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Net-Zero Commitments: Fact or Fiction?

11th Energy Finance Christmas Workshop
Macquarie University Sydney

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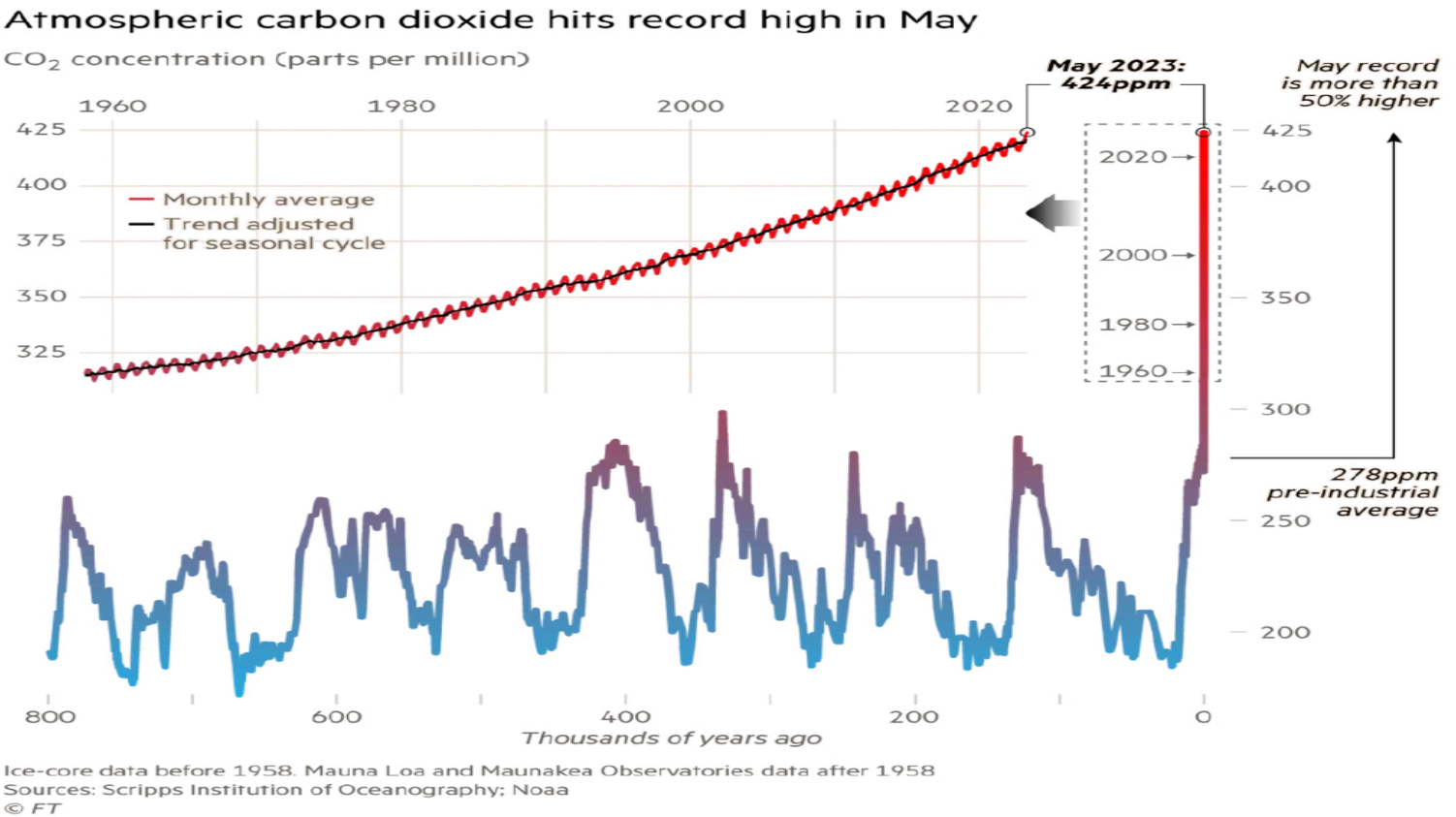
The Anthropocene

- The Anthropocene is a geological epoch which is used to describe the most recent period in Earth's history when human activity started to have a significant impact on our climate and ecosystems.
- Geological epochs are usually determined retrospectively and in most cases named after the extinct index fossil.
- Its official marker could be a small Canadian lake (Crawford Lake) whose sediments capture chemical traces of the fallout from nuclear bombs and other forms of environmental degradation.
- The previous epoch is called the Holocene, which began 11,700 years ago after the last major ice age.

Carbon concentration



A new record high was set in June 2024 with 427 ppm.

Carbon budgets

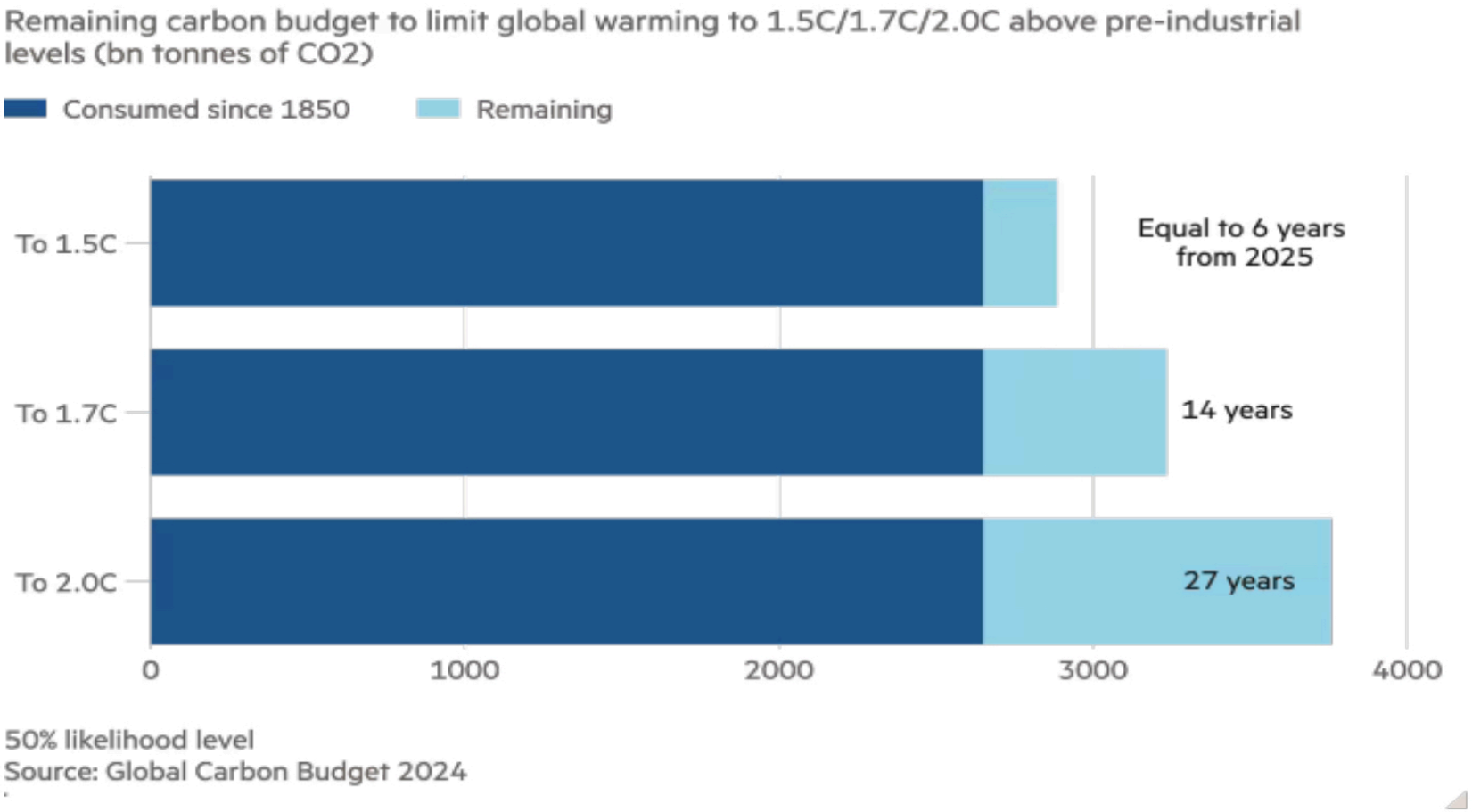


Figure: Remaining carbon budgets for temperature increases

Carbon Budgets and Net Zero Emissions

- Limiting human-caused global warming requires net zero CO_2 emissions.
- Cumulative carbon emissions until the time of reaching net-zero CO_2 emissions and the level of greenhouse gas emission reductions this decade largely determine whether warming can be limited to 1.5°C or 2°C.
- Tipping points – irreversible and self-reinforcing negative changes – could be already crossed at the level of global warming currently reached.
- Tipping points at risk
  - Collapse of the Greenland and West Antarctic ice sheet
  - Abrupt thawing of the permafrost
  - Death of all tropical coral reef systems
  - Collapse of the Labrador Sea current

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Net-Zero Commitments

- Science-Based Target Initiative (SBTi) develop criteria and provide tools to enable businesses and financial institutions to keep global warming below 1.5°C.
  - Companies are expected to develop formal and concrete plans for reaching net-zero emissions that focus on reducing direct emissions and to use carbon offsets only as an additional tool for reaching the target.
  - In some sectors, the transition to net-zero target is limited with the technology in use and thus carbon offsets will play an important role during the transition.
- SBTi has validated targets for 2,079 companies and financial institutions.
- ALDI, Alliance, Bayer, BayWa, Henkel, Mercedes-Benz, Salzgitter, Siemens, Volkswagen . . .

Net-Zero Targets

- Types
  - Net-Zero: balance between emissions and offsets
  - Neutral: Emissions have no net effect on the climate system
  - 1.5°C aligned: Target aligned with scenarios that yield a long-term warming outcome below 1.5°C with some probability, i.e. 50%.
- 151 Countries, 157 Regions, 260 Cities, 981 Companies have set Net-Zero targets (according to carbon tracker).
- Examples

Company	sector	revenue	aim	target	interim
RWE	utility	$ bn 42	neutral	2040	2030
BMW	automobile	$ bn 154	1.5°C	2050	2030

Net-Zero Ambition – any gaps in imagination?

- JPMorgan will use an Energy Mix Carbon Intensity target to define its green transition progress.
- The energy mix carbon intensity target consists of
  - Financing of zero-carbon power generation (solar, wind, ..)
  - Reduction in Oil & Gas scope 3 intensity (which is the job of the clients; switch from oil to gas)
  - Financing of Oil & Gas sector
- Fact: JP Morgan provided $ 39.2 bn of lending to fossil fuel companies in 2022 and the intensity of financed emissions rose by 1%.
- Fun Fact: Projected CO_2 emissions from existing fossil fuel infrastructure without additional abatement would exceed the remaining carbon budget for 1.5°C

Net-Zero Ambition – any gaps in understanding the quotient ?

- Banks use Absolute Financed Emission (AFE)

$$\text{AFE} = \sum \left(\frac{\text{Financing}}{\text{Company Value}} \times \text{Client Absolute Emissions} \right)$$

- The power of the denominator
  - Company Value = (Yearly) Enterprise Value including Cash
  - Rise in Valuation of Oil & Gas companies decreases Absolute Financed Emissions.
- For more on that see: Bajic, A.; Hellmich, M. and Kiesel R., 2023, *Handle with Care: Challenges and Opportunities of using Company-Level Emissions Data for Assessing Financial Risks from Climate Change*, Journal of Climate Finance, Vol. 5. December.

Misleading Net-Zero Targets

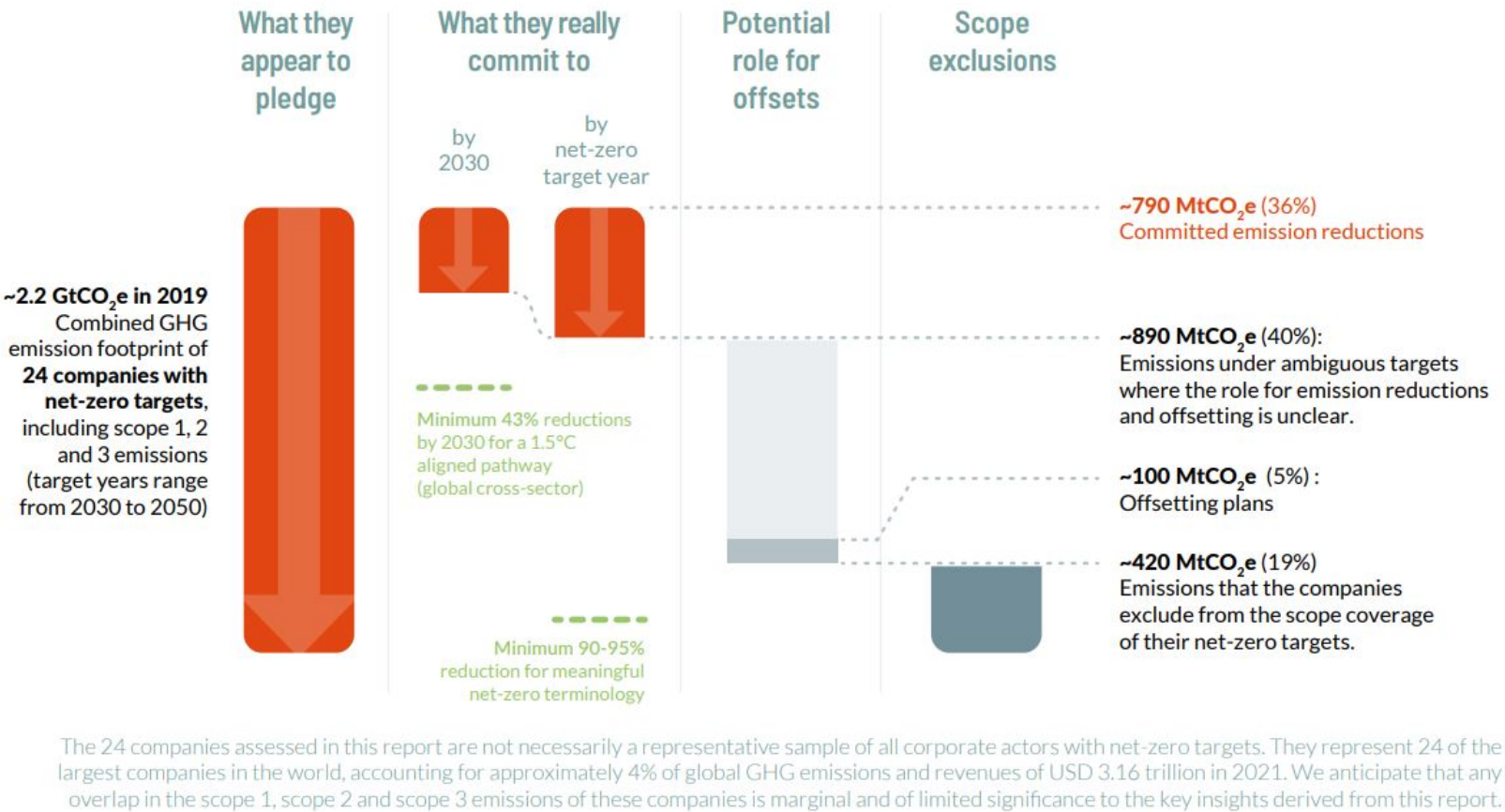

Figure: Misleading Corporate Net-Zero Targets. Source: New Climate Institute 2023.

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Probabilistic emission modelling

- We assume that the carbon emission dynamics $e(t)$ satisfy the following SDE over the transition period $[0, T]$

$$\frac{de(t)}{e(t)} = \mu\, dt + \sigma\, dW(t), \tag{1}$$

where

  - $\mu = \log(1 - \Delta R)$ the emission reduction drift,
  - $\sigma > 0$ is a volatility of emission reduction rates.

- The solution to (1) gives the carbon emission process

$$e(t) = e(0) \exp\left[\left(\mu - \frac{\sigma^2}{2}\right) t + \sigma\, W(t)\right], \tag{2}$$

where $e(0)$ is the carbon emissions amount at time $t = 0$.

Cumulative Emissions

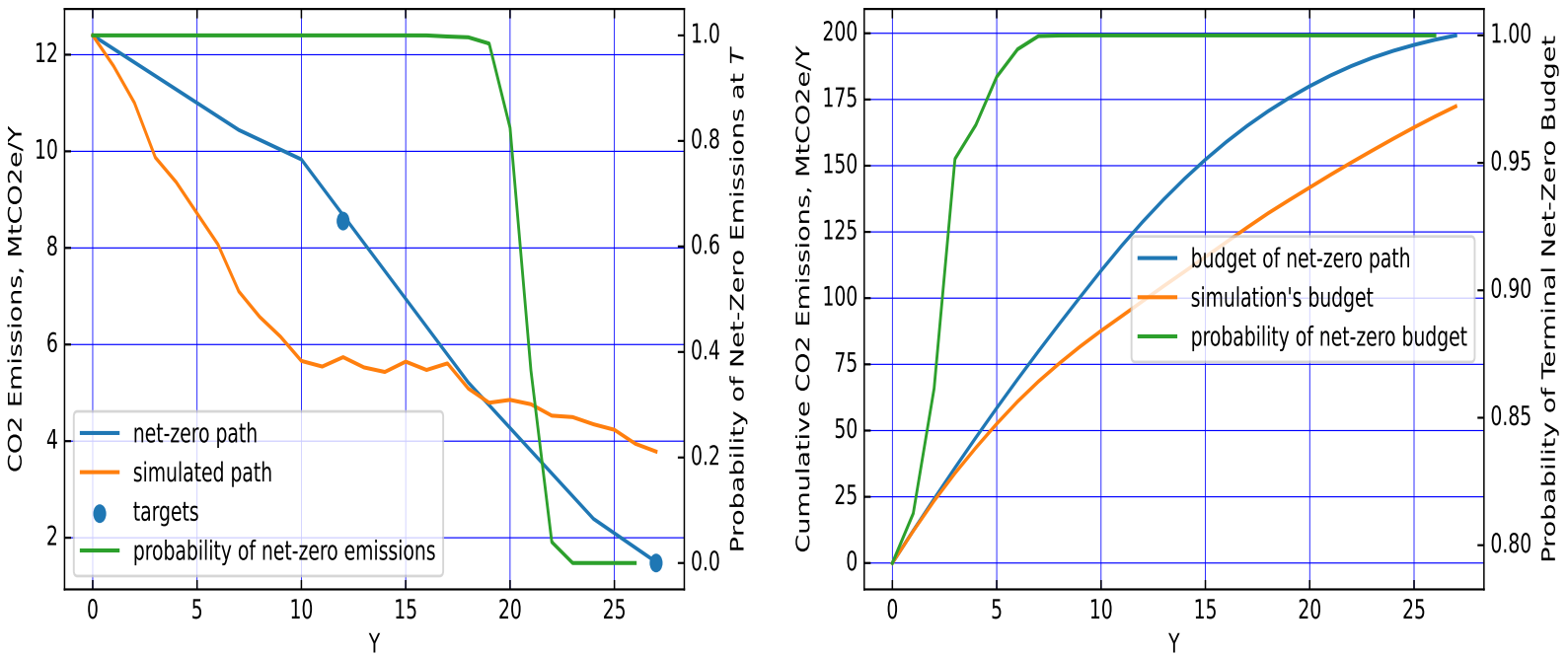
- We define the cumulative emissions ce over $[0, t], t \leq T$ as

$$ce(0, t) = \int_0^t e(s)\, ds.$$

- Using (2), we have

$$ce(0, t) = e(0) \int_0^t \exp\left[\left(\mu - \frac{\sigma^2}{2}\right) s + \sigma\, W(s)\right]\, ds.$$

Simulated Emission Path and Probability of Net-Zero



(a) Emissions (b) Cumulative Emissions

Figure: (a): Simulated Emissions Path; (b): Cumulative Emissions Path.

Estimated Parameters vs. FT Climate Leaders 2024

Company	Drift	Volatility	FT Score
Mercedes-Benz	-0.10	0.03	77.6
Siemens	-0.18	0.13	63.7
Henkel	-0.06	0.05	44.6
Volkswagen	-0.05	0.03	28.6

The FT Ranking is based on

- 80/100 points for the percentage reduction in GHG-intensity 2017-2022
- 20/100 points for reduction in GHG emissions, transparency of disclosure, other commitments such as science-based reduction targets, Carbon Disclosure Project (CDP), ...

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Rank Correlation Heat Map

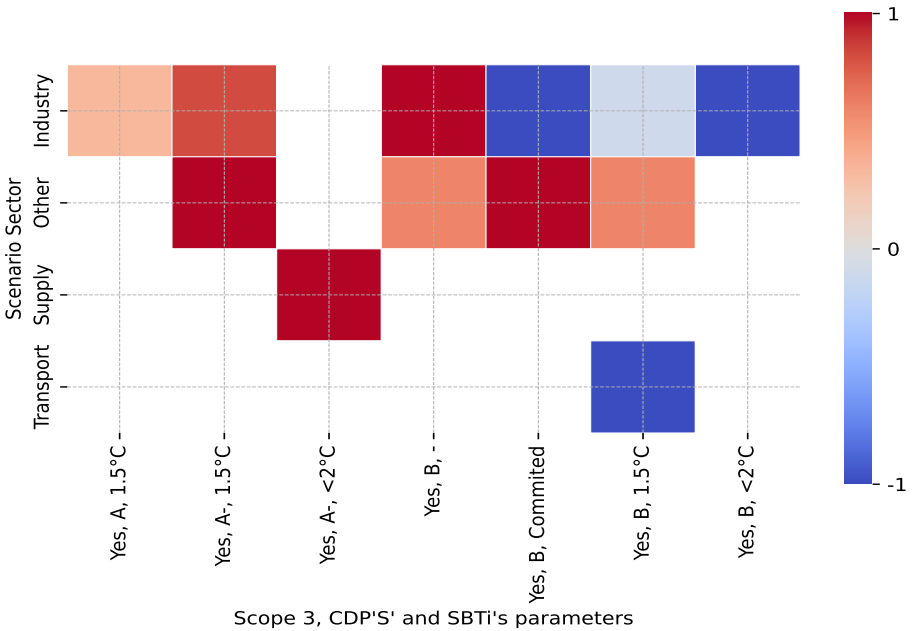


Figure: Kendall rank correlation heatmap between the FT's score and probabilities of staying below the calibrated net-zero budget assuming a historical drift, $p^{B,hist}$, grouped by scenario sector and additional parameters such as Scope 3 disclosure, CDP score and SBTi's target.

Intensity vs Absolute Emission

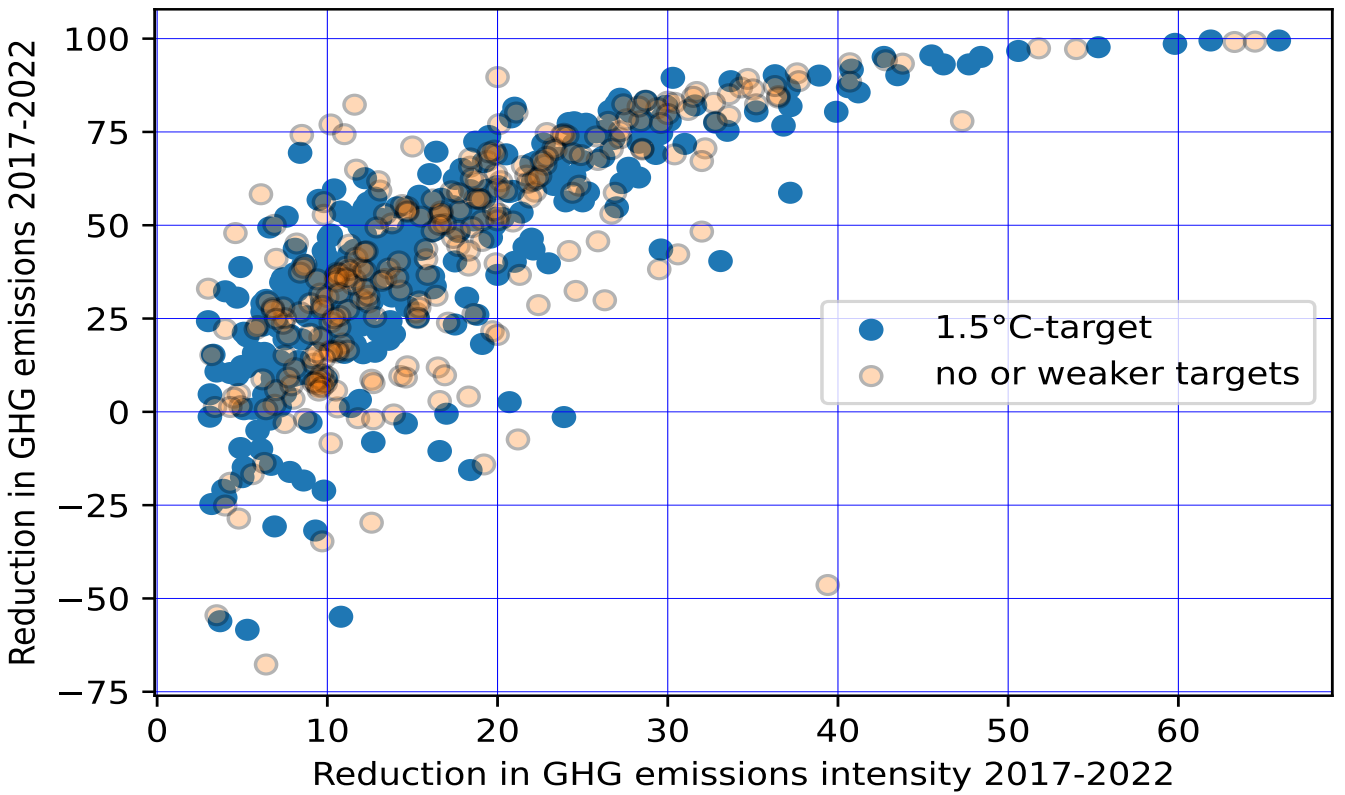
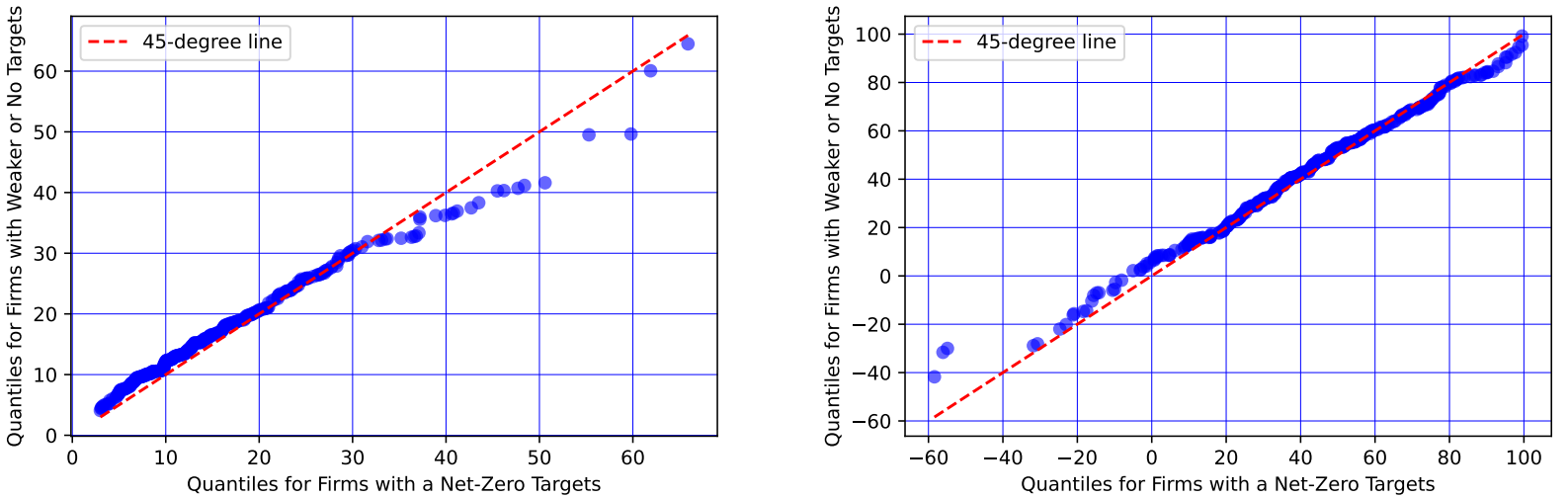


Figure: Intensity vs Emissions in the FT's ranking.

Target or No-Target: Does it matter?



(a) Reductions in Emissions Intensity (b) Reductions in Absolute Emissions

Figure: (a) QQ-plot of interpolated empirical distribution of reductions in emissions intensity during 2017-2022 among firms with a 1.5 °C-target as compared to such empirical distribution of reductions among firms with weaker or no targets; (b): Same for reductions in absolute emissions.

Target or No-Target: Maybe it does not matter

Values	ECDF Distance	p-value
Reductions in Emissions Intensity	0.09	19%
Reductions in Absolute Emissions	0.07	49%

Table: KS-Test Results Considering Original Samples of Reductions in Absolute Emissions and Emissions Intensity Comparing Firms with a 1.5 °C-Target and Weaker or No Targets.

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Climate risk is a systemic risk

- The magnitude of the effects of climate change on all aspects of the political, societal and economic life has been pointed out with increasing detail and accuracy in the IPCC reports.
- It is global, features complex causal structures, is nonlinear in the cause-effect relationship and stochastic in its effect structure, Renn (2016).
- It is uniquely global, uniquely long-term, uniquely irreversible, and uniquely uncertain, Wagner and Weitzman (Climate Shock, 2015).
- The deep uncertainty associated with climate change may hide risks we are not even able to asses.

Most everything we know tells us climate change is bad.
Most everything we don't know tells us it's probably worse.

The Importance of Assessing Net-Zero Targets

- Parallel to the financial budget define a carbon budget for companies
- Implement a probabilistic model to generate paths of the decarbonisation (net-zero) commitment of companies
- Calculate probabilities for reaching net-zero and respecting the carbon budget
- The regulator assesses the performance of a company and applies command-and-control measures if necessary.
- Investors can structure portfolios according to likelihood of respecting carbon budgets.

For further discussion

- watch the podcast with Gerhard Stahl
- `https://www.youtube.com/watch?v=e8QWtmC7XqA`

Figure: Climate Risk Talks

- or contact us directly

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Thank you for your attention...