

CO₂ Emissions Analysis Across New Zealand Regions (2007–2023)

1. Project Objective

The primary objective of this project is to **analyse and visualise carbon dioxide (CO₂) emissions across New Zealand regions over time**, in order to:

- Understand **regional and temporal emission patterns**
- Identify **which regions and years recorded the highest CO₂ emissions**
- Examine **industry-level contributors** to emissions within each region
- Support **evidence-based sustainability and policy decision-making**

An interactive **R Shiny application** was developed to allow users to explore emissions dynamically by region, year, and industry.

2. Business Questions (Project Requirements)

This project was designed to answer the following **key business and policy questions**:

1. **Which New Zealand region contributes the most to CO₂ emissions, and in which year?**
2. **How have CO₂ emissions changed over time within each region (2007–2023)?**
3. **What industries are the major contributors to CO₂ emissions in each region?**
4. **Are there observable reductions in emissions in recent years, and where are they most significant?**
5. **How can regional emission patterns inform sustainability strategies and policy interventions?**

These questions align closely with **public-sector, environmental monitoring, and sustainability analytics requirements**.

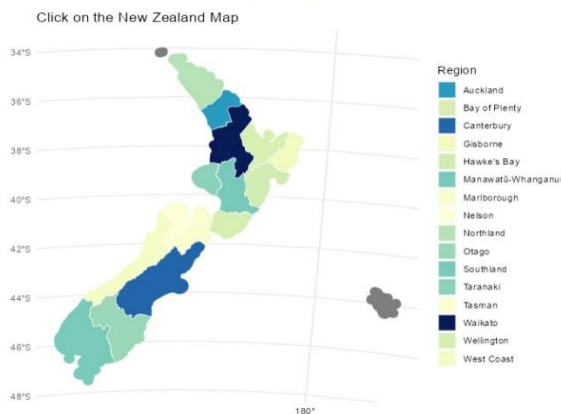
3. Data Overview & Preparation

- **Source:** Stats NZ – Greenhouse gas emissions by region, industry, and household (Year ended 2023)
- **Time period:** 2007–2023
- **Records after cleaning:** ~7,800+
- **Gas type analysed:** Carbon dioxide equivalents only

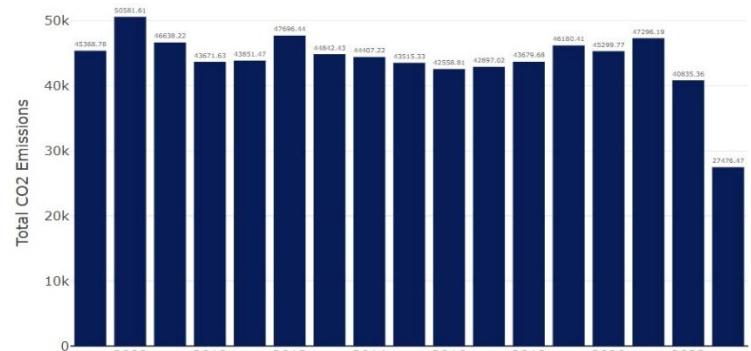
Key preparation steps included:

- Removing aggregated totals (“Total” and “Total all industries”) to avoid double counting
- Standardising region names to align with official New Zealand regional boundaries
- Aggregating emissions by **region, year, and industry**
- Handling missing and duplicate records

CO2 Gas Emissions by Region (Clickable Map)

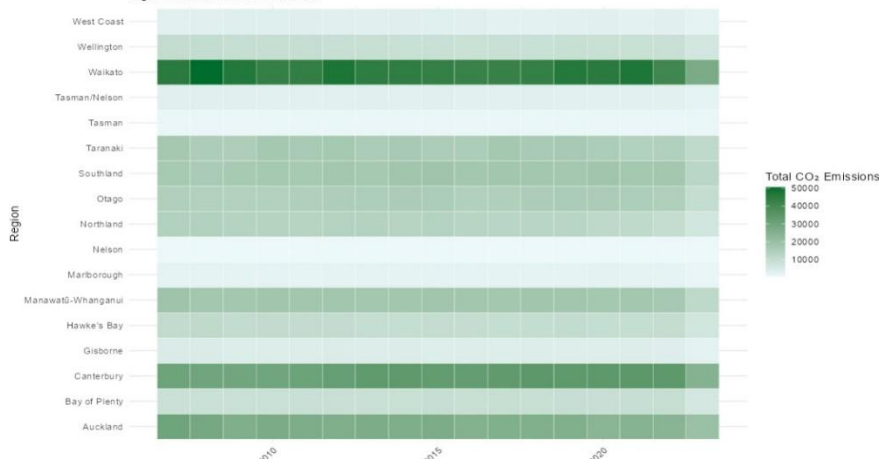


CO2 Emissions in Waikato

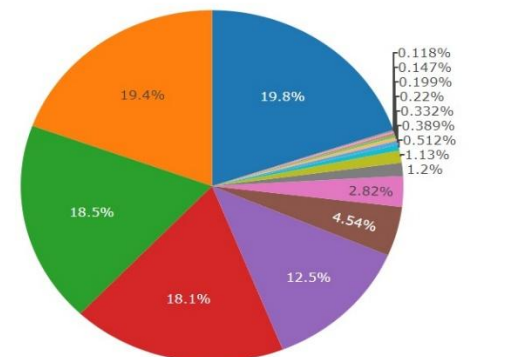


Region: Waikato - Lowest CO2 Emission: 23.04 in 2007 | Highest CO2 Emission: 9053.96 in 2021

CO2 Emissions by Region and Year
Highest emission: Waikato in 2008



Industry-wise CO2 Emissions in Waikato



4. Visual Analytics & Insights

4.1 Regional Emissions Overview (Clickable Map)

The interactive New Zealand map provides a **high-level spatial overview** of CO₂ emissions by region.

Insight:

- Regions such as **Waikato, Canterbury, and Auckland** consistently show **higher emission intensities** compared to smaller regions.

- The map acts as an entry point, allowing users to **drill down into region-specific trends**.

4.2 Emissions Trend by Region (Bar Chart)

For a selected region, annual CO₂ emissions from **2007 to 2023** are displayed as a bar chart.

Key observations:

- Most regions show **relatively stable or rising emissions until the mid-2010s**.
- A **noticeable decline in emissions appears post-2020**, particularly in 2022–2023.
- This reduction is consistent across multiple regions, indicating **systemic rather than localised change**.

4.3 Highest Emitting Region and Year (Heatmap Analysis)

A heatmap comparing **Region × Year** reveals the **global maximum emission point**.

Key finding:

- **Waikato recorded the highest CO₂ emissions in 2008**, making it the peak emission region-year combination in the dataset.

Why this matters:

- The heatmap enables **rapid identification of high-risk regions and periods**
- It supports **long-term trend monitoring** rather than isolated year analysis

4.4 Industry-Wise Emissions Breakdown (Pie Chart)

For each selected region, emissions are broken down by industry.

Consistent insights across regions:

- **Primary industries**
- **Agriculture, forestry, and fishing**
- **Agriculture alone**

Together, these sectors account for **over 70–80% of total CO₂ emissions** in many regions.

Regional variation:

- Urban regions (e.g., Auckland) show relatively higher contributions from **households and service industries**
- Rural regions (e.g., Waikato, Canterbury, Manawatū-Whanganui) are dominated by **agriculture-related activities**

5. Key Takeaways

1. **Waikato is the highest CO₂-emitting region**, with the peak recorded in **2008**, highlighting its long-term environmental impact.
2. **Agriculture and primary industries are the dominant drivers of emissions** across most New Zealand regions.
3. **Post-2020 emission reductions** are visible across multiple regions, likely influenced by:
 - Increased renewable energy adoption
 - Changes in industrial activity
 - Post-COVID shifts such as remote and hybrid work
4. Emission patterns vary significantly by region, reinforcing the need for **region-specific sustainability strategies** rather than a one-size-fits-all approach.
5. Interactive visualisation (maps, trends, and industry breakdowns) enables **faster insight generation and better stakeholder understanding**.

7. Conclusion

This CO₂ emissions analysis project successfully transforms complex, multi-year environmental data into **clear, actionable insights** through interactive visual analytics. By identifying emission hotspots, dominant industries, and long-term trends, the project supports informed decision-making and demonstrates the practical application of **data analytics in sustainability and public-sector contexts**.