

# Pennsylvania

Confronting Climate Change in the U.S. Northeast



**F**rom the Lake Erie shore to the Pocono Mountains to the banks of the Delaware River, the climate of Pennsylvania is changing. Records show that spring is arriving earlier, summers are growing hotter, and winters are becoming warmer and less snowy. These changes are consistent with global warming, an increasingly urgent phenomenon driven by heat-trapping emissions from human activities.

New state-of-the-art research shows that if global warming emissions continue to grow unabated, Pennsylvania can expect dramatic changes in climate over the course of this century, with substantial impacts on vital aspects of the state's economy and character. If the rate of emissions is lowered, however, projections show that many of the changes will be far less dramatic. Emissions choices we make today—in Pennsylvania, the Northeast, and worldwide—will help determine the climate our children and grandchildren inherit, and shape the consequences for their economy, environment, and quality of life.

The research summarized here describes how climate change may affect Pennsylvania and other Northeast states under two different emissions scenarios. The higher-emissions scenario assumes continued heavy reliance on fossil fuels, causing heat-trapping emissions to rise rapidly over the course of the century. The lower-emissions scenario assumes a shift away from fossil fuels in favor of clean energy technologies, causing emissions to decline by mid-century.

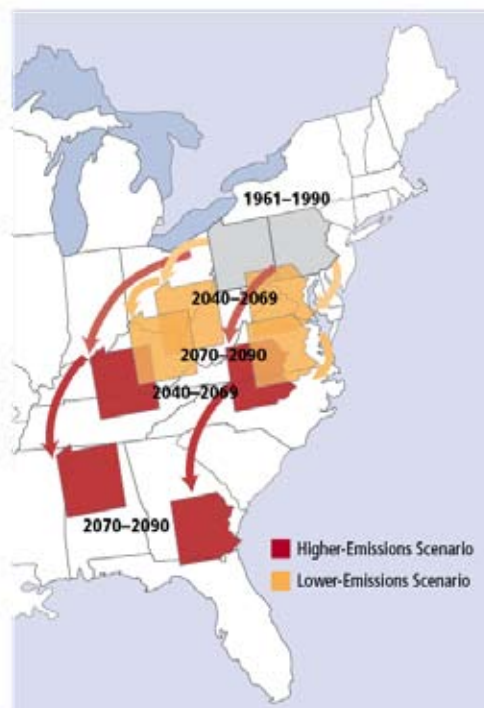
The research also explores actions that individual households, businesses, and governments in the Northeast can take today to reduce emissions to levels consistent with staying *below* the lower-emissions scenario and adapt to the unavoidable changes that past emissions have already set in motion.

## PENNSYLVANIA'S CHANGING CLIMATE

**Temperature.** Average temperatures across the Northeast have risen more than 1.5 degrees Fahrenheit (°F) since 1970, with winters warm-

ing most rapidly—4°F between 1970 and 2000. If higher emissions prevail, seasonal average temperatures across Pennsylvania are projected to rise 7°F to 12°F above historic levels in winter and 6°F to 14°F in summer by late-century, while lower emissions would cause roughly half this warming. Under the higher-emissions scenario Pennsylvania's cities can expect a dramatic increase in the number of days over 100°F (see figure on p.2 and the section on health impacts).

**Precipitation and winter snow.** The Northeast region is projected to see an increase in winter precipitation on the order of 20 to 30 percent. Slightly greater increases are projected under



## Migrating State Climate

Changes in average summer heat index—a measure of how hot it actually feels, given temperature and humidity—could strongly affect quality of life in the future for residents of Pennsylvania. Red arrows track what summers could feel like over the course of the century in western and eastern Pennsylvania under the higher-emissions scenario. Yellow arrows track what summers in the state could feel like under the lower-emissions scenario.

the higher-emissions scenario, which would also feature less winter precipitation falling as snow and more as rain.

Snow is an iconic characteristic of Pennsylvania winters and an integral part of many favorite winter activities and traditions. But rising temperatures over the past few decades have caused snow to become wetter (or more “slushy”) and decreased the average number of snow-covered days across the state. If higher emissions prevail, the Alleghenies, Poconos, and Laurel Highlands—typically snow-covered half of the time in winter—would see a roughly 50 percent shorter snow season by mid-century. Under the lower-emissions scenario the snow season in these areas would be reduced by roughly one-quarter in this time frame.

Heavy, damaging rainfall events have already increased measurably across the Northeast in recent decades. Intense spring rains struck the region in both 2006 and 2007, for example, causing widespread flooding. The frequency and severity of heavy rainfall events is expected to rise further under either emissions scenario.

**Drought.** In this historically water-rich state, rising summer temperatures coupled with little change in summer rainfall are projected to increase the frequency of short-term (one- to three-month) droughts, particularly under the higher-emissions scenario. These droughts are projected to affect the

state every year or two by late-century, compared with once every two to six years historically. These changes would increase stress on both natural and managed ecosystems across the state.

**IMPACTS ON HUMAN HEALTH**

Heat was the United States’ leading weather-related killer in 6 of 10 recent years (between 1993 and 2003). More intense summer heat waves and deteriorating air quality caused by global warming will increase the risks of many health problems.

**Extreme heat.** While Pennsylvanians are accustomed to some summer heat waves, the number of very hot days is expected to increase significantly, particularly under the higher-emissions scenario. This will be especially problematic in cities, where the urban heat-island effect can amplify temperatures. By late-century, for example, Philadelphia could experience nearly 30 days over 100°F every summer under the higher-emissions scenario, compared with less than 10 such days under the lower-emissions scenario. Pittsburgh, which historically averages just one day over 100°F each summer, is projected to face roughly 25 such days every year by late-century if higher emissions prevail (see the figure below).

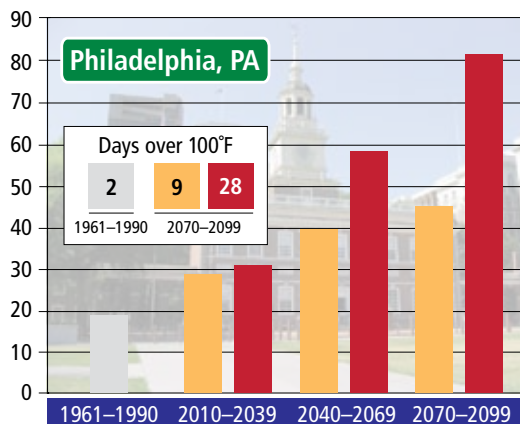
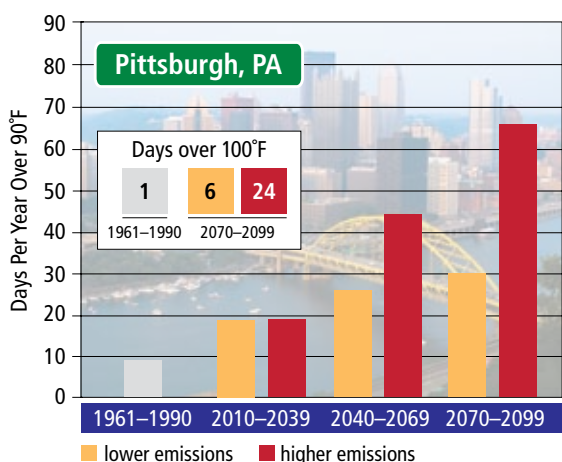
Very hot days are not only unpleasant but also dangerous. As the number of these days increases, so does the risk of heat stress, heart attack, and death.

Philadelphia’s Heat Health Watch/Warning System is a national model of public-health preparedness. Other cities across the state can also develop strong warning systems, and must prepare for an increase in dangerously hot conditions by taking steps (e.g., installing better insulation, establishing cooling centers) that will lessen the impact of extreme heat on vulnerable populations.

**Air quality.** Air pollution from ground-level ozone and other components of smog is a serious concern across much of Pennsylvania. In 2006 the Philadelphia-Camden-Vineland area was ranked the tenth most ozone-polluted metropolitan region in the nation according to U.S. Environmental Protection Agency (EPA) standards; the Pittsburgh-New Castle region ranked seventeenth.

Global warming is expected to worsen air quality in the region, putting more stress on people with cardiovascular and respiratory diseases. In the absence of more stringent controls on ozone-forming pollutants, the number of days with poor air quality is projected to roughly quadruple in Pennsylvania’s large cities by late-century under the higher-emissions scenario. Under the lower-emissions scenario such days could increase by half.

Higher temperatures and increasing levels of carbon dioxide (CO<sub>2</sub>) in the air are also expected to accelerate seasonal pollen production in plants within the next several decades under the



**Extreme Heat in Our Cities**

The number of days over 90°F in Pennsylvania cities is projected to increase in the coming decades until, by late-century, Philadelphia could experience over 80 such days and Pittsburgh over 60 such days under the higher-emissions scenario. Projections under this scenario also show a dramatic increase in the currently small number of days over 100°F (as depicted in the inset boxes).

higher-emissions scenario. This could extend the allergy season, increase asthma risks, and exacerbate symptoms for both urban and rural Pennsylvanians.

**Vector-borne disease.** Mosquitoes and ticks carry West Nile virus (WNV) and Lyme disease-causing bacteria, respectively, and spread them to animals or people. Factors affecting the spread of such vector-borne diseases are complex; however, projections for the Northeast of warmer winters, hotter summers, and more frequent summer dry periods punctuated by heavy rainstorms are the same conditions that can set the stage for more frequent WNV outbreaks.

### IMPACTS ON AGRICULTURE

The fields, silos, and barns of Pennsylvania's farms are not only an idyllic symbol of our agricultural heritage but also a mainstay of the state's economy, generating annual cash receipts of more than \$4 billion. Global warming will present both opportunities and challenges to Pennsylvania's growers and producers; for example, increases in the frequency of short-term drought (see p.2) could necessitate increased irrigation and operational costs, while a longer growing season could benefit those farmers invested in warmer-weather crops such as watermelons, peaches, and peppers.

**Dairy.** A familiar sight along Keystone State byways is that of Holsteins grazing in rolling green meadows. Pennsylvania dairy cows produce roughly 1.2 billion gallons of milk each year, and more than 80 percent of the Northeast's dairy production comes from Pennsylvania and New York. But the state's dairy farmers are expected to feel the heat as financial pressures to boost output grow while hotter temperatures hinder production.

Hot conditions produce heat stress in dairy cows, which depresses milk production. In 2005 the state's dairy in-



PennFuture

**Anglers in Pennsylvania may begin to notice changes in their preferred catch. Rising summer temperatures, changes in peak and low stream flow, and reduced winter ice and snow cover can harm native brook trout. Pennsylvania's state tree, the hemlock, which provides stream-side shade for coldwater fish, is already threatened by the hemlock woolly adelgid, an invasive insect, and faces additional stress with rising temperatures.**

dustry lost more than \$44 million due to heat stress. Under the higher-emissions scenario southern Pennsylvania is expected to reach heat-stress temperature thresholds for dairy cattle by late-century that would reduce milk production as much as 20 percent during key summer months—a substantial loss for an industry with an already small profit margin. Adaptive measures such as air conditioning may curb some of these potential losses (provided the costs are within farmers' reach).

**Crops.** More than 57,000 family farms steward 7.7 million acres of land in Pennsylvania, helping preserve the state's rural character. From its vast fields of corn and soybeans to its fall apples and summer raspberries, Pennsylvania's crops contribute significantly to the state's economy.

If higher emissions prevail, most July days in Pennsylvania late in the century are projected to exceed the heat-stress threshold for the majority of crops currently grown in the state, including corn. Higher summer and winter temperatures also promote the northward expansion of damaging ag-

ricultural pests and weeds (such as kudzu); increases in heavy spring rains could delay planting or cause field flooding.

Growers of heat-tolerant fruit such as European wine grapes may benefit from warmer temperatures. Under the higher-emissions scenario, though, much of southern Pennsylvania is unlikely by mid-century to be sufficiently cold in winter for optimal fruit development of certain popular apple varieties (such as McIntosh), summer-bearing raspberries, and northern blueberries. Under the lower-emissions scenario, production of these crops would remain viable across most of the state until late-century, when parts of southern Pennsylvania would become too warm.

Pennsylvania crop and produce farmers have options (e.g., switching to more heat-tolerant crop varieties) to cope with at least some of the challenges global warming will present, although some, such as flooding during planting season, are more difficult to overcome. Small family farms and others that may lack the profit margins and capital to make needed changes may be unable to cope with such challenges.



## IMPACTS ON FORESTS

Stepping into a cool Pennsylvania forest can provide instant relief on a hot summer day. From the Laurel Highlands to the old-growth stands of the north-central mountains, forests cover 60 percent of the state. These critical ecosystems provide recreational opportunities (e.g., hiking, biking, birding) and important plant and wildlife habitat, and can help offset the region's heat-trapping emissions by capturing and storing carbon. As temperatures climb, the character of Pennsylvania's forests is expected to change.

Maple/beech/birch forests dominate much of the landscape, and the colorful fall foliage of these northern hardwoods has made the Poconos a favorite tourist destination. Although warmer temperatures could increase the productivity of these forests in the near term, under the higher-emissions scenario Pennsylvania's climate will no longer be suitable for these species. Long-lived trees may persist for some time, but become more vulnerable to competition and other stresses that favor species better suited to a warmer climate (such as oak and hickory).

Under the lower-emissions scenario most of northern (and parts of central) Pennsylvania are expected to retain suitable maple/beech/birch habitat through the end of the century.

Other Pennsylvania forests are also at risk. On the Allegheny Plateau, for example, warming temperatures will likely mean the loss of mountaintop spruce/fir forest, threatening the small populations of blackpoll warbler and yellow-bellied flycatcher that call these forests home. Suitable habitat for Pennsylvania's state tree, the hemlock (a common shade tree lining forest streams and keeping waters cool for native fish), is projected to shrink as much as 50 percent in part of the northeast under the higher-emissions scenario, compared with roughly 25 percent under the lower-emissions scenario.

Global warming will also change the nature of hunting and fishing in Pennsylvania. Loss of maple/beech/birch habitat, for example, could reduce populations of the state bird, the ruffed grouse. Loss of hemlocks would mean trouble for the state fish, the native brook trout, and other coldwater fish that rely on the shade provided by

hemlocks to survive hotter summers. In the lifetime of young Pennsylvanians, the chances of bagging a ruffed grouse or catching a native brook trout may diminish.

## IMPACTS ON WINTER RECREATION

With about two dozen ski areas and thousands of miles of snowmobile and cross-country ski trails, Pennsylvanians have many winter recreation opportunities. Winter recreation and tourism in the state will be profoundly affected by global warming as temperatures continue to rise and snowfall declines, especially under the higher-emissions scenario.

Pennsylvania's ski industry is already struggling to survive the changing winter conditions. Warmer winters are projected to continue this trend, shortening the average ski season, increasing snowmaking requirements, and driving up operating costs. Under either emissions scenario ski resorts in the eastern part of the state are projected to be at risk of losing their ski seasons over the next several decades; under the higher-emissions scenario western Pennsylvania ski resorts will face a similar risk by mid-century. As the state's ski resorts falter, Pennsylvanians will need to travel much farther to ski—possibly three times farther for skiers living near Philadelphia and eight times farther for skiers in the southwestern part of the state.

Pennsylvania currently has a relatively short snowmobiling season, and because of the impracticality of snowmaking on its vast network of trails, the state could lose more than half of its snowmobile season within the next several decades—under either emissions scenario. The contraction of the ski and snowmobile seasons, combined with the near-total loss of sledding, snowshoeing, and other family activities, will change the concept of winter fun as Pennsylvanians have known it.

From skiing and snowboarding to snowmobiling, ice fishing, and sledding, many residents of Pennsylvania embrace winter recreation. But the state's winters are warming. Over the course of this century more winter precipitation is projected to fall as rain, and snow is expected to melt more quickly, reducing opportunities for popular winter activities.



## WHAT WE CAN DO

From the Declaration of Independence to the steel used for the country's first railroads, Pennsylvania—the Keystone State—has a long history of laying our nation's foundations. By reducing emissions today, we have an opportunity to help protect our children and grandchildren from the most severe consequences of global warming. At the same time, effective adaptation strategies are needed to help reduce the vulnerability of Pennsylvania's residents, ecosystems, and economies to those changes that are now unavoidable.

Here in Pennsylvania, and across the world, there is growing momentum to meet the climate challenge. Of course our actions alone will not be sufficient to avoid dangerous climate change. But as a global leader in technology, industry, and innovation and a major source of heat-trapping emissions, Pennsylvania (and the rest of the Northeast) is well positioned to drive national and international action. Concerted, sustained efforts to reduce emissions in the region—on the order of 80 percent below 2000 levels by mid-century and just over 3 percent per year on average over the next several decades—can help pull global emissions below the lower-emissions scenario described here.

State and municipal governments have a rich array of strategies and policies at their disposal to meet the climate challenge in partnership with other states, businesses, civic institutions, and the public. These strategies and policies can reduce emissions in the following sectors:

**Electric power.** Because Pennsylvania has substantial coal resources, it is not surprising that electricity generation accounts for 45 percent of the state's total CO<sub>2</sub> emissions. However, the state has seized upon wind energy as both a new energy resource and an economic development strategy. The wind-energy company Gamesa is investing \$84 mil-



Brad Feinknopf

Pittsburgh's David L. Lawrence Convention Center opened in September 2003 as the world's first certified "green" convention center. Its daylighting design provides natural light for 75 percent of the convention center's exhibition space; overall the building uses about 35 percent less energy than a conventionally designed building of comparable size.

lion and creating nearly 1,000 jobs by locating its U.S. headquarters in Philadelphia and building three plants in the state. Similar to other states, Pennsylvania can add a small surcharge on electricity sales to raise substantial revenues for investment in energy efficiency and clean energy development.

Pennsylvania represents a promising locale for storing carbon in geologic formations, but the technical viability and cost-effectiveness of this option is not yet well established.

**Buildings.** The federal Energy Star Buildings program and the U.S. Green Building Council's Leadership in Energy and Environmental Design (LEED) standards are proven tools for substantially improving the energy efficiency of existing and new buildings, and Pittsburgh boasts the largest number of "green" buildings of any city east of the Mississippi. The region has embraced green building technology, related products, and expertise as an economic development strategy that involves systematic collaboration among its design and construction, manufacturing, and higher-education sectors. The state can capture substantial emissions reductions from buildings by translating this expertise into stronger building energy codes.

**Transportation.** Cars and trucks account for 25 percent of total carbon emissions in the Keystone State. Pennsylvania has adopted California's tailpipe emissions standards, which would require reductions of approximately 30 percent below 2002 levels by 2016, beginning with the 2009 model year (implementation is contingent upon a ruling expected from the EPA). State and local governments can further reduce vehicle emissions through sustained investment in public transportation, incentives to purchase low-emissions vehicles, and incentives and regulations that promote "smart growth" strategies such as concentrating development in clusters. In addition, Pennsylvania can adopt standards to reduce the carbon content of fuels.

The governor's call for the state to become a leader in biofuels by producing and using 1 billion gallons annually by 2017 could achieve multiple goals: emissions reductions, a thriving farm economy, and preservation of open space. Achieving these goals requires standards to ensure that biofuels achieve real carbon reductions and are produced in a manner that does not compromise the value of other environmental services provided by forest and agricultural lands.

**Industries and large institutions** can reduce emissions while lowering energy costs by improving the energy efficiency of their buildings and facilities, and by installing combined-heat-and-power systems and on-site renewable energy systems.

**Forestry and agriculture** policies in Pennsylvania can be designed to promote management practices and systems that cost-effectively reduce emissions. Such practices include increased carbon capture in soils, more efficient use of nitrogen fertilizers, reduced on-farm use of fossil fuels, and expanded use of wind and bioenergy—provided the latter is produced in a sustainable manner. Capturing and using methane to power farm operations is one successful strategy already under way on many farms.

## CONCLUSION

Global warming represents an enormous challenge, but we can meet this challenge if we act swiftly. The emissions choices we make today in Pennsylvania, the Northeast, and globally will shape the climate our children and grandchildren inherit. The time to act is now.



Community Energy, Inc.

## A Citizen's Guide to Reducing Emissions

1. **Become carbon-conscious.** The problem of global warming stems from a previous lack of awareness of our “carbon footprint” and its effect on climate. Individuals and families can start by using one of several publicly available carbon-footprint calculators that will help you understand which choices make the biggest difference.
2. **Drive change.** For most people, choosing a vehicle (and how much they should drive it) is the single biggest opportunity to slash personal carbon emissions. Each gallon of gas used is responsible for 25 pounds of heat-trapping emissions.
3. **Look for the Energy Star label.** When it comes time to replace household appliances, look for the Energy Star label on new models (refrigerators, freezers, furnaces, air conditioners, and water heaters use the most energy).
4. **Choose clean power.** Consumers in Pennsylvania can purchase electricity generated from renewable resources that produce no carbon emissions from your local utility. If your local utility does not offer a “green” option, consider purchasing renewable energy certificates.
5. **Unplug an underutilized freezer or refrigerator.** One of the quickest ways to reduce your global warming impact is to unplug a rarely used refrigerator or freezer. This can lower the typical family’s CO<sub>2</sub> emissions nearly 10 percent.
6. **Get a home energy audit.** Take advantage of the free home energy audits offered by many utilities. Even simple measures (such as installing a programmable thermostat) can each reduce a typical family’s CO<sub>2</sub> emissions about 5 percent.
7. **Lightbulbs matter.** If every U.S. household replaced one incandescent lightbulb with an energy-saving compact fluorescent lightbulb (CFL), we could reduce global warming pollution by more than 90 billion pounds over the life of the bulbs.
8. **Buy good wood.** When buying wood products, check for labels that indicate the source of the timber. Forests managed in a sustainable way are more likely to store carbon effectively—thus helping to slow global warming.
9. **Spread the word and help others.** A growing movement across the country seeks to reduce individual, family, business, and community emissions while inspiring and assisting others to do the same.
10. **Let policy makers know you are concerned about global warming.** Elected officials and candidates for public office at every level need to hear from citizens. Urge them to support policies and funding choices that will accelerate the shift to a low-emissions future.



**Union of  
Concerned  
Scientists**

Citizens and Scientists for Environmental Solutions

Two Brattle Square  
Cambridge, MA 02238  
(617) 547-5552

1707 H St. NW, Suite 600  
Washington, DC 20006  
(202) 223-6133

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**For more information on our changing Northeast climate and what you can do, or to download a copy of the full report and additional state summaries, visit [www.climatechoices.org](http://www.climatechoices.org).**

