🌍 Global CO_2 Emissions Tracker by Sector

By Altamash Ali Ansari

Data Analytics & Visualization Project Report

📌 Introduction

Global climate challenges demand accurate and timely monitoring of carbon dioxide (CO_2) emissions. Raw emission data is complex and often fails to inform actionable decision-making. This project aims to solve that by developing a fully interactive analytics dashboard to track, analyze, and forecast CO_2 emissions by country and sector using modern data tools.

📄 Abstract

This project delivers a comprehensive analytical framework using SQL, Python, and Power BI to interpret over five years of global CO_2 emissions data. It transforms static data into a dynamic decision-support system with interactive visualizations and advanced metrics such as Z-Score, Year-over-Year (YoY) Change, Compound Annual Growth Rate (CAGR), and Forecast Risk Scores. By integrating anomaly detection, sector-wise breakdowns, and forward-looking analytics, the dashboard provides clear insights for ESG analysts, policymakers, and sustainability professionals.

🛠️ Tools Used

- **Python (Pandas, NumPy):** Data cleaning, forecasting, spike detection
- **SQL (MySQL):** Aggregations, trend analysis, KPI extraction
- **Power BI:** Dashboard building, DAX calculations, KPI visualization
- **Excel:** Data validation and pivot table previews

⚙️ Steps Involved in Building the Project

1. **Data Collection & Cleaning**
    - Raw dataset with columns: country, sector, date, value, timestamp
    - Cleaned nulls, standardized dates, converted units where necessary
2. **SQL-Based Aggregation**
    - Calculated:
        - Total Emissions by Sector & Year
        - YoY % Change

        - CAGR for long-term growth trends
        - Spike Detection for >30% annual jumps
3. **Python Analysis**
    - Created Z-Score logic to flag statistical anomalies
    - Built emission forecast models per sector
    - Calculated Environmental Scores based on trends
4. **Power BI Visualization**
    - Designed KPI cards, pie/treemap, waterfall, forecast line charts
    - Applied slicers for Year, Country, Sector
    - Built DAX measures for rolling averages, rank indexes, and deviations

📈 Sample Insights

- **Power & Industry** contribute over 60% of total emissions
- **Brazil** showed an unusual spike (>30% YoY), likely tied to land-use changes
- **Residential Sector** emissions are forecasted to decline by 2024
- **Z-Score Outliers**: Ground Transport & Aviation significantly deviate from global average

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✅ Conclusion

The project successfully transforms raw emissions data into a compelling, data-rich dashboard that enables quick insight discovery. It identifies emission-heavy sectors, spike years, and sustainability risks while forecasting future behavior. The solution provides a valuable tool for data-driven climate strategy, offering clarity and confidence for decision-makers.

“From data to decisions—this dashboard translates carbon numbers into climate action.”