



# 3<sup>rd</sup> Summer School on Sustainable Finance

JRC COMMUNITY of PRACTICE in FINANCIAL RESEARCH

## Climate Finance and Natural Language Understanding

### The Quest for AI-based Greenwashing Detection

Markus Leippold\* - University of Zurich



University of  
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## Finance industry and the fight against climate change

- **Sustainable Finance** (SF) become *the buzzword* in the finance industry.
- *Amundi, Franklin Templeton, Sumitomo Mitsui Trust Asset Management, and HSBC Asset Management* are among the latest big investors to sign up to the **Net Zero Asset Managers** initiative launched last December:
  - Signatories have pledged to set short-term emissions reductions targets across their investment portfolios for 2030.
  - Signatories will work with clients who elect to reach net zero on their investments by 2050.
  - Investors are expected to report their exposure based on **Task Force for Climate-related Financial Disclosures** (TCFD)
- This latest move implies that **\$43tn in assets of a \$100tn total funds managed worldwide** (Willis Towers Watson) are committed to a net zero target!
- Has the investment industry reached a “**tipping point**”? (Financial Times, July 6, 2021)



## Op-Eds About SF in the Financial Times

Strauß, N. (2021). [Framing Sustainable Finance: A Critical Analysis of Op-Eds in the Financial Times](#). *International Journal of Business Communication*.

Consensus on  
climate change

1



Axel Weber  
Chairman  
UBS

2



Mark Haefele  
Chief Investment  
Officer  
UBS

3



Zeë Knight  
Managing Director,  
Sustainable Finance  
HSBC

4



Philipp Hildebrand  
Vice-Chairman  
BlackRock



Jessica Alsford  
Global Head of  
Sustainable  
Research  
at Morgan Stanley



David Solomon  
CEO  
Goldman Sachs



## Consensus on Climate Change



- “The Decade to Deliver: A Call to Business Action” (2019)
  - Companies no longer see climate change as an issue for *future* leaders to manage. Climate change happens today.
  - 88% of 1,000 global executives believe our global economic systems need to refocus on equitable growth.



Is she the chief economist or who is she? I’m confused -  
After she goes and studies economics in college she can  
come back and explain that to us.

**Steven Mnuchin**

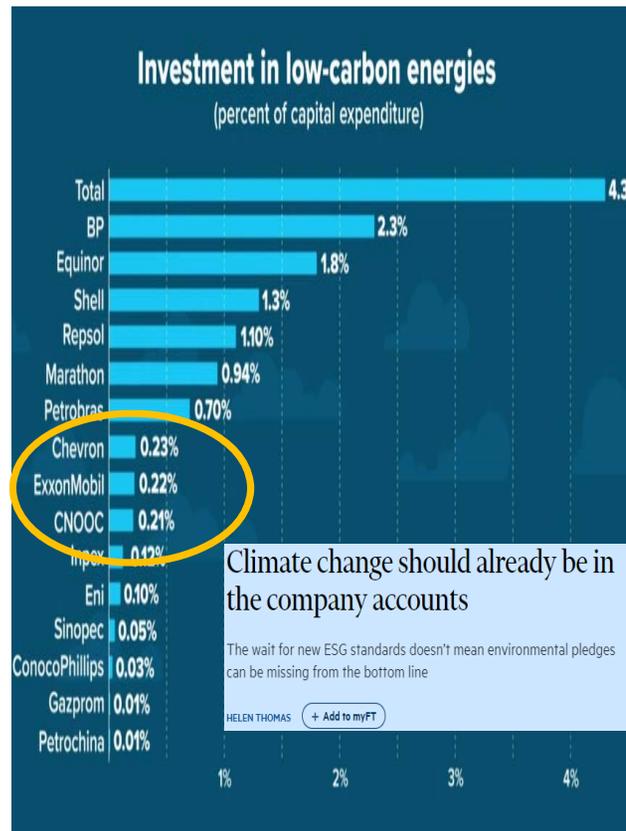
## Even oil-companies start to move away from climate-denial – But...

greenhouse gas performance across all our business lines,” said Darren Woods, chairman and chief executive officer of Exxon Mobil Corporation. “We respect and support society’s ambition to achieve net zero emissions by 2050, and **continue to advocate for policies that promote cost-effective, market-based solutions to address the risks of climate change.**”



Home Our strategy: Powering Progress Business customers Energy and innovation Sustainability Investors Careers

Shell Global Shell Energy Other solutions from Shell Energy Shell Environmental Products



Swiss Politics

Swiss CO2 law defeated at the ballot box



▲ Opponents argued the new law would not help the environment as Switzerland is responsible for only 0.1% of global carbon emissions. Keystone / Ms

## Hence, fact-checking becomes essential...

Mishra, Rahul and Gupta, Dhruv and Leippold, Markus

**Generating Fact Checking Summaries for Web Claims** (October 2020). Conference on Empirical Methods in Natural Language Processing (EMNLP), <https://ssrn.com/abstract=3713376>

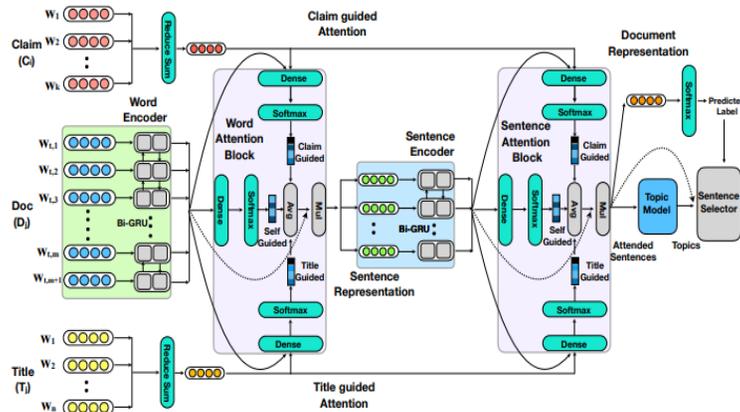


Figure 2: SUMO's neural network architecture for establishing the correctness of Web claims.

Claim:	Label:	Verdict:
<b>Smoking may protect against COVID-19</b>	<b>False</b>	<b>False</b>
<p><b>Summary:</b> The current evidence suggests that the severity of COVID is higher among smokers, prevent the health risk linked to the excessive consumption or misuse<sup>9</sup> of nicotine products by people hoping to protect themselves from COVID-19. Evidence from China, where COVID-19 originated, shows that people who have cardiovascular and respiratory conditions caused by tobacco use, or otherwise, are at higher risk of developing severe COVID-19 symptoms. HO urges researchers, scientists and the media to be cautious about amplifying unproven claims that tobacco or nicotine could reduce the risk of COVID-19. Smoking is also associated with increased development of acute respiratory distress syndrome, a key complication for severe cases of COVID-19.</p>		
<b>Deforestation has made humans more vulnerable to pandemics</b>	<b>True</b>	<b>True</b>
<p><b>Summary:</b> Deforestation can directly increase the likelihood that a pathogen will be transferred from wildlife species to humans through the creation of suitable habitats for vector species. Climate change, including deforestation which drives it, is a key driver of cross-species transmission which is where zoonotic emerging diseases come from . There is a correlation between deforestation and the rise in the spread of infectious diseases affecting humans. Deforestation forces various species into smaller, shared habitats and increases encounters between wildlife and humans. Habitat destruction and fragmentation due to deforestation can also increase the frequency of contact between humans, wildlife species, and the pathogens they carry . This can occur through direct transfer of pathogens from animals to humans or indirectly through cross-species transfer of pathogens from wildlife to domesticated species . Deforestation could be to blame for the rise of infectious diseases like the novel coronavirus.</p>		

Thomas Diggelmann, Jordan Boyd-Graber, Jannis Bulian, Massimiliano Ciaramita, Markus Leippold (December 2020)

**ClimateFEVER: A Dataset for Verification of Real-World Climate Claims**

NEURIPS 2020, ClimateChange AI Workshop.

<https://arxiv.org/abs/2012.00614>



# Current Project: Scientific-claim verification

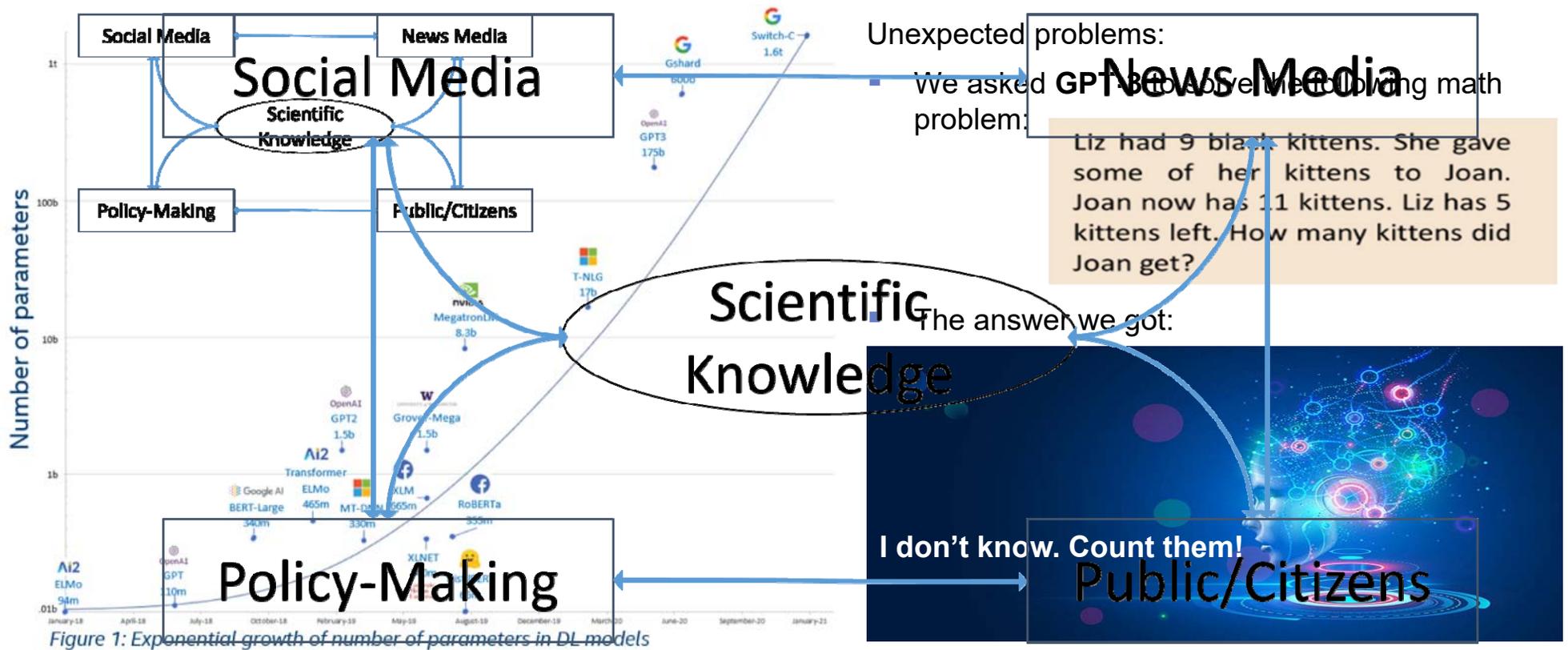


Figure 1: Exponential growth of number of parameters in DL models

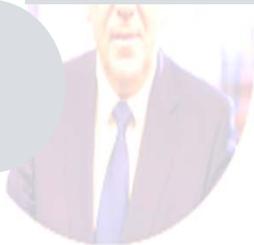


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Sustainability in the name of profit and capital growth



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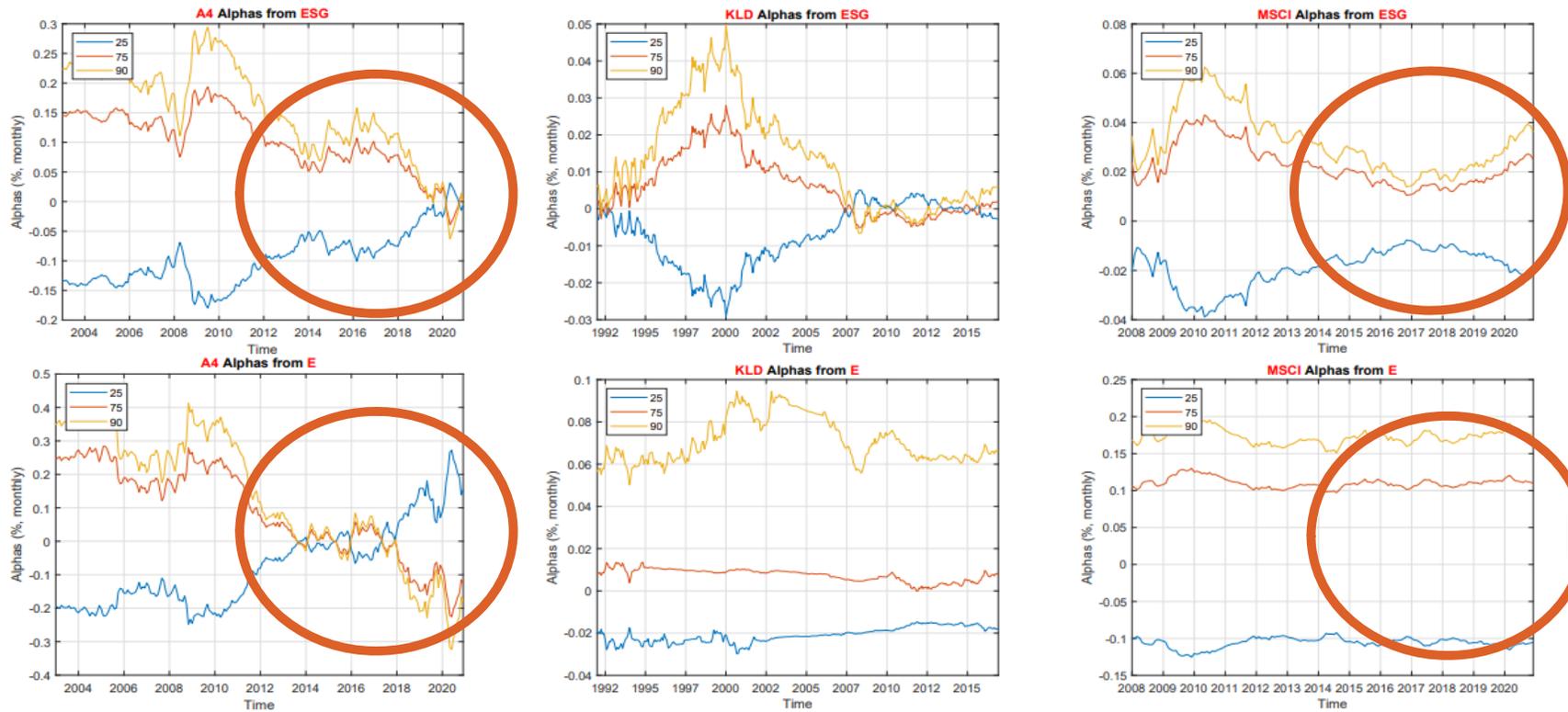
David Solomon  
CEO  
Goldman Sachs



# Are sustainability returns sustainable?

Lioui, Abraham and Tarelli, Andrea, [Chasing The ESG Factor](#) (July 1, 2021). Available at SSRN

Alpha of ESG factors for alternative ESG ratings and conditional on firm characteristics



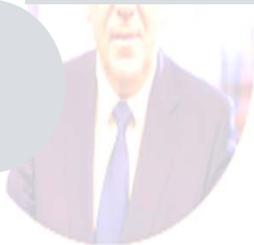


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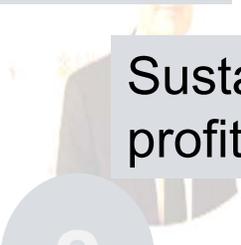
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Sustainability in the name of profit and capital growth

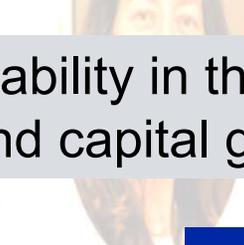
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Data and methodological transparency

3



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Director,  
SF  
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Jennifer Stanford  
Global Head of  
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in Stanley



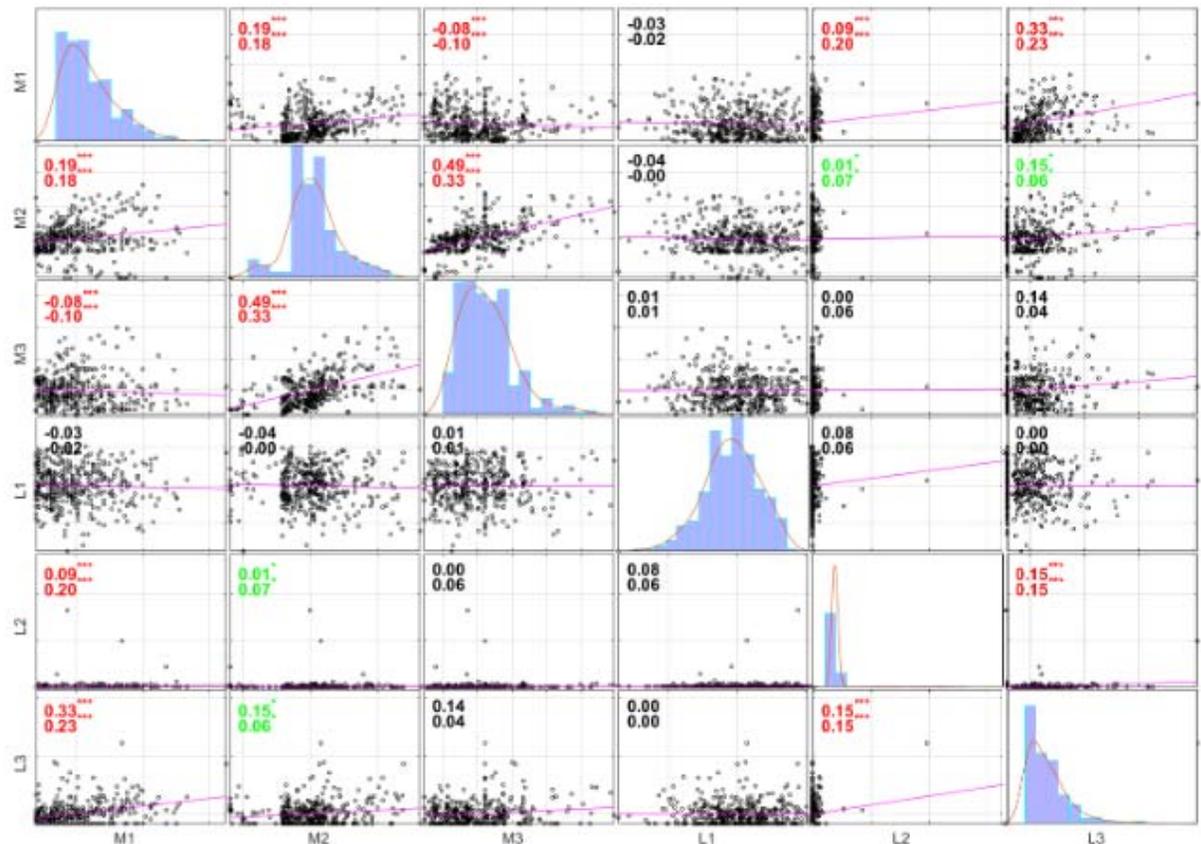
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## Physical risk measures

### Correlations for Horizon 2050, RCP8.5

- Trucost (M1)
- Carbon 4 Finance (M2)
- Southpole (M3)
- Truvalue Labs(L1)
- Firm-level Climate-Change Exposure (L2) (Sautner et al., 2020a)
- BERT-based climate risk measure (L3) (Koelbel et al., 2020).





## Impact on sector ranking and portfolio sorts – make your choice!

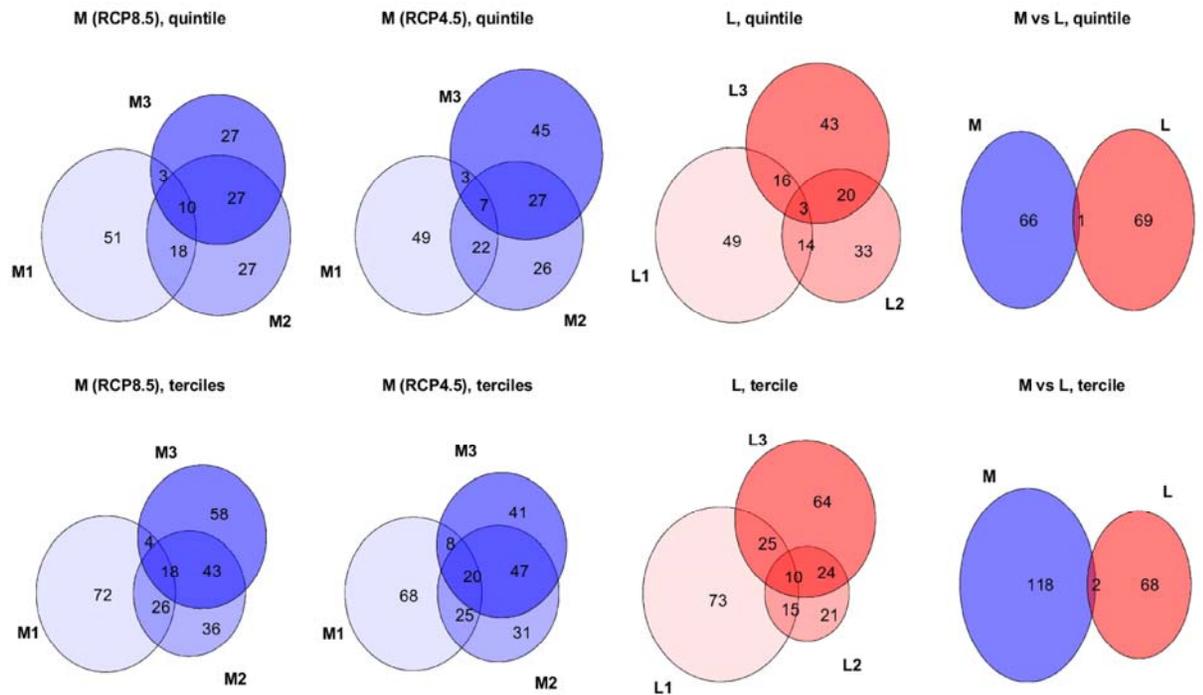
### Sector rankings

Sector	M1	M2	M3	L1	L2	L3	Avg
Health Care	9	6	7	10	9	11	8.7
Consumer Staples	7	5	5	4	8	3	5.3
Consumer Discretionary	3	8	9	6	6	6	6.3
Information Technology	10	7	6	5	10	9	7.8
Energy	4	2	1	7	5	4	3.8
Materials	5	3	2	8	3	2	3.8
Industrials	6	4	8	2	2	7	4.8
Communication Services	8	10	10	3	11	10	8.7
Financials	11	9	3	1	7	8	6.5
Real Estate	2	11	11	9	4	5	7.0
Utilities	1	1	4	11	1	1	3.2

### Legend

- Trucost (M1)
- Carbon 4 Finance (M2)
- Southpole (M3)
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### Portfolio sorts



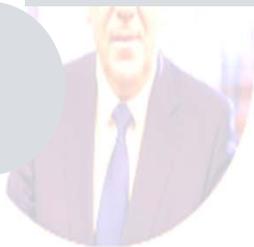


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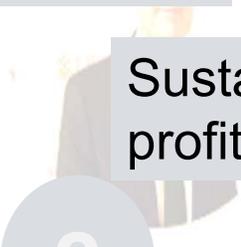
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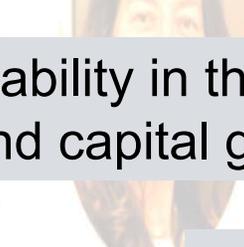
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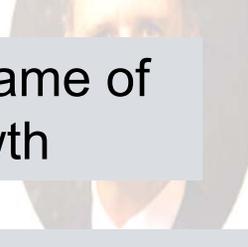
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Transparency and responsibilities

4



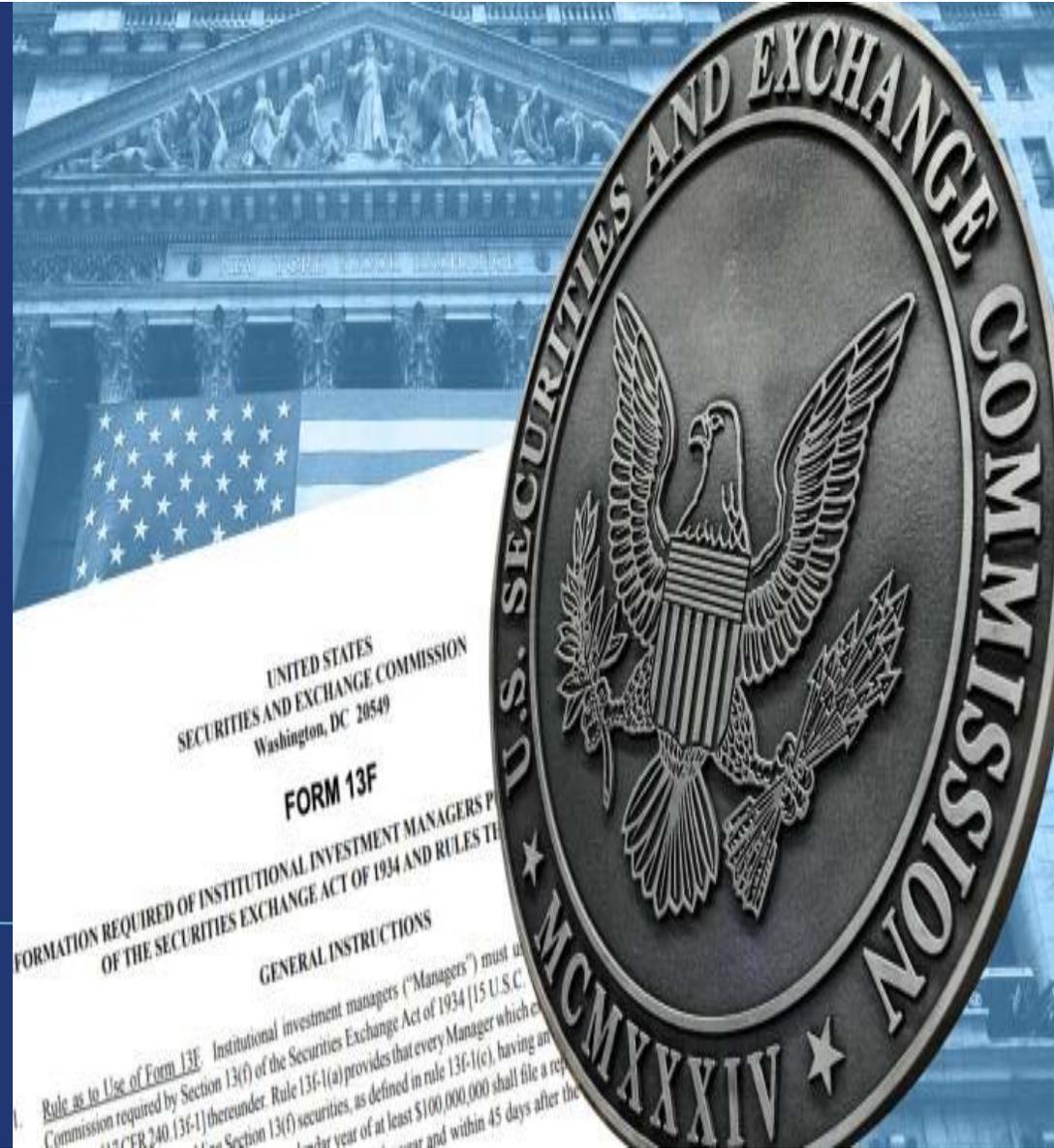
David Solomon  
CEO  
JP Morgan Chase

# TCFD

## Good Practice Handbook



Climate  
Disclosure  
Standards  
Board



UNITED STATES  
SECURITIES AND EXCHANGE COMMISSION  
Washington, DC 20549

FORM 13F

INFORMATION REQUIRED OF INSTITUTIONAL INVESTMENT MANAGERS  
OF THE SECURITIES EXCHANGE ACT OF 1934 AND RULES THEREUNDER

GENERAL INSTRUCTIONS

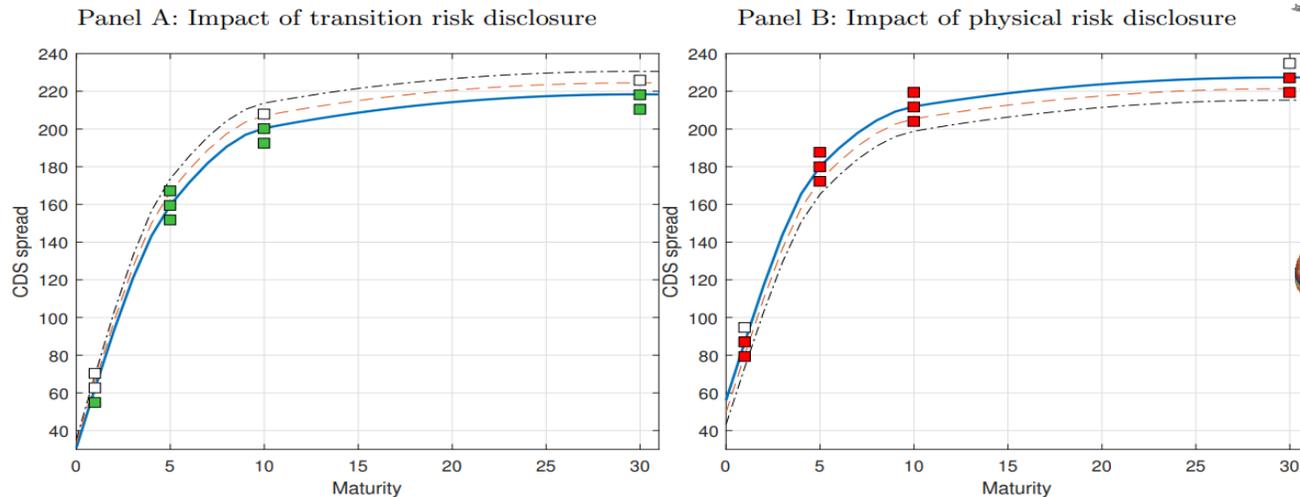
**Rule as to Use of Form 13F.** Institutional investment managers ("Managers") must use Form 13F to report the investment positions of the Manager which are required to be reported under Section 13(f) of the Securities Exchange Act of 1934 (15 U.S.C. 78c(f)) and Rule 13f-1 thereunder. Rule 13f-1(a) provides that every Manager which is required to file Form 13F under Section 13(f) securities, as defined in rule 13f-1(c), having an aggregate net long position in Section 13(f) securities of at least \$100,000,000 shall file a report on Form 13F for each calendar year of at least \$100,000,000 and within 45 days after the end of the calendar year.



## Regulatory disclosure of climate risk impacts CDS spreads

Bidirectional Encoder Representations from Transformers

### A. Statistical significance:



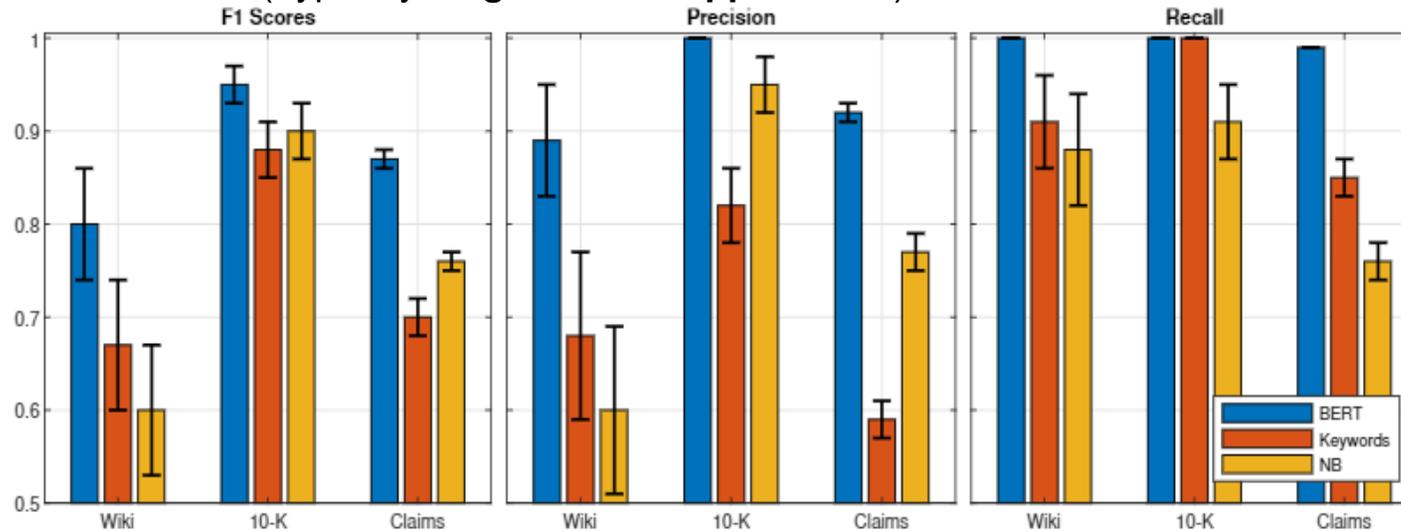
### B. Economic significance:

- A one-standard-deviation increase in transition risk leads to an increase of **6.99bps** in the average five-year CDS spread for the post-Paris period or an **4.3% increase** in the average.
- A one standard deviation in physical risks results in a decrease of CDS spreads of **7.37bps**, which amounts to a **reduction of 4.1%** for the average 5 year CDS contract in our sample.



## Why Bert (or Transformers)?

- Traditional approaches from NLP are based on a **pre-defined list of presumably relevant words** and then search for these words within the documents (Typically: **bag-of-words approaches**).





## Using ClimateBERT for TCFD Disclosures

Table 1. Descriptives of our training sample

- 🔗 >17,300 human-labeled sentences with TCFD categories.
- 🔗 Extensions:
  - 🔗 >600 paragraphs, 5 annotators.
  - 🔗 Additional tasks (climate, sentiment, commitment, specificity).
- 🔗 >300,000 general language sentences from annual reports for training. More than 1,400,000 sentences in total.
- 🔗 Making ClimateBERT a language model.

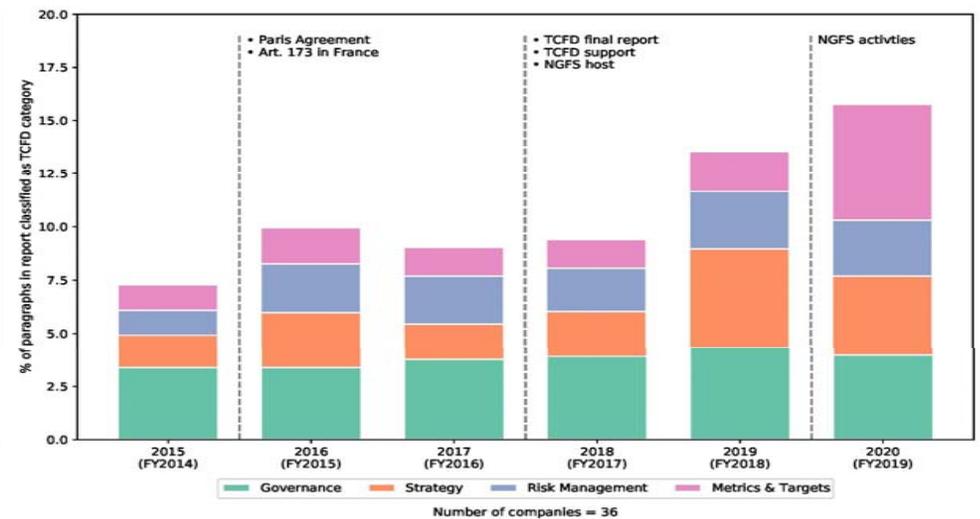
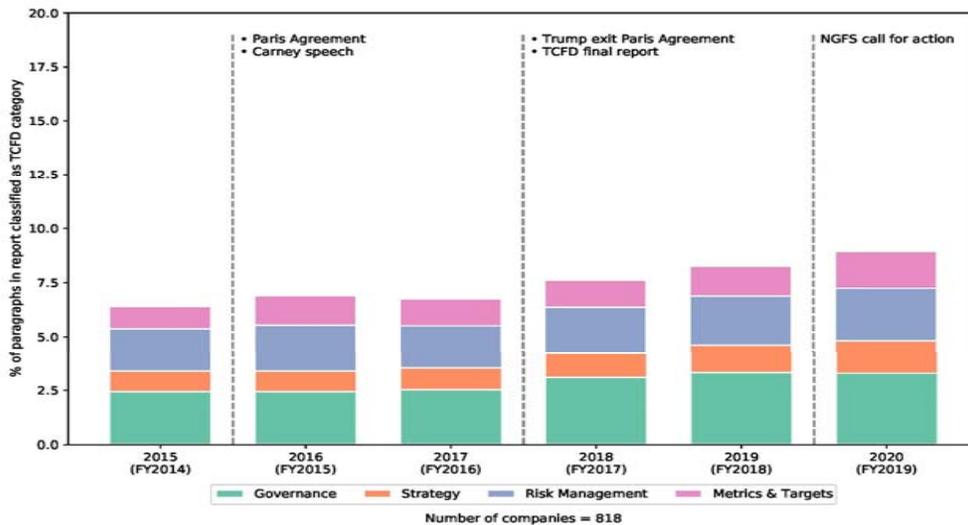
	(a) Sectors	(b) Regions	
		N Firms	N Firms
Financials	100	Europe	113
Materials	34	Asia	71
Utilities	33	North America	53
Industrials	29	Oceania	26
Transportation	19	South America	16
Information Technology	18	Africa	9
Consumer Staples	11	Asia Pacific	6
Energy	11	Central America	3
Real Estate	10	Global	2
Communication Services	10	Caribbean	1
Consumer Discretionary	9	Middle East	1
Other	7		
Government	5		
Health Care	5		
<b>TOTAL</b>	<b>301</b>		<b>301</b>



## Evaluation of classification performance

Table 3. Out-of-sample performance comparison between baseline models and our proposed ClimateBERT. Performance is reported in precision for each category.

	Governance	Strategy	Risk Management	Metrics & Targets	General Language	Overall Accuracy
Tf-idf	0.43	0.00	0.40	0.35	0.00	0.24
Sentence Enc.	0.19	0.57	0.15	0.24	0.00	0.23
RoBERTa Para.	0.26	0.25	0.25	0.25	0.07	0.22
RoBERTa Sent.	0.96	0.92	0.84	0.74	0.32	0.75
ClimateBERT	0.94	0.90	0.79	0.77	0.65	0.81





## Introducing Commitment and Specificity

- We currently extend **ClimateBert** to make predictions about:
  - Risk and opportunity
  - Commitment
  - Specificity

- **Examples:**

- Commitments:

*“We rank among Europe’s market leaders in the grid and retail business and have leading positions in renewables. We intend to spend a total of between €6.5 billion and €7.0 billion in capital throughout the Group from 2017 to 2019.”*

- Firm-specific statements:

*“We emitted 13.4 million tonnes CO2 of Scope 2 (indirect emissions), being emissions arising from our consumption of purchased electricity, steam or heat. Our Scope 3 emissions include emissions from a broad range of sources, including shipping and land transportation. More details on our Scope 3 emissions will be available in our 2014.”*

We make **ClimateBert** a Language-Model by extending the pre-training on a large corpus of text, including:

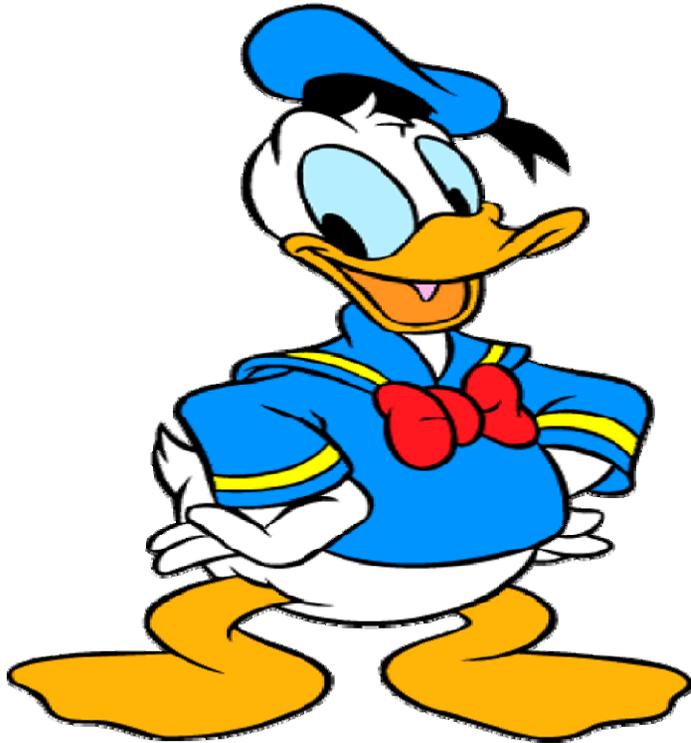
- Climate News (~50k articles)
- ~4000 Annual and ~400 Sustainability Reports 2014-2020
- > 150k Climate-Change Research Papers from Scopus and SSRN.





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## Conclusion





## Conclusion



### 2100 WARMING PROJECTIONS

Emissions and expected warming based on pledges and current policies



May 2021 update

