Unveiling Greenhouse Gas Giants: Tackling Leading Industry Emissions for a Cooler Future

Project Task 6 - Final Presentation

Group 7 | Aliya Icasiano, Janeth Lara, Jianhao (Bob) Zhu, Jimena Lara, Justin Bailey

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Agenda

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- Objectives
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- Lessons Learned
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Introduction

- Greenhouse gases (GHGs) consist mainly of carbon dioxide, methane, and nitrous oxide
  - Ex: burning fossil fuels
- GHG emissions contribute to the greenhouse effect (trap heat from the sun leading to global warming)
- Many different industries emit GHGs (agriculture, transportation, etc.)

Problem Statement

Our Problem: What industries will see the greatest growth of greenhouse gas emissions in 2025?

- GHGs are one of the leading causes of global warming
- These gases are the biggest reasons why we continue to see the global surface temperatures rise.
- It is essential to try to minimize GHG emissions because if it's not done we will see the alarming effects of it in the future.

Objectives

- Create a model demonstrating the relationship between GHG emissions and industries
- Use forecasting analysis to identify which industries will contribute the highest GHGs in 2025
- Provide insightful strategies for industries to lower their emissions

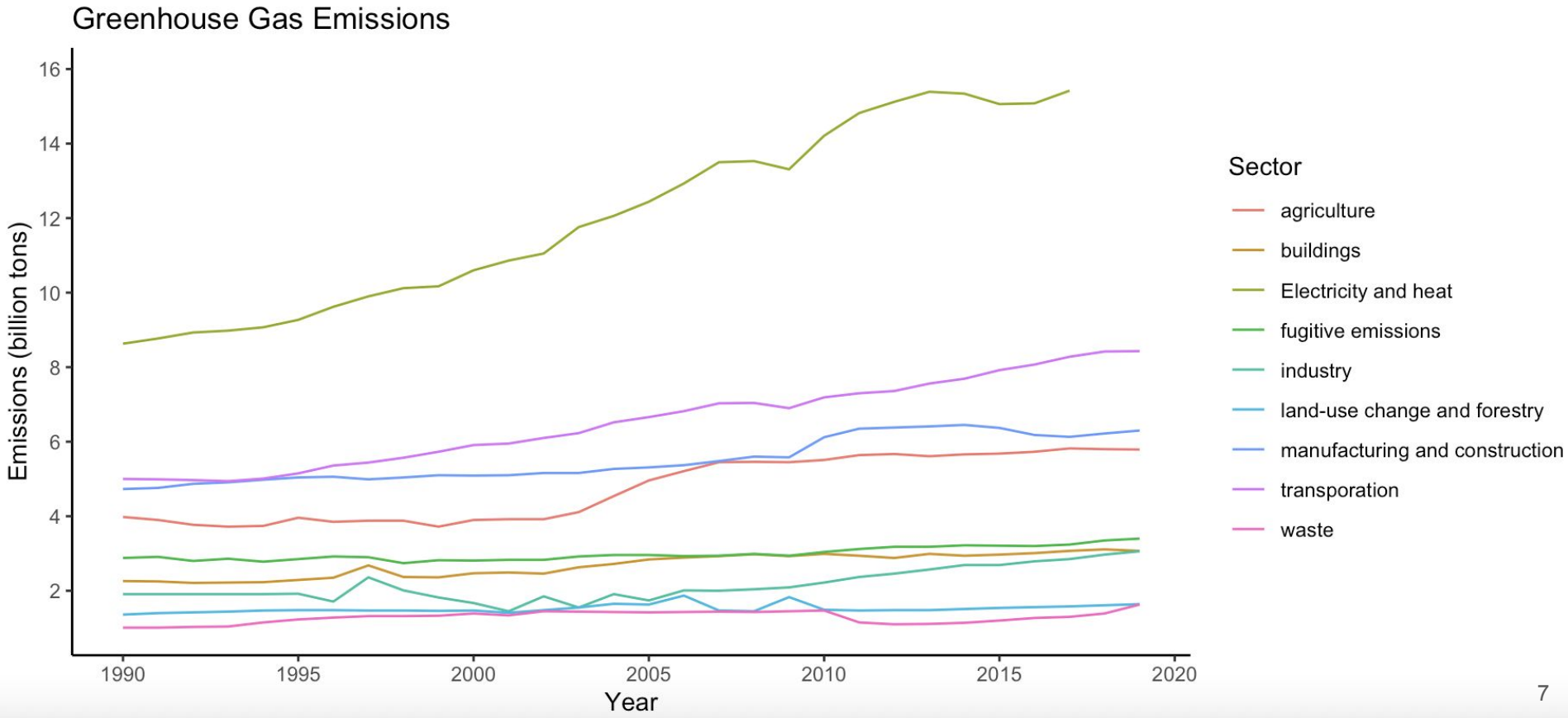
Data Summary

Electricity and heat	transportation	manufacturing and construction	agriculture
Min. : 8.630	Min. :4.940	Min. :4.730	Min. :3.720
1st Qu.: 9.955	1st Qu.:5.473	1st Qu.:5.045	1st Qu.:3.900
Median :12.250	Median :6.590	Median :5.290	Median :4.750
Mean :12.255	Mean :6.518	Mean :5.517	Mean :4.741
3rd Qu.:15.000	3rd Qu.:7.345	3rd Qu.:6.168	3rd Qu.:5.633
Max. :15.880	Max. :8.430	Max. :6.450	Max. :5.820

fugitive emissions	buildings	industry	land-use change and forestry	waste
Min. :2.740	Min. :2.210	Min. :1.450	Min. :1.360	Min. :1.01
1st Qu.:2.853	1st Qu.:2.362	1st Qu.:1.910	1st Qu.:1.470	1st Qu.:1.15
Median :2.935	Median :2.780	Median :2.005	Median :1.480	Median :1.32
Mean :2.990	Mean :2.684	Mean :2.145	Mean :1.521	Mean :1.29
3rd Qu.:3.165	3rd Qu.:2.962	3rd Qu.:2.438	3rd Qu.:1.558	3rd Qu.:1.43
Max. :3.400	Max. :3.110	Max. :3.060	Max. :1.870	Max. :1.63

The highest mean is electricity and heat (12.26 billion tons of GHGs emitted).

Data Visualization



Analytical Approach

a) Type of statistical method: time series forecasting analysis

b) Independent variable: Time (period, year); Dependent Variable: GHG emissions (by sector)

c) Time series analysis equation: $Yt = b0 + b1(t)$

- 9 different equations
- Yt = emissions specific to a sector at a particular year
- $b0$ = baseline level of emissions for each sector
- $b1$ = estimated change in emissions for each sector per one-unit change in year
- t = time (years)

d) Assumption:

- Level of significance: alpha = 0.05
- Linear relationship between the independent variable and dependent variables

Results

a) Used simple linear regression
   - Rounded to 4 decimals due to the scale of the data (billions)

b) The time series variables are significant; all P-values < 0.05

c) MAPE percentages

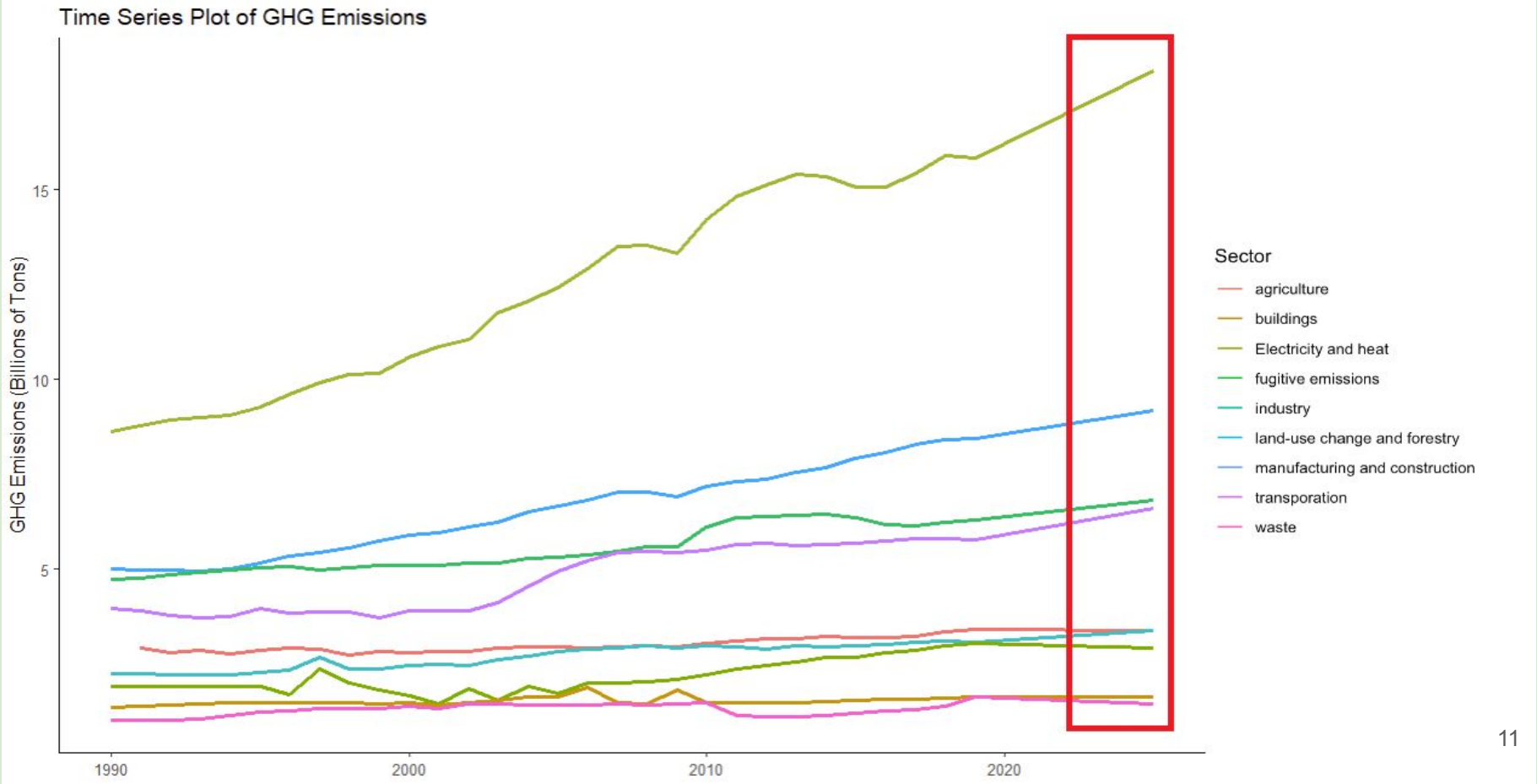
Sector	Time Series Analysis Equation	P-Value	MAPE
Electricity and Heat	7.8219 + 0.2860t	0.00	2.80%
Transportation	4.5041 + 0.1299t	0.00	1.73%
Manufacturing and Construction	4.5381 + 0.0632t	0.00	3.27%
Agriculture	3.3281 + 0.0912t	0.00	5.81%
Fugitive Emissions	2.6892 + 0.0191t	0.00	2.27%
Buildings	2.1557 + 0.0341t	0.00	3.22%
Industry	1.5526 + 0.0382t	0.00	11.81%
Land-Use Change and Forestry	1.4259 + 0.0061t	0.01	4.09%
Waste	1.1733 + 0.0075t	0.03	10.70%

Results

Values of the GHG output predictions for each sector in 2025:

Sector	2025 GHG Prediction
Electricity and Heat	18.12
Transportation	9.18
Manufacturing and Construction	6.81
Agriculture	6.61
Fugitive Emissions	3.39
Buildings	3.38
Industry	2.93
Land-Use Change and Forestry	1.65
Waste	1.44

Results: Visualization



Results cont.

d) Interpretations:

- Electricity and heat is both the biggest sector and the fastest-growing in emissions.
- Transportation also big and increasing
  - Big b0 (4.50) and high b1 (0.13).
- All sectors are still predicted to grow (positive b1)

Conclusions & Recommendations

Conclusions:

- Top 3 contributors by 2025 will be electricity and heat, transportation, and manufacturing and construction.
- Linearly increasing trend pattern

Recommendations:

- Prioritize the development and use of renewable energy
- Implement policies and strategies to gradually phase out reliance on fossil fuels in energy production
- Set clear and measurable targets for reducing GHG emissions in alignment with global climate goals

Lessons Learned

- Electricity and heat contributes the most GHGs and is the fastest-growing
- Prioritize using renewable energy resources instead of fossil fuels
- Teamwork and equal contribution is the key to a successful team

Challenges

- We were unsure which statistical method to use and upon deciding on time series analysis, we weren't sure how to apply it
  - Solution: When coming together after project task 4 feedback, we realized we could forecast GHG output for future years.
- Struggled to meet in person
  - Solution: We actively communicated through text and zoom.

Thank you