

# Using NLP to Understand Corporate Sustainability Issues

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Jenica Andersen  
Metis DSML

June 15, 2022

“Once considered tangential to business decision-making, **environmental, social and governance factors have now become business imperatives**—and, for those companies with foresight, sustainable business strategies are also a **pathway to stable, profitable, long-term economic growth and social prosperity.**”

—Ceres.org



# Ceres

- **Tracks the sustainability reporting of companies**
- **Gathers shareholder resolutions filed by investment network members**
- **Is part of broader investor efforts to encourage companies to address ESG issues**



# Introduction

-Research Question:

**What are the main topics within corporate sustainability shareholder resolutions?  
What is the sentiment of the topics?**

-Business Use:

**Consultants, companies, investors and activists can understand the current state of sustainability practices and can apply the best practices to their own operations.**

# Ceres.org, the data source

Climate and Sustainability Shareholder Proposals

engagements.ceres.org/?\_ga=2.193001133.1671682996.1654368102-1475954746.1654368096

Ceres

Show 25 entries

Status	Proposal	Company	Filer	Year
Filed	Adopt stewardship practices to reduce diversified portfolio ESG costs	3M Co.	The Shareholder Commons	2022
Vote	Report on lobbying	Abbott Laboratories	Unitarian Universalist Association	2022
Vote	Report on lobbying in line with company values/policy	AbbVie Inc.	As You Sow	2022
Withdrawn: Commitment	Adopt GHG reduction targets	Air Products & Chemicals Inc.	The Nathan Cummings Foundation	2022
Withdrawn: Strategic	Adopt GHG reduction targets	Allegheny Technologies Inc.	As You Sow	2022
Withdrawn: Commitment	Report on benefits of product repair	Alphabet Inc.	Green Century Capital Management	2022
Filed	Report on water use risks	Alphabet Inc.	As You Sow	2022
Filed	Report on ESG risks to diversified investors	Alphabet Inc.	John Chevedden	2022
Filed	Establish board committee on sustainability	Alphabet Inc.	SustainInvest Asset Management	2022
Filed	Report on corporate climate lobbying in line with Paris Agreement	Alphabet Inc.	Zevin Asset Management	2022
Vote	Report on retirement plan option alignment with climate policy	Amazon.com Inc.	As You Sow	2022
Vote	Report on plastic pollution	Amazon.com Inc.	As You Sow	2022
Vote	Report on lobbying	Amazon.com Inc.	International Brotherhood of Teamsters, Pension Fund	2022
Withdrawn: Commitment	Report on GHG emissions targets	Amedisys Inc	As You Sow	2022
Withdrawn: Commitment	Report on corporate climate lobbying in line with Paris Agreement	American Airlines Group Inc.	Presbyterian Church (USA)	2022
Withdrawn: Commitment	Adopt financing policy in line with IEA Net Zero Scenario	American International Group, Inc.	Presbyterian Church (USA)	2022
Withdrawn: Commitment	Adopt GHG reduction targets	American Water Works Company, Inc.	Proxy Impact	2022

 Ceres

Adopt stewardship practices to reduce diversified portfolio ESG costs (MMM, 2022)

**Organization:** 3M Co.  
**Year:** 2022  
**Whereas:**

In our Company's 2021 Sustainability Report, CEO Mike Roman states, "We are committed to being leaders in sustainability." A review of that report reveals our Company has addressed many environmental concerns. But 3M's commitment is limited. For example:

- 3M is active in three trade associations that work against comprehensive U.S. policies to address climate change.<sup>2</sup>
- 3M does not appear to have committed to meet the Science-Based Targets initiative for a 1.5-degree Celsius world<sup>3</sup> and failed to receive an "A" grade in 2020 from CDP, a widely used and respected climate rating.<sup>4</sup>
- Belgian regulators recently ordered 3M to stop PFAS production after recent blood samples taken from 800 people near 3M's plant showed elevated levels of PFAS.<sup>5</sup>

Industry	Industrial Conglomerates
Sector	Industrials
Filed By	The Shareholder Commons
Votes	%
Status	Filed
View Memo	<a href="#">View</a>

- **923 documents**
- **~410,000 words**
- **2019-2022**

# Modeled After :



sustainability



Article

## Identifying Corporate Sustainability Issues by Analyzing Shareholder Resolutions: A Machine-Learning Text Analytics Approach

Viju Raghupathi <sup>1</sup>, Jie Ren <sup>2</sup> and Wullianallur Raghupathi <sup>2,\*</sup>

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<sup>2</sup> Gabelli School of Business, Fordham University, New York, NY 10023, USA; jren11@fordham.edu

\* Correspondence: raghupathi@fordham.edu

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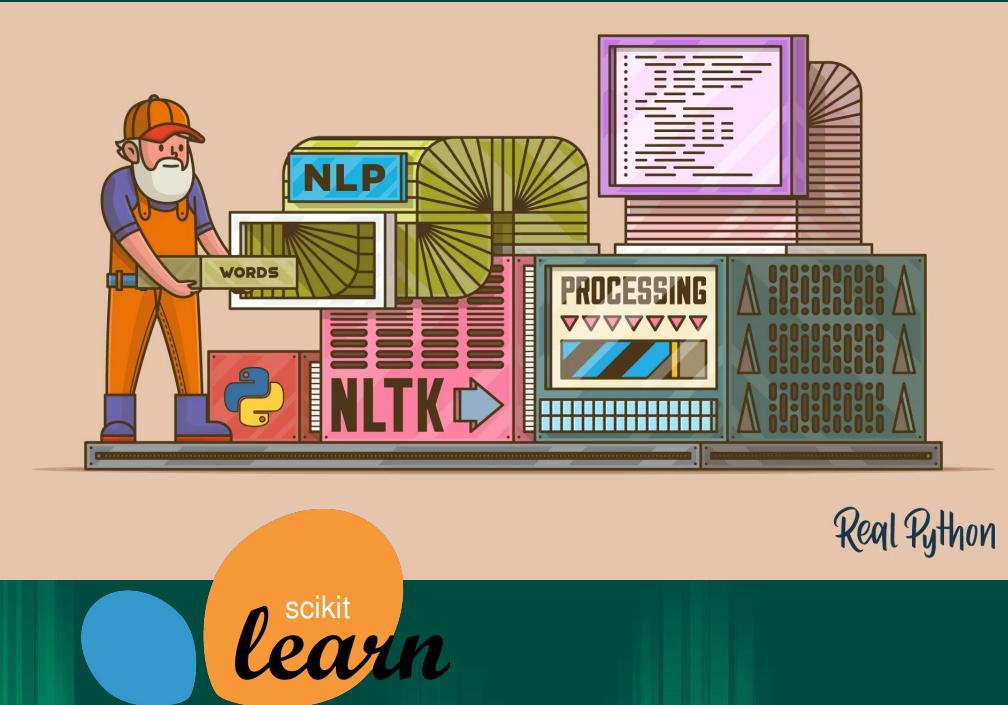


**Abstract:** Corporations have embraced the idea of corporate environmental, social, and governance (ESG) under the general framework of sustainability. Studies have measured and analyzed the impact of internal sustainability efforts on the performance of individual companies, policies, and projects. This exploratory study attempts to extract useful insight from shareholder sustainability resolutions using machine learning-based text analytics. Prior research has studied corporate sustainability disclosures from public reports. By studying shareholder resolutions, we gain insight into the shareholders' perspectives and objectives. The primary source for this study is the Ceres sustainability shareholder resolution database, with 1737 records spanning 2009–2019. The study utilizes a combination of text analytic approaches (i.e., word cloud, co-occurrence, row-similarities, clustering, classification, etc.) to extract insights. These are novel methods of transforming textual data into useful

**2020 paper in *Sustainability* by Dr. Viju Raghupathi, et al.**

Introduction - Method - Results - Summary - Appendix

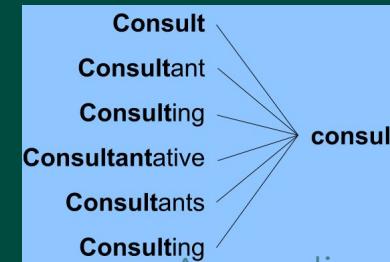
# Method: Natural Language Processing



Introduction - Method - Results - Summary - Appendix

## PREPROCESSING

- Remove stop words & special characters  
English stop words + some custom:  
'www', 'whereas', 'include', 'full', 'request',  
'resolved', 'shareholder', 'company',  
'companies', 'use', 'https', 'pdf'
- Stem the words- Used Porter (most aggressive)



# NLP Topic Modeling

Countvectorizer

N-grams- 1,2,3

NMF

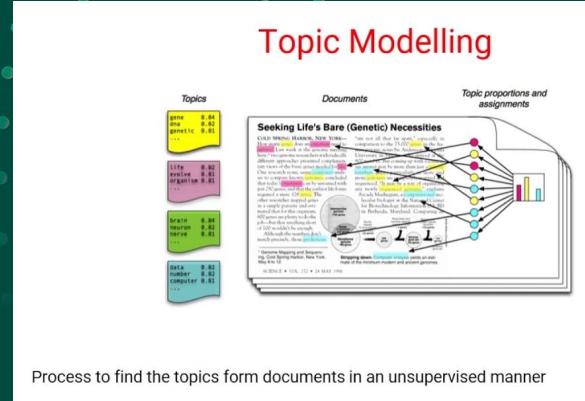
WordCloud

Example DTM  
Data = ['The', 'quick', 'brown', 'fox', 'jumps', 'over', 'the', 'lazy', 'dog']

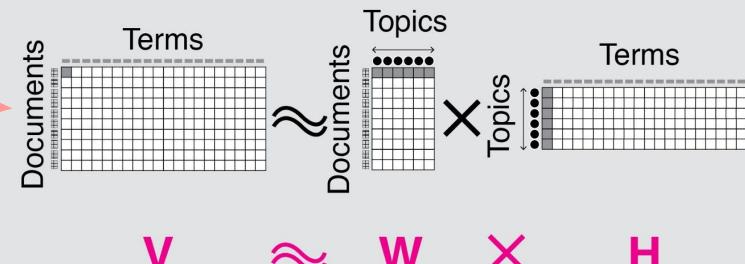


Data	The	quick	brown	fox	jumps	over	lazy	dog
	2	1	1	1	1	1	1	1

min\_df = 6 (got rid of "Zuckerberg")  
max\_df = .99 (conservative, could go lower)



Non-Negative Matrix Factorization Generic Diagram



Visible Variables

Input  
Document x Term Matrix  
 $n \times m$

Weights

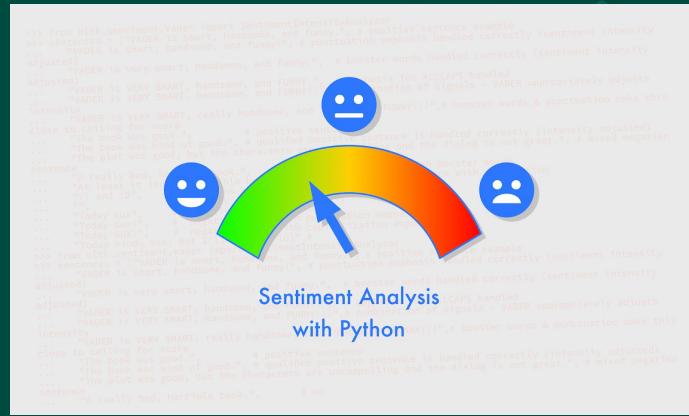
Feature Set  
Document x Topic Matrix  
 $n \times p$

Hidden Variables

Coefficients  
Topic x Term Matrix  
 $p \times m$



# NLP Sentiment Analysis

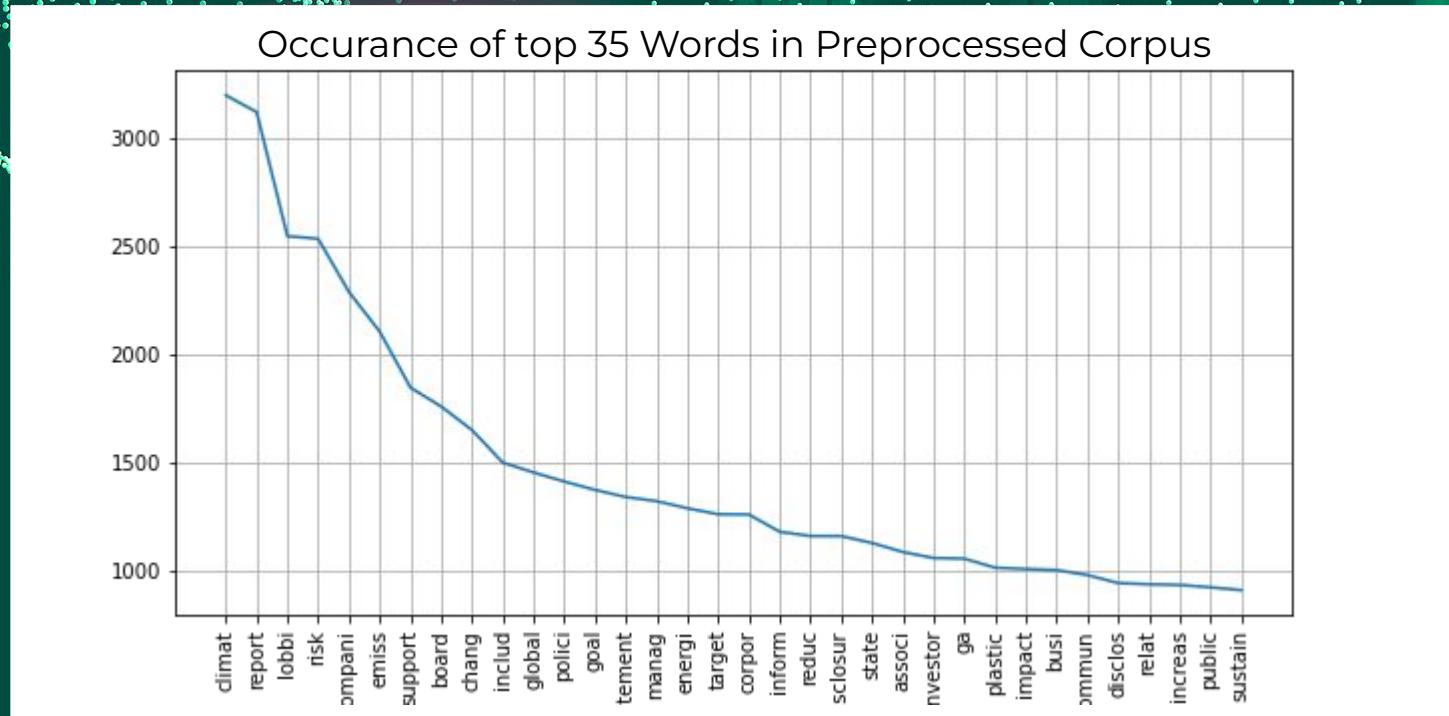


**Vader**  
**SentimentIntensityAnalyzer**  
**Applied to individual**  
**resolutions and entire corpus**



# Results

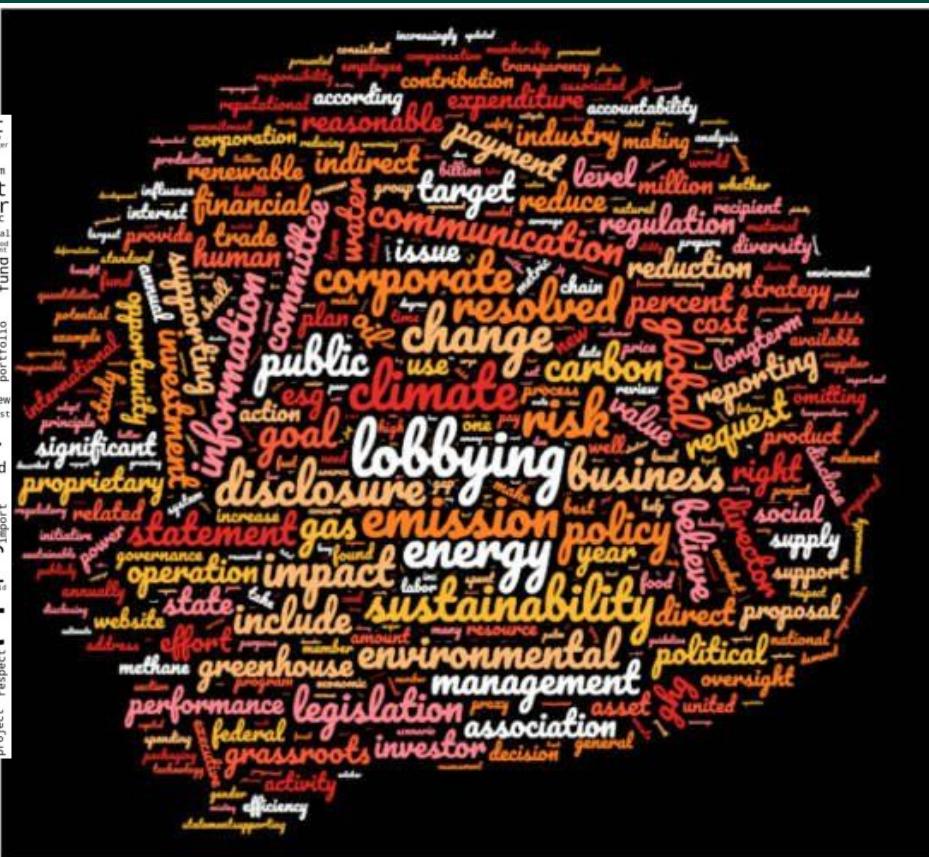
## Word Count



# Word frequency results

disclosure  
emissions  
inform  
company  
goal  
direct  
develop  
harass  
ensur  
monetary  
chain  
signific  
chevron  
plan  
regul  
pollut  
net  
plant  
median  
men  
men  
independ  
fail  
elect  
affect  
ghg  
found  
sover  
need  
proprietary  
harm  
carbon  
ocean  
carbon  
raste  
pesticid  
citizen  
process  
source  
clean  
non  
suppli  
suppli  
way  
earn  
act  
social  
compon  
opportun  
compens  
elector  
term  
decis  
b  
cost  
associ  
public  
divers  
spend  
continu  
adjust  
better  
brand  
b  
social  
host  
view  
senior  
portfoli  
sustain  
interes  
perform  
state  
sustain  
portfoli  
view  
make  
oper  
accord  
well  
mitig  
large  
base  
feder  
nation  
among  
institut  
amazon  
mar  
paid  
consid  
princip  
seek  
data  
express  
data  
commun  
commun  
account  
level  
recent  
integr  
recipi  
consist  
forc  
wast  
contribute  
potenti  
project

# vs. Raghupathi et al



# NMF Cluster Topics

## Topics 2019 - 2022

1. Climate Emissions Targets
2. Activism/lobbying
3. Female Wage Disparity
4. Campaign Contributions
5. ESG Management and Corporate Policies
6. Plastic Pollution and the Ocean
7. Human Rights Impact Assessments

Raghupathi's Topics

2009-2019:

- Emission & energy
- Board
- Regulation
- Politics
- Governance
- Product
- Management
- Accountability

# NMF Cluster Topics

## Topics 2019 - 2022

1. Climate Emissions Targets
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# NMF Topics & top 5 terms

## Topic 1. Climate Emissions Targets

Climat, emiss, target, chang, energi

Adopt GHG reduction targets (APD, 2022  
Resolution)

**Organization:** Air Products & Chemicals Inc.

**Year:** 2022

**Resolved:**

Shareholders request Air Products address the risks and opportunities presented by climate change and the global transition toward net zero emissions by setting emission reduction targets covering the company's full value chain (Scope 1, 2, and 3) GHG emissions.

**Supporting Statement:**

In assessing what targets to set, we recommend, at management's discretion, consideration of the following:

- Adopting short, medium, and long-term GHG emissions reduction targets taking into consideration approaches used by advisory groups such the Science Based Targets initiative (through which over 1,700 companies have set or committed to set science-based GHG reduction targets).
- Adopting quantitative targets to increase sourcing of renewable energy, energy efficiency, and production of green hydrogen.
- Assessing disparate impacts of the company's climate change contributions on communities of color, and, committing to reduce or mitigate local community health impacts from the cumulative emissions generated from its facilities.

Industry	Chemicals
Sector	Materials
Filed By	The Nathan Cummings Foundation
Votes	%
Status	Withdrawn: Commitment
View Memo	

# NMF Topics & top 5 terms

## Topic 2. Activism/Lobbying

Lobi, commun, payment, legisl, indirect

### Report on lobbying (ABT, 2022 Resolution)

**Organization:** Abbott Laboratories

**Year:** 2022

**Whereas:**

We believe in full disclosure of Abbott Laboratories' ("Abbott") direct and indirect lobbying activities and expenditures to assess whether Abbott's lobbying is consistent with its expressed goals and in the best interests of stockholders.

**Resolved:**

The stockholders of Abbott request the preparation of a report, updated annually, disclosing:

1. Company policy and procedures governing lobbying, both direct and indirect, and grassroots lobbying communications.
2. Payments by Abbott used for (a) direct or indirect lobbying or (b) grassroots lobbying communications, in each case including the amount of the payment and the recipient.
3. Abbott's membership in and payments to any tax-exempt organization that writes and endorses model legislation.
4. Description of management's decision-making process and the Board's oversight for making payments described in section 2 above.

**Supporting Statement:**

Abbott spent \$36,700,000 from 2010 – 2019 on federal lobbying. This figure does not

Industry	Health Care Equipment & Supplies
Sector	Health Care
Filed By	Unitarian Universalist Association
Votes	34.7%
Status	Vote
View Memo	<a href="#">View</a>

# NMF Topics & top 5 terms

## Topic 3. Female Wage Disparity

Pay, gap, pay gap, percent, median

bi-gram

Report on pay disparity (FB, 2020 Resolution)

Organization: Facebook, Inc.

Year: 2020

**Whereas:** Whereas: The World Economic Forum estimates the gender pay gap costs the economy 12 trillion dollars annually. The median income for women working full time in the United States is 80 percent that of men. This disparity can equal half a million dollars over a career. Intersecting race, the gap for African American and Latina women is 60 percent and 55 percent. At the current rate, women overall will not reach pay equity until 2059, African American women until 2130, and Latina women until 2224. Research suggests diverse leadership leads to superior stock performance and return on equity. McKinsey states, the business case for the advancement and promotion of women is compelling. Best practices include tracking and eliminating gender pay gaps. Women account for 36.9 percent of our company's workforce and 32.6 percent of leadership. Actively managing pay equity is associated with higher current female representation at the professional through executive levels and a faster trajectory to improved representation. Assessing if a company has pay gaps requires analyzing both equal pay and equal opportunity. This is done using adjusted and unadjusted (median) pay data. The objective of this proposal-median pay gap disclosure-addresses the structural bias affecting the jobs women and minorities hold, when white men hold most higher paying jobs. It is the key metric used by the Organization for Economic

Industry	Internet Software & Services
Sector	Information Technology
Filed By	Not Disclosed in Proxy
Votes	8.607336519%
Status	Vote
View Memo	

# NMF Topics & top 5 terms

## Topic 4. Campaign Contributions

?

### Compani, corpor, thi, elector, spend

Report on indirect political spending (XOM, 2022 Resolution)

**Organization:** Exxon Mobil Corporation

**Year:** 2022

**Resolved:**

That the shareholders of Exxon Mobil Corporation (Exxon or Company) hereby request the Company to prepare and semiannually update a report, which shall be presented to the pertinent board of directors committee and posted on the Company's website, disclosing the Company's:

- Policies and procedures for making electoral contributions and expenditures (direct and indirect) with corporate funds, including the board's role (if any) in that process; and
- Monetary and non-monetary contributions or expenditures that could not be deducted as an ordinary and necessary business expense under section 162(e)(1)(B) of the Internal Revenue Code, including (but not limited to) contributions or expenditures on behalf of candidates, parties, and committees and entities organized and operating under section 501(c)(4) of the Internal Revenue Code, as well as the portion of any dues or payments made to any tax-exempt organization (such as a trade association) used for an expenditure or contribution that, if made directly by the Company, would not be deductible under section 162(e)(1)(B) of the Internal Revenue Code.
- The report shall be made available within 12 months of the annual meeting

Industry	Oil, Gas & Consumable Fuels
Sector	Energy
Filed	Unitarian Universalist
By	Association
Votes	26.7%
Status	Vote
View	
Memo	

# NMF Topics & top 5 terms

## Topic 5. ESG management and corporate policies

Report, sustain, risk, board, manag

Adopt stewardship practices to reduce diversified portfolio ESG costs (MMM, 2022)

Organization: 3M Co.

Year: 2022

Whereas:

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- Belgian regulators recently ordered 3M to stop PFAS production after recent blood samples taken from 800 people near 3M's plant showed elevated levels of PFAS.<sup>5</sup>

Industry	Industrial Conglomerates
Sector	Industrials
Filed By	The Shareholder Commons
Votes	%
Status	Filed
View Memo	<a href="#">View</a>

It appears our Company only addresses sustainability issues when that pursuit optimizes 3M's financial return. The Sustainability Report states:

*Our priority is the comprehensive management of enterprise risks through an ethical tone, governance processes, and clear roles, responsibilities, and accountability.<sup>6</sup>*

# NMF Topics & top 5 terms

## Topic 6. Plastic Pollution & the Ocean

### Plastic, package, recycl, reduc, report

Report on plastic pollution (AMZN, 2022 Resolution)

**Organization:** Amazon.com Inc.

**Year:** 2022

**Description:**

from As You Sow website: supporting individual filer Sara Sackner

**Whereas:**

The growing plastic pollution crisis poses increasing risks to our company.

Corporations could face an annual **financial risk of approximately \$100 billion** should governments require them to cover the waste management costs of the packaging they produce, a policy that is increasingly being enacted around the globe.

Recently, Pew Charitable Trusts released a groundbreaking study, *Breaking the Plastic Wave*, concluding that if all current industry and government commitments were met, ocean plastic deposition would be reduced by only 7%. Without immediate and sustained new commitments throughout the plastics value chain, annual flows of plastics into oceans could nearly triple by 2040.

The Pew report also finds that improved recycling must be coupled with reductions in use, materials redesign, and substitution. It concludes that plastic demand should be reduced by least 1/3, stating that reducing plastic production is the most attractive solution from environmental, economic, and social perspectives. The European Union has banned 10 single-use plastic products commonly found in

Industry	Internet & Direct Marketing Retail
Sector	Consumer Discretionary
Filed By	As You Sow
Votes	48.9%
Status	Vote
View Memo	<a href="#">View</a>

# NMF Topics & top 5 terms

## Topic 7. Human Rights Impacts Assessments

Right, human, human rights, risk, impact

another  
bi-gram

Report on indigenous peoples policy (GS,  
2019 Resolution)

Organization: Goldman Sachs

Year: 2019

Whereas:

Whereas, our Company has been identified as one of the banks financially supporting companies engaged in the development or construction of the Dakota Access Pipeline (DAPL) (Bakken Pipeline), a controversial project which received extensive media coverage and public condemnation because of its environmental destruction, pollution and encroachment upon sacred Sioux Nation land;

Industry	Capital Markets
Sector	Financials
Filed	Harrington Investments, Inc.
Votes	%
Status	Withdrawn: Dialogue
View Memo	

Whereas, in accordance with the United Nations Declaration on the Rights of Indigenous Peoples, Article 11, asserts "the right to maintain, protect and develop the past, present and future manifestations of their cultures, such as archaeological and historical sites... yet the Dakota Access Pipeline construction has already desecrated various ancestral sites, disregarding previous treaties in blatant violation of Indigenous Peoples' Human Rights;

Whereas, Article 29 of the Declaration states "Indigenous Peoples have the right to the conservation and protection of the environment and the productive capacity of their lands or territories and resources";

# Sentiments

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Model ran great with fewer documents  
In MVP stage.

Model does not seem to finish running with the full corpus.  
(Trouble shooting)

Early results:  
**'negative': 17%**  
**'neutral': 70%**  
**'positive': 13%**  
**'compound': 0.68**

Still pretty positive!

# Summary

NLP + NMF can model sustainability topics

Recent topics differ from past:

## Persisting:

- Climate
- Politics
- Management

## Recent:

- Wage Disparity
- Plastic Pollution in Oceans
- Human Rights

# Next steps!

**NMF  
coherence  
scoring for  
optimal  
number of  
topics**

**Topics by year  
& industry**

**Complete  
sentiment  
modeling**

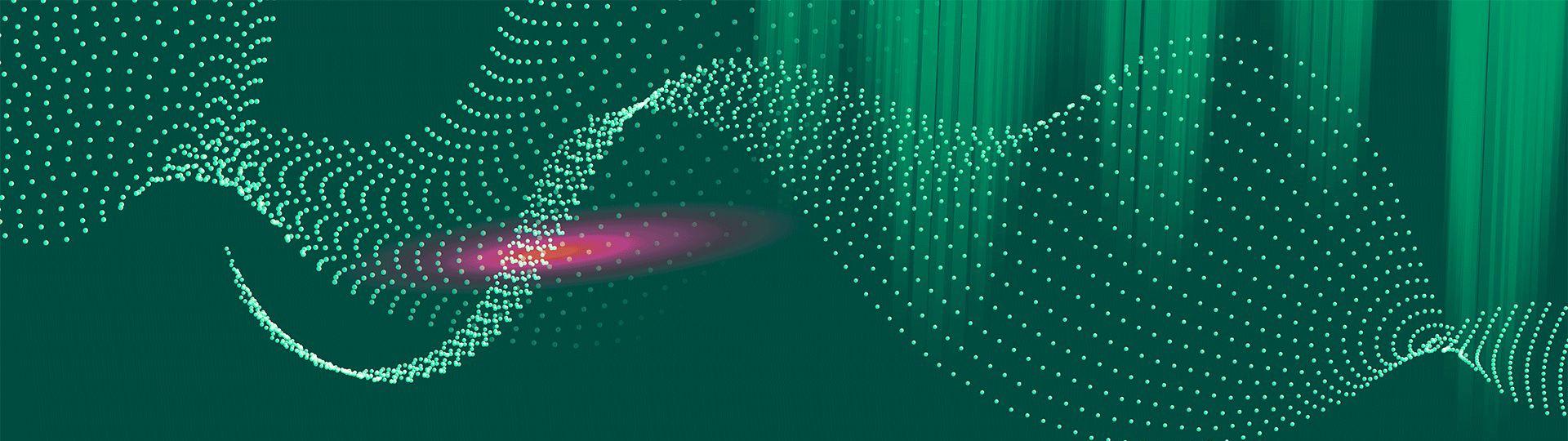
**Sentiments by  
topic**

**Scrape all  
resolutions  
(2009 - 2022)**

**Compare  
results with  
other  
clustering/  
dimensionality  
reduction  
methods**

**Compare NMF  
for other  
Lancaster and  
Snowball  
stemmers**

**Compare & share  
larger results  
with  
Raghupahti et al.**



## References

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Raghupathi, V.; Ren, J.; Raghupathi, W. Identifying Corporate Sustainability Issues by Analyzing Shareholder Resolutions: A Machine-Learning Text Analytics Approach. *Sustainability* 2020, 12, 4753. <https://doi.org/10.3390/su12114753>

# THANK YOU!

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I would love feedback to help me make this better!



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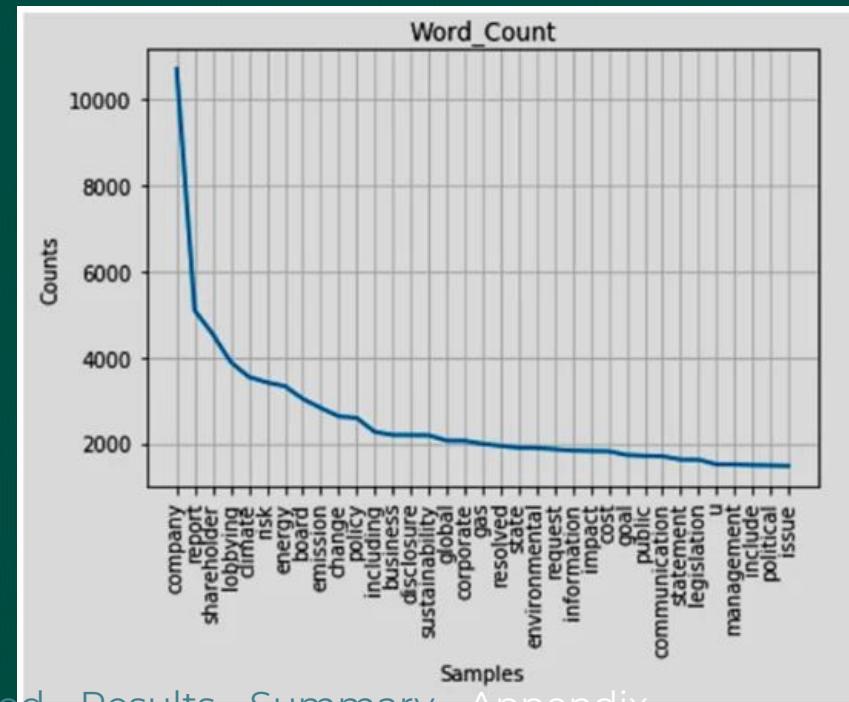
CREDITS: This presentation template was created by Slidesgo, including icons by Flaticon, and infographics & images by Freepik.

# Less Frequent Topics

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- **Financing fossil fuels**
- **Compensation review**
- **Water use and management**
- **Natural gas and liquified natural gas**
- **Plastic pellets pollution/chemical spills**
- **Corporate leaders and accountability**
- **Gender diversity in tech**
- **Sexual harassment reporting**

# Compare Word Count to Raghupathi et al.



# Raghupathi cluster word clouds

## Cluster 1



**Figure 11.** (A) Cluster 1—Emission and Energy. (B) Cluster 2—Board. (C) Cluster 3—Regulation. (D) Cluster 4—Politics. (E) Cluster 5—Governance. (F) Cluster 6—Product Management. (G) Cluster 7—Accountability.

• 100 •

## Specialisation

### **congruence**

### **confidence**

— 1 —

oard

卷八

thnic.com

卷之三

nike™

**Nike** exe

#### **ation**

em

Employment

#### **Assignment**

## production -

## Introduction

### **Cluster 3**



expenditure  
support internal spending  
proper candidate camp  
political supreme transparency accountabi

fund contribution  
entity sect  
citizen payment  
association

company election decision code behalf corporate monetary activity trade disclosure

# Raghupathi cluster word clouds

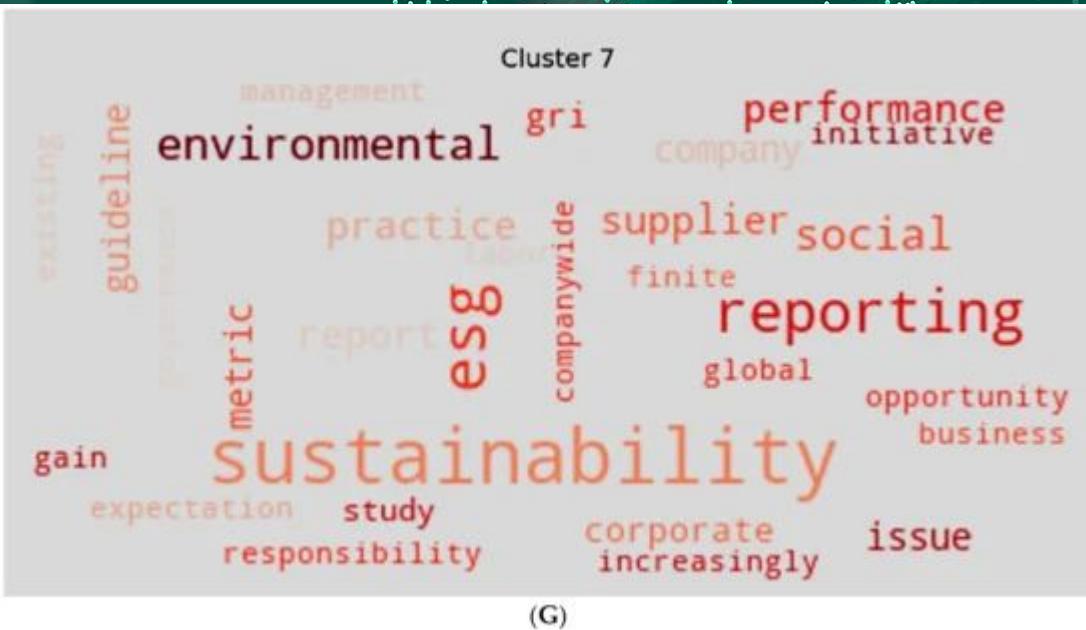
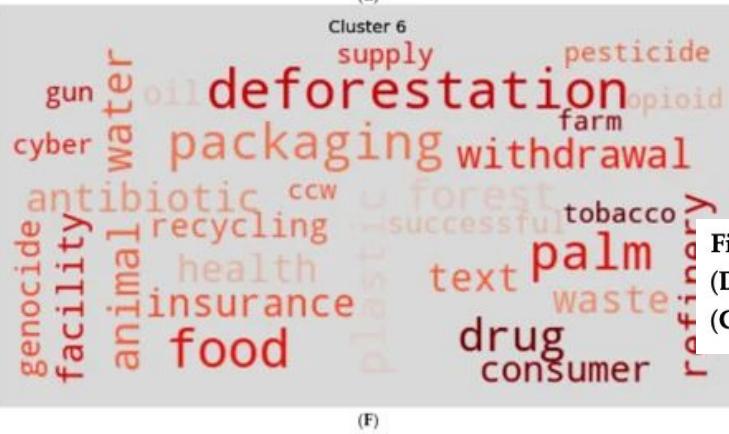
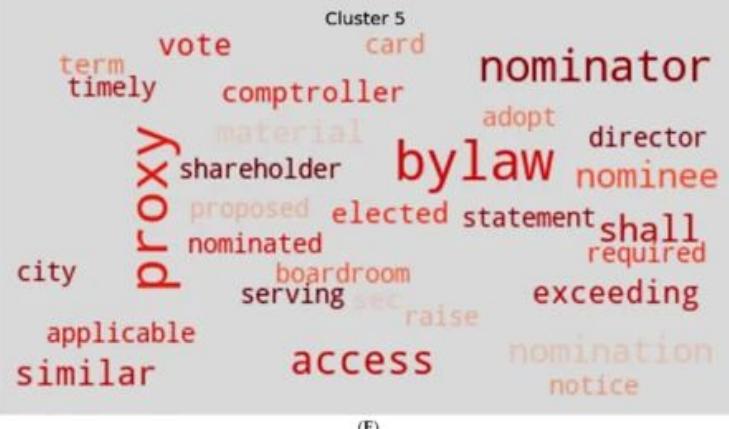


Figure 11. (A) Cluster 1—Emission and Energy. (B) Cluster 2—Board. (C) Cluster 3—Regulation. (D) Cluster 4—Politics. (E) Cluster 5—Governance. (F) Cluster 6—Product Management. (G) Cluster 7—Accountability.