# Sustainability and ESG Data Analytics

NTPU
國立臺北大學
National Taipei University

# Environmental, Social, and Governance (ESG) in Net-Zero Digital Transformation

1131ESGDA02
MBA, IM, NTPU (M5265) (Fall 2024)
Wed 2, 3, 4 (9:10-12:00) (B3F17)

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

aws educate | Cloud Ambassador
2020 Cohort

aws academy Accredited Educator
aws certified Cloud Practitioner
aws certified Solutions Architect Associate


## Min-Yuh Day, Ph.D,
## Professor

Institute of Information Management, National Taipei University

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


2024-09-18

# 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 | Case Study on Sustainability and ESG Data Analytics I |
| 5 | 2024/10/09 | Web 3.0 and Big Data Analysis in Fintech, Green and Sustainable Finance |
| 6 | 2024/10/16 | Task Force on Climate-Related Financial Disclosures (TCFD) and En-Roads Interactive |

# Syllabus

| Week | Date | Subject/Topics |
|---|---|---|
| 7 | 2024/10/23 | ESG Data Gathering, Analysis, and Visualization |
| 8 | 2024/10/30 | Midterm Project Report |
| 9 | 2024/11/06 | Self-Learning |
| 10 | 2024/11/13 | ESG Data Reporting; Corporate Sustainability Reports |
| 11 | 2024/11/20 | 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 |

# Environmental, Social, and Governance (ESG) in Net-Zero Digital Transformation

# Outline

- Environmental, Social, and Governance (ESG)
- Net-Zero Digital Transformation
  - Net-Zero Transformation
  - Digital Transformation

Source: Dipanjan Sarkar (2019), Text Analytics with Python: A Practitioner's Guide to Natural Language Processing, Second Edition. APress.

# Sustainability and ESG Data Analytics

# ESG:

# Environmental

# Social

# Governance

# CSR: Corporate Social Responsibility

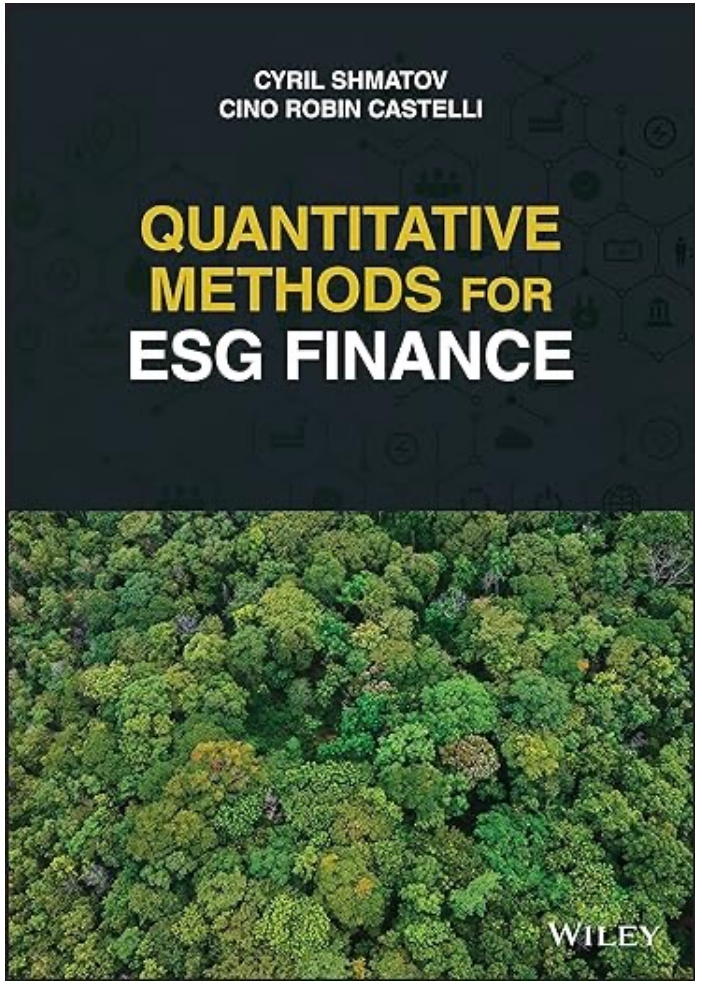
# ESG in Net-Zero Digital Transformation: Foundations and Frameworks

- **Environmental, Social, and Governance (ESG)**
- **Net-Zero Transformation**
- **Digital Transformation**
- **Opportunities and responsibilities**

# Tech for Good – Your Solutions!

- **Challenge:**
  **Most innovative tech solution to an environmental OR social problem**

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



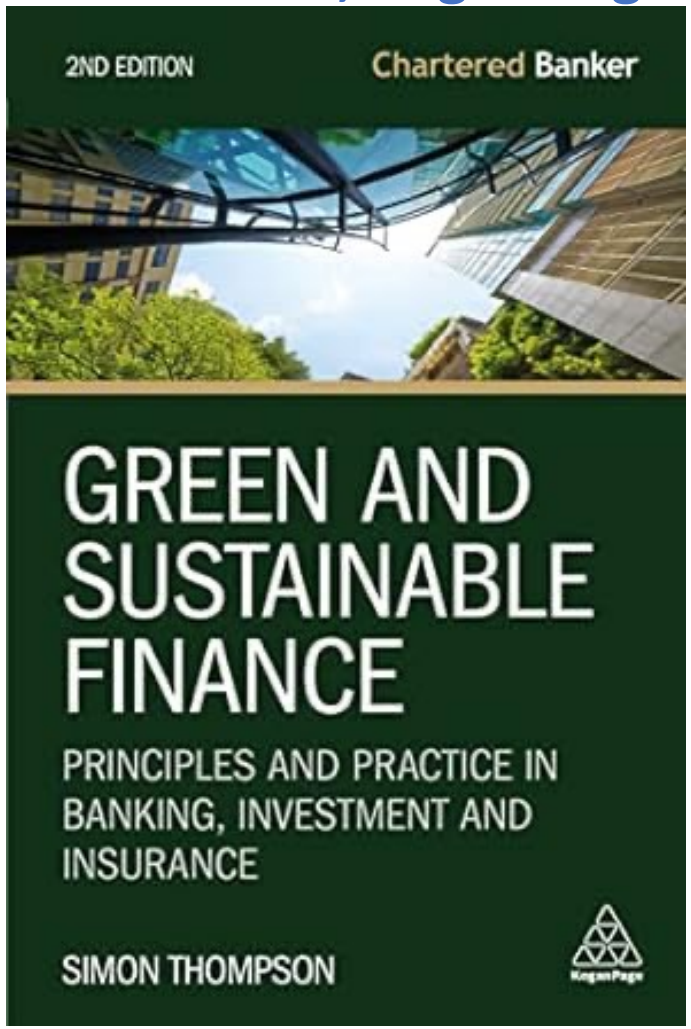

Source: https://www.amazon.com/Quantitative-Methods-Finance-Robin-Castelli/dp/1119903807/

## Simon Thompson (2023),

# Green and Sustainable Finance:

## Principles and Practice in Banking, Investment and Insurance,

## 2nd Edition, Kogan Page.



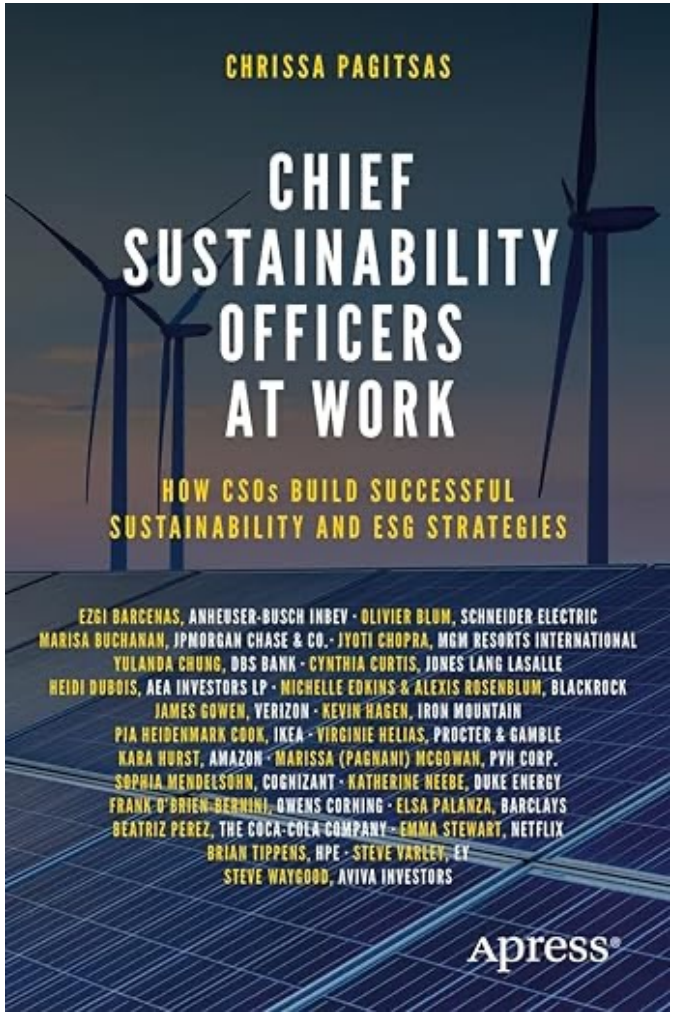

Source: https://www.amazon.com/Green-Sustainable-Finance-Principles-Investment/dp/1398609242/

## Chrissa Pagitsas (2023),

# Chief Sustainability Officers At Work:

# How CSOs Build Successful Sustainability and ESG Strategies,

## Apress.




Source: https://www.amazon.com/Chief-Sustainability-Officers-Work-Successful/dp/1484278658/

# ESG and Net-Zero: The Essentials

- **Environmental**
  - **Climate impact, resource use, pollution, biodiversity**
- **Social**
  - **Labor practices, human rights, community impact, diversity & inclusion**
- **Governance**
  - **Transparency, ethics, board structure, risk management**
- **Net-Zero**
  - **Balancing emissions produced with emissions removed globally**

# Net-Zero Transformation

- **Ambition**
  - Aligned to achieving global net zero by no later than 2050 & to limit warming to 1.5° C
- **Governance**
  - Accountability driven from the top
- **Strategy**
  - Embedded and aligned net zero into company strategy
- **Enterprise**
  - Key operating model changes in support of transformation

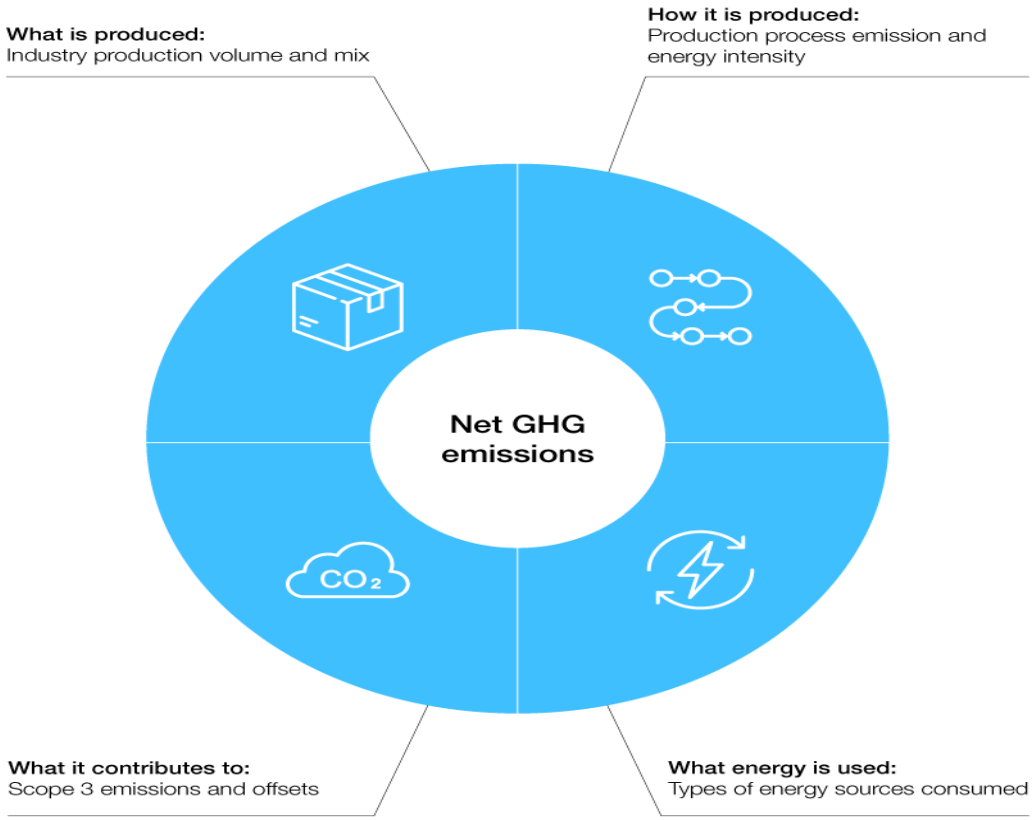
- **Supply chains**
  - Transformed net zero supply chains
- **Innovation**
  - Developed innovation and technologies to deliver net zero
- **Finance**
  - Financing the net zero transformation
- **Transparency**
  - Communicating action
- **Engagement**
  - Enhancing the pace and scale of net zero action

Source: https://www.pwc.com/us/en/services/esg/library/building-blocks-for-net-zero-transformation.html

# Net-Zero Transformation Enablers

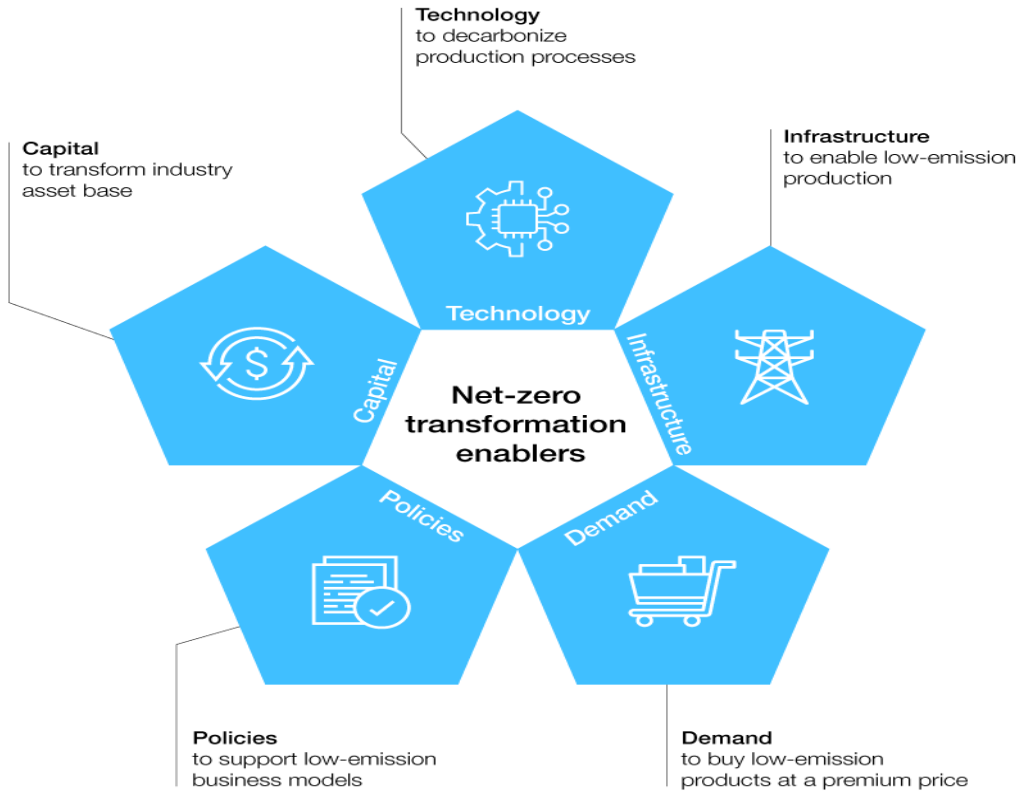
## Net-zero industry performance

The four drivers of industry net greenhouse gas (GHG) emissions:



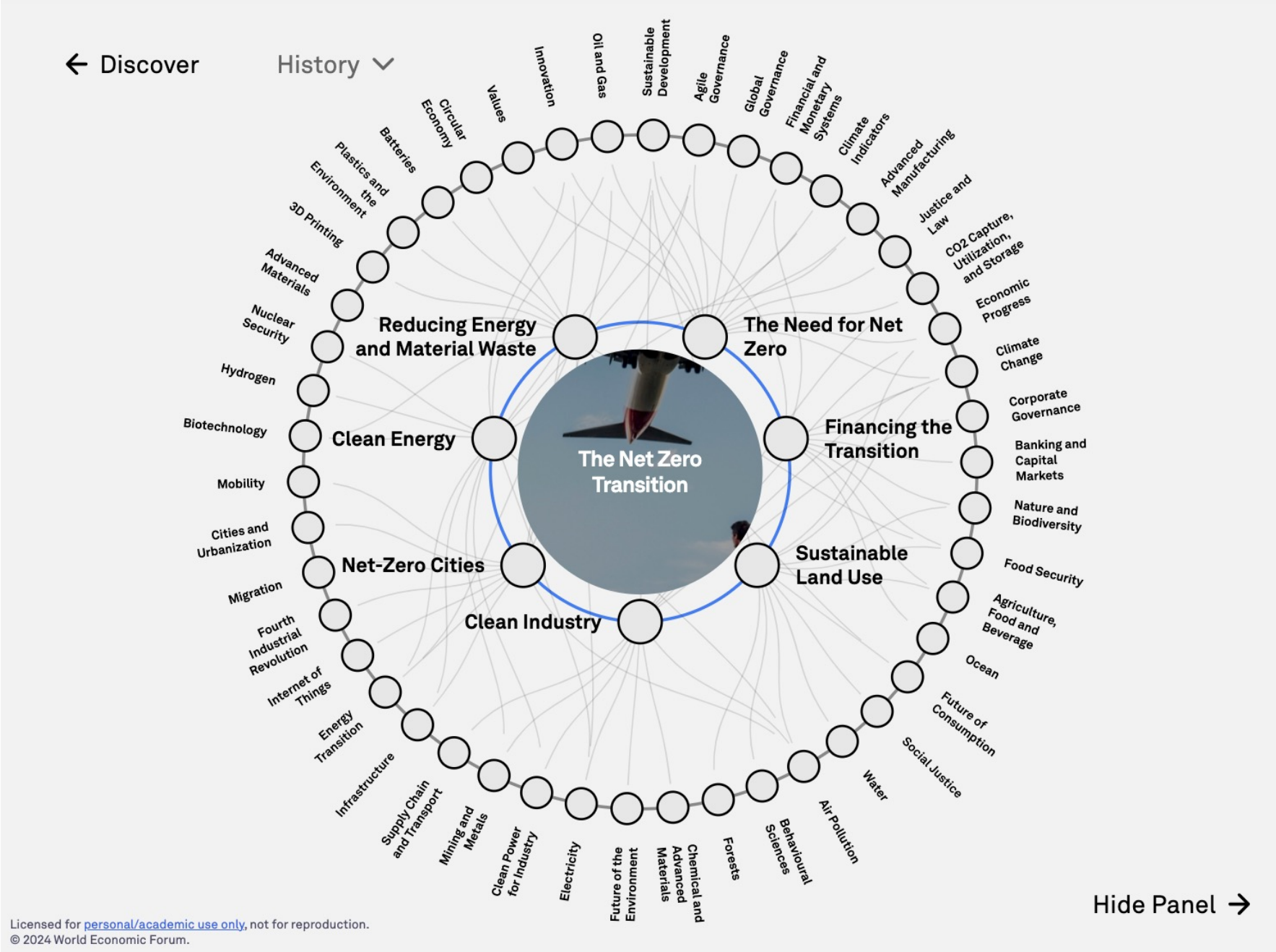

## Net-zero industry readiness

The five enabling dimensions of industry net-zero transformation:



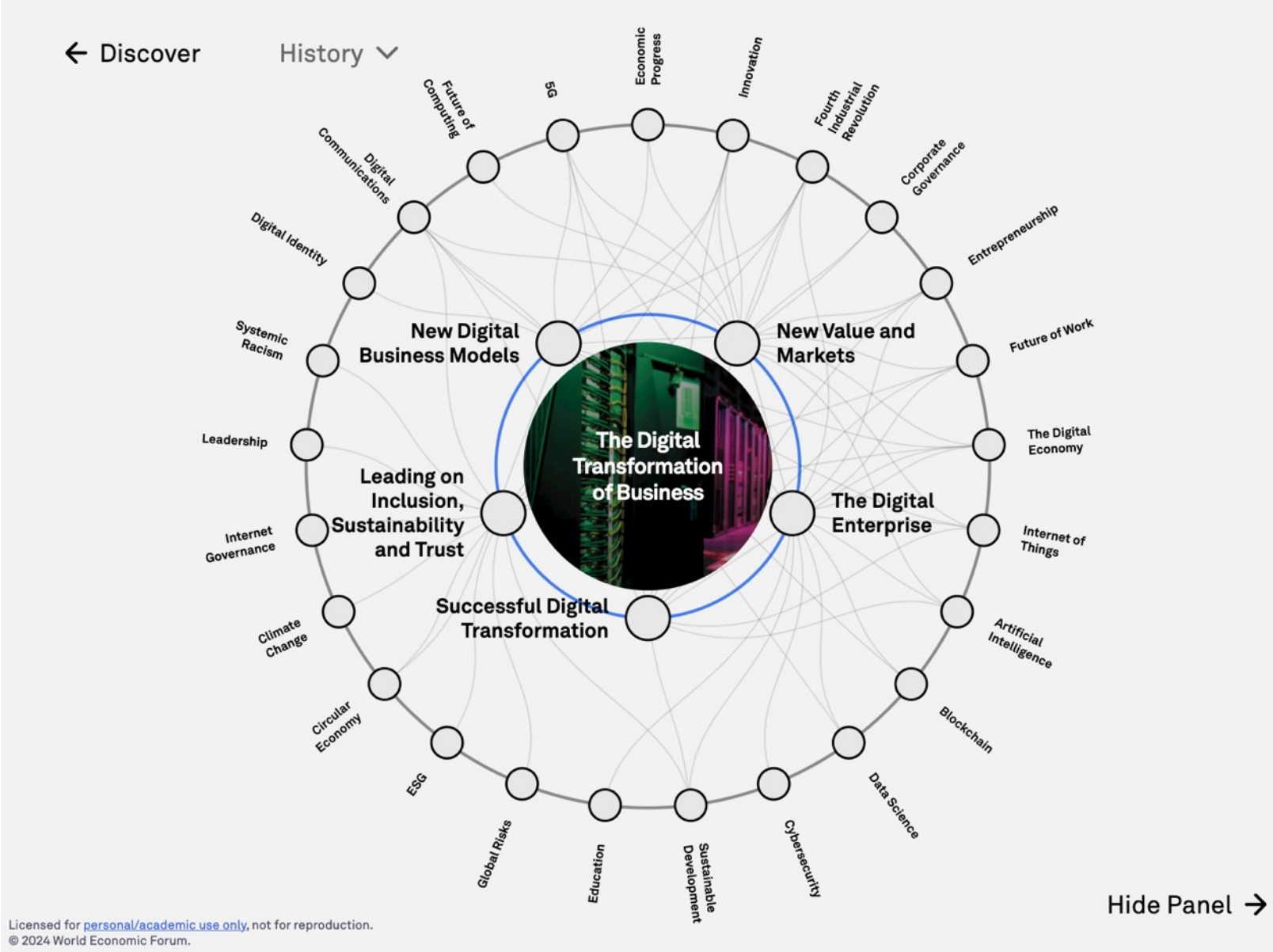

Source: https://www.weforum.org/agenda/2022/07/net-zero-tracker/

# The Net Zero Transition




Source: https://intelligence.weforum.org/topics/a1G680000004C93EAE

# The Digital Transformation of Business



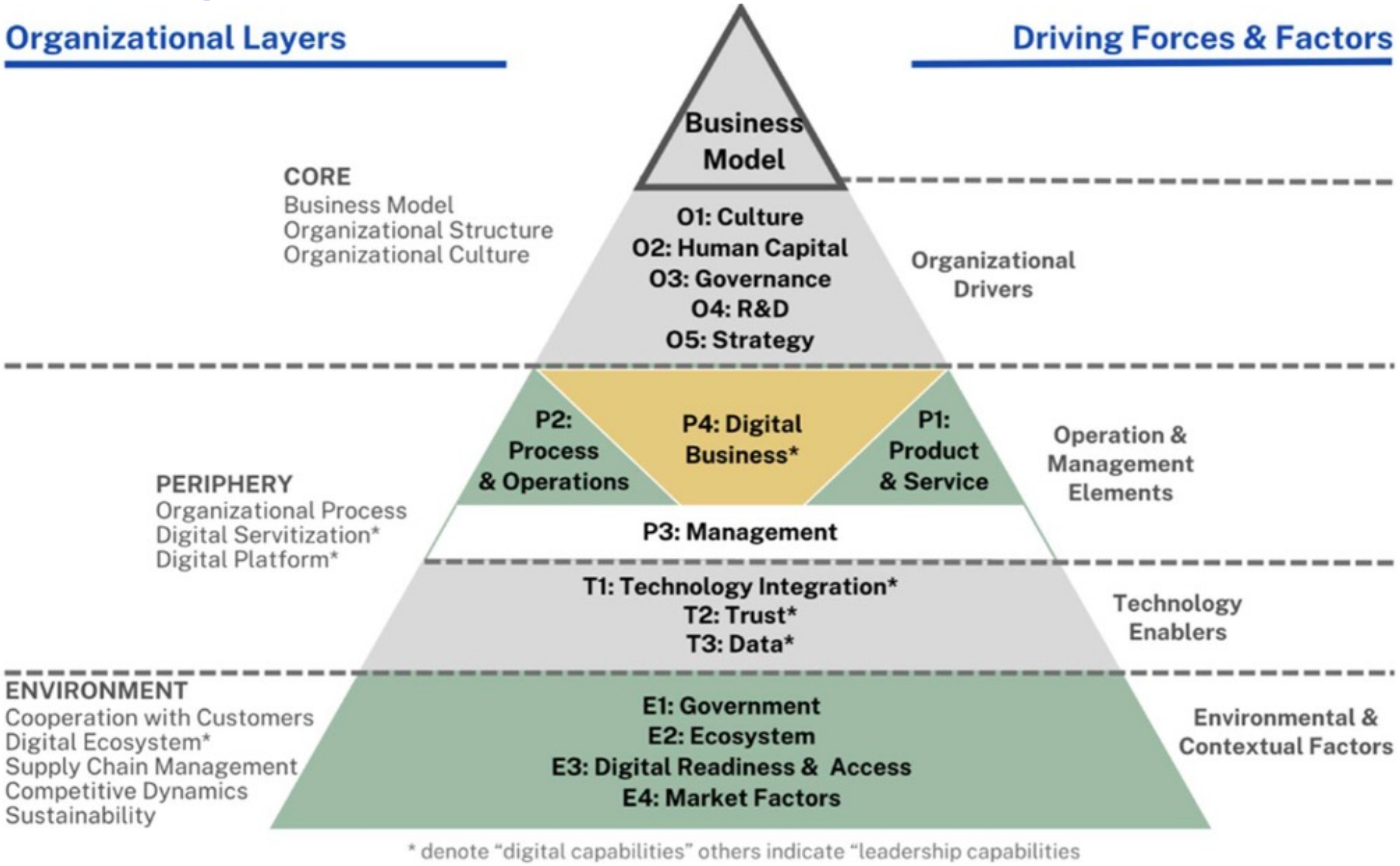

Source: https://intelligence.weforum.org/topics/a1G0X000006DIDZUA4

# Digital Transformation

| Dimensions | Categories |
|---|---|
| A. BUSINESS MODELS | Business Process Innovation<br>Business Strategy |
| B. DIGITAL BUSINESS | Digital Culture, Literacy and Skills<br>Digital Economy<br>Innovation and Socio-technical Shared Values |
| C. TECHNOLOGIES | Technology and Innovation Management<br>Artificial Intelligence<br>Big Data<br>Internet of Things<br>Industry 4.0 |
| D. SUSTAINABILITY | Sustainable Business<br>Sustainable Competitive Advantage<br>Sustainable Development<br>Sustainable Innovation |
| E. HUMAN RESOURCES | Employee Experience<br>Career Dynamics |
| F. SMART CITIES | Sustainable Smart Manufacturing<br>Digital Manufacturing |

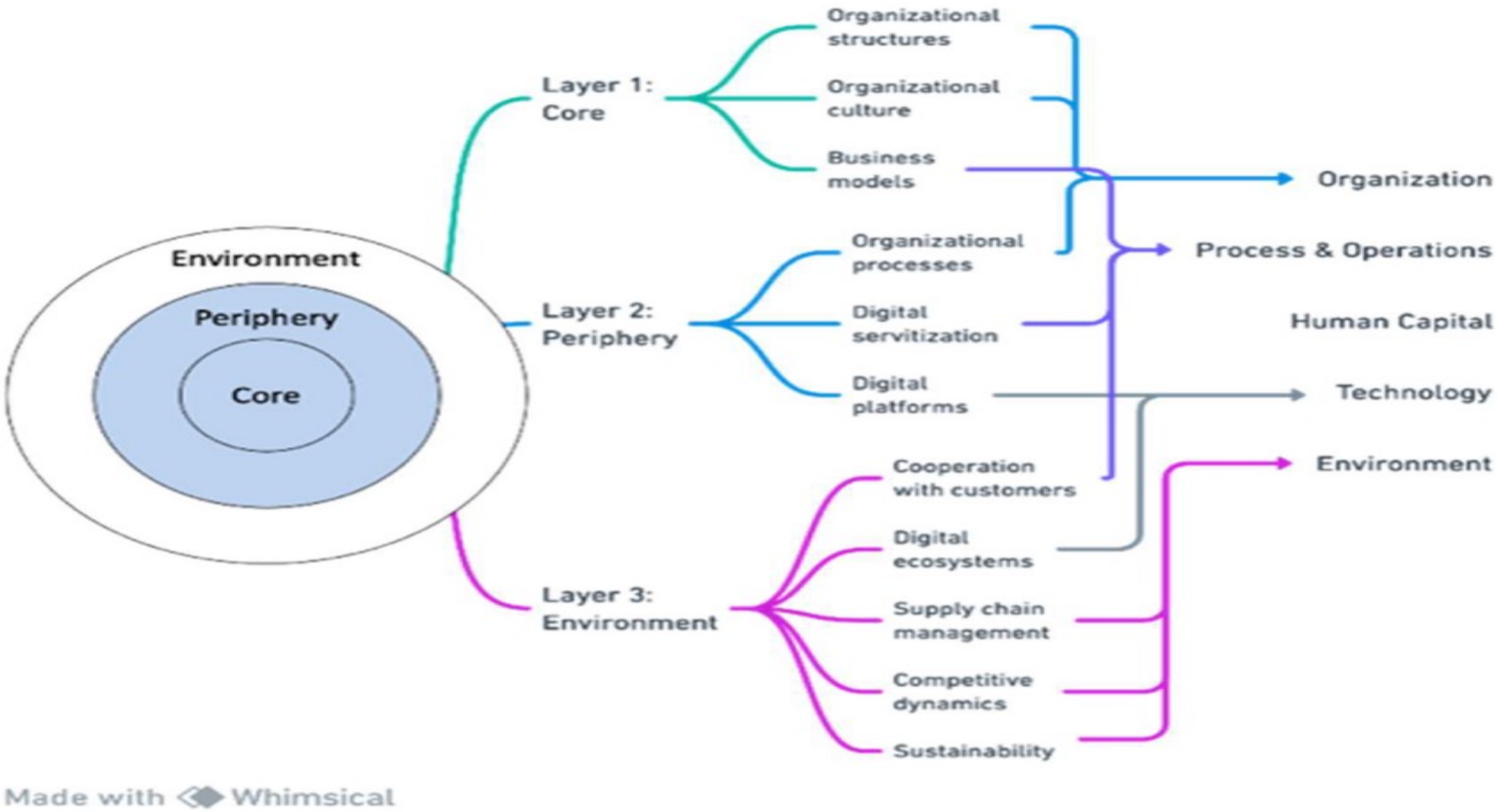
Source: Reis, João, and Nuno Melão (2023). "Digital transformation: A meta-review and guidelines for future research." Heliyon (2023).

# Digital Transformation Framework



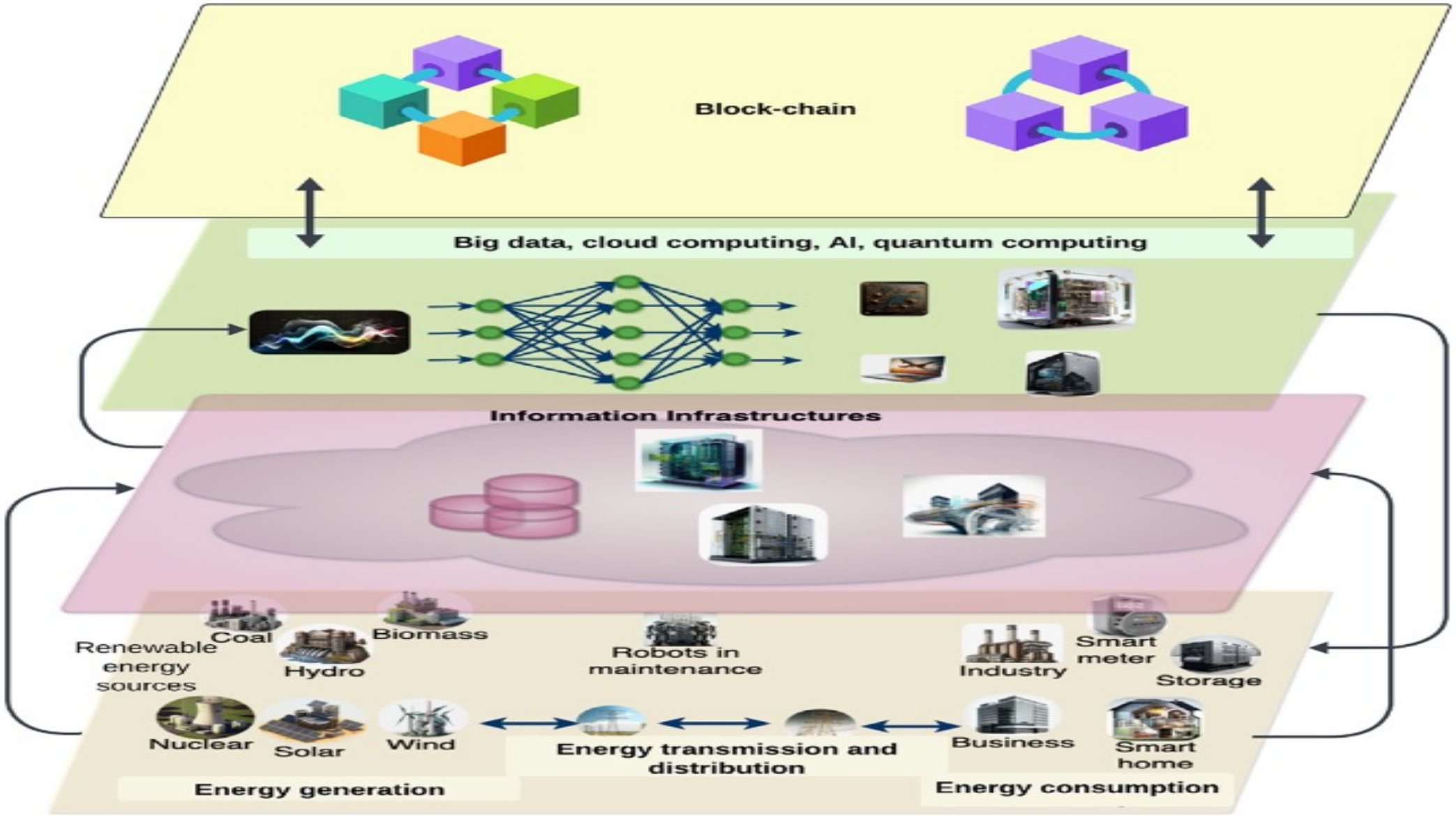

Source: Tangwaragorn, P., Chareonruk, N., Viriyasitavat, W., Tangmanee, C., Kanawattanachai, P., Hoonsopon, D., ... & Khuwadhana, P. (2024). Analyzing Key Drivers of Digital Transformation: A Review and Framework. Journal of Industrial Information Integration, 100680.

# Digital Transformation: Theoretical and practical dimensions



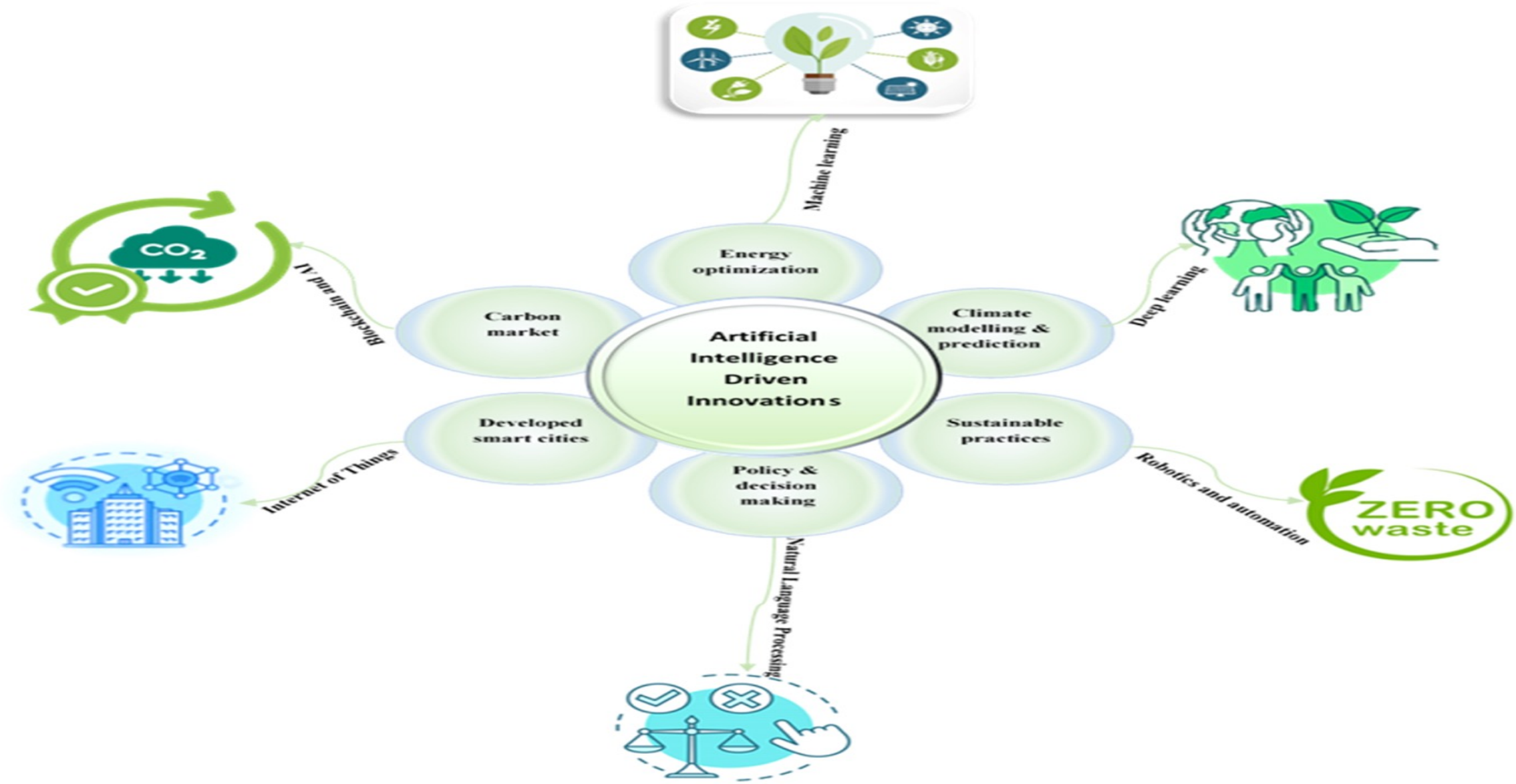

Source: Tangwaragorn, P., Chareonruk, N., Viriyasitavat, W., Tangmanee, C., Kanawattanachai, P., Hoonsopon, D., ... & Rhuwadhana, P. (2024). Analyzing Key Drivers of Digital Transformation: A Review and Framework. Journal of Industrial Information Integration, 100680.

# AI Technology for Net-Zero Energy Transition




Source: Ferdaus, M. M., Dam, T., Anavatti, S., & Das, S. (2024). Digital technologies for a net-zero energy future: A comprehensive review. Renewable and Sustainable Energy Reviews, 202, 114681.

# AI Innovations for Net-Zero Transformation

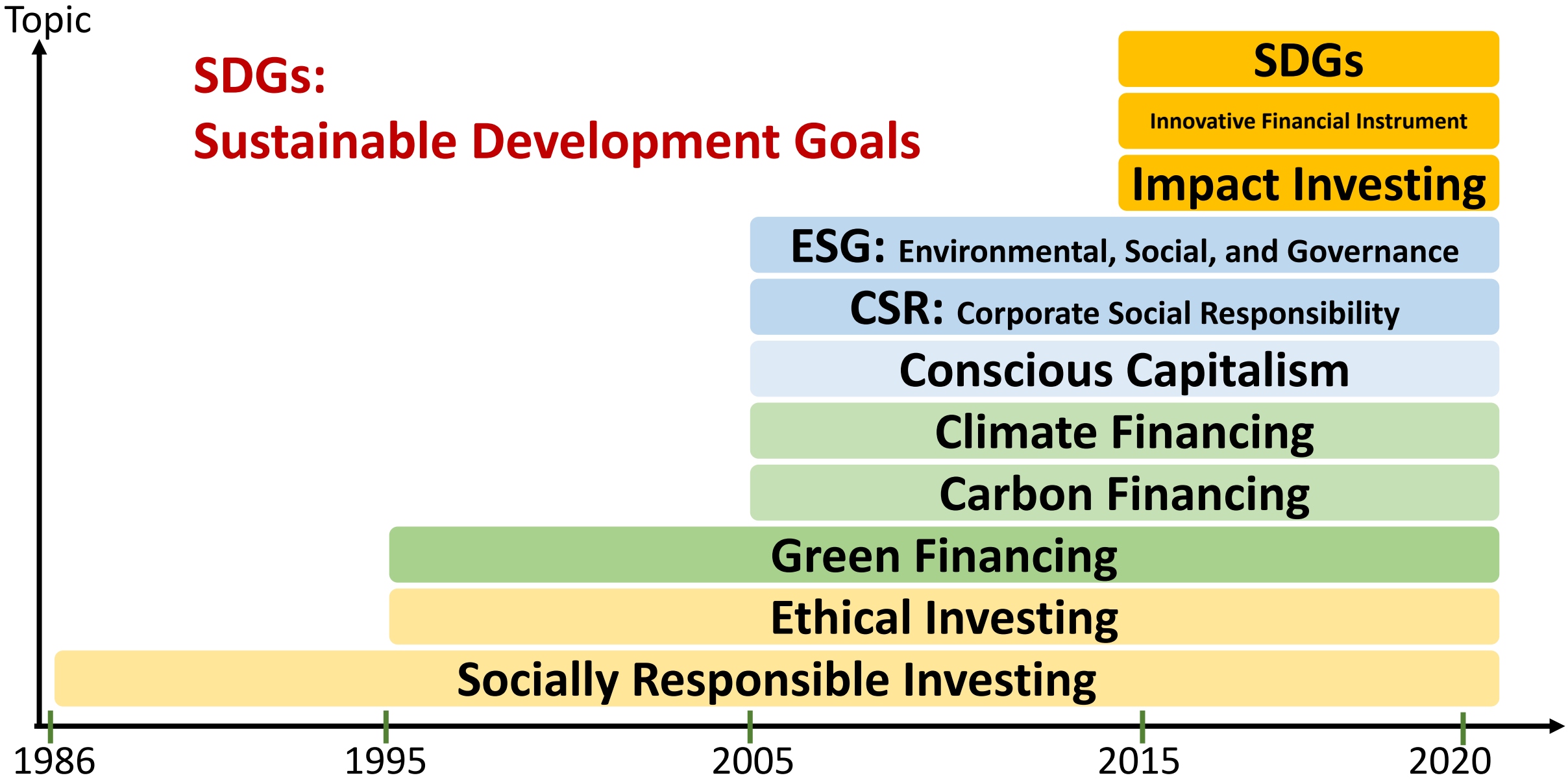



Source: Olawade, D. B., Wada, O. Z., David-Olawade, A. C., Fapohunda, O., Ige, A. O., & Ling, J. (2024). Artificial intelligence potential for net zero sustainability: Current evidence and prospects. Next Sustainability, 4, 100041.

# Sustainable Development Goals (SDGs)


Source: https://sdgs.un.org/goals

# Evolution of Sustainable Finance Research




Source: Kumar, S., Sharma, D., Rao, S., Lim, W. M., & Mangla, S. K. (2022). Past, present, and future of sustainable finance: Insights from big data analytics through machine learning of scholarly research. Annals of Operations Research, 1-44.

# Sustainable Development Goals (SDGs) and 5P

**Partnership**

**Peace**

**Prosperity**

**People**

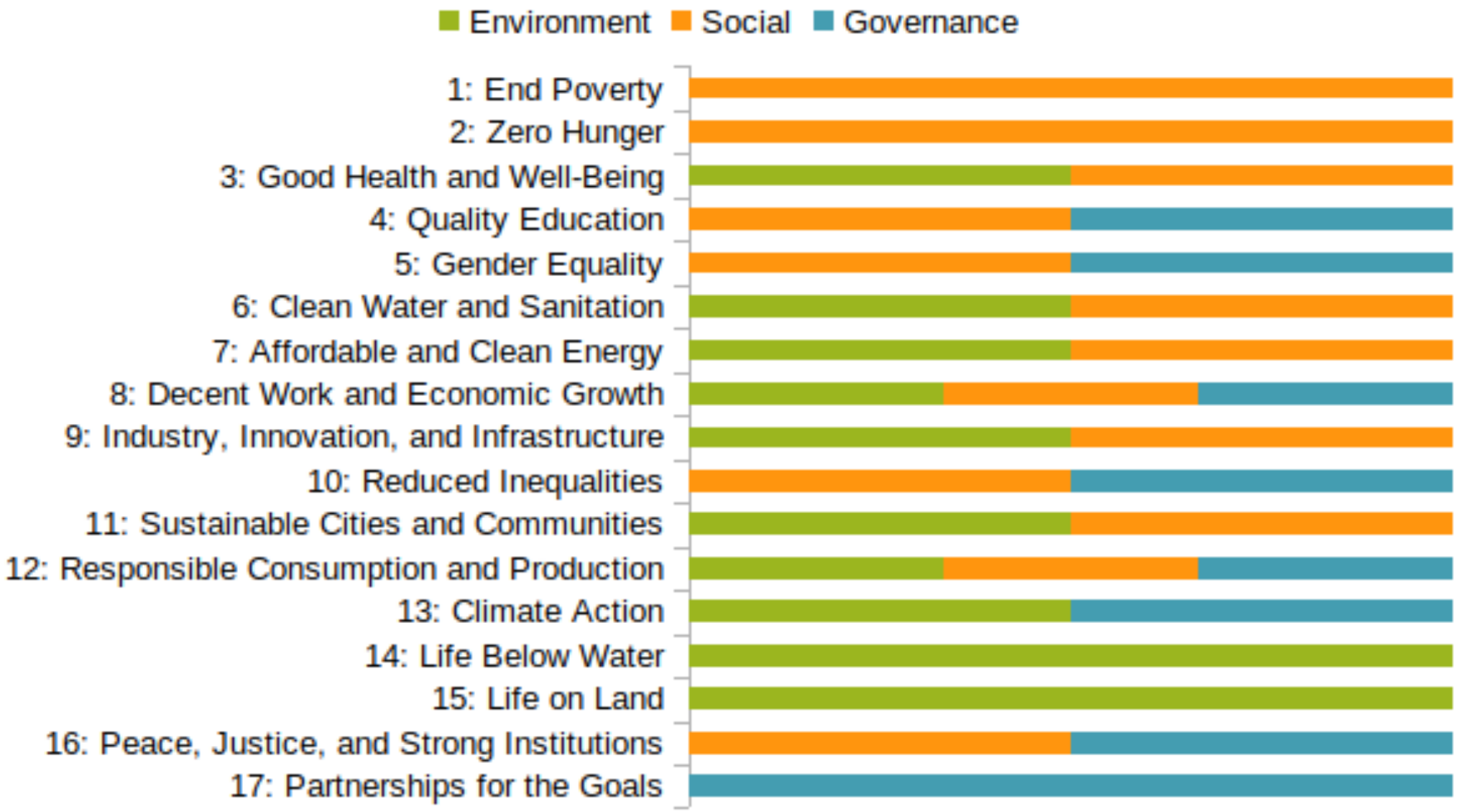
**Planet**


Source: Folke, Carl, Reinette Biggs, Albert V. Norström, Belinda Reyers, and Johan Rockström. "Social-ecological resilience and biosphere-based sustainability science."Ecology and Society 21, no. 3 (2016).

# ESG to 17 SDGs


Source: Henrik Skaug Sætra (2021) "A Framework for Evaluating and Disclosing the ESG Related Impacts of AI with the SDGs." Sustainability 13, no. 15 (2021): 8503.

# ESG to 17 SDGs




Source: https://sustainometric.com/esg-to-sdgs-connected-paths-to-a-sustainable-future/

# Where ESG Meets – It's All Connected

- **Environmental Justice**
  - **Underserved communities disproportionately impacted by pollution, climate hazards**
- **Responsible Tech Supply Chains**
  - **Resource extraction, e-waste, labor rights across the tech lifecycle**
- **Inclusive Product Design**
  - **Accessibility, addressing digital divides, social impacts of technology.**

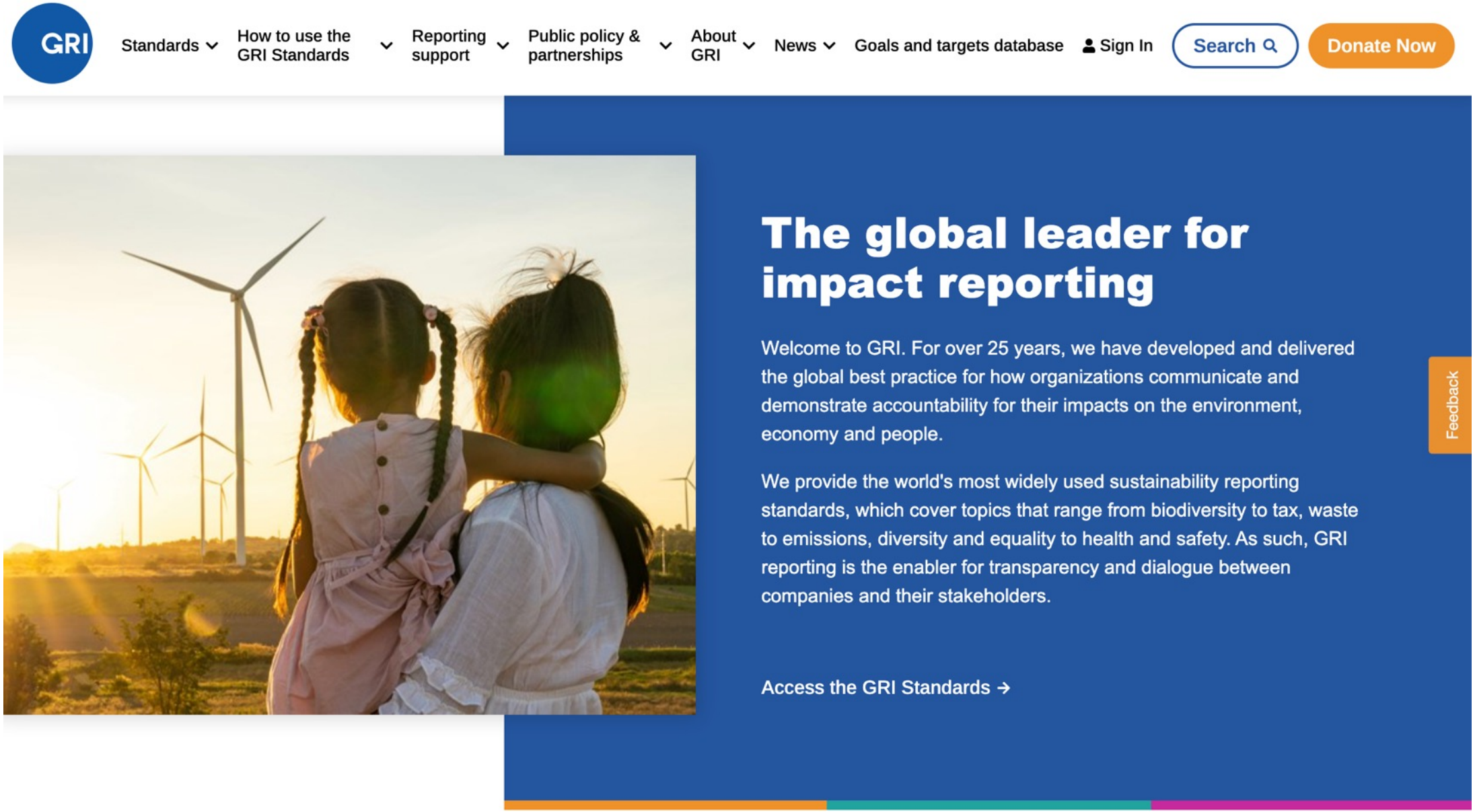
# Digital Transformation: Enabler and Challenge

- Enabler
  - Data-driven decision-making, efficiency gains, new business models, collaboration
  - AI optimizing renewable energy
- Challenge
  - Energy consumption, e-waste, planned obsolescence, AI ethics
  - AI servers representing increased energy use

# Mapping the ESG Standards Landscape

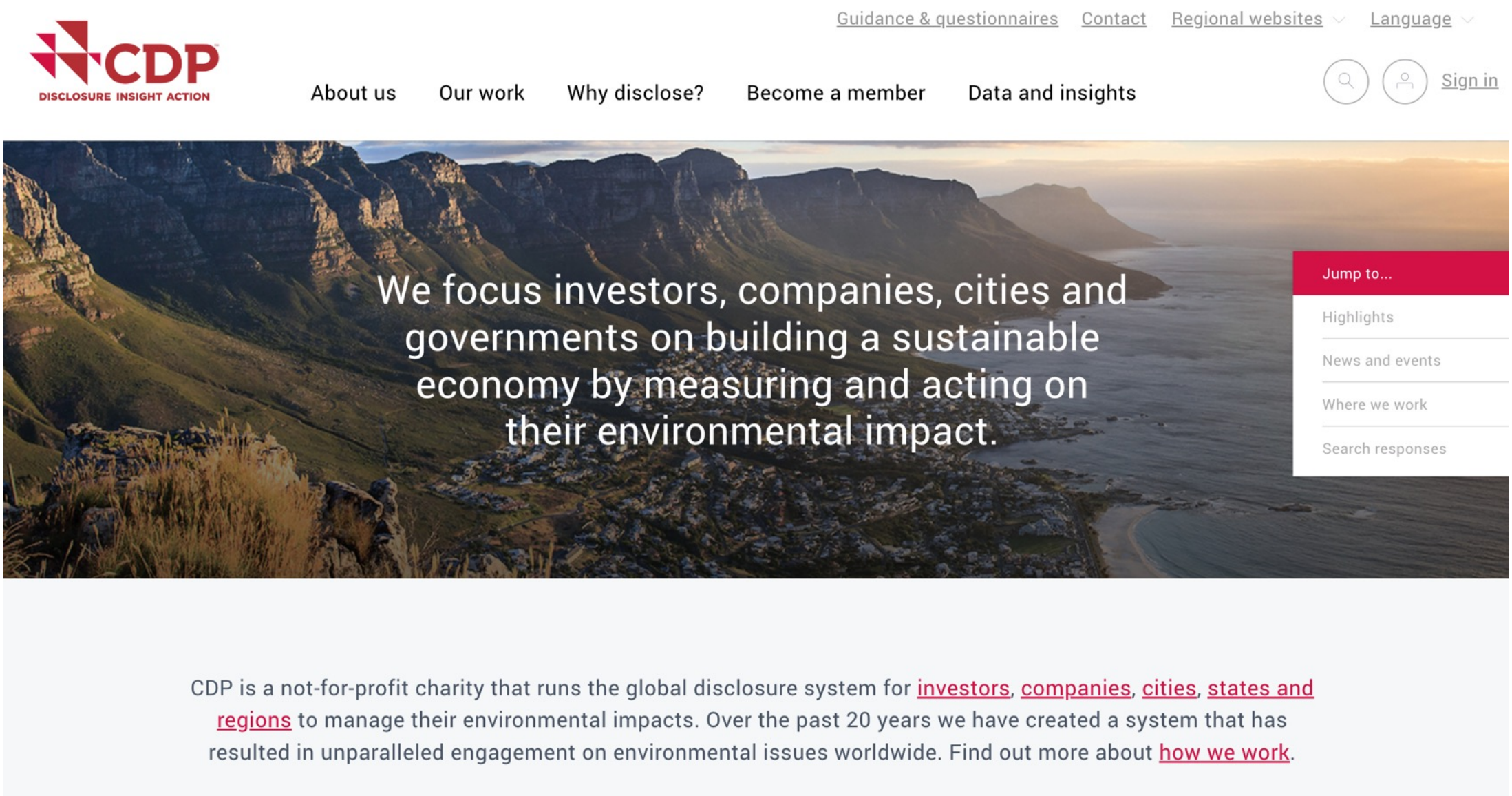
- The most prevalent ESG reporting frameworks
  - GRI (Global Report Initiative)
  - CDP (Carbon Disclosure Project)
  - SASB (Sustainability Accounting Standards Board
  - ISSB (International Sustainability Standards Board)
  - TCFD (Task Force on Climate-related Financial Disclosures
- How companies choose
  - Materiality, industry-specific standards, investor alignment

# GRI (Global Report Initiative)



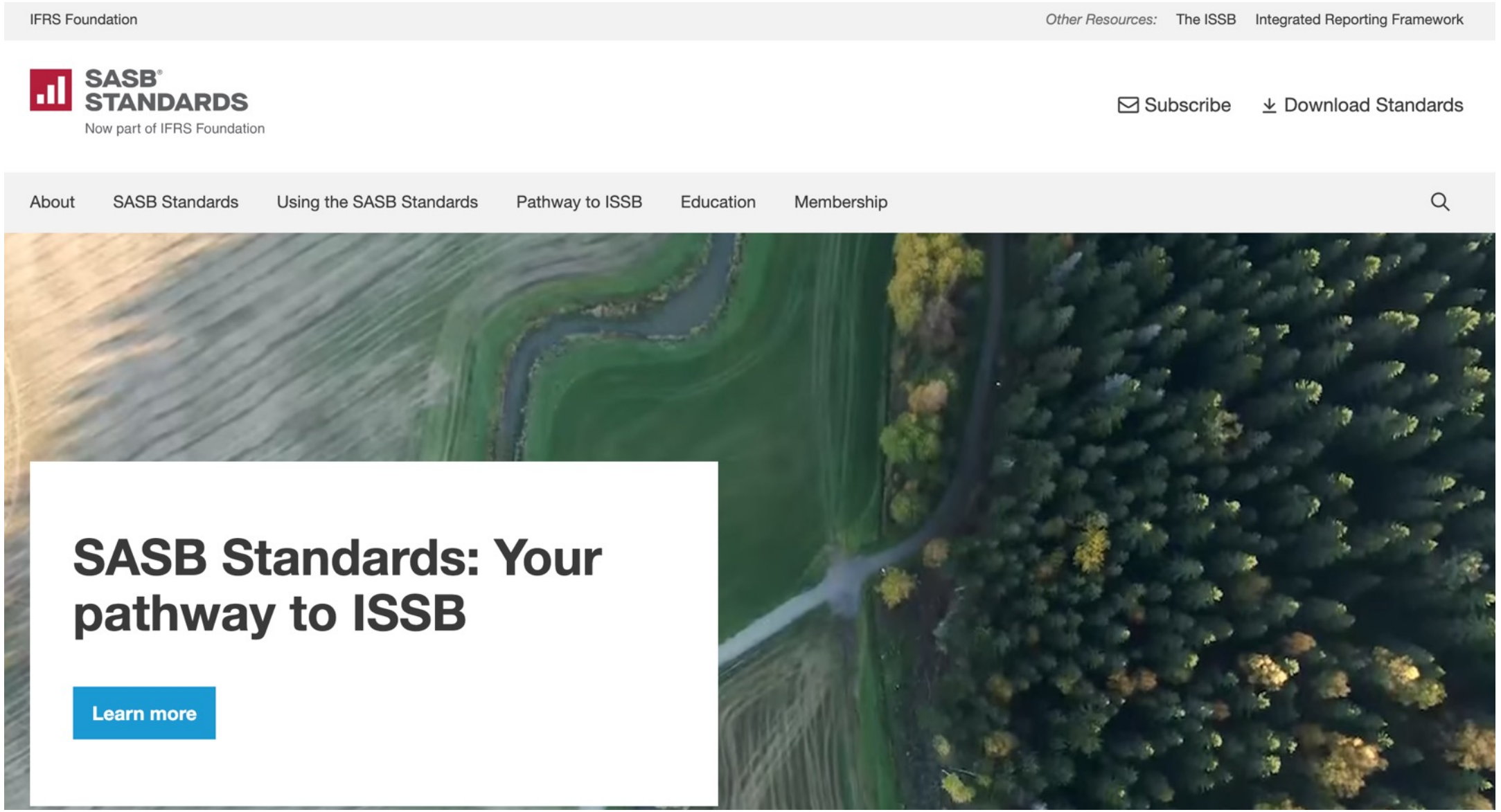

https://www.globalreporting.org/

# CDP (Carbon Disclosure Project)



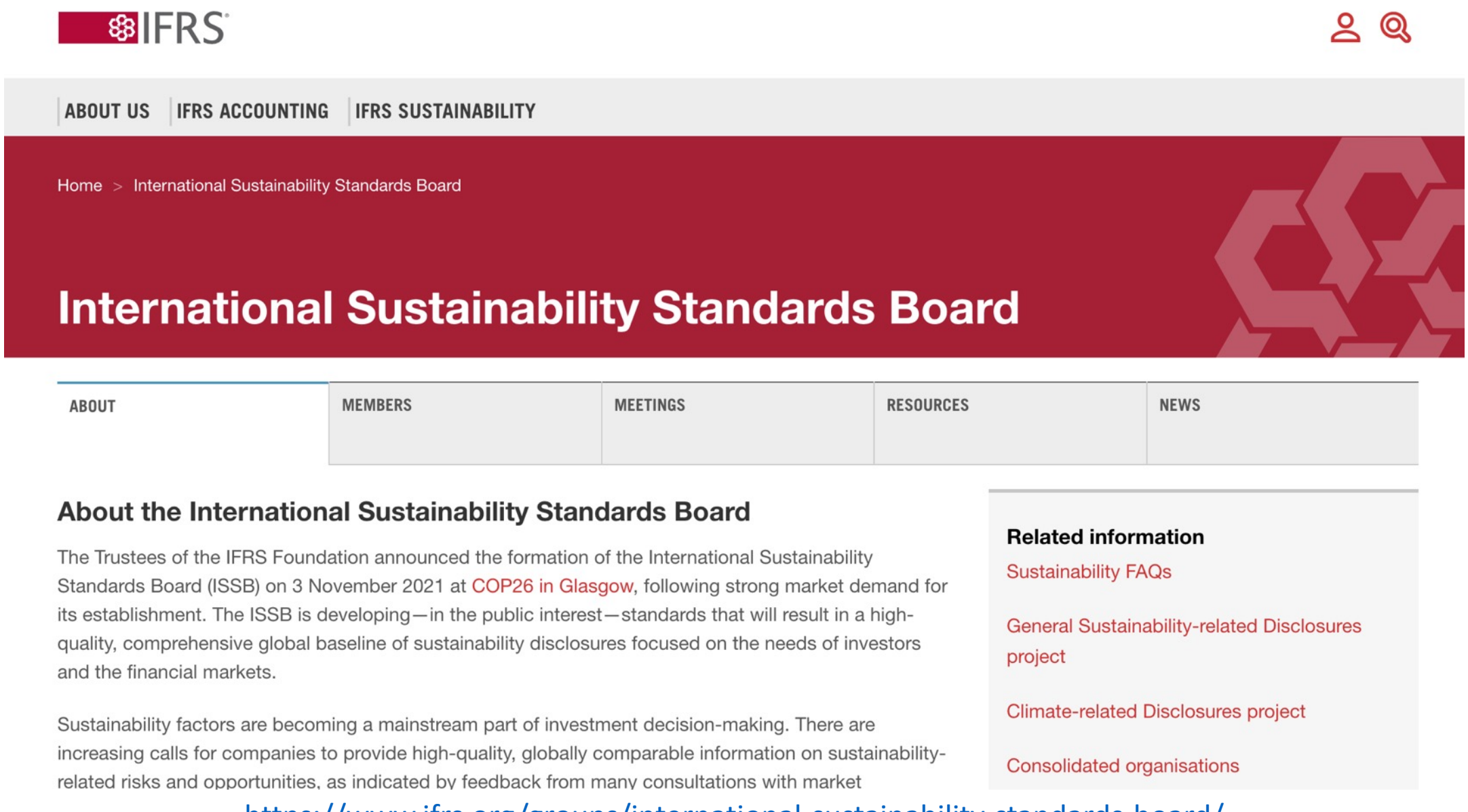

https://www.cdp.net/

# SASB (Sustainability Accounting Standards Board)




https://sasb.org/

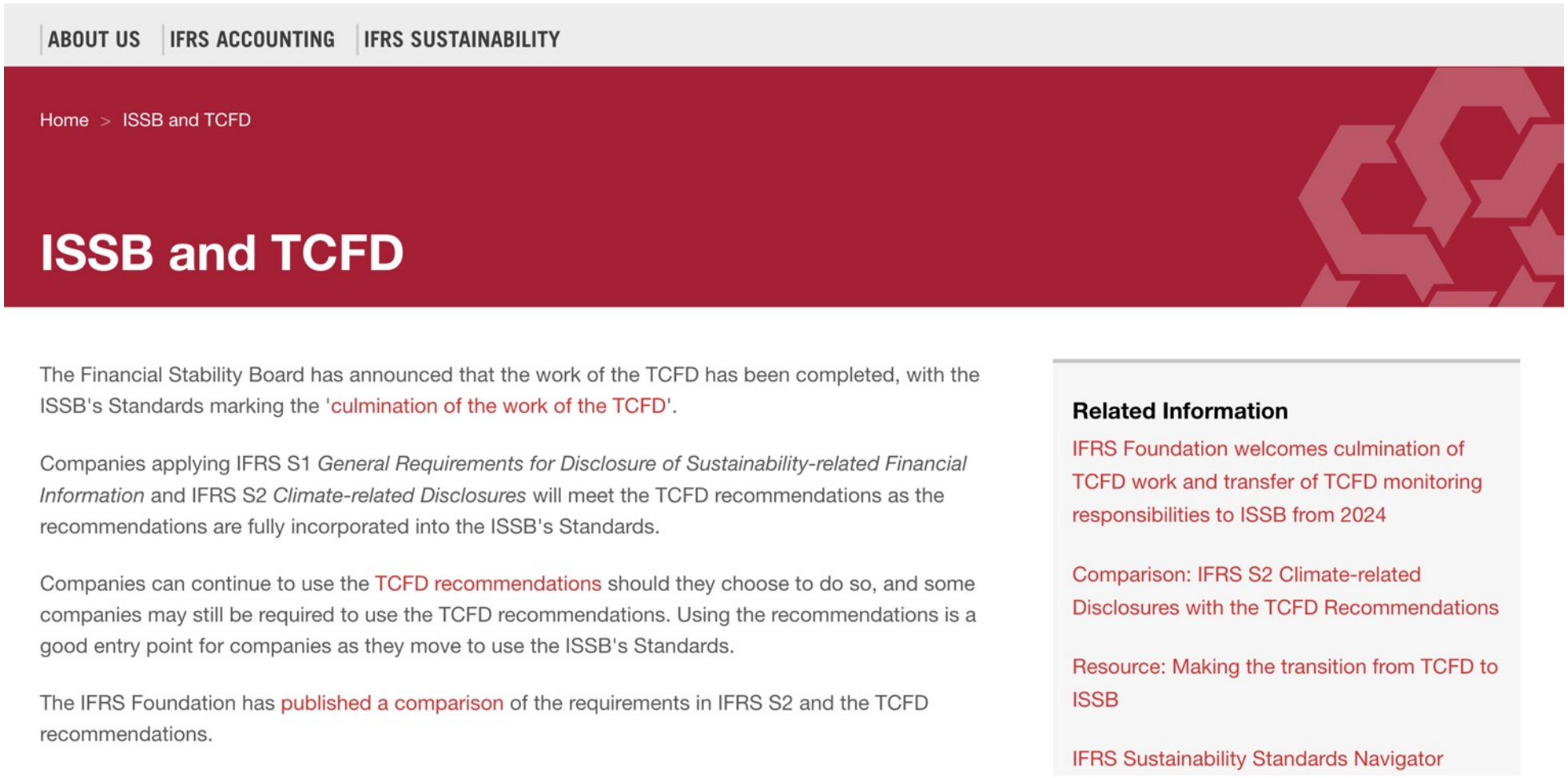
# ISSB (International Sustainability Standards Board)




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

# TCFD
# (Task Force on Climate-related Financial Disclosures)

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



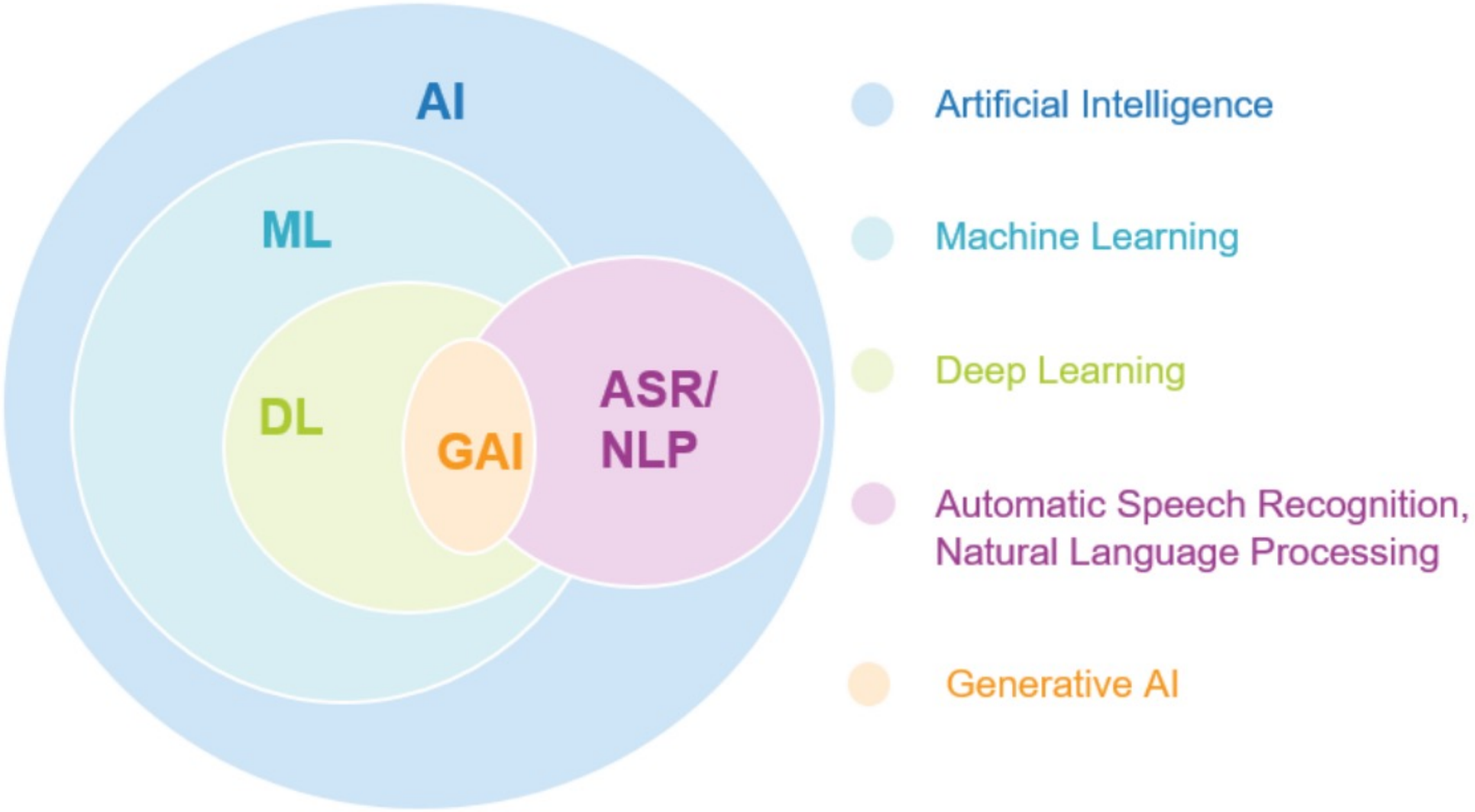

https://www.fsb-tcfd.org/

# The Human Impact of ESG Choices

- Digital Initiatives
- This isn't abstract,
  it's about improving lives
- Positive potential
  when ESG is prioritized

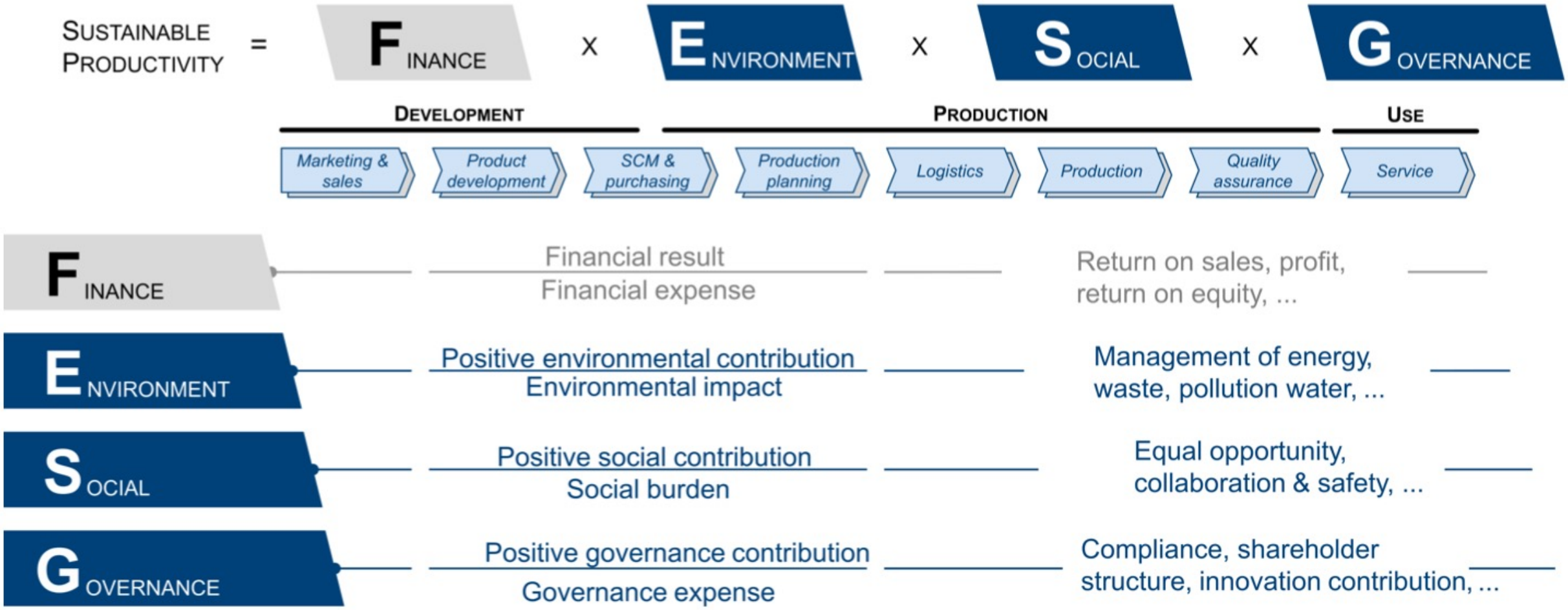
# Generative AI for ESG Applications

# AI, ML, DL, Generative AI



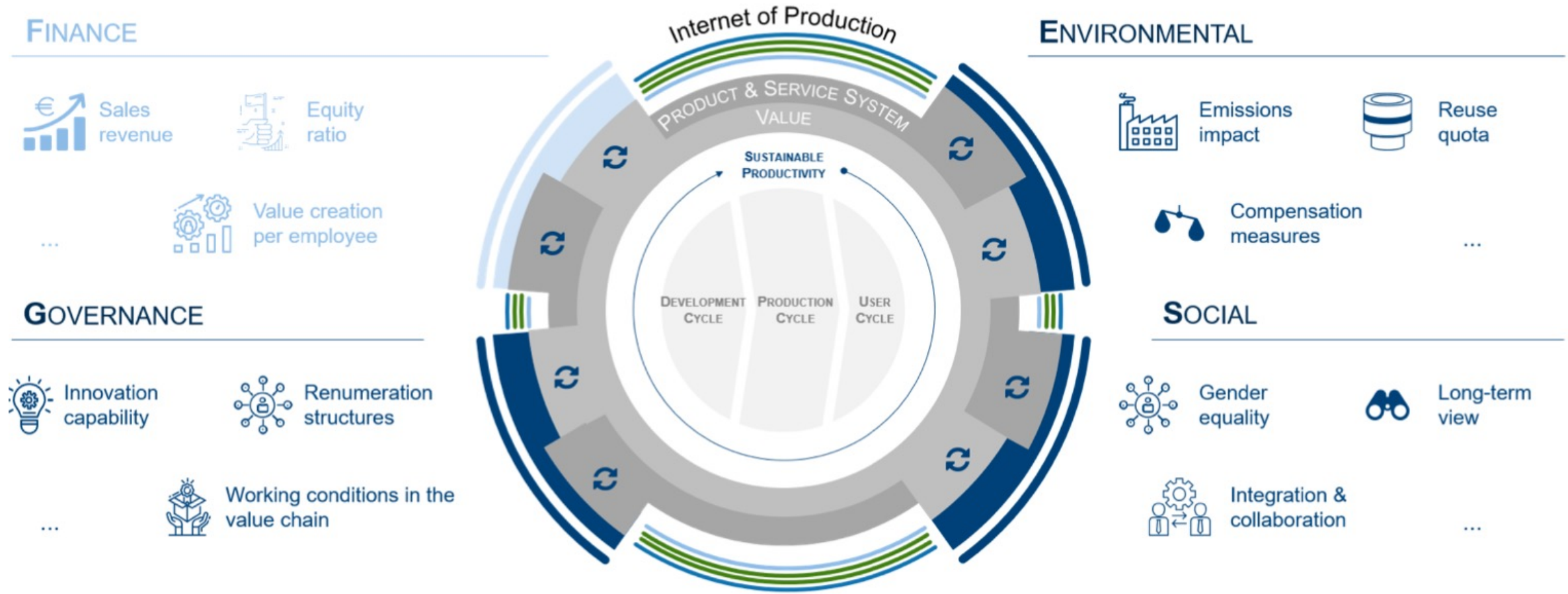

Source: Jeong, Cheonsu. "A Study on the Implementation of Generative AI Services Using an Enterprise Data-Based LLM Application Architecture." arXiv preprint arXiv:2309.01105 (2023).

# Sustainable Productivity: Finance ESG




Source: Huang, Ziqi, Yang Shen, Jiayi Li, Marcel Fey, and Christian Brecher (2021). "A survey on AI-driven digital twins in Industry 4.0: Smart manufacturing and advanced robotics." Sensors 21, no. 19: 6340.

# Sustainable Resilient Manufacturing
# ESG

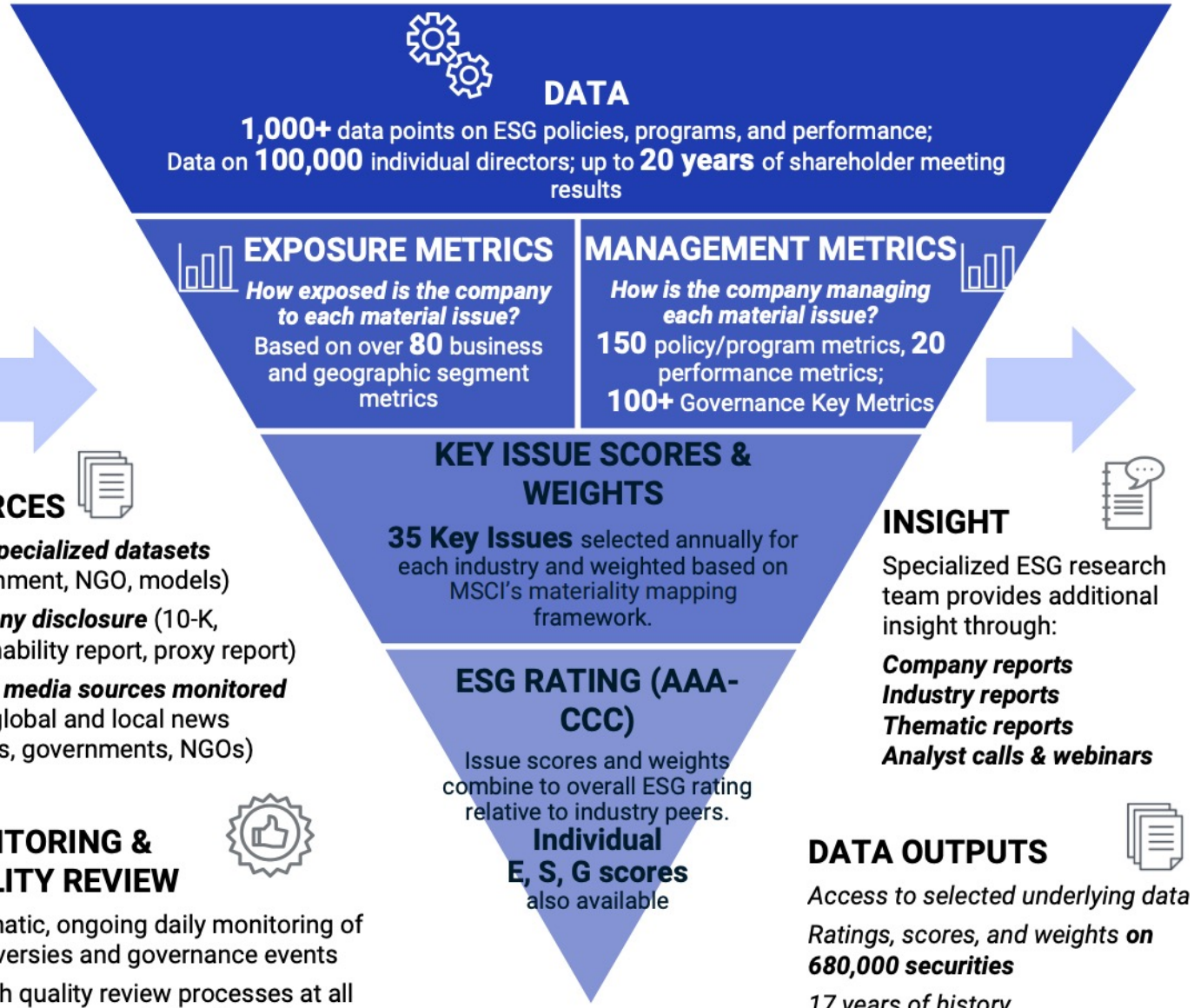



Source: Huang, Ziqi, Yang Shen, Jiayi Li, Marcel Fey, and Christian Brecher (2021). "A survey on AI-driven digital twins in Industry 4.0: Smart manufacturing and advanced robotics." Sensors 21, no. 19: 6340.

# ESG Indexes

- MSCI ESG Index
- Dow Jones Sustainability Indices (DJSI)
- FTSE ESG Index

# MSCI ESG Rating Framework



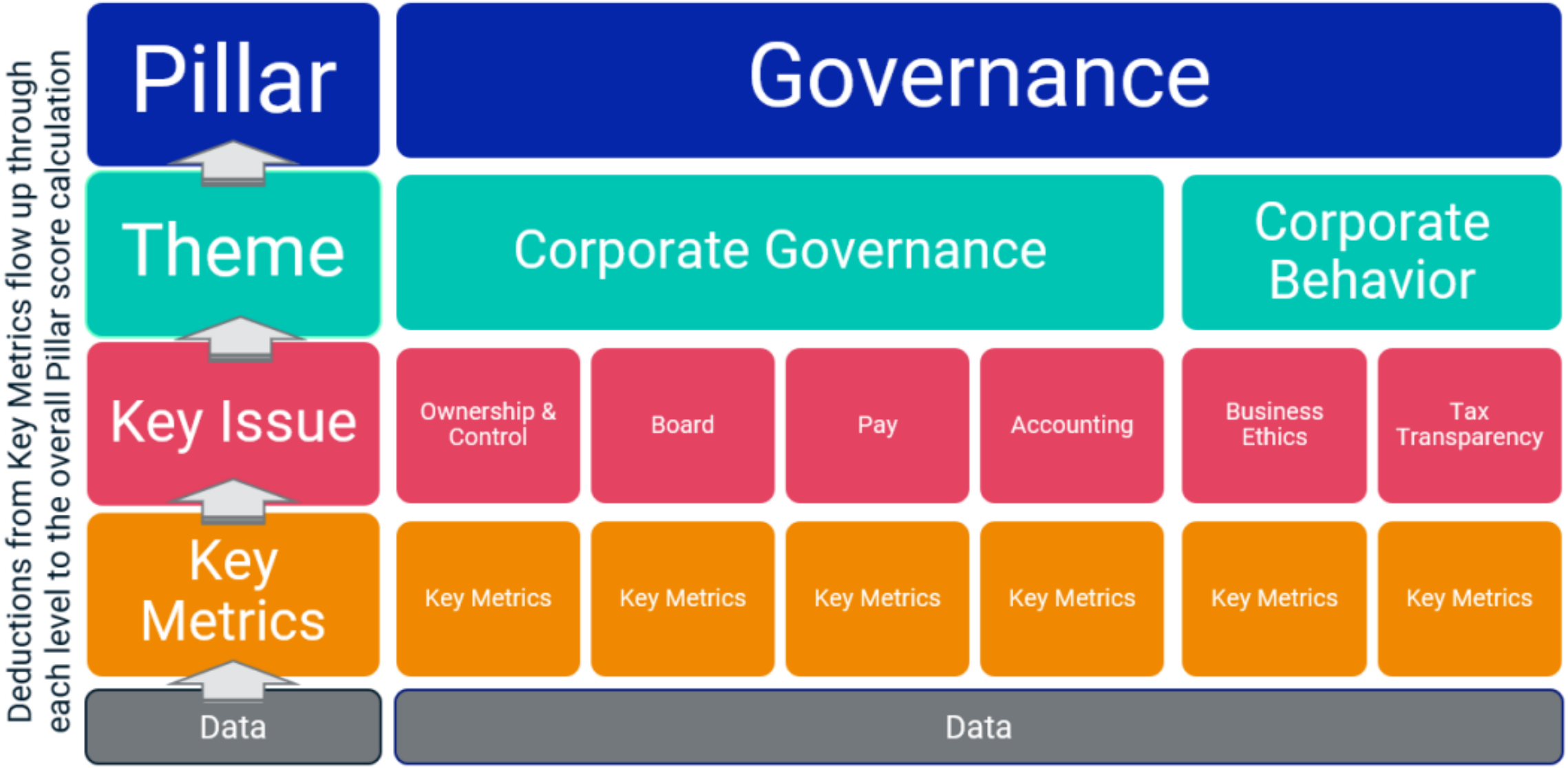

Source: https://www.msci.com/documents/1296102/21901542/ESG-Ratings-Methodology-Exec-Summary.pdf

# 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 | |

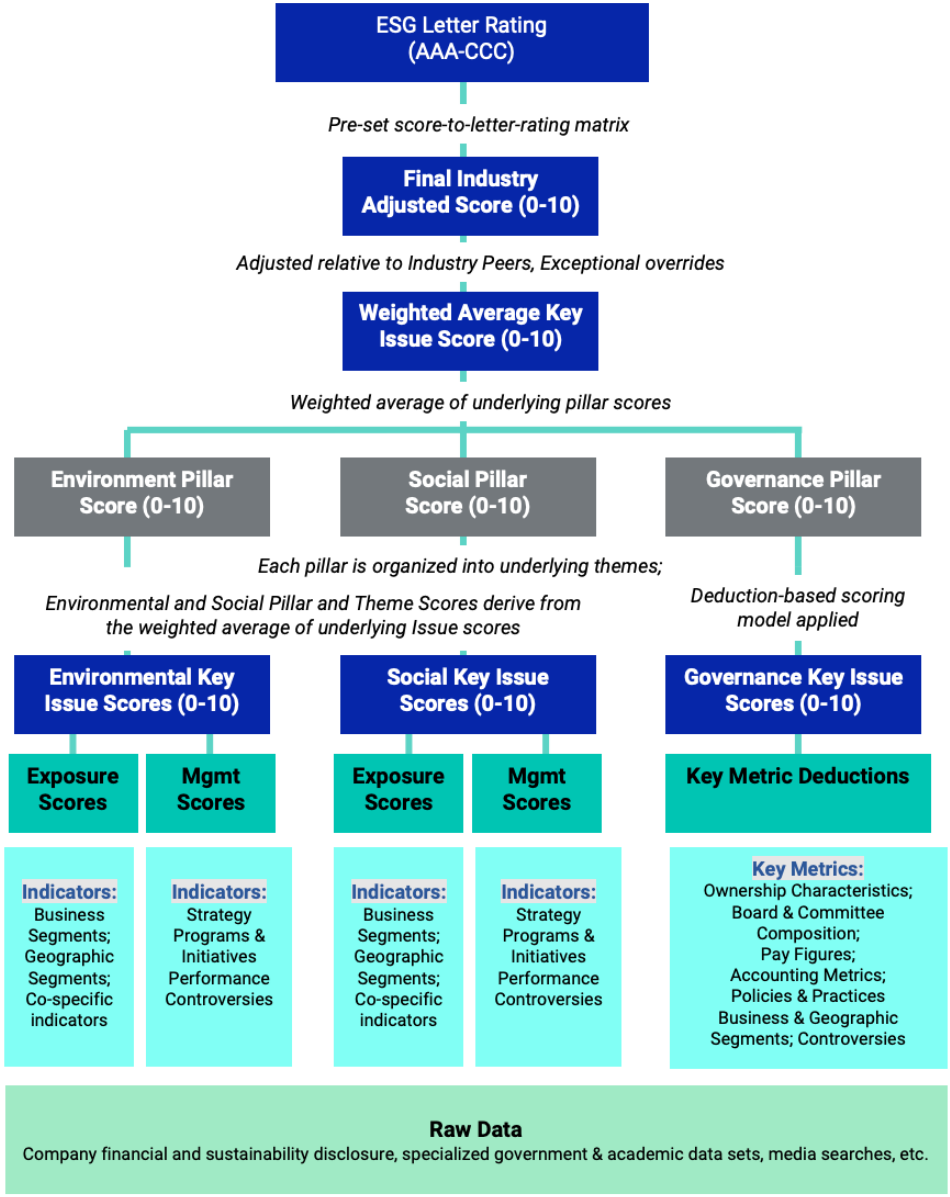
Source: https://www.msci.com/documents/1296102/21901542/ESG-Ratings-Methodology-Exec-Summary.pdf

# MSCI Governance Model Structure




Source: https://www.msci.com/documents/1296102/21901542/ESG-Ratings-Methodology-Exec-Summary.pdf

# MSCI Hierarchy of ESG Scores



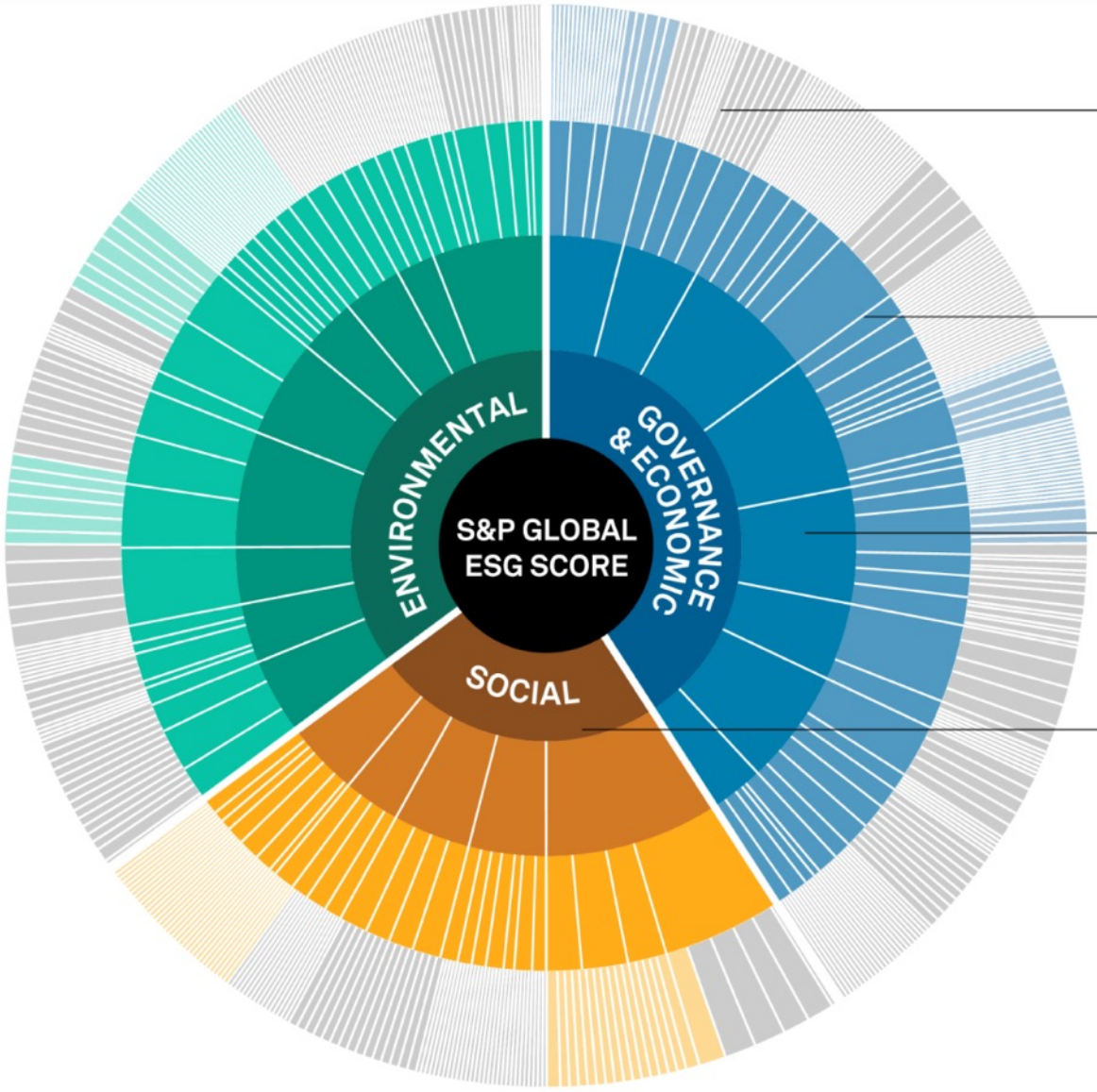

Source: https://www.msci.com/documents/1296102/21901542/ESG-Ratings-Methodology-Exec-Summary.pdf

# DJSI S&P Global ESG Score

**8,000**
Companies

**90%**
Global market capitalization

**340,000+**
Current Research Universe and Active Securities




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

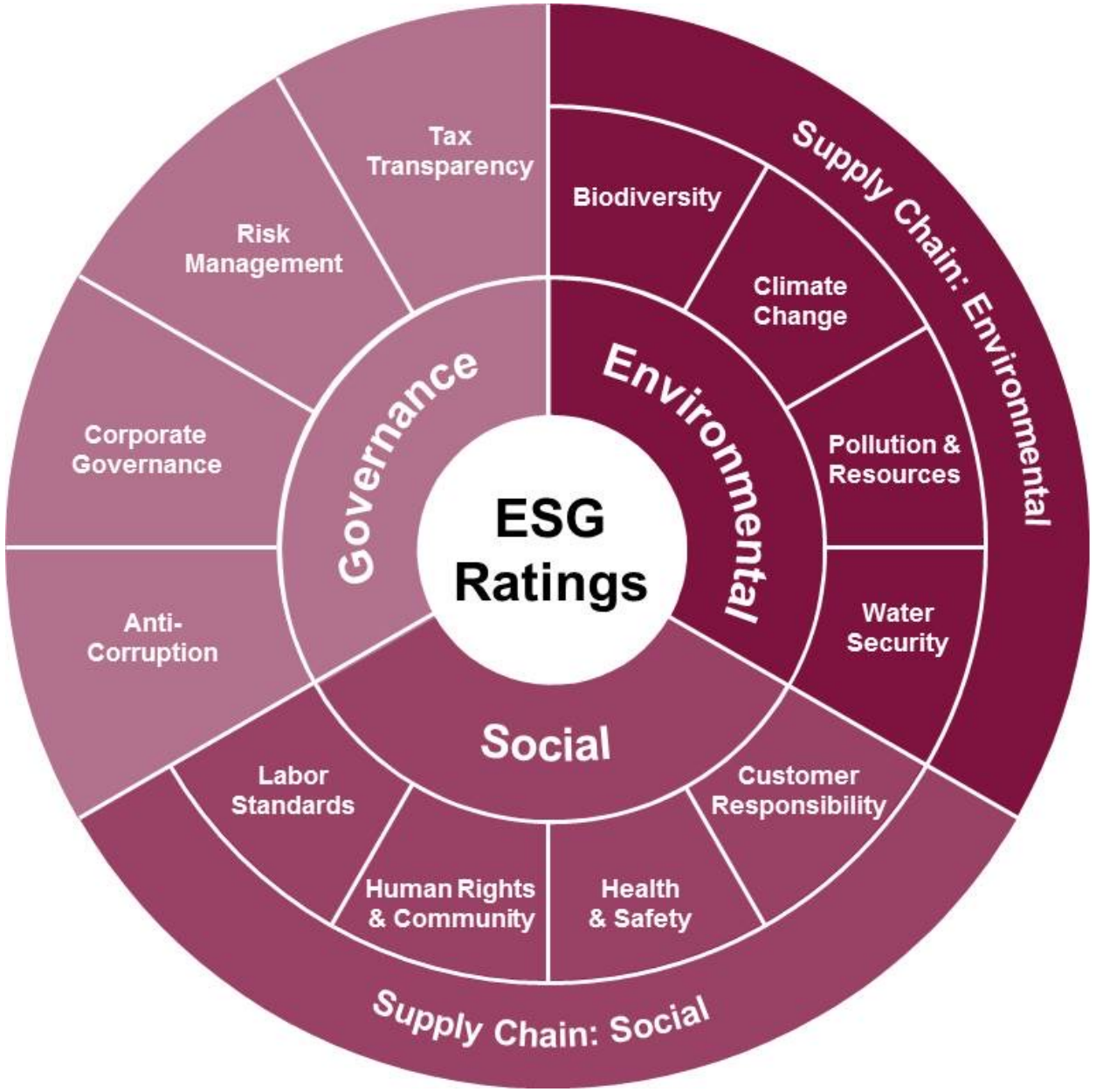
**Weighted criteria scores**
Adjusted for corporate ESG controversies where applicable

**1**
S&P Global ESG Score

**Sum of weighted dimension scores**

Source: DJSI, S&P Global Corporate Sustainability Assessment (CSA), https://www.spglobal.com/esg/solutions/data-intelligence-esg-scores

# FTSE Russell ESG Ratings




Source: https://www.ftserussell.com/data/sustainability-and-esg-data/esg-ratings

SUSTAINALYTICS
a Morningstar company

# Sustainalytics ESG Risk Ratings

Analyst-based approach

Sustainalytics' ESG Risk Ratings measure a company's exposure to industry-specific material ESG risks and how well a company is managing those risks.

| Negligible | Low | Medium | High | Severe |
|---|---|---|---|---|
| 0 - 10 | 10 - 20 | 20 - 30 | 30 - 40 | 40+ |

Source: https://www.sustainalytics.com/esg-data

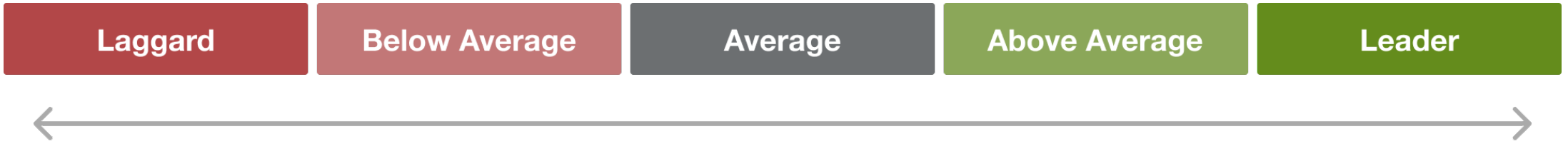
TruValue Labs

FACTSET

# Truvalue ESG Ranks

Machine-based approach

- Truvalue Labs applies AI to analyze over 100,000 sources and uncover ESG risks and opportunities hidden in unstructured text.
- The ESG Ranks data service produces an overall company rank based on industry percentile leveraging the 26 ESG categories defined by the Sustainability Accounting Standards Board (SASB).
- The data feed covers 20,000+ companies with more than 13 years of history.




Source: :https://developer.truvaluelabs.com/data/esg-ranks

# Analyst-driven vs. AI-driven ESG

## Analyst-driven ESG research

Derives ratings in a structured data model

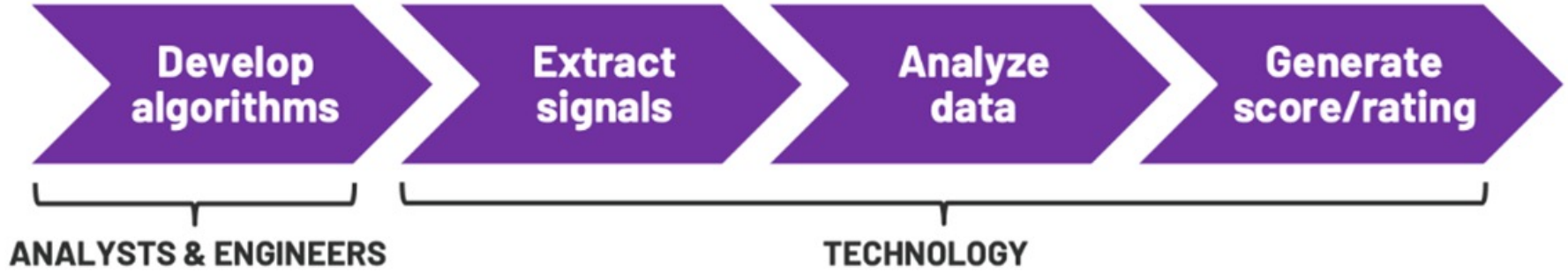
## Sustainalytics


*Analyst role at the end of the process allows subjectivity to color results*

## AI-driven ESG research

Derives signals from unstructured data

## Truvalue Labs

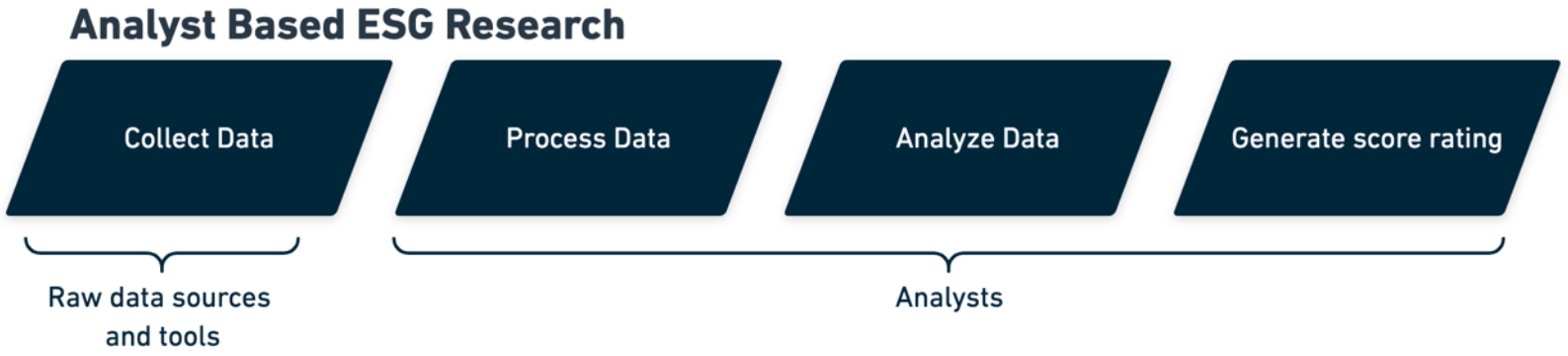


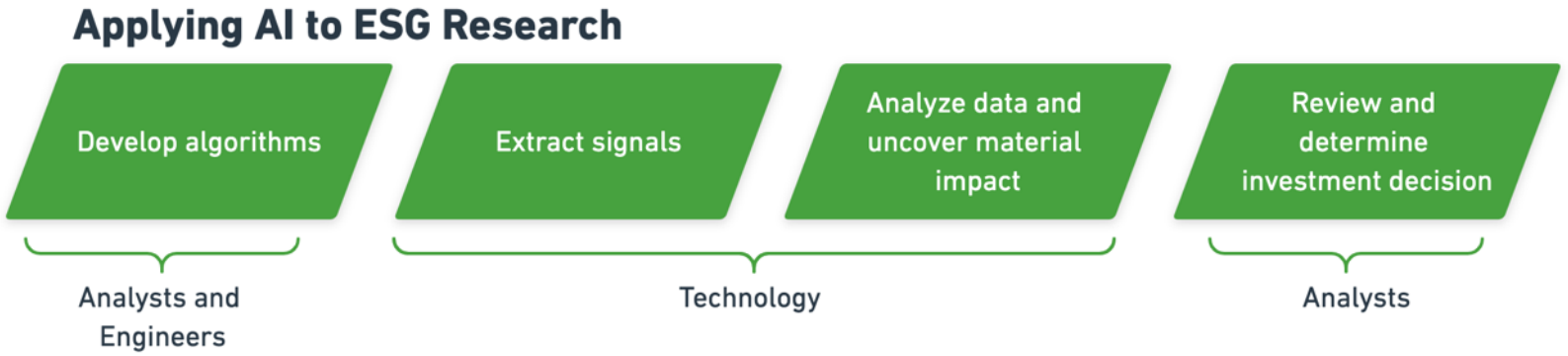

*Analyst expertise at the beginning of the process produces consistent results*

Source: Mark Tulay (2020), Man vs. machine: A tale of two sustainability ratings systems, GreenBiz, https://www.greenbiz.com/article/man-vs-machine-tale-two-sustainability-ratings-systems

# Analyst based ESG Research

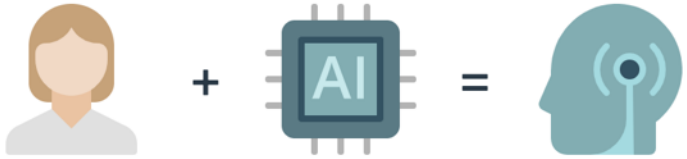
# AI based ESG Research




**It would take an analyst over 5 years to do what our AI can in 1 week**

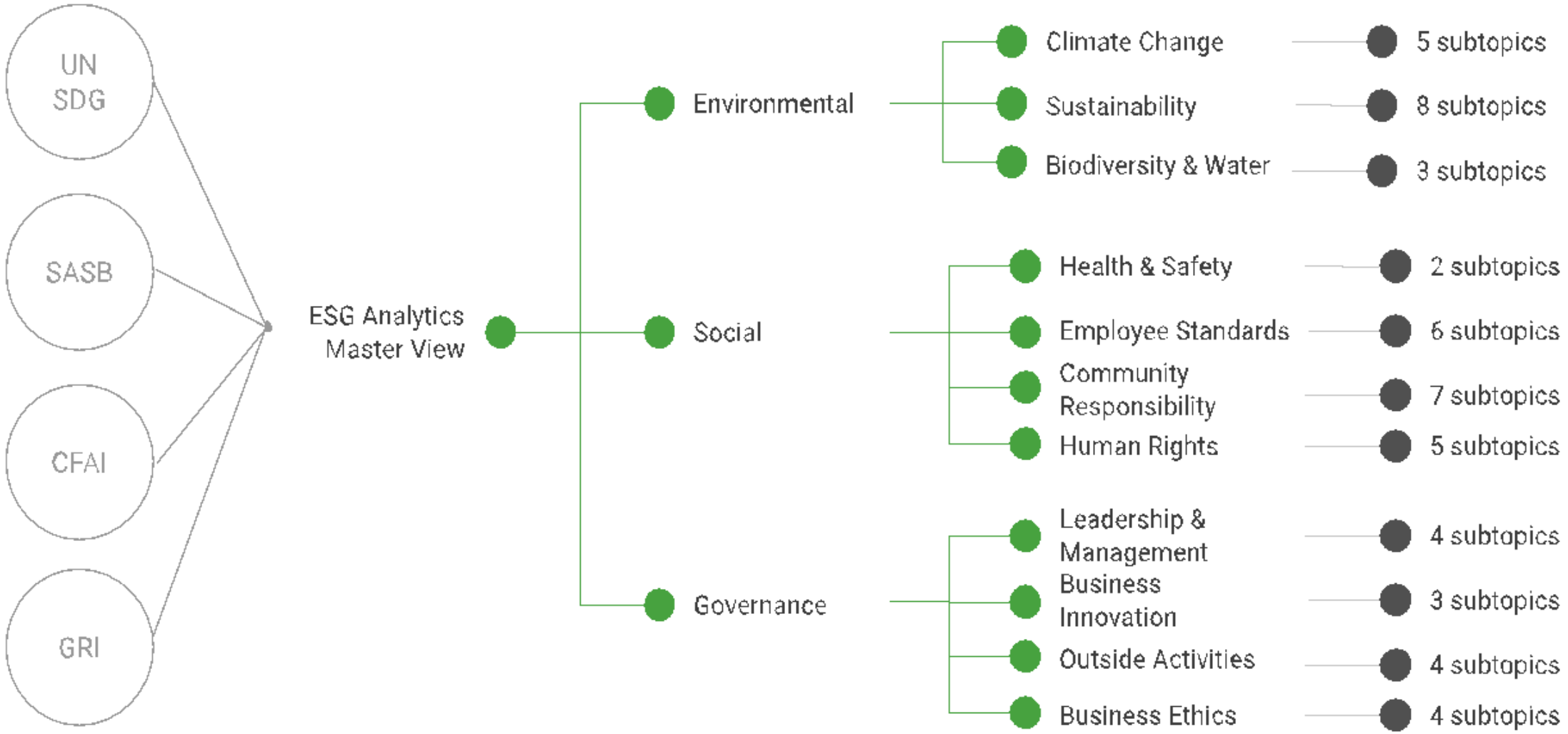
Combining analysts with AI creates gives you the full picture




ESG ANALYTICS
Invest where it matters.

Source: https://www.esganalytics.io/insights/how-data-is-accelerating-esg

# ESG Analytics: NLP Taxonomy

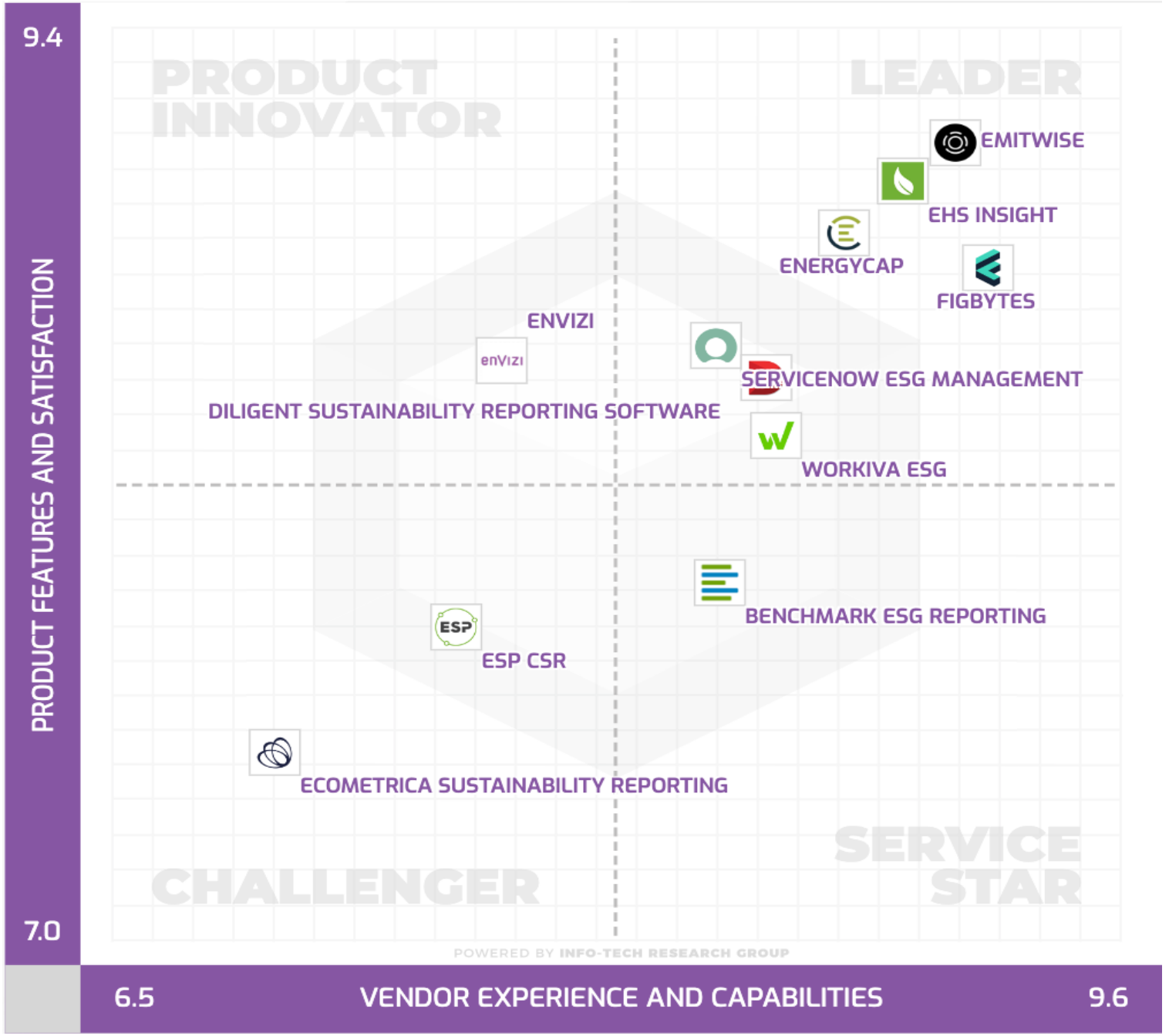



ESG ANALYTICS

Source: https://www.esganalytics.io/insights/how-data-is-accelerating-esg

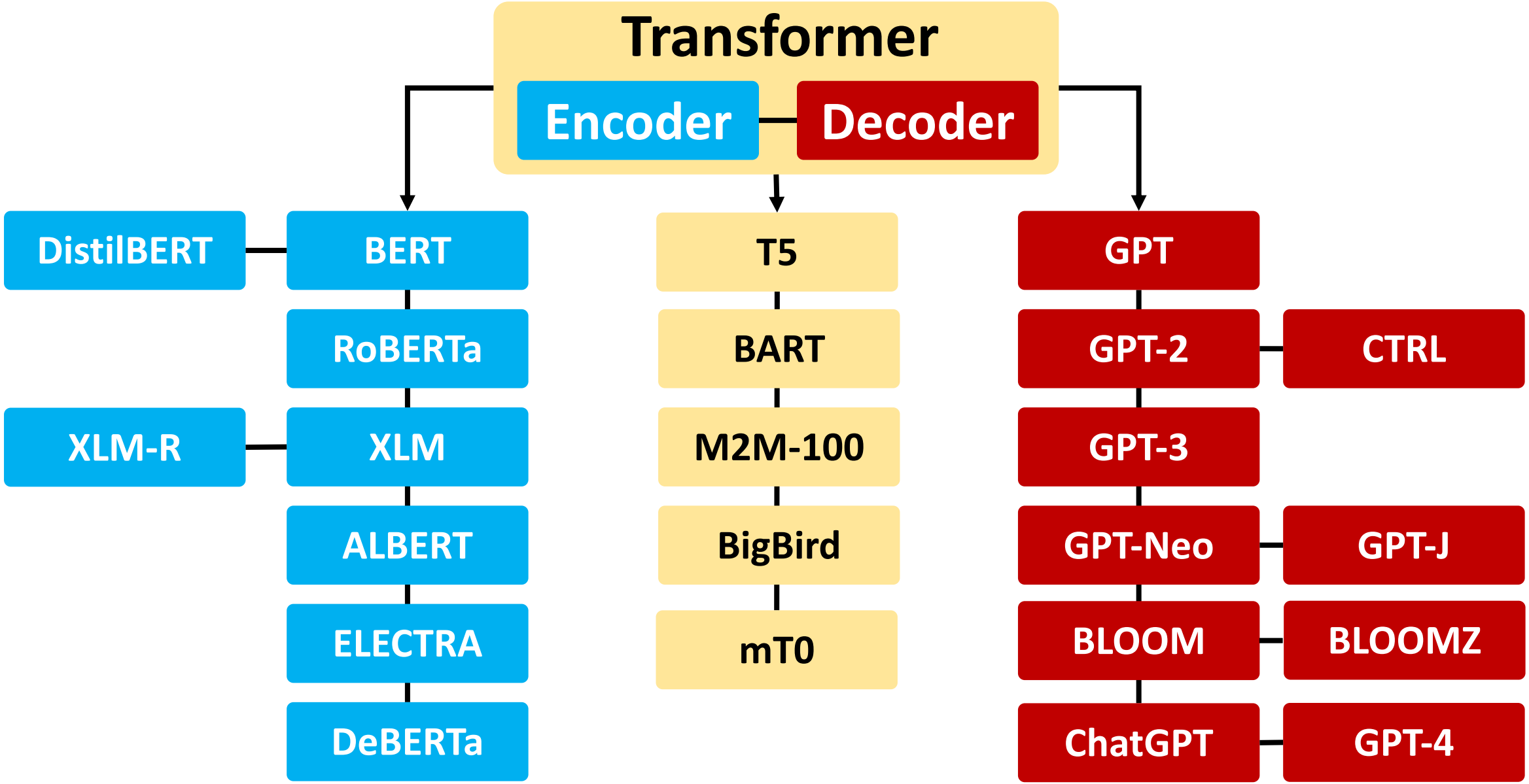
# Top ESG Reporting Software

**Environmental, Social and Governance (ESG) Reporting software** or **Sustainability software** helps organizations manage their operational data, evaluate their impact on the environment and provide reporting to perform audits.



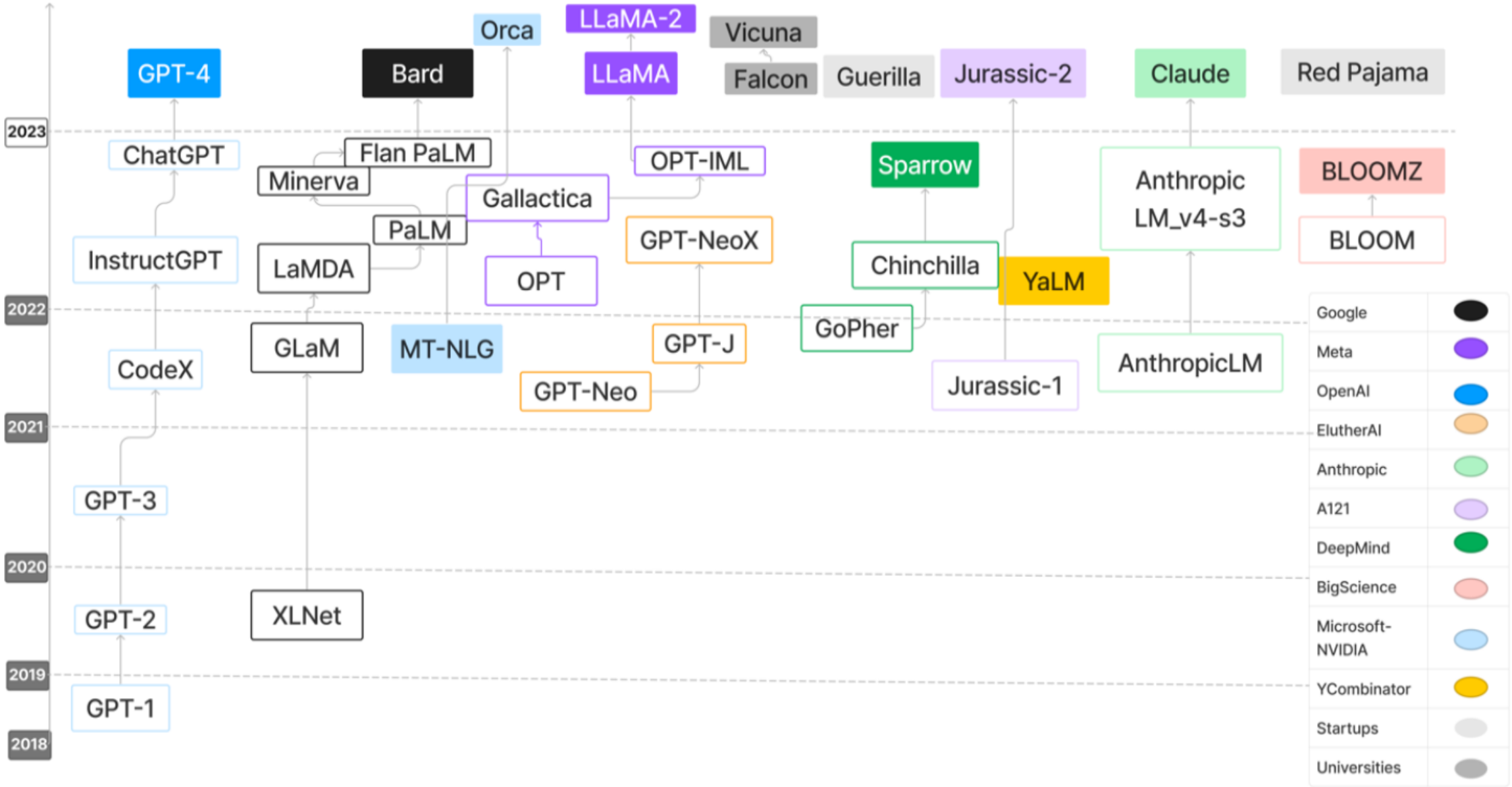

Source: https://www.softwarereviews.com/categories/environmental-social-and-governance-reporting

# Transformer Models



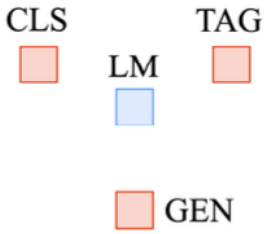
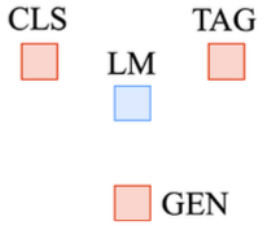
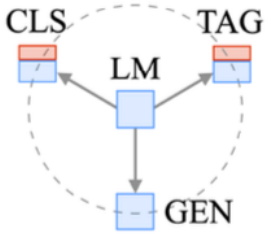
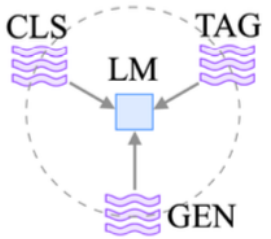

Source: Lewis Tunstall, Leandro von Werra, and Thomas Wolf (2022), Natural Language Processing with Transformers: Building Language Applications with Hugging Face, O'Reilly Media.

# Large Language Models (LLMs)




Source: Hadi, Muhammad Usman, Rizwan Qureshi, Abbas Shah, Muhammad Irfan, Anas Zafar, Muhammad Bilal Shaikh, Naveed Akhtar, Jia Wu, and Seyedali Mirjalili. "Large language models: a comprehensive survey of its applications, challenges, limitations, and future prospects." Authorea Preprints (2023).

# Four Paradigms in NLP (LM)

| Paradigm | Engineering | Task Relation |
|---|---|---|
| a. Fully Supervised Learning (Non-Neural Network) | Feature (e.g. word identity, part-of-speech, sentence length) |   |
| b. Fully Supervised Learning (Neural Network) | Architecture (e.g. convolutional, recurrent, self-attentional) |   |
| **Transfer Learning: Pre-training, Fine-Tuning (FT)** c. Pre-train, Fine-tune | Objective (e.g. masked language modeling, next sentence prediction) |   |
| **GAI: Pre-train, Prompt, and Predict (Prompting)** d. Pre-train, Prompt, Predict | Prompt (e.g. cloze, prefix) |   |

Source: Pengfei Liu, Weizhe Yuan, Jinlan Fu, Zhengbao Jiang, Hiroaki Hayashi, and Graham Neubig. (2023) "Pre-train, prompt, and predict: A systematic survey of prompting methods in natural language processing." ACM Computing Surveys 55, no. 9 (2023): 1-35.

# Generative AI

## Text, Image, Video, Audio Applications

# Comparison of Generative AI and Traditional AI

| Feature | Generative AI | Traditional AI |
| --- | --- | --- |
| Output type | New content | Classification/Prediction |
| Creativity | High | Low |
| Interactivity | Usually more natural | Limited |

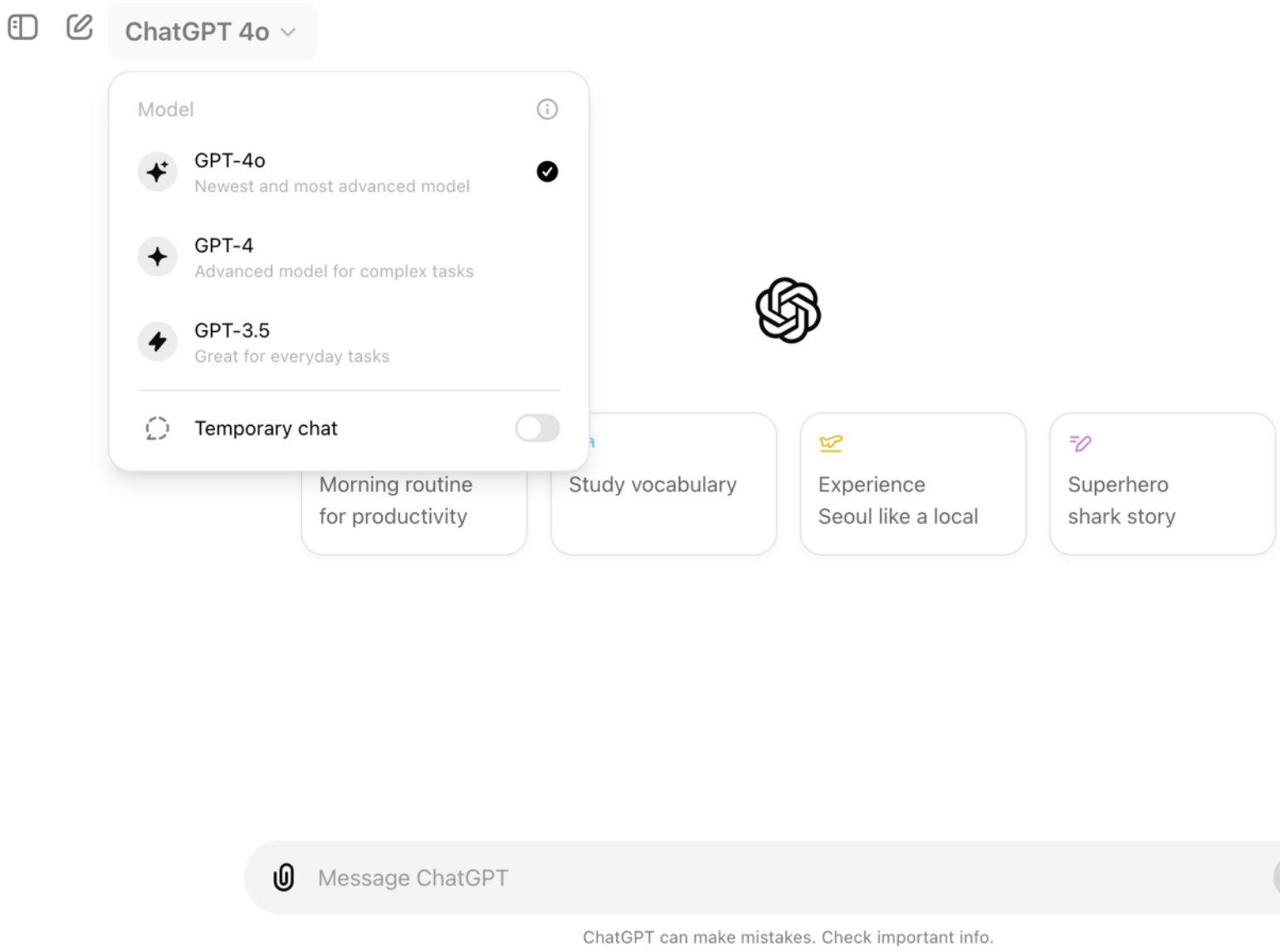
# Generative AI

- **Generative AI: The Art of Creation**
- **Definition: AI systems capable of creating new content**
- **Characteristics: Creativity, interactivity**

# Popular Generative AI

- OpenAI ChatGPT (GPT-4o, GPT-4)
- Claude.ai (Claude 3.5)
- Google Gemini
- Chat.LMSys.org
- Perplexity.ai
- ChatPDF
- Stable Diffusion
- Video: D-ID, Synthesia
- Audio: Speechify

# OpenAI ChatGPT (GPT-4o, GPT-4)



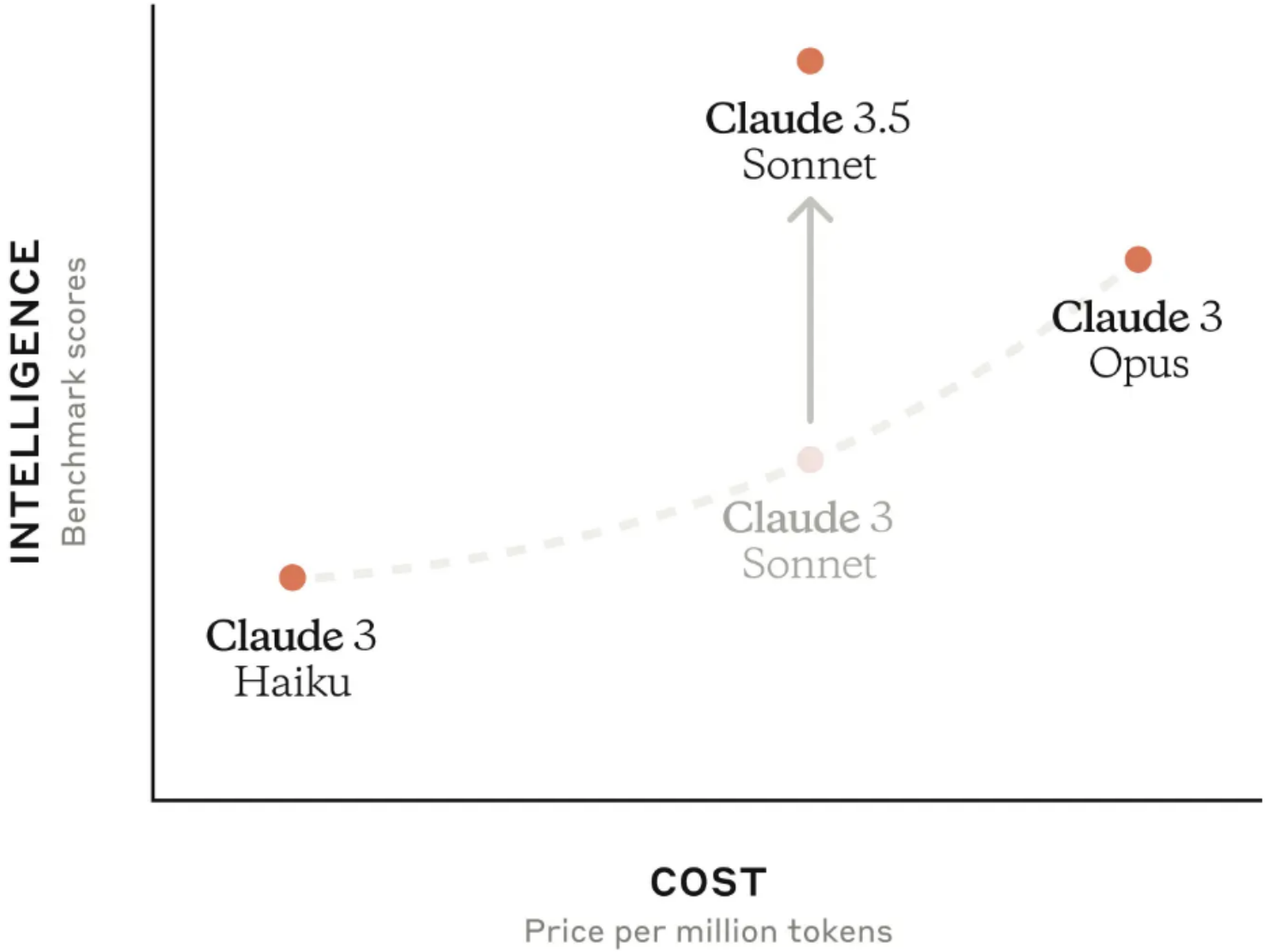

https://chat.openai.com/

# OpenAI ChatGPT (GPT-4) DALL·E 3

Vector graphic of a flowchart depicting the integration of generative AI in the education process, from content creation to virtual experiments, personalized learning, and innovative learning.


https://chat.openai.com/

# Claude 3.5 Sonnet




Source: https://www.anthropic.com/news/claude-3-5-sonnet

# Claude 3.5, GPT-4o, Gemini 1.5 Pro

| | Claude 3.5 Sonnet | Claude 3 Opus | GPT-4o | Gemini 1.5 Pro | Llama-400b (early snapshot) |
|---|---|---|---|---|---|
| Graduate level reasoning *GPQA, Diamond* | 59.4%* 0-shot CoT | 50.4% 0-shot CoT | 53.6% 0-shot CoT | — | — |
| Undergraduate level knowledge *MMLU* | 88.7%** 5-shot<br>88.3% 0-shot CoT | 86.8% 5-shot<br>85.7% 0-shot CoT | —<br>88.7% 0-shot CoT | 85.9% 5-shot<br>— | 86.1% 5-shot<br>— |
| Code *HumanEval* | 92.0% 0-shot | 84.9% 0-shot | 90.2% 0-shot | 84.1% 0-shot | 84.1% 0-shot |
| Multilingual math *MGSM* | 91.6% 0-shot CoT | 90.7% 0-shot CoT | 90.5% 0-shot CoT | 87.5% 8-shot | — |
| Reasoning over text *DROP, F1 score* | 87.1 3-shot | 83.1 3-shot | 83.4 3-shot | 74.9 Variable shots | 83.5 3-shot Pre-trained model |
| Mixed evaluations *BIG-Bench-Hard* | 93.1% 3-shot CoT | 86.8% 3-shot CoT | — | 89.2% 3-shot CoT | 85.3% 3-shot CoT Pre-trained model |
| Math problem-solving *MATH* | 71.1% 0-shot CoT | 60.1% 0-shot CoT | 76.6% 0-shot CoT | 67.7% 4-shot | 57.8% 4-shot CoT |
| Grade school math *GSM8K* | 96.4% 0-shot CoT | 95.0% 0-shot CoT | — | 90.8% 11-shot | 94.1% 8-shot CoT |

* Claude 3.5 Sonnet scores 67.2% on 5-shot CoT GPQA with maj@32
** Claude 3.5 Sonnet scores 90.4% on MMLU with 5-shot CoT prompting

Source: https://www.anthropic.com/news/claude-3-5-sonnet

# Claude 3.5 Sonnet State-of-the-art vision

| | Claude 3.5 Sonnet | Claude 3 Opus | GPT-4o | Gemini 1.5 Pro |
|---|---|---|---|---|
| **Visual math reasoning** *MathVista (testmini)* | **67.7%** 0-shot CoT | **50.5%** 0-shot CoT | **63.8%** 0-shot CoT | **63.9%** 0-shot CoT |
| **Science diagrams** *AI2D, test* | **94.7%** 0-shot | **88.1%** 0-shot | **94.2%** 0-shot | **94.4%** 0-shot |
| **Visual question answering** *MMMU (val)* | **68.3%** 0-shot CoT | **59.4%** 0-shot CoT | **69.1%** 0-shot CoT | **62.2%** 0-shot CoT |
| **Chart Q&A** *Relaxed accuracy (test)* | **90.8%** 0-shot CoT | **80.8%** 0-shot CoT | **85.7%** 0-shot CoT | **87.2%** 0-shot CoT |
| **Document visual Q&A** *ANLS score, test* | **95.2%** 0-shot | **89.3%** 0-shot | **92.8%** 0-shot | **93.1%** 0-shot |

Source: https://www.anthropic.com/news/claude-3-5-sonnet

# Google Gemini

## Largest and most capable AI model
## Making AI more helpful for everyone


Source: https://blog.google/technology/ai/google-gemini-ai

# LMSYS Chatbot Arena Leaderboard

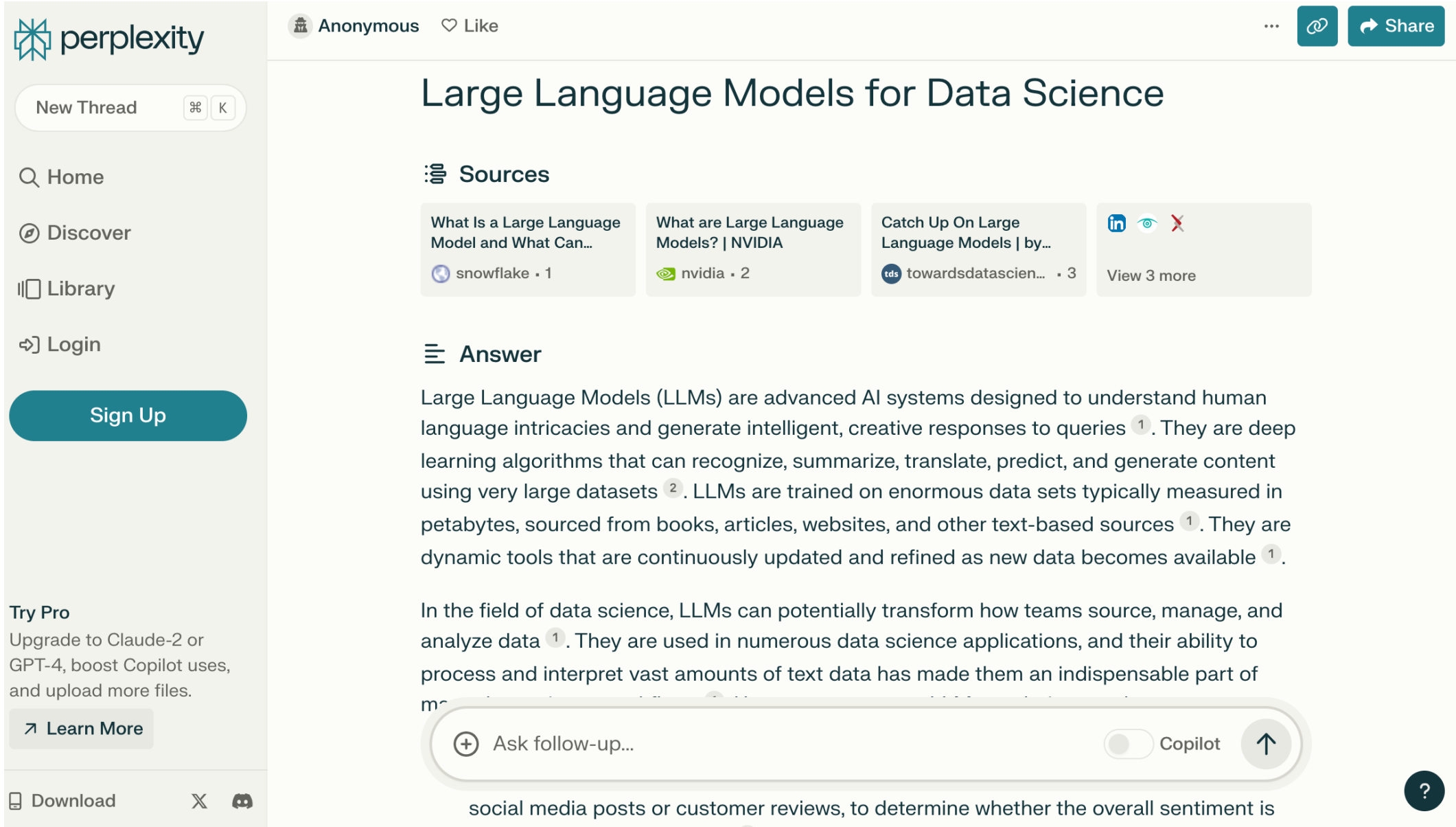
GPT-4o

Claude 3.5

| Rank* (UB) | Model | Arena Score | 95% CI | Votes | Organization | License | Knowledge Cutoff |
|---|---|---|---|---|---|---|---|
| 1 | ChatGPT-4o-latest (2024-08-08) | 1316 | +4/-4 | 24358 | OpenAI | Proprietary | 2023/10 |
| 2 | Gemini-1.5-Pro-Exp-0827 | 1301 | +5/-5 | 19976 | Google | Proprietary | 2023/11 |
| 2 | Gemini-1.5-Pro-Exp-0801 | 1298 | +4/-3 | 25471 | Google | Proprietary | 2023/11 |
| 2 | Grok-2-08-13 | 1295 | +4/-6 | 10170 | xAI | Proprietary | 2024/3 |
| 5 | GPT-4o-2024-05-13 | 1286 | +3/-3 | 83181 | OpenAI | Proprietary | 2023/10 |
| 6 | GPT-4o-mini-2024-07-18 | 1274 | +4/-4 | 23318 | OpenAI | Proprietary | 2023/10 |
| 6 | Gemini-1.5-Flash-Exp-0827 | 1270 | +7/-6 | 6610 | Google | Proprietary | 2023/11 |
| 6 | Claude 3.5 Sonnet | 1270 | +3/-3 | 53610 | Anthropic | Proprietary | 2024/4 |
| 6 | Gemini Advanced App (2024-05-14) | 1266 | +3/-3 | 52225 | Google | Proprietary | Online |
| 6 | Grok-2-Mini-08-13 | 1266 | +6/-6 | 10939 | xAI | Proprietary | 2024/3 |
| 7 | Meta-Llama-3.1-405b-Instruct | 1266 | +3/-4 | 24855 | Meta | Llama 3.1 Community | 2023/12 |
| 7 | GPT-4o-2024-08-06 | 1262 | +7/-5 | 14960 | OpenAI | Proprietary | 2023/10 |
| 10 | Gemini-1.5-Pro-001 | 1259 | +3/-3 | 74909 | Google | Proprietary | 2023/11 |

https://lmarena.ai/

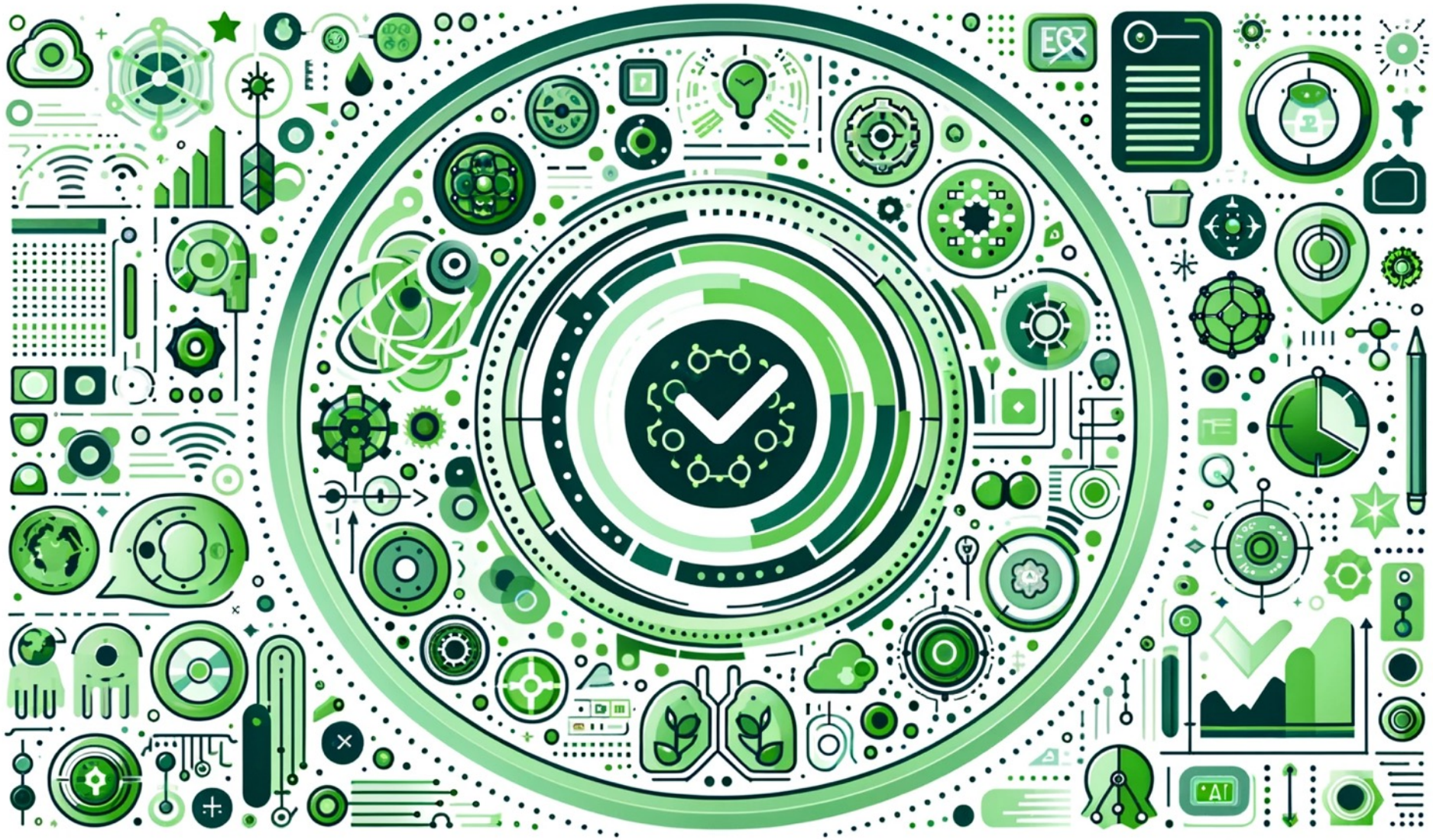
# Perplexity.ai




https://www.perplexity.ai/

# Generative AI and LLMs for Sustainability and ESG Data Analytics

# Generative AI for ESG Rating and Reporting Generation



# Summary

- Environmental, Social, and Governance (ESG)
- Net-Zero Digital Transformation
  - Net-Zero Transformation
  - Digital Transformation

Source: Dipanjan Sarkar (2019), Text Analytics with Python: A Practitioner's Guide to Natural Language Processing, Second Edition. APress.

# References


- Cino Robin Castelli, Cyril Shmatov (2022), Quantitative Methods for ESG Finance, Wiley
- 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.
- Numa Dhamani and Maggie Engler (2024), Introduction to Generative AI, Manning.
- Denis Rothman (2024), Transformers for Natural Language Processing and Computer Vision - Third Edition: Explore Generative AI and Large Language Models with Hugging Face, ChatGPT, GPT-4V, and DALL-E 3, 3rd ed. Edition, Packt Publishing.
- GRI (Global Report Initiative): https://www.globalreporting.org/
- CDP (Carbon Disclosure Project): https://www.cdp.net/
- SASB (Sustainability Accounting Standards Board): https://sasb.org/
- ISSB (International Sustainability Standards Board): https://www.ifrs.org/groups/international-sustainability-standards-board/
- TCFD (Task Force on Climate-related Financial Disclosures): https://www.fsb-tcfd.org/
- Min-Yuh Day (2024), Python 101, https://tinyurl.com/aintpupython101