

OCTOBER 2019

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# The Climate Crisis and Michigan

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# CONTENTS

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Summary.....3

The Science Behind the Climate Crisis.....10

The Impact on Michigan.....12

Solutions for Michigan.....17

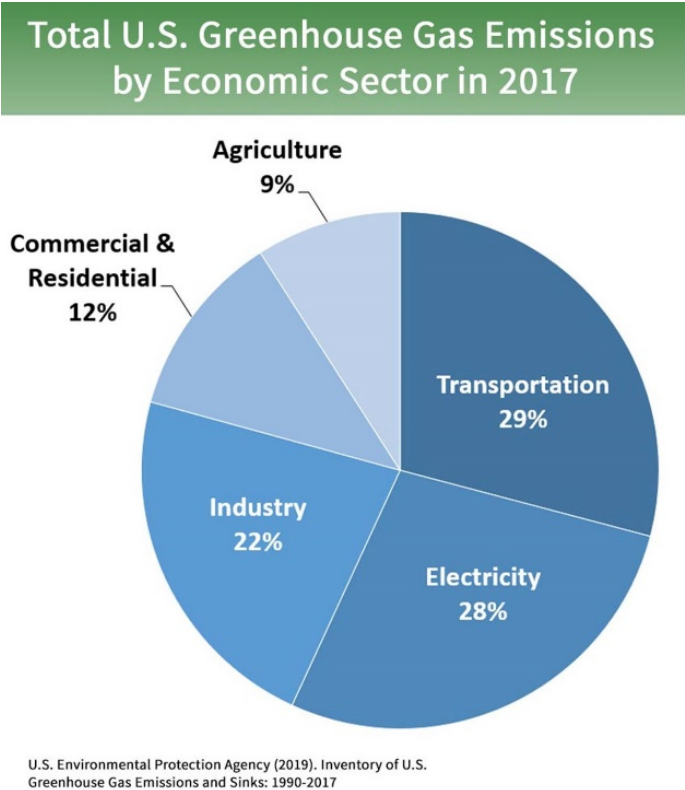
Conclusion.....21

References .....22

# SUMMARY

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The Earth’s average temperature is rising at an unprecedented rate,<sup>1</sup> and the impact is already being felt across Michigan. Simply stated, scientists attribute the climate crisis to human emissions of greenhouse gases that trap heat radiating from Earth.<sup>2</sup> These gases include carbon dioxide, methane, nitrous oxide, and chlorofluorocarbons. The leading sources of these gases in the United States are transportation, electric generation and other industries, commercial and residential buildings, and agriculture.<sup>3</sup>



## THE FACTS: MICHIGAN IS GETTING HOTTER

The average temperatures of all 83 counties in Michigan are higher today than 30 years ago.<sup>45</sup> Water temperatures of each of the Great Lakes have risen since 1995<sup>6</sup>, and Lake Superior is one of the fastest-warming lakes in the world.<sup>7</sup>

# THE CLIMATE CRISIS IS IMPACTING MICHIGAN TODAY

The climate crisis is affecting our economy, agriculture, public health, Great Lakes, and way of life.

## Agriculture and our Economy

- **Warming and Fluctuating Temperatures are Harming Fruit Crops:** Michigan crops like cherries and apples are extremely vulnerable to climate change. While rising temperatures have resulted in longer growing seasons, crops that break dormancy too early under so-called “false spring” conditions are at risk for freeze and frost damage. In 2012, Michigan lost 90% of its tart cherry crop due to warm March temperatures and subsequent freezes in April.<sup>8</sup> Warmer weather also creates an environment for invasive pests that are harming Michigan crops.<sup>9</sup>
- **Planting Delays Impacting Farmers:** Changes in seasonal precipitation are affecting farmers in Michigan and across the Midwest, with planting delays caused by spring flooding and excessively wet soil conditions.<sup>10</sup>
- **Insects Damaging Trees and Forests:** Heat stress is impacting some of Michigan’s unique tree species and forests, with an increase in damaging insect species moving north.<sup>11</sup>
- **Shorter Winter Recreation Season:** Shorter winters and reduced ice cover are shortening the season for ice fishing, skating, skiing and other winter recreation.<sup>12</sup>
- **Commercial Shipping Disrupted:** Climate change might extend the commercial shipping season, with longer ice-free periods and reduced ice cover on the Great Lakes. However, when water levels are low, ships are forced to reduce cargo and adjust their routes. Every one-inch drop in water level limits cargo capacity by 50 to 270 tons, increasing shipping costs by as much as \$30,000 per trip.<sup>13</sup>

## Great Lakes

- **Extreme High and Low Water Levels the “New Normal”:** Scientists predict that swings between extreme high and low lake levels are the new normal.<sup>14</sup> Increased precipitation and more frequent and intense storms have contributed to flooding and high lake levels. Meanwhile, warmer waters and high summer temperatures increase evaporation and decrease lake levels.<sup>15</sup>
- **Coastal Communities at Greater Risk from Erosion and Flooding:** Fluctuating lake levels, reduced ice cover, and intense storms from climate change increase shoreline erosion and leave communities more vulnerable to flooding.<sup>16</sup> According to FEMA, just one inch of flooding can cost a homeowner \$27,000.<sup>17</sup>
- **Warmer Water Threatening Native Fish:** Warming waters displace cool- and cold-water fish like walleye, trout, and salmon while benefitting invasive species like sea lamprey.<sup>18</sup>
- **Unprecedented Algal Blooms in our Lakes:** Warming waters and heavy rains lead to increased runoff from agricultural and urban lands.<sup>19</sup> This has caused unprecedented algal blooms in our Great Lakes and inland waters that pose dangers to human health, pets, and wildlife.<sup>20</sup>
- **Extreme Rain Overwhelming Local Infrastructure and Flooding Homes:** Increased flooding and associated sewage overflow increase human exposure to bacteria and toxic contaminants.<sup>21</sup>

## Public Health

- **Greater Exposure to Disease-Carrying Mosquitoes and Ticks:** Climate change is creating more favorable conditions for mosquitoes, ticks, and other disease-carrying pests in Michigan that can transmit West Nile virus, Lyme disease, and other serious illnesses.<sup>22</sup>
- **More Smog Hurting Children and Adults with Asthma:** Warming air temperatures increase smog that can trigger asthma attacks and other respiratory ailments.<sup>23</sup>

- **Extended Allergy Season:** Climate change is extending the allergy season in parts of Michigan.<sup>24</sup> Rising temperatures extend the growing season, which results in bigger plants capable of creating more pollen. It also expands the range for trees and plants that cause allergy symptoms. Higher carbon dioxide levels also cause plants that produce allergens to grow faster.<sup>25</sup>

## MICHIGAN IS POISED TO LEAD THE WAY

There is no silver bullet to address the climate crisis. Fortunately, by investing in a cleaner and more efficient future, we can boost Michigan's economy and create jobs.

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***Michigan is poised to lead the way, ranking first in the Midwest for clean energy jobs and fifth in the country.***

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Michigan is poised to lead the way, ranking first in the Midwest for clean energy jobs and fifth in the country.<sup>26</sup> The state's clean-energy industry is expected to grow another 9% in 2019 – more than double its growth in 2018, and more than any other state in the Midwest.<sup>27</sup> According to a 2017 study by the Brookings Institution, Ann Arbor had the highest number of clean energy patents for its population in the country; and Bay City was ranked fourth-highest. Among more populated areas of the country, Metro Detroit had the third most clean energy patents.<sup>28</sup>

## Clean Energy Vehicles

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***The widespread adoption of electric and fuel-cell vehicles, and continued improvements to internal-combustion engines, can significantly reduce carbon emissions as well as local air pollution.***

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Transportation is the leading source of greenhouse gas emissions in the United States, accounting for 29% of total emissions.<sup>29</sup> As the auto capital of the world, Michigan is leading in transforming our transportation fleet. Already, Michigan has more jobs in advanced transportation than any other state in the country, and 25,000 of these jobs are associated with electric and hybrid vehicles.<sup>30</sup>

The widespread adoption of electric and fuel-cell vehicles, and continued improvements to internal-combustion engines, can significantly reduce carbon emissions as well as local air pollution.<sup>31</sup> There are nearly 70,000 workers in Michigan who build components and materials that are critical to increasing fuel efficiency and reducing carbon emissions from cars and trucks.<sup>32</sup>

## Renewable Electricity

Michigan is transitioning toward a cleaner energy portfolio and numerous cities have committed to achieving as much as 100% renewable energy generation in the coming decades.<sup>33</sup> Michigan's electric utilities have ambitious long-term carbon reduction goals and renewable energy targets. There are more than 11,400 renewable energy jobs in Michigan, including more than 10,000 focused on the manufacturing and installation of wind turbines and solar panels.<sup>34</sup>

## Energy Efficiency

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***Two out of three clean energy jobs in Michigan – more than 85,000 in total – are in the energy efficiency sector.***

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Two out of three clean energy jobs in Michigan – more than 85,000 in total – are in the energy efficiency sector. This includes manufacturing and installation of more efficient appliances, lighting, heating and cooling systems, and building materials.<sup>35</sup> Using energy more efficiently is an important way to help address the climate crisis. Widespread use of efficient appliances, electronics, equipment, and lighting, along with better insulation and other weatherization, is estimated to cut as much as 550 million metric tons of carbon pollution a year by 2050.<sup>36</sup>

## Workforce Training

Innovations in energy and transportation technology offer significant opportunities for Michigan workers. More than 78% of clean energy jobs in Michigan are in manufacturing and construction.<sup>37</sup> It is critically important that we invest in workforce training through registered apprenticeships, professional skilled trades, and higher education in order to capitalize on these emerging job opportunities.

## Climate-Smart Agriculture and Forestry

Michigan agriculture and forestry is uniquely positioned to address the challenges of climate change. Through voluntary sustainability practices, farmers can lead the way in reducing greenhouse gas emissions from agricultural operations. These include the management of over 8 million acres of cropland and 2 million acres of pastureland in Michigan through well-established practices like rotational grazing and the planting of cover crops. Farmers also are implementing innovative energy efficiency practices on the farm and deploying renewable energy systems like solar panels and small-scale wind turbines.



Michigan trees and forests pull harmful carbon out of the air through their normal growth and store that carbon in their trunks, branches, and root structures. The sustainable management of Michigan's public and private forest lands, and the use of wood products in our homes and commercial wood buildings, are critical in addressing the climate crisis.

# THE SCIENCE BEHIND THE CLIMATE CRISIS

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## **Rising Temperatures**

Great Lakes researchers say the basin is warming faster than the rest of the contiguous United States.<sup>38</sup> The Great Lakes region has already warmed 2.3 degrees Fahrenheit (°F) since 1951, and temperatures could rise by as much as 6°F by midcentury, and 11°F by century's end.<sup>39</sup> Average temperatures of every Michigan county are higher today than 30 years ago,<sup>40</sup> and a report published in the Journal of Great Lakes Research says under projected temperature increases, Michigan summers will start to feel more like those of Missouri or Arkansas by midcentury.<sup>41</sup>

## **Extreme Weather**

According to the Fourth National Climate Assessment, climate change is also causing more frequent and intense extreme weather.<sup>42</sup> The United States is suffering hotter and more frequent heat waves, heavier rain, and severe flooding and droughts as a result of rising temperatures. Climate change may also be causing more frequent and intense winter storms.<sup>43</sup> Some scientists are studying whether a warming Arctic is disrupting the polar jet stream, causing periodic extreme cold and heavy snows in the Great Lakes<sup>44</sup> – like the January 2019 Polar Vortex that produced temperatures as low as -26°F in Marquette, Michigan.<sup>45</sup>

## **Increasing Annual Precipitation**

A warmer atmosphere holds more moisture. As a result, the Great Lakes region is experiencing more rainfall and snowfall on average, according to researchers. Total annual precipitation has increased 10% in the Great Lakes – compared to 4% nationwide – over the last century. Much of this spike is the result of more frequent extreme precipitation events.<sup>46</sup> From 2010 to 2014, Michigan weather stations recorded more extreme rain days per year than ever recorded.<sup>47</sup>

## **Warming Waters**

The temperatures of the Great Lakes are also rising even faster than air temperatures, according to Great Lakes Integrated Sciences and Assessments (GLISA) researchers.<sup>48</sup> The water temperatures of each of the Great Lakes have risen since 1995.<sup>49</sup> Minnesota Sea Grant says Lake Superior is warming at twice the rate of surrounding air temperatures, an average rate of 2°F every ten years,<sup>50</sup> making it one of the fastest-warming lakes in the world.<sup>51</sup>

Warming conditions have also reduced annual ice cover on the Great Lakes. According to the Fourth National Climate Assessment, ice cover on the Great Lakes declined by more than 70% from 1973 to 2010.<sup>52</sup>

# THE IMPACT ON MICHIGAN

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This section details the short- and long-term impact climate change is having on Michigan and our way of life. This includes our health; our Great Lakes and waterways; our farming and forestry sectors; and our wildlife and fisheries.

## THE CLIMATE CRISIS AND MICHIGAN'S ECONOMY

### Agriculture

Extreme weather fluctuations have had a direct impact on Michigan's second-largest industry – agriculture. Michigan is the second most diverse agricultural state in the country in terms of crops produced. Most notably, specialty crops like cherries and apples are extremely vulnerable to climatic stressors. While rising temperatures have resulted in longer growing seasons, crops that break dormancy too early under so-called “false spring” conditions are at risk for freeze and frost damage. Tree fruits are especially vulnerable to these spring freeze events. In 2012, Michigan lost 90% of our tart cherry crop due to warm March temperatures and subsequent freezes in April.<sup>53</sup>

Michigan's unique food and agricultural economy, valued at \$104.7 billion annually,<sup>54</sup> along with the state's forest economy, contributing \$21.1 billion annually,<sup>55</sup> are at risk due to the threat of climate change. Heat stress is impacting some of Michigan's unique tree species and forests, and damaging insect species are moving north.<sup>56</sup> Rising temperatures also are expected to exacerbate risks to food production posed by pests and weeds that damage crops.<sup>57</sup>

Changes in seasonal precipitation are already affecting farmers in Midwestern states as spring flooding and excessively wet soil conditions delay planting. Climate scientists project that climate change will likely reduce crop yields for both soybeans and corn by 10% to 30% in the southern parts of the Great Lakes watershed by 2050.<sup>58</sup>

### Recreation

Similarly, the climate crisis is challenging Michigan's tourism and outdoor recreation industries. Rising global temperatures will especially disrupt winter

recreation. Warmer winters and reduced lake ice cover are shortening the season for ice fishing, skating, snowmobiling, skiing, and other popular sports.<sup>59</sup>

## **Commercial Shipping**

Climate change may extend the commercial shipping season, with longer ice-free periods and reduced ice cover on the Great Lakes.<sup>60</sup> However, extreme lake-level fluctuations directly harm shipping activities.<sup>61</sup> During periods of low water levels, ships are forced to reduce cargo and adjust their routes. According to the Great Lakes Integrated Sciences and Assessments (GLISA), every one-inch drop in water level limits cargo capacity by 50 to 270 tons and adds as much as \$30,000 to the cost of each trip.<sup>62</sup>

## **THE CLIMATE CRISIS AND OUR GREAT LAKES**

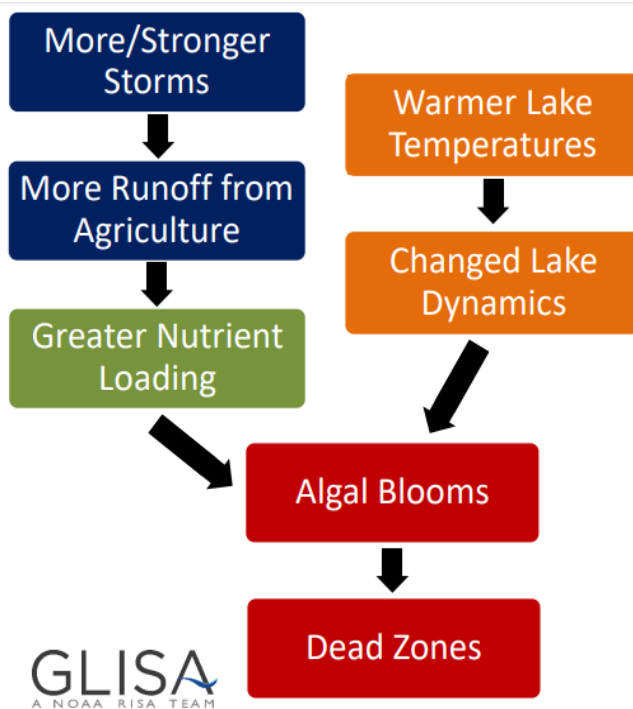
### **Water Levels**

The impact of climate change on lake levels is highly unpredictable.<sup>63</sup> Increased precipitation and more frequent and intense rain have contributed to flooding and high lake levels. Lakes Erie and Superior, for example, reached record-high water levels in May 2019.<sup>64</sup> Conversely, warm waters and high summer temperatures increase evaporation and drive lake levels down. These factors contributed to record-low lake levels in 2013.<sup>65</sup> Scientists from the University of Michigan believe that swings between extreme high and low lake levels are the new normal.<sup>66</sup>

Great Lakes researchers say fluctuating lake levels, along with reduced ice cover and intense storms from climate change, increase shoreline erosion and leave lakeshore communities more vulnerable to flooding.<sup>67</sup>

### **Bacteria, Toxic Contaminants, and Algal Blooms**

Flooding caused by more frequent and extreme rain increases human exposure to bacteria and toxic contaminants. In 2016, extreme rain caused 10.7 billion gallons of sewage overflow across 12 Michigan counties.<sup>68</sup> For cities like Detroit and Port Huron with older sewer systems, extreme rain will result in more overflows during which untreated sewage spills into streets, waterways, and even homes and businesses. According to the Third National Climate Assessment, combined sewer overflows into Lake Michigan may increase by as much as 120% by the end of the century.<sup>69</sup>



Researchers say higher water temperatures and heavy precipitation from climate change are also causing more frequent algal blooms in the Great Lakes – even in our coldest lakes.<sup>70</sup> In 2018, an algal bloom stretched 50 miles along the shores of Lake Superior, a lake typically known for its cold temperature and low level of nutrients.<sup>71</sup> Algal blooms are a danger to humans, pets, and wildlife alike. They reduce water clarity, create dead zones where fish and other lake life can’t survive, and can be toxic.<sup>72</sup> The 2014 Lake Erie algal bloom left 500,000 residents in Michigan and Ohio without safe drinking water for 72 hours.<sup>73</sup>

Source: GLISA, “Climate Change in the Great Lakes,” [http://glisa.umich.edu/media/files/Climate\\_Change\\_in\\_the\\_Great\\_Lakes.pdf](http://glisa.umich.edu/media/files/Climate_Change_in_the_Great_Lakes.pdf)

## Fisheries

Rising water temperatures directly threaten the Great Lakes’ \$7 billion fishery industry,<sup>74</sup> which is already stressed by severe storms, algal blooms, and reduced ice cover. Great Lakes researchers say warming waters displace cool- and cold-water fish like walleye, trout, and salmon. At the same time, warmer conditions benefit invasive species that thrive in warmer waters, like sea lamprey.<sup>75</sup> These and other invasive species are extremely damaging to the environment and economy. According to the U.S. Fish and Wildlife Service, invasive species cost the Great Lakes region more than \$200 million each year to control.<sup>76</sup>

## THE CLIMATE CRISIS AND PUBLIC SAFETY

### Extreme Heat

Rising surface temperatures have exposed Michigan residents to more extreme heat days per year and a greater risk of heat-related illness.

According to the Natural Resources Defense Council (NRDC), average maximum temperatures in Michigan have climbed more than 2 degrees Fahrenheit (°F) over the last century. Daily summer highs at Detroit Metropolitan Airport averaged 82.3 degrees Fahrenheit from 2008 to 2017, compared with 80.6 degrees Fahrenheit in the 1960s. In 2016 alone, Michigan emergency rooms tended to more than 3,900 patients suffering from heat-related illnesses.<sup>77</sup>

These extreme temperatures have especially impacted residents in cities like Detroit that experience the urban heat island effect, where more heat is trapped and generated from dark surfaces like asphalt, tall buildings, and reduced tree cover.<sup>78</sup> According to a study of major U.S. cities, Detroit's summer temperatures from 2004 to 2013 were nearly 4°F higher than those in surrounding, non-urban areas.<sup>79</sup> Heat is the number-one weather-related killer in the United States,<sup>80</sup> and Great Lakes researchers say by 2100, the region could experience as many as 60 more days per year with temperatures above 90°F.<sup>81</sup> Under current trends, NRDC says the metro Detroit area alone could experience an average of 760 excess deaths per year on extreme heat days by midcentury.<sup>82</sup>

### Reduced Air Quality

Warming air temperatures cause more stagnant air that traps and increases air pollution<sup>83</sup> and the formation of ground-level ozone, a harmful pollutant that produces smog.<sup>84</sup> Smog causes and exacerbates asthma attacks and other serious respiratory ailments.<sup>85</sup> This results in more visits to the hospital, lost days from work and school, and premature deaths. Nearly 200,000 children and 850,000 adults in Michigan already suffer from asthma, and in 2012 alone, these people spent on average more than \$2,500 in related medical costs.<sup>86</sup>

Climate change is also extending the allergy season in parts of Michigan. According to reporting from Climate Central, the allergy season in Lansing now lasts one month longer than in 1970.<sup>87</sup> This is partly because higher carbon dioxide levels are increasing the growth rate of plants like ragweed and the pollen

they produce. Rising temperatures also are extending the growing season, thereby creating larger plants that produce more pollen and increasing the areas where allergy-causing trees like oaks and hickories can grow.<sup>88</sup>

## **Disease-Carrying Pests**

Climate change is also creating more favorable conditions for mosquitoes, ticks, and other pests that can carry diseases. Warmer conditions and changes in precipitation have expanded the range of mosquitoes that are capable of carrying West Nile virus. Sustained warmer temperatures have also increased the risk of disease transmission from mosquitoes.<sup>89</sup> According to the Centers for Disease Control, at least 1,306 people have contracted West Nile virus in Michigan since the first case was reported in 2002.<sup>90</sup>

Climate change may also be contributing to the increase in Lyme disease cases across Michigan. According to the NRDC, the number of Michigan counties with blacklegged ticks, which can carry Lyme disease, grew from 27 in 1996 to 40 in 2015.<sup>91</sup> Another study that analyzed data from the Michigan Department of Health and Human Services (MDHHS) found that Lyme disease cases in Michigan increased fivefold from 2000 to 2014.<sup>92</sup> Today, the MDHHS says residents in 37 Michigan counties are at risk for Lyme disease, and most of the state is at potential risk for the disease.<sup>93</sup>



# SOLUTIONS FOR MICHIGAN

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Humans can avoid the worst consequences of climate change by reducing emissions and keeping global warming to a minimum. Fortunately, there is still time to reduce our emissions by increasing renewable power generation, energy efficiency, clean transportation, and climate-smart agricultural practices.

Investments in a cleaner and more efficient future don't just limit global warming, they also generate economic opportunities. According to a survey of clean-energy employment in the Midwest, Michigan already has the most clean-energy jobs in the region, and the state's clean-energy industry is expected to grow another 9% in 2019 – more than double its growth in 2018.<sup>94</sup>

The following examples highlight the ways in which Michigan can mitigate the present and future impacts of climate change while creating new jobs and saving money.

## **Transportation**

Today the transportation sector is the leading source of greenhouse gas emissions in the United States, accounting for 29% of total emissions.<sup>95</sup> The widespread adoption of electric and fuel-cell vehicles, and continued improvements to internal-combustion engines, can significantly reduce carbon emissions as well as local air pollution.<sup>96</sup> The U.S. Department of Energy estimates that replacing one gas-powered vehicle in Michigan with an all-electric model will cut its annual emissions in half.<sup>97</sup> And according to the Union of Concerned Scientists, replacing 400,000 conventional vehicles with EVs would keep 2 million metric tons of carbon dioxide out of the atmosphere each year.<sup>98</sup> As more electricity is produced with renewable energy sources, the adoption of electric vehicles will produce even greater emissions savings.

According to the Clean Jobs Midwest report, Michigan has more jobs in advanced transportation than any other state in the Midwest. The number of these jobs grew 16 percent in 2018, largely due to increases in electric vehicle sales and production. In 2018, there were more than 25,000 jobs in Michigan involved in the design and manufacturing of electric and hybrid electric vehicles.<sup>99</sup> At the same time, nearly 70,000 workers in Michigan build components and materials

that are critical to increasing the fuel efficiency of and reducing carbon emissions from cars and trucks.<sup>100</sup>

Diverse efforts by Michigan universities and businesses are accelerating the manufacturing and design of clean vehicles in Michigan. Our great universities are helping to research and deploy next-generation batteries; strong, lightweight materials; more fuel efficient vehicles; and advanced biofuels. These efforts are sustaining Michigan's transportation legacy while training the next generation of automotive experts and high skilled workers.

## **Renewable Energy**

Behind transportation, electricity generation is the second-largest source of greenhouse gas emissions in the United States, accounting for approximately 28% of total emissions.<sup>101</sup> Transitioning to cleaner, renewable energy sources – including wind and solar – for electricity generation will reduce greenhouse gas emissions and local air pollution. The Clean Job Midwest report estimates there are more than 11,400 renewable energy jobs across Michigan.<sup>102</sup>

In Michigan, wind is the leading source of renewable energy generation, accounting for 69% of the state's renewable energy generation. Hydroelectricity generates 12% of the state's renewable power, and biomass generates 7%. Although solar only makes up 4% of Michigan's renewable generation today, its share in the state's renewable mix is growing.<sup>103</sup> According to the Solar Energy Industries Association, the price of solar electricity has fallen 32% over the last five years, and this could help bring as much as 921 megawatts of new solar online in Michigan over the next five years.<sup>104</sup>

Michigan businesses and state and local leaders have set renewable energy goals that will support the accelerated adoption of these resources. Under state law, energy utilities in Michigan are required to generate at least 12.5% of electricity sales with renewable energy by 2019 and 2020, and 15% by 2021.<sup>105</sup> And Michigan's electric utilities have ambitious long-term carbon reduction goals and renewable energy targets. At the local level, Michigan cities have also set strong goals – some as high as 100% renewable energy generation within the next few decades.

## **Energy Efficiency**

Michigan and the United States can significantly reduce our emissions through better energy efficiency. The widespread use of efficient appliances, electronics, equipment, and lighting, along with better insulation and other weatherization measures, could cut 550 million metric tons of carbon pollution a year by 2050.<sup>106</sup>

Additionally, investments in energy efficiency support existing jobs, create new ones, and reduce energy costs for homeowners and businesses. Today, two out of three clean energy jobs in Michigan – more than 85,000 – are associated with energy efficiency.<sup>107</sup> This includes the manufacturing and installation of more efficient appliances, lighting, heating and cooling systems, and building materials. According to the BlueGreen Alliance, improving the efficiency of city buildings, universities, schools, and health facilities by 20% in Michigan will create 24,000 jobs by 2030, and save 56,000 gigawatts of energy and \$4.5 billion in energy costs.<sup>108</sup>

## **Workforce Training**

According to the Brookings Institution, moving toward a clean energy economy involves jobs in 320 different occupations in three major sectors: clean energy production, energy efficiency, and environmental management.<sup>109</sup> These occupations represent a range of workplace responsibilities, from jobs unique to the energy sector to support services found throughout the broader economy.

Through workforce training – registered apprenticeships, supplemental and short-term education, and other training programs – we can be sure that Michigan’s highly trained workforce is able to benefit with good paying jobs and high quality benefits from a new clean energy economy.

## **Climate-Smart Agriculture**

Michigan agriculture and forestry is uniquely positioned to address the challenges of climate change. Through voluntary sustainability practices, farmers can lead the way in reducing greenhouse gas emissions from agricultural operations. These include the management of over 8 million acres of cropland and 2 million acres of pastureland in Michigan through well-established practices like rotational grazing and the planting of cover crops.

Farmers also are implementing innovative energy efficiency practices on the farm and deploying renewable energy systems like solar panels and small-scale wind turbines. Michigan producers are also leveraging USDA financial incentives – which are made possible through the Farm Bill – to better manage excess fertilizer on their farms. Fertilizer contains nitrogen – a potent greenhouse gas that is vital for crop growth but has been over-applied in the past.

Michigan trees and forests pull harmful carbon out of the air through their normal growth and store that carbon in their trunks, branches, and root structures. The sustainable management of Michigan’s public and private forest lands, and the use of wood products in our homes and commercial wood buildings, are critical in addressing the climate crisis. For example, Michigan State University is currently constructing the state’s first “mass timber” building, which uses carbon-rich wood as the main construction component instead of traditional commercial building materials like concrete and steel. By using wood, the building will lock the trees’ carbon in place for years while the trees planted to replace those used for construction will soak up excess carbon through their natural growth.

While agriculture and forestry face an uncertain future if global temperatures continue to rise, these land-based industries are well situated to be part of the solution.<sup>110</sup>

## CONCLUSION

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The climate crisis is posing increasing threats to Michigan's economy, agriculture industry, public health, Great Lakes, and way of life. As global temperatures rise, we are already seeing significant impacts on our state and our Great Lakes. Without action, the climate crisis will continue to get worse.

Michigan is poised to lead the way in addressing the challenges of the climate crisis. We are leading national efforts toward a cleaner and more efficient future. The state has more clean energy jobs than any other in the Midwest, and its clean energy industry is growing faster than the national average. Investments in renewable energy and new vehicle technologies are creating jobs, lowering the cost of energy, and reducing the impact of climate change across our state, nation, and the world.

By investing in a clean and efficient future, we can boost Michigan's economy, create jobs, and ensure a better future for generations to come.

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