Chandler Brown

**Greenhouse Gas Emissions and the Effects of Climate Change: Montgomery County Versus the World Final Report**

**Datasets**

Montgomery County Weather Data- National Centers for Environmental Information

<https://data.democratandchronicle.com/weather-data/montgomery-county/24031/1917-08-01/table/>

Monthly Greenhouse Gas Emissions- Data Montgomery

<https://data.montgomerycountymd.gov/Environment/Greenhouse-Gas-Emissions/stmn-fdnc/about_data>

Climate Change Knowledge Portal- World Bank Group

<https://climateknowledgeportal.worldbank.org/download-data#htab-1502>

Greenhouse Gas Time Series Data- United Nations Framework Convention on Climate Change

<https://di.unfccc.int/time_series>

Precipitation- UNdata Environment Statistics Database

<https://data.un.org/Data.aspx?q=precipitation&d=ENV&f=variableID%3a6>

**Tools**

I used Python for this project. The libraries I used were pandas, numpy, matplotlib, seaborn, and files.

**Goals**

I have three goals for this project, each in the form of a question I wish to answer:

1. How does Montgomery County’s efforts to reduce emissions compare with the rest of the world?
2. Is Montgomery County suffering from the effects of global warming at a similar rate to the rest of the world?
3. Does local policy reduce the overall effects of global warming on an area?

**Cleaning and Wrangling**

I had to learn something completely new when cleaning and wrangling this dataset, and that is the process of melting a dataset. All of my UN datasets were outputs of either search functionality or an API call, but the output was not formatted in an easy way for me to work with. Instead of having a date/time column, each date was listed as its own separate column. This is where melting comes in, as I was able to change these columns and link column value to a specific county, dissolving the columns and properly transitioning their data int rows that were still connected to the countries and years they originated from. I was then able to combine all of my UN data (three of my datasets) into one, as I was able to combine them by Country and date, as the data I extracted was for the same countries during the same time periods. I had to drop a lot of data from the UN datasets first, as many countries had large amounts of missing data or had no data at all. I also performed several data conversions, such as dividing all Montgomery County Emissions by 1000 to get a common unit with UN emissions, kilotons. I also converted all UN temperatures from Celsius to Fahrenheit.

**Descriptive Statistics**

A graph of a number of different colored lines

Description automatically generated

This shows off monthly facilities emissions, fleet emissions, and total emissions for Montgomery County in kilotons.

A graph showing a graph of a number of blue lines

Description automatically generated with medium confidence

This shows off monthly average temperatures in Montgomery County.

A graph of blue lines

Description automatically generated

This shows off monthly total precipitation values in Montgomery County.

A graph showing a line

Description automatically generated

This shows off the yearly average emissions for all UN countries. The line is the average, and the surrounding parts show the range of values for each year.

A graph showing the average precipitation

Description automatically generated

This shows the yearly average precipitation for all UN countries. This once again also shows the ranges.

A graph showing a number of blue lines

Description automatically generated with medium confidence

This shows the yearly average temperatures in the UN. This once again also shows the ranges like the previous images.

**Final Data Products**

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A graph of different colored lines

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A screenshot of a computer

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A close up of text

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A graph showing the average temperature

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A graph of different colored lines

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A screenshot of a computer

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A graph with blue lines

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A graph of different colored lines

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A screenshot of a computer screen

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A screenshot of a graph

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All of these visualizations were made using matplotlib and seaborn. All of the numerical calculations were done with numpy. The information available I all of these visualizations and calculations include the annual emissions, temperatures, and precipitation values for both Montgomery County and induvial countries of the UN. There is also a visualization of the yearly fleet and facilities emissions in Montgomery County, and heatmaps that show off the correlation between the year, temperature, precipitation, and emission in both Montgomery County and the UN. The calculations find the total change and average rate of change for emissions, temperature, and precipitation in both Montgomery County and induvial UN countries. These products will be useful to the general public to examine emission reduction efforts as well as the effects of climate change, and how each change over time. You can also examine the relationships between these variables easily with heatmaps. These visualizations helped me answer my three questions, as they revealed the trends of both emissions’ reduction and the effect of global warming in both Montgomery County and the UN. I have determined that Montgomery County has reduced emissions in similar manner to the rest of the world, and the effect of global warming vary locally, but are not a direct cause of local climate change policy. It will take a global warming to dampen the effect of climate change. These visualizations and calculations are reproducible.

**Data Experience**

There were several pros and cons to working with this data. For pros, the datasets all had extensive data, with the potential for further analysis of other variables. When gathering the data, most websites I used has easy to use search functionality or built in API calls to easily access only the data I needed for my project. All data was either collected monthly or yearly, making it easy for me to analyze trends and save time on calculations. On the other side, there was limited availability of Montgomery County emissions data, a lot of the UN data was improperly formatted and had a bunch of missing data, and there were gaps between timeseries data between datasets, all of which hindered my work and analysis.

**Ideas for the Future**

I have several ideas on how to improve upon this project given more time. The use of GIS mapping tools and prediction modeling for the future could help visualize geolocational data and work on prediction future trends of emission reduction and the effects of global warming. More global warming indicators can be added for analysis, such as sever weather incidents and heating degree days, and the Montgomery County data can be expanded to include all Maryland counties.

**Acknowledgements**

I would like to thank my friend Mike for helping with visualization ideas and coding errors, Professor Iapalucci for his help and understanding of my unique circumstances this semester, and my fellow classmates for their wonderful projects.

Chandler Brown

**Greenhouse Gas Emissions and the Effects of Climate Change: Montgomery County Versus the World Data Story**

There are three questions I wished to answer with my data analysis in this project. Those are: How does Montgomery County’s efforts to reduce emissions compare with the rest of the world? Is Montgomery County suffering from the effects of global warming at a similar rate to the rest of the world? Does local policy reduce the overall effects of global warming on an area? Here is how I answered these questions.

**Question 1:** How does Montgomery County’s efforts to reduce emissions compare with the rest of the world?

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Description automatically generated

These graphs show emissions over time for Montgomery County and several UN countries. From 2020-2023, Montgomery County has actually seen an increase in emissions at a rate of about 1.963 kilotons per year. Meanwhile, Almost all countries in the UN that were used in the second visualization have decreased emissions since 1990 except Cyprus, which has had an increased rate of emission at about 0.0973 megatons per year. So, in comparison to most of the UN in recent years, Montgomery County is falling behind in terms of emission reductions. However, this conclusion should be taken with a grain of salt, as there is very limited data on Montgomery County emissions, and its data includes post pandemic dates, while the UN data stop at 2021. This could explain Montgomery County’s increase in emissions which might be shared with the UN if the data was available.

**Question 2: Is Montgomery County suffering from the effects of global warming at a similar rate to the rest of the world?**

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A graph with blue lines

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These four visualizations show the average yearly temperatures and total yearly precipitations of Montgomery County and several UN countries. Montgomery County has increased in temperature from 1990 at about 0.02°F per year, and its total precipitation per year is a rate of -0.0330 inches per year. Meanwhile, United Nation countries are feeling the effects of global warming in different ways. Most UN countries are also increasing in temperature, like France at a rate of 0.08°F per year, and Switzerland at a rate of 0.108°F per year. However, the countries of Lithuania and Latvia have decreased in temperature since 1990. In terms of precipitation, UN countries have both increased and decreased since 1990 depending on the area. Norway has increased the most since 1990, at a rate of about 14,024 million cubic meters per year, and Portugal has decreased the most, at a rate of about 1,733 million cubic meters per year. These disparities in temperature increases and decreases, precipitation increases and decreases, and the rates at which they happen reveal that the effects of global warming are completely different on a local level, meaning that the impact of global warming on Montgomery County is vastly different than other areas of the world, and even the country.

**Question 3: Does local policy reduce the overall effects of global warming on an area?**

This question has already been answering itself within the visualizations already shown. To show this, I will further examine the countries of France and Switzerland from the UN. France has the largest reduction in emissions of any country examined, with a rate of 3.913 megatons reduced in emissions per year. Yet, it has seen the effects of global warming just as much as other countries, as its temperature increase of 0.08°F per year is one of the highest amongst the UN. Switzerland, which has one of the lowest total emissions compared to other UN countries and has also been lowering those already low emissions, has the highest temperature increase rate of all, at 0.108°F per year. Meanwhile France has seen an overall reduction in precipitation and Switzerland has seen an increase. Not only does this further prove that the effects of global warming differ locally, but global warming effects are also occurring just as much in countries who are making great efforts in reducing emissions as those who are not doing as well, meaning that local climate change and environmental policies do not have a noticeable effect on reducing the effects of global warming. The fight against climate change must be fought globally to reduce its effects, meaning that global policies such as the Paris agreement are even more important than local policies in the fight against climate change.