

Written Testimony of Kathy Fulton
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For the United States Senate Committee on the Budget

Bottlenecks and Backlogs: How Climate Change Threatens Supply Chains
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Chairman Whitehouse, Ranking Member Grassley, and members of the committee:

Thank you for the invitation to testify before the Committee today. My name is Kathy Fulton and I serve as the Executive Director of the American Logistics Aid Network, a 501(c)(3) non-profit organization formed by senior logistics and supply chain professionals to unify our industry's disaster relief efforts. Created in response to the supply chain failures of Hurricane Katrina, our organization has had the privilege in the last eighteen years to support communities and individuals across the United States. Our mission to save lives and reduce suffering for disaster survivors via well-coordinated logistics solutions affords us the opportunity to work with businesses, non-profits, and emergency management agencies across the United States as they prepare for, respond to, recover from, and mitigate against disasters of all types. These increasingly include those resulting from climate related hazards¹.

As a native of Louisiana now living in Florida, I'm no stranger to disasters and the impacts and costs they have on our country's supply chains and the people serving in and served by those supply chains. My comments today are my own but would not be possible without input from the vast network of supply chain and logistics practitioners, universities, board members, staff, and volunteers that comprise American Logistics Aid Network.^{2,3}

I will focus my comments on three items related to the Impact of Climate Disasters on Supply Chains:

1. Ways in which supply chains are disrupted by climate disasters.
2. Sources of costs realized across supply chains due to climate disasters.
3. Ways in which supply chain stakeholders are already addressing the risks of a changing climate, and opportunities to implement cross-sector solutions to better prepare for the challenges ahead.

¹NOAA National Centers for Environmental Information (NCEI) U.S. Billion-Dollar Weather and Climate Disasters (2023). <https://www.ncei.noaa.gov/access/billions/>, DOI: 10.25921/stkw-7w73

² <https://www.alanaid.org>

³ A special thank you to Phil Palin of <https://supplychainresilience.org> and Dr. Jarrod Goentzel and his team at MIT's Humanitarian Supply Chain Lab. I am humbled to work with you.

WAYS IN WHICH SUPPLY CHAINS ARE DISRUPTED

Supply chains have long seen disruptions from disasters but only recently has the public taken interest in these disruptions. Not long after the beginning of the COVID-19 pandemic, supply chains garnered public attention when everyday items became difficult to find or experienced extended restocking timelines. When supply chains are running smoothly, most people do not think about them. Thankfully for most of us in the United States, being able to find what we need on the shelves of a grocery store or food pantry is like being able to flip a switch and see the lights go on. This abundance of access can be attributed to the agility of today's modern supply chains. But just like with power generation that enables us to turn on that light, there is an intricate set of activities that lead to any one of us being able to obtain food, or fuel, or water, when and where we need it.

This set of activities, commonly referred to as “the supply chain” is both complex and adaptive⁴, composed of numerous physical locations, transportation routes, information flows, and financial transactions.

Disasters cause disruptions to supply chains in three primary ways:

- By disrupting supply, that is, restricting the ability to provide a resource or service;
- By disrupting demand, that is, hampering the ability of an end consumer to access a resource or service in the manner or location they do pre-disaster;
- Or by disrupting the coordination mechanisms, like information flows and financial transactions, that connect sources of supply with sources of demand.⁵

Contemporary supply chains feature capacity concentrations which enable them to push high volumes of items at high velocity in response to demand pull signals from consumers. While we often think of bottlenecks in the negative connotation, these concentrations of capacity are “planned bottlenecks”. Like the neck of a bottle that controls the speed and direction of the flow of liquid from the mouth of the bottle, these locations are where businesses consolidate their activities; and where related businesses often spring up around them. These capacity concentrations drive efficiency, cost-savings, and timely fulfillment of demand by enabling access to common resources like shared infrastructure and a skilled labor pool.

Many of you will recognize capacity concentrations within your own states: the Blue Economy in Rhode Island, farming in Iowa, warehouses and ports in Southern California, petroleum refineries along the Gulf Coast, or any number of locally and regionally important concentrations.

⁴ Pathak, Surya and Day, Jamison and Nair, Anand and Sawaya, William J. and Kristal, Murat, Complexity and Adaptivity in Supply Networks: Building Supply Network Theory Using a Complex Adaptive Systems Perspective (2007). Decision Sciences, Vol. 38, Iss. 4: 547-580, Available at SSRN: <https://ssrn.com/abstract=1079068>

⁵ Ozlem Ergun, Wallace J. Hopp & Pinar Keskinocak (2023) A structured overview of insights and opportunities for enhancing supply chain resilience, IISE Transactions, 55:1, 57-74, DOI: 10.1080/24725854.2022.2080892

When these capacity concentrations are disrupted due to extreme weather events, bottlenecks become chokepoints, and the impacts can ripple far beyond the communities in which they exist. Baxter, a leading manufacturer of hospital products, operates three large facilities in Puerto Rico which manufacture sterile saline solutions for intravenous usage. After Hurricane Maria, all three facilities in this capacity concentration lost power and had to reduce production to levels that could be supported by generators. This resulted in delayed medical procedures in the United States and around the world.⁶ That is a disruption in supply.

Supply chains are also disrupted by shifts in demand. An example of a shift in demand would be evacuations in advance of a hurricane, such as Hurricane Irma, where over six million people left their homes.⁷ This mass migration undoubtedly saved lives, but also created demand for food, fuel, shelter, and medical care in new locations, sometimes many states away. Businesses, government organizations, and non-profits alike scrambled to meet the increased needs created by this population shift.

Finally, disruptions to coordination mechanisms can be as straight-forward as downed communication systems which prevent businesses from checking out customers in their stores or placing orders with their suppliers. But there are also more complex disruptions, like when the New York Stock Exchange closed for two days due to Superstorm Sandy in 2012. When businesses cannot exchange information or funds with their trading partners, the physical movement of goods stops as well.

COSTS TO SUPPLY CHAINS FROM CLIMATE DISASTERS

Any of these supply chain disruptions have a real cost to our economy, to communities, and to individuals and families. Businesses must spend money to protect against future disasters and address unbudgeted costs related to disruption; and many experience the financial effects for years after. Governments take on the cost to rebuild infrastructure; individuals and families take on the costs of rebuilding their lives.

I will only address costs to commercial supply chains, where financial losses and added spending come from a variety of causes, such as:

- Lost or damaged inventories, exemplified by the July 2023 tornado that destroyed the warehouse of a Pfizer pharmaceutical plant in North Carolina;
- Lost sales due to facility closures, such as the many small businesses in Sanibel and Fort Myers experienced after Hurricane Ian in 2022;
- Extra spending on labor and transportation to move supplies to meet increased demands, such as in response to evacuation notices or pre-storm surge spending by

⁶ National Academies of Sciences, Engineering, and Medicine. 2020. Strengthening Post-Hurricane Supply Chain Resilience: Observations from Hurricanes Harvey, Irma, and Maria. Washington, DC: The National Academies Press. <https://doi.org/10.17226/25490>.

⁷ <https://www.weather.gov/mfl/hurricaneirma>

consumers. Extra costs also occur when established transportation routes experience delays; like what we are currently seeing with drought causing reduced number of ships allowed through the Panama Canal, and lower barge capacity to move grain and other goods down the Mississippi River. These costs come in the form of both lost revenues due to reduced equipment availability and fees and penalties from supply chain trading partners.

- Added costs to provide temporary equipment or structures after an event. A major medical care organization lost their facility in Lahaina during the August 2023 wildfires. To continue providing for the medical needs of the community they moved a mobile clinic from California via ocean transport.
- Added costs to repair or rebuild facilities, like businesses in Cathedral City, CA are doing after post-tropical cyclone Hilary swept through in August of this year.
- Increasing costs of insurance to help defray some of these losses; and finally,
- Extra costs to support employees. Every business will tell you that their number one priority following a disruptive event is to support their employees and communities. Indeed, supply chains do not function without people to operate the equipment, drive the trucks, or stock the shelves; nor without consumers who can access the products safely. Businesses take on the added costs of bringing in staff from other parts of the organization so that employees who have been affected can focus on their personal lives. Following Hurricane Ida (2021) in Louisiana, a major grocery retailer brought in employees from multiple states so that they could re-open to serve their communities. Businesses often also provide affected employees with additional benefits like temporary housing, financial support, and more so those employees can begin to recover their lives and livelihoods.

These examples address the direct costs created by disaster, but there are additional indirect costs that are amplified during disasters due to human reactions to uncertainty.⁸ While these are difficult to measure, the symptoms are evident; think of empty store shelves prior to hurricanes or winter storms.

Each of these direct and indirect impacts to a business also means an impact to an individual who works in or is served by that business. And for those individuals and families who are already vulnerable, the effects are amplified. Supply chain failures – when supply and demand are mis-matched, can be life-threatening, such as the previous example of saline bag manufacturing disrupted by Hurricane Maria.

BUSINESS ADAPTATIONS IN RESPONSE TO CLIMATE RISK

Increasingly, businesses are seeking to adapt their supply chains to reduce their exposure to the risks of climate change. They are taking broad, long-term actions, like diversifying their supplier base, or switching to cleaner sources of energy. Supply chain decision makers are taking climate

⁸ Sterman, John D. *Business Dynamics: Systems Thinking and modeling for a Complex World*. Irwin/McGraw-Hill, 2009.

change into consideration when deciding where to place new factories, offices, and warehouses⁹, as well as in planning inventory management strategies.¹⁰

Companies are also addressing current and immediate risks, like adding backup power generation, flood protection, or other mitigation measures. This includes grocery retailers who have invested in back up power generation in response to public safety power shutoffs driven by drought and fire risk in California or regular threats from hurricanes in the Southeast. Adaptations are also being made to protect workforce, as in the example of UPS agreeing to provide air conditioning for delivery drivers working in extreme heat¹¹. Businesses take these protective, adaptive measures so they can continue to serve their customers and remain profitable while doing so.

However, the number of businesses thinking broadly about adaptations is still small, with a recent survey by PricewaterhouseCoopers¹² finding that less than one-fifth of firms "have implemented initiatives to protect their workforce or physical assets from the impacts of climate risk." In many ways this limited response makes sense. Today's supply chain designs have emerged from large capital expenditures over the last fifty to sixty years, while the risks of climate change have only risen to the board room level discussions in the past two decades. Investments have led to supply chains having a certain amount of native resilience; but that resilience fails when a capacity concentration is hit hard.

Supply chains need to continue to function while adjusting to new risks. There is no rip-and-replace solution to reduce or completely remove risk, nor can an individual business bear the adaptation burden alone.

A 2020 National Academies of Science, Engineering, and Medicine consensus study of Hurricanes Harvey, Irma, and Maria¹³ identified four recommendations for strengthening supply chains in a post-catastrophic context. These included (1) "Build system-level understanding of supply chain dynamics as a foundation for effective decision support" and (2) "Support mechanisms for coordination, information sharing, and preparedness among supply chain stakeholders".¹⁴

Whether physical or operational, adapting effectively will require a system-level understanding of supply chain dynamics. We see this in the move for organizations to study and map their suppliers, and their suppliers' suppliers, as far up the supply chain as possible. Where they

⁹ <https://blog.naiop.org/2022/10/how-supply-chain-and-logistics-drive-site-selection/>

¹⁰ <https://www.bloomberg.com/graphics/2023-opinion-apple-supply-chain-climate-change/>

¹¹ <https://about.ups.com/us/en/newsroom/press-releases/people-led/ups-statement-agreement-with-teamsters-on-heat-safety.html>

¹² <https://www.pwc.com/gx/en/issues/esg/how-climate-adaptation-can-both-protect-and-grow-your-business.html>

¹³ <https://www.nationalacademies.org/our-work/building-adaptable-and-resilient-supply-chains-after-hurricanes-harvey-irma-and-maria>

¹⁴ The other two recommendations were directed towards the actions and education of emergency management agencies.

identify threats from climate change or other sources, they work to de-risk by identifying alternate suppliers. These efforts to identify and qualify new sources of supply take time and investment.

This is where the second recommendation comes in: coordination, information sharing, and preparedness among supply chain stakeholders have been shown to improve post-disaster community outcomes.¹⁵ Complex systems are better understood when gaining the perspective of multiple observers and actors; and adaptation is more effective when measures are aligned across and between supply chains. Achieving supply chains capable of meeting consumer demand despite climate obstacles will require partnerships and trust building beyond just data sharing.

Anticipating and adapting to the challenges of climate change requires a collaborative, cross-sector, “whole-of-nation” effort, one in which our country has not yet meaningfully engaged. Understanding how best to direct those collective actions calls for dedicating time, research, and investment. We need sustained private-private and private-public conversation, education, practical mitigation and preparation focused on supply chain resilience. The National Academies study provides a thoughtful roadmap for advancing such conversation and collaboration.

Businesses are willing to lead and drive change when the risks or benefits are clear, quantified and supported by evidence. The hearings hosted by this Committee could form the foundation for a holistic study on the cost implications of climate disasters on supply chains. But without a clear understanding of the potential costs of failing to adapt, or the potential benefits such adaptations can bring, it may be “business as usual” for supply chains until the consequences of extreme events force action.

I hope my comments today have been helpful. I look forward to your questions.

¹⁵ <https://www.vestedway.com/>