# Final project

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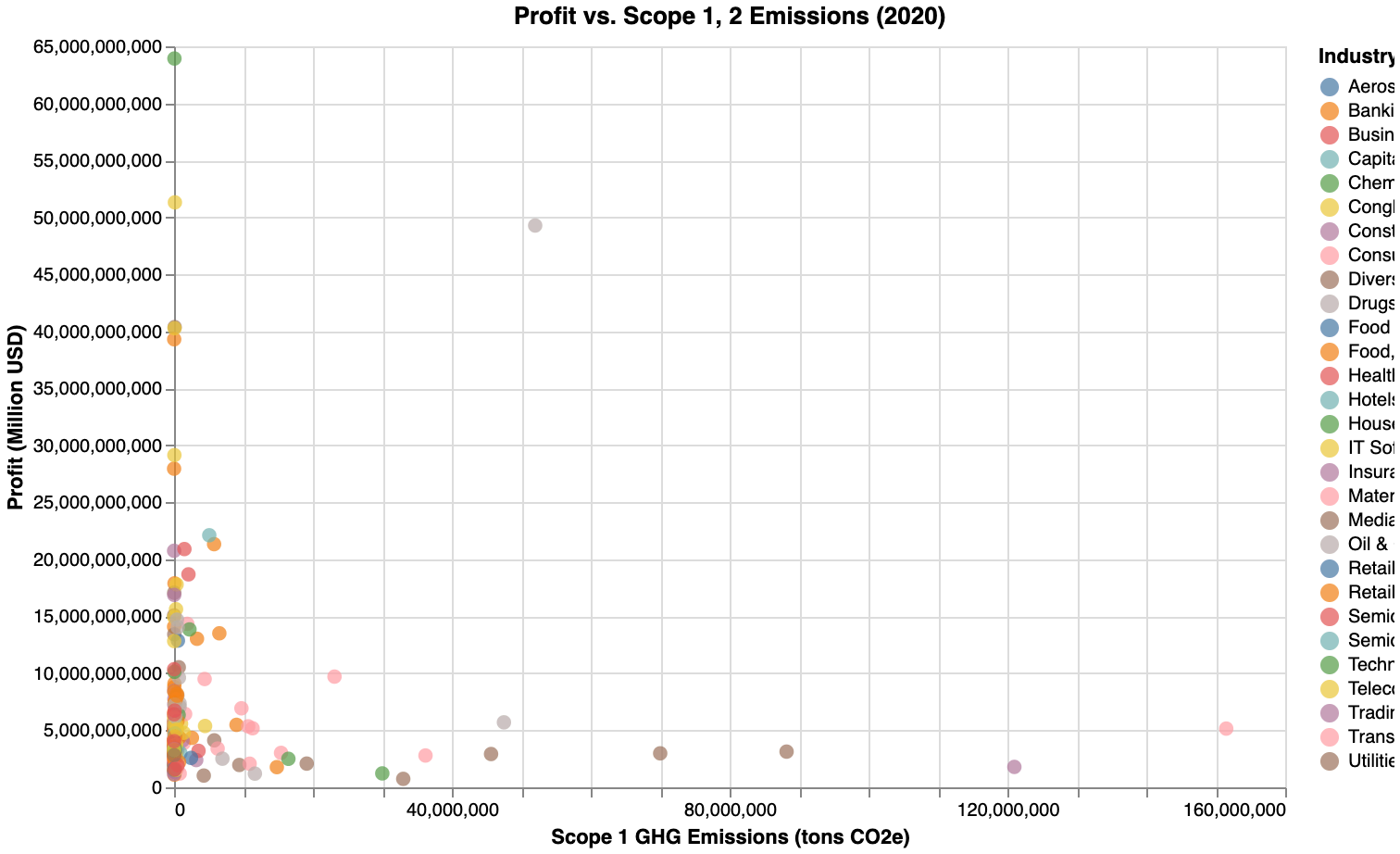
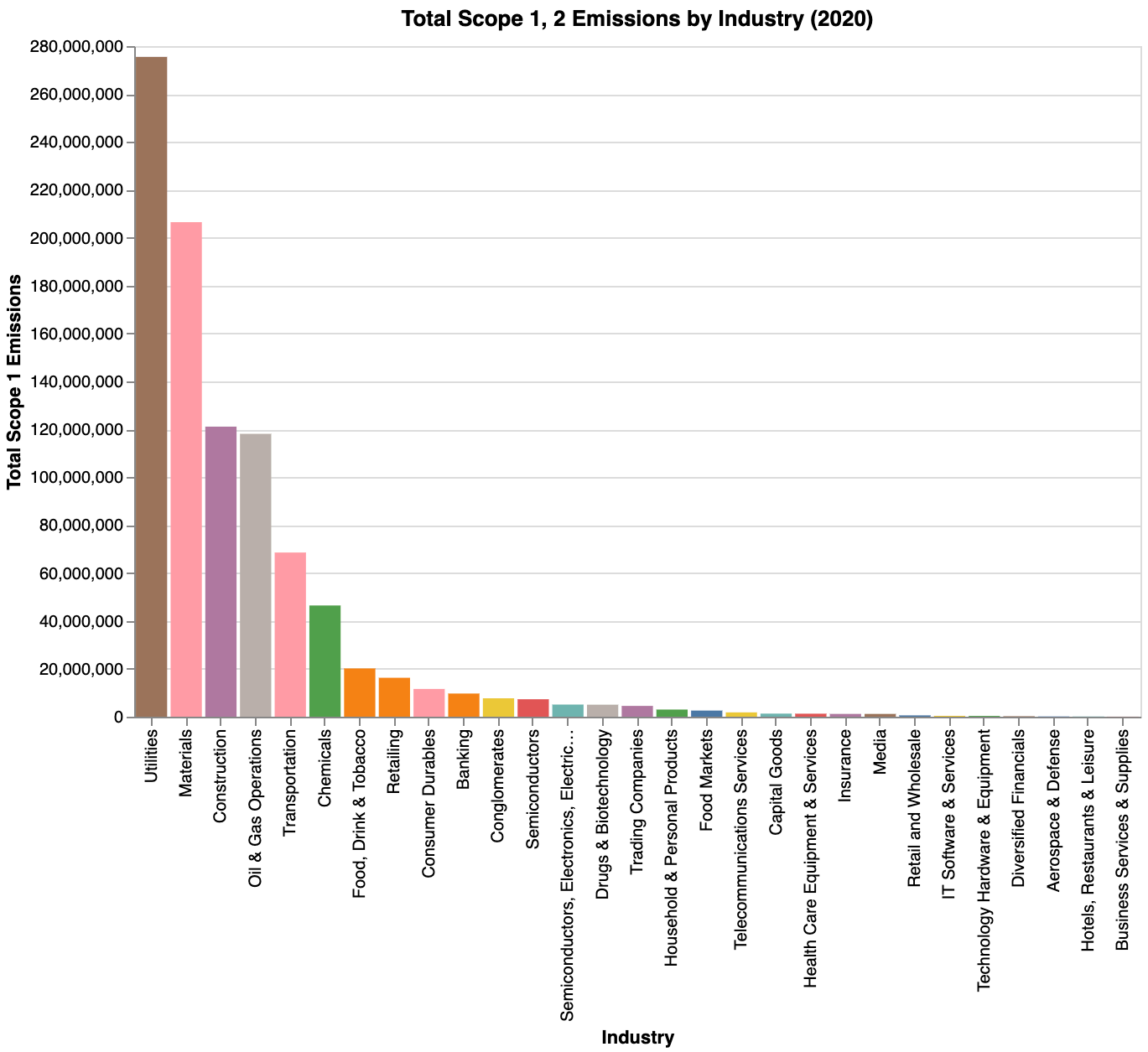
1. Data Loading and Cleaning

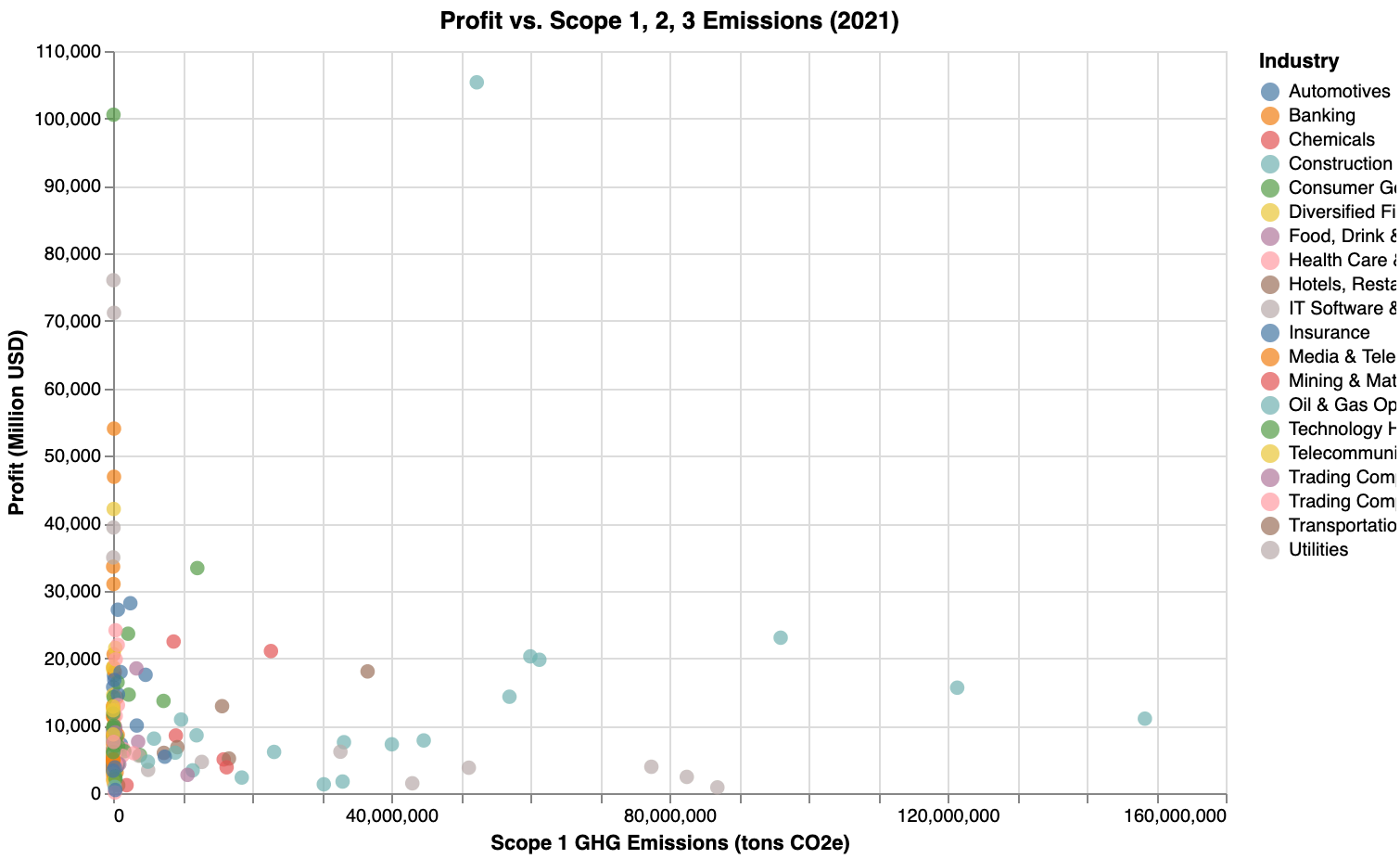
2. Plot

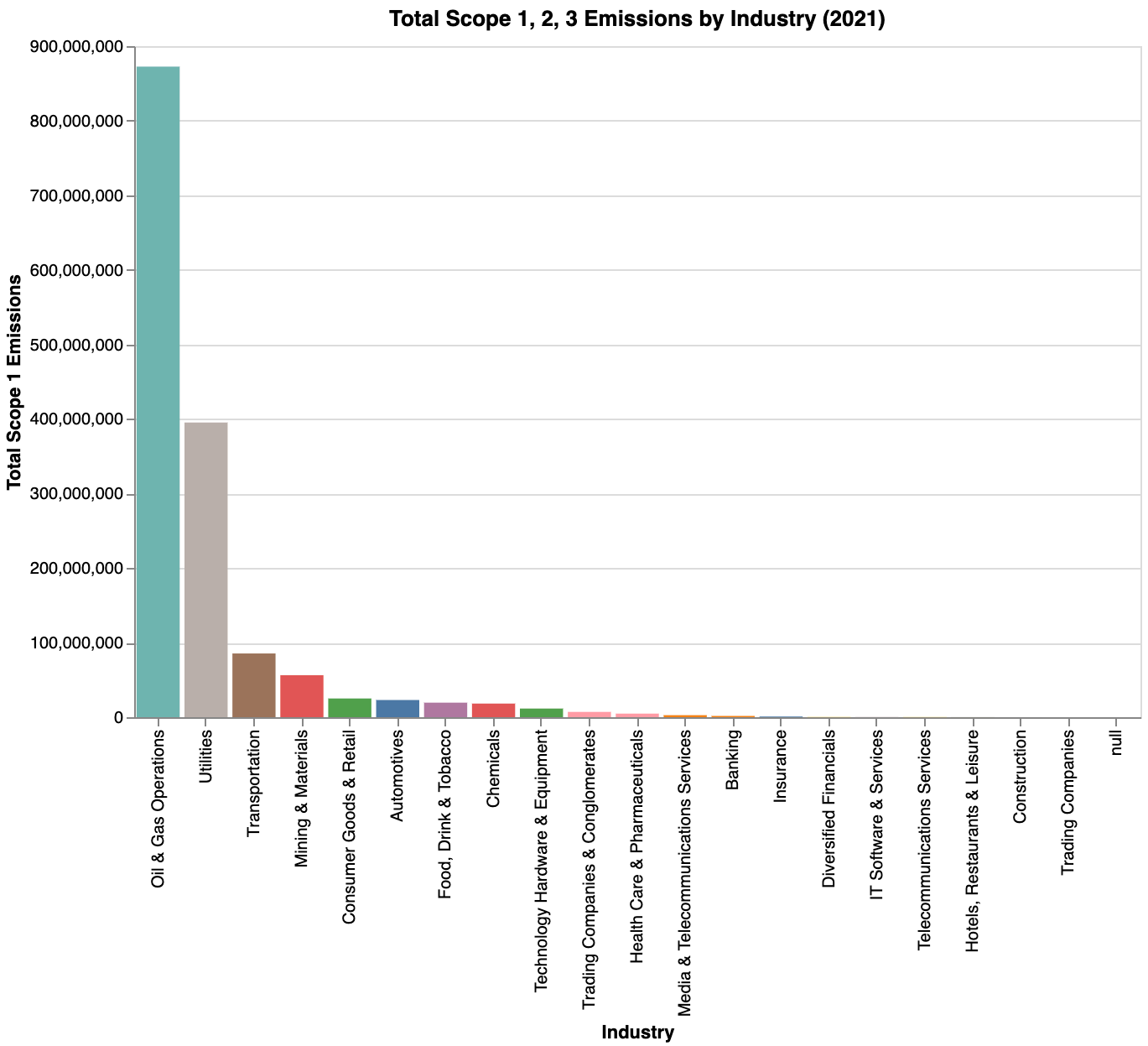
# 2020



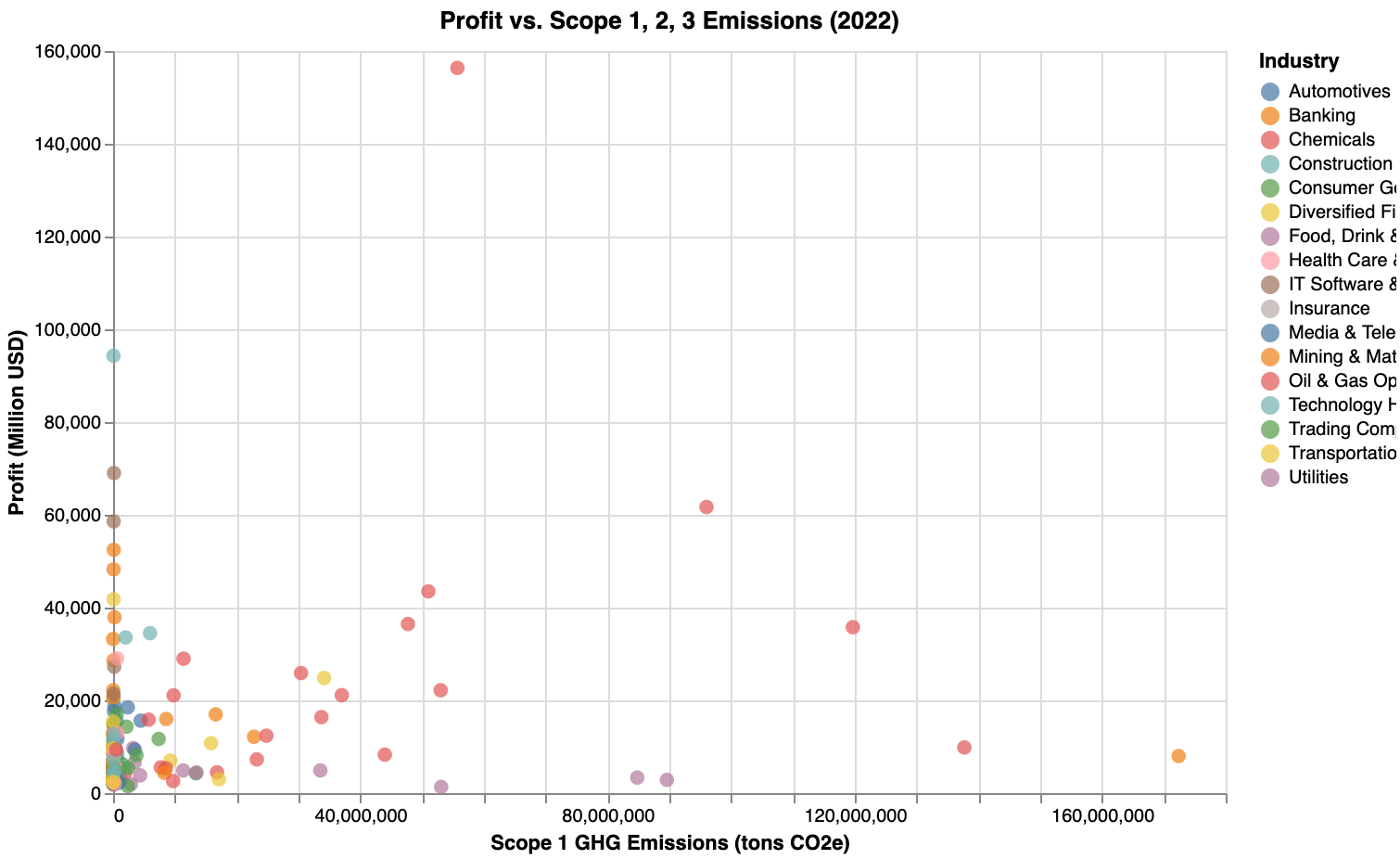

Total Scope 1, 2 Emissions by Industry (2020)
Total Scope 1 Emissions
280,000,000
260,000,000
240,000,000
220,000,000
200,000,000
180,000,000
160,000,000
140,000,000
120,000,000
100,000,000
80,000,000
60,000,000
40,000,000
20,000,000
0
Utilities
Materials
Construction
Oil & Gas Operations
Transportation
Chemicals
Food, Drink & Tobacco
Retailing
Consumer Durables
Banking
Conglomerates
Semiconductors
Semiconductors, Electronics, Electric...
Drugs & Biotechnology
Trading Companies
Household & Personal Products
Food Markets
Telecommunications Services
Capital Goods
Health Care Equipment & Services
Insurance
Media
Retail and Wholesale
IT Software & Services
Technology Hardware & Equipment
Diversified Financials
Aerospace & Defense
Hotels, Restaurants & Leisure
Business Services & Supplies
Industry

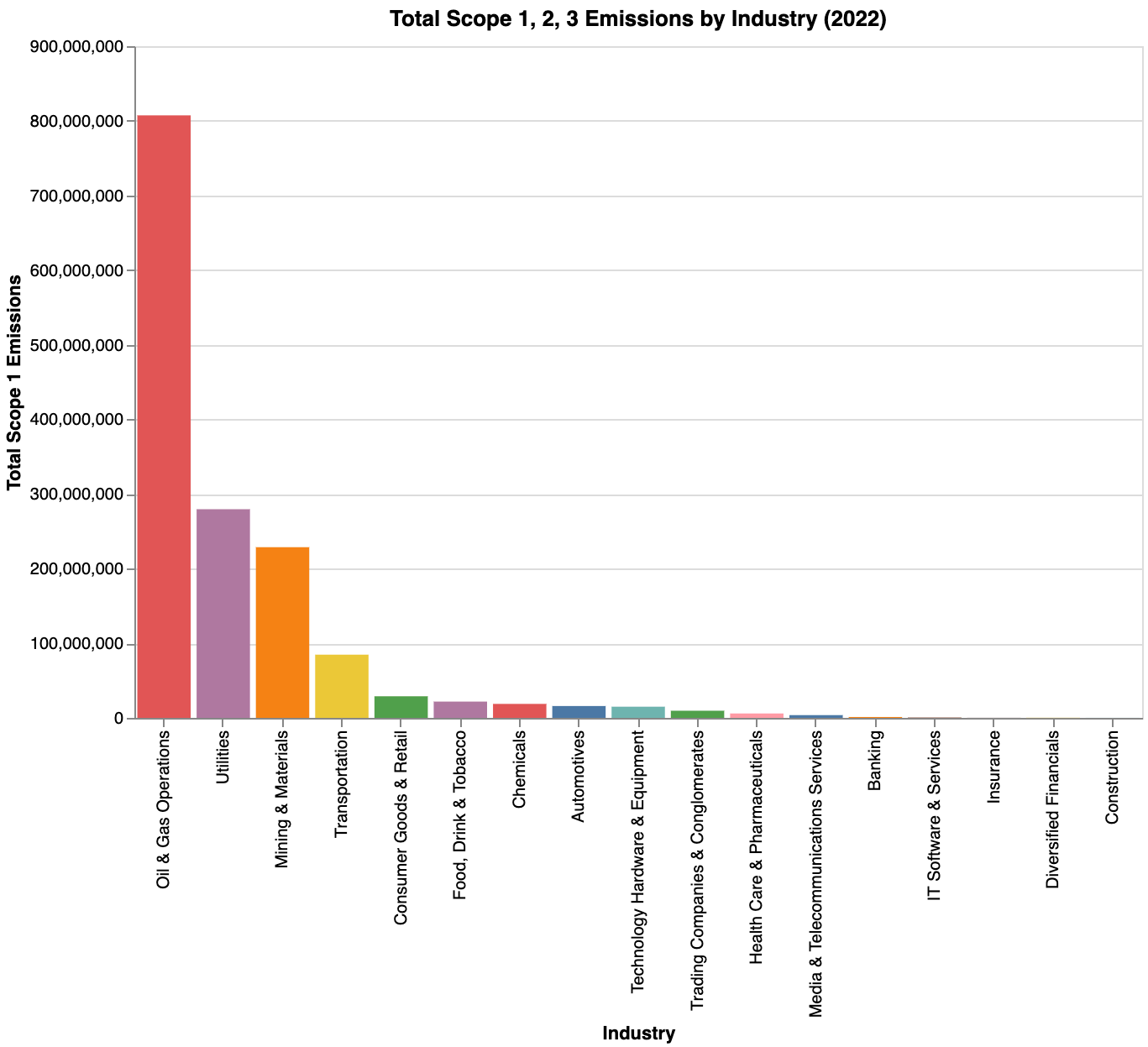
# 2021


Profit vs. Scope 1, 2, 3 Emissions (2021)
Profit (Million USD)
110,000
100,000
90,000
80,000
70,000
60,000
50,000
40,000
30,000
20,000
10,000
0
0
40,000,000
80,000,000
120,000,000
160,000,000
Scope 1 GHG Emissions (tons CO2e)
Industry
Automotives
Banking
Chemicals
Construction
Consumer G
Diversified Fi
Food, Drink &
Health Care &
Hotels, Resta
IT Software &
Insurance
Media & Tele
Mining & Mat
Oil & Gas Op
Technology H
Telecommuni
Trading Com
Trading Com
Transportatio
Utilities


Total Scope 1, 2, 3 Emissions by Industry (2021)
Total Scope 1 Emissions
900,000,000
800,000,000
700,000,000
600,000,000
500,000,000
400,000,000
300,000,000
200,000,000
100,000,000
0
Oil & Gas Operations
Utilities
Transportation
Mining & Materials
Consumer Goods & Retail
Automotives
Food, Drink & Tobacco
Chemicals
Technology Hardware & Equipment
Trading Companies & Conglomerates
Health Care & Pharmaceuticals
Media & Telecommunications Services
Banking
Insurance
Diversified Financials
IT Software & Services
Telecommunications Services
Hotels, Restaurants & Leisure
Construction
Trading Companies
null
Industry

# 2022


Profit vs. Scope 1, 2, 3 Emissions (2022)
Profit (Million USD)
160,000
140,000
120,000
100,000
80,000
60,000
40,000
20,000
0
0
40,000,000
80,000,000
120,000,000
160,000,000
Scope 1 GHG Emissions (tons CO2e)
Industry
Automotives
Banking
Chemicals
Construction
Consumer G
Diversified Fi
Food, Drink &
Health Care
IT Software &
Insurance
Media & Tele
Mining & Mat
Oil & Gas Op
Technology H
Trading Com
Transportatio
Utilities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900,000,000
800,000,000
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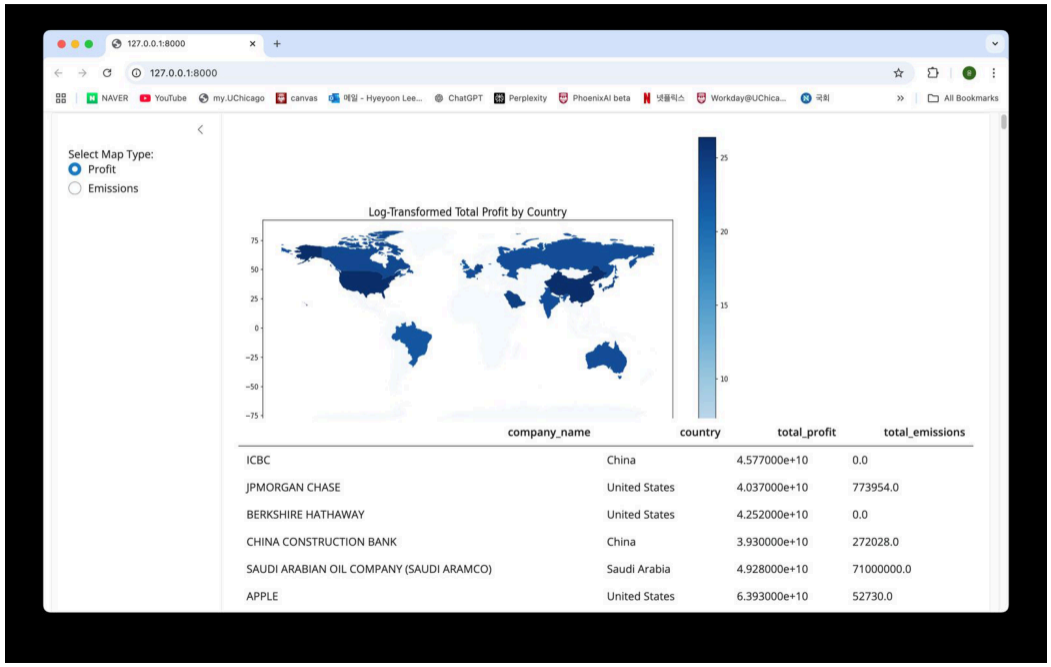
300,000,000
200,000,000
100,000,000
0
Oil & Gas Operations
Utilities
Mining & Materials
Transportation
Consumer Goods & Retail
Food, Drink & Tobacco
Chemicals
Automotives
Technology Hardware & Equipment
Trading Companies & Conglomerates
Health Care & Pharmaceuticals
Media & Telecommunications Services
Banking
IT Software & Services
Insurance
Diversified Financials
Construction
Industry

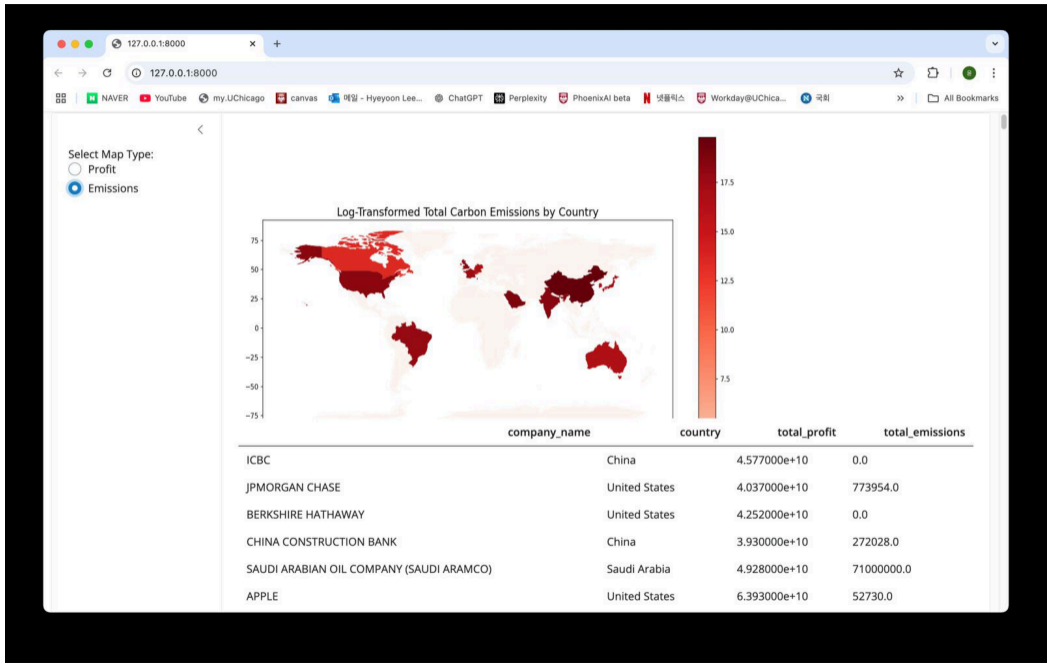
# Map

# Profit Map




| company_name | country | total_profit | total_emissions |
|---|---|---|---|
| ICBC | China | 4.577000e+10 | 0.0 |
| JPMORGAN CHASE | United States | 4.037000e+10 | 773954.0 |
| BERKSHIRE HATHAWAY | United States | 4.252000e+10 | 0.0 |
| CHINA CONSTRUCTION BANK | China | 3.930000e+10 | 272028.0 |
| SAUDI ARABIAN OIL COMPANY (SAUDI ARAMCO) | Saudi Arabia | 4.928000e+10 | 71000000.0 |
| APPLE | United States | 6.393000e+10 | 52730.0 |

Emission Map




# Write-Up

## Research Question

This project investigates the relationship between corporate profitability and carbon emissions (Scope 1, 2, and 3) from 2020 to 2022. The goal is to analyze how emissions efficiency varies by industry, explore shifts in emissions and profitability over time, and provide actionable insights to guide businesses and policymakers toward low-carbon practices.

## Key Questions:

- Which industries achieve high profitability with low emissions, and which struggle to reduce emissions while maintaining profits?

- How do emissions and profitability trends evolve from 2020 to 2022?
- What are the policy and business implications of these findings?

# Approach and Coding Methodology

## Datasets:

- **Source**: Public Profit and Emissions Database (2020–2022)
- **Variables**: Firm-level Scope 1, 2, and 3 emissions, profitability.

## Data Preparation:

- Cleaned and standardized datasets by:
  - Removing non-numeric characters (e.g., "$", ",").
  - Resolving missing values.
  - Standardizing column names.
  - Merging annual datasets.

## Visualization:

- Static visualizations (scatter and bar charts) via Altair.
- Dynamic dashboard (Shiny app) for interactive exploration.

## Challenges:

- **Inter-industry Comparisons**: Emissions baselines differ (e.g., Banking vs. Oil & Gas).
- **Shiny App Performance**: Filtering large datasets required optimization.

# Key Findings

## 2020: Baseline Year

- **High Emission Industries**: Utilities and Oil & Gas dominate emissions (>160M tons $CO_2e$).

- **Low Emission Industries**: IT Software, Banking, and Pharmaceuticals lead in profitability with minimal emissions.

### 2021: Post-Pandemic Recovery

- **Rising Emissions**: Transportation and Mining saw increases due to demand recovery.
- **Persistent Trends**: Oil & Gas remained a high-emission, high-profit sector.

### 2022: Shift Toward Sustainability

- **Decarbonization Efforts**: Utilities began adopting renewable energy.
- **Profitability Gaps**: Low-emission industries solidified their economic viability.

## Shiny App Description

The Shiny app provides interactive visualizations of: - **Profit Map**: Log-transformed total profits by country. - **Emissions Map**: Log-transformed total emissions by country. Users can filter and explore trends interactively.

## Policy Implications and Recommendations

- **Low-Emission Industries**: Showcase profitability of sustainable practices.
- **High-Emission Sectors**: Require significant investments in renewables and carbon capture.
- **Policy Measures**:
  - Decarbonization incentives: Subsidies for green technologies.
  - Carbon pricing: Stricter taxation to reduce emissions.

## Directions for Future Work

- Conduct industry-specific studies to uncover tailored solutions.
- Integrate policy metrics (e.g., carbon tax rates) for a comprehensive analysis.

# Extra Credit

```
Sentiment Polarity: 0.012540584415584425
Sentiment Subjectivity: 0.43852813852813854
```

This article discusses global financial negotiations at the COP29 climate summit in Baku, focusing on helping low-income countries adapt to climate change. The mention of “trillions” highlights the urgency and scale of financial support required. From the sentiment analysis, the tone is generally neutral (polarity: 0.0125) with some subjectivity (subjectivity: 0.4385), reflecting partial interpretation by the reporters regarding the summit’s objectives.