



CLIMATE & BUSINESS

# MICHIGAN

Michigan companies explain  
climate change and severe  
weather risk

February 2018

 **BUSINESS FORWARD**



**T**his report examines how severe weather is distorting commodity prices, disrupting supply chains, damaging plants and equipment, and hurting consumer demand for Michigan 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?*

Michigan'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 Lansing 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.

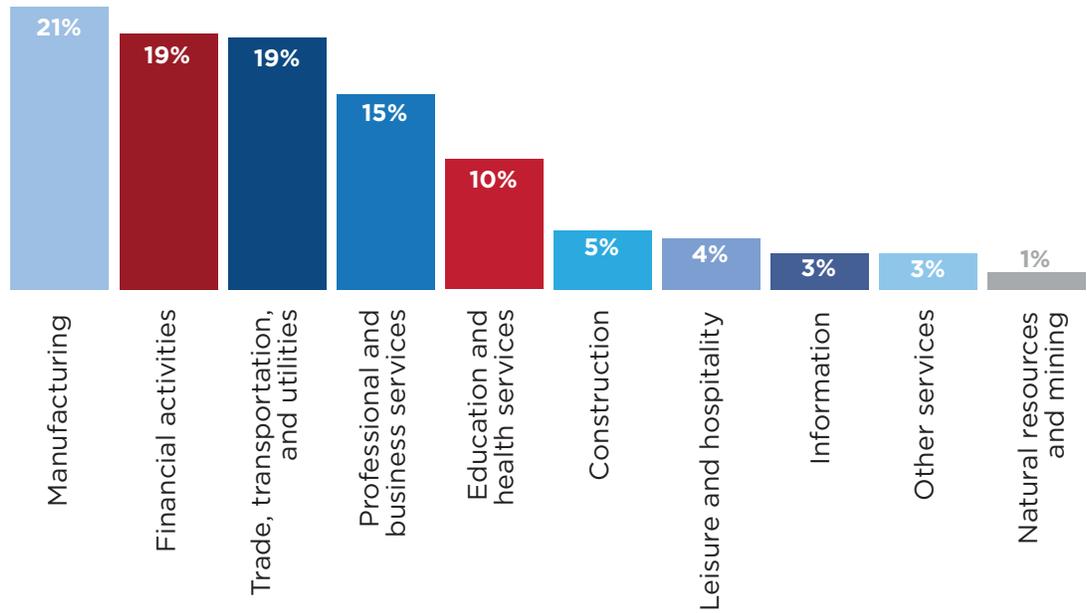
Severe weather affects Michigan's greatest competitive advantage, including our fast-moving global supply chains, model climate for wheat and soybeans, and ready access to the Great Lakes. Severe weather is also affecting key industries, from farms and orchards to aerospace, auto suppliers, railroads, restaurants, and shipping.

Business Forward has worked with more than 5,500 entrepreneurs, executives, and small business owners across Michigan. 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.

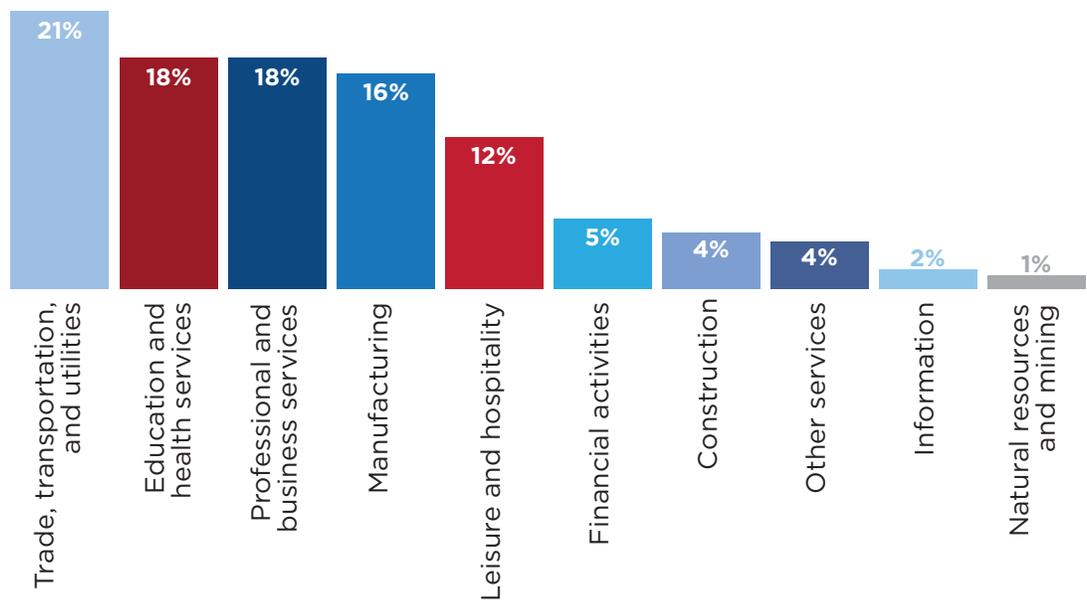
Companies featured in this report include Michigan's largest multinational food manufacturer, furniture manufacturer, and the operators of its largest automotive assembly plants.

# A SNAPSHOT OF MICHIGAN'S ECONOMY

## MICHIGAN GDP BY INDUSTRY, 2016



## MICHIGAN 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 MICHIGAN INDUSTRIES, AS EXPLAINED BY MICHIGAN EXECUTIVES

## AEROSPACE

Michigan has the highest concentration of electrical and mechanical engineers in the U.S. and hosts more than 600 aerospace related companies. Together, they generate nearly \$1 billion in annual sales.<sup>2</sup>

**Lockheed Martin** operates a Rotary and Mission Systems facility in Deer Creek. It “anticipates that the extreme weather events associated with climate change could have an increased impact on operations in the coming decades.”<sup>3</sup> In 2014, about 40 percent of its 24,000 key suppliers reported that climate change or water-related risks could potentially impact its supply chain and business.<sup>4</sup>

**GE Aviation’s Johnson Technology** includes potential supply chain and operational risks due to climate change in its annual SEC filing.

## AIRPORTS

**Delta Air Lines’s** second biggest hub is Detroit, where it operates more than 500 daily departures to 175 destinations.<sup>5</sup> Delta warns investors that “increases in the frequency, severity or duration of thunderstorms, hurricanes, typhoons or other severe weather events, including from changes in the global climate, could result in increases in delays and cancellations, turbulence-related injuries and fuel consumption to avoid such weather.”<sup>6</sup>

## MICHIGAN HAS HAD

# 11

## BILLION-DOLLAR WEATHER AND CLIMATE DISASTERS SINCE 2012.<sup>1</sup>

Seventeen Fortune 500 companies are headquartered in Michigan, and more than one third have issued warnings about severe weather.

Companies operating factories, farms, shops, restaurants, or hotels in Michigan 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. As Michigan businesses grow, their severe weather risks grow, too.

## AUTOMOTIVE MANUFACTURING

Michigan is home to a range of durable goods manufacturers, with automotive manufacturing representing one of the state's largest sectors. Over the past seven years, the automotive industry has invested \$23 billion in Michigan.<sup>7</sup> Michigan's largest export by value is motor vehicle parts and vehicles, valued at \$4.7 billion.<sup>8</sup>

A single automaker with plants in Michigan and Ontario can ship approximately \$4 billion worth of parts between the U.S. and Canada each year. Its plants depend on 600 or more trucks crossing the Ambassador Bridge (which connects Detroit and Ontario) every day. When a winter storm in 2010 closed Highway 402 near Port Huron, officials diverted traffic south to the Ambassador Bridge, causing day-long delays for shippers. Plants in both Michigan and Ontario experienced parts shortages and shut down production lines.

**Ford Motor Company** warns investors that “[w]ith the increasing interconnectedness of global economic and financial systems, a [significant event] in one area of the world can have an immediate and devastating impact on markets around the world.”<sup>9</sup>

**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.”<sup>10</sup>

“Extreme weather events associated with climate change could have an increased impact on operations in the coming decades.”

*Lockheed Martin*

“Changes in the global climate could result in increases in delays and cancellations, turbulence-related injuries and fuel consumption to avoid such weather.”

*Delta Air Lines*

“Any 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.”

*General Motors*

Both **Ford** and **General Motors** warn investors of increased “frequency of drought conditions [that] can further depress water availability for production in water-stressed areas.” This will disrupt production in the near future, particularly in places like Mexico, where General Motors’s production “accounts for about 7% of total global production and a one month disruption of GM’s production could result in loss of \$23 million in net income.”<sup>11</sup> Ford warns that “about 25 percent of our operations are located in regions that are now or will be considered to be at risk for water scarcity by 2025” due to global climate change.<sup>12</sup>

**Ford** has also warned that climate change can disrupt its supply of natural gas, which is critical to manufacturing. “[E]xtreme weather has the potential to disrupt the production of natural gas, a fuel necessary for the manufacture of vehicles.” As a precaution, it has begun installing “propane tank farms at key manufacturing facilities as a source of backup fuel.”<sup>13</sup>

**Penske Automotive Group**, based in Bloomfield Hills, warns investors of the potential substantial losses at its facilities from severe weather conditions due to the “significant concentration of property values, including vehicle and parts inventories, at our operating locations.”<sup>14</sup>

**Delphi Automotive**, based in Troy, warns this “‘just-in-time’ method makes the logistics supply chain in our industry very complex and very vulnerable to disruptions” or “logistical complications due to weather, global climate change.” It also warns that as its business grows in low cost countries, “the risk for such disruptions is heightened. The lack of even a small single subcomponent necessary to manufacture one of our products, for whatever reason, could force us to cease production, even for a prolonged period.”<sup>15</sup>

“About 25 percent of our operations are located in regions that are now or will be considered to be at risk for water scarcity by 2025.”

*Ford Motor Company*

## EFFICIENCY AND CLIMATE RISK

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

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

**Visteon**, an automotive electronics manufacturer based in Van Buren, worked with its insurance provider to assess all its global operations for risks associated with flooding, high winds, and other severe weather events. As a result, it relocated facilities or equipment within those facilities.

Auto suppliers like Michigan's **Superior Industries International**,<sup>16</sup> **Lear Corporation**,<sup>17</sup> and **Gentherm**<sup>18</sup> warn investors they are vulnerable to the same supply chain and operational disruptions from severe weather as their automaker customers. Livonia-based **Tower International** warns investors that consumer demand may decrease due to climate change concerns.<sup>19</sup>

Auto parts supplier **Adient**, based in Plymouth, warns that climate change may increase energy costs or shift consumer demand away from motor vehicles with higher interior content provided by the company, like sports utility vehicles or light trucks.<sup>20</sup>

**BorgWarner**, an auto supplier headquartered in Auburn Hills, has cited "increased frequency, severity, or unpredictability of precipitation events such as snowfall in the southeast or large precipitation/flooding events" as impactful to its facility access and operation.

### CASH CROPS

Michigan's top four crops are corn, soybeans, apples, and wheat. Together, they represent \$2.7 billion in economic output and the bulk of Michigan's field crops.<sup>21</sup>

Even a small temperature increase can have a profound effect on crop yields.<sup>22</sup> These two crops represent the majority (\$1.99 billion) in annual output.<sup>23</sup>

However, climate change could have a positive impact on wheat, due to higher concentrations of atmospheric carbon dioxide and longer frost-free growing seasons.<sup>24</sup>

“Our ‘just-in-time’ method makes the logistics supply chain in our industry very complex and very vulnerable to disruptions.”

*Delphi Automotive*

## 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.

Leading companies (including **ConAgra**, **Anheuser-Busch InBev**, and **SABMiller**) that purchase Michigan cash crops are investing in new seed types that can better withstand a warming climate.<sup>25</sup> **ConAgra** also warns that “with approximately 70 percent of water in the United States used for agriculture, any increase in water scarcity resulting from climate change presents a significant physical risk.”<sup>26</sup>

Real estate investment firm **Gladstone Land** leases blueberry farms in South Haven and Covert. It warns investors that climate change, like more extreme temperatures and increases in volatile weather, may impact the value of its properties and make them less suitable for farming or other alternative uses. It also warns that its investments in “permanent crop farms have a higher risk profile than annual row crop farms” due to higher initial capital costs, replacement costs, and susceptibility to disease and poor weather.<sup>27</sup>

## CHEMICALS

Michigan’s chemical industry is the third largest export sector in the state, shipping \$4.5 billion in products to customers.<sup>28</sup>

**Dow Chemical**, headquartered in Midland, “continues to study the long-term implications of changing climate parameters on water availability, plant siting issues, and impacts and opportunities for products.” In particular, its substantial “operations on the U.S. Gulf Coast, logistics across the region, and the supply of certain raw materials” have been significantly disrupted by major hurricanes.<sup>29</sup>

## CONSTRUCTION & ENGINEERING

Outdoor construction is especially vulnerable to unpredictable weather conditions. Engineering firms also experience severe weather disruptions to their operations.

“With approximately 70 percent of water in the United States used for agriculture, any increase in water scarcity resulting from climate change presents a significant physical risk.”

*ConAgra*

“Dow continues to study the long-term implications of changing climate parameters on water availability, plant siting issues, and impacts and opportunities for products.”

*Dow Chemical*

**Tetra Tech of Michigan PC**, headquartered in Detroit, has experienced “seasonal inclement weather conditions [that] occasionally cause some of our offices to close temporarily or may hamper our project field work in the northern hemisphere’s temperate and arctic regions.”<sup>30</sup>

**Stantec Inc.**, a global construction and engineering services company with four Michigan facilities, reports that its water and construction services are impacted by water scarcity and climate change.<sup>31</sup>

## DAIRY

Michigan ranks eighth in the U.S. in milk production.<sup>32</sup>

**Dean Foods** operates dairy processing facilities in Grand Rapids, Livonia, and Marquette. It warns investors of the financial risk of climate change on its supply chain and commodity prices.<sup>33</sup>

**Coca-Cola’s Fairlife** produces dairy products in its Coopersville facility. Coca-Cola warns “climate change may have long-term direct and indirect implications for our business and supply chain.”<sup>34</sup> An executive explains that “[i]ncreased droughts, more unpredictable variability, 100-year floods every two years...[w]hen we look at our most essential ingredients, we see those events as threats” to the cost of key agricultural commodities.<sup>35</sup>

## DATA & INFORMATION TECHNOLOGY

**Google’s** AdWords sales department operates out of Ann Arbor. It warns investors that its information technology and communication systems “are vulnerable to damage or interruption from...the effects of climate change (such as sea level rise, drought, flooding, wildfires, and increased storm severity).”<sup>36</sup>

“**Centric Design Studio Architects** incorporates sustainable design solutions into each of our architectural projects with the goal of reducing energy emissions to offset the effects of climate change.”

*Sandra Little, Architect, Centric Design Studio*

“**Severe weather** shuts down operations and delays projects which can result in fiscal issues and employee performance.”

*Audie Brinker, President, Nora Contracting LLC*

“**Increased droughts, more unpredictable variability, 100-year floods every two years... When we look at our most essential ingredients, we see those events as threats.**”

*The Coca-Cola Company*

Information technology firm **Covisint**, headquartered in Southfield, warns investors its data centers are at risk of disruption from natural disasters or power outages. It took steps to “eliminate single points of failure in our data center.”<sup>37</sup> Warren-based **MSX International** issued similar warnings to its investors.<sup>38</sup>

**Compuware** operates its headquarters and disaster recovery facility in Detroit. It warns investors its “network performance and service levels could be disrupted by numerous events, including natural disasters and power losses.”<sup>39</sup>

## FOOD PROCESSING & DISTRIBUTION

Michigan has nearly 134,000 workers employed in food processing, plus tens of thousands more working for food wholesalers and distributors. These firms export nearly one-third of their agricultural commodities internationally and rely on affordable and predictable commodity prices.<sup>40</sup>

**Kellogg Company**, a multinational food manufacturer headquartered in Battle Creek, includes brands like **Keebler**, **Kashi**, **Eggo**, and **Pop-Tarts**. It warns investors that “emissions of greenhouse gases and contributing human activities have caused and will continue to cause significant changes in global temperatures and weather patterns and increase the frequency or severity of weather events, wildfires and flooding. As the pressures from climate change and global population growth lead to increased demand, the food system and global supply chain is becoming increasingly vulnerable to acute shocks, leading to increased prices and volatility...unfavorably impact[ing] the cost or availability of raw or packaging materials.”<sup>41</sup>

**Kraft Heinz**, with facilities in Holland and Grand Rapids, warns investors that global climate change can affect prices of raw material, agricultural material, and energy.<sup>42</sup>

“Emissions of greenhouse gases and contributing human activities have caused and will continue to cause significant changes in global temperatures and weather patterns and increase the frequency or severity of weather events, wildfires and flooding.”

*Kellogg Company*

“With the rising cost of food prices due to climate change and severe weather, my clients must make choices between buying fresh food or canceling their life or health insurance.”

*Yolanda Greer, Insurance Agent,  
Insurance Design Center*

**Neogen**, a food and animal safety product manufacturer based in Lansing, warns that severe weather conditions can affect its sales and overall financial performance.<sup>43</sup>

Grocery distributor and retailer **SpartanNash**, headquartered in Grand Rapids, operates 157 retail stores in the Midwest and Great Lakes (**Family Fare Supermarkets, VG's, D&W, Sun Mart, Family Fresh Market**). It warns that many of its stores are dependent on tourism and therefore affected by season and weather patterns, such as “the amount and timing of snowfall during the winter months and the range of temperature during the summer months.”<sup>44</sup>

## HOTELS

**Hilton Worldwide** operates nearly 100 hotels in Michigan. “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.”<sup>45</sup>

**Starwood**, which operates 14 hotels in Michigan, 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% by 2035.<sup>46</sup>

**Hyatt**, which operates seven hotels in Michigan, warns that “climate change and resource scarcity, such as water and energy scarcity” may affect consumer demand for hotel rooms.<sup>47</sup>

“We provide intercultural training to international executives, but extreme weather keeps expats from traveling. Snow and sleet delay moving, and also affect transportation, so my income is seriously affected when the weather is excessively cold.”

*Monica Stevens, CEO, MES Consulting Services LLC*

## SEVERE WEATHER TREND

### MORE SEVERE STORMS

Heavy downpours are increasing nationally. Across Michigan, the amount of rain in the heaviest storms has increased by 35 percent over the past sixty years. The severity of these storms will continue to rise, likely leading to increased flooding.

For example, heavy rains in 2014 led to nearly 10 billion gallons of sewer overflows in southeastern Michigan, much of which ended up in Lake St. Clair and eventually Lake Erie.

**Choice Hotels International** (Ascend, Comfort Inn, Quality Inn) operates more than 40 hotels in Michigan. It warns that severe weather can affect the “cost effective and timely construction of hotels.”<sup>48</sup>

## INSURANCE

The Michigan insurance industry supports 114,000 jobs, directly employing 41,000 Michigan workers.<sup>49</sup>

The **Progressive Corporation** reported that 2015’s “catastrophe-related weather claim volume was 28% higher than the previous record set in 2012, which included Superstorm Sandy.”<sup>50</sup>

Midland’s **Chemical Financial**<sup>51</sup> and Monroe’s **MBT Financial** both warn investors that severe weather could “affect the stability of the Corporation’s deposit base, impair the ability of borrowers to repay outstanding loans, impair the value of collateral securing loans, cause significant property damage, result in loss of revenue and/or cause the Corporation to incur additional expenses.”<sup>52</sup>

**Conifer Holdings**, a specialty insurance provider based in Birmingham, includes climate change in the external events that could increase its exposure to losses.<sup>53</sup>

**Ally Financial**, a Detroit-based bank that caters to the automotive industry, experienced an increase of \$49 million in weather-related insurance losses and loss adjustment expenses due to severe hailstorms in 2016.<sup>54</sup>

## MANUFACTURING

Michigan hosts a range of furniture, plastics, and bioscience manufacturing firms. Western Michigan alone hosts more than 150 furniture manufacturers.<sup>55</sup>

“The climate changes that affect the event management business would include event insurance, increased services for winter related events, and client attendance. Climate change has created an increase in event insurance due to occurrences of flooding, natural disasters, and storms.”

*Marshall Germany, Event Coordinator/Coach, Infinity Event Solutionz*

## SEVERE WEATHER TREND

### SEA-LEVEL RISE & FLOODING

Warmer temperatures can cause sea levels to rise, though the impact on the Great Lakes’ water levels is not yet known.

The average rainfall in most of the Midwest has increased by 5 to 10 percent over the past 50 years, increasing the risk of flooding. Severe rainfall can flood the sewers, overflow into lakes and rivers, and harm the water supply.

Furniture manufacturer **Steelcase**, headquartered in Grand Rapids, warns that climate change “poses many potential risks to the environment, business, people and the communities in which we work, live and serve.”<sup>56</sup> Its “manufacturing model is predominantly make-to-order” and “many of our products are currently produced in only one location in each of the three geographic regions in which we operate (the Americas, EMEA and Asia Pacific).” It warns that any disruption, like a natural disaster or reduced supply of raw materials, will adversely affect its business.<sup>57</sup>

**Herman Miller**, based in Zeeland, warns investors that inclement weather can affect consumer spending and its reliance on just-in-time raw material deliveries makes its manufacturing and assembly operations vulnerable to disruptions.<sup>58</sup>

**Whirlpool**, headquartered in Benton Harbor, has set goals to reduce water and energy use in manufacturing by 15 percent in 2020. It warns investors that natural disasters may disrupt its international operations and supply chain.<sup>59</sup>

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

**La-Z-Boy Inc.**, a furniture manufacturer headquartered in Monroe, reports that “about 55% of our polyurethane foam comes from one supplier. This supplier has several facilities across the United States, but severe weather or natural disasters could result in delays in shipments of polyurethane foam to our plants.”<sup>60</sup>

**Corium’s** pharmaceutical manufacturing facilities are in Grand Rapids. It warns investors these facilities could be severely disrupted by “natural disasters or similar events, like blizzards, tornadoes, fires or explosions or large-scale accidents or power outages.”<sup>61</sup>

“Climate change poses many potential risks to the environment, business, people and the communities in which we work, live and serve.”

*Steelcase*

## TRENDS WORSENING: S&P ON CLIMATE RISK

“The economic cost of natural catastrophes has risen significantly over the past 10 years. Yet, through a combination of existing preventative measures, most companies we rate have managed to mitigate the impact of such events on their corporate credit profiles. Nevertheless, with scientists predicting an increase in extreme climatic events, firms’ vulnerability to natural catastrophes is in our view likely to be sorely tested.”

Madison Heights-based **InfuSystem** provides medical supplies for cancer treatment. It warns severe weather may prevent “many patients from visiting a facility to obtain our ambulatory infusion pumps or receive treatment” and disrupt key suppliers or vendors’ services or materials.<sup>62</sup>

**Universal Forest Products** is headquartered in Grand Rapids and manufactures wood and wood-alternative products. Its sales are seasonal and affected by inclement weather, as the “majority of our products sold to the Retail and Construction markets are used or installed in outdoor construction applications” during the first and fourth quarters.<sup>63</sup>

## OUTDOOR RECREATION

Michigan’s outdoor recreation industry generates \$26.6 billion in annual consumer spending and employs 232,000 workers.<sup>64</sup> The state is second only to New York in operational ski facilities.<sup>65</sup>

Midland-based **SMI Snow Makers, Inc.** supplies snow making machines and serves more than 800 resorts in Michigan and around the world. It invests \$1 million annually in its Midland facility, the only dedicated and integrated snowmaking research and testing facility in the world. It warns there are “over 100 resorts in North America that would have gone out of business without snowmaking” and “the challenges of the weather, particularly in the Pacific Northwest, are causing the resorts to rethink their reliance only on natural snow.”<sup>66</sup>

“Being a key manufacturer of wind turbine components, we are seeing growing commitment to wind energy flourishing in the state, at the same time as costs are going down. This gives us more opportunity to continue to grow and to keep people employed.”

*Scott Viciano, Vice President,  
Ventower Industries*

## PORTS & SHIPPING

U.S. ships carry over \$300 billion worth of cargo over U.S. rivers, lakes, and coastlines each year.<sup>67</sup> Michigan has 3,000 miles of shoreline and 38 deep-water ports with access across the Great Lakes and to the Atlantic. Its largest commercial ports are located in Port Huron, Saginaw, Sault Ste. Marie, and Detroit. By design, ports operate at sea level, which means the power plants, cranes, rail lines, roads, and businesses that serve them are highly susceptible to storm surges and rising sea levels.

In 2013, Lake Huron and Michigan were 23 inches below their normal levels. Ships crossing those lakes carried 6,000 tons less per trip than they carried in 1997 (from 71,000 tons to 65,000 tons). That 8 percent drop in cargo meant lost revenue to the shippers and higher prices for the businesses that rely upon them.

**Universal Logistics Holding** warns that it expects productivity to “decrease during the winter season when severe winter weather impedes operations.” It also expects harsh weather conditions to cause “higher accident frequency, increased freight claims, and higher equipment repair expenditures.”<sup>68</sup>

## RAIL

Michigan has nearly 4,000 miles of operating rail track, operated by 29 railroads. Michigan railroads handle almost 94 million tons of cargo annually.<sup>69</sup>

“Over 100 resorts in North America that would have gone out of business without snowmaking.”

*SMI Snow Makers*

## 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 Michigan, statewide temperatures have increased by about two to three degrees over the past century. Higher temperatures lead to warmer water in Lake Erie and Lake Michigan, causing more algal blooms, which can harm fish and degrade water quality. The lakes are expected to rise in temperature by three to seven degrees over the next 70 years.

**CSX**, which provides rail service across Michigan 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 ESTATE

**Taubman Centers**, an outlet shopping mall REIT based in Bloomfield Hills, warns investors that “a number of our properties are located in areas with a higher risk of natural disasters” and many are “located in coastal regions, and would therefore be affected by any future increases in sea levels.”<sup>70</sup>

**Agree Realty** has 49 of its 366 U.S. properties in Michigan, including its Bloomfield Hills headquarters. It warns investors that its limited geographic diversification makes them more susceptible to adverse conditions in these areas.<sup>71</sup>

## RESTAURANTS

Restaurants and foodservice jobs account for about ten percent of Michigan’s workers and will increase to 472,000 jobs by 2027.<sup>72</sup> Restaurant owners say they are more sensitive than other hospitality businesses to extreme temperatures and severe weather.

“A number of our properties are located in areas with a higher risk of natural disasters...and many [are] located in coastal regions, and would therefore be affected by any future increases in sea levels.”

*Taubman Centers*

“Businesses, cities, and states across America are inspired and moving ahead with carbon reduction initiatives inspired by the Clean Power Plan. Keeping the Clean Power Plan in place not only demonstrates America’s commitment to reduce carbon emissions, but also our leadership and innovation advancing technologies that provide high quality employment and economic vitality. This vision sets an important goal for our country and, most importantly, for the world to aspire to.”

*Keith Winn, President, Catalyst*

Fast-food chains like **McDonald's**,<sup>73</sup> **Wendy's**,<sup>74</sup> **Burger King**,<sup>75</sup> **Taco Bell**, and **KFC**<sup>76</sup> operate hundreds of restaurants across Michigan. It warns investors that severe weather or climate change will adversely impact their supply chains, food pricing, and consumer demand.

**Domino's Pizza** is headquartered in Ann Arbor and operates 11,000 restaurants in the U.S. It warns, "Most ingredients used in our pizza, particularly cheese, are subject to significant price fluctuations as a result of seasonality, weather, demand and other factors."<sup>77</sup>

**Diversified Restaurant Holdings** operates 20 **Buffalo Wild Wings** in Michigan. "Our food, beverage and packaging costs could be significantly affected by increases in the cost of fresh chicken wings and ground beef, which can result from a number of factors, including... drought and other weather phenomena..." It is also sensitive to bad weather impacting guest traffic, which causes "the temporary underutilization of certain seating areas, and, in more severe cases, cause temporary restaurant closures, sometimes for prolonged periods."<sup>78</sup>

**Chipotle**, the fast casual Mexican restaurant with nine Michigan 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..."<sup>79</sup>

## RETAILERS

Major retailers doing business in Michigan (including **Apple**, **Costco**,<sup>80</sup> **CVS**,<sup>81</sup> **Sears**,<sup>82</sup> and **Macy's**<sup>83</sup>) have advised investors that severe weather and extreme temperatures affect the demand for their services or products.

America's largest retailer, **Walmart**, operates more than 110 stores across Michigan. 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..."<sup>84</sup>

Clothing retailers (including **The GAP**,<sup>85</sup> **Nike**,<sup>86</sup> **Abercrombie & Fitch Company**,<sup>87</sup> and **LBrands**<sup>88</sup>) have warned investors about the impact severe weather can have on store sales. As Rockford-based, \$2.5 billion dollar retailer **Wolverine World Wide** (Keds, Saucony, Hush Puppies, Sperry, Stride Rite, Merrell) warns, "consumer traffic may be reduced as a result of extreme weather conditions and a decrease in shopping traffic" and its operations are "highly dependent on future weather conditions and its ability to react to changes in weather conditions."<sup>89</sup>

Surprisingly, winter storms that keep consumers home hurts 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.<sup>90</sup>

## UTILITIES

Heavy rains can weaken poles, while heavy snowfall or ice storms can topple them. Severe winter weather also leads to increased use of road salt, which can damage utilities' underground electric systems.<sup>91</sup> Unseasonable weather and variable temperatures also make it harder for energy utilities to plan generation needs.

“ The Company's results of operations are highly dependent on future weather conditions and its ability to react to changes in weather conditions.”

*Wolverine World Wide*

Michigan is a net electricity exporter, providing electricity to surrounding states. It produces more electricity than half of U.S. states. Natural gas provides about 26 percent of the state's power, three nuclear reactors supply about 28 percent, and coal provides about 41 percent. The remainder is generated by hydro (one percent) and wind and solar (four percent).<sup>92</sup>

**DTE Energy**, Michigan's largest utility provider, has warned that "decreases in Great Lakes water levels due to changes in precipitation and evaporation patterns could have a negative impact on the ability to utilize water for electric generation cooling purposes or in transporting fuel and other raw materials to our plants via water vessels."<sup>93</sup>

**CMS Energy Corporation**, an electric utility provider, is monitoring "changes in the level of the Great Lakes and its tributaries [that] could have a significant financial impact on our generating fleet due to increased dredging or greater fuel costs due to operation of coal barges at less than capacity to meet requirements of shallower channels."

“Decreases in Great Lakes water levels due to changes in precipitation and evaporation patterns could have a negative impact on the ability to utilize water for electric generation cooling purposes or in transporting fuel and other raw materials to our plants via water vessels.”

*DTE Energy*

“Changes in the level of the Great Lakes and its tributaries [that] could have a significant financial impact on our generating fleet due to increased dredging or greater fuel costs due to operation of coal barges at less than capacity to meet requirements of shallower channels.”

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