



Assessing ESG Compliance and Impact: A Zero-Shot Learning Approach to Analyzing Fortune 500 Companies' Sustainability Reports

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Task Definition

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- Analyze corporate sustainability reports released from 2018 to 2022 by five companies in diverse industries: Apple, Walmart, Chevron, General Motors, and JP Morgan
- Utilize a Zero-shot learning model to identify each company's dominant focus area within their sustainability reports and create a visual summary of those insights
- Utilize ESG data to validate each company's claims and determine if they have made progress in their areas of focus



Methods and Approach

Data Collection: Gathering Reports

Used responsibilityreports.com to gather reports released by Apple, Walmart, Chevron, General Motors, and JP Morgan released from 2018 to 2022



Program Development: Data Preprocessing

- Added links to CSRs to Pandas dataframe
- Used PyPDF2 to read in text from linked reports and then cleaned up text by splitting into separate statements and removing unwanted characters, spaces, urls, etc.
- Lemmatized each statement, tokenized and removed stopwords from entire text

	company	url	content
0	Microsoft	https://www.responsibilityreports.com/HostedD...	2022 \nEnvironmental Sustainability Report\nEn...
1	Microsoft	https://www.responsibilityreports.com/HostedD...	2022 \nEnvironmental Sustainability Report\nEn...
3	Microsoft	https://www.responsibilityreports.com/HostedD...	2022 \nEnvironmental Sustainability Report\nEn...
4	Microsoft	https://www.responsibilityreports.com/HostedD...	2022 \nEnvironmental Sustainability Report\nEn...
5	Microsoft	https://www.responsibilityreports.com/HostedD...	2022 \nEnvironmental Sustainability Report\nEn...
...
10865	Pfizer	https://www.responsibilityreports.com/HostedD...	Environmental, Social\n& Governance ReportPfiz...
10867	Pfizer	https://www.responsibilityreports.com/HostedD...	Environmental, Social\n& Governance ReportPfiz...
10869	Pfizer	https://www.responsibilityreports.com/HostedD...	Environmental, Social\n& Governance ReportPfiz...
10872	Pfizer	https://www.responsibilityreports.com/HostedD...	Environmental, Social\n& Governance ReportPfiz...
10873	Pfizer	https://www.responsibilityreports.com/HostedD...	Environmental, Social\n& Governance ReportPfiz...

	statement	lemma
	Environmental Sustainability Report Enabling s...	environment sustain report enabl sustain compa...
	Another 4,998 acres in the United States is co...	anoth unit state contract sinc incept microsof...
	We felt the effects of climate change like nev...	felt effect climat chang like never before plan...
	The most recent report from the Intergovernmen...	most recent report from panel climat chang ipc...
	Meaningful climate action requires an enduring...	meaning climat action requir endur commit from...

	Those standards require that we plan and perfo...	those standard requir that plan perform examin...
	The nature, timing, and extent of the procedur...	natur time extent procedur select depend judgm...
	We are required to be independent and to meet ...	requir independ meet other ethic accord with ...
	In our opinion, managements assertion that the...	opinion manag assert that alloc were alloc acc...
	New York, New York March 16, 2023 AppendixInde...	york york march account report perform appendi...

Program Development: Creating ZSL Model

- Zero-shot learning (ZSL) models are trained on a labeled examples but can then classify new examples belonging to unseen classes
- Used Facebook's pretrained BART-large-mnli model available on HuggingFace
- Utilized model to classify sentences obtained from reports into one of 19 different categories

	company	url	content	statement	label	score	esg	ion_intent	id
0	Apple_202	https://ww	Apple's 202	Apples 202	Ecological I	0.937237	E	Other	23
1	Apple_202	https://ww	Apple's 202	Numbers ar	Air Quality	0.401053	E	Other	21
2	Apple_202	https://ww	Apple's 202	For more ir	Ecological I	0.336693	E	Other	23
3	Apple_202	https://ww	Apple's 202	That work c	Labor Pract	0.482676	S	Other	11
4	Apple_202	https://ww	Apple's 202	But whethe	Ecological I	0.735123	E	Other	23
5	Apple_202	https://ww	Apple's 202	As a compa	Customer V	0.577425	S	Other	6
6	Apple_202	https://ww	Apple's 202	And we app	Employee E	0.817177	S	Other	8
7	Apple_202	https://ww	Apple's 202	At the hear	Human Rig	0.856347	S	Other	10
8	Apple_202	https://ww	Apple's 202	We work w	Human Rig	0.832021	S	Other	10
9	Apple_202	https://ww	Apple's 202	We help cri	GHG Emissi	0.823625	E	Other	25
10	Apple_202	https://ww	Apple's 202	And we pro	Business M	0.214362	G	Other	3
11	Apple_202	https://ww	Apple's 202	In this repo	Access And	0.583984	S	Other	2
12	Apple_202	https://ww	Apple's 202	At Apple, w	Business Et	0.41666	G	Other	0
13	Apple_202	https://ww	Apple's 202	Were engag	Human Rig	0.533226	S	Other	10

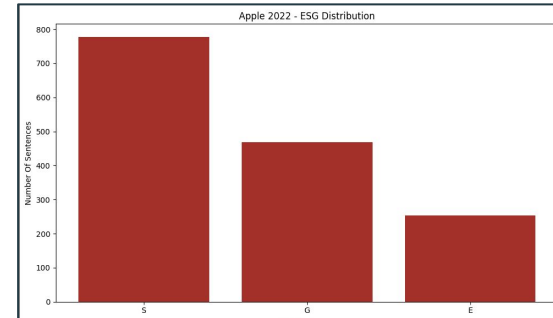
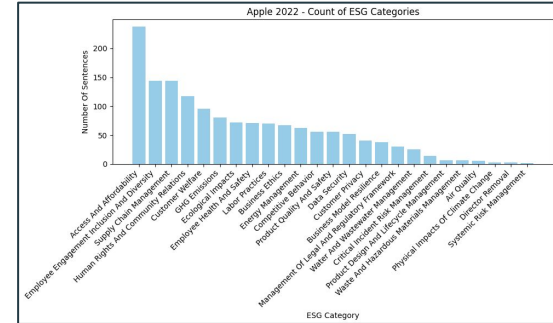
Program Development: ESG Categories

- Categories:

- "Waste And Hazardous Materials Management": "E",
- "Water And Wastewater Management": "E",
- "Air Quality": "E",
- "Ecological Impacts": "E",
- "Energy Management": "E",
- "GHG Emissions": "E",
- "Customer Satisfaction": "S",
- "Employee Engagement": "S",
- "Employee Welfare": "S",
- "Diversity and Inclusion": "S",
- "Human Rights": "S",
- "Labor Practices": "S",
- "Community Relations": "S",
- "Business Ethics": "G",
- "Critical Incident Risk Management": "G",
- "Product Quality And Safety": "G",
- "Product Design And Lifecycle Management": "G",
- "Supply Chain Management": "G",
- "Board Structure": "G"

Program Development: Visualization

- ZSL model outputted the label it believes the sentence belonged to and a confidence score
- Results added to Pandas dataframe containing sentences
- Used Matplotlib to display the distribution of the topics to determine the focus of each report



Data Collection: Obtaining Company Statistics

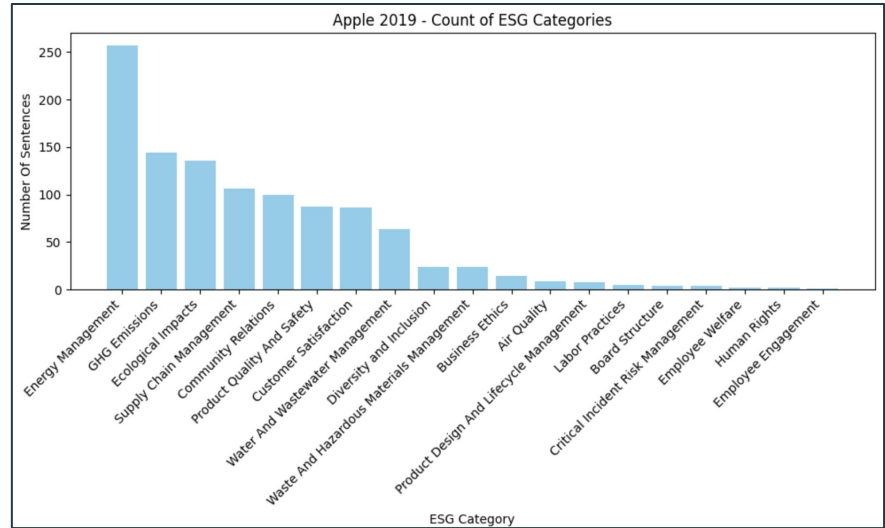
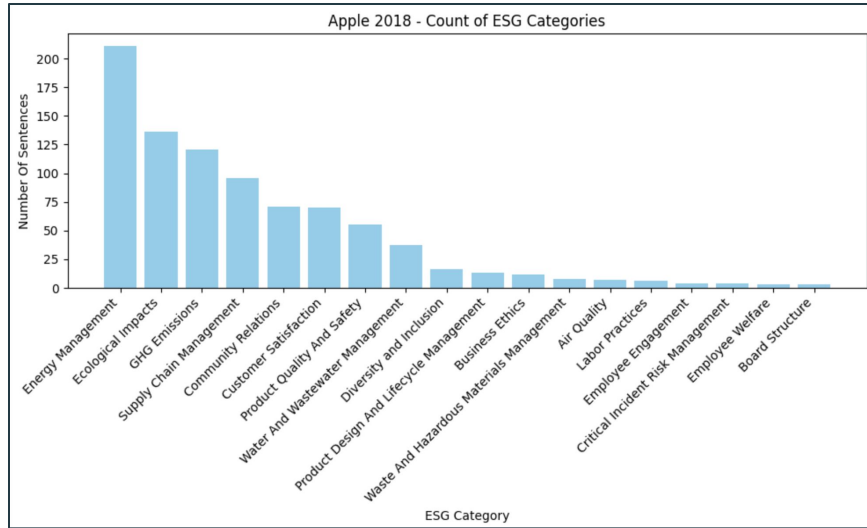
- Model provided the frequency of each category for each report
- Used company websites and reports in order to find data relating to the top three most frequent categories for each CSR
- Analyzed this data to find its significance and understand its implications for the company
- Ultimately determine whether the company's actions matched the areas of focus in their reports

General Motors	Correlating Stat	2018	2019	2020	2021	2022
Environment						
Water And Hazardous Materials Management						
Water And Wastewater Management						
Air Quality						
Ecological Impacts						
Energy Management	Energy Used in GM's Operations (MWh/Vehicle)		2.13	2.06	2.25	2.27
	Renewable Energy as a Percentage of Global Electricity Use	3%	22%	23%	25%	30%
GHG Emissions						
Social						
Customer Satisfaction						
Employee Engagement						
Employee Welfare						
Diversity and Inclusion	Percentage of workforce that are women: men	56%; 44%	57%; 43%	56%; 44%	55%; 45%	55%; 45%
	Percentage of workforce that are non-POC; POC; not reported	43%; 56%; 1%	42%; 57%; 1%	43%; 53%; 4%	41%; 50%; 9%	40%; 47%; 13%
	Percentage of leadership that are non-POC; POC; not reported		72%; 28%; 0%	68%; 28%; 4%	67%; 29%; 4%	66%; 30%; 4%
Human Rights						
Labor Practices						
Community Relations	Grants provided to non-profit and charitable organizations	\$3.2M	\$2M	\$1M	\$3M	\$60M
	Number of employees volunteering for charitable causes	17,548	16,890	15,190	15,234	
	Number of hours employee volunteers have committed	187,315		115,610	95,648	
Governance						
Business Ethics						
Critical Incident Risk Management						
Product Quality And Safety	GM Safety and Noncompliance Recalls (Number of Recalls) Globally:					
	North America	50; 29	44; 28	57; 43	60; 47	44; 36
	GM Safety and Noncompliance Recalls (Vehicle Volume in Millions) Globally: North America	4.2; 2.2	8.9; 7.6	1.8; 1.7	9.7; 9.3	4.6; 4.0
	Number of Global Recalls <=10,000 Vehicles	16	15	30	34	30

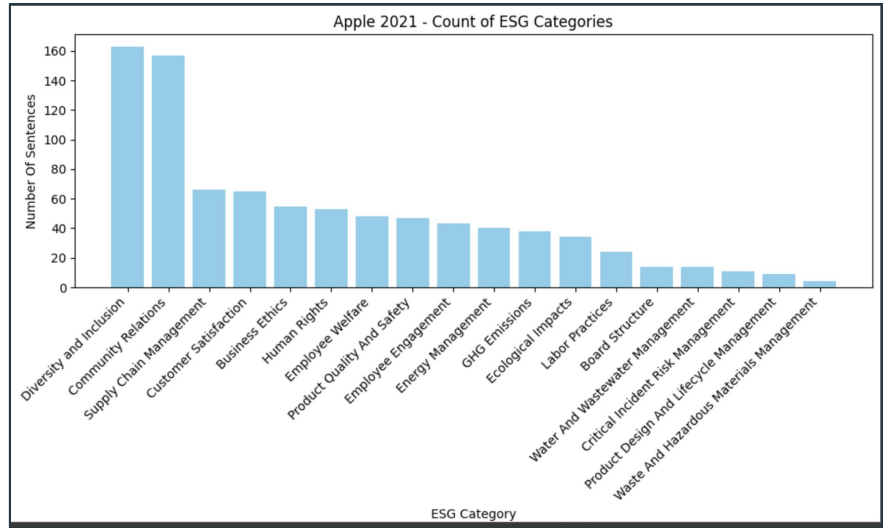
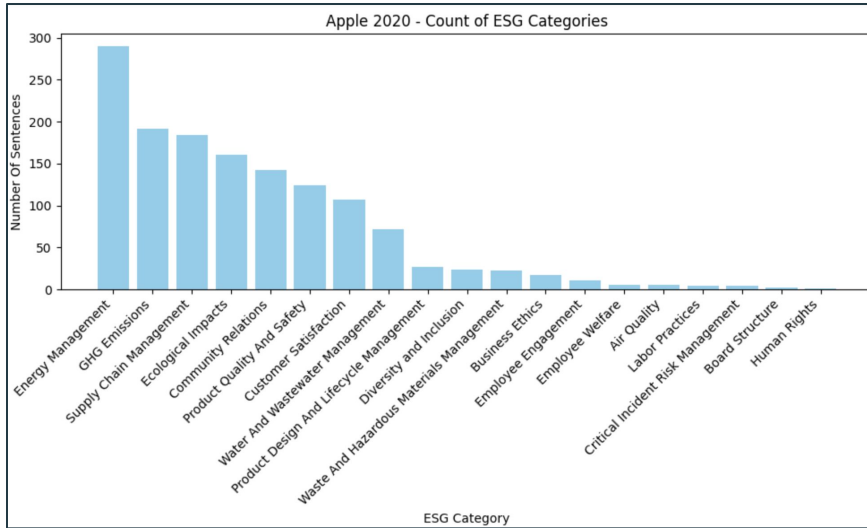


Results

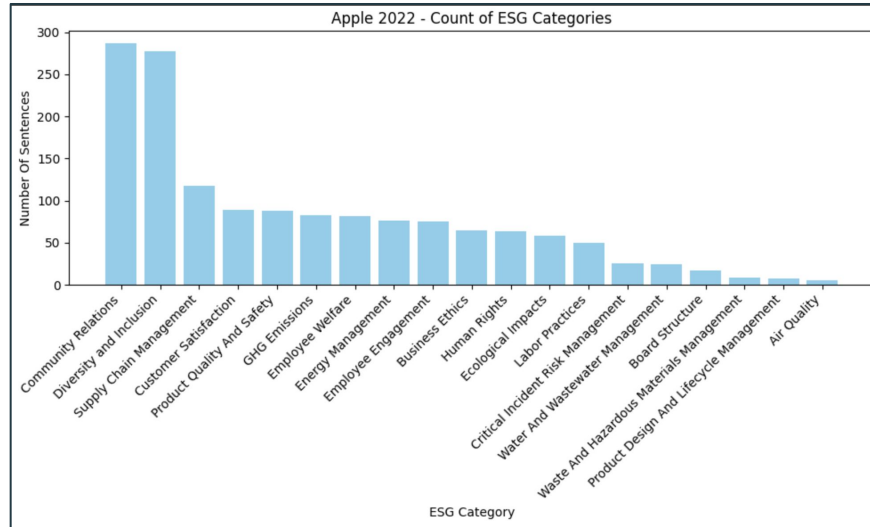
Apple: Visualizations



Apple: Visualizations



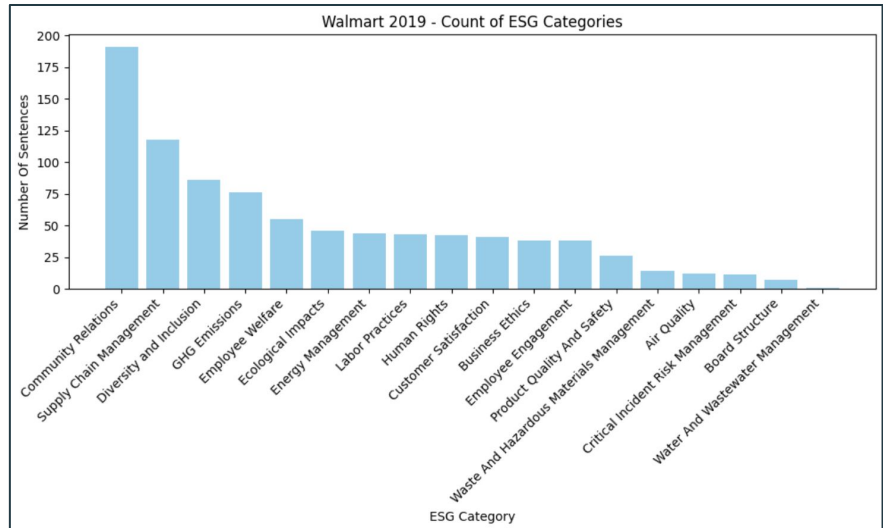
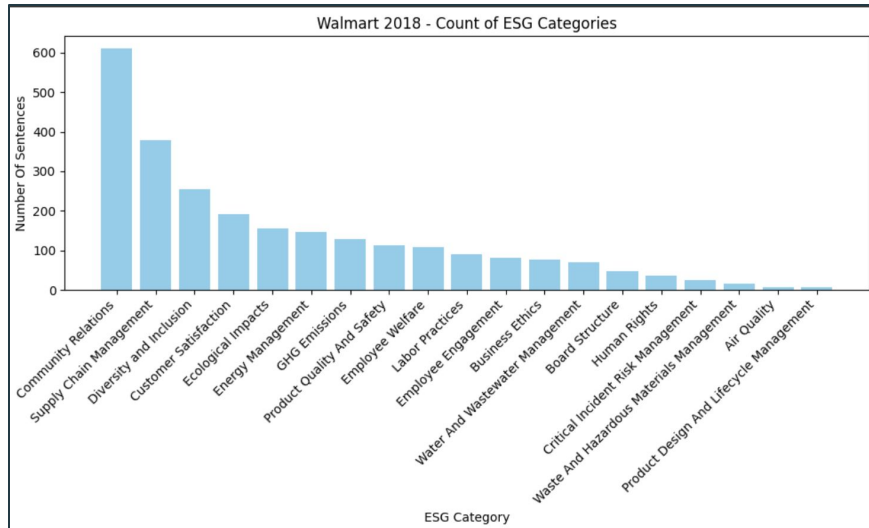
Apple: Visualizations



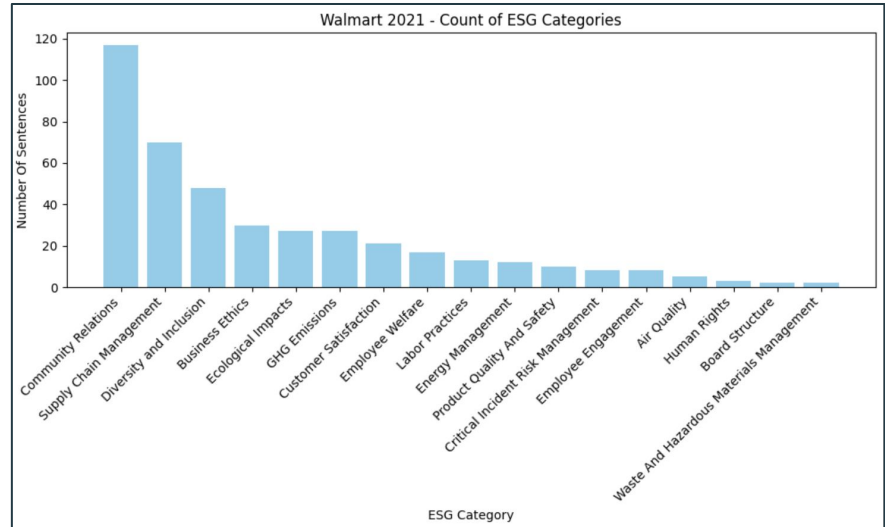
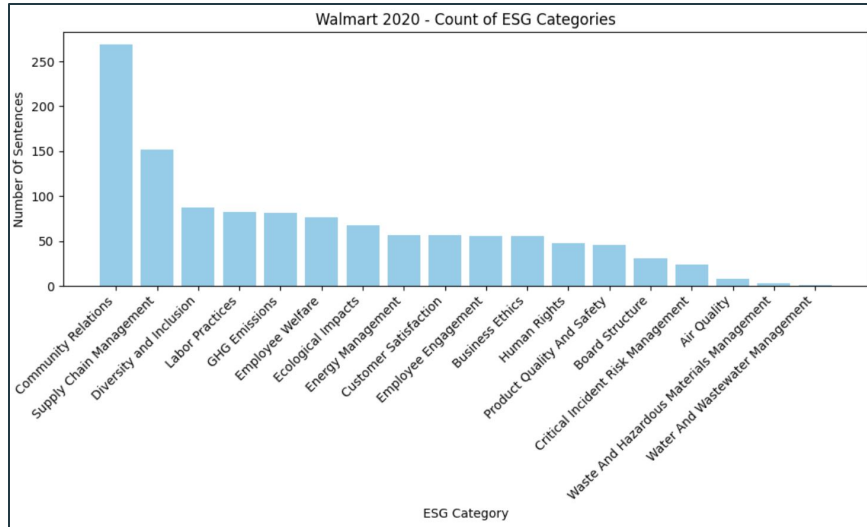
Apple: Analysis

- **Environmental Focus:** Steady progress in environmental sustainability with a transition to renewable energy and waste reduction.
- **Social and Governance Shift:** Shifted focus to social and governance aspects from 2021-2022, coinciding with ESG reporting.
- **Environmental Responsibility:** Reduced hazardous waste and optimized water usage while maintaining tech industry leadership.
- **Slow Social Progress:** Social and governance initiatives, including diversity and corporate donations, showed limited improvement.

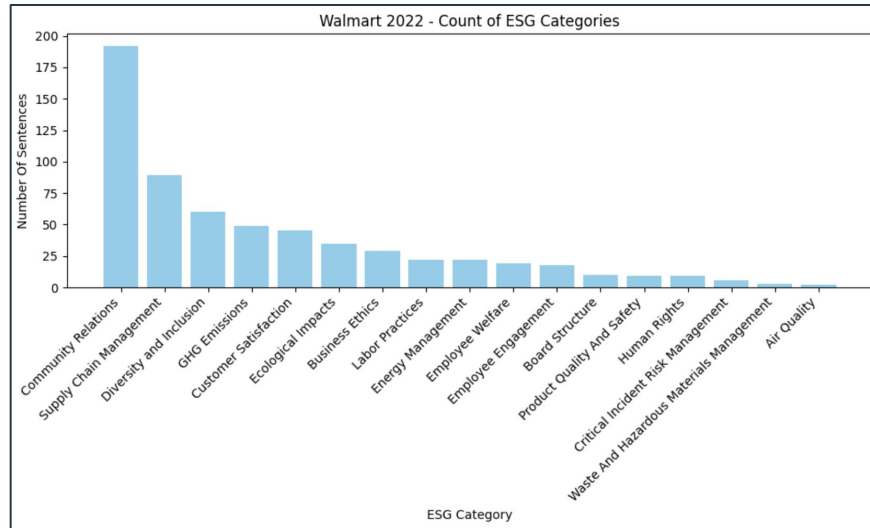
Walmart: Visualizations



Walmart: Visualizations



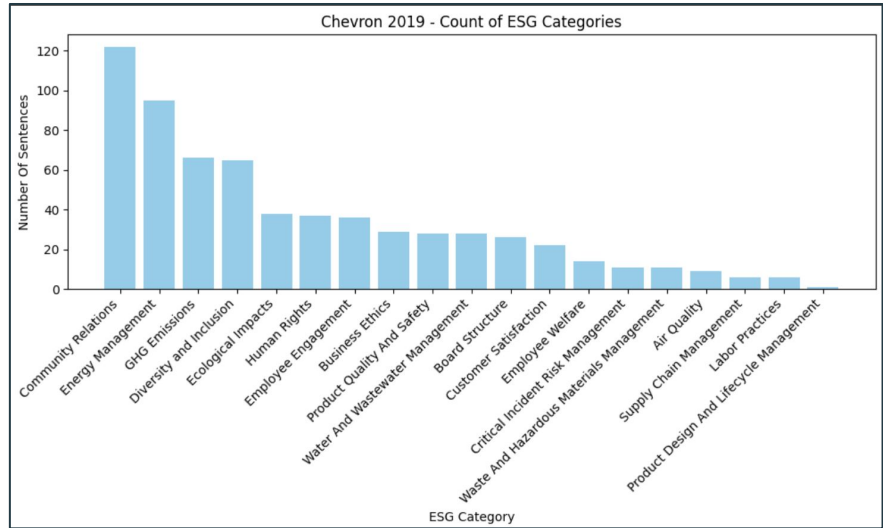
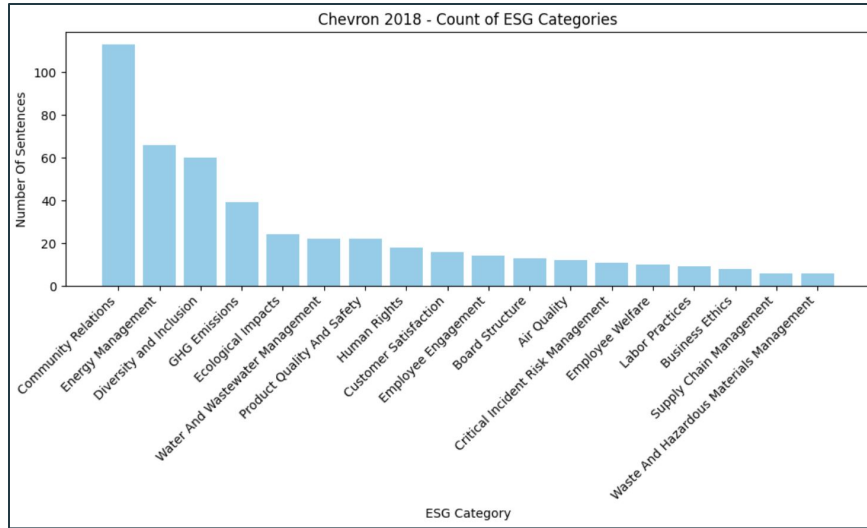
Walmart: Visualizations



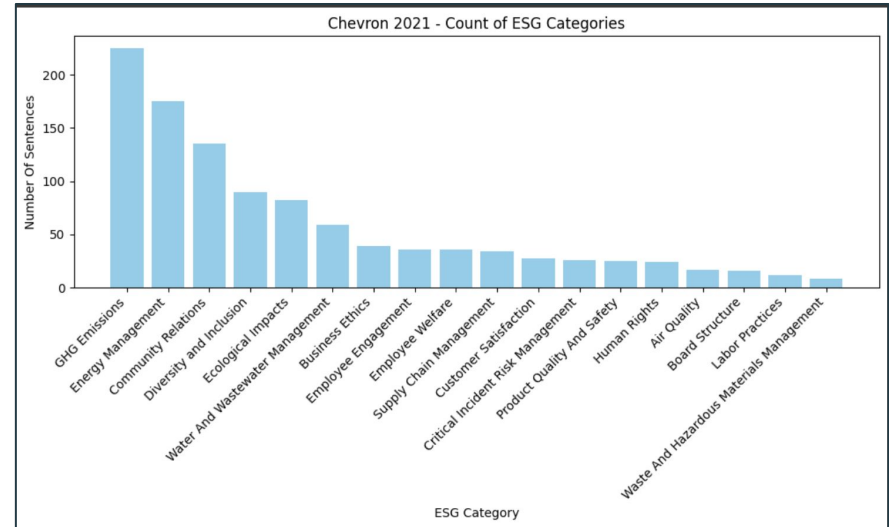
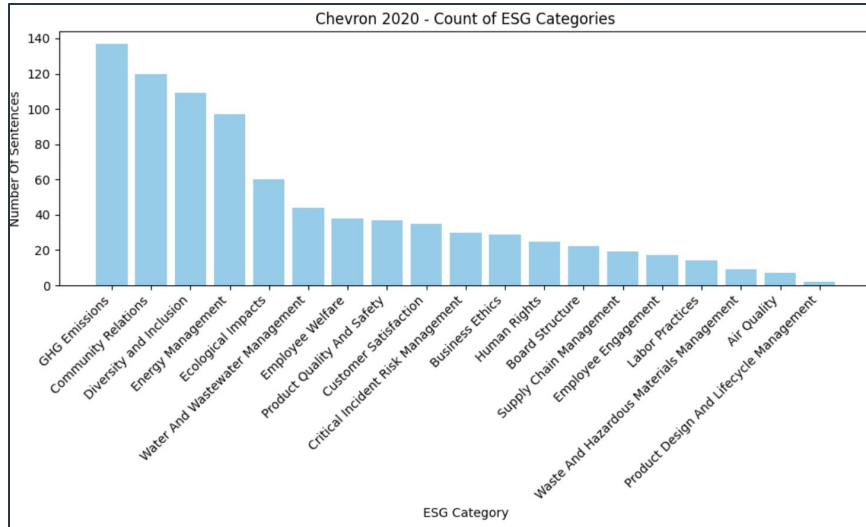
Walmart: Analysis

- **Social and Governance Focus:** Prioritized social and governance aspects, enhancing supply chain, diversity, and community engagement.
- **Supply Chain and Workforce:** Improved supply chain management, enhanced workforce diversity, and contributed to community engagement.
- **Energy and Emissions:** Emphasis on social and governance with less focus on energy usage and GHG emissions.

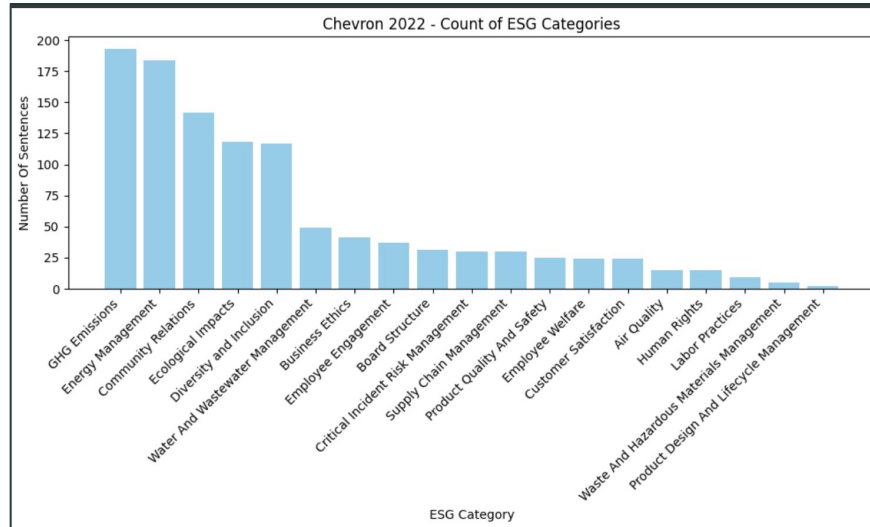
Chevron: Visualizations



Chevron: Visualizations



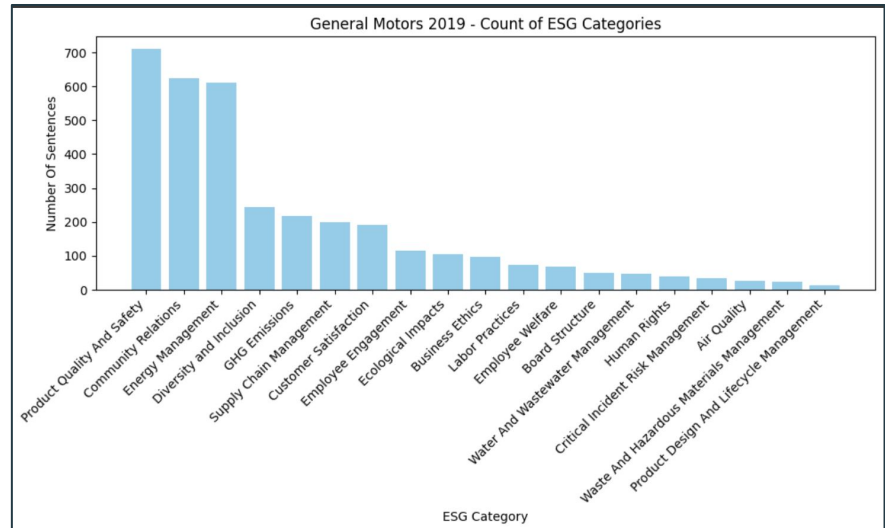
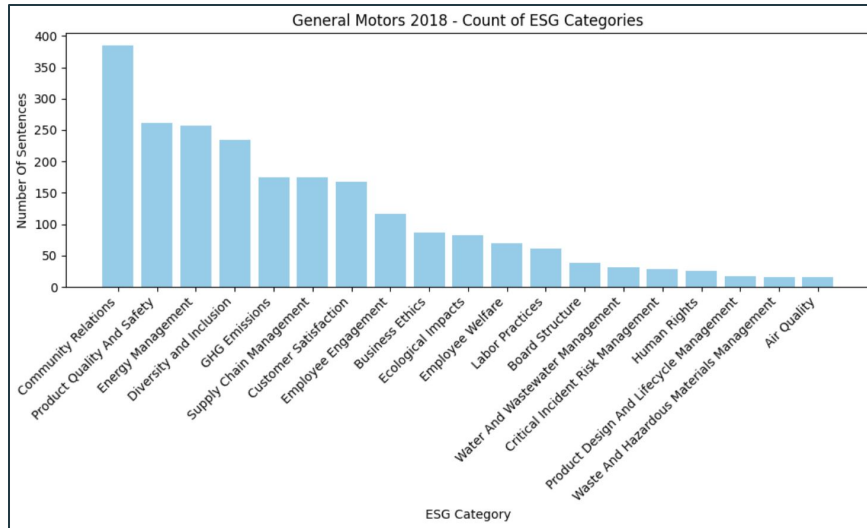
Chevron: Visualizations



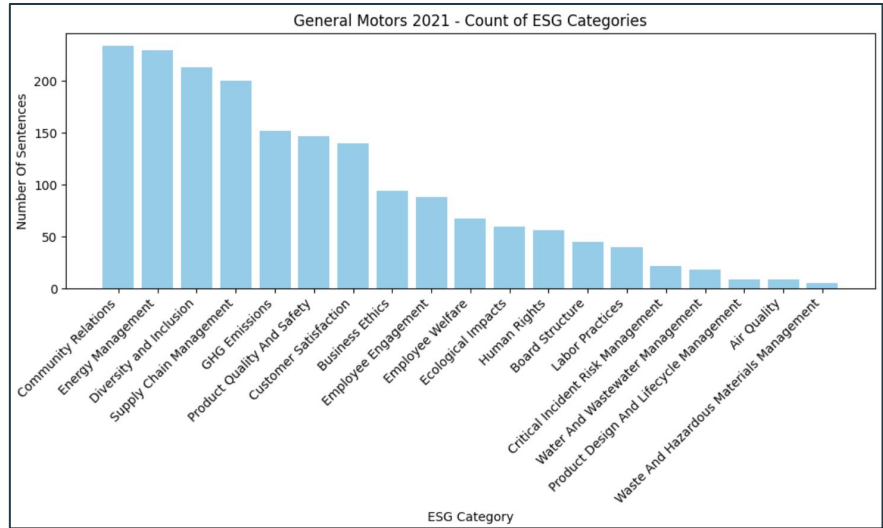
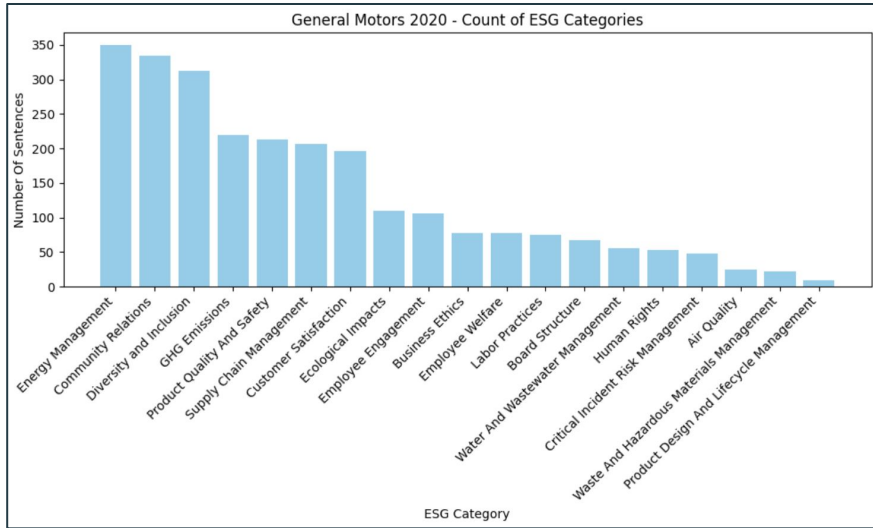
Chevron: Analysis

- **Environmental Responsibility:** Focused on environmental responsibility, reducing energy consumption and direct GHG emissions.
- **Limited Social Emphasis:** Social initiatives, including diversity and community support, exhibited less pronounced improvements.
- **Energy Efficiency:** Steady decline in energy consumption, emphasizing energy efficiency.
- **Scope 3 Emissions:** Minimal changes in Scope 3 emissions related to product use.
- **Ethical Practices:** Prioritized ethical supply chain management and maintained high audit assessments.

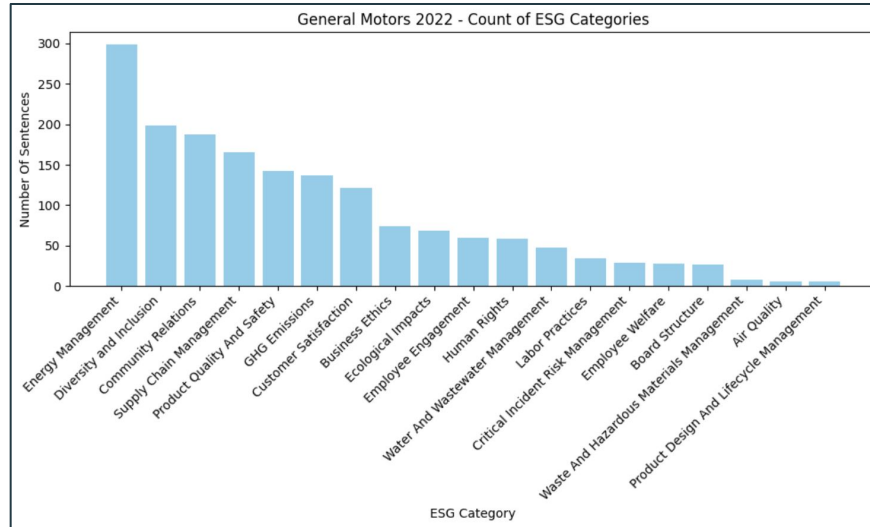
General Motors: Visualizations



General Motors: Visualizations



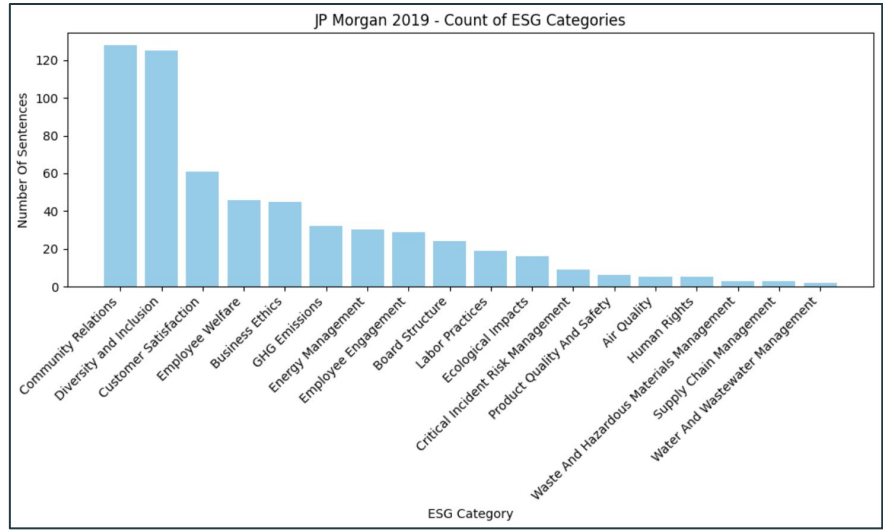
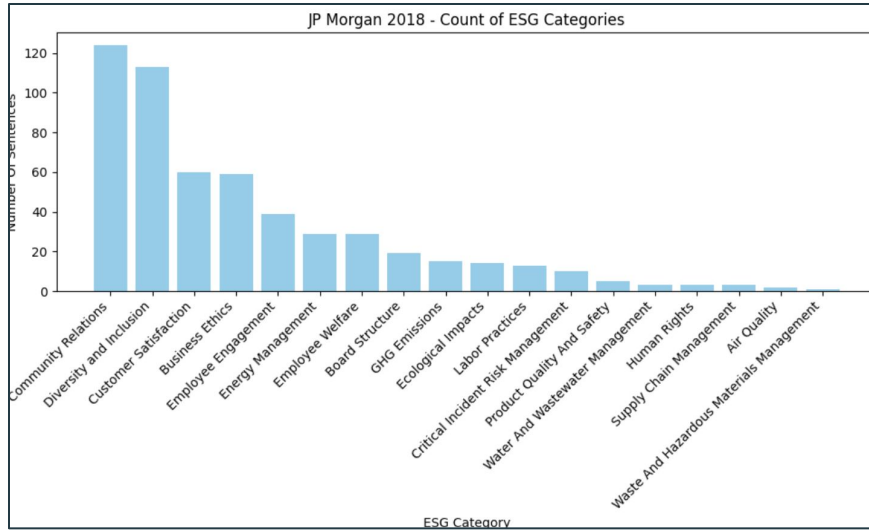
General Motors: Visualizations



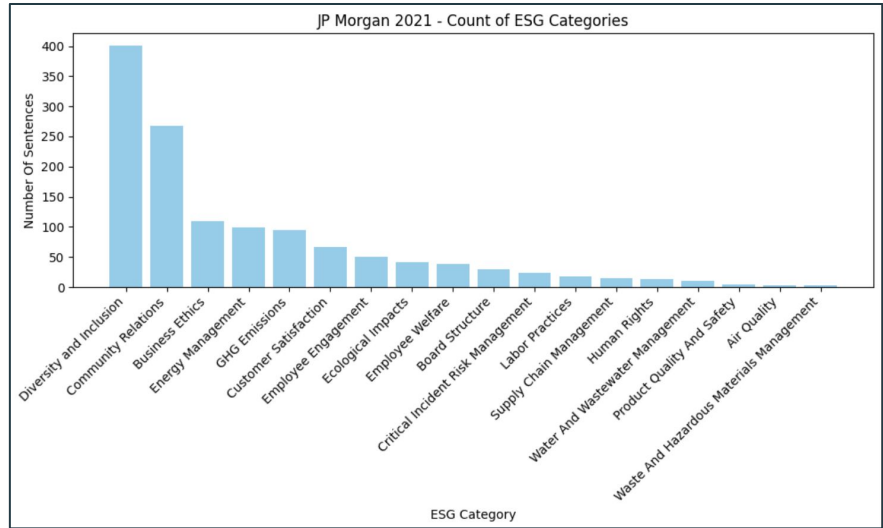
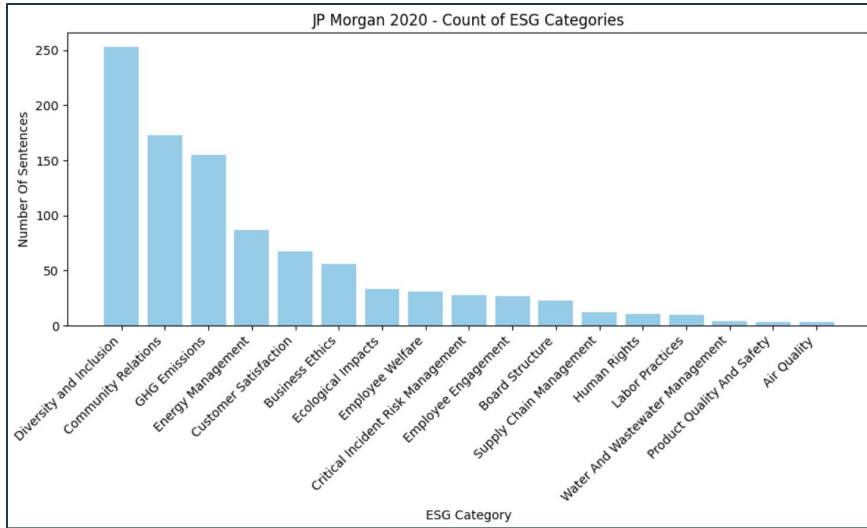
General Motors: Analysis

- **Environmental Responsibility:** Focused on reducing its environmental footprint, emphasizing energy efficiency and renewable energy adoption.
- **Diversity and Inclusion:** Maintained a diverse and inclusive workplace, with balanced gender representation and improvements in ethnic diversity.
- **Community Engagement:** Significantly increased grants to non-profit organizations, demonstrating a commitment to community relations.
- **Energy Efficiency:** Energy consumption per vehicle exhibited variations, underlining its commitment to sustainability.

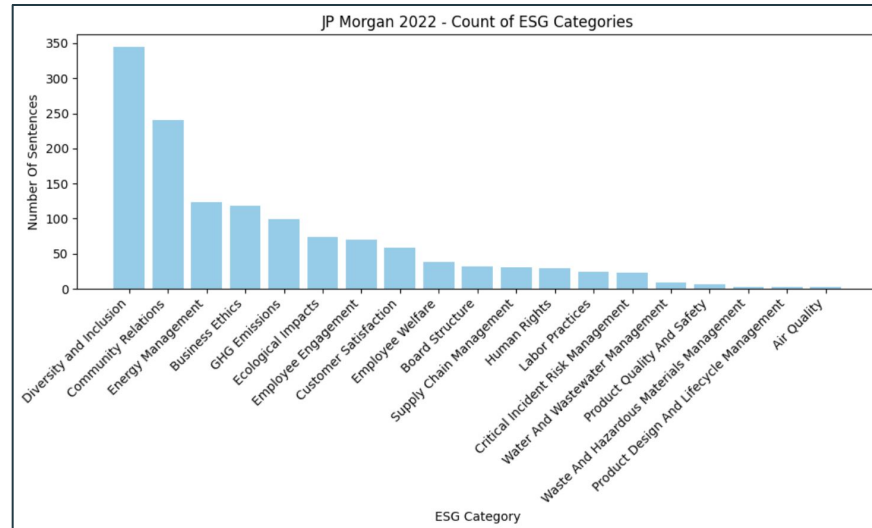
JP Morgan: Visualizations



JP Morgan: Visualizations



JP Morgan: Visualizations



JP Morgan: Analysis

- **Energy Management:** Successfully reduced total energy consumption and GHG emissions, emphasizing optimization and energy efficiency.
- **Workforce Diversity:** Maintained a balanced gender distribution and showed an evolving commitment to enhancing diversity and inclusion.
- **Transparency:** Demonstrated transparency through external links, reinforcing dedication to ESG principles.
- **Commitment to Community:** The bank's financial capacity allowed it to support social and community projects on a large scale.



Further Work

Further Work

- **Validation:** Ensure data alignment with manually labeled data for accuracy
- **Enhanced Correlation:** Use statistical measures to show the relationship between reported commitments and real outcomes (e.g. ESG scores)
- **ESG Fund Holdings:** Check if these companies are held by ESG investment funds
- **Continue writing paper and send first draft within a week**



Thank you!