Big Data Explorative Research on Insurance Companies and Their Reasoning of Climate Action and Decarbonizing Strategies

Prof. Karen Wendt, MBA, President Eccoscience

&

University of Economics and Business, Modul University, Vienna, Austria

1. Research Plan

At COP21 in Paris, 195 countries agreed to work together to limit global warming to 2°C and aim for net zero carbon emissions by the second half of the 21st century. Mainstream investment must be aligned with sustainable development – a process already under way, although hobbled by challenges such as carbon-locked legacy infrastructure or technological path dependence. While the financial sector has been grappling with the environmental and social implications of climate change for at least a decade, the Paris Agreement could represent a tipping point for climate aligned investment and finance. Using the Global Industry Classification Standard GICs)[1] this research first looks into the carbon intensity of different sectors, then focus on the carbon contribution of the insurance industry as a relevant subsector of the financial industry using structured data analysis. The concentration on the insurance industries by investors, policy makers and civil society seems at first glance surprising. The unstructured analysis however provides additional insight in the targeting of this industry by stakeholders and on the line of argument, and spin doctors of this topic.

1.1 Abstract

The recently published International Climate Report by the Intergovernmental Panel on Climate Change (IPCC 2018) [2]requires a restriction of global warming to 1.5 degree. According to reports provided by civil society and - if done properly - governments we have to assume that we are yet far from what needs to be accomplished in order to meet the Paris Agreement targets. At the UN High Level Political Forum in 2018 two main impediments were highlighted throughout the entire conference. Firstly, the lack of financial means to put sustainability concepts into practice. Secondly, the lack of sufficient indicators and data to measure progress

[1] Global Industry Classification Standard GICS see https://www.msci.com/gics
[2] https://www.ipcc.ch

within this field. Part of this problem can, in turn, be traced back to the lack of financial resources just as to the unwillingness of governments and officials to reveal the undisguised present state of affairs. The consequence is the existence of many fragmented data pools that do not relate to and complement each other to have the greatest impact. However, there lies the third problem that is entailed by the data gap. In this research the researcher depicts what is publicly available through a research on structured data. A research gap exists that must be closed. In a first step it is imperative to understand how insurance companies deal with carbon loaded assets and whether they see climate protection as part of their core business[3], want to drive change to a low carbon economy, or continue with financial business as usual. The Science based target group (SBT) wants to phase out coal and the members of this voluntary initiative want to be carbon neutral by 2040 according to the SBT Science Based Targets Initiative.[4][5] Some of their members are insurance companies, however are these front runners aligned to the insurance market as a whole?

1.2 Introduction

Insurance companies are among the ultimate managers of risk in our society. With total assets under management of approximately $31 trillion they are also one of the world's largest groups of institutional investors.[6] With their underwriting and investments they play a major role in shaping the world's industrial development.

The fundamental role of insurers is to protect their clients from the impacts of catastrophic risks. Insurance companies such as Munich Re were among the first business enterprises to publicly warn about the risks of climate change as early as 1973. [7]

The Insurance Industry may need to find out about how much climate risks is embedded in companies they insure. Climate Adaptation Risk and Climate induced risks can hamper the balance sheet of the leading insurance companies. They are increasingly selling holdings in

[3] Allianz, November 30, 2018 https://www.allianz.com/en_GB/press/news/financials/stakes_investments/151126-climate-protection-will-become-part-of-core-business.html
[4] SBT https://sciencebasedtargets.org/companies-taking-action/
[5] Allianz https://www.allianz.com/en_GB/press/news/financials/stakes_investments/151126-climate-protection-will-become-part-of-core-business.html
[6] see Unfriend Coal https://unfriendcoal.com
[7] see Unfriend Coal

coal companies and refusing to underwrite or insure coal- intense operations. Coal might become uninsurable as « The Guardian « reports.8

At the same time leading insurance companies are not just insuring against climate risk, but so have a pension fund or life insurance arm that invests in portfolios of shares and bonds, are subject to pension fund regulations as insurance companies invest fiduciary money (pension schemes). Several are creating metrics to measure climate change-related indicators or are actively monitoring the environmental impact of their investment decisions. These include carbon 'footprint' exercises to assess the emissions produced by the scheme's investments, and similar studies.[9] The following factors may be relevant for insurers:

- Stakeholder Pressure is on the insurance Industry for measuring financed emissions[10]. The next logical step –these stakeholders require insurers to establish sufficiently ambitious portfolio and business-unit reduction targets for their financed emissions.[11]
- The Greenhouse Gas Protocol Initiative[12] has ben joined by leading Insurance Companies in order to report about Green House Gas (GHG) emissions.[13] The question is whether this abides to good governance or is more a greenwash approach of the industry. Launched in 1998, the Initiative's mission is to develop internationally accepted greenhouse gas (GHG) accounting and reporting standards for business and to promote their broad adoption.[14]
- A wealth of international initiatives meanwhile exist concerned with carbon accounting, transparent footprint and reporting in the financial industry.15 Having previously been viewed as a laggard, the financial sector is now seeing an

[8] The Guardian: https://www.theguardian.com/environment/2017/nov/15/growing-number-of-global-insurance-firms-divesting-from-fossil-fuels

[9] https://www.out-law.com/en/articles/2018/november/corporate-pension-funds-climate-change-investment-policy/

[10] The Definition of Carbon Foot-printing and the distinction between Scope 1,2, and 3 emissions has been developed by the Greenhouse Gas Protocol under leadership of the Word Resources Institute

[11] https://www.climateworks.org/wp-content/uploads/2017/09/EU-carbon-loophole_final-draft-for-consultation.pdf

[12] is a multi-stakeholder partnership of businesses, non-governmental organizations (NGOs), governments, and others convened by the World Resources Institute (WRI), a U.S.-based environmental NGO

[13] Further partners are NGOs, and the World Business Council for Sustainable Development (WBCSD), a Geneva-based coalition of 170 international companies.

[14] Distinction : GHG Protocol Corporate Accounting and Reporting Standard - a step-by-step guide for in quantifying and reporting their GHG emissions. GHG Protocol Project Quantification Standard (for quantifying reductions from GHG mitigation projects)

[15] Please refer tot he overview of voluntary initiatives presented in Annex 1

unprecedented commitment to climate leadership by taking prominent roles in international climate initiatives. The topic of climate change and investment is gathering increasing attention from stakeholders and the primary ask to the financial sector is to provide transparency on climate risk and impact by means of disclosure. Figure 1 in Annex 1 shows a selection of the main initiatives in the field.

However questions remain, on the effectiveness of these initiatives, as most of them are based on voluntary self-reporting with some exception in France, where reporting and criteria are mandatory. There is also uncertainty about the data quality and the comparability of data, two issues that are tackled by South Pool [16]and Bloomberg[17] trying to generate comparable data from a set of different voluntary reporting streams. Reported emissions in the major share indices Russell 1000 and MSCI keep more or less stead between 2014 and 2016 as can be seen in Annex 2.

Therefore the following research questions remain relevant:

1. How do Insurance Companies tackle climate change? Do they only consider climate adaptation risk in their insurance/reinsurance business? Or do they account how carbon intense insurance companies' investment portfolios are?
2. What are the driving factors that make them take carbon risk into account when selecting investment strategies? A financial intermediary would opt for the investment with the best net returns. Do insurers see a risk of possibly be harmed by carbon risk in their portfolios where they are subject to fiduciary duties?

1.3 Methodology

This research first analyzes the currently available data of the MSCI and Standard and Poors 500 regarding the reported emission of the finance or insurance industry. In a second step data published by the Carbon –disclosure Project for the Fortune 500 compnies is analyzed to understand the total emissions reported using the data from the Carbon Disclosure Project. The **CDP** (**Carbon Disclosure Project**) is not for profit organisation based in the United Kingdom which supports companies to disclose their carbon footprint. It aims to make carbon reporting and risk management a business norm, and drives disclosure. Since 2002 over 6,000

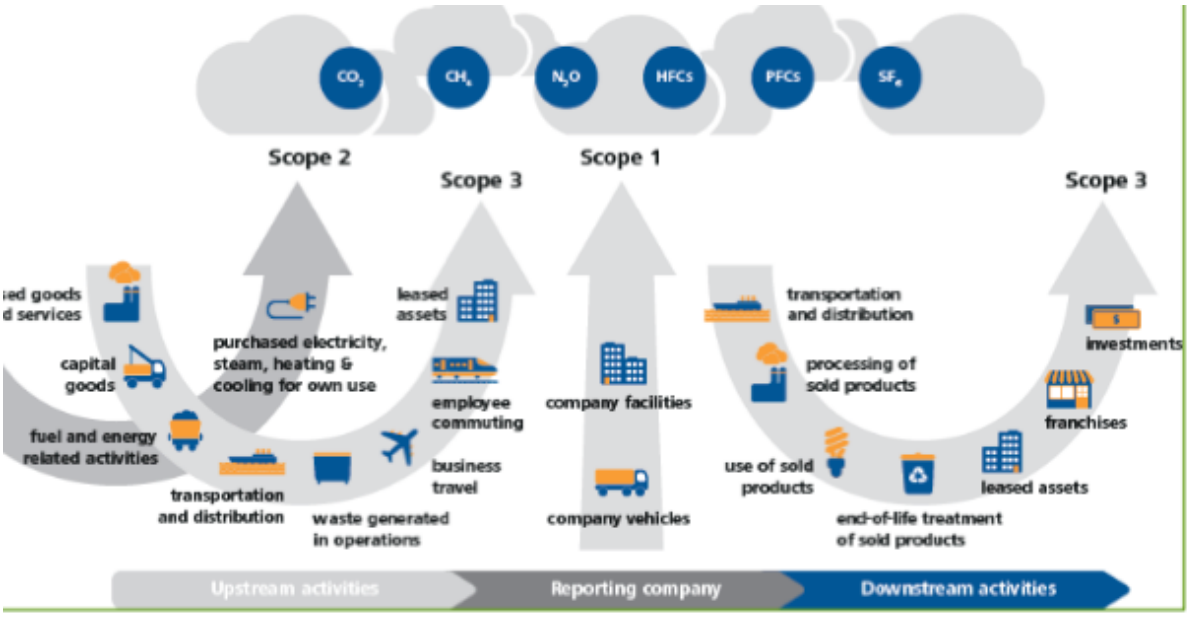
16

17

companies have publicly disclosed environmental information through CDP. [18] The impact of the insurance industry on climate change is analysed using to reported emissions based on the WRI Scoping methodology based on the Greenhouse Gas Protocol [19]-

To conduct a carbon footprint analysis, an understanding of GHG emissions is essential. The definition is based on the GHG Protocol which splits emissions into three scopes: Scope 1, Scope 2 and Scope 3:

- **Scope 1: Direct GHG emissions**
- Scope 1 covers all direct GHG emissions by a company.] It includes fuel combustion, company vehicles and fugitive emissions.[21]
- **Scope 2: Electricity indirect GHG emissions** Scope 2 covers indirect GHG emissions from consumption of purchased electricity, heat or steam]
- **Scope 3: Other indirect GHG emissions**
- Scope 3 covers other indirect emissions in the entire the entire value chain). For some industries induced carbon emission through the business model can represent the largest source of greenhouse gas emissions and in some cases can account for up to 90% of the total carbon impact according to GHG Protocol. This in particular applies to the financial industry including the insurance industry.



[18] https://www.cdp.net/en
https://www.bloomberg.com
Please note that data from the Bloomberg database are a paid service for brokers and industry specialists. Data is not readily available as within the CDP project.
[19] https://www.wri.org/sustainability-wri/ghg-commitments-and-strategy

Figure 1. Scoping Taxonomy.

The emissions per employee, emissions per revenue and the overall share of the financial industry and in particular insurance companies are depicted and analysed in order to answer the questions of carbon footprint scope and share price correlation. Based on the reported figures the question arises of what are the driving factors that make insurance companies take carbon risk into account when selecting investment strategies. Big data research is used to find the patterns and hidden rationale for insurance companies in selecting their carbon related investment strategies using knowledge extraction, word trees, semantics analysis and sentiment analysis. According to rational choice theory it must be assumed that financial intermediary would opt for the investment with the best net returns alone. The research engages in answering the question – whether, why and how insurance companies include carbon strategies into their investment strategies.

The research combines structured and unstructured data analysis according to the Munich Re model combining structured and unstructured data as shown in Figure 2. However the self-reported CPD data and the extracted Bloomberg data is used first for quantitative analysis purposes (descrictive techniques plus regression analysis) and then complemented by the structuring of social media data from weblyzard[20], uneplive.org[21], sentione[22] and IRIS Intelligence tools[23] to

- Extract topics from Social Media
- Find Key Players /Opinion Leader for Carbon Footprint Reductions
- Spin doctors for Carbon Footprint Reductions?
- Triangulation/verification of the data

[20] Weblyzard Technology GmbH Vienna
https://www.weblyzard.com
[21] UNEP Live
http://www.uneplive.org/webintelligence
https://unep.ecoresearch.net/weblyzard/en/
[22] Sentiment Analysis with
https://sentione.com/pro#/dashboards/show/156370
[23] IRIS Data Intelligence Tool
http://iris.lmsal.com/itn26/iris_level2.html

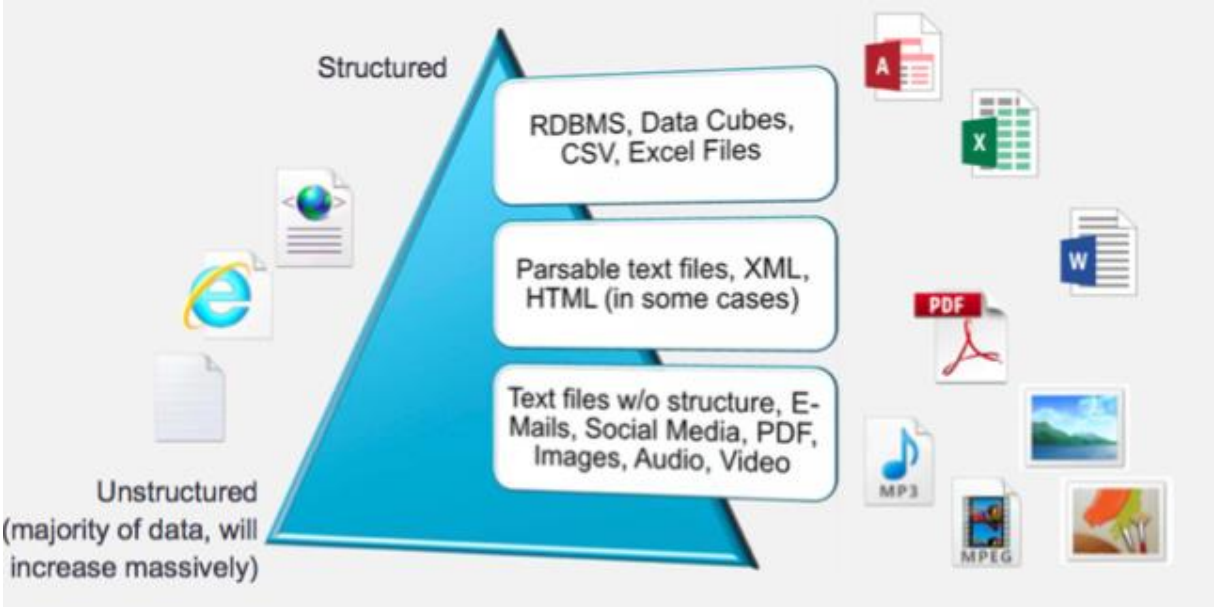


Figure 2 : Munich Re[24] Data analysis using structured and unstructured data in Munich Re

Big Data analytics encompasses a range of techniques that can be used to uncover hidden patterns, discover unknown correlations, highlight market trends and reveal customer insight from the data. The results can lead to more effective marketing, boost in revenue, improved customer service, increased operational efficiency and a competitive edge over rival companies. The primary focus of Big Data analytics is to provide companies and organizations with the necessary information to make more knowledgeable decisions and find hidden and undisclosed patterns, Web server logs, Social Media content, text from customer emails, survey responses, mobile-phone call detail records and many more. This research, with the aid of knowledge extraction from social media and paid services, will explore the capabilities of Big Data Analytics when applied to carbon strategy Insurance scenario[25].

The further paper is structured in the following way: First a structured data research and analysis is provided showing the carbon intensity of the Financial Industry and the Insurance industry as a sub-segment, providing a discussion on quality and completeness of the existing available data sets and deriving a gap analysis. As unstructured data analysis cannot make up for the existing gaps in the structured data analysis process entirely unstructured data is used to answer the question of how insurance companies are now dealing with the carbon issue.

[24] https://www.munichre.com/analytics-suite
[25] https://support.sas.com/resources/papers/proceedings17/1052-2017.pdf

1.4 Structured Data Research and Analysis

The structured Data analysis is using all availabe Bloomberg data on carbon footprinting, based on the GHG Protocoll.[26]

CO2 and other GHG emissions (Scope 1&2) have been made comparable [*million tons CO2 equiv.*] Bloomberg.does not include Scope 3 data (financed emissions, emissions triggered by the use of the product) as the data is not disclosed by companies. US data is based on the Standard and Poors 500 Index (S&P 500), European Data on the Euro STOXX 500 Index. Data from Asia has not benn made available.

	All Index Members	with (comparable) GHG data	
USA (S&P500)	505	**131**	25,9%
Europe (Stoxx600)	600	**351**	58,5%

TABLE 1 : Comparison between US and Europe – Reporting Share in % of listed companies

European data used for GHG per employee

There are three main metrics used by investors for presenting the results of a carbon footprint. Each metric serves a different purpose and there is currently no standard that unifies investors´ efforts.

Emissions per USD invested,27 Emissions / Revenue:28 and Weighted Average Carbon

- [26] The Definition of Carbon Foot-printing and the distinction between Scope 1,2, and 3 emissions has been developed by the Greenhouse Gas Protocol under leadership of the Word Resources Institute
- The Greenhouse Gas Protocol Initiative is a multi-stakeholder partnership of businesses, non-governmental organizations (NGOs), governments, and others convened by the World Resources Institute (WRI), a U.S.-based environmental

NGO, and the World Business Council for Sustainable Development (WBCSD), a Geneva-based coalition of 170 international companies. Launched in 1998, the Initiative's mission is to develop internationally accepted greenhouse gas (GHG) accounting and reporting standards for business and to promote their broad adoption.

- Distinction : GHG Protocol Corporate Accounting and Reporting Standard - a step-by-step guide for in quantifying and reporting their GHG emissions)
- • GHG Protocol Project Quantification Standard (for quantifying reductions from GHG mitigation projects)

[27] This metric displays how many tonnes of CO2e an investor is exposed to in relation to the respective ownership in a certain company or portfolio. The metric describes the carbon intensity of an investment amount. A company's share of emissions is determined by the value of shares held / the company's market cap. For this to be accurate, it is important to control for the date of measurement and financial information used.

28 this metric combines the above emissions / USD invested approach with a similar logic to determine an investor's share of revenue and subsequently dividing one by the other. By linking to

Intensity29, hoever available data may not follow this pattern entirely.

European data is available in abolute terms and in GHG emissions per employee, whereas US data is available in absolute terms and in GHG emissions per revenue unit. The available data has been categorized using the GICS cector categories and ssubjected to a regression analysis and companies lacking the reuqired data (Employees for Europe and Revenues for the US). The correlation between GHG and number of employees is shown below.

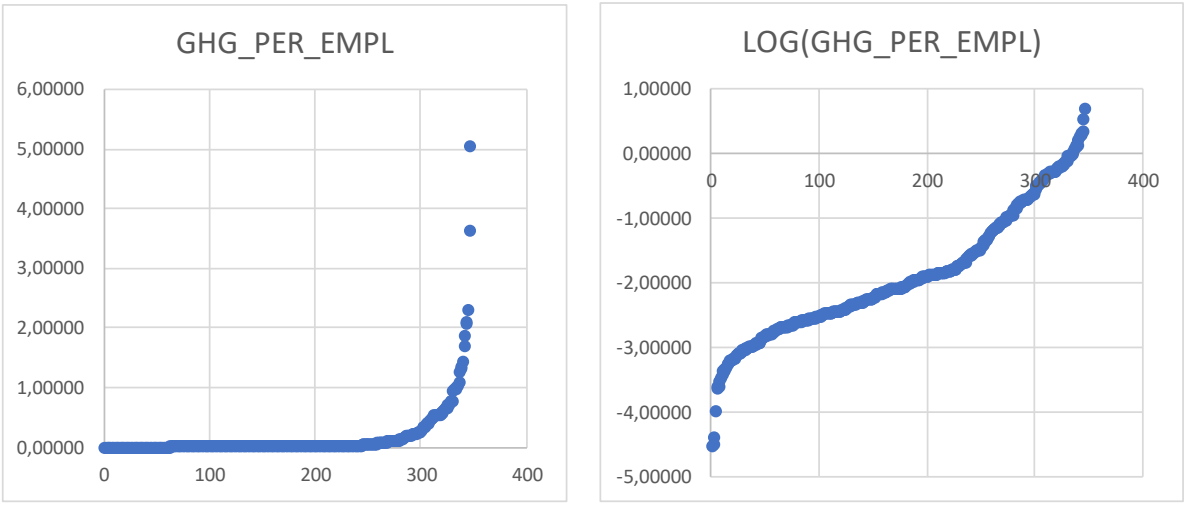


FIGURE 3 : GHG per employee Lost 4 further companies for lack of employees number => *n*=347.

It is remarkable that the Financial Sector and the Health Care Sector are the sector with the lowed GHG emissions per employee based on self-reported information according to the Ccarbon Disclosure Project and and Bloomberg smoothed Scope 1 and 2 GHG emissions.

revenue, the metric aims at describing the greenhouse gas efficiency of the underlying companies.

[29] "this metric measures exposure to carbon- intensive companies and addresses many of the concerns raised. For example, the metric can be applied across asset classes, is fairly simple to calculate, and does not use investors' proportional share of total equity and, therefore, is not sensitive to share price movements." The TCFD goes on to explain the methodology of the metric – "Scope 1 and Scope 2 GHG emissions are allocated based on portfolio weights (the current value of the investment relative to the current portfolio value), rather than the equity ownership approach. Gross values should be used."

	GICS-Sector	GHG per employee	log(GHG/e.)	#
10	Energy	0,680	-0,167	17
15	Materials	0,307	-0,512	41
20	Industrials	0,039	-1,413	74
25	Consumer Discretionary	0,016	-1,801	36
30	Consumer Staples	0,019	-1,724	26
35	Health Care	0,010	-2,021	21
40	Financials	0,003	-2,586	61
45	Information Technology	0,004	-2,448	15
50	Communication Services	0,015	-1,821	24
55	Utilities	1,159	0,064	21
60	Real Estate	0,092	-1,037	11
				347

Table 2 The Sector Taxonomy

As can be seen the Financial Industry and the Health Care Sector are ranking lowest on carbon emissions – at least using the standard approaches above.

US data used for GHG per revenues

Also when comparing the sectors using GHG emissions per revenue the Health Care and the Financial sector stand out even when looking ointo in the low carbon sectors alone.

The low carbon

	GICS-Sector	GHG per revenue	log(GHG/r.)	#
10	Energy	1,151	0,061	6
15	Materials	0,230	-0,639	9
20	Industrials	0,084	-1,074	16
25	Consumer Discretionary	0,088	-1,057	11
30	Consumer Staples	0,084	-1,078	9
35	Health Care	0,012	-1,930	16
40	Financials	0,002	-2,635	6
45	Information Technology	0,009	-2,027	10
50	Communication Services	0,026	-1,593	3
55	Utilities	2,836	0,453	13
60	Real Estate	0,391	-0,408	9
				108

Table 3 : Carbon Emissions per sector

Lost 25 further companies for lack of revenues number => *n*=108.

Have to check for better revenues source.

Estimation for the full sample with *y = log(GHG per revenues)*

n=108	**Coefficient**	**t-value**
sector specific constant	**0,909*** **	12,69
log(employees)	**-0,101*** **	-4,63

Table 4 Regression analysis results for full Bloomberg sample

Estimation for the low carb sectors Health Care, Financials, IT, and Communication only:

n=35	**Coefficient**	**t-value**
sector specific constant	**0,900*** **	5,54
log(employees)	**-0,074**	-1,00

Table 5 : Regression Results for low carbon sectors health care, finance and IT

Looking at the full sample, the GHG emissions per USD of revenues significantly shrinks with rising size of the firm (measured by the number of employees).

However, the number of employees has no significant influence for the low carb sectors. Obviously, the influence of a firm's size is not as straight and simple as the full sample results suggest. Consequently, we have to assume that different specifications will be necessary for the financial sector.

This raises the question how insurance companies deal with the carbon issue as it appears from strucutred data that they are not one of thecarbon heavy industries.

Analysing Data from the Carbon Disclosure Project

Disclosure Data from the Carbon Disclosure Project analysing the Fortune 500 companies[30] shows the Fortune 500 biggest insurers and biggest financial insitutions Scope 1 and 2 emissions, however lacks Scope 3 emissions entirely .

[30] http://fortune.com/fortune500/

Insurance					
Firm	Scope 1	Scope 2	Firm	Scope 1	Scope 2
Allianz SE	83443.00	176675.00	Allianz SE	83443.00	176675.00
Munich Re	64755.00	87106.00	Allstate Cor	40796.00	150401.00
AXA Group	51886.1	119929.95	AXA Group	51886.1	119929.95
Allstate Cor	40796.00	150401.00	Marsh & Mc	3429.21	97423.43
Aviva	23849.00	75733.00	Munich Re	64755.00	87106.00
Ace Ltd.	12912.00	39791.00	Aviva	23849.00	75733.00
Swiss Re	4850.00	8800.00	Ace Ltd.	12912.00	39791.00
AFLAC Incc	3884.00	18536.00	AFLAC Incc	3884.00	18536.00
Marsh & Mc	3429.21	97423.43	Swiss Re	4850.00	8800.00

Finance					
Firm	Scope 1	Scope 2	Firm	Scope 1	Scope 2
Power Asse	8960000.00		Bank of Am	116666.00	1421829.00
Ambev - Cla	757236.00	235799.00	Wells Fargc	93904.00	1333372.00
Altria Group	283926.00	236169	JPMorgan C	83343.00	1219748.00
Manulife Fir	213835.00	195565.00	Citigroup In	35569.83	993687.28
Bank of Am	116666.00	1421829.00	Barclays	46757.00	786547.00
Deutsche B	94031.00	443165.00	HSBC Hold	64918.00	688827.00
Wells Fargc	93904.00	1333372.00	Brookfield A	67649.00	587875.00
JPMorgan C	83343.00	1219748.00	Royal Bank	66586.00	497763.00
BNP Pariba	70319.00	388323.00	Deutsche B	94031.00	443165.00
Brookfield A	67649.00	587875.00	PNC Financ	47606.00	398414

Table 6 :Scope 1 and Scope 2 emissions according to CPD

Ta

Regarding the self reported Scope and 2 emissions insurers are just a tiny portion of total emissions.

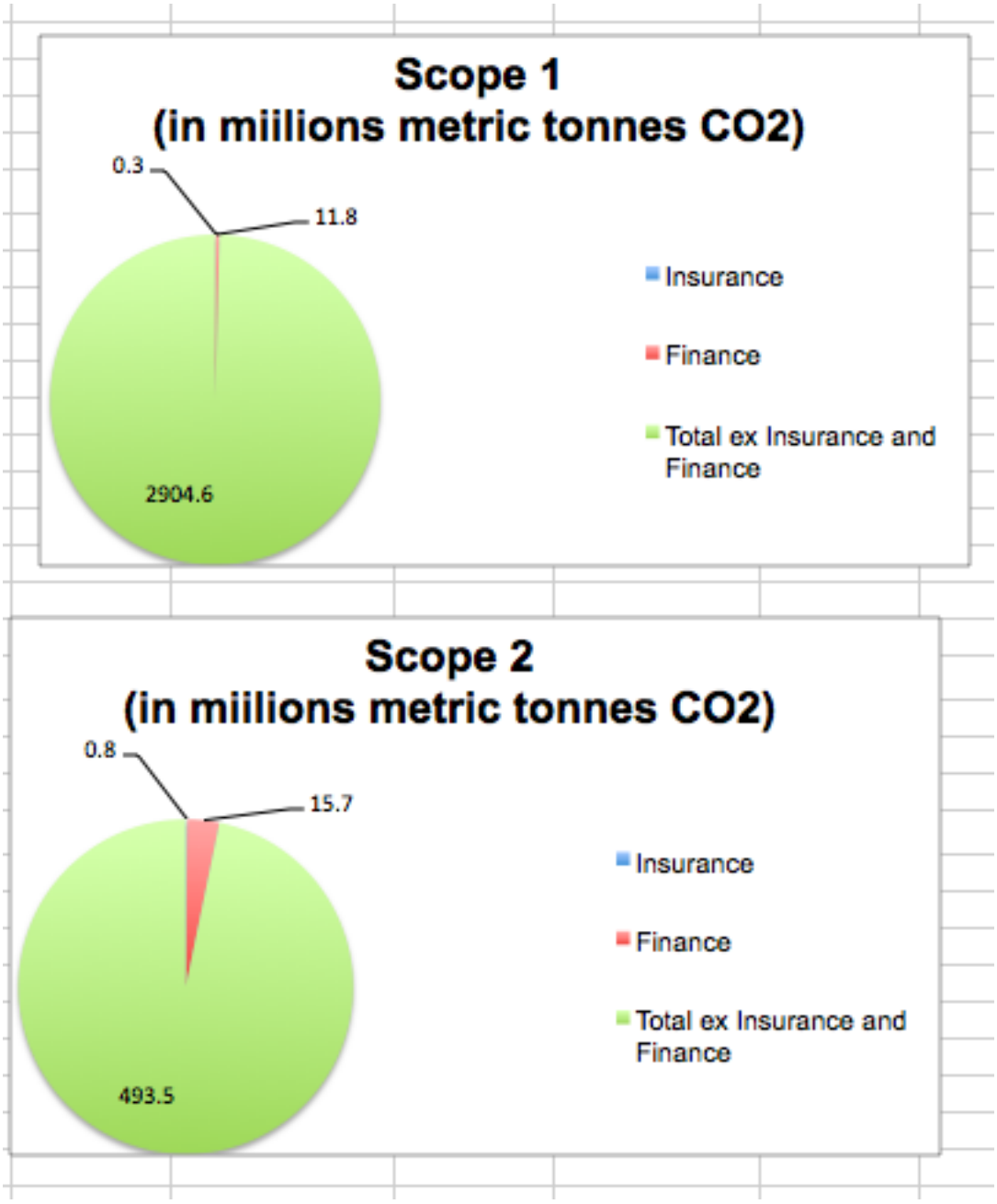


Figure 4 : Scope 2 reported emissions share of Insurrers

and a number of the biggest Fortune 500 Insurance companies do not report emissions at all.

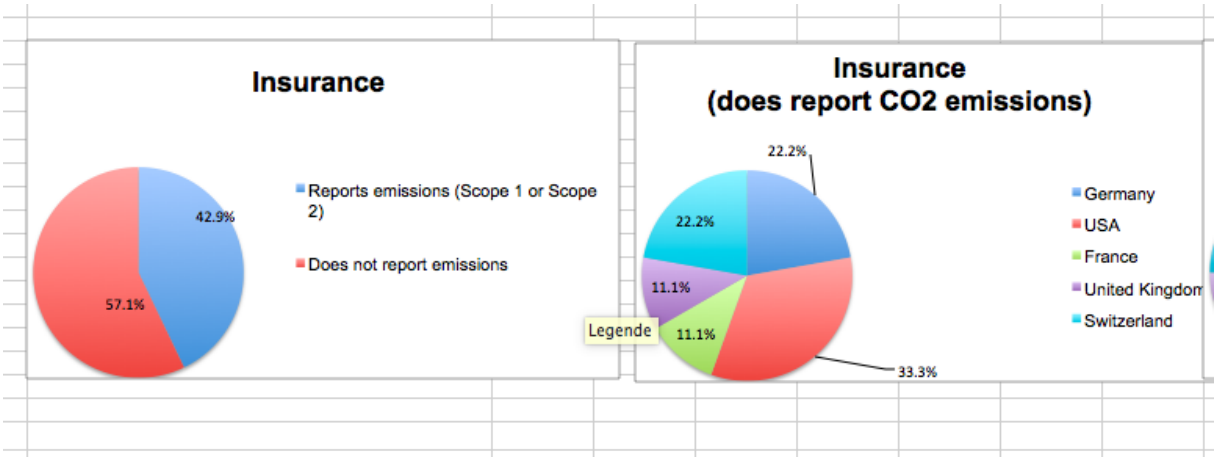


Figure 5 : Reporting and Non Reporting Insurance Companies

As can be seen from Figure 5 above less than half of insurance companies in the Fortune 500 index report scope 1 and scope 2 emissions. None of them reports Scope 3 emissions (financed emissions).

Based on structured data analysis using data from the Carbon Disclosure Project [31] and the Carbon Disclosure Standard Board [32]it may be concluded that CO 2“ emissions have no influence on insurance revenues and are just a tiny portion of the overall emissions volume. Structured data regarding the influence of insurers carbon footprint on share prices could not be collected via paid Bloomberg data sets, nor via the Carbon Disclosure Project or other freely available sources. The best available calculation was the GHG emissions per employee or per USD revenue. The author has not conducted a research on relating the CDP reported Scope 1 and 2 emissions to the market price of insurance companies. This may be an interesting focus of another research. The researcher gained the information to get an overview what is reported, how do the CO2 emissions differ per industry and whether there’s a relation between the sheer size of the company and carbon emissions, which – for the insurance industry does not hold true. Different from other industries insurance companies are intermediaries and trustees with fiduciary duties and therefore the bulk of carbon emissions may be scope 3 emissions (financed emissions), so financed or induced emissions through the business model of the insurer to insure other sectors business from hazards and through buying carbon loaded or less carbon loaded portfolios of assets under the pension schemes they manage. All these emissions fall into the scope 3 emissions taxonomy. Reports on Scope 3 emissions are harder to calculate and this may be the reason why no insurer has made transparent such data. So the carbon impact of insurance companies might be heavily

[31] The Carbon Disclosure Project https://www.cdp.net/en
[32] The Carbon Disclorue Standard Board Framework https://www.cdsb.net/what-we-do/reporting-frameworks

underestimated when looking only into scope 1 and scope 2 emissions. – as insurers different from manufacturing companies have the bulk part of emissions induced through the services they provide.

Apart from the fact, that all carbon figures are self-reported, in all publicly available data, in all self-reported data in the CDP, as well as in the Carbon Disclosure Standards Board Framework (CDSBF), and even the GRI, Scope 3 emissions are missing all over the place. Even in the Bloomberg Database (paid service) there is no revelation of the scope 3 emissions of insurance companies, i.e." financed emissions", which may be the most important part of emissions regarding insurance companies are neglected. It could be argued that Scope 3 emissions the emissions induced through investments and finance of insurance companies and their assets under management may outgrow the Scope 1 and 2 emissions by a multiple.

1.5 Unstructured Data Research and Analysis

First of all it must be noted, that relevant unstructured information can be found through very specialised services only, like Pitchbook using more than 650000 webcrawlers scanning and capturing relevant financial and extrafinancial information from the internet.[33] Less sophisticated or less specialized tools do not find the relevant data in the same quality and precision in a webcrawling process. The author therefore has used more general platforms to get an overview about the topic (like weblizard[34] and googletrends[35], but also highly specilized platforms like Sentione[36] or Pitchbook to get more insight. Pitchbook in particular complements the web crawling process by integrating specialized data teams that collect, calculate and verify key figures to build in-depth datasets with information you cannot find anywhere else. These key figures then are then subject to preventative validations, corrective validations and manual reviews to relentlessly vet every piece of data.

[33] www.pitchbook.com

[34] UNEP Live Webintelligence: http://www.uneplive.org/webintelligence and UNEP EcoResearchNEP https://unep.ecoresearch.net/weblyzard/en/

[35] https://trends.google.de/trends/explore?q=Paris%20climate%20agreement,%2Fm%2F01317vcn,Carbon%20Tracker,%2Fg%2F11bc5tdg03,carbon%20crash

[36] Sentione : https://sentione.com/pro#/dashboards/show/156370

Carbon emissions may be relevant for insurance companies under two perspectives. First of all, they have to insure or re-insure carbon intense sectors and business practices which exposes them to Climate Adaptation Risk. Does the lack of reporting on insurance of carbon intense business (scope3) imply that insurance companies have not yet factored in climate-adaptation risk or climate-related risks into underwriting premiums and deductibles? At lease the UNEP-FI assumes so (UNEPFI 20018).[37] The insurance sector for example usually calculates risk on the basis of historic loss records, rather than using climate models and predictions (UNEPFI 2018). Based on IRIS[38] data analysis insurance companies run the risk of getting stranded with carbon intense asset portfolios. A number of researcher[39] Norways Climate Risk Commission [40] and civil society organizations concerned with climate adaptation risk and stranded assets [41] like the carbon tracker initiative[42], the two degrees initiative[43] and most notably the Science Based Targets Initiative[44] continue to point out that insurance portfolios might be at risk by stranded costs of carbon. The voluntary self-reporting schemes allow insurance companies to neglect their most important emissions: financed emissions or scope 3 emissions.

When getting a short insight from google trends it appears that the Paris Climate Agreement[45] is getting some attention in the social media, however the science based reports like the

[37] UNEPFI www.unepfi.org/.../insurance/unep-fi-working-with-16-global-in..

[38] IRIS – Impact Reprting Investment Standards is the catalog of generally-accepted performance metrics IRIS is managed by the Global Impact Investing Network (GIIN),

[39] Bretzger, Lukas Soretz Susanne 2018 ETH insurance companies run the risk of getting strandet with carbon intense asset portfolios, Mingyu Fang, Ken Seng Tan, Tony S. Wirjanto. Sustainable portfolio management under climate change. Journal of Sustainable Finance & Investment, 2018; 9 (1): 45 DOI: 10.1080/20430795.2018.1522583

[40] https://nettsteder.regjeringen.no/klimarisikoutvalget/files/2018/01/Ploeg_klimarisiko_17January2018.pdf

[41] https://www.esrl.noaa.gov/gmd/ccgg/carbontracker/

[42] http://carbontracker.live.kiln.digital/Unburnable-Carbon-2-Web-Version.pdf

[43] https://edition.cnn.com/specials/opinions/two-degrees

[44] https://sciencebasedtargets.org

[45] Parise Climate Agreement : https://unfccc.int/process-and-meetings/the-paris-agreement/the-paris-agreement: Having achieved global ratification, the focus of COP events and global climate discussions is now fully focused on the 'how'. This 'how' deals with countries putting their Nationally Determined Contributions1 (NDCs) into action and the extent to which the aggregation of those NDCs contribute towards the 2 degrees target. This was demonstrated at COP22 in Marrakech and COP23 in Bonn, with discussions on the Paris "rulebook", which establishes the technical rules and processes required to fulfil the Paris Agreement, with the deadline for the finalized rulebook being COP24 in late 2018. The question for countries to answer during COP22 and COP23 was the extent to which they are meeting their NDCs covering two aspects – financing climate change mitigation (such as through green investment vehicles) and implementing carbon emissions reductions (including changes in national energy policy for example).

Carbon Tracker Report[46] on carbon risk, the investors initiatives like 100 % Divest Invest Movement [47], the carbon crash[48] highlighted by the 2 Degrees initiative get very low and decreasing attention. It is remarkable though that the Paris Climate Agreement now is getting popular and even more reported about that on the big insurer Allianz. However there is no connection found between reporting on Allianz and Paris, as a Sentido analysis

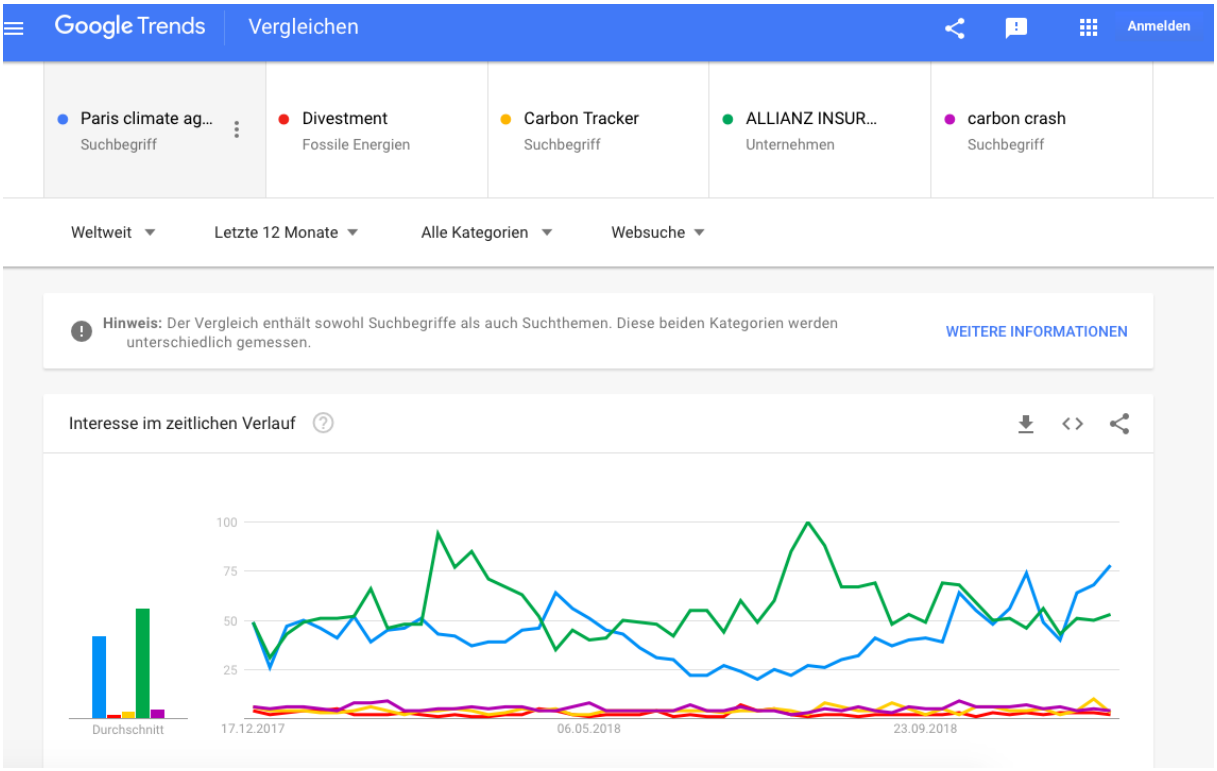


Figure 6: Google Trend Analysis on Paris Climate Agreement, Carbon Tracker, Carbon divestment of Fossile Energies, Carbon Crash and Allianz.

The Paris Agreement and the effects of Climate change attract stakeholders to inquire about the topic and ways to separate companies fueling climate change from those working on climate change abatement strategies, taking a climate resilient or 2 degree trajectory. One can expect that news and social media coverage, scientists and communication professionals want to know how different stakeholders perceive climate risks, climate adaptation risks and also impacts and opportunities of a climate smart economy. However compared to total

[46] Carbon Tracker : https://www.carbontracker.org/reports/mind-the-gap/
[47] The Divest Invest Movement is a coalition of investors that entirely divest carbon assets
[48] 2 Degrees Initiative : https://www.2degrees-investing.org.

information amount, climate strategies of the insurance industries and companies per se contribute only a tiny part in the news and social media. A common tool used in behavioral finance is sentiment analysis, which relates the news about share to their share price development. Theories in behavioral economics seem to match with the phenomenon of social media, which is reflected in sentiment analysis. Finding a suitable quantitative measurement for investor sentiment over time is a rather tricky task. Market sentiment data is difficult to obtain, and fluctuation happens rapidly based on emerging news, daily happenings and long-term perspectives changes.

News agencies supply a vast quantity of undifferentiated general news and it is not clear what is the relationship between such news and a specific financial instrument or commodity. In order to use news specific to an instrument/commodity, it is important that a language processing system has access to the right terminology which is organised systematically under the rubric of an applications ontology. The next level of linguistic description is that of grammar and morphology which are essential for disambiguation – natural language is inherently vague and ambiguous and grammatical and morphological analysis can help in identifying and eliminating ambiguity (Rentoumi et al 2009). A research with the weblizard on insurance companies and the use of finanzen.net sentiment analysis did not provide specific information focused on carbon related risk and insurance companies. A refined research with using IRIS Data Analysis Tool [49] provided at least the major themes that stakeholders appear to be interested in when looking into the relation between insurance companies and their carbon strategies. The following topics show up as driver for stakeholders, investors and Insurers .

[49] https://www.cs.odu.edu/~ccartled/Teaching/2017-Fall/DataAnalysis/Presentations/030-iris-dataset.pdf

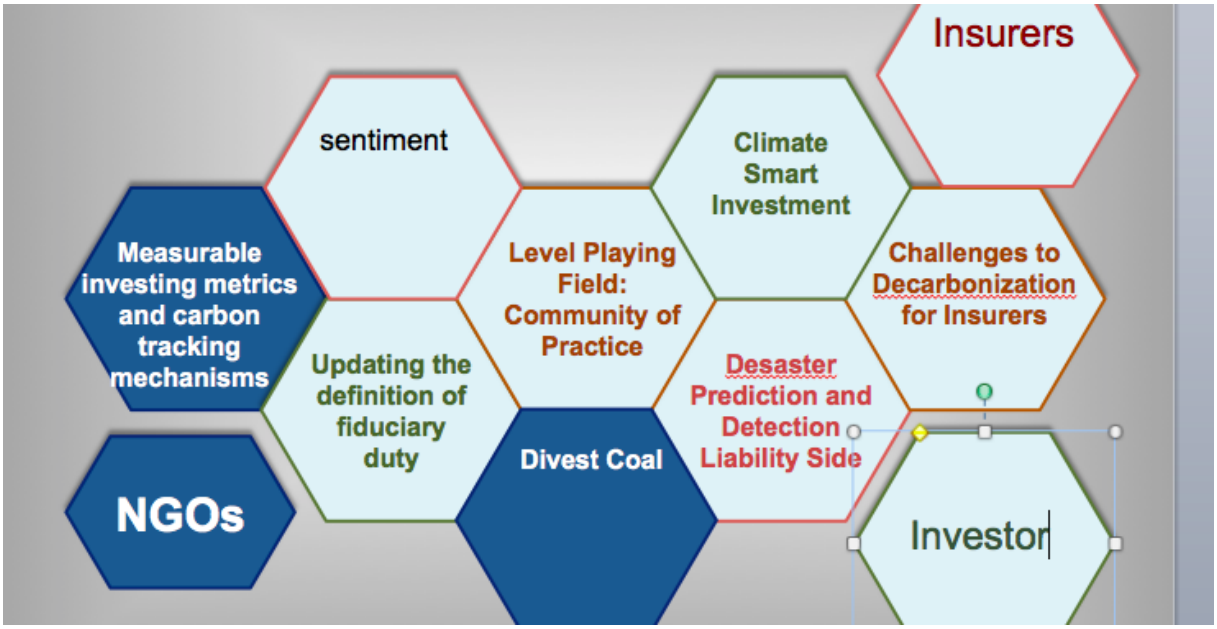


Figure 7 : Focus on Carbon according to IRIS Database

Whereas investors with regard to carbon strategies focus on climate smart investment[50], science based targets sentiment, fiduciary duties, NGOs focus more on carbon tracking, measurable metrics and divestment in coal. Insurers themselves seem to be concerned with the challenges of de-carbonization, the creation of a community of practice and disaster prediction models as well as outplacement of carbon risk using CAT bonds or – in recent time pay for performance schemes using resilience bonds.

According to a search on carbon risk and the financial sector on NGO website, venture capital and financial industry websites (see Annex3) shows however that there is a broad push for insurance companies by stakeholders to divest from carbon. Likewise there appears to be a growing awareness within the insurance market to divest carbon using risk based approaches.

Only recently, the focus of the climate change debate has moved from being mainly a scientific, environmental and social responsibility to becoming one of the core drivers of socio-economic development and risk management in the insurance industry.

[50] see for instance Charles Schwabhttps://intelligent.schwab.com/public/intelligent/home.html?src=SBA&keywordid=21381260222&s_kwcid=AL!5158!10!78821299254528!21381260222&ef_id=We735AAABGp1VvE6:20181216150650:s

An analysis of influencers on blocking carbon from insurance[51]s provides the following players:

Many insurers (Allianz, Munich Re, SwissRe, AXA, AIG Axis, Berkshire Hathaway, Chubbs, Generali, Lloyds , Hannover Re, Metlife, Legal and General, SCORE, MAPFRE, QBE, Zurich Re SOMPRO, TIIA) have announced to divest in their asset management strategies form carbon intense assets and only allow for portfolio selection of assets which make less than 30 percent of their turnover in carbon intense sectors.[52] In 2015 AXA became the first global insurer to reduce investment in coal and now 15 insurers with just over 4 trillion USD in assets have taken action.1 They are collectively divesting about $20 billion in equities and bonds from coal companies or are ceasing to underwrite coal projects, thus making coal uninsurable. The early movers represent about 13 percent of all the assets managed by the global insurance industry. In June 2017, 13 organizations engaged in the campaign asked 25 leading insurance companies around the world to stop underwriting coal, divest their assets from the coal sector, prepare longer-term plans to exit other fossil fuels, and scale up their support for clean energy solutions.[53] An increasing number of leading insurance companies have pulled $20 billion out of investments in coal and a growing number are refusing to underwrite new coal projects, reveals a new scorecard on the industry. This scorecard assesses how insurance companies are performing on coal and climate change. In all, 15 insurers with over $4 trillion in assets have now taken or are planning action on coal, divesting an estimated $20 billion in equities and bonds or ceasing to underwrite projects.[54]

[51] using pitchbook trial access

[52] The Guardian 2018

6 The letter was signed by 350.org, AVAAZ, Divest Invest Individual, Friends of the Earth France, Greenpeace Switzerland, Market Forces, Re:Common, ShareAction, the Sierra Club, the Sunrise Project, Rainforest Action Network, Urgewald, and the Waterkeeper Alliance

[53]

[54] Unfriend Coal : https://unfriendcoal.com/scorecard/

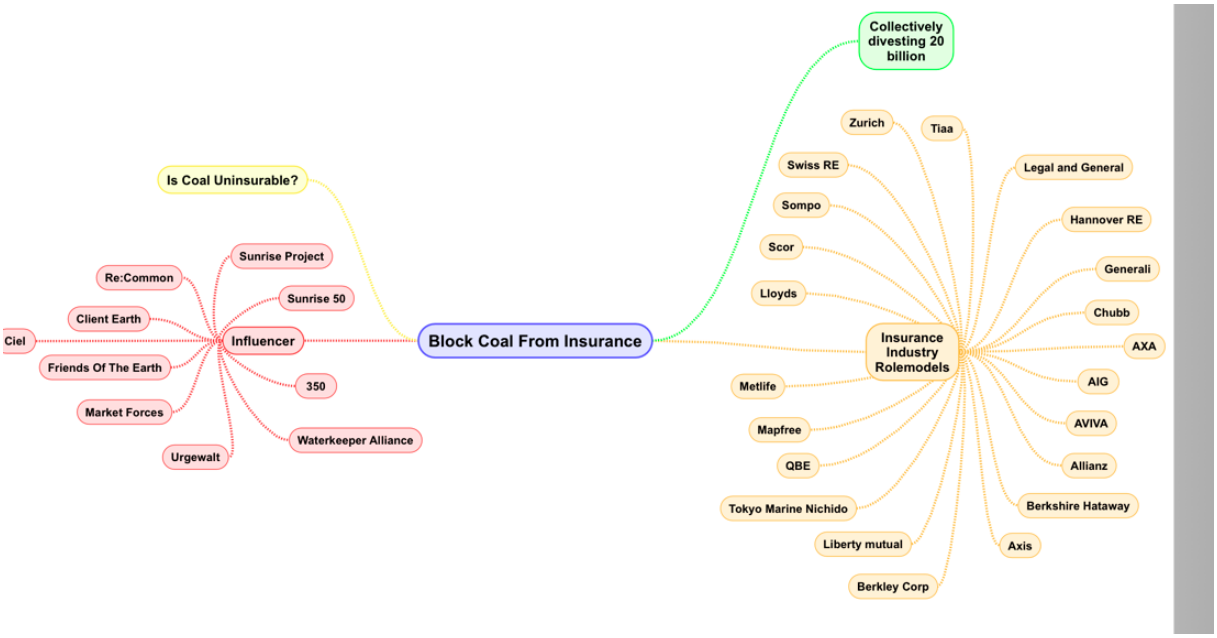


Figure 7:22 Industry leaders in insurance divesting from coal.

Main influencers to prevent insuranca companies to continue to invest in coal intense models are various NGOs like Friends of the Earth, Urgewalt, Water Keeper Alliance but also insurance companies which created initiative around the question of divesting coal. By end of 2018 an initative of more than 22 insurance companies has role-modeled an divested 20 bn in coals intense assets over the past 12 months (Figure 7) as a response to pressure from stakeholders mainly science based insitutions, think tanks and NGOs. .

Spin Doctors

A research on Pitchbook.com has provided an analysis of spin doctors for this divestment move. In addition to a number of voluntary industry initiatives focusing on carbon footprinting (CDP, CPSB, for instance), carbon divesting (Divest-Invest Movement), policy makers in EU member states and globally, think tanks like the task force on climate related financial disclosure, financial industry initiatives like climate bonds, green bonds, banks, NGOs, specialized industry advisors like The Carbon Tracker, Southpole, ISSEthisc, Science Based Targets Group, ,Multilaterals and Development Agencies together brought about the shift in perception of asset managers in the insurance industry. The approach to divest from carbon intense assets and ending insurance for carbon loaded assets follows a clear de-risking assets approach.

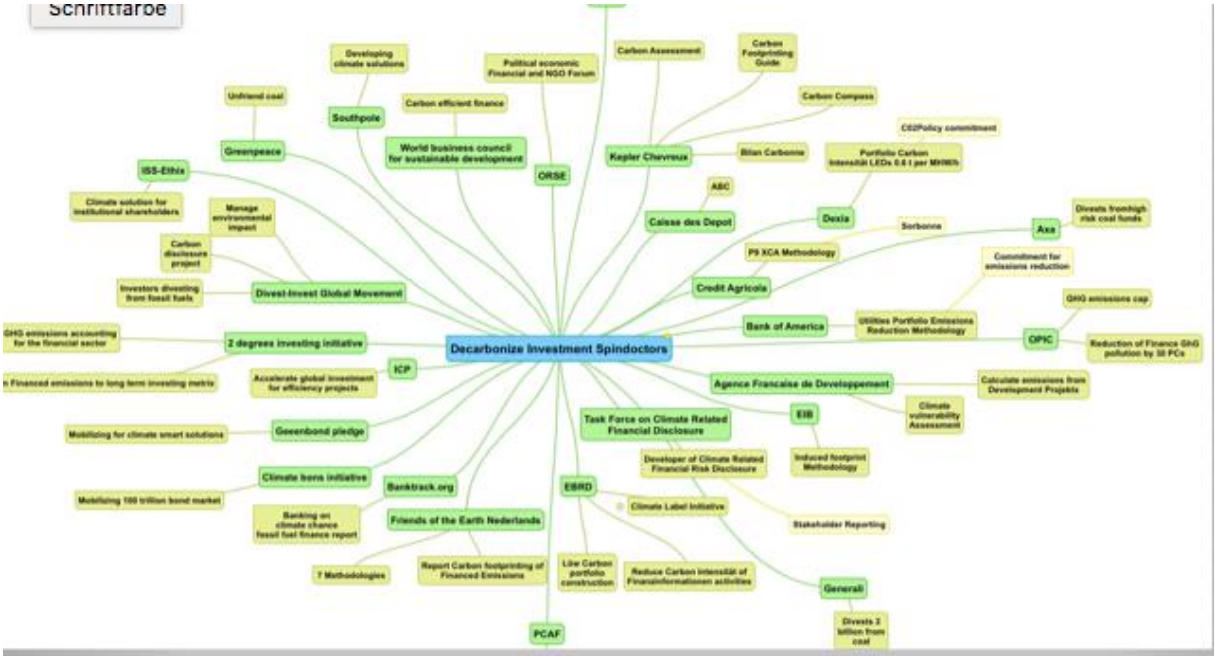


Figure 8: Spin Doctors of Devesting coal in insurance .

2. Conclusions::

One conclusion for this research is that the voluntary self-reporting schemes fall short to measure the most important part of emission – scope 3 emissions in the financial industry and there is no reliable data available on the induced of financed emissions of insurers. So the carbon enabling role of enrurers through finance, investment and insuring carbon loaded sectors is neglected by available structured data.

Nonetheless insurance companies have been targeted by stakeholders and are seen as the most relveant industry to stop carbon finance.

Insurers themselves meanwhile see a risk of stranded assets in carbon loaded industries and therefore an increasing number of industry leaders has adopted a carbon or climate strategy, is engaging in divestment of carbon loaded industries and even some are looking into science based targets fro financing the 2 degree economy.

Among the reasons for divesting are a policy push for reducing losses from climate adaptation risks, preventing stranded carbon and avoiding carbon risks. Insurers have found vessels for cooperation and creation of an ecosystem by using the same think tanks and spin doctors that created a coordinated effort for divestment of carbon and therefore a level playing field.

3. Literature

Banktrack.org: a Climate Strategy for Banks available at https://www.banktrack.org/download/a_climate_strategy_for_banks_know_your_financed_emissions_1/1165opm_factsheet_banken_deflow.pd

Botta, Jochen et al. Carbon Accounting und Controlling – Grundlagen und Praxisbeispiel

Deutsche Post DHL (= Jürgen Weber [Hrsg.]: Advanced Controlling. Band 83). Wiley, 2012, ISBN 978-3-527-50697-2, 3 Relevanz von Treibhausgasemissionen, S. 15–24.

Challenge, C. (2000). *The Insurance Company Case.* Amsterdam: Sentient Machine Research. Also a Leiden Institute of Advanced Computer Science.

CDP – The Carbon Disclosure Project: https://www.cdp.net/en

CDSB: https://www.cdsb.net/what-we-do/reporting-frameworks

Darbyshire, J. H. (2016). *The PRICING and TRADING of Interest Rate Derivatives*.Dietrich, D. (2015). *Data Science and Big Data Analytics: Discovering, Analyzing, Visualizing and Presenting Data.*

Eitelwein und Lukas Goretzki: Carbon Controlling und Accounting erfolgreich implementieren – Status Quo und Ausblick. In: ZfCM Controlling & Management. Band 50, Nr. 1, Februar 2010, doi:10.1007/s12176-010-0010-6. EMC Education Services.

Economist. (2016, March 12). *Technology Quarterly*. Retrieved from After Moore's law: http://www.economist.com/technology-quarterly/2016-03-12/after-moores-law

Elkan, C. (2001). Magical thinking in data mining: lessons from CoIL challenge 2000. *Proceedings of the seventh ACM SIGKDD international conference on Knowledge discovery and data mining,* (pp. 426-431).

Fodor, I. K. (2002). A survey of dimension reduction techniques. *Center for Applied Scientific Computing, Lawrence Livermore National Laboratory 9* , 1-18.

Gartner, I. (n.d.). *IT Glossary: Big Data*. Retrieved from http://www.gartner.com/it-glossary/big-data/ 17STATUS, HOME_ENVIRONMENT, FIRE_PRIVATE_POLICIES, FAMILY_ACCIDENT_POLICES, CUSTOMER_TYPE, PROPERTY_COVER HOUSE_OWNER_RENTED and ECONOMICALL_DEPRIVED

Fortune 500 Index: http://fortune.com/fortune500/

Google. (2012). *internet live stats*. Retrieved from Google Search Statistics: http://www.internetlivestats.com/google- search-statistics/

Guyon, I. a. (2003). An introduction to variable and feature selection. *Journal of machine learning research*, 1157- 1182.

Hanley, J. A. (1982). The meaning and use of the area under a receiver operating characteristic (ROC) curve. In *Radiology 143.1* (pp. 29-36).

Hardin, D. J. (2017). *Logistic Regression*. Retrieved from The Institute for Statistics Education : http://www.statistics.com/logistic-regression/

IBM. (2013). *Bringing big data to the enterprise*. Retrieved from What is big data?: https://www- 01.ibm.com/software/data/bigdata/what-is-big-data.html

Jolliffe, I. (2002). *Principle Component Analysis.* John Wiley & Sons, Ltd.

King, J. E. (2008). Binary logistic regression. In *Best practices in quantitative methods* (pp. 358-384). SAGE.

Laney, D. (2001). 3D data management: Controlling data volume, velocity and variety. pp. META Group Research Note, 6, 70.

Mac Nally, R. (2000). Regression and model-building in conservation biology, biogeography and ecology: the distinction between–and reconciliation of–'predictive'and 'explanatory'models. In *Biodiversity and Conservation 9.5* (pp. 655-671).

Marr, B. (2015, December 15). *How Big Data is Changing Insurance Forever*. Retrieved from Forbes: http://www.forbes.com/sites/bernardmarr/2015/12/16/how-big-data-is-changing-the-insurance-industry- forever/#9e78bce435e8

Mayor, T. (2015, March 20). *Data centers in Iceland? Yes, really!* Retrieved from COMPUTERWORLD: http://www.computerworld.com/article/2899654/data-centers-in-iceland-yes-really.html

Putter, P. V. (2000). *Insurance Company Benchmark (COIL, 2000) Data Set*. Retrieved from UCI Machine Learning Repository: https://archive.ics.uci.edu/ml/datasets/Insurance+Company+Benchmark+%28COIL+2000%29

Pitchbook Data Platform https://pitchbook.com/products

Ramavajjala, V. &. (2012). Policy iteration based on a learned transition model. *Joint European Conference on Machine Learning and Knowledge Discovery in Databases* , 211-226.

Rouse, M. (2014). BIg data. *Big Data and Cloud Business Intelligence*, Tech Targert,30. Retrieved from Big Data and Cloud Business Intelligence.

Schaltegger Stefan and Maria Csutora: *Carbon accounting for sustainability and management. Status quo and challenges.* In: Journal of Cleaner Production. Band 36, November 2012, doi:10.1016/j.jclepro.2012.06.024.

Smith, H. (2012, March 23). *Big Data FAQs*. Retrieved from ARC Community, arcplan, Inc: https://community.arcplan.com/blogs/communityannouncement/big-data-faqs

Sentione Data Platform https://sentione.com/pro#/dashboards/show/156370

Science Based Targets Initiative: sciencebasedtargets.org

Stechemesser Kirsten and Guenther Edeltraud*: Carbon Accounting: a systematic literature review. In: Journal of Cleaner Production. Band 36, November 2012, doi:10.1016/j.jclepro.2012.02.021.*

TechAmerica. (2012). *Demystifying big data: A practical guide to transforming the business of Government*. Retrieved from http://www.techamerica.org/Docs/fileManager.cfm?f=techamerica-bigdatareport-final.pdf

UNEP Live Webintelligence: http://www.uneplive.org/webintelligence

UNEP EcoResearchNEP https://unep.ecoresearch.net/weblyzard/en/

World Resources Institute, World Business Council on Sustainable Development (Hrsg.): Corporate Value Chain (Scope 3) Accounting and Reporting Standard: Supplement to the GHG Protocol Corporate Accounting and Reporting Standard. 2011 (ghgprotocol.org [PDF]).

3. Annexes

Annex 1 : Climate Change and Investment Initiatives according to ISS Ethics Climate Solutions Carbon Footprint Report 2018

Location	Initiative	Description	Owner	Requirement	Status
Global	Task Force on Climate-related Financial Disclosure (TCFD)	Voluntary, consistent climate-related financial risk disclosures for use by companies in providing information to investors and other stakeholders.	Self-governance	Voluntary	In place
	Portfolio Decarbonization Coalition (PDC)	Coalition of investors committing to decarbonizing their investment portfolios	Self-governance	Voluntary	In place
	Montréal Pledge	The Pledge formalizes commitment to the PDC, mobilizing investors to measure, disclose and reduce their footprints.	Self-governance	Voluntary	In place
	ISO 14097	Framework and principles for assessing and reporting investments and financing activities linked to climate change.	Self-governance	Voluntary	Expected
	Asset Owners Disclosure Project (AODP)	A ranking of climate financial disclosures of pension funds, insurers, sovereign wealth funds and endowments.	Civil Society	Voluntary	In place
Europe (EU)	IORP II	EU pensions directive with specific content on climate change requirements.	Regulator	Mandatory	In place
	High Level Expert Group (HLEG)	A body of 20 experts advising the European Commission on how to better integrate sustainability considerations in the EU's financial policy framework.	Regulator	TBD	Expected
France	Article 173 of the Energy Transition Law	Legislation on mandatory carbon disclosure requirements for listed companies and carbon reporting for institutional investors.	Regulator	Mandatory	In place
California	Climate Risk Carbon Initiative	Initiative to evaluate the degree to which California investors are impacted by effects of climate change on the economy.	Regulator	Voluntary	In place
Sweden	National Pension (AP) funds	Co-ordination of carbon footprint reporting for portfolios within the AP funds.	Self-governance	Voluntary	In place
Switzerland	Ministry of the Environment (FOEN)	Report by the FOEN to Swiss pension funds and insurers testing the climate compatibility of portfolios.	Regulator	Voluntary	Announced
Netherlands	Platform Carbon Accounting Financials (PCAF)	Collaboration of 12 Dutch financial institutions to develop an accounting methodology for emissions.	Self-governance	Voluntary	In place

Figure 1 - Climate change and investment initiatives[3]

Annex 2 MSCI ACWI and Russells 1000 based on ISSEthics Research 2016[55]

Russell 1000					
Year	Total Emissions	Disclosing companies	Disclosure (company) %	Disclosure (weight) %	Average Trust Metric
2014	2,558,530,761	337	32%	63%	0.76
2015	2,709,875,223	468	45%	79%	0.77
2016	2,540,710,690	390	39%	73%	0.82

MSCI ACWI					
Year	Total Emissions	Disclosing companies	Disclosure (company) %	Disclosure (weight) %	Average Trust Metric
2014	6,144,561,423	741	58%	70%	0.81
2015	5,775,723,157	951	73%	86%	0.82
2016	5,978,593,072	884	67%	80%	0.86

Figure 3 - Disclosure Level and Quality of Russell 1000 and MSCI ACWI[2]

[55] https://www.msci.com/documents/10199/9386d956-d8a5-4cf1-9eaa-fc597c10ad81 and https://investinganswers.com/financial-dictionary/stock-market/russell-1000-index-1291

Annex 3 : Table of Resources

References from the Industry:

Milieudefensie (Friends of the Earth Netherlands) published in 2009 the report "Carbon Footprinting of Financed Emissions - Existing Methodologies, a Review and Recommendations". This study provides an overview and comparison of seven existing methodologies and their characteristics.

2° investing initiative published in 2013 the report "From financed emissions to long-term investing metrics - State-of-the-art review of GHG emissions accounting for the financial sector". This study provides an overview and comparison of ten existing methodologies and their characteristics.

Kepler Cheuvreux published in 2015 the report "Carbon Compass - Investor guide to carbon footprinting". This study provides a guide through current and developing carbon assessment tools.

L'ORSE, l'ADEME, l'Association Bilan Carbone (ABC) and la Caisse des Dépôts, with the technical expertise of Carbone 4, have published the methodological guide "Understanding the issues around quantifying GHG emissions in the financial sector" in June 2016 with the participation of around twenty French financial institutions, NGOs and experts. The purpose of this guide is to assist a wide range of players in the financial sector (banks, insurers, asset managers) in measuring their direct and indirect GHG emissions. It offers an overview of the issues, identifies and analyses a range of existing tools and methodologies and provides examples of good practice.

Credit Agricole methodology for lending portfolio: the 'P9XCA' methodology was developed in 2011 by Antoine Rose, PhD student from the Paris based Sustainability Chair for Crédit Agricole CIB. It covers commitments to non financial companies and sovereign issuers. Credit Agricole publishes its financed emissions every year in its annual report.

Bank of America methodology for utilities portfolio: the "Utilities Portfolio Emissions Reduction Methodology" describes the methodology used by Bank of America to calculate its emissions reduction commitment for its utilities portfolio. 2007

AFD Carbon Footprint for project finance: simplified analysis tool developed by the French Development Agency to calculate emissions from development projects, also focusing on their vulnerability to climate change. The aim is to allow managers of projects financed by AFD to analyse their carbon content and to enhance project content by integrating climate change.

EIB induced GHG footprint methodology and the EBRD one. January 2007

ATEPF's methodology for retail banking: climate label initiative of the Association for the Transparency and Labeling of Financial Products mentioning the carbon intensity of the activities financed by retail banking products. June 2008

envIMPACT for asset management: Inrate methodology (Switzerland) including scopes 1,2 and 3 of the GHG protocol, the best by far. This is the methodology picked up in the ATEPF's methodology above. It modelizes the GHG emissions of companies over the entire value chain of their products and services. Investors can calculate the carbon footprint of their investments, build low-carbon portfolios or reduce the carbon intensity of existing portfolios.

Twelve Dutch financial institutions – the Platform for Carbon Accounting Financials (PCAF) – have agreed to work together to jointly develop open source methodologies to measure the carbon footprint of their investments and loans. By measuring and disclosing this information they expect to develop more effective strategies that help contribute to a low carbon society, in the hope that other institutions will follow suit.

PCAF was launched via a Dutch Carbon Pledge calling on the negotiators at the Paris Climate Summit in 2015 to take on board the role that investors and financial institutions can play in delivering an essential shift to a low carbon economy.

PCAF has published its final report in December 2017.

The Task Force on Climate-related Financial Disclosures (TCFD) is developing voluntary, consistent climate-related financial risk disclosures for use by companies in providing information to stakeholders.

It published its final report including its recommendations in June 2017.

Bank of America, for example, assesses and reports on greenhouse gas emissions from its utilities portfolio. This is a useful start, but at a minimum should be extended to other GHG intensive sectors such as transportation, manufacturing and agriculture, and to overall portfolio impacts. In 2004, Bank of America committed to "reducing the emissions rate for companies in its utility portfolio 7% by 2008".

Dexia commited in 2008 that the CO2 intensity of its portfolio of power generation assets debt in excess of to USD 10 million and financed in any given year would be less than 0.6 tons of CO2/MWh reducing by 3.5% per year from 2005. It is Dexia policy to remain 30% below the above-stated intensity target of its portfolio of power generation assets. Dexia will thus evaluate on a regular basis the CO2 intensity of its portfolio so as to insure the respect of this target.

The United States Overseas Private Investment Corporation (OPIC) has pledged in 2010 to adopt an annual emissions cap and to reduce GHG pollution in its portfolio of projects by 30 percent in the next 10 years.

More recently, Westpac's climate policy from April 2017 aims to reduce the emissions intensity of its power generation portfolio to 0.30 tCO2e/MWh by 2020.

To get practical, Milieudefensie has also published a special guide "A climate strategy for Banks: Know your financed emissions" in 2009 to assist banks in taking the first steps towards measuring their financed emissions.

https://sentione.com/pro#/dashboards/show/156370

http://www.uneplive.org/webintelligence

https://unep.ecoresearch.net/weblyzard/en/