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PHYSICIANS FOR
SOCIAL RESPONSIBILITY

DEATH BY **DEGREES**

THE EMERGING
HEALTH CRISIS OF
CLIMATE CHANGE



NEW HAMPSHIRE REPORT

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HEALTH CRISIS OF
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GLOBAL CLIMATE CHANGE AND NEW HAMPSHIRE

Global warming is here. Signs are already appearing that over-reliance on gasoline and other fossil fuels is contributing to changes in the climate. The health impacts of global warming in New Hampshire could be surprising and severe. But there is still time to prevent the emergence of a full-blown crisis. In this report, Physicians for Social Responsibility alerts residents of New Hampshire to the damaging health effects of global climate change and encourages them—as well as their elected officials, businesses and industry—to act to reduce reliance on fossil fuels.

Executive Summary

The ice storm of 1998. The drought in the summer of 1999. Unhealthy levels of smog in the air. Sea level rising at Portsmouth. The signs are everywhere. Like most of the world, New Hampshire is beginning to sense the effects of global warming.

What Global Warming Has in Store for New Hampshire

- **More injuries, illnesses and fatalities from ice storms, floods and hurricanes.**
- **More asthma attacks and respiratory disease from air pollution and heat waves.**
- **New and increased infectious diseases from warmer, wetter weather conditions and from higher ocean temperatures.**
- **Higher Medicare and insurance costs.**
- **Greater stress on the emergency care system.**
- **More water-borne disease due to drought-driven water source contamination.**

Although uncertainties exist in the measurement of this complicated phenomenon, the overwhelming consensus among scientists is that the earth's temperature is increasing and weather patterns are changing in ways potentially harmful to human health. The mathematical forecasting models gain credibility every day, as weather and other natural occurrences confirm scenarios that were once only

hypothetical. In fact, a growing body of evidence from reputable sources, such as the U.S. Centers for Disease Control and Prevention, the Environmental Protection Agency, and the University of New Hampshire, indicates that combustion of fossil fuels is indeed changing the environment.

Even residents of the Granite State, accustomed as they are to turbulent weather and wide temperature fluctuations, are noticing the increasing fury of the storms making their way to New Hampshire:¹

In January 1996, a blizzard blanketed New England with over 30 inches of new snow.

In October 1996, a coastal rainstorm produced over 19 inches of rainfall.

New Hampshire's seacoast recorded its warmest single-day February temperature ever in 1997.

The ice storm in January 1998 damaged 17 million acres of forests in northern New England and New York; 37 counties were declared federal disaster areas,² and 17 deaths were recorded in New England and New York.³

In 1999, New Hampshire has twice requested federal emergency assistance related to extreme weather events — the summertime drought and Tropical Storm Floyd in September.

Extreme weather events such as these match the shifts predicted by computer models that forecast the effects of climate change.

Many people associate global warming with warmer weather and with potentially disastrous consequences for New Hampshire's skiing, maple syrup, and tourism industries.⁴ But other changes in weather patterns also can bring about a wide range of potentially severe health consequences. Increases in the number and severity of ice storms, floods, hurricanes, and heat waves bring more injuries, illnesses, and fatalities. Smog, intensified by warm weather, is pushing up the number of attacks that asthma sufferers experience in the summertime. Increased drought can threaten water supplies. Infectious diseases, such as E. Coli, Salmonella, Cyclospora, Lyme disease, and Hepatitis A may be on the rise with wetter, warmer conditions.

This report examines health impacts of global climate change: temperature change and extreme weather events, air pollution, diseases, and sea level rise. The facts are daunting:

Over the next several decades the state can expect much heavier precipitation in the winter — on the order of 25 to 60 percent,⁵ and more intense winter storms.

This can lead to more accidents, hypothermia, and cardiac deaths, as well as more carbon monoxide poisonings.

Heat waves have been on the rise in the last 20 years, as have minimum nighttime temperatures. This is a deadly combination that contributes to heat-related deaths⁶ and a trend that will likely continue.

Floods, hurricanes, and droughts may intensify as a result of the increasingly variable and unstable climate. Flooding and droughts increase the risk of water contamination and gastrointestinal illnesses.⁷

In New Hampshire each year, summertime smog already sends an estimated 690 persons to hospitals with respiratory-related symptoms, including 75 asthma

► **THE COMPLEX ORIGINS OF CLIMATE CHANGE**

Since the end of the last Ice Age 10,000 years ago, temperatures worldwide have risen about 9 degrees F, mainly due to natural changes in the geographical distribution of the sun's energy and in the amounts of dust, carbon dioxide, and other gases in the atmosphere.⁹¹

In recent years, the rate of increase in temperatures has been accelerating. Globally, the average surface temperature of the earth has risen by .6 degrees F to 1.2 degrees F since the late 19th Century, and the sea level has risen by 4 to 10 inches.⁹²

Eight of the 10 warmest years in recorded history occurred in just the last decade, with 1998 topping them all.⁹³

Human activities are among the factors making the earth warmer. When motor vehicles burn gasoline and electric utilities burn coal, they release carbon dioxide and other gases into the atmosphere that trap warm air near the earth's surface, in much the same way as glass panels trap warm air inside a greenhouse—hence the term, “greenhouse effect.” Since pre-industrial times, the concentration of greenhouse gases in the atmosphere has increased by 30%.⁹⁴ The gas will remain there for centuries, trapping heat and putting human health at risk.

sufferers seeking emergency room treatment. In addition, ozone is associated with 30,000 asthma attacks in the state.⁸

The number of cases of Lyme disease reported in New Hampshire has risen markedly since the early 1980s.⁹

Making matters worse, about 12 percent of New Hampshire residents are not covered by insurance;¹⁰ New Hampshire is among the 25% of states with the highest outlays on Medicare costs.¹¹ Vulnerable citizens — the uninsured, children, the elderly, those with respiratory or other chronic conditions, and those with compromised immune systems — are likely to be the first casualties of climate change.

1. Forecast: Climate Change Means Extremes

Global warming means not only warmer temperatures, but also more unpredictability in weather patterns and more extreme weather conditions.¹² The concentration of greenhouse gases that causes global warming increases heat and moisture in the atmosphere. Heat and water vapor cause instability in the atmosphere, and spawn more frequent, and possibly more severe, weather activity.¹³ In addition, the effects of changing weather patterns associated with melting polar ice are expected to be felt more strongly in northern areas, such as New Hampshire.¹⁴

All this means more floods, hurricanes, severe winter storms, droughts, heat waves, and other natural disasters. Although New Hampshire is accustomed to rapid and extreme swings in weather conditions,¹⁵ the extreme events forecast to occur with global climate change will be unlike any experienced previously.

Extreme weather conditions have wide-reaching health impacts — they can cause accidents, illnesses, injuries, and deaths. They can disrupt electric power supplies, compromise access to public service broadcasts, and contaminate drinking water supplies, thereby placing populations in jeopardy. Downed electrical power lines and leaks from natural gas or propane tanks can cause fires, electrocution, or explosions. Intense rainstorms can cause floods, washing raw sewage into drinking water supplies and spreading infectious diseases such as Salmonella, Cryptosporidiosis, and Giardiasis. Ice storms, hurricanes, and droughts can intensify forest fires, leading to injuries, fatalities, and respiratory illnesses. Residents displaced from their homes by floods and hurricanes also may experience psychological problems, ranging from depression to post-traumatic stress syndrome.¹⁶

Depending on their severity, extreme weather events can tax or even cripple emergency care systems. A survey of hospital emergency departments in Maine found a 47% increase in the number of patients treated during the ice storm of 1998.¹⁷

Ice Storms and Extreme Snowfall

While average temperatures are expected to rise in New Hampshire in the winter, the increased variability of the climate will also mean winters with more days of extremely low temperatures.¹⁸ Over the next several decades the state can expect much heavier precipitation in the winter — on the order of 25 to 60 percent.¹⁹ Increased precipitation in winter will mean even more intense major winter storms. Having endured the ice storm of 1998 (see sidebar), most New Hampshire residents are not eager to experience more such storms. Although the conditions necessary for the formation of ice storms are hard to predict, some scientists expect that warmer winter temperatures will lead to more ice storms in the future.²⁰

Unexpectedly cold weather and large snowfalls can pose a variety of possible health risks, such as accidents, hypothermia, cardiac deaths, and other risks already familiar to New Hampshire residents. However, one of the less familiar risks is posed by carbon monoxide. Carbon monoxide is an odorless, colorless gas that can attach itself to hemoglobin, impairing the oxygen-carrying capacity of the blood and starving a body's tissues and organs of oxygen.²¹ Carbon monoxide poisonings can occur during blizzards when people sit in idling automobiles with exhaust pipes blocked by snow.²² Poisonings can also occur during power outages, when people often use unvented residential appliances such as stoves and heaters.²³ Kerosene and propane-fueled space heaters, gas fueled log sets, and cooking devices used improperly for heating can expose people to potentially hazardous levels of carbon monoxide as well as other toxic gases.²⁴ Such events occurred in the ice storm of 1998.

Precipitation, Hurricanes, and Floods

Although precipitation has been on the decrease generally in New Hampshire, over the next several decades the state can expect rainier summers and falls (about a 10% increase) in addition to the heavier precipitation in the winter.²⁵ New Hampshire is not immune from hurricanes and the damage they cause. Most recently, in October 1999, New Hampshire was declared a major disaster area and was approved for federal assistance to help communities in Belknap, Cheshire, and Grafton counties recover from the effects of Tropical Storm Floyd.²⁶

Heavy rainfall and hurricanes can cause flooding, especially in association with sea level rise. Although floods are not usually thought of as a public health problem, they certainly can be. Floods cause an average of 146 deaths per year nationwide, most of which are due to drownings associated with motor vehicles in flash flood conditions.²⁷ More generally, flood waters can contain fecal material from overflowing sewage systems and from agricultural and industrial byproducts. New Hampshire's farming communities, in particular, face risks when grazing pastures are flooded. Although skin

► THE ICE STORM OF 1998

From January 7 to 16, 1998, a series of freezing rainstorms brought much of New Hampshire to a halt, as well as Vermont, Maine, New York, and three Canadian provinces. The ice storm of 1998 is the worst storm on record for New Hampshire and meteorologists have compared it to the great hurricane of 1938. Natural resource losses are estimated at over \$1 billion. The ice developed when warm, moist air from the Gulf of Mexico flowed over cold, dense Arctic air, cooling and freezing as it fell. Up to three inches of ice fell, damaging 700,000 acres in New Hampshire, including parts of the White Mountain National Forest. Seventeen deaths were reported in New York and New England, many due to carbon monoxide poisoning and asphyxiation from improper ventilation of power generators.⁹⁶ Damage estimates in New Hampshire run about \$20 million for public property alone.⁹⁷ The federal government appropriated \$6 million in emergency funds in May 1998. Nine counties including 140 towns in New Hampshire sustained enough damage to require disaster assistance.⁹⁸ Over the four-state region affected, approximately 1.5 million people were without electricity for up to three weeks.⁹⁹ On January 17, 1998, a survey of 111 Maine households hard hit by the ice storm found that among the 36 households that

were still without electric power, 13 were using propane or kerosene heaters.¹⁰⁰ Several households had placed a gasoline generator in an enclosed porch or garage rather than outdoors. In three hospitals surveyed as part of the study, carbon monoxide poisonings increased from zero to 101 cases. Other increases reported were associated with cold exposure, burns, lower respiratory tract disease, and cardiac complaints. Over the longer term, the ice storm has left forest debris on the ground and hanging off trees, heightening concerns about large fires in the next four to eight years, and their associated respiratory health effects¹⁰¹ and property damage. The New England Foresters Association believes that it may take a decade or more to determine the full impact of the ice storm on both the forests and the communities of New England.¹⁰² Like other affected states, New Hampshire has established an ice storm recovery center with an appointed Ice Storm Recovery Coordinator. The state is developing a community grants program for affected communities, purchasing new firefighting equipment for rural towns, and participating in regional assessment and monitoring programs carried out by the U.S. Forest Service.¹⁰³

contact with flood water does not, by itself, pose a serious health risk, there is a risk of disease from eating or drinking anything contaminated with flood water. When people drink contaminated water, they ingest parasites and bacteria in the water that can cause stomach cramps, diarrhea, nausea, fever, and other symptoms. Diarrheal illnesses are particularly threatening to those groups most susceptible to disease, the elderly and the very young, and in the worst cases the results of long-term infection can be fatal. Floods also result in large expanses of standing water in which mosquitoes proliferate, some of which can carry disease-causing viruses.²⁸ (See section 4 below.)

Droughts and Forest Fires

It may seem odd to think about droughts alongside floods and increased rainfall, but a variable and unstable climate that shifts from one extreme to another is exactly what global warming has in store. The climate shifts predicted by some global climate change models may exacerbate the frequency and severity of New England droughts.²⁹

On average, New England experiences moderate drought conditions about once every ten years.³⁰ The worst episode this century was in the mid-1960s. More recently, a prolonged drought occurred in the summer of 1997. In addition to the economic losses, drought can result in water shortages, impairing local sewer systems or forcing individuals to curtail their use of water for hygiene, washing food, and caring for livestock. Most of New Hampshire experienced a severe drought in the summer of 1999, accompanied by reports of wells running dry and water shortages. About 439,000 Granite State residents, or about 37% of the population, use private wells or other non-public water systems³¹ and may be particularly vulnerable to wells running dry.

Droughts concentrate microorganisms and encourage pests such as aphids, locust, and whiteflies.³² A pattern of drought interrupted by sudden rains can lead to large increases in rodent populations.³³ Drought conditions also dry out forests, exacerbating the effects of forest fires. Forest fires pose risks of injury and fatalities to firefighters and nearby residents, and increased respiratory illness, such as asthma and chronic obstructive pulmonary disease, particularly for people with pre-existing respiratory conditions.³⁴

Rising Temperatures and Heat Waves

Average temperatures in New Hampshire have been rising — as much as 2°F over the last century in Hanover.³⁵ Two degrees may not seem like a lot, but for hundreds of millions of years, average temperatures across the globe have varied by no more than 5 to 7°F. And temperatures at the time of the last ice age were only 9° F lower than they are today. If greenhouse gas concentrations increase by 1% per year, New Hampshire is predicted to warm by about 5.4°F in the next 50 years,³⁶ a rate unprecedented in history. Already, there are 11 more frost-free days in New England than there were two decades ago.³⁷

Heat waves have also been on the rise in the last 20 years. From 1949 to 1995, the number of 4-day heat waves in Concord went from being negligible in the 1950s and 1960s to 14 in the 1970s and 9 in the 1980s. (See Figure 1.) With heat comes high humidity, which interferes with the body's ability to cool itself through perspiration. Unable to restore a normal temperature, organs can shut down entirely, contributing to death from heatstroke. Or the strain can lead to heart attack or stroke in individuals with pre-existing conditions. Some people may adapt to higher temperatures, but many will not. (See sidebar: "Air Conditioning: The Vicious Cycle.") At greatest risk are infants, small children, the very elderly, and those suffering from chronic heart disease. Other heat-related ailments include heat exhaustion, heat cramps, sunburn, and heat rashes. Greater exposure to the sun without skin protection could lead to increases in skin cancer as well.

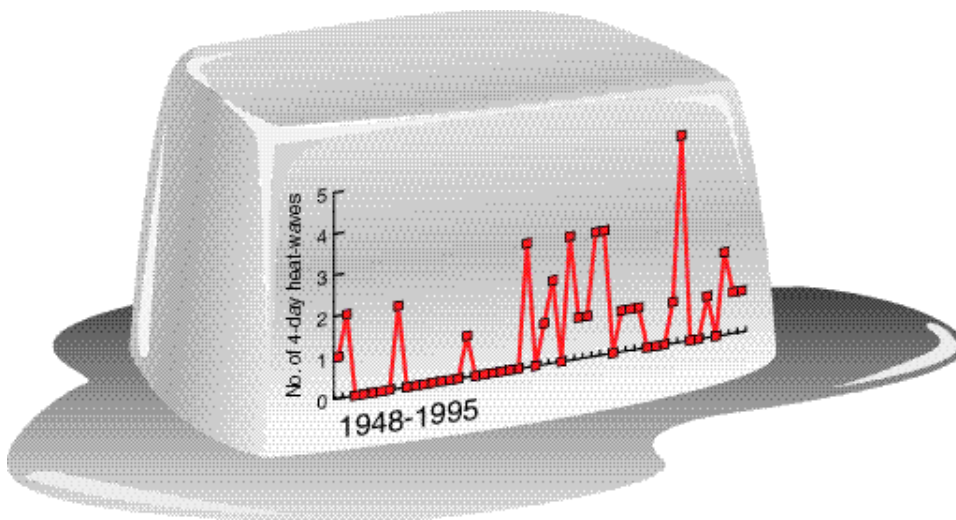


Figure 1

Deadly heat waves become more frequent ... Concord has experienced a growing number of four-day heat waves over the past half-century. The National Oceanic and Atmospheric Administration (NOAA) has studied the occurrence of days when the average summertime heat index—a combined measure of temperature and humidity—exceeded the 85th percentile in a number of cities. The 85th is the point at which heat-related deaths begin to rise sharply. Three or four such days in a row constitute a heat wave.

Source: NOAA. Available at <http://gus.arlhq.noaa.gov/pub/climate/extremes/extremes.txt>
 The data in this figure were developed by NOAA scientists for the purpose of determining trends in extreme heat events. Extremes are defined using threshold values of temperature and apparent temperature. Extremes vary from one city to another because people acclimate to local conditions. (Dian Gaffen, Trends in U.S. Extreme Heat Indices (updated 6/27/99). Available at: <http://gus.arlhq.noaa.gov/milestn/mile3.htm>). Threshold values are defined as apparent temperature values that are exceeded on only 15 percent of days in July and August. Apparent temperature, or heat index, is a combination of air temperature and humidity (NOAA Climate Variability and Trends Group, Climate Extremes and Health (updated 8/17/99). Available at <http://www.arl.noaa.gov/ss/climate/research/extremes.htm>). When apparent temperature exceeds the 85th percentile threshold value, NOAA considers that an extreme heat stress day. Figure 1 shows the number of times each year when four extreme heat stress days occurred in a row.

► **AIR CONDITIONING: THE VICIOUS CYCLE**

Although residents of warmer states seem to acclimate to hot temperatures, one of the sad lessons of the heat waves of the 1990s is that people who are unused to hot weather and who do not have air conditioning suffer the most. In the deadly 1995 Chicago heat wave that killed over 600 people, the highest casualties were among elderly residents with no air conditioning. Unlike previous heat waves, overnight temperatures did not drop sufficiently to provide much needed relief. Minimum nighttime temperatures increased abruptly in the 1970s and are on the rise, thus the cooling effect of night air is no longer available during heat waves.¹⁰⁴ About one-third of households in the Northeast do not have any form of air conditioning.¹⁰⁵ During the heat wave in the summer of 1999, New Hampshire received more than \$750,000 in federal emergency funds to assist those state residents most vulnerable to the extreme heat. The Governor's Office of Energy and Community Services made funds available for the purchase of a single-room air conditioner to individuals whose physicians verified that they were at serious medical risk from the heat. As the weather heats up, people with respiratory illnesses who do not have air conditioning are more likely to keep their windows

open to allow for air circulation. Unfortunately, it is during the summer months that air pollutant levels are at their highest, thus increasing the chances that ozone will exacerbate asthma episodes. Asthma sufferers tend to be disproportionately poor and therefore less likely to be able to afford adequate air conditioning.¹⁰⁶ On the other hand, those who can afford air conditioning are likely to use it a lot more as the weather gets warmer. Demand for air conditioning was already at record levels in the exceptional heat during the summer of 1999.¹⁰⁷ The hotter it gets, the more the demand for air conditioning increases. The increased energy used to provide air conditioning results in increased greenhouse gas emissions into the atmosphere that cause global warming, as well as increased emissions of other air pollutants from power plants.

2. Asthma and Other Illnesses from Air Pollution

Asthma is reaching epidemic proportions in the United States, particularly among children. A leading cause of absences from school, asthma can reduce lung capacity and, if left untreated, can be fatal.³⁸ Children's airways are smaller than those of adults and they breathe more rapidly. When someone suffers repeated asthma attacks, the pathways of the lungs become so narrow that simple breathing is as difficult as "sucking a thick milk shake through a straw." (See Figure 2.) The prevalence of asthma in children under age 18 rose 72% in the 12 years from 1982 to 1994, while the death rate from asthma for children 19 years and younger in the United States increased by 78% from 1980 to 1993.⁴¹ Asthma accounts for one in six pediatric emergency room visits in the U.S. In New Hampshire in 1998, the estimated prevalence of self-reported asthma was 78,500 cases, or 6.6% of the population.⁴²

Physicians still do not fully understand what causes asthma, but warmer weather will unquestionably make it worse. One study found that warmer average temperatures are associated with increased asthma prevalence, possibly because higher temperatures are associated with higher levels of allergen exposure.⁴³ More generally, however, asthma is associated with air pollutants such as ozone and particulate matter, and warmer temperatures increase the concentration of these pollutants in the atmosphere.⁴⁴

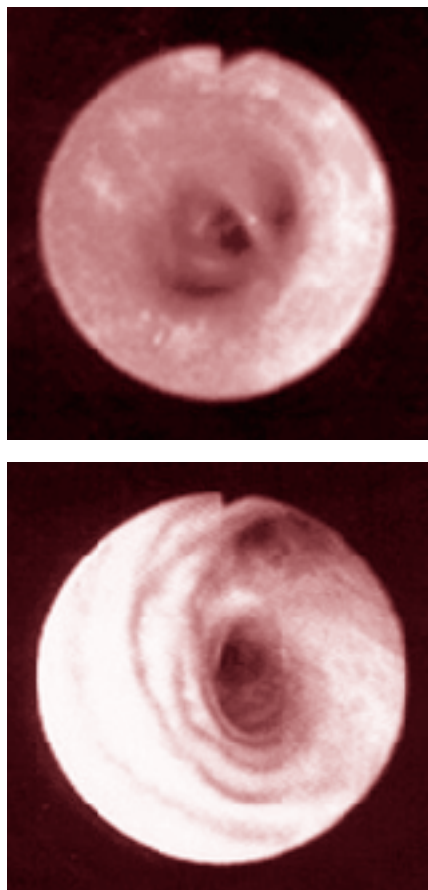


Figure 2

Smog causes redness, swelling... Ozone pollution, which will worsen as the climate heats up, inflames the lung's lining, and repeated episodes of inflammation can cause lung damage. This photo shows a healthy air way (top) and an inflamed lung air way (bottom).

Source: U.S. EPA, Office of Air Quality Planning and Standards. Smog—Who Does It Hurt? What You Need to Know About Ozone and Your Health. Available at: <http://www.epa.gov/airnow/health/smog1.html#5>.

Smog

Ground-level ozone is the major component in what we commonly call smog, the most pervasive outdoor air pollutant in the United States. Smog is at its worst on hot, sunny days, which are likely to become more numerous with global warming. It is a toxic and irritating gas that, even in small amounts, can affect lungs and health. Smog is formed when nitrogen oxides and volatile organic compounds, emitted from motor vehicles, power plants, refineries, factories, and other combustion and industrial sources, are heated by sunlight.⁴⁵

Exposure to elevated ozone can cause serious coughing, shortness of breath, pain when breathing, lung and eye irritation, and greater susceptibility to respiratory infections such as bronchitis and pneumonia.⁴⁶ Numerous studies have shown that higher ozone levels cause more asthma attacks, increase the need for medication and medical treatment, and result in more hospital admissions and visits to emergency rooms.⁴⁷ Even moderately exercising healthy adults can experience a 15% to over 20% reduction in lung function from exposure to low levels of ozone over several hours.⁴⁸ In addition to the effects on those suffering from respiratory illnesses, some healthy people are simply more sensitive to ozone than others, and experience more health effects from ozone exposure than the average person.⁴⁹

In the summer of 1999, there were 18 smog alerts on nine different days, affecting the communities of Nashua, Portsmouth, Keene, Rye, and Rochester.⁵⁰ This was up sharply from the 1998 total of 11. A recent report estimates that during a typical ozone season (April-October) in New Hampshire, smog already sends an estimated 690 persons to hospital emergency rooms with respiratory symptoms, including 75 asthma sufferers.⁵¹ In addition, ozone is associated with an estimated 30,000 asthma attacks in the state.⁵²

Particulate Matter

Particulate matter (PM) is the general term for mixtures of solid particles and liquid droplets in the air. Particles can be coarse, such as soot and smoke, or fine, invisible particles less than 2.5 micrometers in diameter. Particulate matter is generated in two ways: directly from motor vehicles, power generation, or industrial facilities, and as a result of photochemical reactions that occur when sunlight shines on sulfur dioxide and nitrogen oxides. This secondary PM is made worse by rising temperatures.

Particulate matter is possibly the greatest consistent threat to respiratory health. Health effects of inhaling PM include premature death, increased hospital admissions and emergency room visits, increased respiratory symptoms and disease, decreased lung function, and alterations in lung tissue and structure and in respiratory tract defense mechanisms. Sensitive groups that appear to be at greater risk from such effects include

► **SMOG IN NEW HAMPSHIRE**

Although New Hampshire has a reputation for clean air and water, that reputation may not fare as well as the climate changes. Already New Hampshire is experiencing air pollution problems in the extreme south, and climate change will only make matters worse.

In the summer of 1999, the Clean Air Network reported that ozone measurements in some spots in the White Mountains and the seacoast exceeded those in Nashua and Boston.¹⁰⁸ Meters showed ozone levels of 100 parts per billion on top of Mount Washington, well above the proposed federal standard of 84 parts per billion per eight-hour period.¹⁰⁹

The U.S. Environmental Protection Agency sets a standard for ozone levels that may not be exceeded; counties and states that exceed the standard are considered to be “non-attainment areas.” Currently, the entire state of New Hampshire is in attainment for the 1-hour federal health standard for ozone;¹¹⁰ however, that standard may be phased out in favor of an 8-hour standard to protect against longer exposure periods.¹¹¹ Over the last five years (1993-98), areas of New Hampshire have exceeded EPA’s 8-hour standard on 6 to 10 days each summer.¹¹² EPA’s new standard is being disputed in the courts, so new attainment designations are currently not

being made in New Hampshire. However, it is likely that counties in the extreme southern and extreme coastal areas of the state (Hillsborough, Rockingham, and Strafford) that have historically been designated “serious non-attainment areas” for the 1-hour standard¹¹³ would be in violation of the 8-hour standard. These three counties account for about 63% of New Hampshire’s population. In the summer of 1999, there were 18 “smog alerts” — recorded exceedances of federal and state standards — on nine different days, affecting the communities of Nashua, Portsmouth, Keene, Rye, and Rochester.¹¹⁴ This is up sharply from the 1998 total of 11 exceedances. Because air pollutants move with the weather systems, emissions from New York and Boston can find their way to New Hampshire,¹¹⁵ as can emissions from Midwestern power plants. The three fossil-fuel plants operated by the Public Service of New Hampshire — in Bow, Newington, and Portsmouth — also play a role. Although their nitrogen oxide emissions fell 14% from 1996 to 1998, these plants increased their emissions of sulfur dioxide by 10 percent, while their soot emissions in 1998 were at their highest in 10 years.¹¹⁶ Legislation has been introduced in Congress to require older power plants such as these to finally meet the same air

the elderly, individuals with respiratory disease such as asthma, and children. New Hampshire has low particulate levels compared to most other states, but particulate matter that comes from out-of-state sources continues to be a source of concern.

Volatile Organic Compounds (VOCs)

Another set of air pollutants consists of VOCs that are emitted by large power plants and municipal waste combustors, as well as by small sources such as dry cleaners, printers, cars and trucks. VOCs include a variety of hazardous air toxins, including benzene, toluene, xylenes, and heavy metals such as cadmium, mercury, chromium, and lead. These hazardous air pollutants are associated with cancer as well as adverse neurological, reproductive, and developmental effects. Higher temperatures cause VOCs to evaporate and disperse more rapidly into the atmosphere.⁵⁴

A total of 24 toxic air pollutants in New Hampshire have been identified as exceeding the benchmark screening level of one-in-a-million risk of cancer and other adverse health effects. The most prominent risks are in association with 1,3-butadiene, formaldehyde, and benzene, that originate chiefly from motor vehicles, small businesses, and consumer products.⁵⁵ As for industrial facilities, three of the top 10 regional emitters of VOCs are located in New Hampshire.⁵⁶

Pollen

Finally, when the thermometer starts rising on warm days, pollen counts rise as well. Many scientists believe that rising temperatures will create favorable conditions for an even wider variety of pollen-producing plants, and increase levels of airborne pollen and spores that aggravate respiratory disease, asthma, and allergic disorders.⁵⁷ Hay fever sufferers in New Hampshire are likely to experience more attacks, during more months of the year.

3. A Plague of Ticks and Mosquitoes

In the warmer and wetter days to come, insects and rodents are likely to multiply, increasing the possible incidences of the diseases they spread. In terms of vector-borne diseases (i.e., diseases carried by a host such as a mosquito or tick), the rate of insect biting and the maturation of the disease-carrying microorganisms depend on temperature; both rates will increase with warmer weather, as shown in Figure 3.⁵⁸ Within a certain range, warmer temperatures will also increase the number of insects and favor their spread to higher elevations and more temperate latitudes.

Lyme disease, carried by ticks, is endemic to several regions of the United States, and accounts for more than 95% of all reported cases of vector-borne illness in the United States.⁵⁹ Lyme disease is already on the rise in New Hampshire. A warming trend could increase New Hampshire’s tick populations, while warmer winters will permit people to

enter tick-infected habitats earlier in the season, thereby increasing the risk of transmission of the disease.⁶⁰ In 1997, New Hampshire ranked 11th in the country for incidence of Lyme disease, with 3.42 cases per 100,000 population.⁶¹ The number of cases of Lyme disease reported in New Hampshire has been rising, particularly in the last decade (see Figure 4). Ticks in New England also carry babesiosis (animal malaria), ehrlichiosis (a treatable bacterial disease), and a virus that can cause encephalitis.⁶²

Other more exotic and frightening diseases could also be on the rise as the weather gets hotter and wetter. Public health officials throughout the world are seeing an alarming resurgence of parasitic diseases, such as malaria, and arboviruses (viruses borne by arthropods), such as dengue fever. Outbreaks are occurring more frequently in the United States due to factors such as immigration and increased travel abroad by Americans who bring the disease home. Once the parasite that causes the disease is brought into the state by travelers, a warmer climate will foster faster growth of the parasite as well as the host organism, thus increasing the risk of local transmission. Here are some examples of new and threatening diseases:

Malaria: Malaria in New Hampshire? It sounds unlikely, but consider this: New Hampshire had 5 cases of traveler-borne malaria in 1998 and 2 so far in 1999.⁶³ In New York and New Jersey, a relationship was observed between exceptionally hot and humid weather and sporadic malaria transmission in the 1990s.⁶⁴ Some scientists estimate that an increase in average global temperature of several degrees by the year 2100 will increase the capacity of mosquitoes to transmit the disease 100-fold in temperate countries.⁶⁵

Dengue: Dengue is a mosquito-transmitted disease that brings on sudden fever, headache, rash, nausea, vomiting, and other symptoms. Dengue shock syndrome has a fatality rate of 44%.⁶⁶ One suspected case of dengue was reported in New Hampshire in 1996, imported by a resident returning from foreign travel.⁶⁷ Simultaneous increases in temperature and humidity could lead to denser mosquito populations and add to the chances that residents of New Hampshire may be bitten and infected.

Hantavirus: Even hantavirus is not inconceivable in New Hampshire. The geographical range of the deer mouse, a hantavirus-carrying species, extends into most parts of New Hampshire. Though no cases of hantavirus have been reported in New Hampshire to date, cases have been reported as far north as Rhode Island.⁶⁸ Nearly half of all cases of hantavirus result in death.

West Nile Encephalitis: One of the most recent and disturbing outbreaks was the West Nile virus in the New York City area. The virus is carried mainly by mosquitoes but also by ticks, and is passed along to birds and humans. Until this summer, the virus had never been reported in the Western Hemisphere.⁶⁹ Fifty-six cases were identified as of October 19, 1999, resulting in seven deaths.⁷⁰

pollution standards that new plants must meet, but Members of Congress need encouragement to pass such legislation. Meanwhile, in New Hampshire, Governor Shaheen has developed an agreement with the Public Service of New Hampshire on how deregulation of the utility will proceed in the state. The agreement, however, contains nothing about environmental standards that the power plants will have to meet in the future.

► **WHERE PHYSICIANS FOR SOCIAL RESPONSIBILITY (PSR) STANDS**

Physicians for Social Responsibility (PSR), the active conscience of American medicine, uses its members' expertise and professional leadership, influence within the medical community, and strong links to policy makers to address this century's greatest threats to human welfare and survival.

Despite the uncertainties that exist in predicting global warming and its impacts, we are moved to action for several compelling reasons. First, the overwhelming consensus among scientists is that the earth's temperature is increasing. Second, the reality of weather events and other natural phenomena is increasingly confirming the predictions of mathematical forecasting models. This fact is overlooked in statements funded by the energy industry that attempt to minimize the severity of global warming. Third, just like businesses, governments, and responsible individuals, we feel the need to act decisively in the face of uncertainty to protect individuals whose welfare has been entrusted to us. We cannot say exactly when to expect a noticeable increase in floods, or in deaths from asthma among people living in smog-congested cities. No one can. But as Surgeon General Luther Terry stated in his 1962 report on

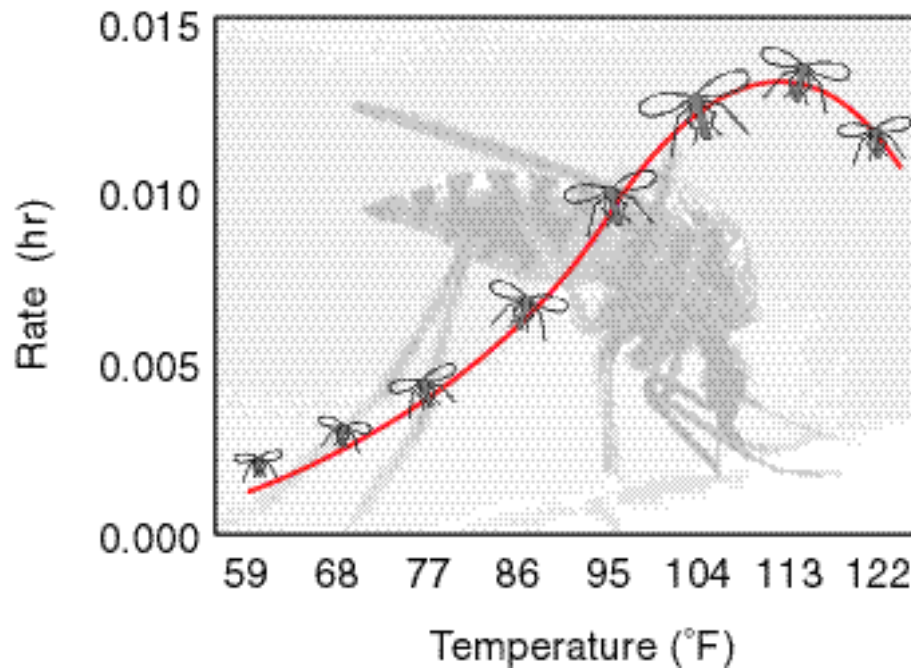


Figure 3

Warmer weather promotes breeding by disease-carrying mosquitoes... Warmer temperatures speed up the rate at which mosquito larvae mature. With climate change, more frequent outbreaks of malaria, dengue fever, encephalitis, and other diseases transmitted by mosquitoes may begin to occur in temperate zones such as New Hampshire.

Source: Focks et al. *J Med Entomol.* 1993; 30: 1003-17. Cited in Kovats S, Patz JA, Dobbins D. Global climate change and environmental health: Proceedings of the 1997 annual conference of the Society for Occupational and Environmental Health. *Int J Occup Environ Health.* 1998;4:41

4. Food and Water Contamination

Certain diseases caused by food and drinking water contamination are likely to spread more quickly in weather characterized by higher temperatures, increased rainfall, and drought. Diseases transmitted by fish and shellfish are a case in point. The problem arises when poisonous algae known as dinoflagellates bloom along New England shores in the spring or fall. These harmful algal blooms stain the water red (hence, the expression "red tides") and contaminate clams, mussels, and other shellfish.⁷¹ Whether eaten raw or cooked, the shellfish pass the toxins along to humans, causing paralytic shellfish poisoning.

In Prince Edward Island in 1988, three people died and more than 100 became sick after they ate contaminated shellfish.⁷² The disease can cause tingling, numbness, drowsiness, fever, rash, and staggering. The most severe cases result in respiratory arrest within 24 hours. In 1990 and 1993, red tide levels were so high that Maine, New Hampshire, and Massachusetts closed their shorelines to shellfish diggers. However, illegal poaching continued in closed shellfish beds, and contaminated shellfish were brought to markets.⁷³ Under New Hampshire law, illegal shellfish digging is only a

Reports of Lyme Disease Rise in New Hampshire

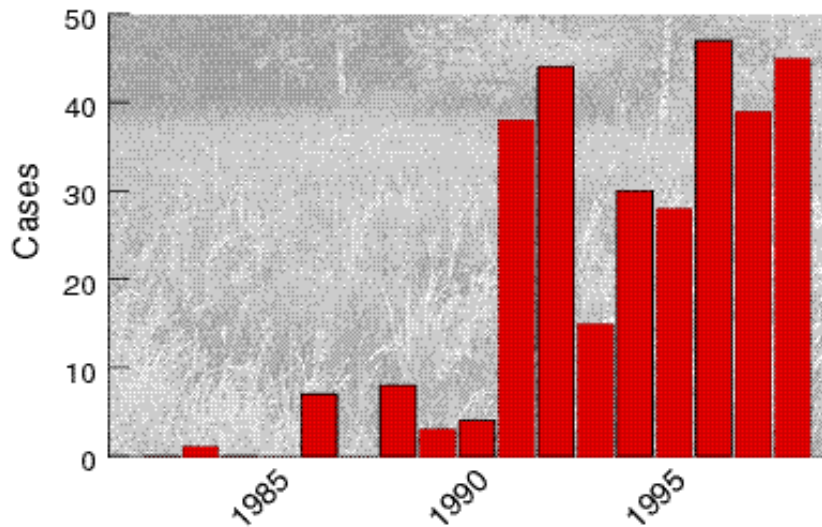


Figure 4

Lyme disease on the rise... Many more cases of Lyme disease are being reported in New Hampshire today than in the 1980s. Scientists express concern that the ticks that carry Lyme disease will proliferate in a warmer climate.

Sources: Centers for Disease Control and Prevention. Lyme Disease Cases Reported to CDC by State Health Departments, 1982-1997. (1998) http://www.cdc.gov/ncidod/dvbid/ld82_97.pdf. Centers for Disease Control and Prevention. Provisional cases of selected notifiable diseases, United States. Morbidity and Mortality Weekly Report, January 2, 1999. http://wonder.cdc.gov/mmwr/mmwr_reps.asp?mmwr_table=2B&mmwr_year=1998&mmwr_week=52
1998 data: <http://www.cdc.gov/epo/mmwr/preview/mmwrhtml/00056174.htm>

violation, with fines up to \$1000.

Warm weather, higher rainfall, and warmer ocean temperatures are thought to stimulate the growth of the algae and could lead to a resurgence of red tides.⁷⁴ Nationwide, compared to 25 years ago, scientists have identified more toxic algal species and more algal toxins, and there have been more areas affected, more fisheries resources affected, and higher economic losses. The reasons for this change are likely many; however, it is worth noting that in the case of New England, the algae that continue to cause red tides were first introduced into southern New England waters in 1972 immediately following a hurricane.⁷⁵

Warmer, moister weather also encourages the spread of diseases caused by food contaminated with toxic *E. coli*, *Salmonella*, *Cyclospora*, and Hepatitis-A. Hepatitis-A,⁷⁶ for example, is a liver disease with symptoms of jaundice, fatigue, abdominal pain, loss of appetite, intermittent nausea, and diarrhea. An estimated 125,000-200,000 total

motor vehicles and air pollution, the need for further research should not stop us from taking "all practicable steps to minimize" the hazard. We are certain that fossil fuels play a role in global warming, one that we can control. For the sake of our own well-being, and the health of future generations, we need to act now.

PSR is working to create a world free of nuclear weapons, global environmental pollution, and gun violence. In 1985, PSR shared the Nobel Peace Prize with International Physicians to Prevent Nuclear War.

infections of Hepatitis-A occur yearly in the United States and 100 deaths are reported annually.⁷⁷ Hepatitis-A is usually transmitted by fecal-oral routes of exposure or food/waterborne outbreaks, and is contagious. In New Hampshire in 1998, 11 cases were reported.

Extreme weather events that cause flooding or disruptions in water supplies, or droughts that can cause water shortages, may bring on other types of gastrointestinal diseases. Two of the newest and largest threats are from *Giardia* and *Cryptosporidium*. (See section 1 on droughts.)

Giardiasis: Giardiasis is an illness caused by a one-celled, microscopic parasite that lives in the intestines of people and animals. During the past 15 years, *Giardia lamblia* has become recognized as one of the most common causes of waterborne disease in humans in the United States⁷⁸ and it is New Hampshire's most common gastrointestinal disease, affecting 327 New Hampshire residents in 1997.⁷⁹ Diarrhea, abdominal cramps, and nausea are the most common symptoms of giardiasis. Contaminated water in New Hampshire's lakes and streams ingested by campers and swimmers may be a source of giardiasis in the state.⁸⁰

Cryptosporidiosis: Another major threat to the United States water supply is from an organism called *Cryptosporidium*, which is resistant to chlorine, small and difficult to filter, and ubiquitous in many animals.⁸¹ Symptoms include diarrhea, stomach cramps, an upset stomach, or a slight fever. In people with AIDS and others whose immune system is weakened, crypto can be serious, long-lasting, and sometimes fatal.⁸² As of October 16, 1999, there have been 3,137 cases of crypto in the United States, and 14 reported in New Hampshire.⁸³

5. Sea Level Rise

The sea level along much of the United States coastline has been rising at a rate equal to 10-12 inches per century.⁸⁴ Most of the rise has occurred as warmer temperatures cause the ocean to expand. Melting glaciers contribute to the rise as well. Global warming will increase the rate of sea level rise due to further expansion of the sea's surface layer and glacial melting.⁸⁵ EPA and other organizations expect the sea level along the Gulf and Atlantic coasts to rise an additional foot by 2050, possibly as early as 2025. It is likely that sea level will rise by two feet over the next century, and possibly by as much as four feet.⁸⁶

At Seavey Island/Portsmouth, the current rate of sea level rise is 7 inches per century. This rate is likely to accelerate in coming decades. Predicted sea level rises of 12 to 20 inches could cause large-scale alteration of Great Bay, eliminate some coastal estuaries, and cause flooding in rivers.⁸⁷ Such sea level rise will displace New Hampshire residents or force them inland, and could cause property damage and harm the tourist industry.

Smog, Mosquitoes Threaten Health

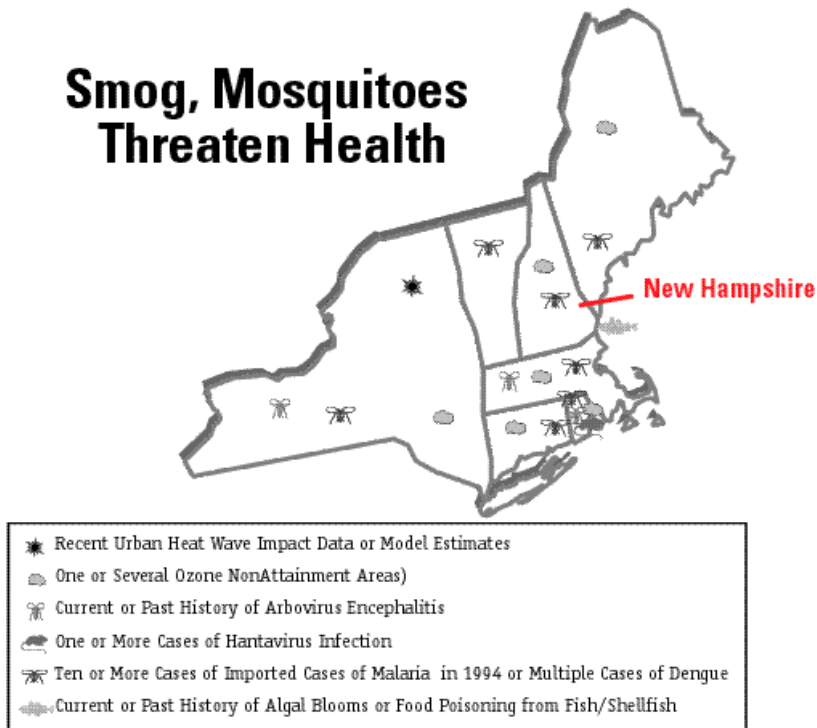


Figure 5

Even New Hampshire is vulnerable. In some locations ozone (smog) levels exceed federal standards. In addition, there have been recent cases of imported mosquito-borne diseases (malaria or dengue fever), and local algal blooms have killed marine life and increased the risk of food poisoning among humans. Climate change is likely to worsen these conditions and the related health effects.

Source: Longstreth, Op.cit.

6. What You Can Do

Concern over climate change is slowly making inroads in New Hampshire. The New Hampshire Department of Environmental Services identified climate change as one of its 11 priority issues for the next several years, calling it a “pressing, impending environmental concern both locally and globally.”⁸⁸ In July 1999, Governor Jeanne Shaheen launched a voluntary greenhouse gas registry that encourages businesses to decrease emissions of pollutants now by allowing them to register reductions. Thus, if federal reductions are mandated in the future, the State will use its registry to help ensure that a company’s pollution reductions are counted toward the new requirements.

Local governments in New Hampshire, on the other hand, have not been reading the handwriting on the wall. In October 1999, most local New Hampshire officials declined to join 567 mayors and other municipal officials in 47 states who called on Congress and the Clinton Administration to work with them to end global warming.⁸⁹

Can residents of New Hampshire do anything to reverse the trends before global warming creates a perpetual state of emergency in the Granite State? Yes! The number one

priority is to lower the use of fossil fuels, and opportunities for making that happen are everywhere. There's a lot you can do, starting now, to reduce consumption of fossil fuels:

1. Urge the businesses you patronize to become energy-efficient. U.S. businesses spend about \$100 billion on energy each year to operate commercial and industrial buildings. By using energy efficient products and operational procedures, businesses could reduce their energy use by 35 percent or \$35 billion nationally. There are now numerous programs in place to help businesses change their energy usage and save money at the same time. Put your favorite businesses in touch with EPA's Energy Star Buildings program (1-888-STAR-YES, <http://www.epa.gov/greenlights>,) and Climate Wise program (1-800-459-WISE (9473), <http://www.epa.gov/climatewise>).

2. Demand that electric utilities use low-carbon technologies and renewable energy. New Hampshire environmentalists have launched an intensive campaign to get state officials to require old power plants to meet the same federal standards as new plants. Support their efforts by writing to the Governor and attending public hearings. The next few months could be a crucial time as negotiations proceed over the deregulation of the Public Service of New Hampshire. Contact New Hampshire Clean Water Action (603-430-9565, <http://www.cleanwateraction.org>), Appalachian Mountain Club/New Hampshire (603-744-8011, <http://www.amc-nh.org>), Seacoast Anti-Pollution League (603-431-5089) or New Hampshire Citizen's Alliance (603-225-2097 ext 20).

3. Reduce your gasoline consumption. However you choose to do it — through carpooling, walking, bicycling, telecommuting, or using public transportation — leave that car at home for one or two days a week, and you'll prevent tons of CO² emissions from entering the air. Each gallon of gasoline burned in your car releases 19 pounds of CO². When upstream sources, such as refineries, fueling stations, and transportation of gasoline are factored in, the amount of CO² per gallon goes up to 26-30 pounds. If you leave your car at home, you may end up demanding more public transportation as well.

4. Get your house in order. Use energy-efficient light bulbs such as halogen or fluorescents. Install a solar thermal system to help provide your hot water (CO² reduction: 720 lbs/year). Recycle all your home's waste newsprint, cardboard, glass, and metal (CO² reduction: 850 lbs/yr). Insulate your home, tune up your furnace, and install energy-efficient showerheads (CO² reduction: 2,480 lbs/yr).

5. Buy fuel-efficient vehicles. If you are buying a new car, go for an energy-efficient one. That means considering miles per gallon as an important factor when choosing your new car or sport utility vehicle (SUV). Not only will this save you dollars

at the gas pump each year, but also you will release less CO² into the air. While at times New Hampshire living may call for sturdier off-road vehicles, some vehicles get better fuel economy than others, and a car gets more miles per gallon than any SUV. Choosing a vehicle that gets 25 miles per gallon rather than 20 will prevent 10 tons of carbon dioxide from being released into the air over the lifetime of your vehicle. To find the miles per gallon of any 2000 model car, compare the fuel efficiency of cars side by side, find the most fuel efficient trucks and SUVs, or learn about alternative fuel vehicles, go to: <http://www.fueleconomy.gov>.

6. In the coming election year, work for candidates who are serious about reducing emissions of carbon dioxide and other greenhouse gases. Ask your Senators to take a stand in favor of ratifying the international agreement on global climate change, the Kyoto Protocol. Tell Members of Congress that we are not afraid of higher fuel efficiency (“CAFE”) standards — for cars, SUVs, and light trucks — and they shouldn’t be either!

7. Urge New Hampshire legislators to support the Kyoto Protocol. A resolution rejecting ratification of the Kyoto Protocol was deferred by the New Hampshire Senate in October for lack of information. However, it may return in New Hampshire’s next congress.

8. Make deregulation work for the environment. With deregulation of utilities, people can choose where to get their power. Investigate your options in New Hampshire, and support renewable sources of energy or gas-fired power plants.

To be sure, questions remain about the exact causes of global warming and how seriously it threatens human health. But enough is known to require action now. Global warming’s potential to cause harm is indicated by the insurance industry’s decision to create a \$200 billion reserve to pay for damages expected to be caused by the increase in hurricanes and other extreme weather events.⁹⁰ Moreover, the energy conservation techniques recommended here to protect against global warming will also reduce energy consumption and result in cleaner air. This “no regrets” policy means no regrets now — and none for our children in the future. The quality of our children’s lives will depend on the actions we take today.

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¹¹⁰ Non-attainment areas are those with ground-level ozone concentrations exceeding the 1-hour ozone standard of 0.12 parts per million more than once per year, based on a three-year average. U.S. EPA, Ozone non-attainment areas in New England. (1999). Available at <http://www.epa.gov/region01/eco/ozone/nattainm.html>.

¹¹¹ EPA set the 8-hour standard at 0.08 parts per million (ppm), defined as the 3-year average of the annual 4th-highest daily maximum 8-hour ozone concentrations.

¹¹² U.S. EPA. Historical exceedance days in New England of EPA's 8-hour ozone standard. Available at: <http://www.epa.gov/region01/eco/ozone/standard.html>. Accessed September 22, 1999.

¹¹³ U.S. EPA. Ozone non-attainment counties for NH. (1996). Available at: <http://134.67.55.16:7777/dc/ghg.nsf/NonAttainmentCountiesSearch/?SearchView&Query=NH>. This view was expressed by Richard Burkhart, U.S. EPA Region 1, telephone conversation, July 28, 1999 and August 11, 1999.

¹¹⁴ New Hampshire Citizens Alliance. Press Release. October 1999.

¹¹⁵ New England Climate Initiative. *New England's Changing Climate, Weather, and Air Quality*. cit.

¹¹⁶ Braile R. Power plant report shows need for emissions caps, activists say. *The Boston Globe* April 11, 1999, New Hampshire Weekly, p.