

# Climate Change & Business: What Every MBA Needs to Know

## Executive Summary

Already disrupting business and supply chains across the globe, climate change is one of the biggest challenges to 21st century economic systems and one of the threats that business leaders are most concerned about in their assessment of global business risks.<sup>i</sup> The value at risk to manageable assets from climate change is estimated to exceed \$4.2 trillion, with tail risks of up to another \$13.8 trillion.<sup>ii</sup> Pressure is coming from both investors and regulators for companies to disclose their climate risks. In response, companies from **Microsoft** to **Duke Energy**—in fact, fully one-fifth of the world’s 2,000 largest publicly listed companies—have announced public commitments to achieving “net-zero” emissions targets.<sup>iii</sup>

There are also tremendous opportunities to be had in responding to climate change. Investors and entrepreneurs looking to capitalize on the estimated \$2+ trillion market for climatetech are pursuing new investments in clean energy, electric vehicles, carbon removal technologies, sustainable agriculture, and more.

Climate awareness is no longer optional, but a business imperative. Climate change will affect how leaders plan for and respond to crises in the future, how investors think about the cost of capital, how customers perceive the brands they buy, where new offices and manufacturing facilities are sited, where and how raw materials are sourced, and what materials are available for new products. Every MBA thinking about the future of business should grasp the risks and opportunities facing their industry from climate change.

**“We know that climate risk is investment risk. But we also believe the climate transition presents a historic investment opportunity.”**

– Larry Fink, CEO, BlackRock, 2021 Letter to Shareholders

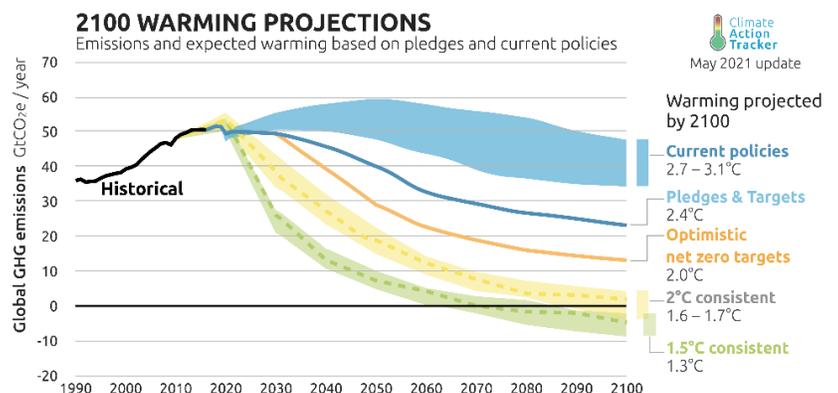
<https://www.blackrock.com/corporate/investor-relations/larry-fink-ceo-letter>

## The Issue

The climate is changing as carbon dioxide (CO<sub>2</sub>) and other greenhouse gases emitted by transportation, agricultural, and industrial activity interfere with the earth’s natural climate system. Heat-trapping gases are producing an overall rise in average global temperature (“global warming”), but also disrupting the atmosphere’s typical patterns, producing complicated changes that are interrelated but not uniform.

### Causes

Changes to the climate are due to an increase in CO<sub>2</sub>, methane, and other greenhouse gases due to industrial activity, transportation, and other activities, as well as deforestation (the removal of trees which naturally absorb CO<sub>2</sub> from the atmosphere). The most significant contributors to climate change include:



Source: Climate Action Tracker. 2100 warming projections (May 2021 update).

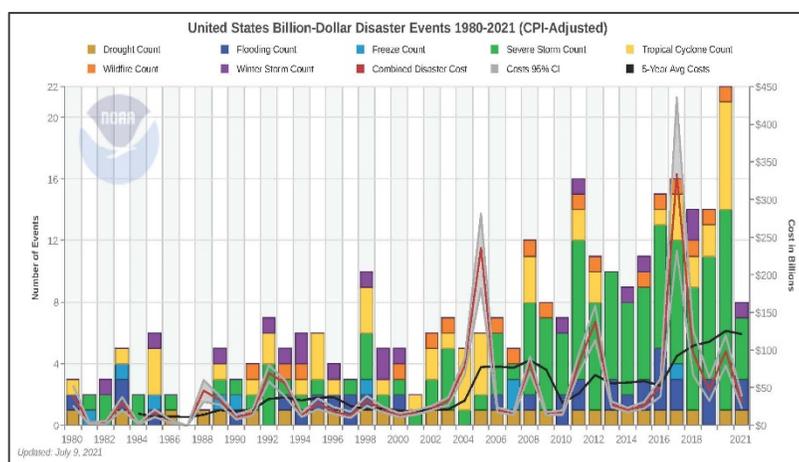
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- The use of fossil fuels for transportation and electricity, which emits CO<sub>2</sub>
- Deforestation to clear land for agriculture, timber harvesting, and development
- Agricultural and industrial activities which release methane and nitrous oxide into the atmosphere

## Impacts

The effects of climate change are already visible, and accelerating. The extent and pace of change will depend on how fast policy and business mitigation strategies take effect. Climate change effects include:

- **Global warming and temperature extremes.** At the crux of climate change is a rise in the average global temperature. 2020 was tied with 2016 for the hottest year on record, with temperatures 1.02°C (1.84°F) higher than the historical average.<sup>iv</sup> As climate change disrupts the flows of air and water around the earth, regions can experience times of anomalous cold (for instance, when warm air displaces Arctic air over the U.S., causing "polar vortex" events) as well as excess heat. In the U.S., up to 26% of metropolitan areas could see more than 100 days a year of 95°F heat by 2060–2080, versus only 1% today.<sup>v</sup> Extreme heat intensifies the potential for drought and wildfires, presents health risks to populations, and decreases worker productivity in industries like agriculture and construction.
- **More extreme weather events in more locations.** Climate change affects how much moisture the air holds, increasing the intensity of hurricanes (cyclones), rainstorms, and snowstorms. Some regions will experience extreme rainfall and flooding, even as others are experiencing droughts and wildfires. Displacing populations and disrupting business, these events are costly; in the past two decades, the number of extreme weather disasters costing over \$1 billion has risen dramatically.
- **Sea level rise.** As land ice in the Arctic melts and warming ocean water expands, sea levels are rising, causing coastlines to move inland and increasing the destructiveness of storm surges. Even in the absence of storm surges, "sunny day flooding" (or "nuisance flooding") caused by sea level rise increasingly interrupts business and damages properties in some coastal cities like Miami, FL. In the U.S. 40% of the population (126 million people) live in coastal counties<sup>vi</sup> that could be affected by rising sea levels.
- **Agricultural growing region shifts.** With a warming climate, growing regions for crops are shifting. For example, the growing regions for wheat in the U.S., Europe, and Russia are creeping further north each year. Heat, drought, and storms also affect crop yields generally. Some crops that have limited or specialized growing regions—like coffee, cocoa, almonds, and vanilla—are particularly vulnerable.
- **Population displacement.** Sea level rise will force migration of people from coastal areas and island nations to higher ground. Other large population shifts will occur as events like prolonged drought and natural disasters displace inhabitants.



Billion-Dollar Weather and Climate Disasters: Time Series, National Oceanic & Atmospheric Administration, July 9, 2021  
<https://www.ncdc.noaa.gov/billions/time-series>

As climate impacts worsen, there are likely to be compounded impacts. Population displacement, drought, and food shortages might threaten local or regional political stability. Extreme heat and expanded ranges for water- and mosquito-borne diseases will bring new public health issues.

## Business Risks

Climate change impacts present tangible and intangible risks to businesses. In KPMG's 2019 Global CEO Outlook, CEOs from across sectors listed environmental/climate change risk as the number one threat to growth—ahead of disruptive technology risk, cyber security, and operational risk.<sup>vii</sup>

### Physical asset risks

Extreme weather events intensified by climate change directly threaten real property assets. A 2020 S&P Global report estimates that 60% of the companies in the S&P 500 Index (with a market capitalization of \$18 trillion) hold assets that are at high risk of at least one type of climate-change physical risk.<sup>viii</sup> When Hurricane Harvey hit Houston, TX in 2017, flooding shut down 25% of the region's oil and gas production<sup>ix</sup> and corporate productivity was reduced by 10%.<sup>x</sup> Munich Re estimates that natural disasters globally caused \$210 billion in damages in 2020.<sup>xi</sup> BlackRock estimates that extreme weather events also pose growing risks for the credit worthiness of state and local issuers in the \$3.8 trillion U.S. municipal bond market.<sup>xii</sup>

### Supply chain disruptions

In a world of global supply chains, a company's operations can be interrupted even when its own facilities are not directly affected by natural disasters. In early 2019, for example, a record heat wave in Australia affected the consumer goods manufacturing company Mars. "One of our facilities in Australia had to shut down ... because the temperature spiked, the price of electricity spiked at the same time, and it was just no longer financially viable for us to have that facility open and running and producing the things that it produces for our consumers in Australia," said Lisa Manley, Mars' Senior Director of Sustainability Engagement & Partnerships, adding, "I think that we've got very real business risks as a result of climate change."<sup>xiii</sup>

**“Over three-quarters of CEOs (76 percent) say that their organization’s growth will depend on their ability to navigate the shift to a low-carbon, clean-technology economy.”**

- KPMG 2019 Global CEO Outlook

### “Net zero” commitments

Companies ranging from [Burberry](#) to [Bank of America](#) have announced targets for reducing their carbon footprint—typically, pledging to get to “net zero” carbon through a combination of reducing their emissions and purchasing carbon credits to offset any emissions they can't avoid. More than 1,500 companies have set climate targets through the [Science Based Targets initiative \(SBTi\)](#). [PwC](#), [Apple](#), and [IBM](#) have pledged to reach net zero by 2030. Some companies are going even farther: [Microsoft](#), for instance, has pledged to offset all of its carbon emissions since the history of the company's founding, while also investing \$1 billion in solutions through its Climate Innovation Fund.

### Raw material supply & price volatility risks

The growing regions and yields for many agricultural products are shifting because of climate change. For instance, in Brazil and Central America, 80% of the land currently used to grow Arabica coffee will become unsuitable by 2050<sup>xiv</sup>—a scenario likely to reduce coffee supply and drive up prices globally. Companies that source agricultural inputs need to take a good look at the vulnerability of their suppliers under different climate scenarios and evaluate whether their supply chains have redundancy and adaptation strategies. [Starbucks](#), for instance, is working directly with coffee farmers to adapt growing practices and test new plant strains for a warming world.

### Regulatory/policy risk

The U.S. has not (to date) imposed a comprehensive federal climate policy, but other countries are developing regulations and carbon taxes that affect U.S. multinationals—for instance, the EU's [“Fit for 55” package of regulatory proposals](#), which will mandate emissions reductions of 55% by 2030 compared with 1990 levels. Other policies incentivize the switch to fossil-free alternatives, like the U.S. federal [renewable energy Production Tax Credit](#) and California's [executive order requiring that, by 2035, all new cars and passenger trucks sold in California be zero-emission vehicles](#). As more policies come online, many companies will find themselves with “stranded assets” if carbon taxes make it too costly to operate carbon-intensive facilities.

### Reputation risk

Social media enables consumers increasingly to hold companies accountable for social and environmental positions. Consumer-facing brands that fail to address climate change issues face potential public outcry and even boycotts from some consumer segments. Failure to address climate can also hurt a company's image

with employees. In May 2019, for example, 7,700 [Amazon](#) employees made news as they formed a group called Amazon Employees for Climate Justice and spoke at the company's shareholder meeting to call for stronger climate action.

### Access to capital

All of the above risks have the potential to affect a company's cost of capital. "We are very focused on carbon transition risks and how those risks are affecting all kinds of sectors globally," Jim Hempstead, managing director of the ESG Group at [Moody's](#), said in a May 2019 interview.<sup>xv</sup> The [Task Force on Climate-Related Financial Disclosures \(TCFD\)](#), created by the Financial Stability Board, put forward climate risk disclosure recommendations in 2017. Since then, financial regulators in the EU and U.S. are evaluating mandatory climate risk reporting, and investors have begun requiring greater disclosure—with real implications for companies. In the 2021 proxy season, [BlackRock](#) voted against 319 companies on climate-related grounds over the 12 months ending in June.<sup>xvi</sup>

**“Climate change is one of the biggest challenges we face. Delivering essential technologies and reliable climate information ... is at the heart of how Facebook can help address the crisis. And we believe we can do it with a net zero carbon footprint.”**

— Mike Schroepfer, Chief Technology Officer, Facebook

<https://sustainability.fb.com>

## Business Opportunities

In a 2019 survey by the nonprofit [CDP](#), 225 of the world's 500 biggest companies estimated that climate-related opportunities represent potential financial impacts totaling over \$2.1 trillion.<sup>xvii</sup> “[ClimateTech](#)” (or “climate tech”) investment, which includes energy transition, mobility, agtech, and other decarbonization technologies, attracted more than \$17 billion in VC funding in 2020.<sup>xviii</sup>

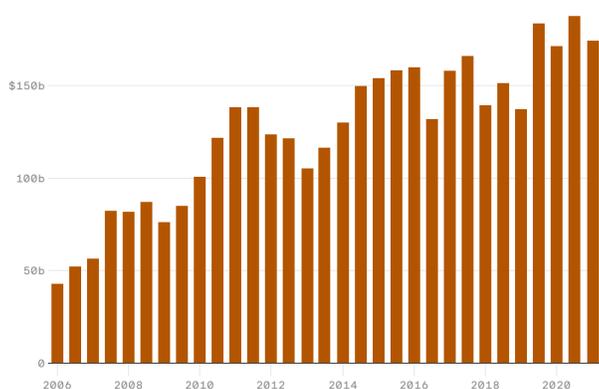
### Energy transition

Critical to achieving climate goals is a complete transition from fossil fuel-based power generation to low-carbon energy sources (solar, wind, hydropower, nuclear)—to the tune of about \$73 trillion globally, by one estimate.<sup>xix</sup> The energy transition is underway but will take decades to complete. [BloombergNEF](#) projects that,

of \$11.5 trillion to be invested globally in new power generation capacity between 2018 and 2050, \$8.4 trillion will go to wind and solar and a further \$1.5 trillion to other zero-carbon technologies such as hydro and nuclear.<sup>xx</sup> Energy storage (batteries) and related grid infrastructure are also key to this transition.

### Global investment in renewable energy

H1 2006 to H1 2021



Data: [BloombergNEF](#); Chart: Danielle Alberti/Axios

<https://www.axios.com/newsletters/axios-generate-c12f3238-coa7-487e-g074-d113cf5238d2.html>

[Carbon Engineering](#), a startup with a system that pulls CO<sub>2</sub> out of the air (“direct air capture”), has raised \$110 million in VC funding. Other companies, like [LanzaTech](#) and [NET Power](#), want to capture and reuse CO<sub>2</sub> at the point of emission. Elon Musk is funding a [\\$100 million X Prize for carbon removal](#) solutions. And, if other solutions fail, some investors are banking on far-out “geoengineering” strategies, like the [Arctic Ice Project](#), which attempt to cool the planet through large systems-level environmental innovations.

### Electric vehicles & charging infrastructure

By 2040, projections estimate that 54 million EVs will be sold annually, representing a 58% market share of passenger vehicle sales.<sup>xxi</sup> Electrification is coming not only for passenger cars, but also for buses, light-duty trucks, semis, ships, and airplanes. Companies developing vehicles, batteries, charging infrastructure, software, and alternative fuels technologies will all see market opportunities. (For more detail, see [Markets to Watch: Electric Vehicles](#).)

### Carbon removal and sequestration technologies

Technologies to remove carbon from the atmosphere (carbon capture and sequestration) are still frontier technologies but are poised to be huge moneymakers if the technologies pan out.

**Growth market opportunities**

- Renewable & low-carbon energy
- Energy efficiency technologies
- Batteries, energy storage, "smart grid" technologies
- Electric vehicles & charging infrastructure
- Electric aviation
- Carbon removal & sequestration (carbontech)
- Climate-resilient real estate & building systems
- Adaptation infrastructure (sea walls, flood defense systems, raised roadbeds)
- ESG (environment-social-governance) investing
- Hydrogen, alternative fuels
- Agtech / climate-resilient agriculture / regenerative ag
- Meat alternatives
- Cooling/air conditioning
- Climate bonds & insurance products
- Climate predictive analytics & risk management
- Climate strategy consulting

**Real estate**

Investing in flood protection and climate-resilient infrastructure is a priority for many of the world's major cities (see [100 Resilient Cities](#) and [C40 Cities](#)). REITs and companies with significant real estate assets may consider climate impacts in siting new facilities, identify and fortify buildings that are at risk of flooding, and install onsite solar, wind, and battery storage systems to provide emergency power to facilities in areas where electric power could fail.

**Agtech and sustainable agriculture**

Beef and dairy farming is one of the biggest emitters of the greenhouse gas methane, so there's growing demand for plant-based proteins (like [Impossible Burger](#)), lab-grown meat ([UPSIDE Foods](#)), and alternative proteins (like [Exo's](#) cricket protein). [Barclay's](#) predicts the alternative meat market could be worth \$140 billion by 2029.<sup>xxii</sup> Biotech crops that are heat-tolerant and drought-resistant, as well as climate-adaptive agtech innovations will also be big. Companies like [McDonald's](#) and [Nestlé](#) are moving to risk-proof their ag supply chains, and other companies are realizing opportunities to address this market. Firms like [Indigo Ag](#) see opportunities in carbon sequestration through "regenerative agriculture."

**Resilient and redundant supply chains**

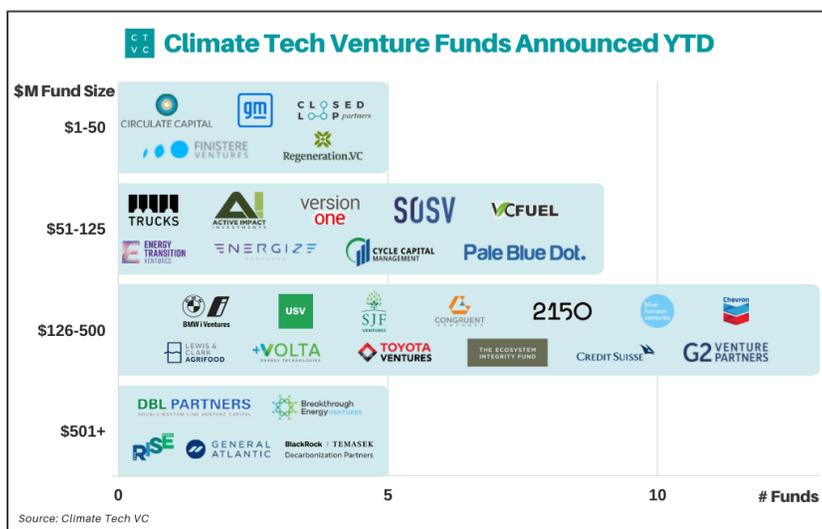
Many companies are examining their supply chains for potential climate-related risks—especially for sites vulnerable to extreme weather events—and developing contingency plans. For example, [General Motors \(GM\)](#) developed supplier mapping to help provide visibility into vulnerable suppliers and developed an active crisis center that monitors the weather and begins contacting suppliers when extreme weather events are forecast.<sup>xxiii</sup>

**ESG investing, climate finance, climatetech investing**

The scale of capital shifting to ESG (environmental-social-governance) investing and climate finance in just the past two years is staggering. Bloomberg estimates that ESG assets may reach \$53 trillion by 2025—a third of global assets under management.<sup>xxiv</sup> Companies like [Fidelity](#) are creating new products to appeal to ESG investors, like the Fidelity Climate Action Fund. [HSBC](#) and the [Climate Bonds Initiative](#) assess the market for climate-aligned bonds at \$1.7 trillion.<sup>xxv</sup> In 2021, [TPG Rise](#) announced the first close of \$5.4 billion in subscriptions to its inaugural climate investment fund.<sup>xxvi</sup> [Breakthrough Energy Ventures](#) and [Generate Capital](#) have both raised more than \$2 billion for climate tech and energy infrastructure.

**Climate data, strategy, and consulting**

Startups like [Jupiter](#) and [Persefoni](#) see opportunities in climate data analytics and reporting. [BCG](#), [Bain](#), and other consultancies now offer climate change strategy consulting; [ICF](#), [Cadmus](#), and others provide emissions measurement, modeling, and reporting services.



Climate Tech Funds Announced Year-to-Date, as of July 26, 2021  
 ©Climate Tech VC  
<https://climatetechvc.org/%f0%g%8c%8e-green-capital-is-heating-up-64/>

## Takeaways for MBAs

1. Climate change is affecting businesses and supply chains in many ways. Companies may face direct physical risks, supply chain disruptions, policy and reputation risks, and access to capital risks.
2. As with any global challenge, there are business opportunities for savvy entrepreneurs, investors, and corporate actors. Companies stand to gain first-mover advantages in mitigating climate risk exposure now. There are also multi-billion-dollar markets available to entrepreneurs in clean energy, low-carbon transportation, resilient agriculture and real estate, climate finance, and carbon technologies.
3. Every MBA graduating today should be thinking about how climate change and its related effects will impact their industry, supply chains, and consumers in the future.

## Further Reading

[The Big Picture on Climate Risk](#), S&P Global, 2020.

[Climate Risk and Response](#), McKinsey, 2020.

[The State of Climate Tech 2020: The Next Frontier for Venture Capital](#), PwC, 2020.

[Climate Risk and Real Estate Investment Decision-Making](#), Urban Land Institute (ULI) and Heitman LLC, 2019.

[Climate Rising Podcast](#), Harvard Business School.

[Climate Tech VC newsletter](#), Climate Tech VC.

[ClimateCAP: The Global MBA Summit on Climate, Capital, & Business](#)

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- <sup>i</sup> [http://www3.weforum.org/docs/WEF\\_The\\_Global\\_Risks\\_Report\\_2021.pdf](http://www3.weforum.org/docs/WEF_The_Global_Risks_Report_2021.pdf)
- <sup>ii</sup> <https://eiperspectives.economist.com/sustainability/cost-inaction>
- <sup>iii</sup> <https://www.reuters.com/article/us-global-climate-carbon-business-trfn/net-zero-emissions-targets-adopted-by-one-fifth-of-worlds-largest-companies-idUSKBN2BF2ZX>
- <sup>iv</sup> <https://climate.nasa.gov/news/3061/2020-tied-for-warmest-year-on-record-nasa-analysis-shows/>
- <sup>v</sup> <https://www.blackrock.com/ch/individual/en/literature/whitepaper/bii-physical-climate-risks-april-2019.pdf>
- <sup>vi</sup> <https://coast.noaa.gov/states/fast-facts/economics-and-demographics.html>
- <sup>vii</sup> <https://assets.kpmg/content/dam/kpmg/xx/pdf/2019/05/kpmg-global-ceo-outlook-2019.pdf>
- <sup>viii</sup> <https://www.spglobal.com/en/research-insights/featured/the-big-picture-on-climate-risk>
- <sup>ix</sup> <https://www.thebalance.com/hurricane-harvey-facts-damage-costs-4150087>
- <sup>x</sup> <https://www.wsj.com/articles/harveys-rebuilding-squad-your-employer-1504797709>
- <sup>xi</sup> <https://www.spglobal.com/marketintelligence/en/news-insights/latest-news-headlines/munich-re-estimates-overall-2020-nat-cat-losses-at-210b-62014389>
- <sup>xii</sup> <https://www.blackrock.com/ch/individual/en/literature/whitepaper/bii-physical-climate-risks-april-2019.pdf>
- <sup>xiii</sup> <https://www.youtube.com/watch?v=B4frj8xPxf8>
- <sup>xiv</sup> <http://www.ciatnews.cgiar.org/2015/10/27/climate-change-scientists-pinpoint-the-worlds-most-vulnerable-coffee-zones/>
- <sup>xv</sup> <https://www.greenbiz.com/article/episode-171-cdps-new-leader-speaks-steelcase-cso-takes-stock-moodys-wants-feedback>
- <sup>xvi</sup> <https://www.climateiskreview.com/p/weekly-round-up-july-19-23>
- <sup>xvii</sup> <https://www.cdp.net/en/research/global-reports/global-climate-change-report-2018/climate-report-risks-and-opportunities>
- <sup>xviii</sup> <https://about.bnef.com/blog/climate-tech-vc-investing-tops-17bn-in-2020/>
- <sup>xix</sup> <https://e360.yale.edu/digest/the-global-price-tag-for-100-percent-renewable-energy-73-trillion>
- <sup>xx</sup> <https://about.bnef.com/new-energy-outlook/#toc-download>
- <sup>xxi</sup> <https://about.bnef.com/electric-vehicle-outlook/>
- <sup>xxii</sup> <https://www.marketwatch.com/story/alternative-meat-market-could-be-worth-140-billion-in-ten-years-barclays-says-2019-05-22>
- <sup>xxiii</sup> <https://www.businessinsurance.com/article/20180613/NEWS06/912321991/Climate-change-extreme-weather-boost-supply-chain-risks>
- <sup>xxiv</sup> <https://www.bloomberg.com/professional/blog/esg-assets-may-hit-53-trillion-by-2025-a-third-of-global-aum/>
- <sup>xxv</sup> [https://www.climatebonds.net/files/reports/cbi\\_climate-aligned\\_bonds\\_issuers\\_2020.pdf](https://www.climatebonds.net/files/reports/cbi_climate-aligned_bonds_issuers_2020.pdf)
- <sup>xxvi</sup> <https://www.businesswire.com/news/home/20210727005569/en/TPG-Announces-5.4-Billion-First-Close-of-TPG-Rise-Climate-Fund>