House of Energy Markets & Finance

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Net-Zero: Fact or Fiction?

Rüdiger Kiesel: DAV/DGVFM Herbsttagung, Hannover, 2023

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Agenda

Ambition gap 2030 – on the way to 2.9° C

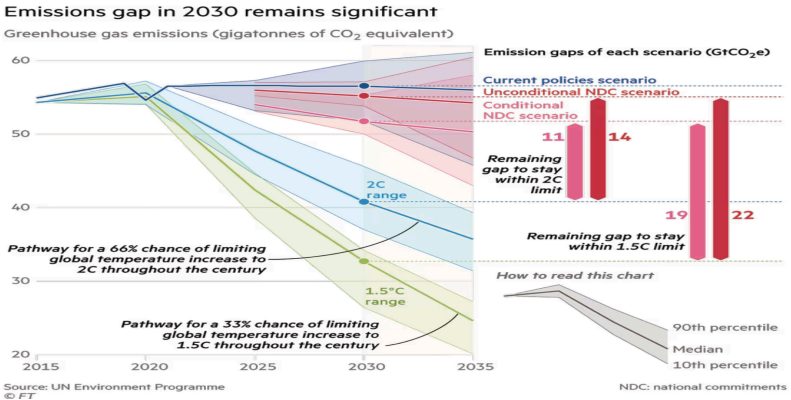

Figure: Global Warming Projections 2023 (Source: FT, UNEP)

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%.

Net-Zero Ambition – any gaps in understanding the quotient

- Banks use Absolute Financed Emission

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

- 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.

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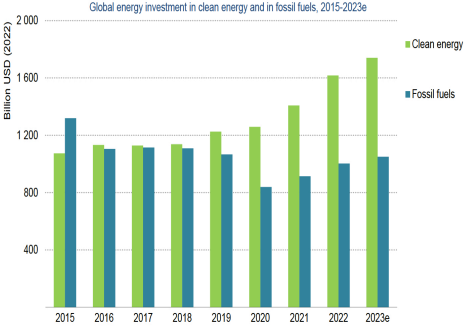
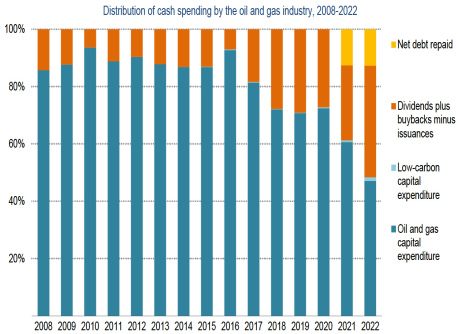
The positive investment gap



(a) Fossil vs Clean Investment



(b) Fossil Cash Spending

The climate insurance protection gap – Systemic risk

- EIOPA and ECB published a joint discussion paper in April 2023 on how to better insure households and businesses in the European Union against climate-related natural catastrophes such as floods or wildfires.
- Currently, only about one-quarter of all climate-related catastrophe losses in the European Union are insured. In some countries, the figure is below 5%.
- It is well documented that natural disasters can be a source of systemic risk for financial institutions and financial markets
  - Physical damage of assets can lead to reduced collateral values and/or substantial repricing of loans and securities for financial institutions exposed to high-risk areas
  - Physical risks can lead to supply chain disruptions, which can, in turn, cause large losses for the real economy and on financial institutions' balance sheets
  - Concentration of key economic activities in high-risk areas may amplify such losses.

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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°
  - 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° aligned: Target aligned with scenarios that yield a long-term warming outcome below 1.5° 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	automobil	$ bn 154	1.5° target	2050	2030

The Scopes

The GHG Protocol *Corporate Accounting and Reporting Standard* has developed a standard to measure the GHG emissions of companies using three scopes.

- **Scope 1** emissions are the direct emissions of a company, notably from company vehicles and energy use in facilities.
- **Scope 2** emissions are indirect upstream emissions that come from the purchase of electricity, heating and cooling.
- **Scope 3** emissions are also indirect and refer to both upstream supply-chain emissions such as upstream logistics and purchased goods and services, as well as downstream activities, notably emissions from the use and disposal of sold products, as well as emissions from franchises. The GHG emissions from investments (financed emissions) also fall into this category.

Carbon Certificates and Credits

- Carbon Certificates: Mandatory scheme that covers approximately 12,000 large emitters in the EU that are responsible for 50% of total CO_2 emissions. Regulated (compliant) sectors include energy industry, combustion, cement, etc.
- A Voluntary carbon credit is a certificate representing one metric ton of CO_2 that is either prevented from being emitted into the atmosphere (emissions avoidance/reduction) or removed from the atmosphere as the result of a voluntary carbon-reduction project.
- a Carbon Border Adjustment Mechanism (CBAM) to ensure that production is not being relocated to countries with less ambitious policies

Voluntary Carbon Credits: Trees?

- durability: carbon cycle of trees is measured in decades; CO_2 emission in centuries
- durability: wildfires in Washington and Oregon states destroyed forests that had generated credits
- credibility: Guardian and Zeit, January 2023 – 90% of Verra's (one of the leading providers of Carbon Credit) are worthless
  - hardly any deforestation reduction
  - overstatement of threats to forests
- South Pole faces similar allegations (Bloomberg 2023).

Voluntary Carbon Credits: DAC ?

- Direct air capture (DAC) technologies extract CO_2 directly from the atmosphere and permanently store it in deep geological formations or use it.
- Capture cost estimate are wide-ranging from $ 100/t to $ 1000/t.
- Large scale DAC plants are now being developed (see e.g. climeworks).
- The US Government committed itself to spend $ 1.2 bn on large scale DAC plants
- JPMorgan Chase will spend $200 mn on DAC to compensate its emissions.

Current Carbon Emission Prices

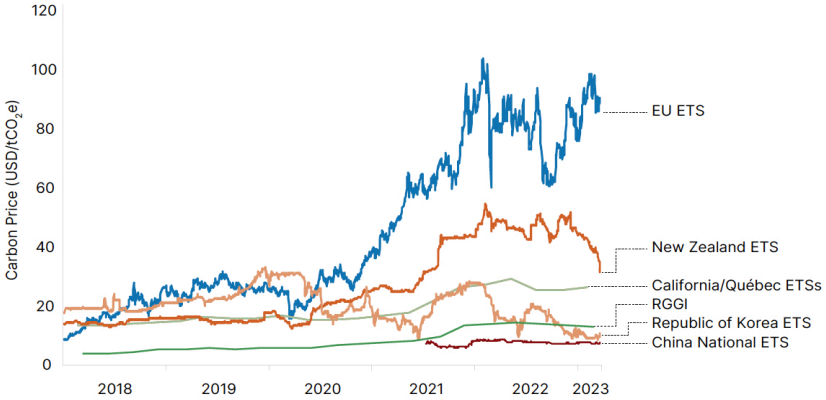


Figure: World Bank Carbon Pricing Dashboard

Voluntary Carbon Credit Prices

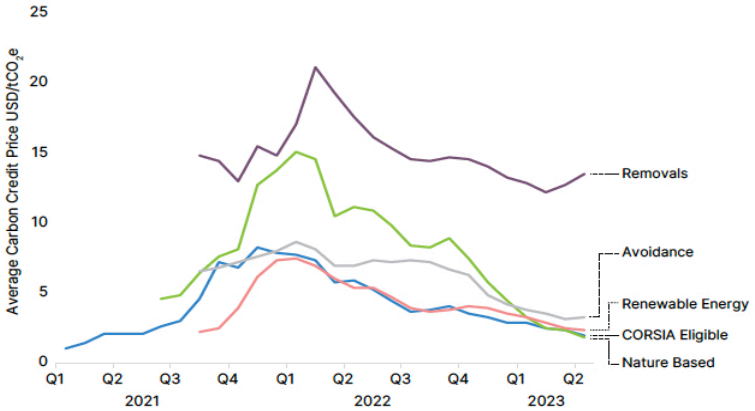


Figure: Carbon Credit Prices

Carbon Emission Pricing

- Stern (2007): Climate change is the biggest market failure in history! Emissions costs are still mostly loaded on the planet rather than borne by polluters.
- Litterman (2020): Without an effective price on carbon, financial markets lack the most efficient incentive mechanism to price climate risks. Therefore, all manner of financial instruments – stocks, bonds, futures, bank loans – do not incorporate those risks in their price. Risk that is not quantified is difficult to manage effectively. Instead, it can build up and eventually cause a disorderly adjustment of prices.

Market Prices?

- Carbon risk in CDS spreads; Blasberg, Taschini, Kiesel (2022)
- Utilising the information contained in the spreads of CDS, we construct a market-implied, high-frequency and forward-looking carbon risk (CR) factor.
- Document amplifying effect of a carbon risk on credit risk:
  - The effect is larger for European than North American firms
  - It varies substantially across industries
  - Lenders expect adjustments in carbon regulations in Europe will cause relatively larger policy-related costs in the near future
  - Existing or expected emission pricing increases the effect

Agenda

Direct Net-Zero Using Linear Interpolation

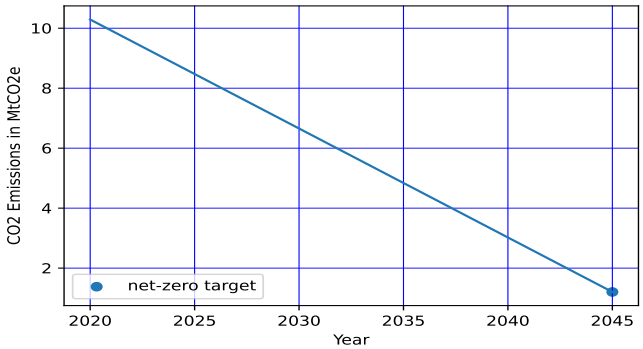


Figure: Net-Zero 2045 Path with a Constant Annual Relative Emission Reduction for a Company.

Net-Zero with Intermediate Targets Using Linear Interpolation

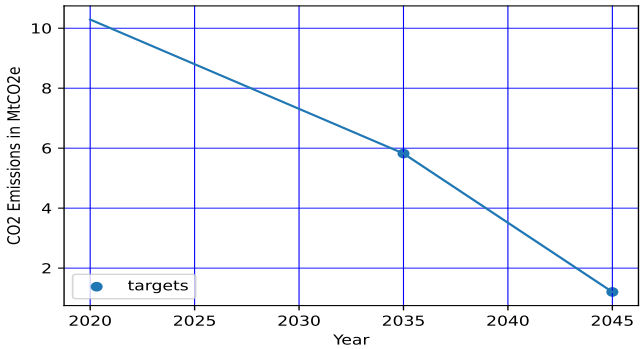


Figure: Net-Zero 2045 Path with a Constant Annual Relative Emission Reduction between the Targets for a Company.

Net-Zero with Intermediate Targets Using Sectoral Scenario Path

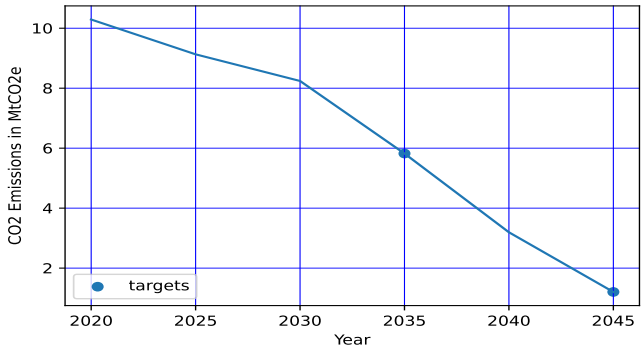


Figure: Net-Zero 2045 Path Including Targets and Based on the Sectoral Net-Zero Path for a Company in Chemicals Sector.

Net-Zero Pathways

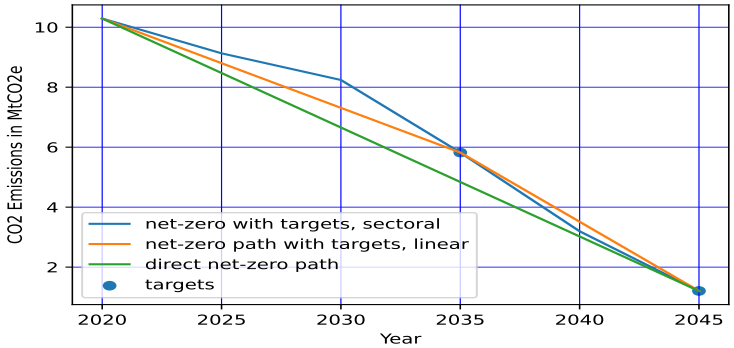


Figure: A Comparison of All Three Approaches: Direct Net-Zero, Net-Zero with Targets using Linear Interpolation and Net-Zero with Targets using the Sectoral Net-Zero Path.

Deterministic Emission Reduction Rate

- The European Union has created two climate benchmark labels: the climate transition benchmark (CTB) and the Paris-aligned benchmark (PAB).
- They consider the total reduction of carbon emissions $R(t_0, t)$ between t_0 and t. Assume an minimum reduction rate R^- and an average yearly reduction rate ΔR. Then

$$R(t_0, t) = 1 - (1 - \Delta R)^{t - t_0}(1 - R^-) \tag{1}$$

- For CTB resp. PAB the minimum reduction are $R^- = 30\%$ resp. $R^- = 50\%$ while $\Delta R = 7\%$ in both cases.

Emissions

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

$$\frac{de(t)}{e(t)} = \mu\, dt + \sigma\, dW(t), \tag{2}$$

where

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

- The solution to (2) gives the carbon emission process

$$e(t) = e(0) \exp\left[\left(\mu - \frac{\sigma^2}{2}\right) t + \sigma\, W(t)\right], \tag{3}$$

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

Cumulative Emissions

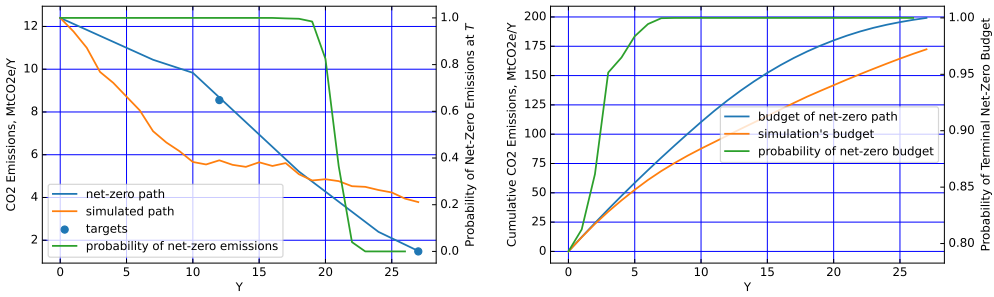
- We and define the cumulative emissions ce over $[0, t], t \leq T$ as

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

- Using (3), 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 Absolute Reduction 2016-2021

Company	Drift	Volatility	FT Absolute
Siemens AG	-0.18	0.13	65.8%
Mercedes-Benz Group AG	-0.10	0.03	36.8%
Henkel AG & Co KGaA	-0.06	0.05	31.9%
Volkswagen AG	-0.05	0.03	25.3%
Salzgitter AG	-0.02	0.05	7.9%

Forward-looking Extension

- Identify possible narratives (based on the country-wide NGFS scenarios and firm disclosure) for growth of assets, carbon emissions and technological development on individual firm levels.
- Assign probabilities to the various asset growth, carbon emission and technological development combinations, using the Bayesian Nets framework.
- Use Natural Language Processing (NLP) techniques to identify firms that have a higher commitment, established procedures and technological means to stay on a given decarbonising path.

Assessing Net-Zero Commitments

- We refer to a net-zero transition plan as a plan on how a firm will achieve its strategy to pivot its existing assets, operations and entire business model towards a net-zero trajectory.
- We develop a set of questions to ask to determine the scale of credibility of a net-zero commitment.
- We consider three layers:
  - Strategy: assess the firms' inherent strategic interest to reach net-zero.
  - Climate Transition Plan: existence and credibility
  - Implementation: check short-term steps and assess long-term planning in terms of capital reallocations, investments and further restructuring towards net-zero

Possible Question Sets

- Does the company sees opportunities/risks in net-zero?
- Is the company affected by net-zero regulations? Does it expect to be affected by net-zero regulations?
- Has the company developed a net-zero transition plan?
- Which action did the company recently to implement short-term decarbonization steps?
- Which long-term steps does the company plan in terms of capital reallocation, investments and other structural changes towards net-zero?

Simple Bayesian Net

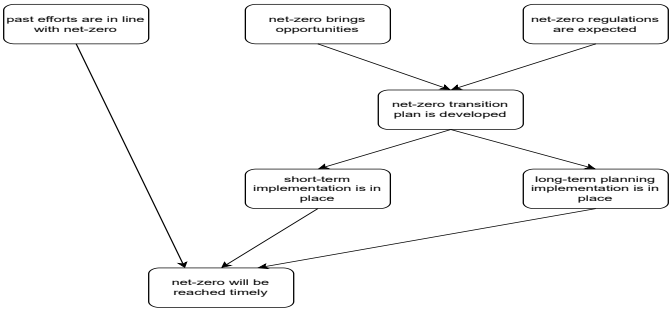


Figure: A Bayesian net to determine the probability that a net-zero budget will be preserved. Arrows denote directed causal links. Nodes are Boolean variables.

Summary: 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.

Agenda

Climate risk is a systemic risk

- The magnitude of the effects of climate change on all aspects of the political, societal and economic live 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.

Climate Risk Metric

- We need to stop putting carbon in the atmosphere before we stop using carbon (Carbon Capture and Storage: equinor aims for 15-30 million tonnes CO_2 per year by 2035, but emission were 36.8 billion tonnes CO_2 globally)
- Develop a climate risk taxonomy (Bob Buhr, Imperial College Business School).
  - Physical risks (water and heat stress, wildfires, extreme storms)
  - Transition risks related to adaptation (infrastructure, supply chains)
  - Transition risks related to mitigation, (regulatory, ligitation)
  - Natural capital risks (depletion of both renewable and non-renewable)

The Role of Finance

- Develop a consistent approach towards financing emissions – disclosure of emissions
- Identify and finance new decarbonisation opportunities – forward looking emission metrics
- Develop and scale new financial products and structures to help raising finance for decarbonisation – carbon allowances and carbon credits
- ..but, Lengwiler, M. (Risky calculations: financial mathematics and securitization since the 1970s, 2016)
  - socio-political conventions were replaced by financialized, market-oriented conventions,
  - together with privatisation of public responsibilities

The Tragedy of Data

- Ever since Mark Carney's landmark speech (2015) Breaking the Tragedy of the Horizon – Climate Change and Financial Stability transition planning focused on data and disclosure
  - The Task Force on Climate-related Financial Disclosure (TCFD) developed a disclosure framework for climate-related financial risk
  - The Network for Greening the Financial System (NGFS) developed a range of climate change scenarios (stress tests) planning for net-zero central banking
  - Further: Glasgow Financial Alliance for Net Zero (GFANZ), International Sustainability Standards Board (ISSB) launched by the trustees of the IFRS, Science Based Targets Initiative (SBTi), ...
- Why no progress? Social dimension lags behind! We need a just transition in net-zero plans. Thus the S in ESG will be crucial!

Political Challenge

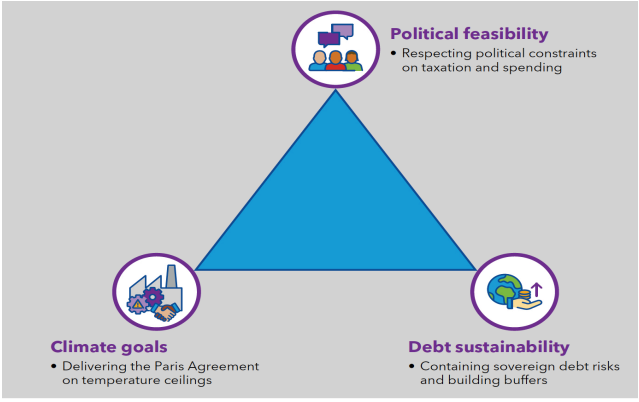


Figure: The Climate Change Trilemma, Source: IMF 2023

On The Right Track?

Figure: Als Bittsteller in Quatar (FAZ)

Energy policy

- In 2001 Germany introduced feed-in tariffs for renewable – globally hailed as a leading innovation in energy policy
- 2022 Germany decided to build an LNG infrastructure (Qatar, Saudi-Arabia).
  - LNG from Qatar accounts for 3% of current German needs, but uses up more than 30% of the new LNG terminal in Brunsbüttel.
  - An LNG Terminal will cost more than 6 bn€
  - In case the terminals should switch to hydrogen (be carbon-neutral) 50 to 70% of the initial investment will be needed
- Generation from Gas was 1.7%, Lignite 5.4%, hard coal 21.4 % higher in 2022 than in 2021.

For Further Discussion

- watch the podcast with Gerhard Stahl
  `https://www.youtube.com/@hemf7685`

Figure: Climate Risk Talks

- or contact us directly

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Thank you for your attention...