Analysing UK Greenhouse Gas Emissions: Trends, Insights, and Forecasts.

Understanding greenhouse gas (GHG) emissions trends is essential for effective climate policy. This analysis examines UK GHG emissions from 1990 to 2023, combining historical data, industry-specific trends, and future forecasting to identify key contributors and predict how trends may develop.

Using a linear regression model, I've highlighted significant insights about emission reductions and areas where progress is still needed. Alongside, visualisations provide a clear narrative, supporting findings about industry contributions and relative changes over time.

Data and processing

This analysis used the dataset 'Atmospheric emissions: greenhouse gases by industry and gas', covering UK GHG emissions from 1990 to 2022, with provisional data for 2023. While the dataset includes sheets for specific gases (e.g., CO2, CH4), I focused exclusively on the GHG Total sheet to analyse overall trends.

Substantial cleaning was needed to prepare the dataset for analysis. The sheets contained two tables that needed to be separated before processing. Rows of metadata had to be removed, headers were standardised, numeric data was cleaned to handle missing or invalid values. I also calculated annual total emissions to use as a foundation for modelling. These steps ensured the data was structured and ready for analysis, to allow for clear insights and future forecasting.

Model and Assumptions

To analyse and predict GHG emissions trends, I opted for a linear regression model, for its simplicity, interpretability, and suitability for long-term trends. By fitting a straight line to historical data, it provides an ideal basis for projecting future values.

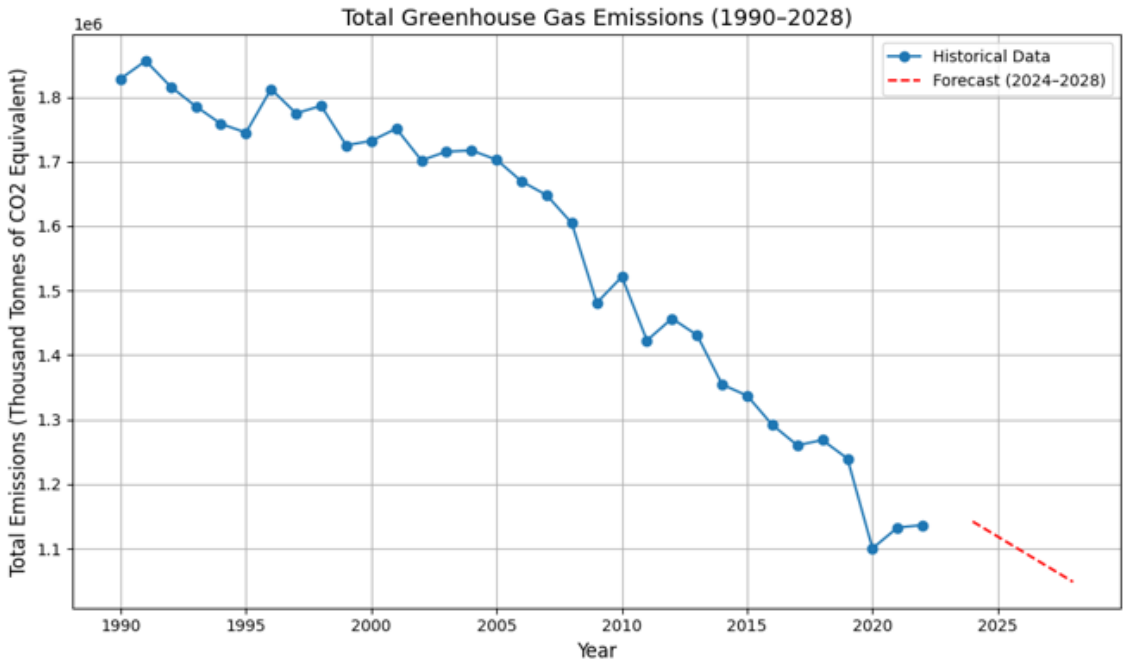
It is important to acknowledge that this model relies on the assumption that the trend in emissions over time is linear, that emissions will continue to decrease as it did historically. This simplifies the reality that emissions trends could be influenced by sudden policy changes or economic fluctuations.

Despite its simplicity, the linear regression model effectively highlights trends and supports clear visualisations, enabling actionable insights. The insights can be critical for identifying areas of progress and sectors requiring further attention. With further

exploration, the causes of these findings can be understood, helping to make informed policy decisions.

Key Findings

Figure 1: Total GHG Emissions (1990-2023) and Forecast (2024-2028)



The historical trend of total GHG emissions in the UK (1990-2023) reveals a steady decline, reflecting three decades of progress in reducing emissions. We can see a particularly notable drop in 2019, likely driven by the UK government's commitment to achieving net zero by 2050, which was established into law that year. We can see the effect of policies on total emissions, another example is the drop in 2013, corresponding with the introduction of the Carbon Price Floor, which increased the cost of fossil fuel-based power generation.

The forecast for 2024-2028 predicts a continuation of this downward trend, suggesting that the policies driving these reductions are having a lasting impact. On the other hand, from this forecast, we can see that the projected rate of decline may not be sufficient to meet the UK's net zero by 2050 targets. This highlights the need to continue to push efforts, and implement additional measures and policies, particularly in industries that are failing to reduce their emissions fast enough. Figure 2 explores this output of my model in more detail, breaking It down at the industry level.

Figure 2: Industry-Specific Trends in GHG Emissions (1990-2023)

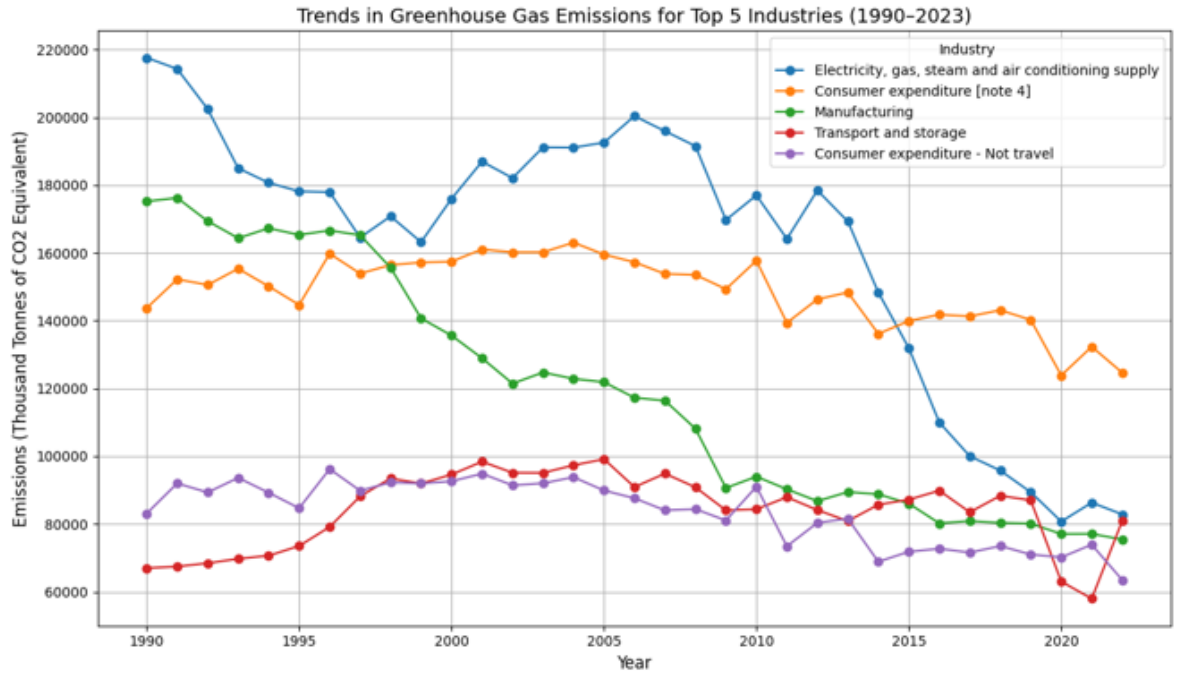


Figure 2 provides a closer look at GHG emissions, building on the output of the model. The chart highlights varying progress between sectors, offering insights into where emissions have been successfully reduced and where further efforts are required.

Sectors like electricity, demonstrate great progress, which align with the overall decline we saw in figure 1. However, other sectors, such as transport, show much slower progress. This observation may spark the investigation of what challenges these industries are facing. This can push the UK government to enforce industry specific measures to reduce emissions.

By breaking down emissions at the industry level, figure 2 showcases how the model can be used to identify sectors that are failing to perform and informs where targeted interventions may be necessary. This ensures that policy decisions can be better aligned with industry specific challenges, helping to reach the UK's net zero goal.

Figure 3: industry contributions to Total GHG Emissions as Percentages (1990-2023)

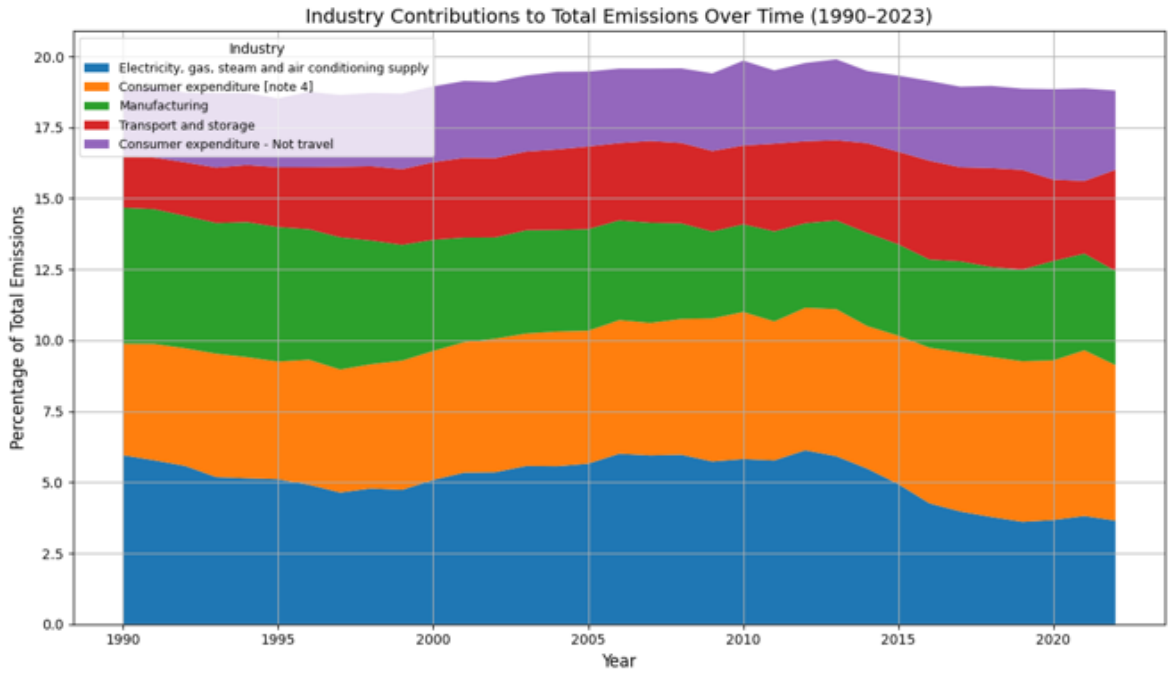


Figure 3 provides a breakdown of each industry's share of total GHG emissions, offering a perspective that complements the trends we saw in figures 1 and 2. We can see that the share from some sectors have decreased, reflective successful efforts, while others (e.g. transport) have kept a steady share, further highlighting the need for intervention in this area. This breakdown reinforces the need for targeted intervention, helping the UK's steady progress towards net zero.

Limitations

This analysis is subject to several limitations. A major one being its focus only on total GHG emissions. Data on specific gases, such as CO2 and CH4 were not analysed or considered. While my approach still allowed for a comprehensive view on GHG emissions, my model has limited ability to explore trends and impacts of individual gases, insights from this could be used to make policies even more targeted and specific.

Also, the linear regression model assumes a consistent, linear trend over time (as discussed earlier), While effective for broader trends, this approach simplifies the complexities of real-world changes. Further, the model cumulates emissions at the industry level, which could overlook finer details, such as variations within specific sectors or the contributions of emerging sectors.

Finally, the scope of the analysis was constrained by time, which influenced the decision to focus on only total emissions and exclude additional layers of analysis.

Addressing these limitations could provide a better understanding of UK GHG emissions.

Conclusion and Implications

This analysis highlights the steady progress that the UK is making in reducing GHG emissions, while pointing out the sectors that are lagging. The forecast suggests that current efforts may not meet net zero targets by 2050, Targeted interventions, particularly in these lagging sectors like transport, will be critical for maintaining momentum.

Future improvements to this model, such as incorporating gas-specific trends or using more advanced forecasting models, could enhance the accuracy and utility of this analysis, providing policymakers with even greater clarity, to help hit the UK's climate goals.