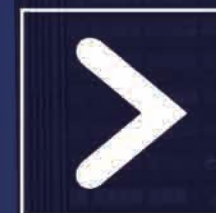


ISSUE BRIEF : Q4 2019

# MICHIGAN COMPANIES EXPLAIN CLIMATE CHANGE AND SEVERE WEATHER RISK

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**BUSINESS FORWARD**  
FOUNDATION

# EXECUTIVE SUMMARY

This report examines how severe weather is disrupting supply chains, distorting commodity prices, 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: Can we fix climate change without wrecking our economy?

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 mitigate the effects of climate change. And they are issuing warnings to their investors about climate change that skeptics in Lansing and Washington, D.C. should not ignore.

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

Business Forward has worked with more than 6,400 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 1,500 of them have participated in our climate change and clean energy program, where they have learned about renewable energy options and shared their experience managing severe weather costs.

**14 OF MICHIGAN'S 16  
FORTUNE 500  
COMPANIES  
ARE FEATURED IN THIS  
REPORT, INCLUDING LEADERS IN  
AUTOMOTIVE MANUFACTURING,  
RETAIL, FOOD PROCESSING AND  
ENERGY**

# KEY THEMES FROM FORTUNE 500 WARNINGS ABOUT CLIMATE CHANGE

## “JUST IN TIME” EFFICIENCY RAISES CLIMATE RISK

To boost profits, U.S. companies source from across the globe, encourage their suppliers to specialize, and reduce overhead costs with “just in time” inventory.

As our supply chains grow more global, more specialized, and faster, severe weather events grow more expensive.

## CLIMATE CHANGE THREATENS COMPARATIVE ADVANTAGES ACROSS SUPPLY CHAINS

Michigan’s projected 2019 corn<sup>1</sup> and tart cherry<sup>2</sup> yields are down due to abnormally high rainfall and a colder-than-anticipated spring. Rising sea levels on the Great Lakes pose a threat to Michigan’s beaches and shorelines.

Elsewhere, Wisconsin dairy and Iowa soybeans are hurting. New England’s fishing fleets are struggling to survive.

## DAMAGE TO THE DEVELOPING WORLD HURTS U.S. COMPANIES

Developing markets face greater climate risk: their populations live in hotter climates and are concentrated in coastal areas with poor infrastructure.

This hurts Fortune 500 companies, because much of their future growth is supposed to come from those developing markets.<sup>3</sup>

## FOR RETAILERS, RESTAURANTS, AND THE ENTERTAINMENT INDUSTRY, WEATHER = DIFFERENCE BETWEEN A GOOD YEAR AND GOING OUT OF BUSINESS

Good weather allows golf courses to sell more afternoon rounds and restaurants and sports teams to fill outdoor seating. For low-margin businesses, marginal sales are critical to survival.

## SMALL BUSINESSES ARE LESS LIKELY TO SURVIVE SEVERE WEATHER LOSSES

They have smaller cash reserves, are more likely to operate out a single location, are less likely to have backup systems, and have a harder time relocating.

Small business failures are also bad news for the big companies they supply.

# CLIMATE CHANGE HITS MICHIGAN WHERE IT HURTS - INFRASTRUCTURE

Michigan's infrastructure is particularly vulnerable to severe weather events. According to the American Society of Civil Engineers (ASCE), Michigan has **140 high hazard potential dams** and **1,175 structurally deficient bridges**.<sup>4</sup> Only **18%** of the state's public roads are in good condition, costing the average motorist more than **\$645** in operating and maintenance costs each year.<sup>5</sup> The state of Michigan spends only **\$172/driver** on highway maintenance each year, the **lowest** in the United States.<sup>6</sup> Owners of drinking water infrastructure in the state are underfunding system improvements by **\$284 to \$563 million** every year.<sup>7</sup>

The Federal Government has been underfunding infrastructure for years, resulting in a system that fails: the ASCE gave the United States a **D+** on infrastructure in 2017.<sup>8</sup> According to the Des Moines Register, Michigan has the **fourteenth** worst infrastructure in the United States.<sup>9</sup> Without a strong federal partner, local and state governments are left to themselves. The high number of governmental units makes coordinating policy or collaborating much more difficult. Michigan has **2,875** total governmental units, ranking **twelfth** highest in the country.<sup>10</sup>

Because of these factors, Michigan companies are warning investors that climate change threatens to reduce productivity and profits.

**D+**  
RATING FOR  
INFRASTRUCTURE  
FROM ASCE

ONLY  
**18%**  
OF BRIDGES  
ARE IN GOOD  
CONDITION

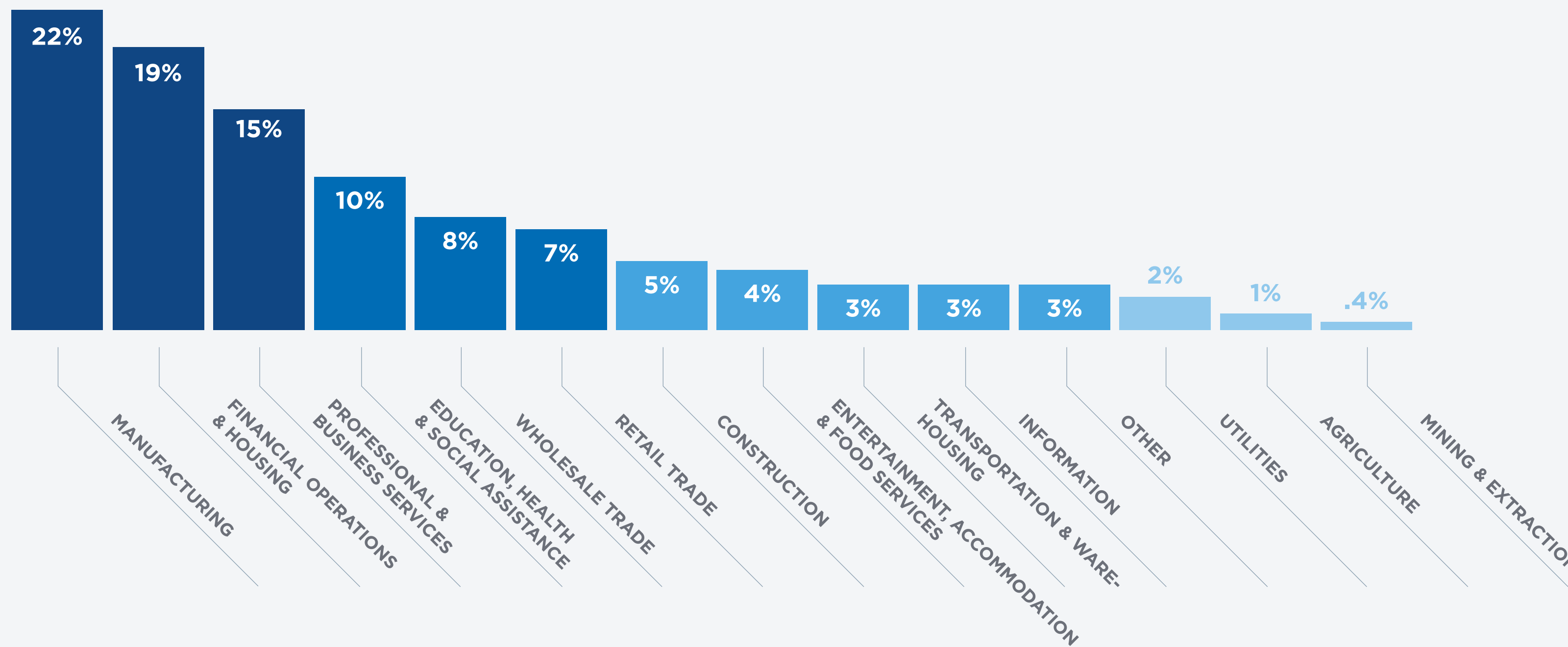
**50%  
INCREASE**  
OF BRIDGES  
IN POOR  
CONDITION BY  
2023

**\$13B**  
IN DRINKING WATER  
INFRASTRUCTURE  
NEEDS OVER THE NEXT  
20 YEARS

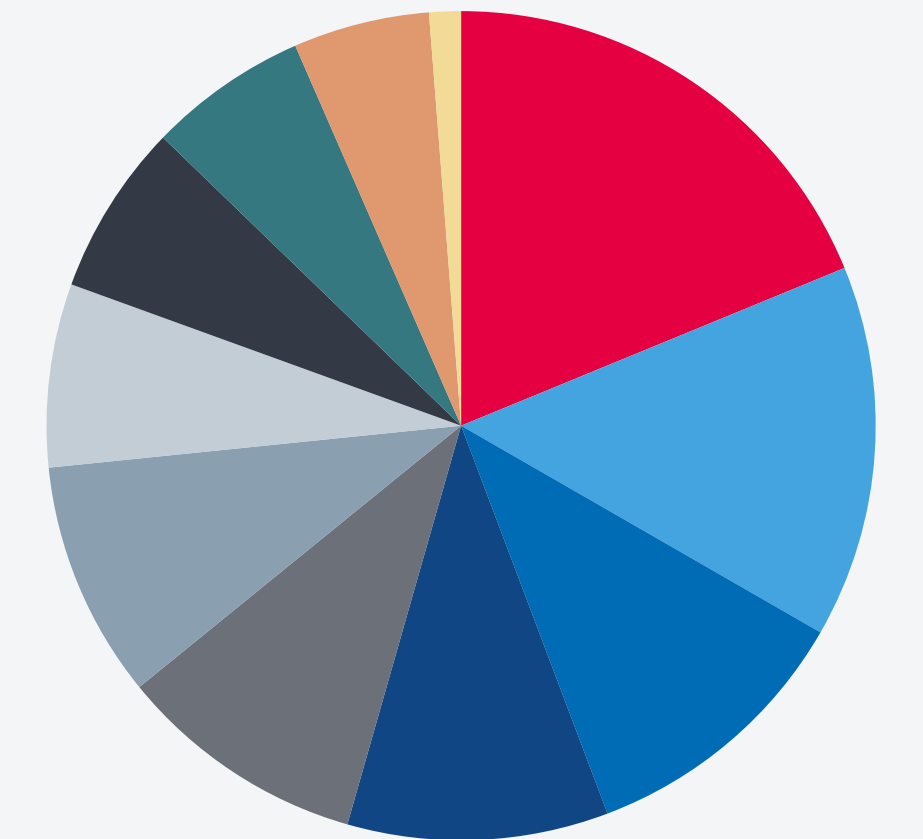
# A SNAPSHOT OF MICHIGAN'S ECONOMY



**GROSS DOMESTIC PRODUCT BY INDUSTRY (2018)**



**EMPLOYMENT BY INDUSTRY (2018)**



- 19% - OFFICE MANAGEMENT & SUPPORT
- 15% - FINANCIAL OPERATIONS & SALES
- 11% - MANUFACTURING
- 10% - CONSTRUCTION & MAINTENANCE
- 10% - HEALTH CARE
- 9% - FOOD SERVICES & AGRICULTURE
- 7% - SKILL INTENSIVE
- 7% - TRANSPORTATION & SHIPPING
- 6% - PERSONAL & PROTECTIVE SERVICES
- 5% - EDUCATION
- 1% - ENTERTAINMENT

SOURCE: GDP DATA IS FROM THE BUREAU OF ECONOMIC ANALYSIS. EMPLOYMENT DATA IS FROM THE BUREAU OF LABOR. POPULATION FROM THE CENSUS BUREAU. ENERGY DATA FROM EIA.

# 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 is home to more than 800 aerospace-related companies.<sup>11</sup> Altogether it has attracted nearly \$750 million in aerospace capital investments over the past 18 months.<sup>12</sup>

**Lockheed Martin** is a major global aerospace manufacturer with 163 small business connections and 469 suppliers in Michigan.<sup>13</sup> The company warns, “we are limited in the amount of insurance we can obtain to cover certain natural hazards such as earthquakes, fires or extreme weather conditions. We have significant operations in geographic areas prone to these risks.”<sup>14</sup>

**GE Aviation** recently invested \$14.5 million in their Muskegon subsidiary, **Johnson Technology**; they built a third aviation engine manufacturing facility, adding 100 jobs to an existing 700.<sup>15</sup> **GE** warns of the risks that climate change poses to its supply chain and operations in its annual SEC filing.<sup>16</sup>

## AIRPORTS

Detroit Metropolitan Wayne County Airport (DTW) serves 35.2 million passengers per year and contributes \$10.2 billion in economic impact.<sup>17</sup> Major airlines operating at DTW include **Delta**, **American**, **United**, and **Southwest**.<sup>18</sup>

**Delta Air Lines** operates a large hub at DTW, and they warn 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>19</sup>

**American Airlines** reports that their operations are vulnerable to “weather and natural disasters, including increases in such disasters and related costs caused by more severe weather due to climate change.”<sup>20</sup> **United Airlines** similarly warns investors: “We may incur substantial costs as a result of changes in weather patterns due to climate change.”<sup>21</sup>



**MICHIGAN HAS HAD  
11 BILLION-DOLLAR  
WEATHER & CLIMATE  
DISASTERS SINCE 2014<sup>22</sup>**

Sixteen Fortune 500 companies are headquartered in Michigan, and all but two of them 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.

**Southwest** also flies through DTW, and warns that, “adverse weather and natural disasters such as hurricanes and earthquakes in third quarter 2017... resulted in approximately \$100 million in reduced revenues for the company as a result of approximately 5,000 canceled flights.”<sup>23</sup> In the third quarter of 2018, **Southwest** had to cancel another 2,200 flights because of extreme weather.<sup>24</sup>

Smaller airlines are even more susceptible to the effects of climate change. **Frontier Airlines** warns investors: “Cancellations or delays due to adverse weather conditions or natural disasters... may affect us to a greater degree than other, larger airlines.”<sup>25</sup>

### **AGRICULTURE AND FOOD PROCESSING**

The agribusiness industry in Michigan includes 51,600 farms across 10 million acres of farmland. Producing over 300 agricultural commodities per year, Michigan is the second most agriculturally diverse state. The food processing sector generates nearly \$25 billion for Michigan’s economy and supports 2,200 licensed food processors.<sup>26</sup>

Michigan’s top crops are corn and soybeans. Together they contribute \$2.1 billion of direct economic output to the state’s economy and form the bulk of Michigan’s field crops.<sup>27</sup> It is predicted that for every degree Celsius (1.8 degrees Fahrenheit) the Earth warms, corn and soybean yields will go down an average of 7.4 percent and 3.1 percent, respectively.<sup>28</sup> Food processors rely on farms to consistently deliver products; climate change is making that more difficult.

Agribusiness leaders in Michigan include Fortune 500 companies **Kellogg** and **SpartanNash**. Headquartered in Battle Creek, **Kellogg** includes brands like **Keebler**, **Kashi**, **Eggo**, and **Pop-Tarts**. The food manufacturer warns investors: “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, especially if such events have a negative impact on agricultural productivity or on the supply of water.”<sup>29</sup>



## **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.

Grocery distributor and retailer **SpartanNash**, headquartered in Grand Rapids, operates retail stores across the Midwest (**Family Fare Supermarkets, VG's, D&W, Family Fresh Market**).<sup>30</sup> The company warns that many of their stores are dependent on tourism and therefore are affected by weather patterns, such as “the amount and timing of snowfall during the winter months and the range of temperature during the summer months.”<sup>31</sup>

Real estate investment firm **Gladstone Land** leases blueberry farms in South Haven and Covert.<sup>32</sup> They report that “in addition to the general risks that adverse weather conditions will pose for the tenants... the value of our properties will potentially be subject to risks associated with long-term effects of climate change.” **Gladstone** warns that “the effects of climate change could make our properties less suitable for farming or other alternative uses.”<sup>33</sup>

**Kraft Heinz** has a facility in Holland<sup>34</sup> and warns investors that global climate change and severe weather can affect prices of raw and agricultural materials.<sup>35</sup>

Midwestern packaged food company **ConAgra** warns: “In the event that such 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... we may also be subjected to decreased availability or less favorable pricing for water.”<sup>36</sup>

Michigan ranks sixth in the U.S. in milk production<sup>37</sup> and **Dean Foods** operates dairy processing facilities in Grand Rapids, Livonia, and Marquette.<sup>38</sup> They warn investors of the financial risk of adverse weather conditions, including climate change, on their supply chain and commodity prices,<sup>39</sup> and recently had significant layoffs in Michigan.<sup>40</sup>

**Coca-Cola** produces **Fairlife** dairy products in their Coopersville facility<sup>41</sup> and warns that across systems, “climate change may have long-term direct and indirect implications for our business and supply chain.” Their official statement explains that, “the consensus on climate science is increasingly unequivocal, global climate change is happening and man-made greenhouse gas emissions are a crucial factor.”<sup>42</sup>

“ We need four days of dry weather, wind and sunshine to dry things out. It seems every day we get three-tenths to a half-inch of rain. We get one good day of drying and then it rains again. We don't ever catch that complete window, where everything is dry enough to at least get in the fields. ”

- CHRIS MCCALLISTER  
AGRONOMIST, STATE LINE FARMS

“ Climate change may have long-term direct and indirect implications for our business and supply chain. ”

- COCA-COLA



## AUTOMATIVE MANUFACTURING

The automotive industry is integral to Michigan's economic identity. The state is home to 27 assembly plants, more than 2,200 facilities directly involved in automotive manufacturing and upwards of 14,000 total manufacturing facilities.<sup>43</sup> Seventy-six percent of North American automotive research and development currently happens in Michigan, attracting \$12 billion per year. Of North America's top 100 auto suppliers, 96 have a presence in Michigan, illustrating just how important Michigan is to the industry.<sup>44</sup>

Leaders of Michigan's automotive industry include the state's top four Fortune 500 companies: **Ford**, **General Motors**, **Penske Automotive Group**, and **Lear**.

**General Motors** explains, "our use of 'just-in-time' manufacturing processes allows us to maintain minimal inventory." However, maintaining low levels of inventory makes **General Motors** more vulnerable to production disruptions: "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."<sup>45</sup>

**Ford** has warned investors that due to the growing interconnectedness of global markets, natural disasters and other significant events "can have an immediate and material adverse impact on markets around the world."<sup>46</sup> In 2014, **Ford** warned 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>47</sup> From 2010 to 2019, **Ford** reduced their water usage by 14.5 percent, working toward their goal to "make zero water withdrawals for the manufacturing process" to promote sustainability.<sup>48</sup>

**Penske Automotive Group** warns of potential substantial losses due to adverse weather conditions, underlining the "significant concentration of property values, including vehicle and parts inventories" at their operating facilities. **Penske** includes severe weather among "events that interrupt vehicle or parts supply to our dealerships," which "would likely have a significant and adverse impact on the industry as a whole, including us." Hurricanes in Puerto Rico, Florida, Georgia, and Texas all caused storm-related losses in 2017.<sup>49</sup>

“ Any disruption of our production schedule caused by an unexpected shortage of systems, components, raw materials or parts ... could cause us to alter production schedules or suspend production entirely. ”

- GENERAL MOTORS

“ 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

Other automotive suppliers in Michigan include Southfield's **Lear**<sup>50</sup> and Northville's **Gentherm**.<sup>51</sup> The two major manufacturers warn investors that they are vulnerable to supply chain and operational disruptions from severe weather and natural disasters. Based in Livonia, **Tower International**<sup>52</sup> also reports that demand and pricing for their products are subject to energy and fuel costs, as well as concerns about climate change.

Auto supplier **Adient** has seven manufacturing locations in Michigan<sup>53</sup> and warns that climate change threatens their operations by "impacting the availability and cost of materials needed for manufacturing and could increase insurance and other operating costs." They also report that both "indirect financial risks passed through the supply chain" and "process disruptions due to physical climate changes" could affect prices for their own products and the resources needed for production.<sup>54</sup>

With its North American headquarters in Auburn Hills, **Autoliv** is another Fortune 500 auto supplier that warns of the risks associated with climate change: "The manifestations of climate change, such as extreme weather conditions or more frequent extreme weather events could disrupt our operations, damage our facilities, [and] disrupt our supply chain."<sup>55</sup> **BorgWarner**, an auto supplier also headquartered in Auburn Hills, cites "weather emergencies" among factors that "result in occasional shortages or delays" from their suppliers.<sup>56</sup>

## CHEMICALS

Michigan's chemical industry is a \$15.9 billion market and the third-largest export sector in the state, shipping \$4.5 billion in products globally. The state's chemical industry provides nearly 30,000 direct jobs and generates \$2.5 billion in annual pay, at an average wage that is 31 percent higher than other jobs in the Michigan's manufacturing sector.<sup>57</sup>

**Dow Chemical**, headquartered in Midland, has been based in Michigan since 1897 and employs more than 5,300 workers.<sup>58</sup> The company warns that the threat of severe weather is "significant in scale and could negatively impact operations." **Dow** is studying the "implications of changing climate parameters on water availability, plant siting issues, and impacts and opportunities for products." Their supply of raw materials has been significantly disrupted by major hurricanes.<sup>59</sup>

## EFFICIENCY & 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.

**Air Products & Chemicals** has a plant in Detroit<sup>60</sup> and warns that “severe weather conditions such as hurricanes, floods, earthquakes, storms... could cause a serious business disruption that could affect our ability to produce and distribute products... additionally, such events could impact our suppliers or customers, which could cause energy and raw materials to be unavailable to us.”<sup>61</sup>

## DATA AND INFORMATION TECHNOLOGY

The data and IT fields represent growing opportunities in the state. Between 2010 and 2016, the growth rate of jobs in the information technology industry grew by more than 18 percent in both the Detroit-metro and West Michigan regions. This is approximately 6 percent higher than the national average. As of 2015, Michigan ranked eighth in the nation for STEM degree completions at 25,895 total completions statewide. The tech industry in Michigan added 13,160 jobs in 2017, which is third only to California and Texas.<sup>62</sup>

**Google’s** advertisement division, **Alphabet**, has major offices in Ann Arbor and Detroit.<sup>63</sup> The company warns investors that its information technology and communication systems “are vulnerable to damage, interference or interruption from...the effects of climate change (such as sea level rise, drought, flooding, wildfires, and increased storm severity).”<sup>64</sup>

**OpenText** acquired Southfield’s Information technology firm, **Covisint**, in 2017. **Covisint’s** parent company warns investors that “climate change may furthermore aggravate natural disasters that affect our business operations.”<sup>65</sup>

**Compuware** operates its headquarters and disaster recovery facility in Detroit.<sup>66</sup> Focusing on software for information technology, **Compuware** warns investors: “Network performance and service levels could be disrupted by numerous events, including natural disasters and power losses.”<sup>67</sup>

“

Climate change may furthermore aggravate natural disasters that affect our business operations.

”

- COVISINT

“

The changes in climate are causing increased risks for respiratory illnesses and extreme heat. We’ve had to design cooling centers for people who don’t have access to or funds for air conditioning. The solutions are there. We can get off fossil fuels in all sectors of society for the same prices we’re paying now, or less - so it will be good for the economy.

”

- DEBRA ROWE  
DETROITERS WORKING FOR  
ENVIRONMENTAL JUSTICE

## HEALTH CARE AND PHARMACEUTICALS

The health care industry directly employs more than 602,000 of the state's workers, making it the largest creator of private-sector jobs in Michigan. The industry pays over \$38 billion in direct wages and salaries and adds a total value of \$81 billion to the state's economy.<sup>68</sup>

**AmerisourceBergen**, an American drug wholesale and health care supplier company that ranks tenth on the Fortune 500 list,<sup>69</sup> has a full-line distribution center in Williamston.<sup>70</sup> They report concern that "extreme weather, natural disasters, power outages or other unexpected events could result in physical damage to and complete or partial closure of one or more of distribution centers... long-term disruption in the supply of products, delay in the delivery of products to our distribution centers, and/or disruption of our ability to deliver products to customers."<sup>71</sup>

**Rite Aid** has over 250 Michigan locations<sup>72</sup> and warns that severe weather could disrupt their operations, negatively impact consumer shopping patterns, and adversely affect their financial positions.<sup>73</sup>

## HOTELS

The hotel and lodging industry spurs economic activity and employment in Michigan. The lodging industry employs more than 155,000 people and generates almost \$24 billion in annual revenue for the state.<sup>74</sup>

**Hilton** operates hotels all across Michigan and warns investors: "factors beyond our control can reduce demand for hospitality products and services, including demand for rooms at our hotels... [such as] climate change or availability of natural resources, natural or man-made disasters and extreme weather conditions."<sup>75</sup>

**Marriott International** also owns hotels across the state, including **Starwood**, **Sheraton**, and **Westin** hotels.<sup>76</sup> **Marriott** warns of the property damages related to catastrophes, "such as earthquakes, hurricanes and floods... For example, in 2018 substantial increases in property insurance costs occurred due to the severe and widespread damage caused by the 2017 Atlantic hurricane season and other natural disasters."<sup>77</sup>



## SEVERE WEATHER TREND

### MORE SEVERE STORMS

Heavy downpours are increasing nationally. Across Michigan, spring is predicted to become rainier and stormier, driving down corn and soybean production by 10% to 30% by 2050. The rising severity of storms will likely lead to increased flooding.<sup>78</sup>

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.<sup>79</sup>

**Hyatt** operates 10 hotels in Michigan<sup>80</sup> and reports that “climate change and resource scarcity, such as water and energy scarcity” can adversely affect consumer demand for hotel rooms.<sup>81</sup>

**Choice Hotels International** owns **Ascend**, **Comfort Inn**, and **Quality Inn**, among other subsidiaries.<sup>82</sup> **Choice** operates hotels all across Michigan and warns that severe weather is an unpredictable external factor that will negatively impact their business and operations.<sup>83</sup>

## INSURANCE

The Michigan insurance industry supports 138,207 jobs, directly employing 80,109 workers in the state. In total, the economic contribution of the insurance industry in Michigan was over \$38 billion in 2018.<sup>84</sup>

The **Progressive Corporation** reports that “our profit results were vastly affected by weather and natural catastrophes...unfortunately, our retained catastrophe losses and loss adjustment expenses from hurricanes, hail, winter storms, and the California wildfires totaled \$295 million.” They also warn that increasing average temperatures, as a result of global climate change, “may increase how often severe weather events and other natural disasters occur.”<sup>85</sup>

**Chemical Bank**<sup>86</sup> and **Monroe Bank & Trust**<sup>87</sup> are both headquartered in Southeast Michigan, and warn investors that severe weather could have an extreme adverse effect on their businesses. **MBT** explains that severe weather “could affect the stability of the Bank’s deposit base, impair the ability of borrowers to repay outstanding loans, cause significant property damage, result in loss of revenue and/or cause the Bank to incur additional expenses.”<sup>88</sup>

**Conifer Holdings**, a specialty insurance provider based in Birmingham,<sup>89</sup> reports that the “underestimation [of climate change] could have a material adverse effect on our financial strength.”<sup>90</sup>

**Ally Financial**, a Fortune 500 Detroit-based bank<sup>91</sup> that caters to the automotive industry, experienced \$295 million in weather-related insurance losses and loss adjustment expenses in 2018.<sup>92</sup>

**Auto-Owners Insurance** is a Fortune 500 company with headquarters in Lansing that employs more than 5,500 workers.<sup>93</sup> They experienced two landfall hurricanes in 2018; Hurricane Michael was the second most expensive catastrophe in the company’s history.<sup>94</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

“

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

## MANUFACTURING, CONSTRUCTION, AND ENGINEERING

Michigan hosts a range of furniture, plastics, and bioscience manufacturing firms. Western Michigan alone hosts more than 150 furniture manufacturing establishments, with over 15,000 total jobs that average earnings of \$71,830.<sup>95</sup>

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

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>96</sup> The company’s “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>97</sup>

**Herman Miller**, based in Zeeland, warns investors that inclement weather can affect consumer spending and their reliance on just-in-time raw material deliveries makes their manufacturing and assembly operations vulnerable to disruptions.<sup>98</sup>

**Whirlpool**, headquartered in Benton Harbor, has expressed that disruptions from natural disasters “could interrupt our ability to manufacture certain products. Any significant disruption could negatively impact our revenue and/or earnings performance.”<sup>99</sup>

**La-Z-Boy Inc.**, a furniture manufacturer headquartered in Monroe, reports that “about 50% 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>100</sup>

**Corium**’s pharmaceutical manufacturing facilities are in Grand Rapids. They warn investors that disruptions caused by “natural disasters or similar events, like blizzards, tornadoes, fires or explosions or large-scale accidents or power outages” could make it “impossible for us to continue our business for a substantial period of time.”<sup>101</sup>

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

- AUDIE BRINKER  
PRESIDENT,  
NORA CONTRACTING LLC,  
CONSTRUCTION MANAGEMENT

“ Any significant disruption could negatively impact our revenue and/or earnings performance. ”

- WHIRLPOOL

Madison Heights-based **InfuSystem** provides medical supplies for cancer treatment. They warn that 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>102</sup>

**Universal Forest Products** is headquartered in Grand Rapids and manufactures wood and wood-alternative products. Their 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 colder first and fourth quarters. “Our global operations also may be adversely affected by... natural disasters and significant weather events.”<sup>103</sup>

**American Axle** has their headquarters in Detroit and produces a number of automobile driveline components like axles.<sup>104</sup> The company is vulnerable to natural disasters in its supply chain, and with a high concentration of the company’s global business being supported by its Guanajuato, Mexico location, **American Axle** can be adversely harmed by disruptions in the global supply chain.<sup>105</sup>

**Tetra Tech of Michigan PC**, headquartered in Detroit, understands the consequences of climate change because they provide climate change and energy management consulting services. **Tetra Tech** has said that “seasonal inclement weather conditions 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. These occurrences result in fewer billable hours worked on projects and correspondingly, less revenue recognized.”<sup>106</sup>

**Stantec Inc.**, a global construction and engineering services company with four Michigan facilities, reports that their water and construction services are impacted by water scarcity and climate change. They also warn that extreme weather events caused by climate change put their business and staff safety at risk, and that the estimated overhead cost of not addressing climate change is 10%.<sup>107</sup>



## SEVERE WEATHER TREND

### HIGHER TEMPERATURES

Temperatures across the U.S. are 1.8 degrees warmer, on average, than they were at the beginning of last century, and most of this increase has occurred since 1970. The last five years have been the globe’s warmest on modern record, and 18 of the 19 warmest years have occurred this century.<sup>108</sup>

In Michigan, statewide temperatures have increased by nearly two degrees in the last 30 years. Higher temperatures lead to warmer water in Lake Erie and Lake Michigan, causing more algal blooms, which can harm fish and degrade water quality.<sup>109</sup>

## MILITARY

Michigan is home to 4 military bases<sup>110</sup> and almost 26,000 active duty service members, reservists, Army and Air National Guard members, and Department of Defense civilian employees.<sup>111</sup> Every year, military and defense operations in the state spend nearly \$11 billion and support over 100,000 jobs.<sup>112</sup>

In January 2019 the Pentagon released a report examining how climate change affects our national defense: “The effects of a changing climate are a national security issue with potential impacts to Department of Defense missions, operational plans, and installations.” Of the 79 military facilities examined, the Pentagon found about two-thirds are vulnerable to “current or future recurrent flooding” and more than one-half to “current or future drought.” In 20 years, seven more locations are expected to be vulnerable to flooding, five to drought, and seven to wildfires.<sup>113</sup>

## PORTS AND SHIPPING

There were 2.3 billion tons of commodities moved on the U.S. port and waterway systems in 2014.<sup>114</sup> Michigan has 3,000 miles of shoreline and 38 deep-water ports with access across the Great Lakes (the largest reservoir of fresh water in the world) and to the Atlantic. Its largest commercial ports are located in Port Huron, Saginaw, Sault Ste. Marie, and Detroit.<sup>115</sup> 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 changing sea levels.<sup>116</sup>

In 2013, Lake Huron and Michigan were 23 inches below their normal levels due to reduced ice cover and increased evaporation from warmer lake temperatures.<sup>117</sup> In 2019, Lakes Superior, St. Clair, Erie and Ontario all set record high levels for the past 100 years, in part because of periods of unusually heavy rainfall.<sup>118</sup> This volatility is a direct result of climate change, which makes the shipping and cargo industries less predictable and more costly. Michigan has over 500,000 jobs supported by having access to the Great Lakes St. Lawrence Seaway, by far the most of any state and one-third of total jobs.<sup>119</sup>

**Universal Logistics Holdings**, based in Warren, warns that they expect productivity to “decrease during the winter season when severe winter weather impedes operations.” They also expect harsh weather conditions to cause “higher accident frequency, increased freight claims, and higher equipment repair expenditures.”<sup>120</sup>

**FedEx** warns that “given the broad and global scope of our operations and our susceptibility to global macroeconomic trends, we are particularly vulnerable to the physical risks of climate change.”<sup>121</sup>



## SEVERE WEATHER TREND

### SEA-LEVEL RISE & FLOODING

Warmer temperatures can cause sea levels to rise. Lakes Erie, St. Clair, and Superior saw record high monthly water levels in May 2019. Shoreline erosion and coastal flooding will continue to threaten the Great Lakes.<sup>122</sup>

The percent of days with very heavy rain in the Midwest has increased by 37% since the late 1950s, increasing the risk of flooding. Severe rainfall can flood the sewers, overflow into lakes and rivers, and harm the water supply.<sup>123</sup>



## RAIL

Michigan's rail system has approximately 3,600 miles of operating rail track, is operated by 29 railroads, and handles almost 94 million tons of cargo annually.<sup>124</sup>

Three Class One railroad operators (a railroad with an annual operating revenue greater than \$256 million) are in Michigan: **CSX Transportation, Norfolk Southern Railway** and **Canadian National**.<sup>125</sup>

**CSX Transportation** reports that "operations may be affected by external factors such as severe weather... the Company's rail network may be damaged, its workforce may be unavailable, fuel costs may rise, and significant business interruptions could occur. In addition, the performance of locomotives and railcars could be adversely affected by extreme weather conditions."<sup>126</sup>

**Norfolk Southern** warns that "severe weather could result in significant business interruptions and expenditures. Severe weather conditions and other natural phenomena, including hurricanes, floods, fires, and earthquakes, may cause significant business interruptions and result in increased costs, increased liabilities, and decreased revenues."<sup>127</sup>

**Canadian National** recognizes that climate change creates "risk exposure to extreme weather events, including flooding, heat and cold extremes, cyclones and tornadoes. For example, we assess extreme heat risks on thermal rail expansions that result in rail misalignment and track buckling, as well as extreme cold risks that could result in track freezing, leading to greater frequencies of broken rails, frozen switches, and high rates of wheel replacements. We also assess the impact of episodes of flash flooding, which could result in landslides in unstable mountainous regions and mudslides further damaging rail bed support structures and cause overflows onto our tracks. Vulnerability and risks of tornado and cyclones are also assessed, particularly at our sites and network within the U.S. Tornado Belt, the Midwest and New Orleans area."<sup>128</sup>

## REAL ESTATE

Real estate is an important economic driver in the state of Michigan. In 2018, the real estate industry accounted for \$84.6 billion, or 16.0%, of the gross state product.<sup>129</sup> Every home sale has an average economic impact of nearly \$60,000, making it critically important for the state's economy to have a steady stream of real estate purchases.<sup>130</sup>

## UNPREDICTABLE GREAT LAKES

### VOLATILE LAKE LEVELS

"Property owners and businesses all along our shorelines may face devastating costs as the coastlines of the Great Lakes advance or withdraw as temperatures rise. Let's not forget that over the past 25 years or so, natural variability in the lake levels has inflicted hundreds of millions of dollars of expenses on marinas and other shoreline businesses because of dredging costs - to deepen channels so boats can get in and out - all because the lakes rose or fell a foot or two. How much worse once climate change impacts are felt in full?"<sup>131</sup>

**JOHN GALLAGHER**  
**DETROIT FREE PRESS**

**Taubman Centers**, an outlet shopping mall real estate investment trust (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>132</sup>

**Agree Realty** has 51 of their 645 U.S. properties and nearly 10% of their annualized base rent in Michigan, including their Bloomfield Hills headquarters. They warn investors that their limited geographic diversification makes them more susceptible to adverse conditions in these areas such as natural disasters.<sup>133</sup>

## RESTAURANTS

Restaurants and foodservice jobs employ 440,600 Michiganders and generate nearly \$16 billion annually in sales statewide.<sup>134</sup> Restaurant owners say they are more sensitive to extreme temperatures and severe weather than other hospitality businesses.

Fast-food chains like **McDonald's**,<sup>135</sup> **Wendy's**,<sup>136</sup> **Burger King**,<sup>137</sup> **Taco Bell**,<sup>138</sup> and **KFC**<sup>139</sup> operate well over a thousand restaurants collectively across Michigan. **McDonald's** warns investors that severe weather or climate change will adversely impact their supply chains, food pricing, and consumer demand, with similar effects being felt by their competition.<sup>140</sup>

**Domino's Pizza** is headquartered in Ann Arbor and operates 11,000 restaurants in the U.S. They warn: “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>141</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>142</sup>

**Chipotle**, the fast-casual Mexican restaurant with 36 Michigan locations, tells their investors that “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>143</sup>

“ 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

“ Tackling climate change is essential if we are to protect Michigan's thriving brewing industry as well as our state's economy, environment, and quality of life. Michigan needs policies and programs that support the transition to clean energy in a way that benefits all Michiganders. ”<sup>92</sup>

- KRIS SPAULDING  
OWNER, BREWERY VIVANT

## RETAIL

Major retailers doing business in Michigan (including **Costco**,<sup>144</sup> **CVS**,<sup>145</sup> **Sears**,<sup>146</sup> and **Macy's**<sup>147</sup>) have advised investors that severe weather and extreme temperatures affect the demand for their services or products.

**Apple** does business throughout the state of Michigan and expresses concern to investors about the potential consequences of climate change. “Global climate change could result in certain types of natural disasters occurring more frequently or with more intense effects. Such events could make it difficult or impossible to manufacture and deliver products to its customers, create delays and inefficiencies in the Company’s supply and manufacturing chain...because the company relies on single or limited sources for the supply and manufacture of many critical components, a business interruption affecting such sources would exacerbate any negative consequences...”<sup>148</sup>

America’s largest retailer, **Walmart**, operates 127 stores across Michigan. They have warned that “the occurrence of one or more natural disasters, such as hurricanes, tropical storms, floods, fires... or extended winter storms, droughts and tornadoes, whether as a result of climate change or otherwise severe changes in climate... could adversely affect our operations and financial performance.”<sup>149</sup>

Rockford-based, \$2.5 billion-dollar retailer **Wolverine World Wide** (**Keds**, **Saucony**, **Hush Puppies**, **Sperry**, **Stride Rite**, **Merrell**) warns that “if the weather conditions for a particular season vary significantly from those typical for that season...demand for seasonally appropriate products could be affected,” and that “extreme weather conditions can also adversely impact the company’s business” due to concerns over consumer traffic.<sup>150</sup>

Surprisingly, winter storms that keep consumers home hurts online sales as well—because most people do their online shopping at work. CNBC reported that the “impact of a storm means people can’t go into the office to sit at their desk, login to their computer, and begin adding items to their cart.”<sup>151</sup> 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>152</sup>

**The Home Depot** is a major employer in Michigan, with 68 locations statewide.<sup>153</sup> The retailer cites “weather-related events” and natural disasters as factors that can disrupt their supply chain and halt operations. They also report, “extreme weather conditions such as excessive precipitation, warm temperatures during the winter season... could render a portion of our inventory incompatible with customer needs... [resulting in] interruption to our operations [and] increased costs.”<sup>154</sup>

“

**Extreme weather conditions can also adversely impact the company’s business.**

”

- WOLVERINE WORLD WIDE

“

**The occurrence of one or more natural disasters... whether as a result of climate change or otherwise severe changes in climate... could adversely affect our operations and financial performance.**

”

- WALMART

Many clothing retailers (including **The Gap**,<sup>155</sup> **Nike**,<sup>156</sup> **Abercrombie & Fitch**,<sup>157</sup> and **L Brands**<sup>158</sup>) have warned investors about the negative effect severe weather has on their operations and sales. **American Eagle Outfitters**<sup>159</sup> has 26 Michigan locations and warns that “extreme weather conditions or changes in climate conditions or weather patterns” could negatively affect their financial performance and operations.<sup>160</sup>

## TOURISM

Visitors to Michigan inject \$20 billion per year and over 340,000 jobs are supported by the travel and tourism industry.<sup>161</sup> **Mackinac Island**, **Great Lakes Region**, and **Detroit** are among Michigan’s major tourism destinations; all three are susceptible to climate change and increasingly severe weather conditions.

**Mackinac Island** is the #1 ranked summer tourist destination in America according to TripAdvisor.<sup>162</sup> A town of fewer than 500 permanent residents<sup>163</sup> draws over 1 million visitors to its state parks annually,<sup>164</sup> and relies on sustainable tourism levels. **Mackinac Island** does not allow cars anywhere on the island, making it especially important that summer weather patterns do not include severe weather events. Increased flooding or rainfall can depress visitation and harm the local economy.

The **Great Lakes Region** offers many recreational activities in Michigan: hiking and biking trails, vineyards, beaches, fishing, and wildlife. But climate change and warmer temperatures can significantly change sea levels and trigger shoreline erosion and coastal flooding. By June 2019, Lakes Superior, Ontario and Erie had all reached record high water levels.<sup>165</sup> Beyond recreation, the **Great Lakes** are also an essential water supplier for the region; since 1958, the Midwest has seen 42 percent more “very heavy rainfall events.”<sup>166</sup> The warmer, wetter climate in the region is causing flooding that threatens both the water quality and availability.

**Detroit**’s metro area is home to 4.3 million people<sup>167</sup> and welcomed 19 million visitors in 2017.<sup>168</sup> The city’s location and connection to the Great Lakes makes it vulnerable to climate change events like severe weather or heavy rainfall that can adversely affect tourism. In the summer of 2019, an unprecedented level of flooding caused the city to declare a rare state of emergency after the Detroit River flooded into the low-lying Jefferson Chalmers neighborhood for the first time since 1986.<sup>169</sup> Severe weather events exacerbate existing infrastructure problems, such as Detroit’s sewage system being overwhelmed by the flooding and spilling raw sewage into Lake Huron and Lake Erie tributaries.<sup>170</sup>



We provide inter-cultural training to international executives, but extreme weather keeps ex-pats 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



Warming has forced shorter seasons at Crystal Mountain Resort... The ski season starts a few weeks later now than it used to... It’s more difficult to make snow. We have less time to make snow before the busy holidays and, of course, the busy holidays are extremely important for the ski industry. We’ve also had some cases where we started late and ended early.<sup>83</sup>



- JIM MACINNES  
CHIEF EXECUTIVE, THOMPSONVILLE RESORT

Michigan's outdoor recreation industry generates \$26.6 billion in annual consumer spending and directly employs 232,000 workers.<sup>171</sup> The state is second only to New York in operational ski facilities.<sup>172</sup>

According to the National Ski Areas Association, 91 percent of ski areas have invested millions of dollars to install snowmaking systems on their mountains.<sup>173</sup> Midland-based **SMI Snow Makers, Inc.** supplies snow making machines and serves more than 800 resorts in Michigan and around the world. They invest \$1 million annually in their Midland facility, the only dedicated and integrated snowmaking research and testing facility in the world.<sup>174</sup> They warn there are "over 100 resorts in North America that would have gone out of business without snowmaking" and "the challenges of the weather...are causing the resorts to rethink their reliance only on natural snow."<sup>175</sup>

## UTILITIES

"Our nation's aging and deteriorating infrastructure is further stressed by increases in heavy precipitation events... Without adaptation, climate change will continue to degrade infrastructure performance over the rest of the century, with the potential for cascading impacts that threaten our economy, national security, essential services, health, and well-being."<sup>176</sup> Climate change threatens energy infrastructure and makes the likelihood of more frequent and longer-lasting power outages much greater. Unseasonable weather and variable temperatures also make it harder for energy utilities to plan generation needs.

Coal fuels the largest share of Michigan's electricity generation, but coal-fired power plants' share declined to 37% of Michigan's net electricity generation in 2018, down from 53% five years earlier. The share of Michigan's net electricity generation fueled by natural gas surpassed that of nuclear power for the first time in 2018. They each provided slightly more than 26% of state generation. Renewable resources provided just 8% of Michigan's net electricity, and the state is in the top 15 states in the nation in electricity generation by wind power.<sup>177</sup>

**DTE Energy**, Michigan's largest utility provider, has warned that in times of severe weather or natural disasters their "registrants may not be fully covered by insurance... in place to provide coverage for various types of risks, including catastrophic damage as a result of severe weather or other natural disasters."<sup>178</sup>

**CMS Energy Corporation**, an electric utility provider with its corporate headquarters in Jackson, 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."<sup>179</sup>

“

[D]ecreases 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 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.

”

- CMS ENERGY CORPORATION

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