Project Milestone 2: Write-up

Evelyn Tollar, Emma Chen, Andrea Chen, Maya Barron, Jinwen Xu

From project milestone 1, we developed three main topics that we aim to observe, including greenhouse gas emissions, mortality, morbidity, and welfare cost from exposure to environment-related risks, and the environmental policy stringency index of each country. All of the data we used for our visualizations came from the Organisation for Economic Co-Operation and Development website, and the code that was used for preprocessing can be found here. With this in mind, we decided to answer these questions separately by using different visualization approaches.

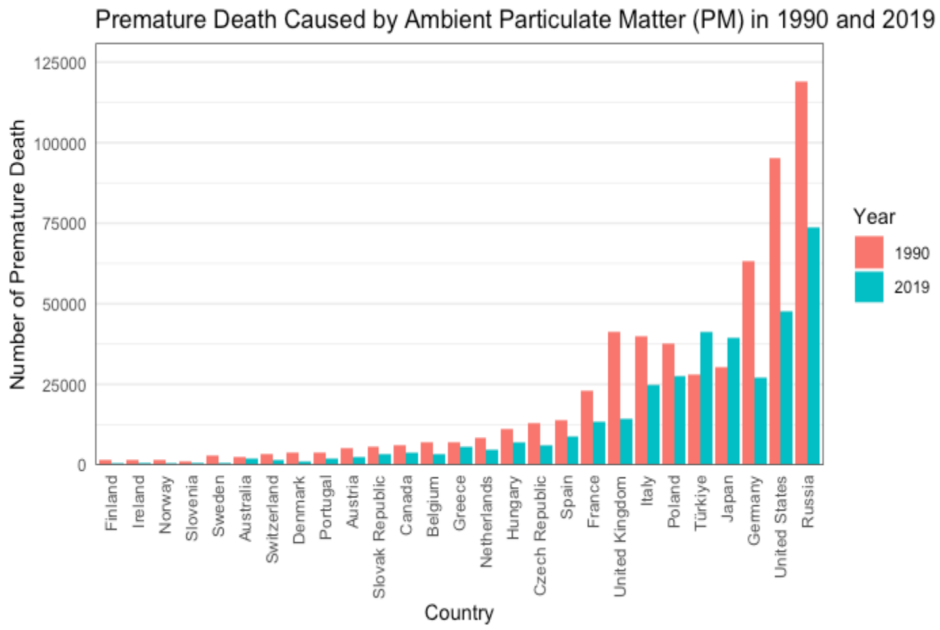
1. Greenhouse gas emissions

First, we implemented an interactive prototype of heatmap to show which country is contributing the most to greenhouse gas emissions over a given time period. The two graphs in this section are displayed using tab panels. It allows users to identify which countries contribute to greenhouse gas emissions the most over the years by looking at the differences in colors on the heat map. Users can more easily comprehend the information for a large number of countries through our heat map rather than a line graph. Users are allowed to choose their preferred type of greenhouse gas and year range. Moreover, we also apply a bar graph to show the average of all the emission types over the given time range. It is good to visualize the average division of emission types for each country throughout the chosen time period. It displays the proportion of each type of emission by country and helps identify which country contributes the most. (Figure 1 and 2: Link to a video recording which displays our heatmap and bar graphs here; Link to code here)

2. Mortality, morbidity, and welfare cost

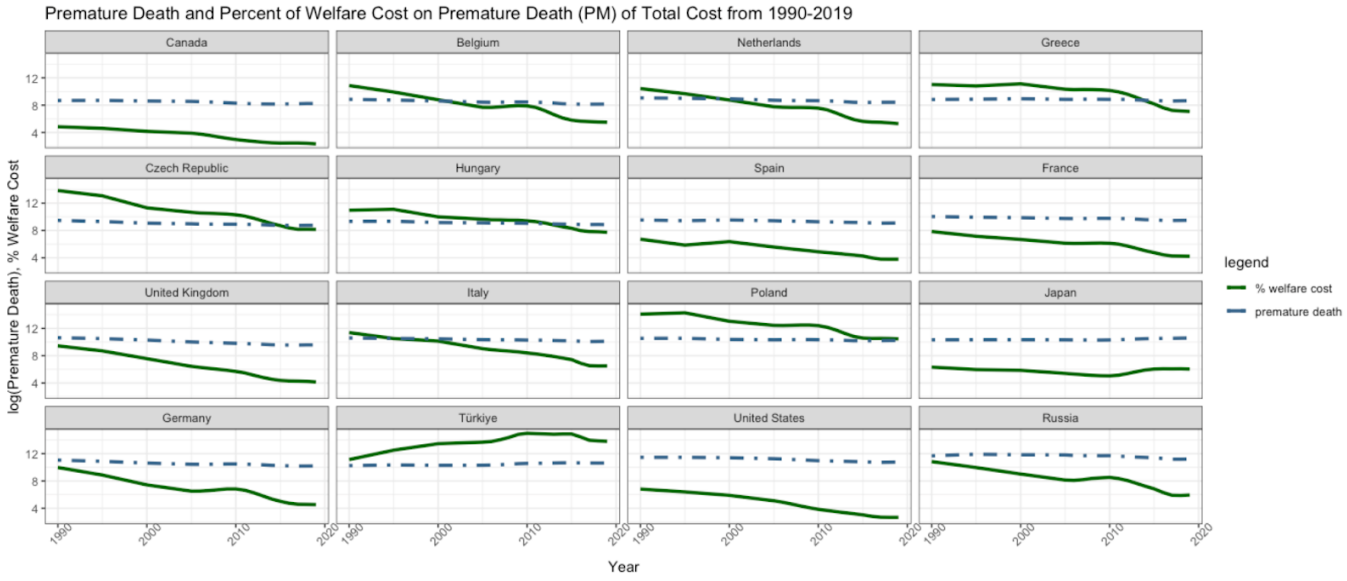
Second, in this section, we only included countries with all 30 years of records in greenhouse gas emissions and policy stringency index, aligned with the country selection in goal 3. To identify the mortality, morbidity, and welfare cost from exposure to environment-related risks, we implemented a bar graph that visualizes the premature death caused by ambient particulate matter (PM) in each country in the years 1990 and 2019. It allows users to identify the number of premature deaths across each country and compare it during 2019 to what it was like 29 years ago by looking at the bars with different colors. Also, the countries are arranged by the average number of deaths between the 1990 and 2019, from lowest to highest, helping users to identify which country obtains a higher number of premature deaths.

- Figure 3. Premature deaths caused by ambient particulate matter (PM) in each country in the years 1990 and 2019



Moreover, based on the number of premature deaths, we then picked the top 16 countries with the most premature deaths caused by PM, since they have a noticeable change in time. To see the percentage of welfare cost of premature death caused by PM within the total welfare cost on premature deaths, we apply faceting over the countries from 1990 till 2019. As we are observing how greenhouse gas emission, mortality and welfare, and policy stringency might correlate with each other, it is useful to see the trend of changes in premature deaths and percent of welfare cost throughout the years in each country with a faceted line plot. To make it comparable with welfare cost percent in the same plot, premature death is logged. Based on the graph, the percentage of welfare cost generally goes down from 1990 to 2019 except for Turkey, whereas premature death from exposure to PM drops except for Japan and Turkey. One issue of this graph is that the change and trend in premature deaths throughout years is hard to identify since it's logged to be comparable with percentage. (Link to code here)

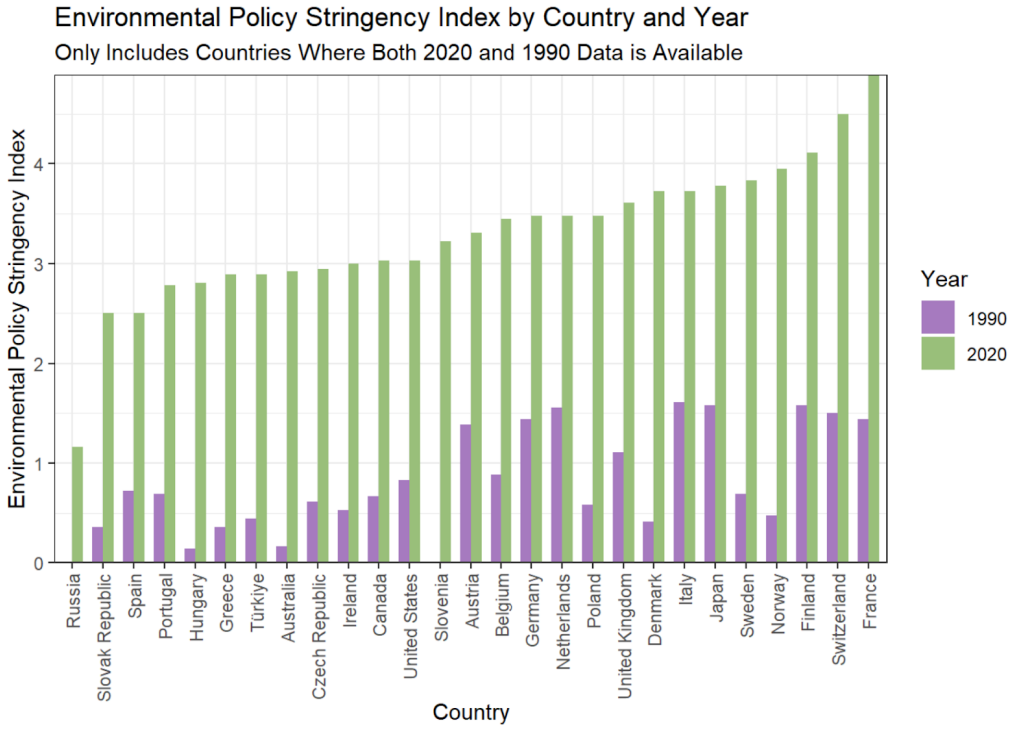
- Figure 4. Premature Death and Percent of Welfare Cost on Premature Death (PM) of Total Cost from 1990-2019



3. Environmental policy stringency index

Lastly, to observe countries' progress in combating the issue, we implemented a bar graph to visualize the Environmental Policy Stringency Index of selected countries. It displays the index of each country in the years 1990 and 2020, allowing users to identify the differences in indexes by looking at bars with different colors and heights. To provide some context, the Environmental Policy Stringency Index is an internationally-comparable measure that ranges from 0 to 6, with 6 being the most strict environmental policy, and 0 being no environmental policy. This bar graph is arranged in increasing order by each country's individual index for the year 2020, which helps identify the countries that are leading the way for reducing global emissions. Moreover, since each country in this graph had data available from both 1990 and 2020, if countries like Russia or Slovenia obtain an index of 0, it indicates that there was no environmental policy in place. (Link to code here (the last {r} code chunk corresponds with this plot))

- Figure 5. Environmental Policy Stringency Index by Country and Year



3. Critical evaluation. Now that you see the designs on your real data, what trade-offs do you think exist between alternative designs? How do you plan to proceed in the final interface or review?
trade-offs

- Heatmap vs line graph

Although the line drawings are reasonable, the visual design has significant limitations that hinder readability and make it challenging to compare gas emissions between countries over time. The large number of countries and the long time span result in an overwhelming number of lines, causing them to bend and overlap in the image. Consequently, it's challenging to discern trends and identify differences in emissions between countries, making it difficult to determine which country is best at controlling gas emissions.

To address this, we suggest an alternative solution: using a heatmap layout to display the same data. Heatmaps use colors to represent data and are easier to read than line graphs. By ranking the average emissions of gasses, we can more quickly navigate and understand the rankings. Additionally, using rectangular heatmap tiles instead of lines solves the problem of visual congestion, allowing us to visualize the data more clearly.

- Facet

Faceting makes it possible to divide the dataset into smaller subsets and create multiple graphs or charts for each subset. This makes it easier to compare and contrast different groups or categories in the data.

Proceeding to the final interface, we have four ideas in mind. First, we want to implement select input for the premature deaths and environmental policy stringency index bar graphs. In this way, users will be allowed to select the information from two separate years to compare ranging from 1990 to 2019, for example, selecting the premature deaths of 2000 and 2019. Following this, we want to make our color schemes consistent, so that it is visually appealing. Third, we will add explanations on how to interpret the values of greenhouse gas emissions and the environmental policy stringency index. In this way, it helps users comprehend the information that we are presenting and better communicate the findings of the visualizations. Finally, we aim to implement tab panels so that all of our visualizations are organized.