**Data Visualization for Storytelling**

**Final Project Report**

**Need to Shift towards Renewable Energy Resources**

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**Introduction**:

Air pollution is an escalating global concern that poses significant threats to human health and the environment. The detrimental effects of air pollution are widespread, contributing to various respiratory and cardiovascular diseases, and resulting in millions of premature deaths each year. The quality of the air we breathe is a crucial determinant of public health, and its degradation directly correlates with increasing healthcare burdens and environmental damage. The urgency of addressing air pollution cannot be overstated, as it not only affects current generations but also poses severe risks for future ones by contributing to climate change and ecosystem degradation.

This report delves into the global analysis of air pollution, highlighting the trends in key pollutants and their concentrations over the years. It aims to provide a comprehensive overview of how different regions and countries contribute to air pollution, the resultant health impacts, and the effectiveness of existing mitigation strategies. By examining data from credible sources such as the World Health Organization (WHO), this report seeks to uncover the underlying factors driving air pollution and assess the progress made in combating this pervasive issue.

Understanding the dynamics of air pollution is essential for developing targeted interventions and policies. This report addresses critical questions such as the trends in air pollutant concentrations, the impact of air pollution on global mortality rates, and the contribution of major industrial nations like the United States and the United Kingdom to the overall pollution levels. Additionally, it explores the relationship between air pollution and ozone concentration in the atmosphere, offering insights into how these factors interplay and affect environmental and public health. Through detailed visualizations and statistical analyses, this report aims to shed light on the multifaceted nature of air pollution and underscore the need for collaborative efforts to mitigate its adverse effects.

**Methodology:**

The methodology of this analysis involves a comprehensive examination of air pollution trends and their impacts using data sourced from the World Health Organization (WHO) and other reputable sources. The study employs various statistical techniques and visualizations to interpret the data effectively. Key pollutants such as nitrogen oxides (NOx), non-methane volatile organic compounds (VOCs), and sulfur dioxide (SO₂) are analyzed for trends. Additionally, the study examines the percentage of deaths attributed to air pollution globally and within specific countries, spanning from 1990 to 2019. A drill-down analysis is conducted to compare contributions from the United States and the United Kingdom. Furthermore, the research explores the relationship between air pollution and ozone concentration, providing a global overview of PM2.5 levels. The study also investigates the correlation between air pollution and the consumption of controlled substances across various countries. This multi-faceted approach ensures a thorough understanding of air pollution dynamics and its health implications.

**Dataset - 1**

* State of Global Air. (n.d.). Air quality data. Retrieved from [https://www.stateofglobalair.org/data/#/air/plot](https://www.stateofglobalair.org/data/%23/air/plot)
* Description: This dataset provides comprehensive information on air quality metrics, including concentrations of various pollutants like PM2.5, ozone, and nitrogen oxides, across different countries and regions. It is used to track trends in air pollution and analyse the effectiveness of air quality regulations and interventions globally.

**Dataset - 2**

* State of Global Air. (n.d.). Health impact data. Retrieved from [https://www.stateofglobalair.org/data/#/health/plot](https://www.stateofglobalair.org/data/%23/health/plot)
* Description: This dataset includes data on the health impacts of air pollution, detailing the number of deaths and the burden of diseases attributable to air pollution in various countries. It provides insights into how air pollution affects public health and helps in identifying regions with significant health challenges due to poor air quality.

**Dataset - 3**

* International Monetary Fund. (n.d.). Climate Change Indicators Dashboard. Retrieved from <https://climatedata.imf.org/datasets/d22a6decd9b147fd9040f793082b219b_0/explore>
* Description: This dataset provides comprehensive climate-related indicators, including greenhouse gas emissions, climate finance, and adaptation metrics, and economic cost spent by various countries.

**Analysis:**

**Visual Analysis Story: The Global Air Pollution Saga**

In the early 21st century, the world was grappling with an invisible adversary that threatened both human health and the environment—air pollution. To understand this menace, a meticulous analysis of air pollutant concentrations from 2000 to 2015 was undertaken, revealing a narrative of both progress and persistent challenges.

**Chapter 1: The Battle Against NOx and SO₂**

As the new millennium dawned, the line charts depicting the trends of nitrogen oxides (NOx) and sulfur dioxide (SO₂) showed a glimmer of hope. The early years were marked by high levels of these pollutants, notorious for their role in respiratory illnesses and environmental degradation. However, as the years progressed, a downward trend became evident. This decline was attributed to stringent regulatory measures and technological advancements. Countries around the globe implemented policies to curb industrial emissions and promoted cleaner technologies, leading to a 7notable reduction in NOx and SO₂ levels. This chapter was a testament to the power of concerted efforts and innovation in combating air pollution.

A screenshot of a computer screen

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**Chapter 2: The Stubborn VOCs**

Contrasting the success with NOx and SO₂, the saga of non-methane volatile organic compounds (VOCs) unfolded differently. VOCs, known for their role in forming ground-level ozone and smog, showed a stable yet troubling trend. Despite regulatory measures, their concentrations remained relatively unchanged, suggesting a more complex battle ahead. The sources of VOCs, ranging from industrial processes to vehicle emissions and even household products, proved challenging to manage. This chapter called for deeper investigation and more targeted strategies to tackle the sources of VOCs effectively.

**Chapter 3: The Grim Toll on Human Life**

The narrative took a somber turn with the bar chart illustrating the percentage of deaths attributed to air pollution in 2019. This visual starkly highlighted the global health crisis spurred by poor air quality. Countries such as India and China bore the brunt, with significantly higher mortality rates due to air pollution-related diseases. The chart underscored the urgent need for comprehensive measures to protect public health, revealing a stark reality where cleaner air could save millions of lives.

**Chapter 4: A Global Perspective on Mortality**

Extending the timeline, a line chart from 1990 to 2019 depicted the global trend in air pollution-related deaths. While there was a slight decrease in recent years, the data revealed that air pollution remained a formidable threat to global health. This chapter emphasized the ongoing importance of addressing air quality issues through targeted interventions and robust policy actions. The persistent high mortality rates called for renewed efforts and sustained commitment to improving air quality worldwide.

**Chapter 5: The US and UK Contributions**

A drill-down bar chart painted a detailed picture of the contributions of the United States and the United Kingdom to global air pollution. Both countries emerged as major contributors, particularly in terms of NOx and VOCs emissions. This revelation underscored the need for these nations to lead by example, implementing stricter emission controls and investing in cleaner technologies. The chapter highlighted the pivotal role of national efforts in the global fight against air pollution.

**Chapter 6: The Ozone Conundrum**

The interplay between air pollution and ozone concentration added a layer of complexity to the story. A line chart tracking these variables from 2000 to 2019 showed fluctuations that suggested a potential relationship. The data called for further analysis to unravel this connection and its implications for public health and environmental protection. This chapter hinted at the intricate dynamics of air pollutants and their broader impact on atmospheric conditions.

A screenshot of a graph

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**Chapter 7: The PM2.5 Global Map**

A global map provided a stark visual of PM2.5 levels, revealing significant variations in air quality across regions. Countries like India and China again appeared as hotspots with dangerously high levels, while regions like Scandinavia showed much cleaner air. This chapter highlighted the need for targeted interventions tailored to the specific sources and conditions of PM2.5 pollution in different regions. It was a call to action for global cooperation and localized strategies to tackle the particulate matter menace.

**Chapter 8: The Enigma of Prohibited Chemicals**

The final chapter explored the relationship between air pollution and the consumption of prohibited chemicals. The visual analysis revealed a mixed picture; some countries with high consumption of controlled substances also faced high PM2.5 levels, while others did not. This chapter underscored the complexity of air pollution, suggesting that factors beyond direct emissions, such as regulatory frameworks and cultural norms, also played significant roles.

As the story of global air pollution unfolded through these visualizations, it became clear that while progress had been made, much work remained. The narrative called for continued vigilance, innovative solutions, and a collaborative global effort to create a cleaner, healthier future for all.

**Key Findings:**

* There is a general decrease in concentrations of certain air pollutants, such as nitrogen oxides (NOx) and sulphur dioxide (SO₂), from 2000 to 2015 due to regulatory measures and technological advancements.
* Volatile organic compounds (VOCs) levels have remained stable, indicating a need for further investigation into their sources and mitigation strategies.
* Air pollution significantly contributes to global mortality rates, with a high percentage of deaths attributed to air pollution in various countries as of 2019.
* Despite a slight decrease in air pollution-related deaths from 1990 to 2019, air pollution remains a major global health concern.
* The United States and the United Kingdom are substantial contributors to global air pollution, particularly in terms of NOx and VOCs emissions.
* There is noted variability in ozone concentrations, potentially influenced by air pollution levels.
* The global overview of PM2.5 levels reveals significant regional differences, with some countries experiencing alarmingly high levels of particulate matter.
* The relationship between air pollution and the consumption of prohibited chemicals shows mixed results, necessitating further research to understand these dynamics.

**Recommendations:**

* Implement Stricter Regulations: Enforce stringent policies to reduce emissions from vehicles, industries, and other sources.
* Increase Public Awareness: Launch educational campaigns and public health initiatives to inform communities about the health risks of air pollution.
* Promote Clean Energy and Sustainable Transport: Encourage the transition to renewable energy and the use of public transport, cycling, and walking.
* Strengthen International Cooperation: Develop and implement global strategies for air quality improvement through collaboration and sharing of data, technologies, and best practices.
* Targeted Interventions for PM2.5: Implement tailored strategies to address specific sources of PM2.5 emissions in regions with high pollution levels, considering local sources and conditions for effective reductions in particulate matter.

**Conclusion:**

In conclusion, air pollution remains a critical global challenge with profound implications for public health and the environment. The analysis reveals that despite some progress in reducing concentrations of certain pollutants like nitrogen oxides (NOx) and sulfur dioxide (SO₂), overall air quality levels remain a significant concern. The steady levels of volatile organic compounds (VOCs) highlight the need for further investigation and targeted mitigation strategies. Air pollution's contribution to global mortality is substantial, with considerable variations in impact across different countries. The relationship between air pollution and ozone concentration suggests complex interactions that require further study to fully understand their implications on public health and environmental protection.

The findings underscore the major roles played by industrialized nations such as the United States and the United Kingdom in contributing to global air pollution, particularly through NOx and VOCs emissions. Additionally, the global overview of PM2.5 levels points to significant regional disparities, indicating the necessity for region-specific interventions. To address these challenges effectively, it is crucial to implement stricter regulations, promote clean energy solutions, and enhance public awareness about the health risks associated with air pollution. International cooperation is essential to tackle transboundary air pollution and develop comprehensive strategies to create a healthier environment for all.

**Additional Research Questions:**

1. What are the primary sources of VOCs, and why have their concentrations remained stable compared to other pollutants?
2. How do socioeconomic factors influence the variations in air pollution impacts among different countries?
3. What specific policies have been most effective in reducing NOx and SO₂ emissions in countries that have shown significant improvements?
4. How can international cooperation be strengthened to address transboundary air pollution more effectively?
5. What are the long-term trends in air pollution-related diseases, and how might they evolve with current mitigation strategies?

**References:**

Health Effects Institute. (n.d.). State of Global Air: Air Data. Retrieved from <https://www.stateofglobalair.org/data/#/air/plot>

Health Effects Institute. (n.d.). State of Global Air: Health Data. Retrieved from <https://www.stateofglobalair.org/data/#/health/plot>

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