



CLIMATE & BUSINESS

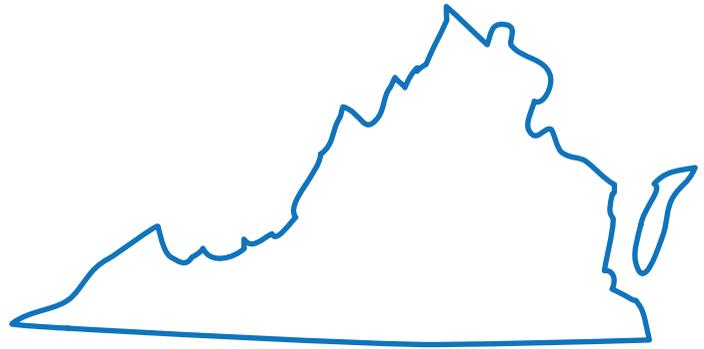


VIRGINIA

Virginia companies
explain climate change
and severe weather risk

February 2018

 **BUSINESS FORWARD**



This report examines how severe weather is distorting commodity prices, disrupting supply chains, damaging plants and equipment, and hurting consumer demand for Virginia businesses. It is meant to serve as a resource for local, state, and Congressional officials and media interested in energy and climate change policy. Specifically, the points made here should help media and officials answer a simple question about climate change: *How can we afford **not** to fix it?*

Virginia's top entrepreneurs, executives, investors, and small business owners are changing how they build, where they locate, and how they insure their assets. They are creating new business lines and models to capture the opportunities severe weather is creating. And they are issuing warnings to their investors about how climate change affects their bottom lines that climate policy opponents in Richmond and Washington, DC, should not ignore. Policymakers should also recognize the economic opportunities a transition to cleaner sources of energy brings and the jobs that come with it.

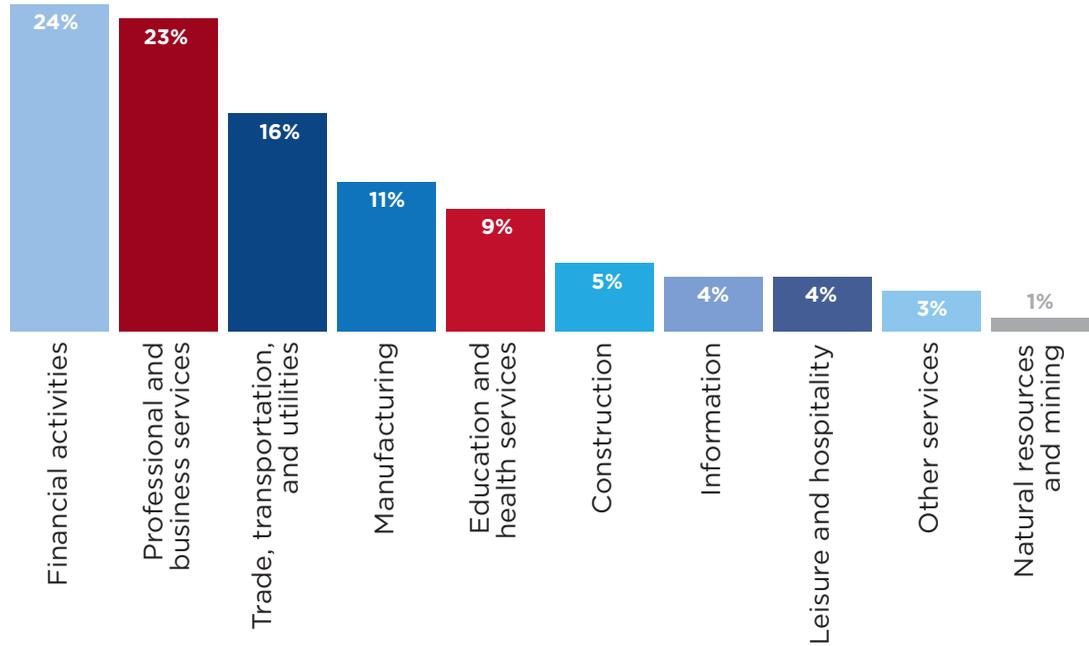
Severe weather is affecting Virginia's key industries, from farms and orchards to aerospace, energy utilities, food distributors, railroads, and shipping. Climate change threatens many of Virginia's greatest competitive advantages, including our fast-moving global supply chains, diversified economy, and model climate for hay, soybeans, and tobacco.

Business Forward has worked with nearly 4,500 entrepreneurs, executives, and small business owners across Virginia. These leaders have helped brief Congress, the White House, and state legislatures on a range of issues, including tax reform, trade agreements, infrastructure investment, and immigration reform. More than 1,300 of them have participated in our climate change and clean energy program, where they have learned about energy options and shared their experience managing severe weather costs. They have also expressed their support for the Clean Power Plan and policies that promote a transition to renewable fuels.

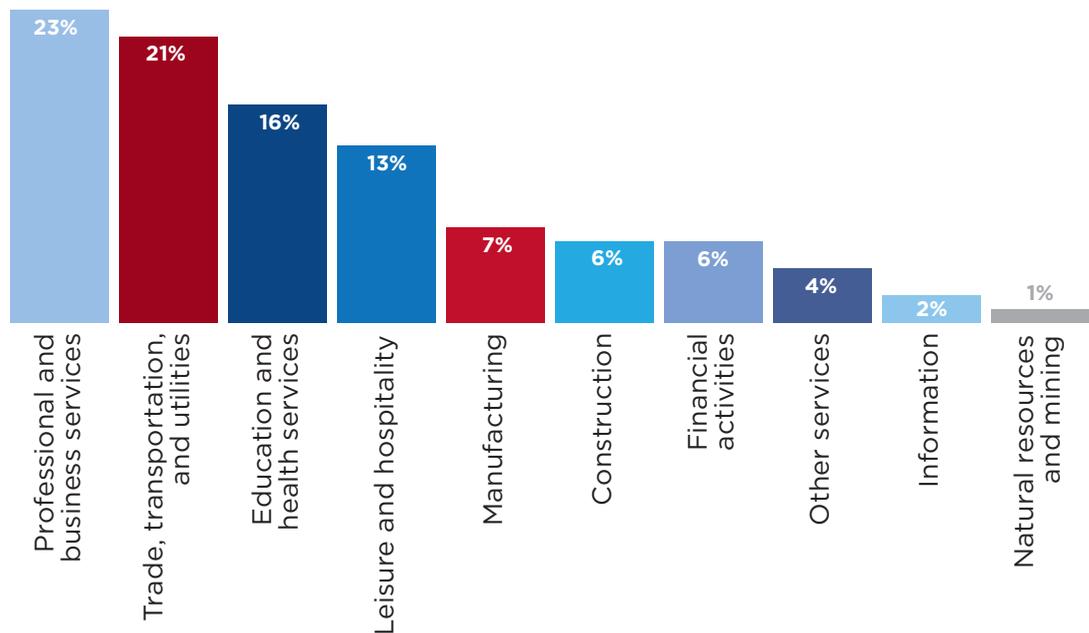
Companies featured in this report include Virginia's leading aerospace company, tobacco producer, hotel, and railway company.

A SNAPSHOT OF VIRGINIA'S ECONOMY

VIRGINIA GDP BY INDUSTRY, 2016



VIRGINIA EMPLOYMENT BY INDUSTRY, 2016



Gross Domestic Product (GDP) data is from the Bureau of Economic Analysis. Employment data is from the Bureau of Labor. Natural Resources and Mining includes agriculture and agribusiness data.

HOW SEVERE WEATHER AFFECTS KEY VIRGINIA INDUSTRIES, AS EXPLAINED BY VIRGINIA EXECUTIVES

AEROSPACE

Two thirds of American aerospace firms have operations in Virginia, producing \$7.4 billion in value each year.² Virginia is home to the Mid-Atlantic Regional Spaceport, the NASA Wallops Flight Facility, and Rolls-Royce's jet-engine production facility.³

Citing how water restrictions in Texas, flash-floods in New York, and wildfires in Colorado have affected its facilities, **Lockheed Martin** informed investors that it "anticipates that the extreme weather events associated with climate change could have an increased impact on operations in the coming decades."⁴ The company operates eight facilities across Virginia.

Northrop Grumman, which is based in Northern Virginia and operates worldwide, has noted "an increase in heating/cooling days in several regions [affected by extreme temperature changes]...resulting in increased utility costs."

AIRPORTS

Virginia's economy depends on a strong network of international airports that provide commercial passenger and cargo service. The state has five airports with more than half a million commercial enplanements per year: Washington Dulles (IAD), National Airport (DCA), Norfolk (ORF), Richmond (RIC), and Newport News (PHF).

VIRGINIA RANKS

6th

IN NUMBER OF BILLION-DOLLAR WEATHER AND CLIMATE DISASTERS SINCE 2012, BY STATE.¹

Nineteen Fortune 500 companies are headquartered in Virginia, and nearly one third of them have issued warnings about severe weather.

Companies operating factories, offices, shops, restaurants, or hotels in Virginia have reported that rising temperatures, extreme weather, and drought are affecting their operations here.

Many also report that increasingly severe weather is affecting their global operations, from higher prices for crops grown in California to disrupted semi-conductor supply chains in Thailand. As Virginia businesses grow, their severe weather risks grow, too.

National Airport and **Norfolk** are both susceptible to flooding in a storm surge. The runway at National Airport, which serves more than 20 million passengers a year, is only 10.3 feet above the Potomac River that it abuts. National Airport is one of the country's most vulnerable airports in terms of sea level rise. Norfolk Airport serves more than 1.6 million passengers per year and its facilities are located at 26.7 feet above sea level. Despite the higher location, its proximity to the ocean makes it susceptible to the types of storm surge seen in a Category 4 hurricane.⁵

CASH CROPS

Virginia's top four crops are hay, soybeans, corn, and tobacco. Together, they represented \$911 million in economic output and the bulk of Virginia's field crops.⁶

Even a small temperature increase can have a profound effect on crop yields.⁷ Between 2020 and 2039, corn and soybean yields are expected to decrease 17 percent and nine percent, respectively. These two crops represent \$386 million in annual output.

Richmond-based **Altria**, one of the world's largest producers of tobacco products, has warned investors "the price Altria's tobacco operating companies pay for tobacco leaf can be influenced by economic conditions and imbalances in supply and demand of crop quality and availability which may be influenced by variations in weather patterns, including those caused by climate change both in the southeastern United States and across the globe."⁸

HOW SEVERE WEATHER AFFECTS CASH CROPS (AND FOOD PRICES)

1

Consistently warmer temperatures stress plants and livestock, reducing crop yields and livestock health.

2

Rising surface temperatures are disrupting weather patterns, affecting rainfall, and even the timing and duration of growing seasons.

3

More severe storms are damaging crops and livestock.

Climate change will have a positive impact on some crops. However, the crops likely to benefit most are not prevalent in Virginia. For example, rising temperatures and increased carbon in the atmosphere could boost crop yields for cotton and wheat. Unfortunately, their \$115 million annual output represents just one-eighth of Virginia's hay, soybeans, corn, and tobacco annual output (\$386 million).

Leading companies (including **ConAgra**, **Anheuser-Busch InBev**, and **SABMiller**) are investing in new seed types that can better withstand a warming climate.⁹

COAL

Coal is Virginia's second largest export by value at \$639 million and critical both to the economies of southwest Virginia and the companies that ship it out of state. **Norfolk Southern** "faced significant headwinds during 2015 as operating revenues were negatively impacted by the steep decline in energy prices [due in part to warmer weather], which drove both reduced fuel surcharge revenue and volume decreases in coal and energy-related products." The railroad also noted that "severe weather conditions...could have an adverse effect on our financial position."¹⁰

CONSTRUCTION & ENGINEERING

Outdoor construction is especially vulnerable to unpredictable weather conditions. **Jacobs Engineering Group**, a global civil engineer company with four Virginia locations, has reported operational disruption due to flooding and has increased its climate change risk assessment of construction sites and its business, in general.

EFFICIENCY AND CLIMATE RISK

For decades, Virginia companies have built increasingly large, complex and fast-moving supply chains. To reach the lowest-cost producers, Virginia companies depend more on Asian, South American, and African markets. To maximize each individual supplier plant's efficiency, Virginia companies have encouraged their suppliers to specialize. And, to reduce overhead costs, more Virginia companies are following just-in-time inventory practices, which require their supply chains to operate with greater speed.

As their supply chains become more global, Virginia factories, stores, and plants grow more vulnerable to severe weather in other countries.

DATA & INFORMATION TECHNOLOGY

Nearly 150,000 individuals work in Virginia's IT sector. Virginia also hosts 650 data centers, which together employ 10,500 workers and service 70 percent of the world's internet traffic.¹¹

Adobe Systems, Symantec, AT&T, and Google have warned investors of how extreme temperatures increase their already sizable cooling costs for their data centers and other facilities.¹²

ENTERTAINMENT

Virginia's film production industry is a fast-growing sector of its economy, with a total economic impact of almost \$616 million.¹³

News Corp. advised investors of how severe weather had affected traffic at its movie theaters: "Superstorm Sandy in the U.S. reduced box office sales in a key market. Estimates suggest that the 12-25% drop in total U.S. box office sales at the time was due in large part to closed theaters."¹⁴ **Twenty First Century Fox** advised investors that winter storms in the northeast in January 2014 led to a drop in box office attendance in the region of as much as 30 percent.

FISHERIES

Virginia has the most valuable seafood industry in the Mid-Atlantic Region, with more than 19,000 jobs and sales exceeding \$1.7 billion.¹⁵ Major sources of income include oysters, blue crabs, and striped bass. These species are at risk by ocean acidification, which makes it harder for shellfish to form their shells, and warmer water that kills the plants fish use for food and shelter.¹⁶

W. E. Kellum Seafood, a Chesapeake Bay seafood supplier, has recently made significant investments to raise the height of its buildings to manage sea level rise.

“During baseball season, we want every day to be 75 and sunny, but unfortunately that doesn't happen over the course of a 70-home-game season. It's like my second job is being a meteorologist. We learn the weather patterns pretty well, because one rain event can dramatically affect our revenue.”

Allen Lawrence, Vice President and Assistant General Manager, Salem Red Sox

“The rise in sea levels is already affecting the Chesapeake Bay oyster industry. Over the last 35 years, we've faced increasingly higher tides. We just raised the pier side of our oyster houses by three feet because the storm surges were getting too close to our drainage outlets on. If storm water contaminates the oyster houses, we lose the house full of shellfish.”

Tommy Kellum, Owner, W. E. Kellum Seafood

FOOD PROCESSING & DISTRIBUTION

Virginia has more than 34,000 workers employed in food processing, plus tens of thousands more working for food wholesalers and distributors. These firms rely on affordable and predictable commodity prices.

Each year, **PepsiCo**, which has franchised bottlers across Virginia and spends about \$19 billion on commodities for its products (including water, fruit, and sugar), has reported that its “revenues are sensitive to...changes in crop yields due to changes in precipitation and temperature patterns, increases in transportation costs and increased supply chain costs due to changes in crop locations, increased energy cost, increased fiberboard cost or disruptions due to flooding.”¹⁷

The Kraft Heinz Company, which produces several products, including Capri Sun and Kool-Aid Burst in Virginia, has warned that “[p]rices for commodities, energy, and other supplies are volatile and can fluctuate due to conditions that are difficult to predict, including...severe weather or global climate change...”¹⁸

Kroger, which operates more than 100 supermarkets in Virginia under the Kroger and Harris Teeter brands, has advised investors that “increases in the cost of inputs, such as utility costs or raw material costs, could negatively affect financial ratios and earnings... Earnings and sales also may be affected by natural disasters or adverse weather conditions, particularly to the extent that they disrupt our operations or those of our suppliers; create shortages in the availability or increases in the cost of products that we sell in our stores or materials and ingredients we use in our manufacturing facilities; or raise the cost of supplying energy to our various operations, including the cost of transportation.”¹⁹

Kroger has also warned that a “large number of our stores and distribution facilities are geographically located in areas that are susceptible to hurricanes, tornadoes, floods, droughts and earthquakes. Weather conditions and natural disasters could disrupt our operations at one or more of our facilities, interrupt the delivery of products to our stores, substantially increase the cost of products, including supplies and materials and substantially increase the cost of energy needed to operate our facilities or deliver products to our facilities.”²⁰

JM Smucker Company, which produces several product lines, including coffee, in Virginia, has advised investors, “the emission of carbon dioxide and other greenhouse gases may have an adverse impact on global temperatures, weather patterns, and the frequency and severity of extreme weather and natural disasters. In the event that climate change has a negative effect on agricultural productivity, we may be subject to decreased availability or less favorable pricing for certain commodities that are necessary for our products, such as green coffee, peanuts, sweeteners, edible oils, wheat, milk, cocoa, and various fruits and vegetables.”

Mars, a global confectionary and food manufacturer headquartered in McLean, is also addressing climate change and sustainability for its agricultural suppliers, like cocoa farmers.²¹

HOTELS

Hilton Worldwide, based in McLean, operates 4,300 properties around the world. “The potential for changes in the frequency, duration, and severity of extreme weather events that may be a result of climate change could lead to significant property damage at our hotels and other assets, affect our ability to obtain insurance coverage in areas that are most vulnerable, such as the coastal resort areas where we operate, and have a negative effect on revenues.”

“ We are a market research firm specializing in travel and tourism and have experienced greater uncertainty due to our travel clients’ exposure to variability in climate conditions. When our clients need to invest in the development of disaster plans and alternate operating plans resulting from variable weather conditions, they are not investing as much in research and other core elements of the business. Marketing research is one of those areas where funding gets reduced in order to allocate resources to climate related planning efforts.”

Laura Mandala, CEO, Mandala Research

Starwood, which operates 25 hotels in Virginia, has warned investors that “[c]hange in average temperature can also lead to increased operational costs for Starwood, due to an increase in utility costs.” The company has cited projections by the International Energy Agency that space cooling demand could increase by 170 percent by 2035.²² Droughts in the Southeastern U.S. recently caused the chain to close swimming pools and pay higher costs for basic supplies.

INSURANCE

Even for non-property and non-casualty insurers, severe weather is a factor. **Genworth Financial** warns that the “increased frequency or severity of catastrophic weather or other natural events possibly related to climate change could increase the number of life and mortgage insurance policy claims Genworth receives which would impact our revenue.”²³

MANUFACTURING

Virginia is home to a range of durable goods manufacturers, with automotive manufacturing representing one of the state’s fastest growing sectors. Over the past ten years, the automotive industry has invested \$2 billion in Virginia, including the Volvo Truck North America, the world’s largest truck plant. Virginia also hosts more than 200 plastics companies and a range of life science and technology firms.²⁴

Virginia’s largest export by value is electronic integrated circuits, valued at \$717 million.²⁵

Micron Technology, Inc., a global microchip manufacturer with a plant in Manassas, has had to extend lead times for the supply of raw materials to account for disruptions in transportation lines due to climate change. It has “experienced disruptions in our manufacturing process as a result of power outages...earthquakes, or other environmental events.”²⁶

“Home insurance premiums keep going up to pay for the increase in claims we’ve seen as severe weather has gotten more common. I see more people buying flood policies. When I started out in the business people in Virginia refused to talk about this coverage, now they are quick to ask how much? The last thing you want in the time of the claim is to find out you don’t have the coverage you need.”

Virginia Kinneman, Agency Owner, Kinneman Insurance

Volvo, which has an automotive plant in Dublin, has listed climate change and resource scarcity as a top three global trend in its annual report since 2011.

Masco, a building supply manufacturer, monitors infrastructure risk. For example, it avoids locating its facilities in 100-year flood risk areas.

Volkswagen, which has its U.S. headquarters in Herndon, monitors extreme weather and warns that “storms or floods can lead to failure of information and communication technology, supplier failure resulting in production stoppages, or general production downtime at one of our more than 100 production locations worldwide.”²⁷

General Motors has explained that “[o]ur use of “just-in-time” manufacturing processes allows us to maintain minimal inventory quantities of systems, components, raw materials and parts... [However, a]ny disruption of our production schedule caused by an unexpected shortage of systems, components, raw materials or parts even for a relatively short period of time could cause us to alter production schedules or suspend production entirely.”²⁸

Beyond changes in farming, Richmond-based **Altria** faces challenges with its manufacturing operations. It warns, “risks inherent in reliance on a few significant facilities and a small number of significant suppliers. A natural or man-made disaster or other disruption that affects the manufacturing operations of any of Altria Group, Inc’s tobacco subsidiaries or the operations of any significant suppliers...could adversely impact the operations.”

SEVERE WEATHER TREND

HIGHER TEMPERATURES

Temperatures across the U.S. are 1.3 to 1.9 degrees warmer, on average, than they were when measurements were first recorded in 1895, and most of this increase has occurred since 1970. Nineteen of the 20 hottest years on record occurred in the past two decades. Heat waves have become more frequent and intense.

In Virginia, statewide temperatures have increased by about one degree over the past century.²⁹

MATERIALS

Virginia-based **MeadWestvaco** (now **WestRock**) is a global packaging company that services many of the world's most famous brands. Globally, it has identified 22 facilities that are "in risk locations for catastrophic wind storms and/or flooding. The replacement value of these facilities is about US\$8.7 billion," including business interruption.³⁰

MILITARY BASES

Virginia is home to 27 military bases, including the Pentagon and the world's largest naval installation, Naval Station Norfolk.³¹

Given the importance of the military to the Commonwealth's economy and the amount of government funding devoted to it, we will be covering this more fully in a separate paper.

PORTS

The Port of Virginia is one of the three busiest container ports on the East Coast.

The Norfolk Customs District processes six percent of the nation's imports and exports. It is also America's largest coal export center, responsible for 35 percent of exports in 2015.³²

RAIL

Norfolk Southern, which is based in Virginia and operates 20,000 miles of railroad across 21 other states, has warned "changes in temperature extremes, particularly more frequent occurrences of extreme heat and extreme cold, could reduce or disrupt Norfolk Southern's rail services." Even a one percent delay in network speeds due to extreme weather can cause \$105 million in lost revenue.

SEVERE WEATHER TREND

MORE SEVERE STORMS

Heavy downpours are increasing nationally. Across Virginia and the southeast, the amount of rain in the heaviest storms has increased by 27 percent over the past 60 years. The severity of these storms will continue to rise. Consistently warmer ocean surface temperatures are increasing the power and frequency of storms and severe weather. Warmer ocean waters sustain hurricanes better than cooler waters, which means, all else being equal, hurricanes will travel farther, last longer, and generate more power as ocean surface temperatures rise.³³

CSX, which provides rail service across Virginia and 22 other states, has warned that “CSX employees, track infrastructure, locomotives and railcars are all susceptible to weather events. Hurricane events can temporarily interrupt operations in a specific area by creating unsafe work conditions. Extreme winds or flooding resulting from hurricane activity can damage track structure or signal systems and lead to an increase in repair or recovery costs in addition to interrupting operations.” In fact, “[a]ny increase in the number or severity of hurricanes on the eastern half of the United States could result in significant business interruptions and expenditures.”

REAL PROPERTY

The Norfolk-Virginia Beach Metropolitan Area ranks 10th in the world in value of assets exposed to increased flooding due to sea-level rise.³⁴

During normal weather, parts of the Virginia coastline will be inundated by rising sea levels. As much as \$139 million in property will be below mean sea level by 2030 (and as much as \$306 million by 2050).³⁵

Storm losses (attributed to climate change) along the Virginia coast are likely to reach \$135 million per year higher in 2030 than would otherwise be (and \$522 million higher in 2050).³⁶

RESTAURANTS

Restaurant owners say they are more sensitive than other hospitality businesses to extreme temperatures and severe weather. One Virginia-based restaurant owner noted that, “When the weather is bad, the hotels will still get their money, as will the retail stores, but not the restaurants.” Furthermore, restaurants that rely heavily on outdoor seating suffer “when temperatures grow too hot, or when the weather is simply too volatile to plan a date.”

SEVERE WEATHER TREND

SEA-LEVEL RISE & FLOODING

Hampton Roads is currently experiencing the highest sea-level rise on the East Coast due to rising sea levels and sinking land. Assuming current emission trends, mean sea level at Norfolk will likely rise 1.1 to 1.7 feet by 2050 and 2.5 to 4.4 feet by 2100.³⁷

Chipotle, the fast casual Mexican restaurant with more than 80 Virginia locations, has warned, “Increasing weather volatility or other long-term changes in global weather patterns, including any changes associated with global climate change, could have a significant impact on the price or availability of some of our ingredients...such as chicken, beef, cheese, avocados, beans, rice, tomatoes and pork... Any such changes to our available menu may negatively impact our restaurant traffic and comparable restaurant sales, and could also have an adverse impact on our brand.”³⁸

RETAILERS

Major retailers (including **Apple** and **Walmart**) have advised investors that severe weather and extreme temperatures affect the demand for their services or products.

Carmax, based in Richmond, has found its profits to be susceptible to interruption early in the year: “If conditions arise that impair vehicle sales during the first or second fiscal quarters, these conditions could have a disproportionately large adverse effect on our annual results of operations.” Those conditions include severe weather that “could cause store closures or affect the timing of consumer demand.”³⁹

Surprisingly, winter storms that keep consumers home hurt online sales as well – because most people do their online shopping at work. **Adobe** analyzed the impact of a 2015 storm that left three feet of snow across the Northeast United States. Sales on the day of the storm dropped by \$35 million, or 4.5 percent below the national average.⁴⁰

The GAP,⁴¹ **Nike**,⁴² and **Abercrombie & Fitch Company**⁴³ operate more than 30 stores in Virginia. They have warned investors about the impact severe weather can have on store or website sales.⁴⁴

“Climate change is disrupting crucial deliveries of exports to countries that are heavily affected by severe weather. Our members are taking numerous steps but timing of shipments to foreign destinations is difficult at best given the uncertainty of when and where the next storm will hit.”

John Saylor, Chairman, Virginia-Washington, DC District Export Council

As **L Brands** explained, “heavy snowfall, rainfall or other extreme weather conditions over a prolonged period might make it difficult for our customers to travel to our stores and thereby reduce our sales and profitability.”

America’s largest retailer, **Walmart**, operates more than 80 stores across Virginia. It has warned of “weather conditions, patterns and events, climate change... [and] resulting damage to our units and store and club closings and limitations on our customers’ access to our stores and clubs resulting from such events.”⁴⁵

TIMBER

Virginia is a major timber producer, but its 15.4 million acres of timberland are being affected by rising temperatures. In the short term, higher temperatures encourage pests that harm trees. Over the long term, higher temperatures could cause a northward shift of tree species. By mid-century, Virginia will have fewer oak and pine trees and potentially lose Virginia’s state tree, the Flowering Dogwood.⁴⁶

UTILITIES

Heavy rains can weaken poles, while heavy snowfall can topple them. Heavy snowfall also leads to increased use of road salt, which can damage utilities’ underground electric systems.⁴⁷

Natural gas provides about 40 percent of the state’s power, two nuclear reactors supply about 30 percent, and coal provides about 20 percent. The remainder is generated by biomass (five percent), hydro (two percent), and a small but growing portfolio of wind and solar.⁴⁸

SEVERE WEATHER AND CONSUMER DEMAND

The best way to understand climate change-related costs to consumer businesses is to appreciate the impact losing marginal business can have on profits. A golf course in Charlotte depends heavily on the number of temperate weeks it enjoys, because it can sell more afternoon rounds. For a tight-margin business, those extra rounds can represent the difference between a good season and an unprofitable one.

Dominion Energy, the Commonwealth’s largest utility headquartered in Richmond, has warned that “operations could be adversely affected and our physical plant placed at greater risk of damage should changes in global climate produce, among other possible conditions, unusual variations in temperature and weather patterns, resulting in more intense, frequent and extreme weather events, abnormal levels of precipitation and, for operations located on or near coastlines, a change in sea level or sea temperatures.”⁴⁹

American Electric Power Company operates as the Appalachian Power Company (APCo) over its 11,000 square-mile territory in central and southwestern Virginia. Floods and tornadoes have flooded coal yards, shut down distribution centers, and stopped its barge shipments. Increases in extreme weather frequency could “increase AEP’s cost of providing service... A negative impact to water supplies due to long-term drought conditions or severe flooding could adversely impact AEP’s ability to provide electricity to customers, as well as increase the price they pay for energy.”⁵⁰

WINERIES

Wineries have become a \$1 billion industry in Virginia that employ more than 8,000 workers across 420 wineries.⁵¹ Rising temperatures are expected to significantly reduce the productivity of these vineyards and potentially shift the industry to states further north by 2050.⁵²

“**More severe weather events negatively affect Virginia vineyards. For example, an unseasonably warm March might advance bud break and then a seasonably cold event in April could destroy the crop with a frost. Virginia vineyards rely on stable and predictable growing conditions to produce quality wine.**”

Tony Wolf, Professor of Viticulture, Virginia Tech University

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