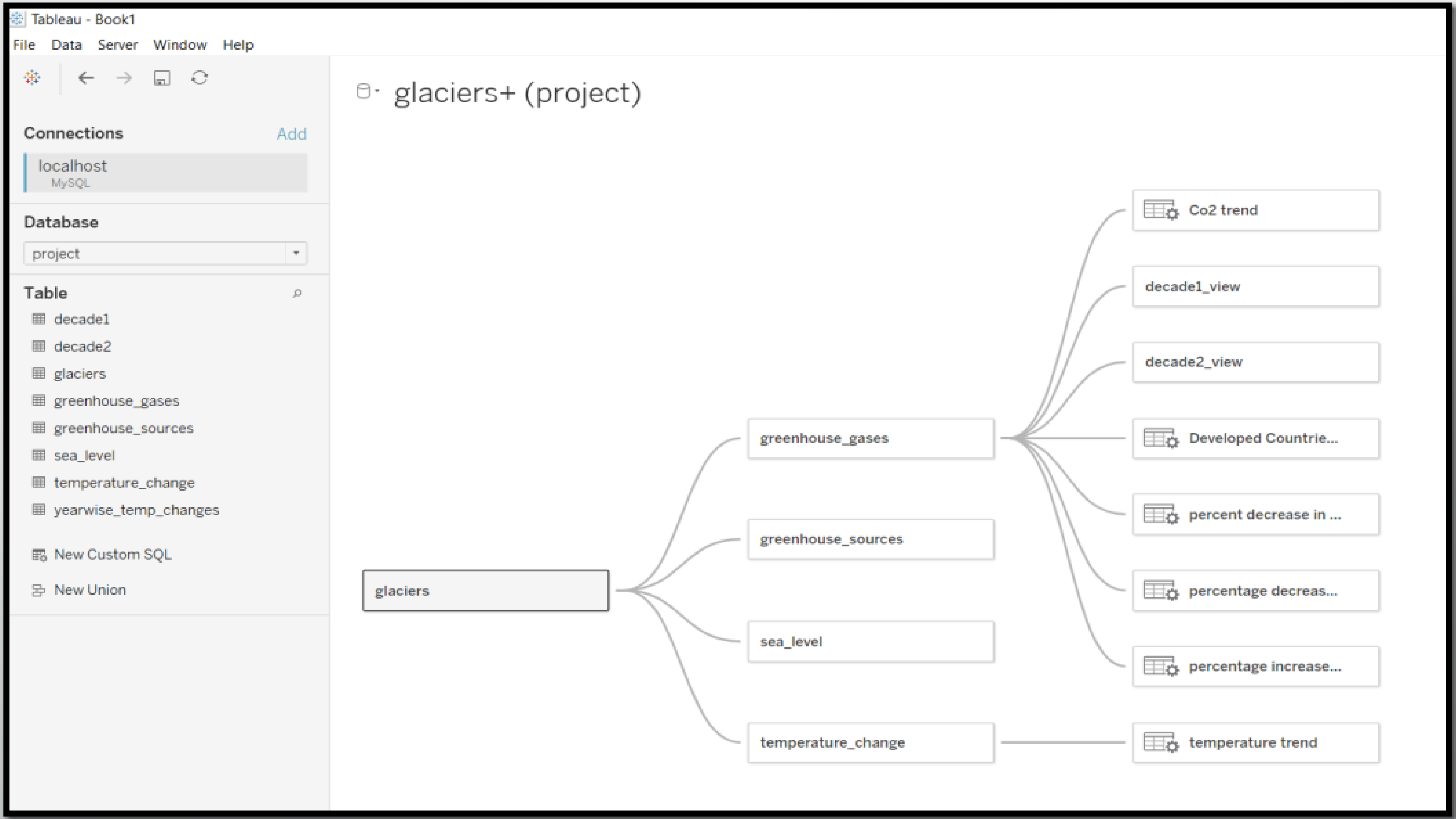
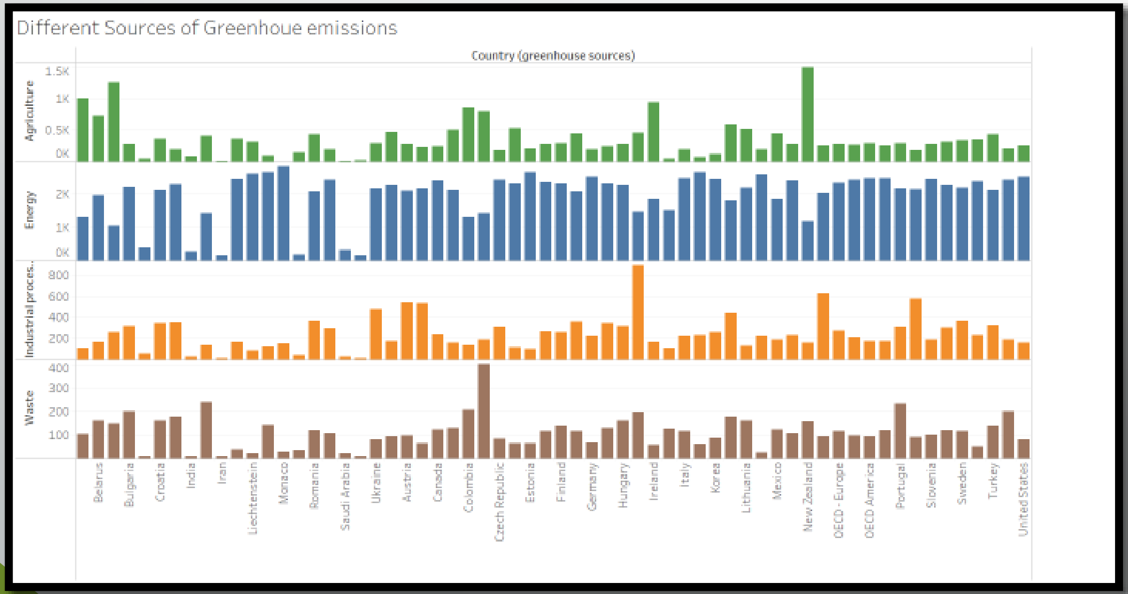
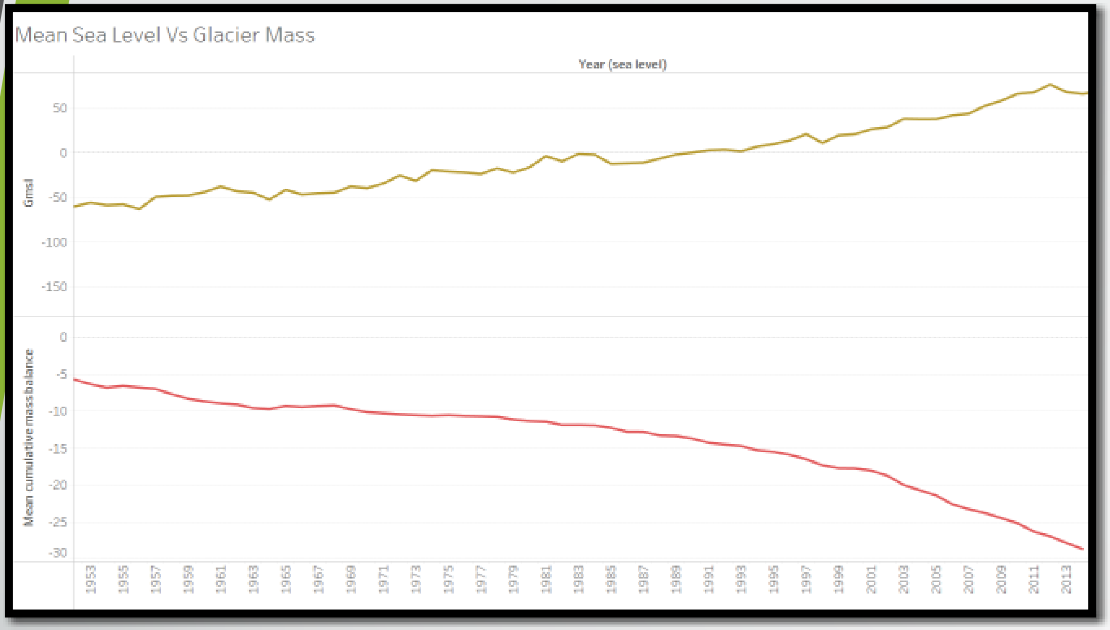


Tableau Visualizations

The adjacent figure shows the average CO2 emissions across the globe.

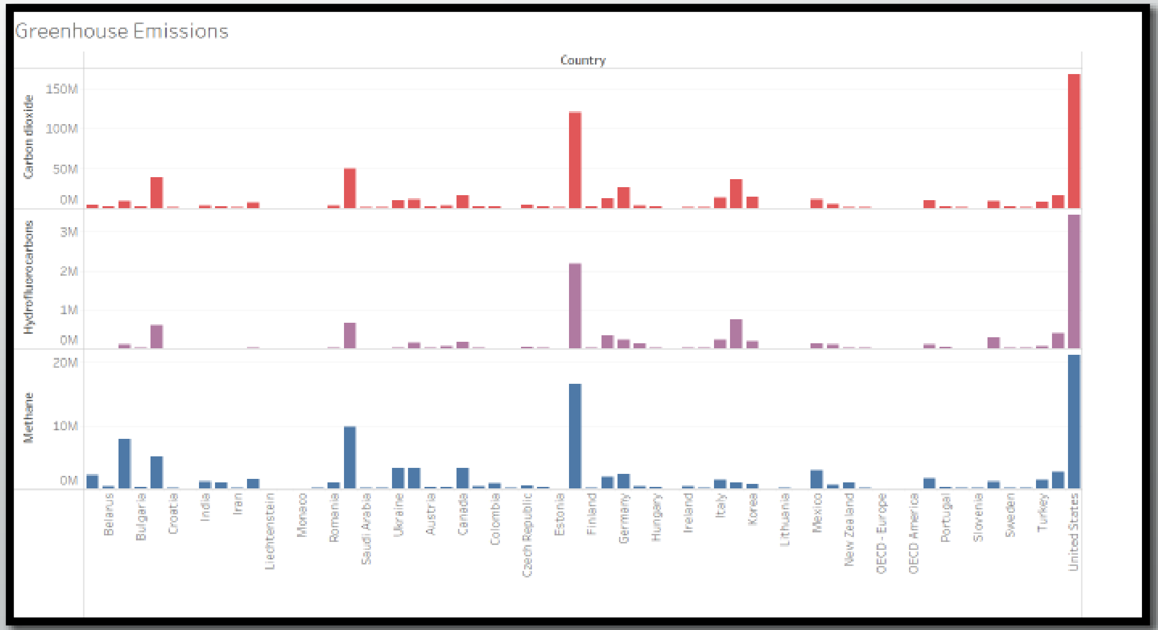


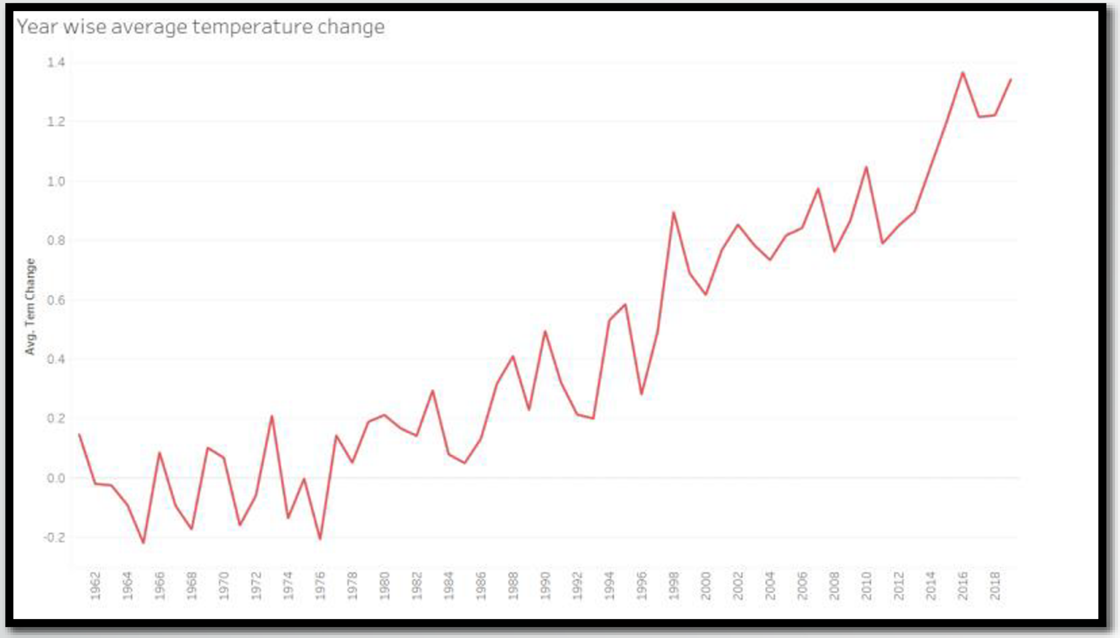
The adjacent figure shows the different sources of greenhouse gasses and its emissions in metric tons.



The adjacent figure shows how global mean sea level is varying with melting of polar ice caps.

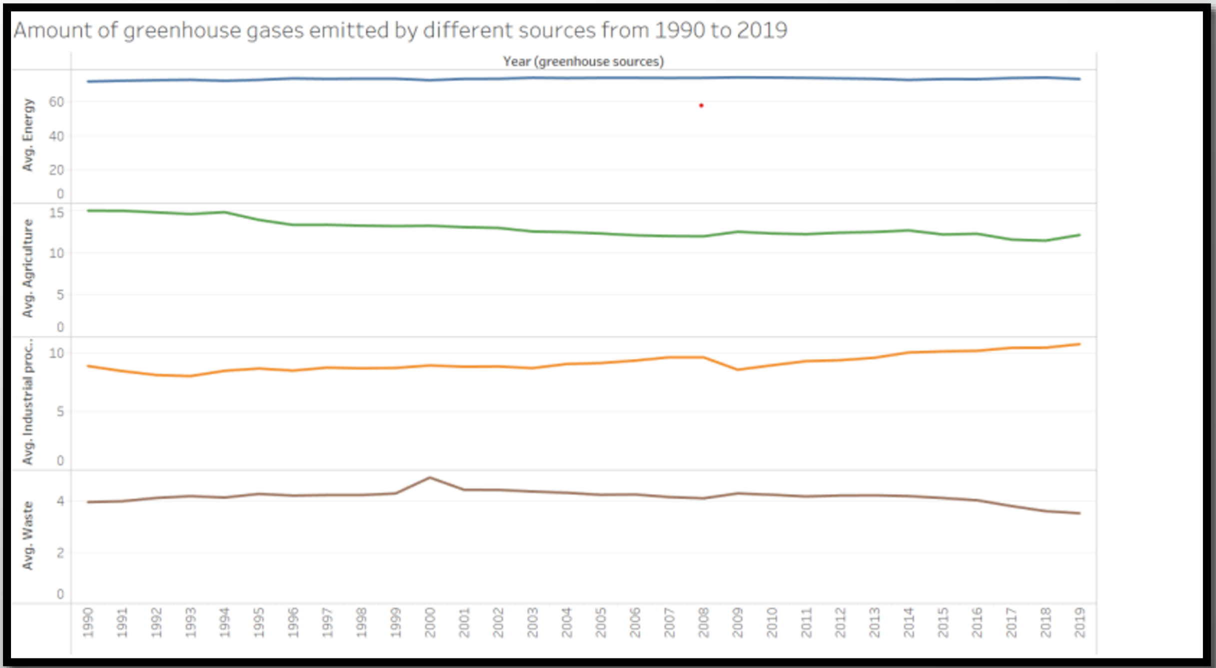
The adjacent figure shows the emission trends of different greenhouse gasses emitted by different countries

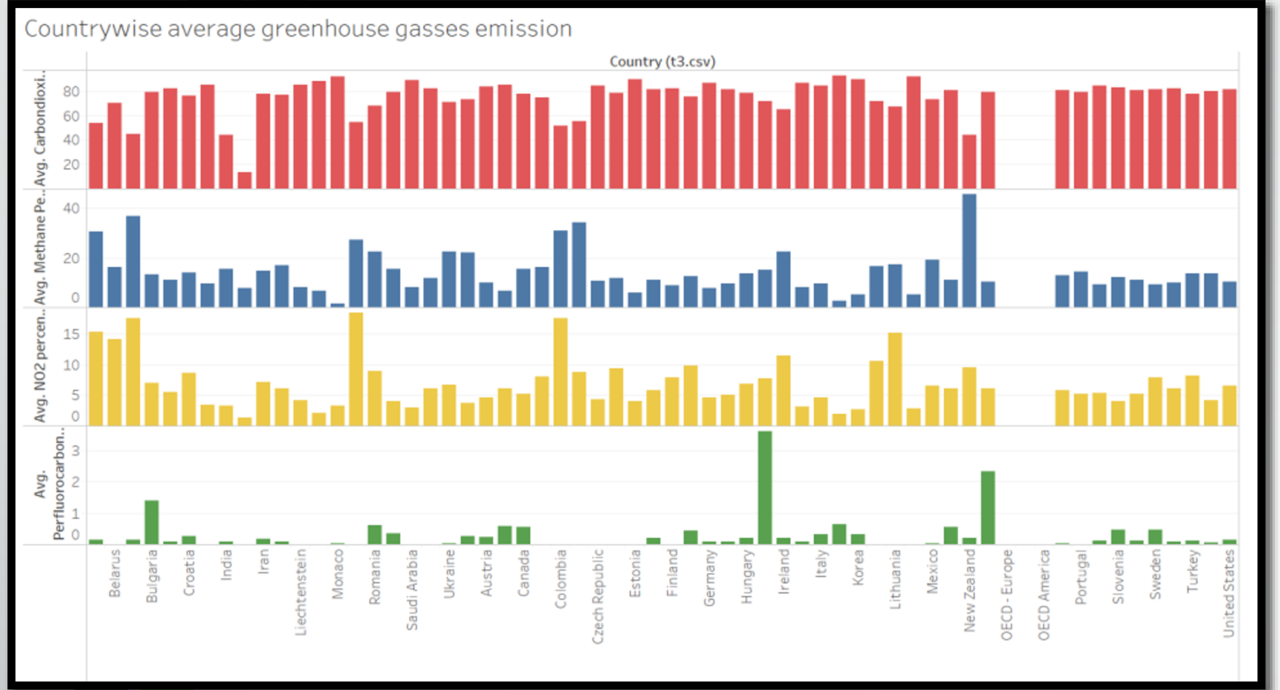




The adjacent visualization describes how temperature is varying over a period of 50 years. This is Global average change in temperature

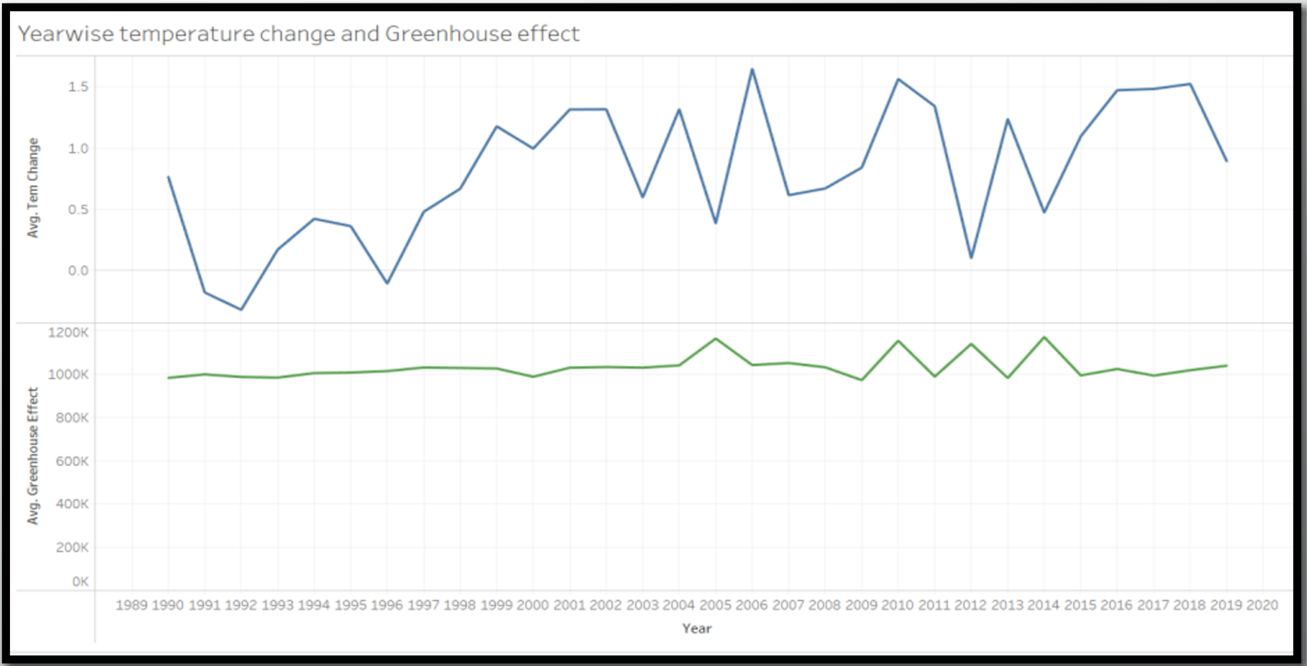
The adjacent figure represents the major sectors which are responsible for greenhouse emissions over a period of 30 years.

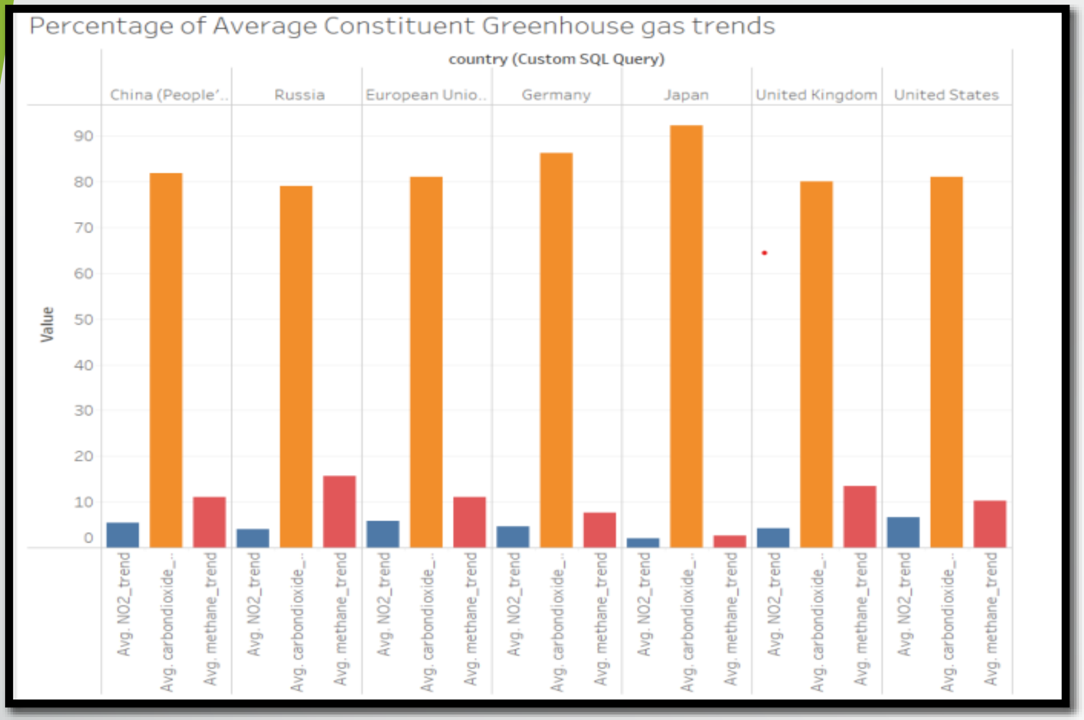




The adjacent figure represents the country wise percentage of average greenhouse emissions. We have represented the constituent gasses

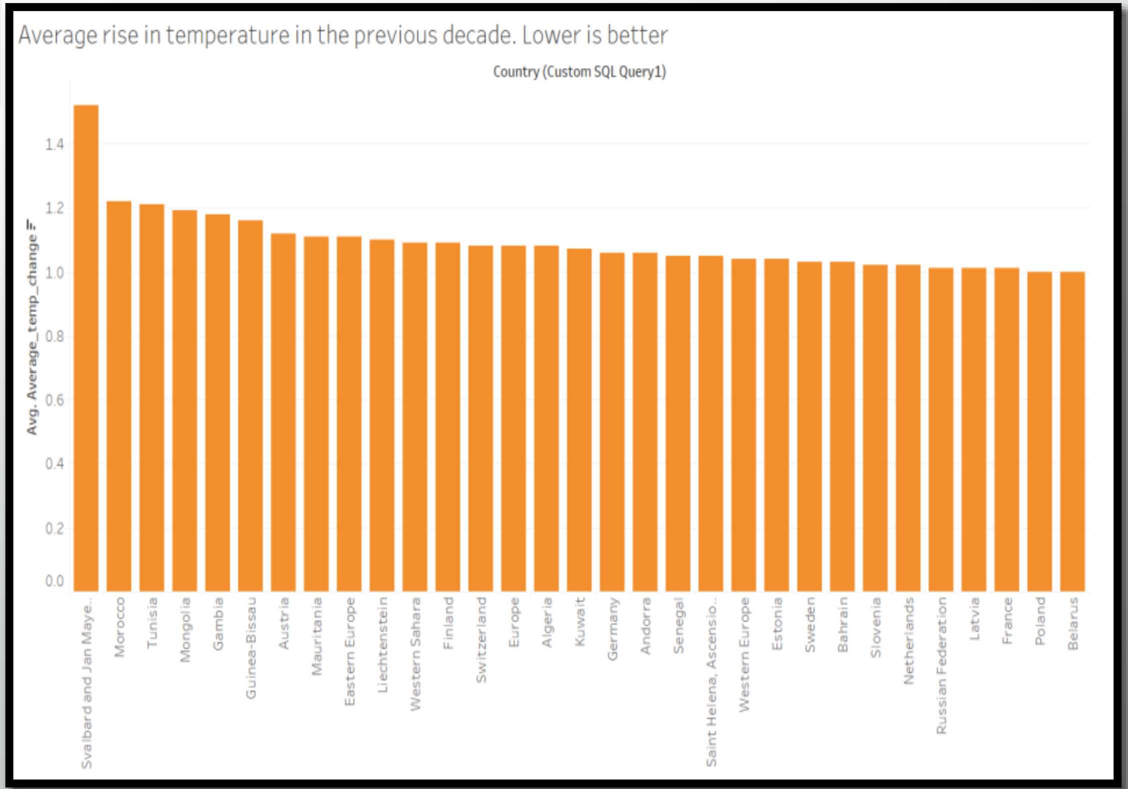
The figure represents the relation between the amount of greenhouse emissions emitted and the change in temperature for every year.

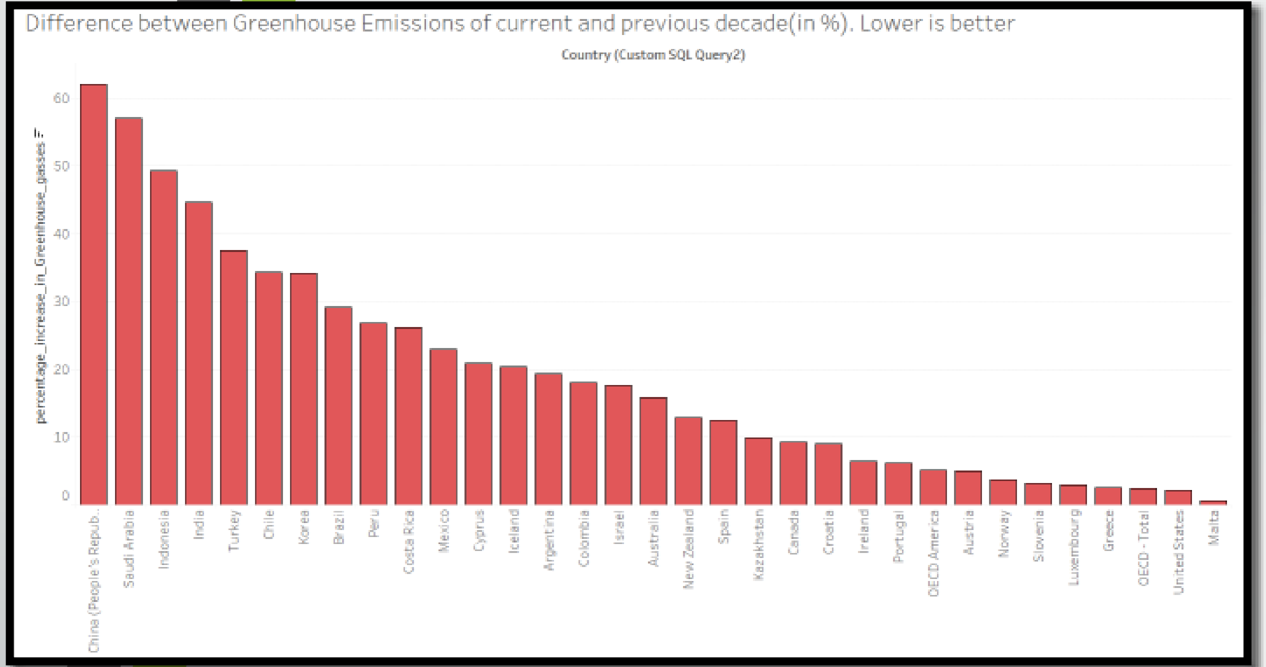




The adjacent figure represents the trends of greenhouse gasses like Nitrous oxide, carbon dioxide and methane for developed nations

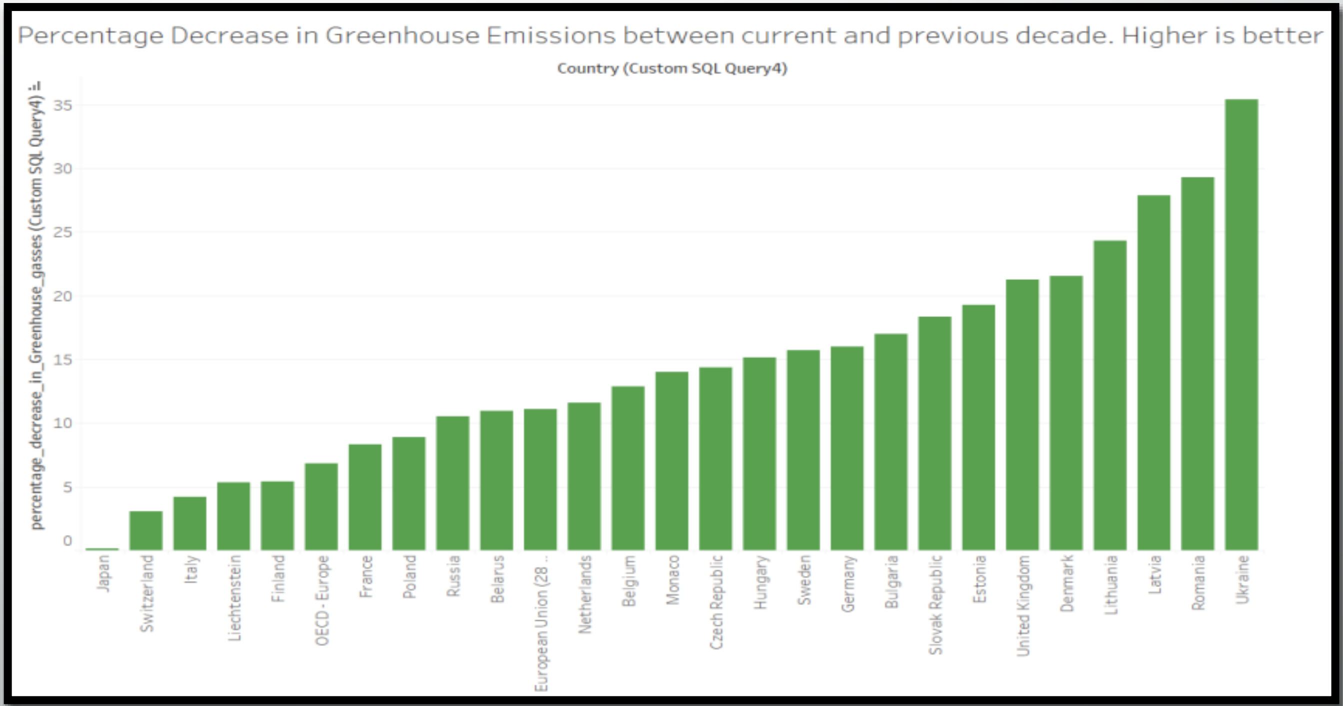
The average rise in temperature in the previous decade is represented in the adjacent diagram. Lower value is better





The percentage increase in greenhouse emissions from the previous decade by different countries is represented in the adjacent diagram. Lower value is better

The percentage decrease in greenhouse emissions from the previous decade by different countries is represented in the adjacent diagram. Higher value is better



Special Observations

- Since we are using statistical data collected from different sources, the data is mostly numerical. We tried to reduce the number of null values present in the data as it might affect the output of the queries.
- We came up with a multiple primary key approach for some tables as it is difficult to use single attribute as a primary key as the data is repeating. Choosing multiple primary keys gave us a chance to combine to attributes and the result is a unique key.
- We tried to use aggregate functions like Average, max, count etc., rigorously in our queries as it gives us an exact big picture of all the data points available.
- We used inner joins in multiple queries to combine multiple tables to fetch meaningful information from the data we have. So far, it has worked perfectly, and we are able to fetch the data without any issues.
- We tried to implement some questions using Tableau instead of MySQL by using Custom SQL query editor available in Tableau.

Conclusion

- The analysis we did during the course of our project proved our initial assumptions regarding the effects of greenhouse effect. So far, the assumptions we had, the research questions we had are ascertained by the results we have. Apart from proving it, this project has given an insight over the extent of the damage that has been caused so far due to the irresponsible and unquenchable thirst for energy .
- As we know that every data point imparts some wisdom, The wisdom which our project imparted is discussed in short below.
  - Carbon dioxide is the primary culprit which is reaping the greenhouse effect. So appropriate measures should be taken to curb the CO_2 emissions in all possible ways.
  - The average temperature change between the previous decade and the current decade is astonishing. It is evident from our research that cooler regions are becoming hotter and hotter by the day.
  - There is an average rise in temperature of 0.8 degree Celsius globally, which led to the melting of 20 meters of polar ice caps which in turn lead to the increase of sea level by 40 meters. If this keeps on happening, soon our coastal areas will be submerged under oceans.
  - Energy sector is the leading emitter of Greenhouse gasses. This includes Thermal energy and automobiles both since they both use fossil fuels to generate energy. A better, greener and safer ways of generating energy should be implemented.
  - Developed nations have more industries, agreed but they should come up with stricter and more efficient by laws to prevent this chaos from getting out of hands. They should come up with better and viable initiatives so that other countries will follow.

References

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THANK YOU