Sustainability and ESG Data Analytics

ESG Data Reporting
Corporate Sustainability Reports
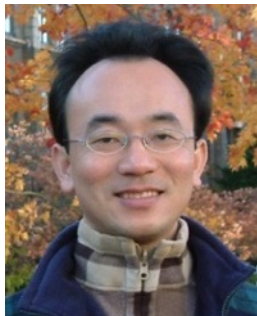# ESG Data Verification

1131ESGDA07
MBA, IM, NTPU (M5265) (Fall 2024)
Wed 2, 3, 4 (9:10-12:00) (B3F17)

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https://web.ntpu.edu.tw/~myday

https://meet.google.com/miy-fbif-max

2024-11-20

Syllabus

Week   Date   Subject/Topics

1 2024/09/11 Introduction Sustainability and ESG Data Analytics

2 2024/09/18 Environmental, Social, and Governance (ESG) in
Net-Zero Digital Transformation

3 2024/09/25 Data Science for Sustainability and ESG

4 2024/10/02 (Class Canceled due to Typhoon)

5 2024/10/09 (Self-Learning) Web 3.0 and Big Data Analysis in Fintech,
Green and Sustainable Finance

6 2024/10/16 Case Study on Sustainability and ESG Data Analytics I

Syllabus

Week   Date   Subject/Topics

7 2024/10/23 (Self-Learning) Task Force on Climate-Related Financial
                    Disclosures (TCFD) and En-Roads Interactive;
                    ESG Data Gathering, Analysis, and Visualization

8 2024/10/30 (Self-Learning)

9 2024/11/06 Self-Learning

10 2024/11/13 Midterm Project Report

11 2024/11/20 ESG Data Reporting; Corporate Sustainability Reports;
                    ESG Data Verification

12 2024/11/27 Case Study on Sustainability and ESG Data Analytics II

Syllabus

Week   Date   Subject/Topics

13 2024/12/04 Artificial Intelligence of things (AIoT) in
                    ESG and Sustainability Applications

14 2024/12/11 Generative AI for ESG Rating and Reporting Generation
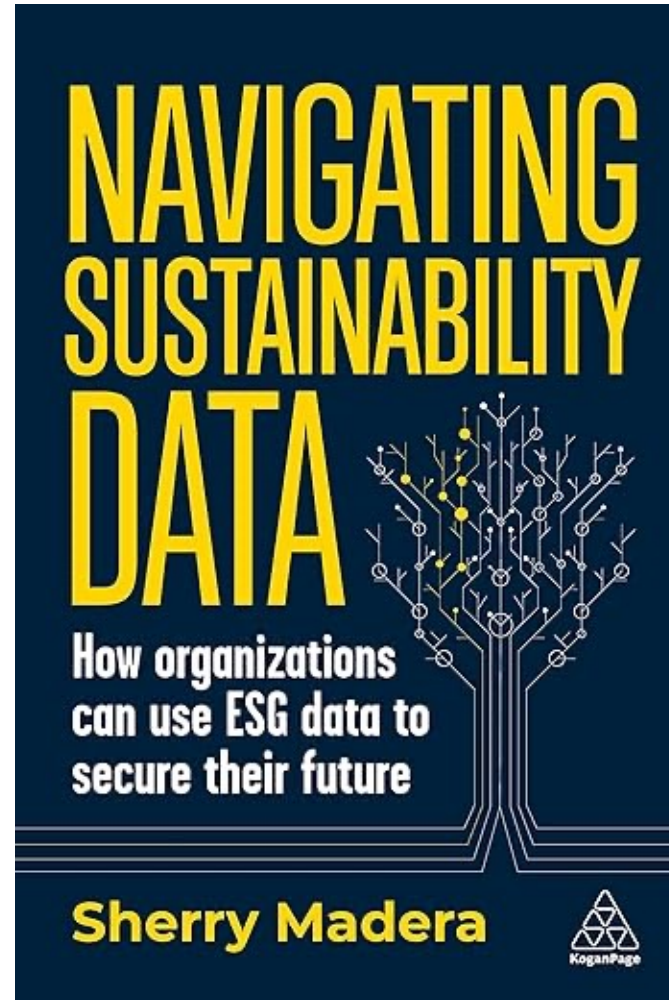
15 2024/12/18 Final Project Report I

16 2024/12/25 Final Project Report II

ESG Data Reporting
Corporate Sustainability Reports
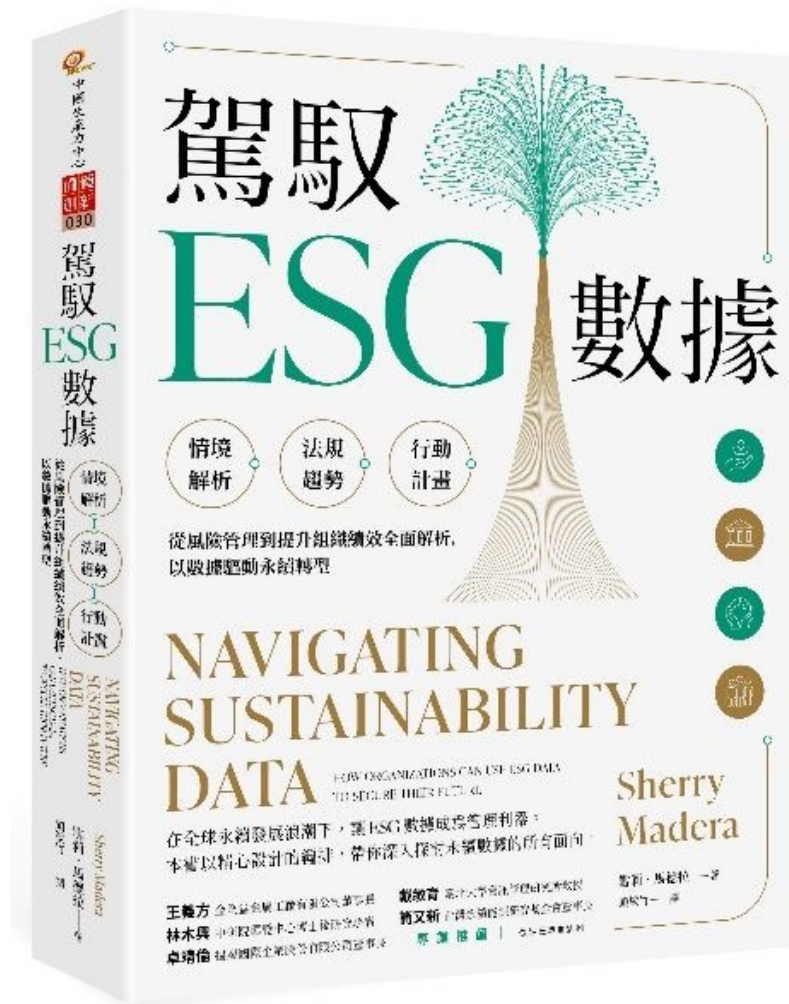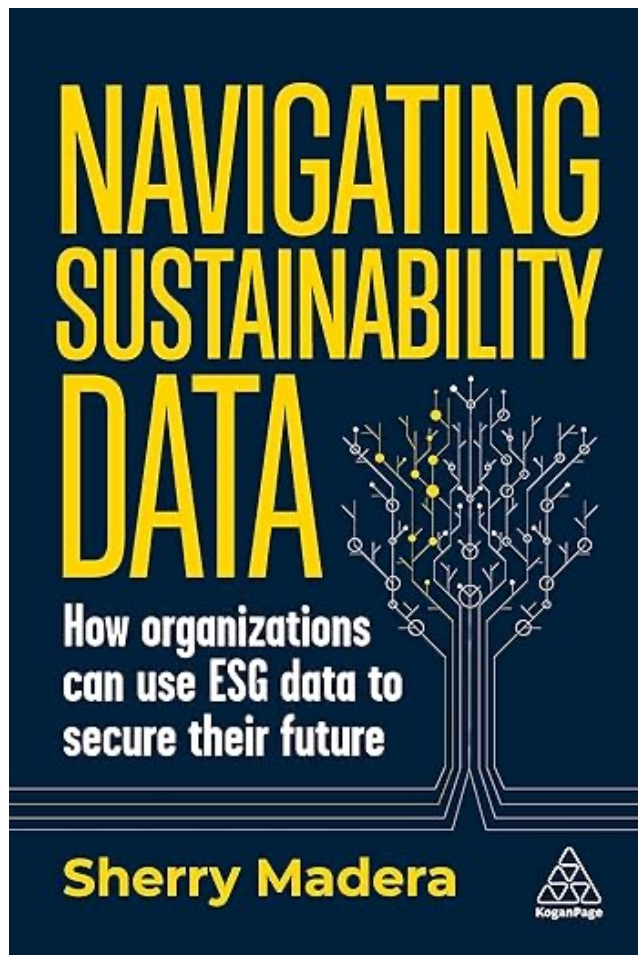# ESG Data Verification

Outline

- **ESG Data Reporting**

- **Corporate Sustainability Reports**

- **ESG Data Verification**

Sherry Madera (2024),
Navigating Sustainability Data: How Organizations can use ESG Data to Secure Their Future, Kogan Page

雪莉・馬德拉 (Sherry Madera) (顏敏竹 譯) (2024), 駕馭ESG數據 (Navigating Sustainability Data), 財團法人中國生產力中心

專業推薦：
王義方
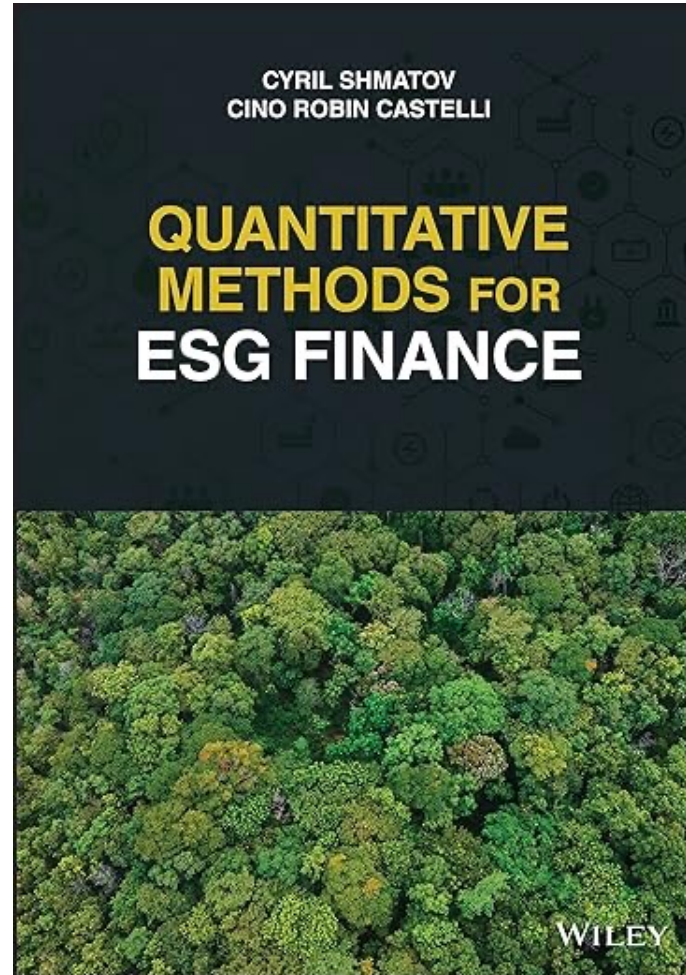（金全益金屬工廠有限公司董事長）
林木興
（中研院環變中心博士後研究學者）
卓靖倫
（揚秦國際企業股份有限公司董事長）
戴敏育
（國立臺北大學資訊管理研究所教授）
簡又新
（台灣永續能源研究基金會董事長）

Cino Robin Castelli, Cyril Shmatov (2022), Quantitative Methods for ESG Finance, Wiley

Source: https://www.amazon.com/Quantitative-Methods-Finance-Robin-Castelli/dp/1119903807/

Simon Thompson (2023),

Green and Sustainable Finance:

Principles and Practice in Banking, Investment and Insurance,

2nd Edition, Kogan Page.
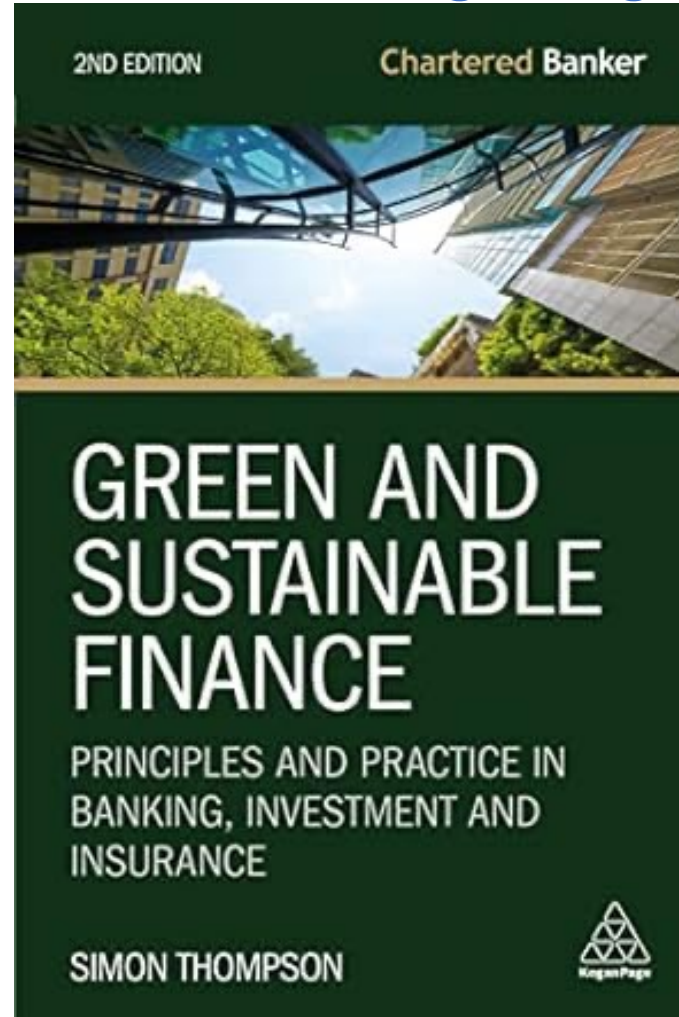
Chrissa Pagitsas (2023),
Chief Sustainability Officers At Work:
How CSOs Build Successful Sustainability and ESG Strategies,
Apress.
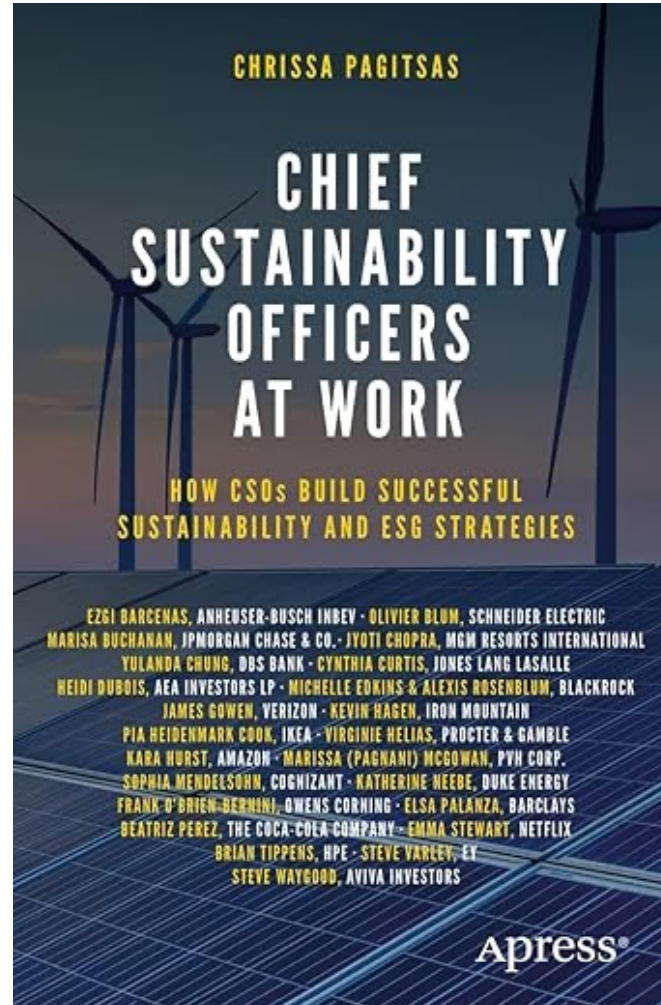
Sustainability and ESG Data Analytics

Definition of ESG Reporting

- **Disclosure of Environmental, Social, and Governance (ESG) factors impacting business operations.**

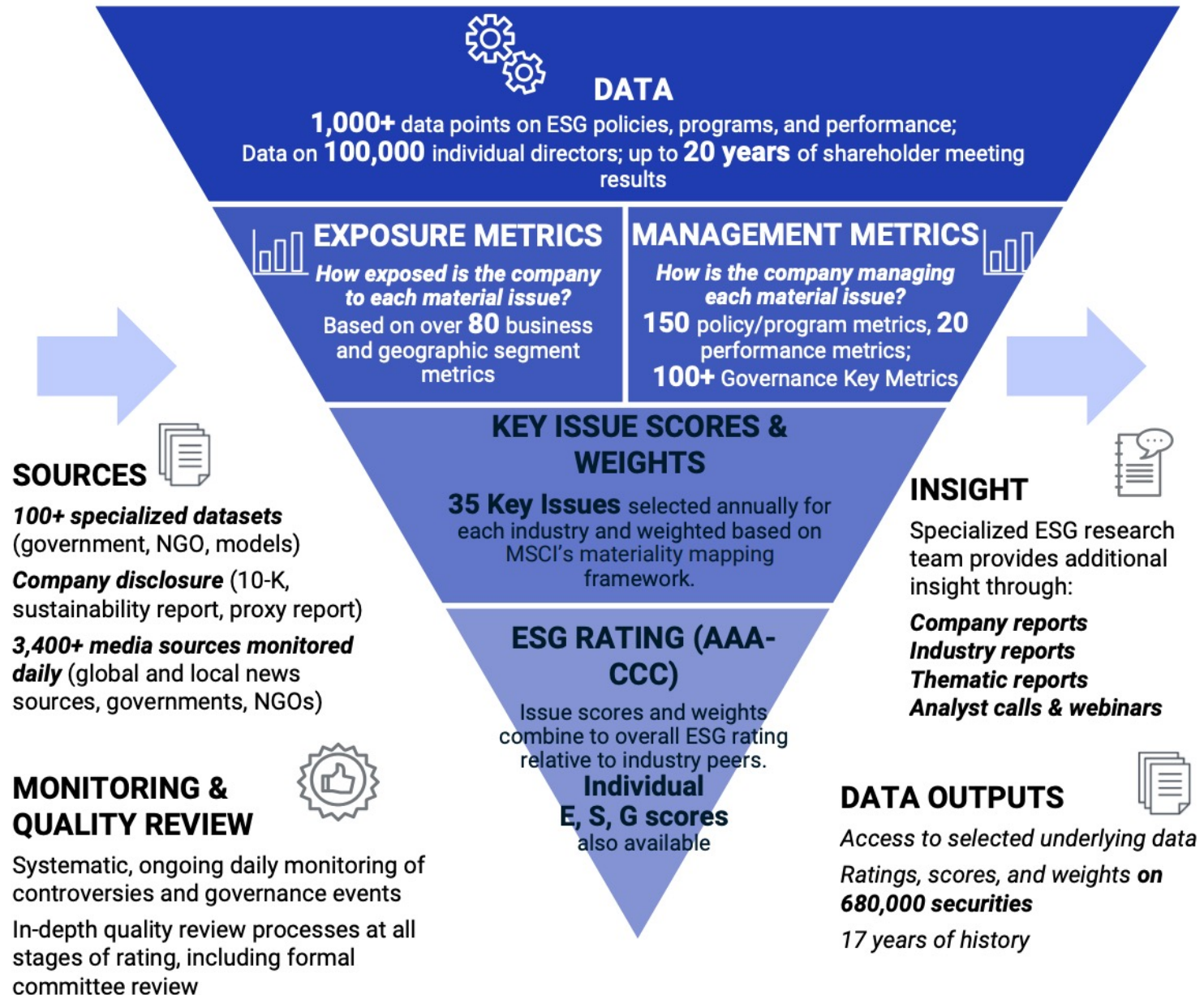# **Importance of ESG Reporting**
Why ESG Data Reporting Matters

- **Informed decision-making for investors**

- **Transparency and building trust**

- **Identifying risks and opportunities**

- **Benchmarking against peers**

ESG Data Reporting
Key Components

- **Environmental Metrics:**
  - **Carbon footprint, energy consumption, waste management.**
- **Social Metrics:**
  - **Labor practices, community engagement, diversity and inclusion.**
- **Governance Metrics:**
  - **Board composition, executive compensation, ethical practices.**
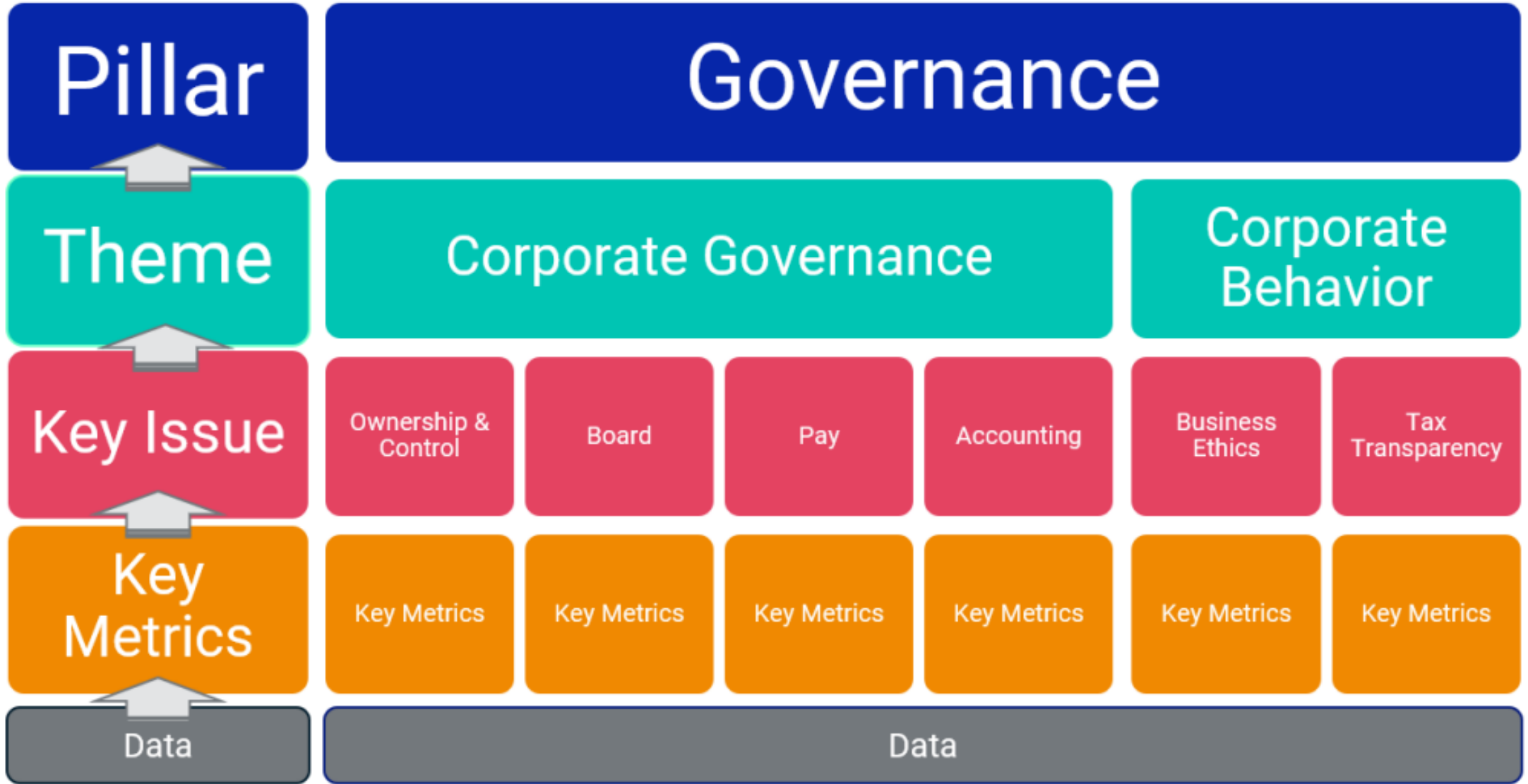
MSCI ESG Rating Framework

DATA
1,000+ data points on ESG policies, programs, and performance; Data on 100,000 individual directors; up to 20 years of shareholder meeting results

EXPOSURE METRICS
How exposed is the company to each material issue?
Based on over 80 business and geographic segment metrics

MANAGEMENT METRICS
How is the company managing each material issue?
150 policy/program metrics, 20 performance metrics; 100+ Governance Key Metrics

KEY ISSUE SCORES & WEIGHTS
35 Key Issues selected annually for each industry and weighted based on MSCI's materiality mapping framework.

ESG RATING (AAA-CCC)
Issue scores and weights combine to overall ESG rating relative to industry peers. **Individual E, S, G scores** also available

SOURCES
100+ specialized datasets (government, NGO, models)
Company disclosure (10-K, sustainability report, proxy report)
3,400+ media sources monitored daily (global and local news sources, governments, NGOs)

MONITORING & QUALITY REVIEW
Systematic, ongoing daily monitoring of controversies and governance events
In-depth quality review processes at all stages of rating, including formal committee review

INSIGHT
Specialized ESG research team provides additional insight through:
Company reports
Industry reports
Thematic reports
Analyst calls & webinars

DATA OUTPUTS
Access to selected underlying data
Ratings, scores, and weights **on 680,000 securities**
17 years of history

MSCI ESG Key Issue Hierarchy

3 Pillars	10 Themes	35 ESG Key Issues	
Environment	**Climate Change**	Carbon Emissions	Financing Environmental Impact
		Product Carbon Footprint	Climate Change Vulnerability
	Natural Capital	Water Stress	Raw Material Sourcing
		Biodiversity & Land Use	
	Pollution & Waste	Toxic Emissions & Waste	Electronic Waste
		Packaging Material & Waste	
	Environmental Opportunities	Opportunities in Clean Tech	Opportunities in Renewable Energy
		Opportunities in Green Building	
Social	**Human Capital**	Labor Management	Human Capital Development
		Health & Safety	Supply Chain Labor Standards
	Product Liability	Product Safety & Quality	Privacy & Data Security
		Chemical Safety	Responsible Investment
		Consumer Financial Protection	Health & Demographic Risk
	Stakeholder Opposition	Controversial Sourcing	
		Community Relations	
	Social Opportunities	Access to Communications	Access to Health Care
		Access to Finance	Opportunities in Nutrition & Health
Governance	**Corporate Governance**	Ownership & Control	Pay
		Board	Accounting
	Corporate Behavior	Business Ethics	
		Tax Transparency	

MSCI Governance Model Structure

MSCI Hierarchy of ESG Scores
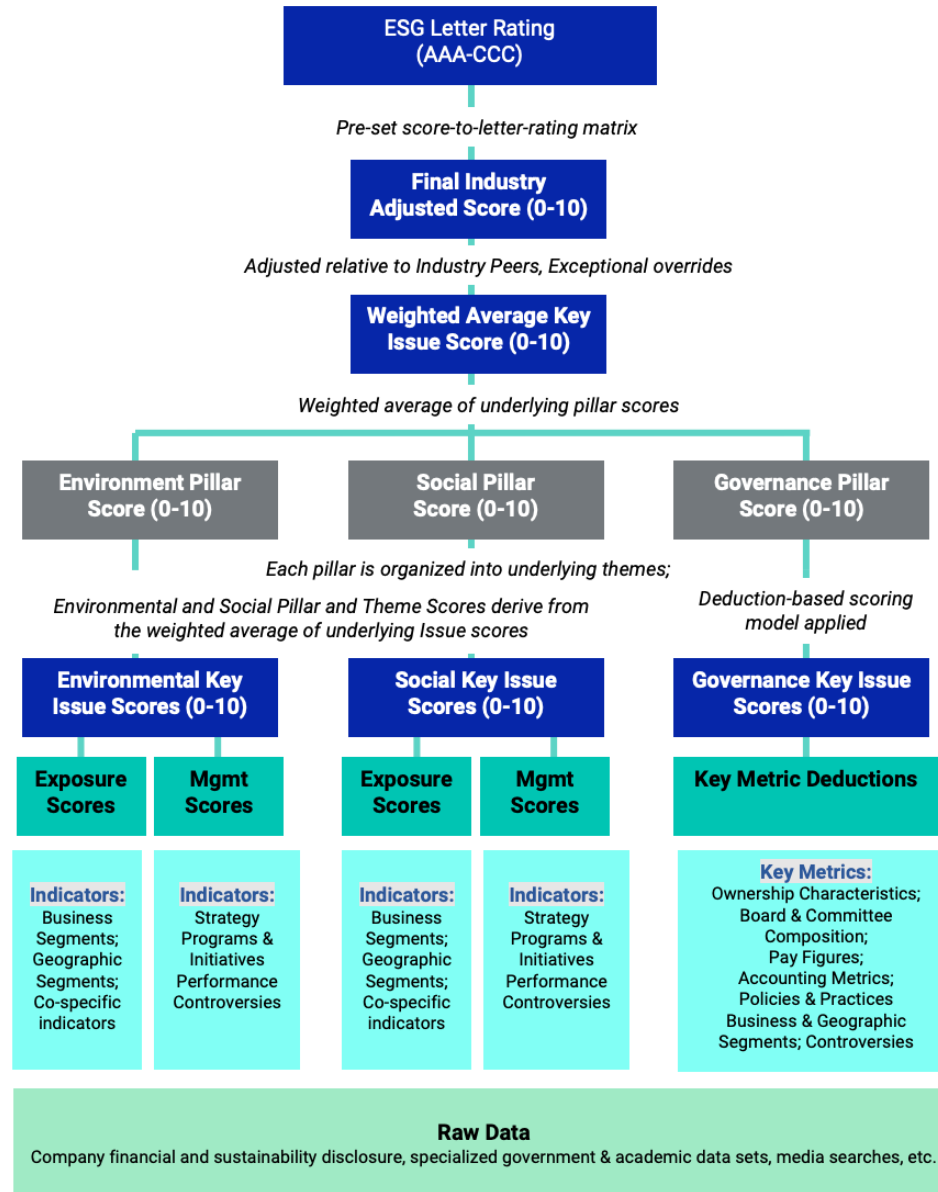
DJSI S&P Global ESG Score

8,000 Companies

90% Global market capitalization

340,000+ Current Research Universe and Active Securities

ENVIRONMENTAL

GOVERNANCE & ECONOMIC

SOCIAL

S&P GLOBAL ESG SCORE

Approx. **1,000** Datapoints — Assessed values, text, checkboxes, documents
Sources: Web-based questionnaire and company documents

130+ Questions — Weighted data point scores
Up to 50% industry-specific

Ave. **30+** Criteria scores — Weighted question scores
61 industry specific approaches, with tailored questions, criteria and related weightings

3 Dimension scores — Weighted criteria scores
Adjusted for corporate ESG controversies where applicable

1 S&P Global ESG Score — Sum of weighted dimension scores

FTSE Russell ESG Ratings

ESG Data Reporting
Reporting Frameworks and Standards

- **Global Reporting Initiative (GRI):**
  - **Provides a comprehensive framework for sustainability reporting**
- **Sustainability Accounting Standards Board (SASB):**
  - **Focuses on industry-specific standards for disclosing financially material sustainability information**
- **Task Force on Climate-related Financial Disclosures (TCFD):**
  - **Offers recommendations for climate-related financial disclosures**

GRI (Global Report Initiative)

CDP (Carbon Disclosure Project)

https://www.cdp.net/

SASB (Sustainability Accounting Standards Board)

ISSB (International Sustainability Standards Board)

About the International Sustainability Standards Board

The Trustees of the IFRS Foundation announced the formation of the International Sustainability Standards Board (ISSB) on 3 November 2021 at COP26 in Glasgow, following strong market demand for its establishment. The ISSB is developing—in the public interest—standards that will result in a high-quality, comprehensive global baseline of sustainability disclosures focused on the needs of investors and the financial markets.

Sustainability factors are becoming a mainstream part of investment decision-making. There are increasing calls for companies to provide high-quality, globally comparable information on sustainability-related risks and opportunities, as indicated by feedback from many consultations with market

Related information

Sustainability FAQs

General Sustainability-related Disclosures project

Climate-related Disclosures project

Consolidated organisations

https://www.ifrs.org/groups/international-sustainability-standards-board/

TCFD
(Task Force on Climate-related Financial Disclosures)

IFRS https://www.ifrs.org/sustainability/tcfd/

ABOUT US | IFRS ACCOUNTING | IFRS SUSTAINABILITY

Home > ISSB and TCFD

ISSB and TCFD

The Financial Stability Board has announced that the work of the TCFD has been completed, with the ISSB's Standards marking the 'culmination of the work of the TCFD'.

Companies applying IFRS S1 *General Requirements for Disclosure of Sustainability-related Financial Information* and IFRS S2 *Climate-related Disclosures* will meet the TCFD recommendations as the recommendations are fully incorporated into the ISSB's Standards.

Companies can continue to use the TCFD recommendations should they choose to do so, and some companies may still be required to use the TCFD recommendations. Using the recommendations is a good entry point for companies as they move to use the ISSB's Standards.

The IFRS Foundation has published a comparison of the requirements in IFRS S2 and the TCFD recommendations.

Related Information

IFRS Foundation welcomes culmination of TCFD work and transfer of TCFD monitoring responsibilities to ISSB from 2024

Comparison: IFRS S2 Climate-related Disclosures with the TCFD Recommendations

Resource: Making the transition from TCFD to ISSB

IFRS Sustainability Standards Navigator

https://www.fsb-tcfd.org/

Corporate Sustainability Reports (CSR)
Purpose and Benefits

- **Enhancing transparency and accountability**
- **Building trust with stakeholders**
- **Identifying risks and opportunities related to sustainability**

Corporate Sustainability Reports (CSR)
Structure and Content

- **Executive Summary**

- **Materiality Assessment**

- **Performance Indicators and Metrics**

- **Case Studies and Success Stories**

- **Future Goals and Commitments**

Corporate Sustainability Reports (CSR)
Best Practices

- **Align reports with recognized frameworks (e.g., GRI, SASB)**

- **Ensure data accuracy and completeness**

- **Engage stakeholders in the reporting process**

- **Commit to continuous improvement and regular updates**

ESG Data Verification

- **Enhances credibility and reliability of reported data.**
- **Meets regulatory and stakeholder expectations.**

ESG Data Verification
Verification Methods

- **Internal audits and controls**

- **Third-party assurance services**

- **Use of technology and data analytics for validation**

ESG Data Verification Challenges

- **Ensuring consistency across reporting periods**

- **Addressing data gaps and limitations**

- **Balancing transparency with confidentiality concerns**

Essential Python Libraries for ESG Data Reporting

- **Pandas**
  - **Data loading, manipulation, cleaning**
- **NumPy**
  - **Numerical calculations**
- **Matplotlib/Seaborn**
  - **Data visualization**

Collecting ESG Data

- **Free repositories**
  - **MSCI ESG Ratings**
  - **Sustainalytics**
- **Paid Providers**
  - **Highlight specialization and more granular data**
- **Company Websites**
  - **Sustainability reports, investor relations**

Processing and Analyzing ESG Data
Transforming Data into Insights

- **Cleaning and preprocessing**
  - **handling missing data**
- **Calculating ESG Scores or metrics**
- **Normalization**
  - **for cross-company comparison**

Corporate Sustainability Reports
Why Analyze Sustainability Reports?

- **The Power of Data-Driven ESG Analysis**

- **Speed and scale compared to manual reading**

- **Track performance trends more precisely**

- **Deeper insights and comparisons**

- **Identify areas for critical evaluation**

Python for Sustainability Reports Analysis

- **BeautifulSoup**
  - **Handle HTML reports**
- **pdfminer.six**
  - **Extract text from PDF reports**
- **Pandas**
  - **Store and manipulate extracted data**
- **Matplotlib/Seaborn**
  - **Data visualization**

Corporate Sustainability Reports
Finding Sustainability Data

- **Company Websites**
  - **Investor relations section, dedicated reports page**
- **Sustainability Report Repositories**
  - **GRI, etc.**

Extracting Data (HTML)
Scraping Data from Web-Based Reports

- **Finding the right HTML tags**
  - **(using browser inspection tools)**
- **BeautifulSoup to parse and extract into structured data**

Extracting Data (PDF)
Handling PDF-Based Reports

- **Using pdfminer.six for text conversion**

- **Potential use of regular expressions for cleaning**

Analysis with Pandas
Turning Data into Insights

- **Loading into DataFrames**

- **Cleaning (handling missing values, formats)**

- **Calculating ESG metrics or ratios**

- **Comparing data across years**

Visualizing Results
Communicating ESG Performance

- **Choose charts that align with analysis goals**
- **Clear visuals: labeling, annotations**

ESG Data Analysis and Visualization

```python
# ESG Data Analysis and Visualization
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
from datetime import datetime
import random

# Generate synthetic data
np.random.seed(0)
data = {
    'company': ['Company A', 'Company B', 'Company C', 'Company D', 'Company E'],
    'emissions': np.random.randint(10000, 50000, 5),
    'diversity': np.random.uniform(0.2, 0.9, 5),
    'employee_satisfaction': np.random.uniform(60, 90, 5),
    'waste_type': ['Plastic', 'Organic', 'Electronic', 'Metal', 'Other'],
    'waste_amount': np.random.randint(100, 500, 5)
}
df = pd.DataFrame(data)
```

ESG Data Analysis and Visualization

```python
# Separate DataFrame for time series and correlation
time_series_data = pd.DataFrame({
    'year': np.repeat(np.arange(2018, 2023), 5),
    'company': np.tile(['Company A', 'Company B', 'Company C', 'Company
    D', 'Company E'], 5),
    'energy_use': np.random.randint(1000, 5000, 25)
})

# Simulating correlation data with a slight positive trend
diversity = np.linspace(0.2, 0.9, 100)
np.random.shuffle(diversity)
employee_satisfaction = 60 + (diversity - 0.2) * 150
employee_satisfaction += np.random.normal(0, 5, 100)

correlation_data = pd.DataFrame({
    'diversity': diversity,
    'employee_satisfaction': employee_satisfaction
})
```
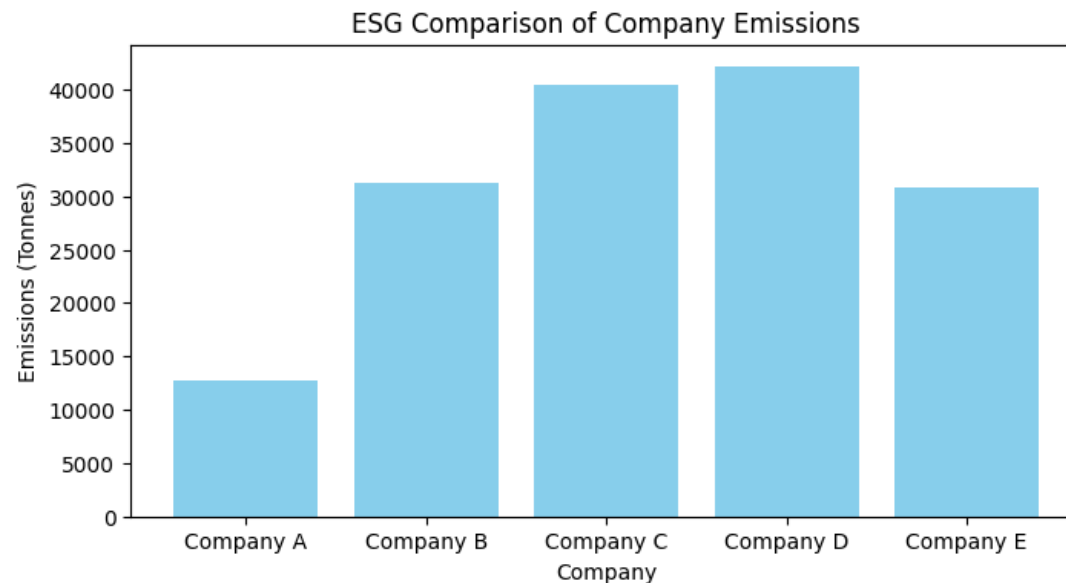
ESG Data Analysis and Visualization

```python
# Save DataFrame to CSV
df.to_csv('ESG_Dataset.csv', index=False)

# Calculate statistics for each company
statistics = df.describe()
statistics = statistics.applymap(lambda x: format(x, '.4f'))
print(statistics)
statistics.to_csv('Company_ESG_Statistics.csv')
```

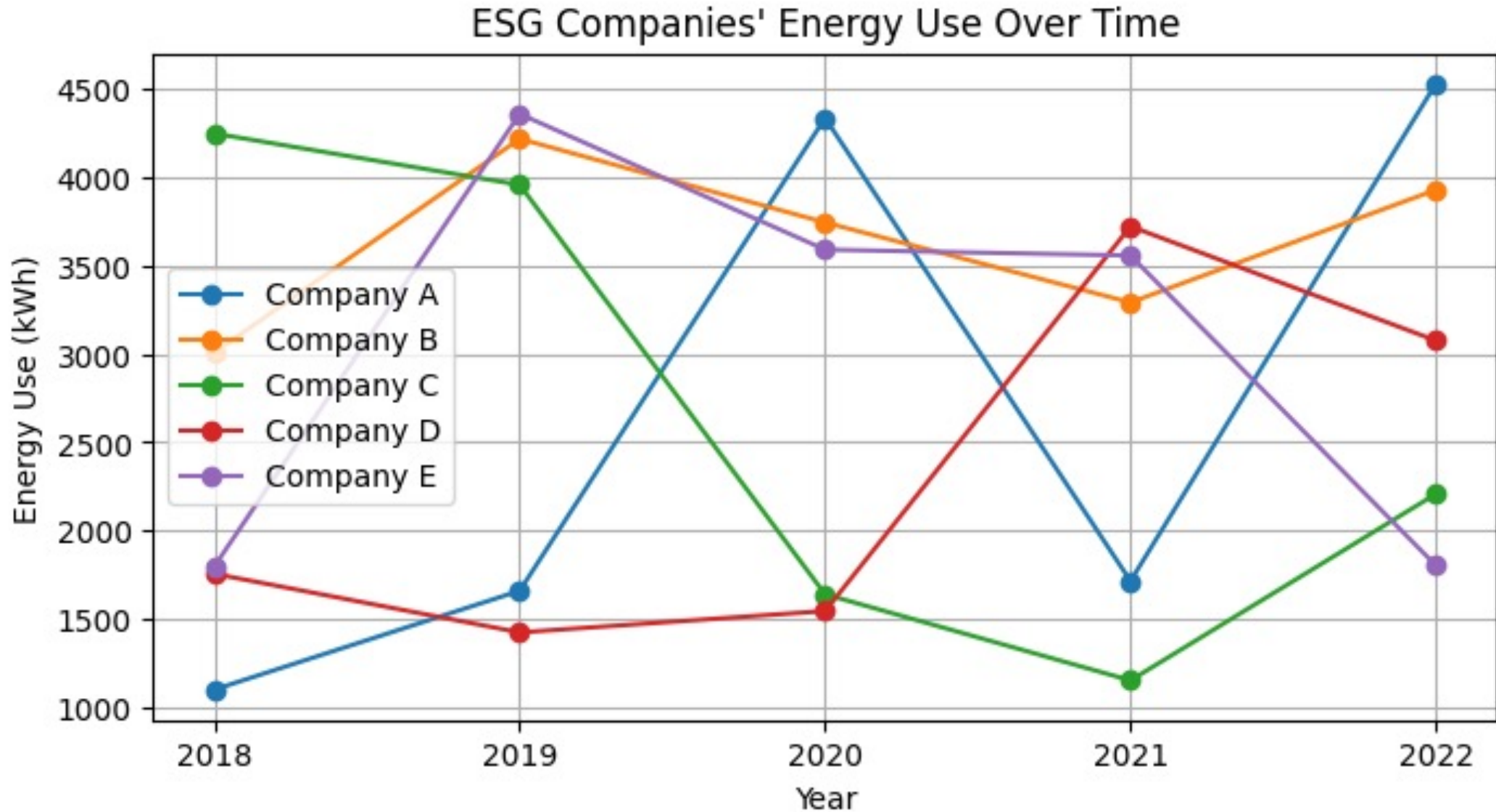|	emissions	diversity	employee_satisfaction	waste_amount
count	5.0000	5.0000	5.0000	5.0000
mean	31447.6000	0.4085	77.1504	345.6000
std	11667.5748	0.1099	7.0841	94.8093
min	12732.0000	0.2397	70.1219	215.0000
25%	30757.0000	0.3909	71.7835	297.0000
50%	31243.0000	0.4083	74.3993	343.0000
75%	40403.0000	0.4691	84.3651	435.0000
max	42103.0000	0.5344	85.0824	438.0000

ESG Data Analysis and Visualization

```python
# Create visualizations and save them at 300 dpi
# Bar Chart for Emissions
plt.figure(figsize=(8, 4))
plt.bar(df['company'], df['emissions'], color='skyblue')
plt.xlabel('Company')
plt.ylabel('Emissions (Tonnes)')
plt.title('ESG Comparison of Company Emissions')
plt.show()
plt.savefig('ESG Company_Emissions.jpg', format='jpg', dpi=300)
```


ESG Comparison of Company Emissions

ESG Data Analysis and Visualization

```python
# Line Chart for Energy Use
plt.figure(figsize=(8, 4))
for company in time_series_data['company'].unique():
    company_data = time_series_data[time_series_data['company'] ==
    company]
    company_data = company_data.sort_values(by='year')
    plt.plot(company_data['year'], company_data['energy_use'],
    marker='o', linestyle='-', label=company)
plt.xlabel('Year')
plt.ylabel('Energy Use (kWh)')
plt.title("ESG Companies' Energy Use Over Time")
plt.xticks(company_data['year'].unique()) # Ensuring only whole years
are marked
plt.legend()
plt.grid(True)
plt.show()
```

ESG Data Analysis and Visualization

ESG Companies' Energy Use Over Time

ESG Data Analysis and Visualization

```python
# Scatter Plot for Diversity vs. Satisfaction
plt.figure(figsize=(8, 4))
plt.scatter(correlation_data['diversity'],
correlation_data['employee_satisfaction'], alpha=0.7)
plt.xlabel('Board Diversity (Ratio)')
plt.ylabel('Employee Satisfaction (%)')
plt.title('ESG Correlation Between Board Diversity and Employee
Satisfaction')
plt.grid(True)
plt.show()
plt.savefig('ESG_Diversity_vs_Satisfaction.jpg', format='jpg', dpi=300)
```

ESG Data Analysis and Visualization

ESG Correlation Between Board Diversity and Employee Satisfaction
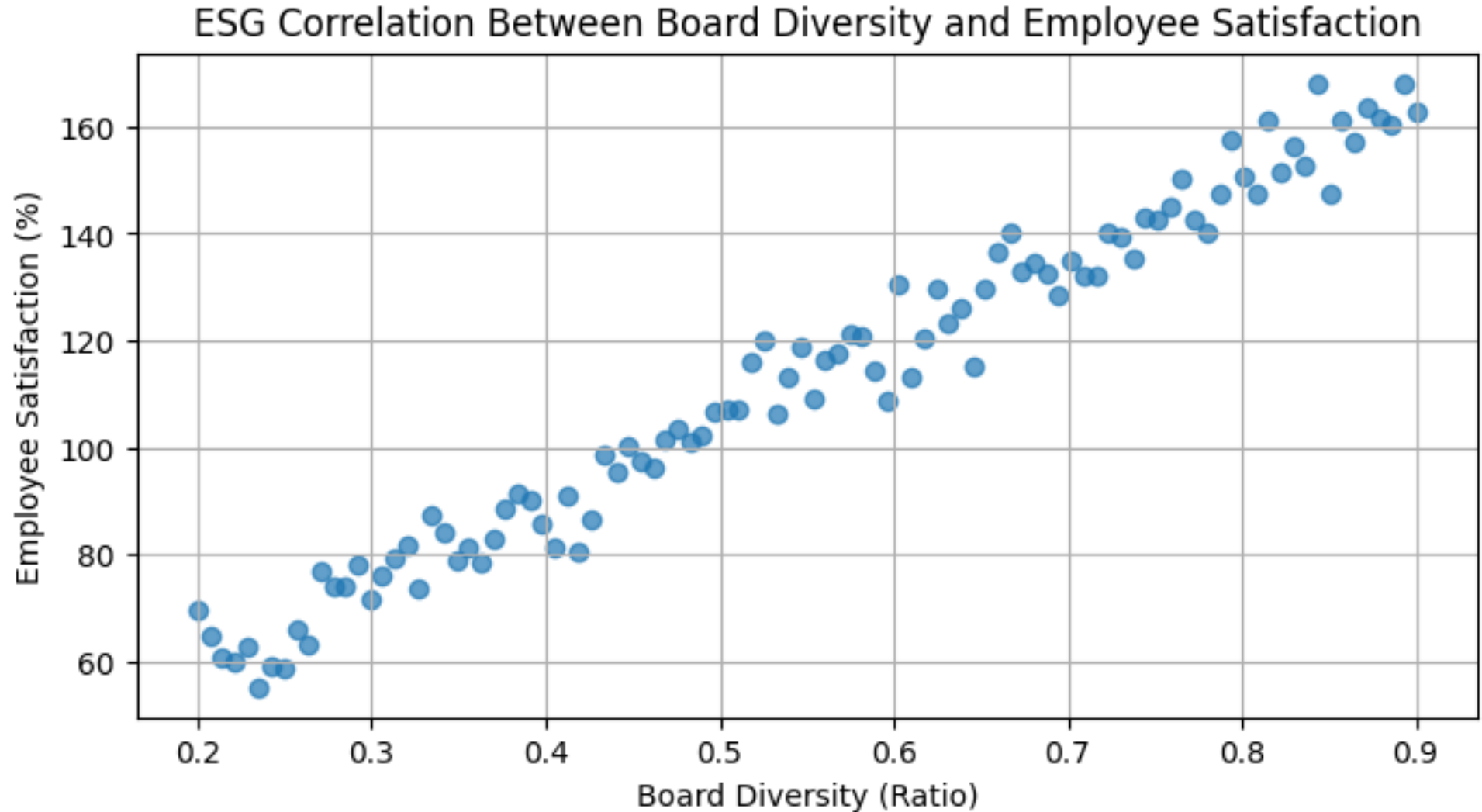
ESG Data Analysis and Visualization

```python
# Pie Chart for Waste Types
plt.figure(figsize=(8, 4))
plt.pie(df['waste_amount'], labels=df['waste_type'], autopct='%1.1f%%',
startangle=140)
plt.title('ESG Waste Types')
plt.axis('equal') # Equal aspect ratio ensures that pie is drawn as a
circle.
plt.show()
plt.savefig('ESG_Waste_Type_Breakdown.jpg', format='jpg', dpi=300)
```

Python in Google Colab (Python101)

https://colab.research.google.com/drive/1FEG6DnGvwfUbeo4zJ1zTunjMqf2RkCrT

https://tinyurl.com/aintpupython101

Summary

- **ESG Data Reporting**

- **Corporate Sustainability Reports**

- **ESG Data Verification**

References

- Sherry Madera (2024), Navigating Sustainability Data: How Organizations can use ESG Data to Secure Their Future, Kogan Page
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- Chrissa Pagitsas (2023), Chief Sustainability Officers At Work: How CSOs Build Successful Sustainability and ESG Strategies, Apress.
- Wes McKinney (2022), "Python for Data Analysis: Data Wrangling with pandas, NumPy, and Jupyter", 3rd Edition, O'Reilly Media.
- Cino Robin Castelli, Cyril Shmatov (2022), Quantitative Methods for ESG Finance, Wiley
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- Chrissa Pagitsas (2023), Chief Sustainability Officers At Work: How CSOs Build Successful Sustainability and ESG Strategies, Apress.
- Min-Yuh Day (2024), Python 101, https://tinyurl.com/aintpupython101