

# Growing Costs of Inaction: Climate-Related Disruptions in Global Supply Chain

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As highlighted in the Denny Center's *Inaugural Report on the Health of Democratic Capitalism*, "the costs of continued environmental degradation and the effects of climate change have concrete impacts for society, long-term business interests, and the lives of every American."<sup>1</sup> 2022 was no exception. While short-term threats such as COVID-19 are well-known to have disrupted global supply chains, climate fluctuations and extreme weather patterns are creeping long-term pressures that must be given adequate consideration by businesses and governments alike.<sup>2</sup>

In the last year alone, the Mississippi River water levels fell so low that in October of 2022 barges were no longer able to float, the Texas freeze in February of 2021 caused one of the worst blackouts in U.S. history, shutting down railroads and impacting supply chains between Texas and the Pacific Northwest, and Hurricane Ida was the fifth most expensive hurricane in U.S. history causing disruptions to industries such as plastics and pharmaceuticals, and forcing the diversion of trucks across the country.<sup>3</sup>

Similar supply chain challenges were also felt in Europe and Asia. The Rhine River saw its banks burst due to heavy rainfall in February, but by April water levels were so low due to drought that cargo ships could only load 50% of their usual capacity.<sup>4</sup> Flooding in central China and a Typhoon in Malaysia caused what *TechWireAsia* called "arguably the worst flooding in history,"<sup>5</sup> while Yangtze River in China fell to a historic low.<sup>6</sup> Climate scientists have warned that these intense fluctuations will continue to intensify as the world warms, and water scarcity will increase with droughts costing up to €65 billion by the year 2100, thereby compromising global supply chains.<sup>7</sup>

## Climate Change, Extreme Weather, and Supply Chain Shocks

According to the Intergovernmental Panel on Climate Change (IPCC), increases in atmospheric greenhouse gases (GHG) since the Industrial Revolution are mainly the result of human activity

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<sup>1</sup> Denny Center Inaugural Report on the Health of Democratic Capitalism, p.30

<sup>2</sup> See Jacques Leslie, How Climate Change Is Disrupting the Global Supply Chain, YALEENVIRONMENT360 (Mar. 10, 2022), <https://e360.yale.edu/features/how-climate-change-is-disrupting-the-global-supply-chain>.

<sup>3</sup> See *Id.*

<sup>4</sup> See Everstream Team, Current Rhine River Water Levels Could Permanently Disrupt Shipping Routes, EVERSTREAM ANALYTICS (Oct. 1, 2022), <https://www.everstream.ai/articles/current-rhine-river-low-water-levels-disrupt-shipping-routes/>.

<sup>5</sup> See Leslie, *supra* note 2.

<sup>6</sup> See Helen Davidson, China Drought Causes Yangtze to Dry Up, Sparking Shortage of Hydropower, THE GUARDIAN (Aug. 22, 2022), <https://www.theguardian.com/world/2022/aug/22/china-drought-causes-yangtze-river-to-dry-up-sparking-shortage-of-hydropower>.

<sup>7</sup> See European Commission News Announcement, Global Warming Could More than Double Costs Caused by Drought in Europe, Study Finds (May 10, 2021), [https://joint-research-centre.ec.europa.eu/jrc-news/global-warming-could-more-double-costs-caused-drought-europe-study-finds-2021-05-10\\_en](https://joint-research-centre.ec.europa.eu/jrc-news/global-warming-could-more-double-costs-caused-drought-europe-study-finds-2021-05-10_en).

and are largely responsible for the observed increases in global temperature.<sup>8</sup> The National Oceanic and Atmospheric Administration's (NOAA) Annual Greenhouse Gas Index (AGGI) tracks the warming influence of the main human-produced greenhouse gases and, in 2021, the AGGI hit 1.49 indicating a 49% increase in the warming influence of greenhouse gases compared to 1990.<sup>9</sup> Furthermore, about 66% of this heat increase is due to carbon dioxide with the second biggest contributor being methane at 16%.<sup>10</sup> This warming influence of greenhouse gases raises global temperatures which creates prolonged heat waves and thus more frequent and intense droughts, but also results in more evaporation from oceans, therefore creating more moisture in the air, and leading to extreme rainfall and floods. Overall, climate change is contributing to increases in the frequency and intensity of flooding, drought, and other extreme weather events.<sup>11</sup>

A recent study by [Harvard Business Review](#) highlights the areas in the U.S. where supply chains are most vulnerable to extreme temperature and rain fluctuations. Increased frequency of extreme weather means that companies, their supply chains, and their accompanying infrastructure are more likely to experience repeated or overlapping disasters and may not be able to fully recover between events.<sup>12</sup> Some areas may even see forms of extreme weather stack on top of each other causing disruptions across multiple levels of the supply chain -- land, workforce, and transportation.<sup>13</sup> As our supply chain system is so interconnected, risks or disruptions in one area can create stress on the entire system. Thus, while this interconnectedness improves efficiency, it also exacerbates vulnerabilities to extreme weather events.

While there is still uncertainty in climate modeling stemming mainly from natural climate variability, model uncertainty, and future emission uncertainty – it is becoming clear that financial risks stemming from fluctuating weather patterns are real and increasing.

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<sup>8</sup> See *generally* Intergovernmental Panel on Climate Change, *Climate Change 2013 – The Physical Science Basis: Working Group I Contribution to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change*, (Cambridge: Cambridge University Press 2014).

<sup>9</sup> See The NOAA Annual Greenhouse Gas Index (AGGI), NOAA Global Monitoring Laboratory (last updated Spring 2022), <https://gml.noaa.gov/aggi/aggi.html>; see also Rebecca Lindsey, *Climate Change: Annual Greenhouse Gas Index*, Climate.gov (Jun. 17, 2022), <https://www.climate.gov/news-features/understanding-climate/climate-change-annual-greenhouse-gas-index>.

<sup>10</sup> See The NOAA Annual Greenhouse Gas Index (AGGI), NOAA Global Monitoring Laboratory (last updated Spring 2022), <https://gml.noaa.gov/aggi/aggi.html>.

<sup>11</sup> See Valerie Masson-Delmote et al., *Climate Change and Land: An IPCC Special Report on Climate Change, Desertification, Land Degradation, Sustainable Land Management, Food Security, and Greenhouse Gas Fluxes in Terrestrial Ecosystems*, Intergovernmental Panel on Climate Change (Jan. 2022), [https://www.ipcc.ch/site/assets/uploads/sites/4/2020/02/SPM\\_Updated-Jan20.pdf](https://www.ipcc.ch/site/assets/uploads/sites/4/2020/02/SPM_Updated-Jan20.pdf)

<sup>12</sup> See Commissioner Allison Herren Lee, *Shelter from the Storm: Helping Investors Navigate Climate Change Risk*, U.S. Securities and Exchange Commission (Mar. 21, 2022), [https://www.sec.gov/news/statement/lee-climate-disclosure-20220321#\\_ftn7](https://www.sec.gov/news/statement/lee-climate-disclosure-20220321#_ftn7).

<sup>13</sup> See Al Shaw, *Abraham Lustgarten, New Climate Map Shows a Transformed United States*, ProPublica (Sept. 15, 2020), <https://projects.propublica.org/climate-migration/>.

### In the Short-Term...

Predicting climate fluctuations and the associated financial risks are crucial for supply chain continuity. The Federal Reserve found that the financial performance of suppliers is negatively affected by heat and flooding incidents and showed that the financial consequences of these shocks propagate to customers through existing supply chain links.<sup>14</sup> Customers feel the direct impacts of disrupted supply chains, including through higher prices and volatility in the availability of products. Thus, when weather shocks reduce operating performance below customers' expectations, they look to alternatives. In fact, the Federal Reserve found that in these scenarios, customers are 6-11% more likely to terminate the existing supplier relationship.<sup>15</sup> They then turn to suppliers with lower climate risk exposure to reduce future disruptions.

Furthermore, because unpredictable weather patterns are disrupting 'just in time' business models, companies may need to consider alternative suppliers or simply hold more inventory. The 'just in time' business model does not allow for slack in the system; thus, if one part of the supply link is disrupted, the whole chain is affected. However, as weather patterns become more uncertain, redundancy in supply chains and accumulation of inventory may shift from an inefficiency to an asset.

In the short-term, companies and governments must consider emergency plans to safeguard against extreme weather and plan for a climate-altered future. Companies may begin to consider climate metrics and risks in their financial plans through [ESG considerations](#). Governments may implement climate policies to ensure economic preparedness and recovery from both short-term events such as hurricanes or longer-term weather patterns including rising temperatures and sea levels. They may also increase funding to better assess the impact of extreme weather events on trade, critical infrastructure, insurance companies, and GDP.

### In the Long-term...

Decision-makers in both businesses and governments may want to rethink supply chains as a potential climate mitigation tool. Climate neutral supply chains focus on zero-emissions beyond just carbon neutrality including methane and others. In fact, 8 supply chains – food, construction, fashion, fast-moving consumer goods, electronics, automotive, professional services, and freight – make up over 50% of global GHG emissions, and over 40% of these emissions could be affordably mitigated.<sup>16</sup> Thus, reducing emissions from supply chains is

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<sup>14</sup> See Pankratz, Nora M.C., Christoph M. Schiller, Climate Change and Adaptation in Global Supply-Chain Networks, Finance and Economics Discussion Series 2022-05, Washington: Board of Governors of the Federal Reserve System (Aug. 16, 2022), <https://doi.org/10.17016/FEDS.2022.056>.

<sup>15</sup> See *Id.*

<sup>16</sup> See Net-Zero Challenge: The Supply Chain Opportunity Insight Report, World Economic Forum (Jan. 2021), [https://www3.weforum.org/docs/WEF\\_Net\\_Zero\\_Challenge\\_The\\_Supply\\_Chain\\_Opportunity\\_2021.pdf](https://www3.weforum.org/docs/WEF_Net_Zero_Challenge_The_Supply_Chain_Opportunity_2021.pdf).

essential for climate change mitigation.<sup>17</sup> A global shift toward climate-neutral supply chains could be an opportunity to enhance economic growth and business competitiveness while also creating new opportunities for workers.

As reported by CDP Global in 2021, over 200 major companies representing US\$5.5 trillion in procurement spending already requested over 23,000 suppliers to disclose their emissions.<sup>18</sup> Despite interest in emissions data from major companies and investors, data quality and availability remains a [challenge](#). Most companies struggle in extracting and exchanging data with suppliers – a problem perhaps avoided by government-driven disclosure requirements. Furthermore, as carbon accounting is not yet sophisticated enough to provide the level of detail needed for financial statements, emission standards are mainly based on average institutional emission standards rather than product-specific data.<sup>19</sup> Once the data is available, companies will better be able to establish baseline reduction targets on emissions. There is still work to be done both to improve the availability of emissions data, manage and reduce supply chain emissions, and attenuate weather fluctuations.

### A Path Forward

Business-as-usual in 2022 meant disruptions and delays. In the short-term, supply chains must be flexible enough to adapt to disruptions due to extreme weather shocks, be it through rethinking business models to accumulate more inventory or considering alternative suppliers. But in the long-term, a rethinking of supply chains is central to lowering greenhouse gas emissions and mitigating increasingly extreme weather patterns. As we look toward the future, further engagement is needed to align decision-maker incentives with the priorities of managing supply chain risks from weather shocks and emissions reduction targets to mitigate the longer-term effects of climate change. Managing emissions is becoming a strategic necessity to avoid further supply chain disruptions.

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<sup>17</sup> See Kris Timmermans, How Sustainable Supply Chains can Unlock Net Zero Emissions, Accenture (Jan. 6, 2022), <https://www.accenture.com/us-en/insights/supply-chain-operations/supply-chains-key-unlocking-net-zero-emissions>.

<sup>18</sup> See Engaging the Chain: Driving Speed and Scale, CDP Global Supply Chain Report 2021 (Feb. 2022), <https://www.cdp.net/en/research/global-reports/engaging-the-chain>.

<sup>19</sup> See Peter Spiller, Making Supply-chain Decarbonization Happen, McKinsey & Company (Jun. 14, 2021), <https://www.mckinsey.com/capabilities/operations/our-insights/making-supply-chain-decarbonization-happen>.