

## OHIO

### ASSESSING THE COSTS OF CLIMATE CHANGE

#### CLIMATE TRENDS IN OHIO

During the last century, Ohio has experienced rising temperatures, increased precipitation, more extreme weather events, and decreased water availability. Average annual temperatures for the southern Great Lakes region increased by 1.3° F since 1895, while the average annual temperature in Columbus, Ohio, increased by 0.3° F during the same period.<sup>1</sup> Since 1900, precipitation has increased by 10 percent in northern Ohio and decreased by 10 percent in southern Ohio. Heavy precipitation has increased during the summer months in the southern Great Lakes region, and winter snowfall has decreased in response to warmer winter temperatures. The spring thaw now occurs earlier in the season, and less precipitation falls as snow.<sup>2</sup> Since 1997, Lake Erie's water level has dropped by 3.5 feet, and similar decreases are occurring throughout Ohio's surface water resources.<sup>3</sup>

#### OVERVIEW

In the coming decades, the economic effects of a changing climate are expected to increase in Ohio and the nation. The most recent climate modeling predicts warmer temperatures and lower water levels for much of Ohio. These changes will be more pronounced if global emissions of greenhouse gases are not reduced. Shipping and water resources are likely to be affected, resulting in billions of dollars in economic losses. Since state economies are directly linked to the economies of neighboring states and regions, policymakers may wish to consider both state and regional policies to address climate change.

These trends are likely to continue, due to climate change and average yearly temperatures are expected to rise by 3° F to 4° F, with the greatest increases in winter and spring.<sup>4</sup> Although precipitation is expected to increase,<sup>5</sup> higher temperatures will cause more surface water evaporation and snow melt, reducing Ohio's surface water levels during the next century. Lake Erie is likely to experience a 34 inch drop in water level during the next 60 years, reducing the lake's surface area by 15 percent.<sup>6</sup>

#### ECONOMIC IMPACTS

##### *Shipping and Manufacturing*

Manufacturing accounts for nearly 20 percent of Ohio's gross domestic product (GDP); the top eight export items in 2006 totaled \$27.8 billion.<sup>7</sup> Ohio industries rely on Lake Erie shipping routes for imports and exports. The projected decrease in Lake Erie's water depth would require shipping vessels to reduce their capacity or require more shipping channel dredging. According to the Great Lakes Carriers' Association, a 305-meter-long vessel—the type used for intra-lake transportation—loses 270 tons of capacity for each 1 inch reduction in water level (to accommodate for shallower waters). The estimated loss due to lighter loads is nearly \$30,000 per vessel.<sup>8</sup> Lower lake and river levels also would necessitate more frequent channel and harbor dredging, dock adjustments, and intake pipe and other infrastructure changes.

If lower water levels result in a 2 percent decline in shipping activity, this would cause an annual loss of approximately \$556 million to the shipping industry and result in a \$452 million loss for the rest of



the economy. Should that decrease continue for 10 years, the shipping industry would experience total economic losses of nearly \$5.54 billion, and the rest of the state economy would see losses in excess of \$4.49 billion, imperiling 49,000 jobs by 2017.<sup>9</sup>

## *Water Supply*

Higher rates of evaporation and reduced snow pack could lead to decreased availability of surface water and less groundwater recharge. Since most Ohio cities, towns and industries rely upon groundwater, reduced supply could create problems, especially in times of drought.<sup>10</sup> Farmers currently use about 2 billion gallons of ground water annually for irrigation. That amount is expected to increase as temperatures rise, which may interfere with household drinking water needs and industry use.<sup>11</sup>

After the droughts of 1988 and 1991-1992, farmers' more frequent use of wells lowered groundwater levels, which concentrates agricultural pollutants and increases the risk of contamination. Public groundwater supplies have dried up in some cases, leading to a scarcity of potable water.<sup>12</sup>

## *Tourism, Recreation and Natural Resources*

Ohio's forests and lakes support varied tourism and recreational activities that are a major source of revenue for the state. The Ohio Department of Development reports that visitors spent more than \$33 billion in 2005, supplying 8 percent of Ohio's state GDP.<sup>13</sup> The Ohio travel and tourism industry employs more than 560,000, bringing in \$10.2 billion in wages, and direct taxes from tourist spending generate more than \$2 billion.<sup>14</sup>

Increasing temperatures in Ohio could result in range shifts and altered fish habitat, which could affect recreational and commercial fishing. Although warmer lake temperatures could have a positive effect on walleye habitat area, reduced lake levels may more than offset this effect, resulting in a net habitat decline for this popular sport fish.<sup>15</sup>

Rising water temperatures, coupled with other ecosystem changes, also may allow invasive species and diseases to thrive. The Great Lakes, especially Lake Erie, are notorious for harboring invasive species from around the world. Thirty-four non-native invasive fish species and a growing number of fish-damaging pathogens live in Lake Erie, causing stress for the native fish populations that are vital to the local culture and economy of Ohio's Erie shoreline.<sup>16</sup>



Ice fishing in the Lake Erie Islands is important for area businesses. As winter temperatures increase, Lake Erie, the shallowest of the Great Lakes, is projected to freeze later and thaw earlier. In the winter of 2002, for example, the lake did not freeze, and many businesses were forced to shut down during what is usually the busiest season. At least \$1 million in losses were reported at Put-in-Bay Island, which is one of several that rely on tourism for economic growth.<sup>17</sup>

A warming climate also could affect ecosystems that provide food and habitat for birds. Wetlands and lakes are forecasted to shrink, reducing habitat and food resources for migratory birds, shorebirds and waterfowl. Climate change could negatively affect migratory duck populations in Ohio by decreasing wetlands in the prairie pothole region of the northern plains. Lower water levels in this area may decrease duck populations by as much as 70 percent. A reduction in hunting would have negative effects on Ohio's economy and the 14,000 jobs generated by the hunting industry. Hunters spend about \$600 million per year in the state, providing state tax revenues of more than \$58 million.<sup>18</sup> If interest in the sport declines by 40 percent due to lower bird populations, the annual impact on the economy would be a loss of more than \$23 million.

Forests cover 30 percent of the state and support valuable logging, furniture and paper pulp industries. The forest products industry contributes \$16 billion to Ohio's economy and employs more than 119,000. Climate change is predicted to reduce soil moisture and lead to changes in tree species composition, geographic range, and overall forest health and productivity. Ohio's forest areas could decline by as much as 50 percent, depending on the degree of climate change and forest management practices. In a warmer climate, forested areas could become dominated by pine and scrub oaks—which are of little economic value—replacing the economically useful eastern hardwoods common throughout the state. A decline of 50 percent in existing forest cover would amount to \$8 billion in economic costs and the loss of tens of thousands of jobs.

## **OTHER ECONOMIC IMPACTS**

### *Agriculture*

The total market value of all agricultural products sold in 2002 was approximately \$5 billion, about 1.25 percent of the total state gross domestic product.<sup>19</sup> Although warmer weather, combined with higher carbon dioxide and nitrogen levels, may increase some crop yields, higher ozone and severe weather, especially during planting and harvesting, could decrease productivity.<sup>20</sup> Drier conditions also may decrease water available for irrigation, adding to production costs. Soil erosion from increased precipitation and runoff and invasion

by warm-climate pests may affect the agriculture sector. The dairy industry also could see losses, since higher temperatures can decrease milk production.<sup>21</sup> The economic effect of climate change on agriculture depends upon a host of other factors such as strategies adopted by farmers, technology changes and market demand.

Climate change is likely to bring longer periods of drought, which may decrease agricultural yields, particularly in the southern part of the state. In 1999, a late-season dry spell contributed to a more than 11 percent decrease in corn yields, causing farmers' incomes to fall by nearly the same amount.<sup>22</sup> A more severe yield loss occurred in 2007, when drought decreased yields by 50 percent to 60 percent.<sup>23</sup> The likelihood of similar droughts is predicted to increase as a result of climate change.

### *Infrastructure*

More intense rainstorms, flooding and high temperatures also may damage infrastructure. Higher temperatures make the ground harder and less permeable, leading to more runoff and increased risk of flooding. Ohio's March 1997 flood cost nearly \$232.5 million and required the evacuation of 20,000 people.<sup>24</sup>

### *Health*

A study released by Physicians for Social Responsibility in 2000 reported that increasing temperature and ground level ozone in Ohio would cause more heat-related illness and death. Although increased use of air conditioning and other measures will help people adapt to higher temperatures, higher energy consumption causes more pollutants to be released by power plants. Higher winter temperatures may cause fewer cold-related deaths, but a rise in summer temperatures will increase the occurrence of heat stroke and heat-related deaths. Increased flooding due to more frequent heavy rainstorms also could cause water-borne diseases such as the Norwalk Virus to become more common.

## CONCLUSION

If lower water levels occur as forecast, Ohio likely will face challenges to shipping routes, which may result in losses in the shipping sector. More detailed research related to water decreases and the potential effect on the shipping industry would help to plan for and allocate resources to respond to these changes if they occur.

Better assessment of the effects of local climate change on fresh water supplies for drinking and agriculture will help to plan for potential change in the availability of water resources. Since flooding is likely to be more intense when it occurs, planners and policymakers may wish to create assessments of those areas most likely to be affected so that flood response plans can be modified and mitigation measures can be taken.

Since climate change is likely to create stress on ecosystems, policies that create large, connected wildlife preserves—allowing species to migrate to others areas as needed—will greatly improve their ability to adapt. Small preserves surrounded by development may change with the climate and will not allow plants and animals to move to other regions to find appropriate food, water and habitat.



#### MISSING INFORMATION AND DATA GAPS

This report is subject to the uncertainties inherent in measuring global climate change and climate change itself and attempts to reflect this reality. Data gaps exist between the effects of climate change in one sector and the ripple effects in connected sectors. More information about shipping and manufacturing for specific regions and goods would be valuable to help estimate and prepare for climate change. Knowing the portfolio of goods shipped through Lake Erie and whether these goods could be transported with smaller vessels or by other means would help determine policy alternatives.



## NOTES

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