Carbon Footprint Analysis of Product Industries

Executive Summary

This project analyzes **product carbon footprints (PCF)** across major industry groups using real-world emissions data. The goal is to identify which industries contribute the most to global greenhouse gas emissions through their products, as measured by CO_2 equivalents, and to spotlight where climate action and corporate responsibility will have the greatest impact.

Project Objectives

- Calculate and compare the total product carbon footprint by industry.
- Understand industry-level patterns in carbon emissions attributable to products.
- Present an actionable summary for sustainability strategists, industry leaders, and environmental policymakers.

Technologies & Tools Used

- **Database:** PostgreSQL
- **Data Sources:** `product_emissions` table (public data compiled from The Carbon Catalogue and nature.com)
- **Analysis Platform:** Jupyter notebook
- **SQL Techniques:** Aggregation, grouping, filtering, subqueries

Dataset Description

The analysis draws on data from the `product_emissions` table, which includes:

Column	Description
`id`	Unique product ID
`year`	Year of emission record
`product_name`	Name of the product
`company`	Producing company
`country`	Country of production
`industry_group`	High-level industry category
`weight_kg`	Product weight in kilograms
`carbon_footprint_pcf`	Total carbon footprint (CO_2e) per product
`upstream_percent_total_pcf`	Share of footprint from supply chain
`operations_percent_total_pcf`	Share from operations
`downstream_percent_total_pcf`	Share from distribution/use/disposal

The analysis focuses on the **latest available year** for each industry.

Approach & Methodology

- Selected data for the **most recent year** in the dataset.
- Grouped emissions by `industry_group`, counting unique companies and summing total product carbon footprint.
- Ranked industries by total carbon emissions.
- All queries and summaries were generated with optimized, readable SQL and reproducible Jupyter notebook outputs.

Key SQL Query

```
WITH latest_year AS (
  SELECT MAX(year) AS max_year
  FROM product_emissions
)
SELECT
  industry_group,
  COUNT(DISTINCT company) AS num_companies,
  ROUND(SUM(carbon_footprint_pcf)::numeric, 1) AS total_industry_footprint
FROM product_emissions
WHERE year = (SELECT max_year FROM latest_year)
GROUP BY industry_group
ORDER BY total_industry_footprint DESC;
```

Results & Impact

Industry Breakdown — Latest Year

Industry Group	Companies	Total Product Carbon Footprint (tCO_2e)
Materials	3	107,129.0
Capital Goods	2	94,942.7
Technology Hardware & Equipment	4	21,865.1
Food, Beverage & Tobacco	1	3,161.5
Commercial & Professional Services	1	740.6
Software & Services	1	690.0

Key Insights:

- **Materials and Capital Goods industries produce the largest product carbon footprints by a wide margin**, responsible for over 200,000 tCO_2e combined.
- **Technology Hardware & Equipment** is also a significant contributor, reflecting the energy and materials-intensive nature of electronics and IT products.

- **Service-oriented sectors** (Commercial, Software) have considerably smaller total product footprints, but may still have large indirect/operational emissions.

Visuals

Photo by Maxim Tolchinskiy on Unsplash

Challenges & Solutions

- **Data Coverage:** Only recent years and certain industries/companies available; expansion would improve coverage.
- **Footprint Calculation Consistency:** Relied on published CO_2e methodologies for product-level analysis.
- **Industry Mapping:** Used existing groupings for clear, actionable summary tables.

Conclusion

This analysis highlights the global variation in product-level carbon emissions—pinpointing where industrial decarbonization efforts will have the largest climate impact. The approach demonstrates strong

SQL and data communication skills, and informs both sustainability policy and corporate ESG (Environmental, Social, and Governance) strategy.

Next Steps & Recommendations

- Drill down: Analyze drivers within largest industries (e.g., which materials or companies have outsized footprints?).
- Expand: Integrate with supply chain and lifecycle emissions.
- Visualize: Build dashboards to track company and industry progress over time.
- Act: Companies in high-impact sectors should set science-based, product-level emission reduction targets.

For details and reproducible code, see the project notebook.