



GOOGLE FY2024 GREENHOUSE GAS EMISSIONS.

OPERATIONAL VS SCOPE 3 ANALYSIS AND DASHBOARD



Author: Anshu Ukey

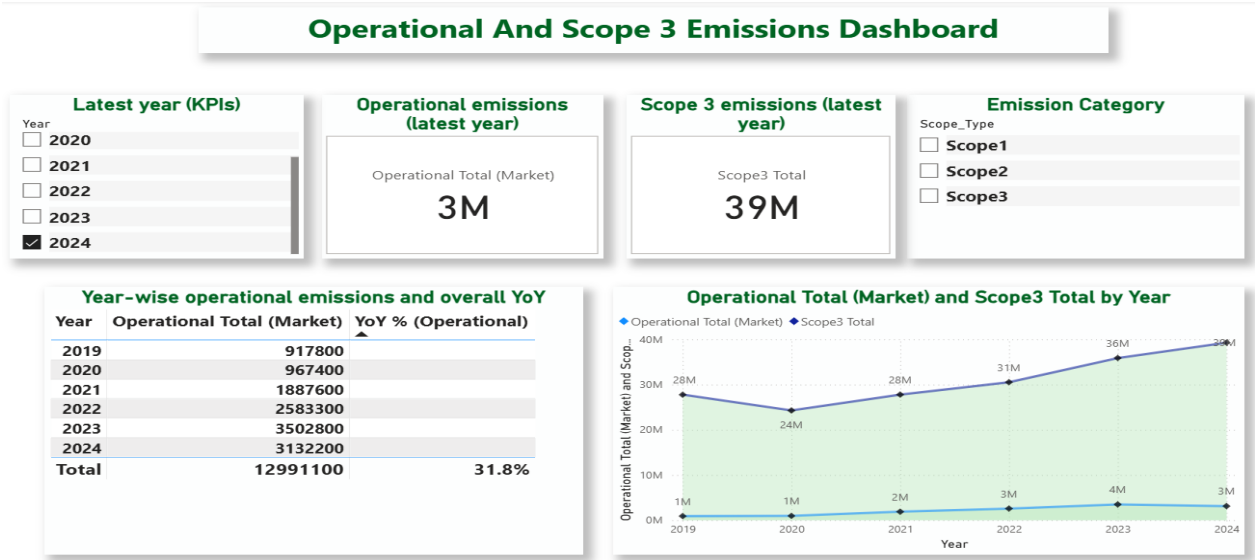
Affiliation: Data Analytics Portfolio Project

Email: anshu.ukey@gmail.com | Location: Bhopal, India

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Abstract:

This report analyses Google’s FY2024 greenhouse gas emissions, focusing on Operational totals (Scope 1 + Scope 2, market-based) and Scope 3 value-chain categories. A Power BI dashboard summarizes trends from 2019–2024, highlights latest-year KPIs, and ranks top contributors using SQL-based analysis. Results show Scope 3 as the dominant driver, while operations demonstrate decoupling via efficiency and cleaner electricity. Recommendations prioritize supplier clean-electricity programs and low-carbon construction materials.



Contents

Introduction	3
Dataset.....	3
Executive summary	3
Background.....	3
Scope and Ambition	3
Methods	4
Dashboard Overview	4
Results.....	6
Insights	6
Recommendations	6
Conclusion.....	6
Limitations.....	6
Reproducibility.....	7
Appendices	7
Appendix B: SQL.....	7
B1. Top3_contributors.sql — Combine scopes and categories; compute 2024 percent-of-total and ranks.....	7
B2. YoY_growth_scope3.sql — Year-over-year growth rate and rank for Scope 3 categories (2024 vs 2023)	9
B3. Top5_contributors_emission_scope3.sql — Top 5 Scope 3 categories with totals.....	9
B4. Scope1_vs_Scope2.sql — Operational composition and ranks	10

Introduction

This report presents an analysis of Google's operational and Scope 3 emissions. The objective of this project is to evaluate year-over-year changes, highlight key trends, and provide insights into operational and Scope 3 emissions data for better sustainability tracking.

Dataset

The dataset includes year-wise operational and Scope 3 emission figures from 2019 to 2024. The key categories of emissions considered are Scope 1, Scope 2 (location-based and market-based), and Scope 3 emissions. The data was analyzed and visualized using Excel and Power BI.

Executive summary

- FY2024 operational emissions ≈ 3.13 MtCO₂e (Scope 1 + Scope 2, market-based), down year over year.
- FY2024 Scope 3 ≈ 39 MtCO₂e, with increases from capital goods and construction activity.
- 2019–2024 trend: Scope 3 $\sim 28\text{M} \rightarrow \sim 39\text{M}$; Operational peaks $\sim 4\text{M}$ (2023) and $\sim 3\text{M}$ (2024).
- Priorities: supplier clean electricity, low-carbon materials, and continued efficiency.

Background

- Objective: Present FY2024 emissions with 2019–2024 context for portfolio documentation and insights.
- Definitions: Operational = Scope 1 + Scope 2 (market-based); Scope 3 = sum of relevant value-chain categories per inventory boundary.
- Data notes: Metrics mirror published disclosures; values are structured and visualized without recalculation.

Scope and Ambition

- Scope: This analysis covers Operational emissions (Scope 1 + Scope 2, market-based) and relevant Scope 3 categories as disclosed in the latest inventory; Scope 2 is tracked using the market-based method for comparability.
- Ambition: Near-term ambition is consistent with science-based target thresholds (e.g., $\geq 42\%$ reduction for Scopes 1+2 by 2030 from a recent base year, and measurable Scope 3 reduction pathways where Scope 3 exceeds 40% of total).

- Focus areas: Prioritize Scope 3 hotspots (capital goods, construction) and maintain operational decarbonization via clean electricity and efficiency to align with 1.5°C pathways.

Methods

- Data preparation: Tables emissions_yearly and emissions_scope3 analyzed with SQL for ranking, %-of-total, and YoY.
- Visualization: Power BI produced KPI cards and a 2019–2024-line chart; images exported as PNG.
- Assumptions: Latest-year values follow published inventory and category boundaries.

Dashboard Overview

The dashboard provides an interactive view of emissions data. It includes KPIs for the latest year, year-over-year percentage changes, and a time-series visualization of both operational and Scope 3 emissions.

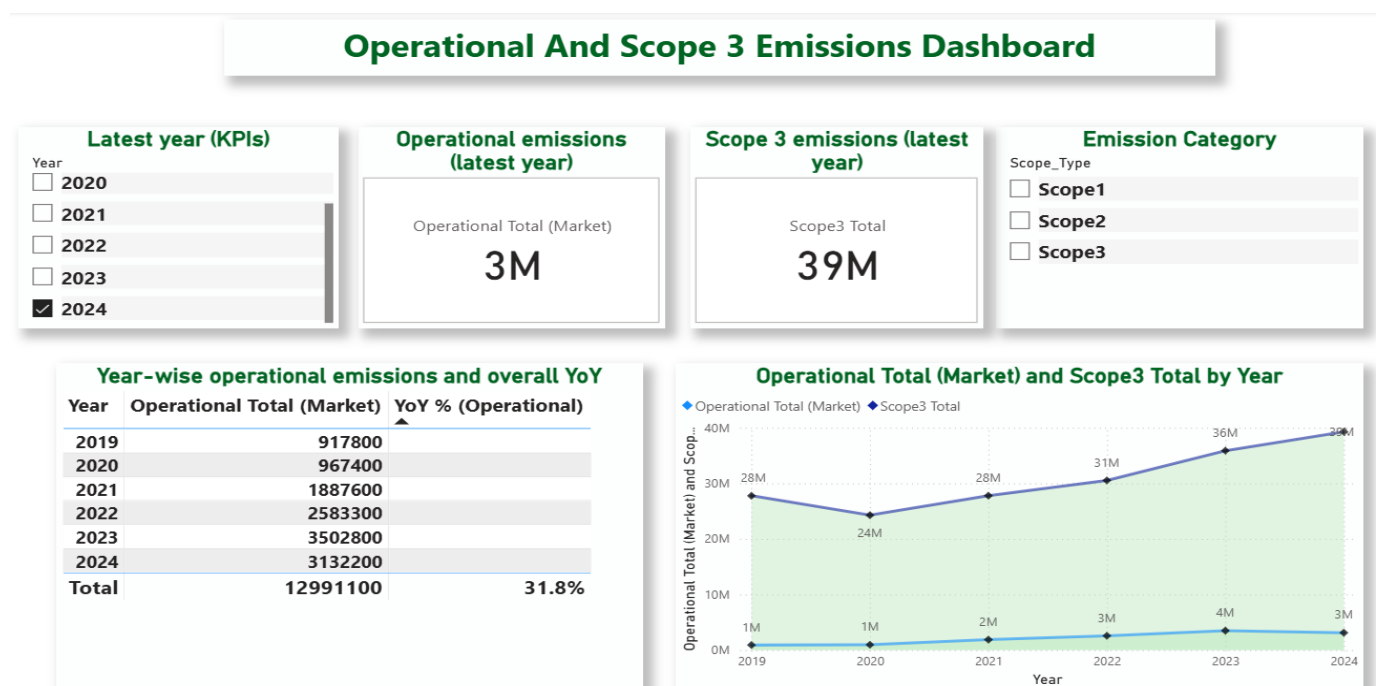


Figure1. Dashboard overview: "FY2024 KPIs; Operational \approx 3M, Scope 3 \approx 39M."



Figure2. Operational (Scope 1 + Scope 2, market-based) \approx 3.13 MtCO₂e; YoY down versus 2023.

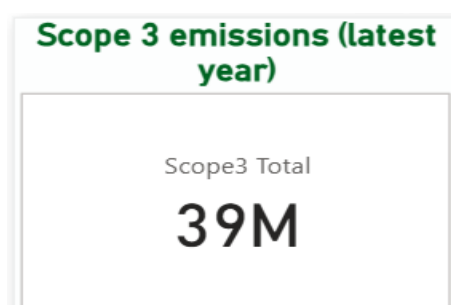


Figure3. Scope 3 total \approx 39M tCO₂e (FY2024); higher year over year, driven by capital goods and construction-related activity

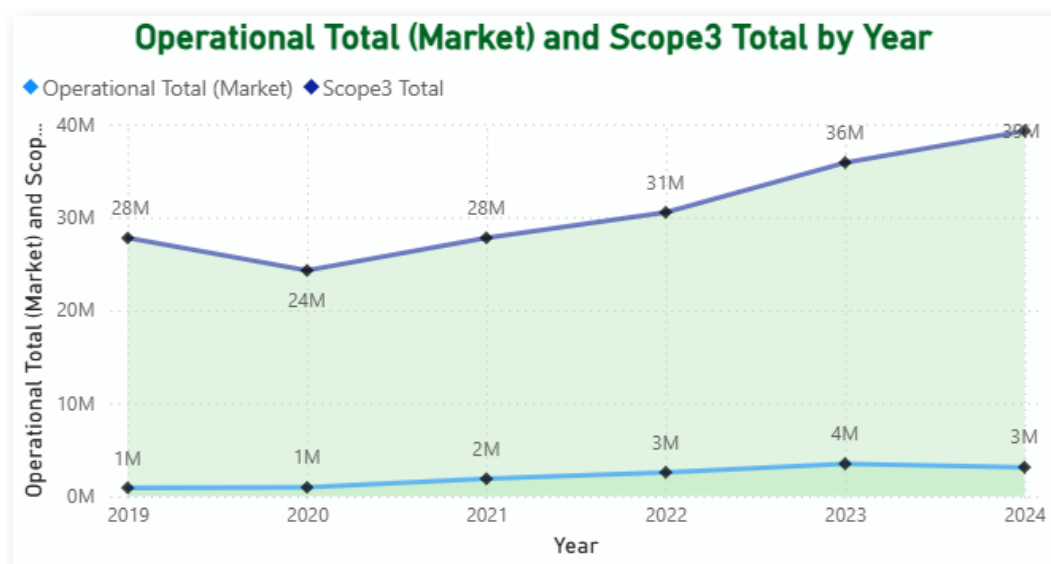


Figure4. Operational vs Scope 3 emissions trend (2019–2024): Scope 3 rises from \sim 28M to \sim 39M, while Operational increases to \sim 4M in 2023 and eases to \sim 3M in 2024.

Results

- FY2024 totals: Operational ≈ 3.13 MtCO₂e; Scope 3 ≈ 12.05 MtCO₂e; operational down YoY, Scope 3 up YoY.
- Multi-year: Scope 3 accelerates post-2021; operational stays an order of magnitude lower with improvement in 2024.
- Contribution: 2024 emissions concentrate in a small set of Scope 3 categories, guiding prioritization.

Insights

- Decoupling operations: Lower operational emissions despite higher electricity demand.
- Scope 3 concentration: Capital goods and construction drive increases; target supplier programs.
- Regional signal: Vary procurement by location based on carbon-free energy and hourly matching.

Recommendations

- Supplier clean electricity: Standardize clean-energy commitments with high-impact suppliers.
- Low-carbon materials: Specify low-carbon concrete and steel in new builds.
- Operations: Maintain low PUE and carbon-intelligent computing to sustain declines.

Conclusion

This dashboard provides a consolidated view of Google's operational and Scope 3 emissions. It highlights the growing impact of Scope 3 emissions and the need for stronger sustainability measures. The insights gained can guide data-driven strategies for emission reduction.

Limitations

- Source dependency: Values mirror published inventory and boundaries; some categories aggregated.

- No primary recalculation: Analysis structures and visualizes reported data; no independent accounting.

Reproducibility

- Artifacts: PBIX, PNG images, SQL scripts, and this document.
- Workflow: Run SQL → export CSV → refresh visuals → export images → assemble Word → Save as PDF.
- Repo layout: /docs, /images, /sql, /pbix, /data.

Appendices

Appendix A: Images

A1: Year-over-year Operational table

Year-wise operational emissions and overall YoY		
Year	Operational Total (Market)	YoY % (Operational)
2019	917800	
2020	967400	
2021	1887600	
2022	2583300	
2023	3502800	
2024	3132200	
Total	12991100	31.8%

A1. Year-over-year Operational emissions: 2019–2024 values with annual % change.

The prior rise into 2023 reflects load growth; the 2024 decline narrows operational impact even as Scope 3 remains the dominant driver.

Appendix B: SQL

B1. Top3_contributors.sql — Combine scopes and categories; compute 2024 percent-of-total and ranks

```
WITH combined_emissions AS (
  -- Scope 1 and Scope 2 (market-based)
  SELECT
    `Greenhouse gas emissions inventory` AS Category,
    `2019`, `2020`, `2021`, `2022`, `2023`, `2024`
  FROM google_env_ghg.emissions_yearly
```



```

WHERE `Greenhouse gas emissions inventory` IN ('Scope 1', 'Scope 2 (market-based)')

UNION ALL

-- Scope 3 categories (exclude totals)
SELECT
  `Scope 3 Emissions` AS Category,
  `2019`, `2020`, `2021`, `2022`, `2023`, `2024`
FROM google_env_ghg.emissions_scope3
WHERE `Scope 3 Emissions` NOT LIKE '%total%'
),

total_2024 AS (
  -- Calculate combined total for % contribution
  SELECT SUM(`2024`) AS total_2024
  FROM combined_emissions
)

SELECT
  c.Category,
  c.`2019`, c.`2020`, c.`2021`, c.`2022`, c.`2023`, c.`2024`,
  ROUND(c.`2024` / t.total_2024 * 100, 2) AS Percent_of_total_2024,
  ROW_NUMBER() OVER (ORDER BY c.`2024` DESC) AS Ranks
FROM combined_emissions c
CROSS JOIN total_2024 t
ORDER BY c.`2024` DESC;

```

OutputB1. Ranked table with 2024 percent-of-total for all scopes and categories.

	Category	2019	2020	2021	2022	2023	2024	Percent_of_total_2024	Ranks
►	Scope 3 (Category 2: Capital goods) and (Cate...	4584000	4176000	4462000	3886000	4583000	6337000	41.73	1
	Scope 3 (Category 1: Purchased goods and ser...	2787000	2404000	2886000	3504000	3951000	3601000	23.71	2
	Scope 2 (market-based)	835900	911600	1823500	2492100	3423400	3059100	20.14	3
	Scope 3 (Category 4: Upstream transportation ...	476000	440000	460000	533000	570000	853000	5.62	4
	Scope 3 (Category 3: Fuel- and energy-related ...	425000	512000	753000	1004000	1295000	714000	4.70	5
	Scope 3 (Category 6: Business travel)	461000	179000	36000	268000	291000	399000	2.63	6
	Scope 3 (Category 7: Employee commuting)	203000	52000	29000	115000	96000	137000	0.90	7
	Scope 1	81900	55800	64100	91200	79400	73100	0.48	8
	Scope 3 (Category 5: Waste generated in oper...	14000	7000	7000	7000	8000	12000	0.08	9
	Scope 3 Emissions	2019	2020	2021	2022	2023	2024	0.01	10

B2. YoY_growth_scope3.sql — Year-over-year growth rate and rank for Scope 3 categories (2024 vs 2023)

```
WITH yoy_analysis AS (  
  SELECT  
    `Scope 3 Emissions` AS Category,  
    `2023`,  
    `2024`,  
    RANK() OVER (ORDER BY `2024` DESC) AS Emissions_Rank,  
    ROUND(((`2024` - `2023`) / `2023`) * 100, 2) AS YoY_Growth_Rate  
  
  FROM google_env_ghg.emissions_scope3  
  WHERE `Scope 3 Emissions` LIKE 'Scope 3 (Category%'  
)  
SELECT  
  Category,  
  `2024` AS Current_Emissions_2024,  
  Emissions_Rank,  
  YoY_Growth_Rate,  
  CASE  
    WHEN YoY_Growth_Rate < -10 THEN 'Significant Improvement'  
    WHEN YoY_Growth_Rate < 0 THEN 'Improving'  
    WHEN YoY_Growth_Rate < 10 THEN 'Stable'  
    ELSE 'Needs Attention'  
  END AS Performance_Status  
FROM yoy_analysis  
ORDER BY Current_Emissions_2024 DESC;
```

OutputB2. Table of Scope 3 categories with 2024 rank and YoY_Growth_Rate

Category	Current_Emissions_2024	Emissions_Rank	YoY_Growth_Rate	Performance_Status
Scope 3 (Category 2: Capital goods) and (Cate...	6337000	1	38.27	Needs Attention
Scope 3 (Category 1: Purchased goods and ser...	3601000	2	-8.86	Improving
Scope 3 (Category 4: Upstream transportation ...	853000	3	49.65	Needs Attention
Scope 3 (Category 3: Fuel- and energy-related ...	714000	4	-44.86	Significant Improvement
Scope 3 (Category 6: Business travel)	399000	5	37.11	Needs Attention
Scope 3 (Category 7: Employee commuting)	137000	6	42.71	Needs Attention
Scope 3 (Category 5: Waste generated in oper...	12000	7	50.00	Needs Attention

B3. Top5_contributors_emission_scope3.sql — Top 5 Scope 3 categories with totals.

```
(  
  SELECT
```

```

`Scope 3 Emissions` AS Category,
`2019`, `2020`, `2021`, `2022`, `2023`, `2024`,
ROW_NUMBER() OVER (ORDER BY `2024` DESC) AS Ranks
FROM google_env_ghg.emissions_scope3
WHERE `Scope 3 Emissions` LIKE 'Scope 3 (Category%)'
ORDER BY `2024` DESC
LIMIT 5
)
UNION ALL
(
SELECT
`Scope 3 Emissions` AS Category,
`2019`, `2020`, `2021`, `2022`, `2023`, `2024`,
" AS Ranks -- Empty for totals
FROM google_env_ghg.emissions_scope3
WHERE `Scope 3 Emissions` LIKE 'Scope 3 (total%)'
OR `Scope 3 Emissions` LIKE 'Total emissions%'
);

```

OutputB3. Table of Top5_contributors_emission_scope3.sql — Top 5 Scope 3 categories by 2024 emissions with total row.

	Category	2019	2020	2021	2022	2023	2024	Ranks
►	Scope 3 (Category 2: Capital goods) and (Cate...	4584000	4176000	4462000	3886000	4583000	6337000	1
	Scope 3 (Category 1: Purchased goods and ser...	2787000	2404000	2886000	3504000	3951000	3601000	2
	Scope 3 (Category 4: Upstream transportation ...	476000	440000	460000	533000	570000	853000	3
	Scope 3 (Category 3: Fuel- and energy-related ...	425000	512000	753000	1004000	1295000	714000	4
	Scope 3 (Category 6: Business travel)	461000	179000	36000	268000	291000	399000	5
	Scope 3 (total)	8950000	7770000	8633000	9317000	10794000	12053000	
	Total emissions: Scope 1, 2 (market-based), an...	9867800	8737400	10520600	11900300	14296800	15185200	

B4. Scope1_vs_Scope2.sql — Operational composition and ranks

```

SELECT
`Greenhouse gas emissions inventory` AS Category,
`2019`, `2020`, `2021`, `2022`, `2023`, `2024`,
ROW_NUMBER() OVER (ORDER BY `2024` DESC) AS Ranks
FROM google_env_ghg.emissions_yearly
WHERE `Greenhouse gas emissions inventory` IN ('Scope 1', 'Scope 2 (market-based)')
ORDER BY `2024` DESC;

```

OutputB4. Table of Scope 1 vs Scope 2 by year with ranks

	Category	2019	2020	2021	2022	2023	2024	Ranks
▶	Scope 2 (market-based)	835900	911600	1823500	2492100	3423400	3059100	1
	Scope 1	81900	55800	64100	91200	79400	73100	2