# Insights into Greenhouse Gas Emissions in Malaysia: Analysis by Emission Type

Sho Ming Kang (CB21065)
Faculty of Computing
University Malaysia Pahang Al-Sultan Abdullah
26600 Pekan, Pahang, Malaysia
cb21065@adab.umpsa.edu.my

***Abstract* —** This research aims to visualize and evaluate greenhouse gas (GHG) emissions data in Malaysia, focusing on emission types—such as carbon dioxide ($CO_2$), methane ($CH_4$), and nitrous oxide ($N_2O$)—using temporal visualization techniques aligned with the United Nations Sustainable Development Goal (SDG) 13, "Climate Action." The visualization technique in this research is carried out, including line charts, stacked area charts, bar charts, pie charts, as well as tools like Looker Studio and Google Sheets. The data for this research includes the annual GHG emissions by type for Malaysia, sourced from reliable organizations through the Our World in Data platform.

**Keywords—Greenhouse gas (GFG) emissions, Rising Temperature, Climate Change, Climax Action, Line Chart, Stacked Area Chart, Stacked Bar Chart, Pie Chart**

## I. Problem Statement

The rapid increase in greenhouse gas (GHG) emissions, including carbon dioxide ($CO_2$), methane ($CH_4$), and nitrous oxide ($N_2O$), is accelerating climate change, contributing to global warming, and severely impacting ecosystems worldwide, by trapping heat in the atmosphere [1]. This warming effect not only accelerates polar ice melt in the northern and southern hemispheres but also drives global temperatures higher.

In 2024, a report titled "No Rain a Pain for Malaysia's Padi Farmers" highlighted the potential shortage of local white rice in Malaysia due to hot weather [2], emphasizing the broader consequences of rising greenhouse gas (GHG) emissions. In Malaysia, greenhouse gas emissions contribute to more extreme temperatures, unpredictable weather patterns, and significant shifts in local climate conditions. This situation highlights the urgent need to prioritize "Climate Action" under Sustainable Development Goal (SDG) 13, calling for coordinated national and global efforts to reduce emissions and address the root causes of climate change.

## II. Technical Description

For this research, the primary dataset will consist of annual emissions of major greenhouse gases (GHGs)—including carbon dioxide ($CO_2$), methane ($CH_4$), and nitrous oxide ($N_2O$)—from 2005 to 2022 for Malaysia, sourced from Our World in Data [3].

### A. *Line Chart*

Each line chart focuses on one specific type of greenhouse gas—carbon dioxide ($CO_2$), methane ($CH_4$), or nitrous oxide ($N_2O$)—with an additional chart representing total GHG emissions, resulting in four separate charts. In each chart, the y-axis displays emissions measured in tons of $CO_2$-equivalents, while the x-axis represents the years over the observed period. This approach allows for a clearer view of the individual trends for each gas type as well as the total emissions trend.

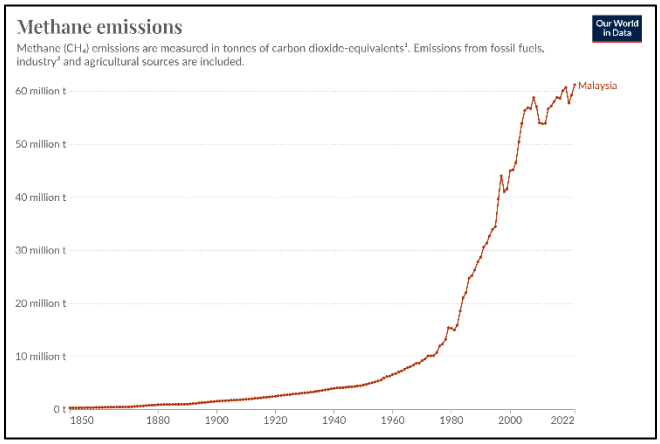


*Figure II-1: Line Chart for Methane Emissions*

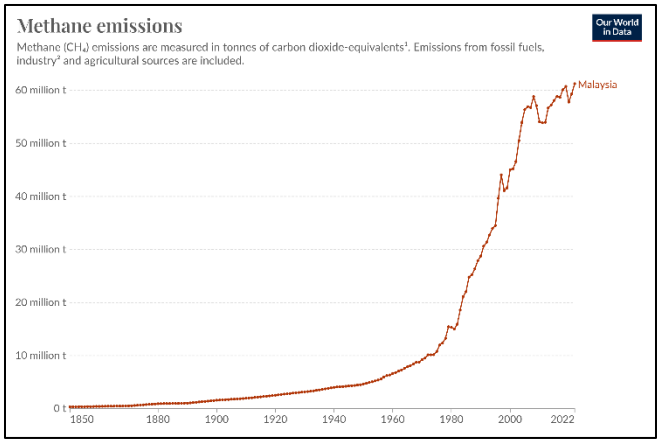


Figure II-1 provides an example of a line chart specifically for methane ($CH_4$) emissions.

### B. *Stacked Area Chart*

The stacked area chart will illustrate the trend of overall GHG emissions over time, with different colors representing each gas type—$CO_2$, $CH_4$, and $N_2O$—indicating their individual contributions to the total emissions. This chart will have two versions:

1. **Total Emissions (Stacked Area Chart)**: Shows absolute values of each gas type in tons of $CO_2$-

equivalents, stacked to reveal overall emission trends.

2. **Percentage Contribution (100% Stacked Area Chart)**: Displays each gas type's share of total emissions, highlighting shifts in the composition of greenhouse gases over time.

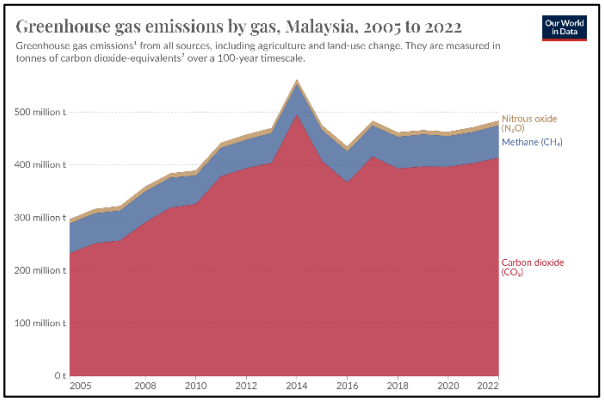


*Figure II-2: Stacked Area Chart for Total GHG by Gas Type*

Figure II-2 shows total emissions, highlighting the contributions of $CO_2$, $CH_4$, and $N_2O$ over time.

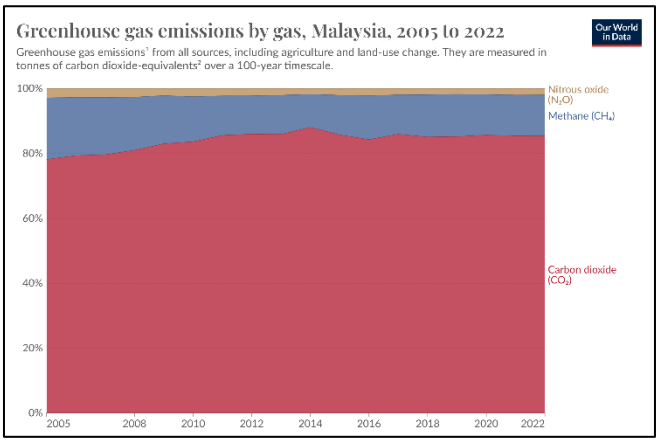


*Figure II-3: Stacked Area Chart for Percentage Contribution of Greenhouse Gas Emissions Over Time*

Figure II-3 illustrates the percentage contribution of each greenhouse gas ($CO_2$, $CH_4$, and $N_2O$) to total emissions over time, displayed in a stacked area chart.

### *C. Stacked Bar Chart*

The stacked bar chart will be used to display the relative contributions of each greenhouse gas type—$CO_2$, $CH_4$, and $N_2O$—to the total emissions for each year. In this chart, the x-axis represents the years within the observed period, and the y-axis represents the percentage of total emissions. Each bar is divided into segments for each gas tye, with the segment height corresponding to the gas's proportion of total emissions in that year.

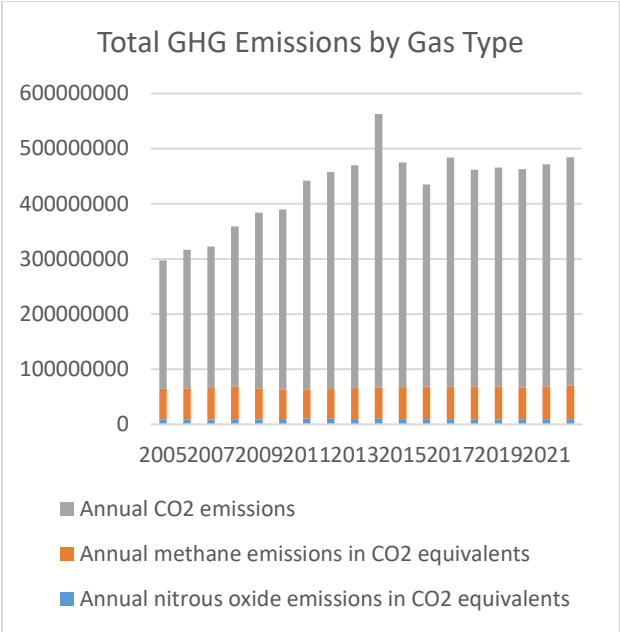


*Figure II-4: Total GHG Emissions by each Greenhouse Gas Type*

Figure II-4 shows the total GHG emissions by each greenhouse gas type over time, highlighting how the composition of emissions has shifted across the years.

### *D. Pie Chart*

The pie chart for the latest four years will be used to show the distribution of greenhouse gas emissions ($CO_2$, $CH_4$, and $N_2O$) in each of those years. Each slice of the pie will represent the proportion of emissions contributed by each gas type, with the size of each slice corresponding to its percentage of the total emissions for that specific year.

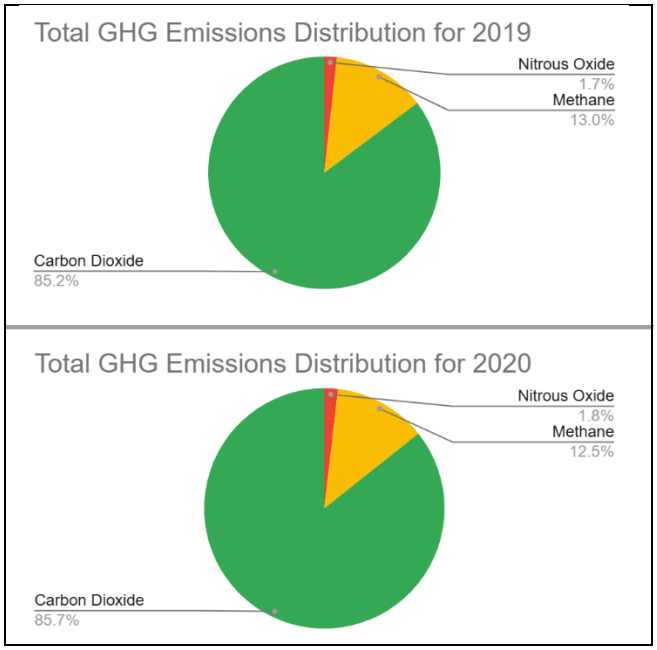


*Figure II-5: Pie Chart for Total GHG Emissions Distribution in 2019 vs. 2020.*

Figure II-5 compares the relative contributions of $CO_2$, $CH_4$, and $N_2O$ emissions in 2019 and 2020, highlighting the distribution of each greenhouse gas over the two years.

## III. Targeted Stakeholder

The targeted stakeholders include the Malaysian government, particularly the Ministry of Natural Resources and Environmental Sustainability, as well as NGOs, researchers focused on environmental studies, and the general public. Each of these groups can use the insights from this visualization to understand emission trends by gas type, promote policy changes, and raise awareness about the impacts of $CO_2$, $CH_4$, and $N_2O$ on the climate. This aligns with efforts toward achieving Malaysia's sustainability goals under SDG 13, "Climate Action." The data visualization also helps the Ministry of Natural Resources and Environmental Sustainability develop informed solutions for reducing GHG emissions and implementing effective strategies to combat climate change.

## IV. Value Proposition

The data visualization technique provides actionable insights for stakeholders to effectively analyze and interpret trends in greenhouse gas (GHG) emissions over time. By breaking down emissions by gas type ($CO_2$, $CH_4$, and $N_2O$), it offers a clear understanding of the contributions of each gas to overall emissions. This is critical for the government, particularly the Ministry of Natural Resources and Environmental Sustainability, to evaluate annual GHG emissions, enabling informed decision-making and the development of strategies to reduce emissions and mitigate climate change.

If GHG emissions continue to rise, the impacts will be severe, including more frequent and intense extreme weather events, rising sea levels, and significant disruptions to ecosystems and human health. [4] For example, in 2023, an article from The Straits Times highlighted a potential shortage of local white rice in Malaysia, particularly in Kedah, due to unpredictable weather and a shortage of "Padi" seeds [5]. Climate change has disrupted traditional farming cycles, causing delays in planting that disrupt rice production and supply.

Such issues highlight the broader consequences of rising GHG emissions, including agricultural disruptions, food shortages, higher rice prices, and biodiversity loss. The proposed visualization directly supports stakeholders, such as the government, NGOs, researchers, and the general public, by providing clear and accessible data to guide climate action. This aligns with Malaysia's commitment to achieving the United Nations Sustainable Development Goal (SDG) 13: Climate Action, emphasizing the urgent need for targeted efforts to reduce emissions and address the effects of climate change.

## V. Illustration of Visualization


*Figure V-1: Sketch of the Interactive Dashboard Prototype for Visualizing Greenhouse Gas Emissions.*

## VI. Information of Requirements

1. **Data**
   Malaysia's GHG emissions data is collected from Our World in Data for multiple years. It includes annual emissions for carbon dioxide ($CO_2$), methane ($CH_4$), and nitrous oxide ($N_2O$).

2. **Software**
   Looker Studio and Google Sheets are utilized for data visualization. Google Sheets stores and organizes the collected data, while Looker Studio transforms the raw data into an interactive visual dashboard.

3. **Financial**
   There is no cost associated with this research, as Looker Studio and Google Sheets are free to use.

4. **Time**
   The expected time to collect and organize the relevant data is four days, with an additional three days for preparing the proposal and documentation. The estimated time to visualize the data is four weeks.

5. **Skill**
   Proficiency in data analysis, visualization, and technical tools like Looker Studio and Google Sheets are essential for creating accurate and interactive dashboards.

## VII. Visualization Tools

To uncover hidden trends and insights in Big Data, a visualization tool is essential for simplifying the data analysis process. The following section provides an in-depth discussion of the powerful data visualization tools.

### A. *Looker Studio*


*Figure VII-1: Data Visualization Tool - Looker Studio*

Looker Studio is a free visualization tool that allows users to create interactive dashboards by displaying data through highly customizable charts and tables. It connects quickly to various data sources, enabling users to share insights with their team or a global audience and collaborate on reports. With Looker Studio, users can easily generate reports from diverse datasets without the need for programming. It integrates data from sources like MySQL, flat files via CSV uploads, Google Cloud Storage, and social media platforms such as Instagram, X (Twitter) and Facebook.

## VIII. Project Time-Line

| Tasks | Weeks | | | | |
|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 |
| Collecting Data | | | | | |
| Organize Data | | | | | |
| Writing Proposal | | | | | |
| Visualize Data | | | | | |

## References


[1] N. Sarwar, Atique-Ur-Rehman, S. Ahmad, Mirza Hasanuzzaman, and Springerlink (Online Service, *Modern Techniques of Rice Crop Production*. Singapore: Springer Nature Singapore, 2022.

[2] Straits Times, "No rain a pain for Malaysia's padi farmers," *The Straits Times*, Singapore, Jan. 22, 2024. Available: https://www.straitstimes.com/asia/se-asia/no-rain-a-pain-for-padi-farmers

[3] H. Ritchie, P. Rosado, and M. Roser, "Greenhouse gas emissions," Our World in Data, 2020. https://ourworldindata.org/greenhouse-gas-emissions (accessed Nov. 14, 2024).

[4] M. Filonchyk, M. P. Peterson, L. Zhang, V. Hurynovich, and Y. He, "Greenhouse gases emissions and global climate change: Examining the influence of CO2, ch4, and n2o," Science of The Total Environment, vol. 935, p. 173359, Jul. 2024. doi:10.1016/j.scitotenv.2024.173359

[5] Straits Times, "Malaysia faces looming white rice shortage amid uncertain weather and expensive padi seeds," *The Straits Times*, Singapore, Nov. 11, 2023. Available: https://www.straitstimes.com/asia/se-asia/malaysia-faces-looming-white-rice-shortage-amid-uncertain-weather-and-expensive-paddy-seeds