

# **Climate Change and Human Health in the United States**

## **Catholic Health Initiatives**



This resource was created by Catholic Health Initiatives Advocacy Department as a tool to raise awareness about the impacts of climate change in the United States. This resource was based on multiple sources, as listed below:

**Sources for: *Climate Change and Human Health in the United States***

[National Climate Change Assessment: Climate Change Impacts in the United States – Chapter 9 \(2014\)](#)

[National Climate Assessment: Full Report](#)

[The Impacts of Climate Change on Human Health in the United States: A Scientific Assessment](#)

[A Human Health Perspective on Climate Change](#)

[EPA – Climate Change](#)

[NASA Global Climate Change: Vital Signs of the Planet](#)

[World Health Organization \(WHO\) – Climate Change and Human Health](#)

[WHO – Climate Change and Human Health: Risks and Responses](#)

[CDC – Climate Effects on Health](#)

[The Obama White House: Climate Change](#)

[Fossil Fumes: A Public Health Analysis of Toxic Air Pollution from the Oil and Gas Industry](#)

For more information, contact [laurakrausa@catholichealth.net](mailto:laurakrausa@catholichealth.net).

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## Climate Change and Human Health in the United States

This resource is based upon the three following reports: [The Impacts of Climate Change on Human Health in the United States \(2014\)](#); [The National Climate Assessment: Climate Change Impacts in the United States \(2014\)](#); and [A Human Health Perspective on Climate Change \(2010\)](#). In addition, numerous other resources were used, a listing of which can be found on page 27 of this resource.

The first evidence that man would contribute to the warming of the earth was demonstrated in the work of scientist [Svante Arrhenius](#) (1896), 120 years ago. Arrhenius identified that human-produced carbon emissions would raise the earth's temperature, but he underestimated the rate at which this would occur. Predicting the change would occur over thousands of years, reality has defied this prediction and it has taken approximately 120 years for earth to witness a [rise in temperature between 1.3 and 1.9 degrees Fahrenheit](#). While this rise may seem insignificant, it is not. The effects of this rise are already impacting the world today and are evidenced in many physical realities, including in the state of human health. Leading scientists predict an even greater rise in temperature by the end of the 21<sup>st</sup> century – potentially [between 2.5 – 10 degrees Fahrenheit](#). Such a rise could be devastating for the health of the entire planet, and human health consequences are predicted to be severe.



### **What is climate change?**

To better understand climate change, it is important to distinguish climate and weather. Weather is the condition of the atmosphere at a given place and time. Climate is the *average* of weather conditions over a significant period of time (i.e., decades). Climate *change* is the detectable alteration of the average weather conditions over time. Climate change affects temperatures, ice/glacier melting, precipitation/weather patterns, sea levels, air quality, oceanic acidification and extreme weather events, which in turn have enormous impacts on human health. The two [primary ways climate change affects health](#) include:

- Increasing the severity and frequency of existing illnesses [e.g., increased cases of asthma, including more serious cases]
- Causing unpredicted and/or unprecedented illnesses in places where they have not previously been witnessed, or in ways in which they have not previously been witnessed [e.g., the spread of Lyme Disease in new areas due to a change in climate that supports the migration of ticks]

### **What are the drivers of climate change and what does this have to do with health?**

History proves that the earth has gone through many periods of heating and cooling, due to natural events/circumstances that have nothing to do with human contribution. However, emerging science proves that man has accelerated warming by contributing to the levels of greenhouse gases that cover the earth – acting like a blanket. The [primary sources of greenhouse gas emissions](#) include: electricity, transportation, industry, commercial and

residential (heat, waste, use of products), and agriculture. In addition to the impacts these sources have on climate change that affects human health, the emissions also have a very *direct* impact on human health. In essence, human health suffers twice: both from man-made emissions and from the change in the climate that is the result of man-made emissions.

### **How has this affected me? I don't feel anything different...**

The severity of the impact for a given community will depend upon the [vulnerability](#). The vulnerability of individuals/communities is dependent on the exposure to the given climate event, sensitivities to the exposure and adaptive capacity (e.g., the ability to mitigate, adjust or respond). Unfortunately, the kind of communities most often defined as vulnerable will also be most susceptible to the impacts of climate change on health. The elderly, the young, communities of color, communities that rely on the environment, pregnant women, socio-economically disadvantaged and people with existing health conditions are all far more susceptible to the health impacts of climate change. However, climate change *is* affecting all communities, whether or not the outward signs are recognizable.

### **What is the impact on human life?**

Recently, the [World Health Organization \(WHO\) assessed the long-term impact of health consequences](#) that will result from climate change, and the results are staggering:

*Between 2030 and 2050, WHO estimates there will be an additional 250,000 deaths per year, due to the effects of climate change on human health.*

- 38,000 of the deaths will be the result of heat exposure in elderly populations.
- 48,000 of the deaths will be the result of diarrhea.
- 60,000 of the deaths will be the result of malaria.
- 95,000 of the deaths will be the result of child malnutrition.

### **I want to know more...**

Great! The links in the section below present the latest scientific thought on illnesses that are or will be impacted by climate change. Not all science is conclusive, and certainly more research is needed in many areas, but much of this information has some common sense connections that validate conclusions.

## **[Diseases Impacted by Climate Change](#)**

The following is a list of diseases and illnesses that are impacted by climate change. Click on each one to learn more about how climate change is contributing and what effects it is having.

[Cancer](#)

[Cardiovascular Diseases](#)

[Extreme Weather Events and Injury and Illness](#)

[Neurological Conditions](#)

[Nutrition-Related and Foodborne Illnesses](#)

## **Vulnerability: Who is Most at Risk in the U.S.**

Certainly, no one is immune to the health impacts of climate change. In the U.S., while we experience far fewer issues than those seen in developing countries, [health consequences are being experienced – disproportionately so by certain vulnerable populations](#). Some of the groups that will be most impacted include the following:

- Elderly
- Young children
- Pregnant mothers and their unborn children
- People with pre-existing, chronic or immunodeficiency conditions
- People with disabilities
- Immigrants – especially those with language barriers
- Indigenous peoples
- Low-income
- Communities of color
- People in certain occupations (e.g., agriculture)

In addition to the direct impact of climate change-related events, research demonstrates that the social determinants of health play a role in vulnerability as well. The same issues that cause health inequities in the U.S. will potentially exacerbate the effects of climate change due to the increased vulnerability (e.g., economic stability, neighborhood/environment, health/health care, social and community context, and education). For example, a lack of access to health care can exacerbate chronic conditions that are aggravated further by climate change-related phenomena (e.g., extreme heat, air pollution, etc.).

Another factor involved in assessing vulnerability is a person's or population's ability to adapt to the conditions of climate change. This can vary among populations as well as individuals and can be associated directly with an individual or can be attributable to a community. For example, people on medications that prevent them from regulating body temperature will be extremely susceptible to heat waves. Communities that have no disaster-preparedness plan will be more susceptible to extreme weather events.

## **Becoming Part of the Solution**

Climate change can be mitigated when significant efforts are made to reduce greenhouse gas emissions. These efforts must come on a global scale and therefore must involve countries and governments from around the world. However, everyone can play a part in reducing their own emissions, which can contribute significantly to the global reduction efforts when collective efforts are taken into consideration.

Before you start, evaluate your own [carbon footprint](#), and familiarize yourself with the major contributors to greenhouse gases. These include:

- Electricity generation
- Transportation
- Industry
- Commercial and residential practices (heat, waste, use of products)
- Agriculture

Learn about ways you can reduce your carbon footprint [at home](#), [on the road](#), and [at work](#).

Additionally – you can become a climate change advocate and let your local, state and federal governments know that you care and that you expect them to take actions to mitigate climate change!

A few examples of **state and local efforts** could include advocacy for:

- Better public transit
- Development of bike lanes and walkable cities
- Solar-powered street lights
- Development of green spaces
- Recycling in government buildings/facilities
- Standards for green building design
- Smarter traffic design
- Development of climate change adaptation & resiliency plans

The **federal government** has been very active in addressing climate change, and you can learn about recent efforts and [let your legislators know](#) that climate change mitigation matters! Learn about:

- [President Obama's plan](#) to address climate change
- [EPA plan](#) to address climate change
- [Learn about legislation](#) in the 114<sup>th</sup> Session of Congress

## [How CHI is Part of the Solution](#)

Facilities throughout CHI are working to increase environmental sustainability that mitigates climate change and increases resiliency for CHI as a whole. Some facilities have more capabilities than others, but efforts continue to help all facilities move in the direction of increased sustainability. Here are some of the things CHI is doing (in some or all markets) to be a part of the solution:

- Increasing energy efficiency through retrofitting and the installation of energy-saving fixtures.
- Increasing recycling efforts better waste stream management, smarter purchasing and device reprocessing.
- Moving to healthier food options that reduce the amount of meat consumed and increase vegetables.
- Green building that minimizes chemical exposure, recycles materials and focuses on sustainable energy use.

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## CANCER

Sources: [The Impacts of Climate Change on Human Health in the United States \(2016\) \(Chapters 3 & 4\)](#); [The National Climate Assessment: Climate Change Impacts in the United States - Chapter 9 \(2014\)](#); [A Human Health Perspective on Climate Change \(2010\) \(Chapter 2\)](#), and [Fossil Fumes: A Public Health Analysis of Toxic Air Pollution from the Oil and Gas Industry](#).

While research is less robust regarding climate change and the impacts on cancer, preliminary research and common-sense conclusions lead researchers to believe that there are indeed cancer ramifications for people that result directly from climate change. Higher temperatures, increased precipitation and depleted ozone all contribute to ecological events that increase exposure to contaminants that can be carcinogenic.

### **Contributing Factors and Cardiovascular Health:**

- Carcinogen exposures
  - Airborne contaminants
  - Water contaminants
  - Food contaminants
- Depleted ozone

### **Impacts on Health:**

#### Airborne Carcinogens

As temperatures increase, there is the potential for volatile and semi-volatile organic compounds (VOC) to be released from water and wastewater, potentially increasing human exposure and expanding geographic regions that can be impacted by airborne carcinogens. VOCs enter water sources through the use of chemicals, including cleaning and disinfecting agents, paints, fuels, etc., and are aerosolized by extreme temperature. They are proven to have short- (respiratory irritations) and long-term health impacts (cancer, liver and kidney disease, nervous system damage).

Additionally, it is significant to bring attention to the [double-impact of the fossil fuels industry](#) and its ramifications for cancer. Certainly, the burning of fossil fuels greatly impacts climate change, but its production, processing, transmission/storage and distribution also lead to the release of a host of poisonous pollutants including Benzene and Formaldehyde – both of which are linked with causing cancer.

#### Waterborne and Foodborne Carcinogens

Increased precipitation will result in higher incidences of flooding and greater runoff. Flooding can increase water contamination when storage facilities containing toxic chemicals are breached. Runoff increases toxic chemicals in the water supply from polluted land sources (e.g., agricultural land that has been exposed to pesticides). Many of these chemicals are considered carcinogenic.

Tap water is regulated for 80 contaminants, but unregulated for a host of other known toxins. [Bottled water](#) – often thought to be a safe alternative – is also not immune to unregulated contaminants. Freshwater contamination will increase with extreme precipitation events resulting from climate change and could therefore increase the prevalence of toxins in the water supply.



Additionally, food sources from both fresh and salt water (fish, shellfish) can become contaminated by toxic runoff, affecting human health on yet another level.

### Depleted Ozone

The science around the impact of climate change on stratospheric ozone is not entirely definitive, but many scientists believe that global warming has an impact. As the earth's surface rises in temperature, the stratosphere cools, and this process impedes the stratospheric ozone's natural repair process. The resulting "hole" in the ozone layer allows harmful ultraviolet (UV) rays to penetrate the atmosphere, giving rise to certain skin cancers. One positive outcome – vitamin D levels can actually increase as the ozone hole grows, which can protect against some forms of cancer. Nonetheless, the additional UV exposure has the potential to increase rates of skin cancer.

### What Can We Do?

One of the most important steps we can take to mitigate climate change is to reduce energy use and look for alternative sources of energy that are not reliant on fossil fuels. The fossil fuels industry contributes doubly to cancer risk – first by producing a consumer-used product that directly impacts the greenhouse effect, and second by releasing toxic chemicals in the production, processing, transmission/storage and distribution of its products. Reducing our dependence on fossil fuels will have a significant impact. Alternative energy sources like solar and wind power are ideal. When it comes to cars, however, even [electric cars](#) (that may rely on a coal-driven power grid) are cleaner than cars that rely on fossil fuel.

Additionally, we must be cognizant of the chemicals we use and dispose of, understanding that in extreme weather events that produce run-off and flooding, our water, air and food sources are becoming infected with chemicals that can cause illnesses like cancer. Where we can use natural cleaning products, we should! Where we can safely dispose of chemical products (e.g., medicines and other health care waste), we must ensure that we are doing so!

Remember – even the smallest steps have a collective impact. So, if solar power is not within your reach, know that energy reduction *is*. Turn off the lights. Keep your thermostat at temperatures that require minimal use. Unplug cords that aren't in use. Take public transportation or carpool...these are but a few ideas that almost everyone can do!

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## CARDIOVASCULAR ILLNESS AND DISEASE

Sources: [The Impacts of Climate Change on Human Health in the United States \(2014\) \(Chapters 2-4\)](#); [The National Climate Assessment: Climate Change Impacts in the United States - Chapter 9 \(2014\)](#); and [A Human Health Perspective on Climate Change \(2010\) \(Chapter 3 & 5\)](#).

Extreme temperature differences play a significant role in exacerbating many cardiovascular conditions, including heart-related illnesses and stroke. Climate change directly affects temperatures extremes, precipitation patterns and extreme weather events, which in turn impact cardiovascular illness (through extreme heat/cold, stress from extreme weather events). Climate change also exacerbates poor air quality and alters vector ecology – both of which have ramifications for cardiovascular health.

### **Contributing Factors and Cardiovascular Health:**

- Temperature extremes
- Extreme weather events
- Air Quality
- Vectorborne disease

### **Impacts on Health:**

#### Temperature Extremes

The gradual warming of the climate results in temperature extremes – both hot and cold – worldwide. Excessive heat and excessive cold contribute to heart attack and other instances of acute coronary syndrome, stroke and cardiac dysrhythmias that account for significant increases in hospitalizations and sometimes death. Extreme heat also increases the negative impacts of air quality (e.g., ozone and fine particulates) on cardiovascular health, ultimately intensifying cardiovascular distress. Fine particulates contribute to systemic inflammation, decreased heart function, atherosclerosis and other cardiac dysfunctions.

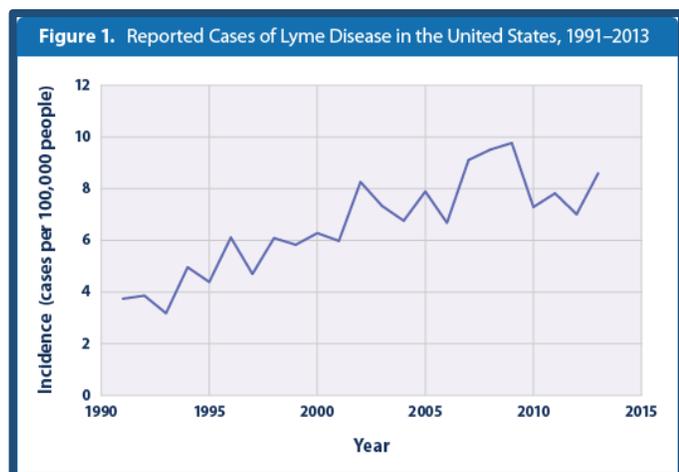
#### Extreme Weather Events

Stress and anxiety that result from climate change-associated extreme weather events can negatively impact cardiovascular health, potentially causing heart attack and even sudden death. Additionally, extreme weather events can complicate access to medical care by disrupting services or complicating transportation to care facilities.

#### Vectorborne Disease

With changing temperatures and precipitation patterns, vector ecology is shifting and increasing in severity and frequency. Certain vectorborne diseases have a severe impact on the cardiovascular system.

Lyme disease is one example of a vectorborne illness that is particularly taxing to the cardiovascular system. The United States has seen



Centers for Disease Control and Prevention, 2015

a shift and increase in the prevalence of Lyme Disease, with some studies reporting activity in at least half of all U.S. counties. The changes in the geographic distribution of the disease are related to changing climate patterns that result in warmer temperatures lasting longer (starting earlier in spring and lasting longer into the colder months). Additionally, warmer winters lead to a higher tick population, and longer warm seasons increase human exposure, as more time is spent outside. So as the climate continues to change, vectorborne illnesses are expected to increase in frequency and severity, appearing in new regions that have heretofore not been exposed.

### What Can We Do?

Extreme events and extreme temperatures are the climate change drivers that impact cardiovascular health. Mitigating risk means we must address all [greenhouse gas](#) contributors by looking at the [source of emissions](#) and making necessary adjustments. The primary sources include: electricity, transportation, industry, commercial/residential, and agriculture.

**Electricity:** As a global citizen, our governments need to reduce the amount of electric power that relies on fossil fuels. As consumers and caring citizens – we can advocate for legislation and regulation that moves us toward that clean energy goal!

**Transportation:** With regard to transportation, we can move toward fuel-efficient vehicles, hybrid vehicles and electric vehicles (which still are cleaner than vehicles that use fossil fuels), but we can also move to modes of public transportation and carpooling. We can make these changes personally, but we can also become advocates for legislation and regulations that support this transition!

**Industry/Commercial/Residential:** As consumers, we can demand changes within the industry and commercial sectors that mitigate emissions. At home, we can be responsible with our own use of energy sources that contribute to harmful emissions (e.g., reducing electric and natural gas use)!

**Agriculture:** We can also impact the agriculture industry through consumer choices that focus on less meat – thus, [less methane](#) – thereby reducing emissions while making healthier choices!

Also – we must protect and replenish our forests. Forests are one of the major protectors of our environment, soaking up vast amounts of CO<sub>2</sub> that would otherwise contribute to greenhouse gases. Advocate for managed forests...and go plant a tree!

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## **EXTREME WEATHER EVENTS AND INJURY AND ILLNESS**

Sources: [\*The Impacts of Climate Change on Human Health in the United States \(2014\) \(Chapters 2-8\)\*](#); [\*The National Climate Assessment: Climate Change Impacts in the United States - Chapter 9 \(2014\)\*](#); and [\*A Human Health Perspective on Climate Change \(2010\) \(Chapter 11\)\*](#).

The devastation from recent U.S. hurricanes (Katrina and Sandy) is still prominent within the American conscience as an example of the impact of extreme weather on human health. Many people died as a direct result of the storm, and there were more deaths in the aftermath. But extreme weather is more than hurricanes; it includes events like flooding and drought. In fact, flooding is at a 100-year high in the U.S. midwest, with heavy rainfall events increasing 100% in that 100-year period. Heavy precipitation events have also increased in the U.S. northeast, seeing a rise of 67% over the past 50 years. In the U.S. southwest, the recent drought has contributed to water scarcity, and severely impacted crops and livestock. Unfortunately, scientists predict these drought conditions will continue and possibly increase.

### **Contributing Factors and Extreme Weather Events:**

- Extreme precipitation events (hurricane, flooding, coastal storm surge)
- Drought events
- Winter storm events



### **Impacts on Health:**

#### Extreme Precipitation Events

Violent weather events, such as hurricanes, can cause injury, illness and death both as a direct or indirect result. Direct impacts can include drowning, injury related to collapsing infrastructure or injury/illness resulting from gas line breaks (inducing poisoning or fire). Indirectly, a storm of this magnitude can have multiple effects, including: poor mental health (depression, PTSD, suicidal thoughts/actions), water borne disease, food borne illness (spoilage from loss of electricity), injuries related to post-event transportation, and unsafe/unsanitary living conditions. Additionally, medical services and medical needs can go unattended, due to a lack of access to health care providers and facilities.

Flooding as a result of heavy precipitation inland can also result in drowning, injury and illness. The number one factor in flood-related deaths is drowning, but injury, electrocution, gastrointestinal illnesses and infections are also associated with flood events. Such injuries and illnesses also affect first responders, which can in-turn exacerbate the health of the community.

#### Drought Events

Changing precipitation patterns that are a result of climate change also impact drought conditions. Drought can cause wildfire, dust storms, and flash flooding, and it is often associated with extreme heat and poor air quality – all of which can have a multitude of impacts on human health. Injury and death associated with wildfire and flooding is obvious. Dust storms are responsible for adding fine particulate matter to the air which results in a myriad of respiratory illnesses (allergies, asthma, pneumonia, bronchitis, etc.). Extreme heat has significant ramifications for cardiac events as well as heat-related stroke or severe dehydration. Additionally, heat contributes to poor air quality and thus negatively impacts the respiratory system.

Drought will eventually lead to a shortage of freshwater resources, leaving affected communities in situations of water scarcity. Extreme scarcity greatly impacts developing countries in many ways, but it affects the U.S. as well – specifically

our food resources [e.g., crops and livestock]. This can lead to increased food prices that can adversely affect economically challenged populations.

### Winter Storm Events

Extreme cold can affect cardiac health through direct stress on the heart as well as stress associated with shoveling snow. Extreme snowstorms and cold can result in increased cases of hypothermia and frost-bite, and can cause ice-related accidents. Storms impacting electricity can lead to carbon monoxide poisonings as a result of people using alternative and inappropriate methods of heat.

### What Can We Do?

In addition to making efforts to mitigate climate change by minimizing emissions, the next best thing we can do is to be prepared for extreme events. While being prepared for inevitable extreme events isn't part of the overall solution to the changing climate, it is an essential reality as we deal with the very present impacts of climate change.

For the health care sector, here are two resources that can assist with preparedness efforts:

[U.S. Climate Resilience Toolkit: Building Health Care Sector Resilience](#)

[Practice Greenhealth – Climate and Health Resources](#)

As individuals, we must prepare as well. Tools and resources are available on the [Federal Emergency Management Agency's \(FEMA\)](#) website. Also, check with your local, county and state governments for recommendations specific to your region.

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## NEUROLOGICAL DISEASES

Sources: [The Impacts of Climate Change on Human Health in the United States \(2014\) \(Chapters 5-8\)](#); [The National Climate Assessment: Climate Change Impacts in the United States - Chapter 9 \(2014\)](#); and [A Human Health Perspective on Climate Change \(2010\) \(Chapter 8\)](#).

The U.S. has seen an increase in neurological diseases/disorders like [Alzheimer Disease \(AD\)](#) and [Parkinson Disease \(PD\)](#), as well as evidence that these diseases are appearing earlier in life. There is a growing concern that the rise is associated with environmental factors – many of which are attributed to climate change. These factors also are suspected of being significant contributors to learning disabilities in children.

### **Contributing Factors and Neurological Diseases:**

- Precipitation events
- Weather pattern changes
- Wind and water currents, sunlight
- Vectors



### **Impacts on Health:**

#### Precipitation Events

Chemicals that enter fresh and marine waters due to runoff or flooding from extreme precipitation events can impact water and food quality. In coastal areas, breaking surf can aerosolize these toxins and cause respiratory distress/illness. Exposure to these kind of contaminants during developmental periods (fetus and young children) is thought to increase susceptibility to numerous conditions later in life (AD, PD). Exposure to heavy metals is shown to exacerbate neurological conditions and learning disabilities in children.

#### Weather Pattern Changes

Climate change impacts weather systems (precipitation, temperature) that in turn impact the paths and prevalence of certain pests – insect, weeds and fungus. As weather patterns change, diseases that impact the health of crops migrate and can also increase in frequency and severity. This increases the need for and use of chemical pesticides, herbicides and fungicides – all of which can have neurological impacts from ingestion, inhalation or absorption through the skin.

#### Wind and Water Currents

[Algal blooms](#) – which can occur in fresh and marine waters – produce neurotoxins that accumulate in certain fish (shellfish and some freshwater fish). Algal blooms form in still waters and ample sunlight, and they thrive on contaminants (nitrogen and phosphorous) from runoff – all of which have a relationship to climate change events (weather patterns, temperature, precipitation events).

The toxins created by the blooms are thought to contribute to conditions like AD and PD, and they have been known to cause significant immediate illness and even death. Contaminated seafood can cause amnesia, numbness, respiratory paralysis, and symptoms that mimic AD and PD. Research show that exposure to even small amounts can lead to neurodegeneration. The toxins can also impact the developing fetus and may be responsible for illnesses such as epilepsy.

Read more about algal blooms [here](#).

## Vectorborne

Insects, particularly mosquitos, are capable of transmitting diseases that can significant impacts on the neurological system. [West Nile Virus](#), for example, can cause meningitis, myelitis, and encephalitis – all of which inflame the brain and/or the spinal cord and can have devastating neurological consequences. Additionally, diseases like the [Zika virus](#) can cause severe birth defects and a host of neurological issues. As the climate continues to change, mosquitos that carry such diseases are migrating into new regions of the United States, exposing populations to diseases that have heretofore been thought of as relevant only in other climate regions.

## What Can We Do?

In addition to mitigating climate change overall through a focus on addressing sources of emissions, we can and must be cognizant of the chemicals we are using, and how they are impacting our soils and our fresh- and salt-water sources. Natural cleaning products, pesticides, herbicides and fungicides should be the preferred choice when choosing between products. We must also advocate for legislation and regulations that move our country toward safer alternatives.

Additionally, we must be aware of our waste stream and ensure that we are not disposing of toxic products inappropriately. Check with your local, county and/or state government about safe disposal.

With regard to vectorborne diseases, prevention is the best defense. We must work to mitigate climate change, but we must also be prepared to prevent and treat new diseases. Individually, long-sleeve clothing and long pants are an earth-friendly prevention method, but there are many natural pesticides that can ward off disease-carrying vectors.

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## NUTRITION-RELATED AND FOODBORNE ILLNESSES

Sources: [\*The Impacts of Climate Change on Human Health in the United States \(2014\) \(Chapter 7\)\*](#); [\*The National Climate Assessment: Climate Change Impacts in the United States - Chapter 9 \(2014\)\*](#); and [\*A Human Health Perspective on Climate Change \(2010\) \(Chapter 4\)\*](#).

The changing climate has an extraordinary impact on food – affecting nutritional content, food scarcity and contributing to foodborne illness and disease. While this is perhaps most-evident in vulnerable populations in developing countries, these impacts are real and relevant in the U.S. as well.

### **Contributing Factors to Nutrition- and Foodborne-Related Illness:**

- Excessive CO<sub>2</sub>
- Extreme temperatures
- Changing precipitation patterns
- Extreme weather events
- Ocean acidification



### **Impacts on Health:**

#### Extreme Heat and CO<sub>2</sub>

The increase in CO<sub>2</sub>, one of the primary contributing greenhouse gases, has an interesting impact on certain crops – one that might seem beneficial upon first glance. Some crops proliferate in an atmosphere where there is increased CO<sub>2</sub> (e.g., wheat, rice), which would mean there is a greater food supply. However, there is a downside to this extreme growth. Crops that proliferate as a result of CO<sub>2</sub> are shown to have a decreased nutritional value. Protein and concentrations of micro- and macro-nutrients (e.g., iron, zinc, calcium, magnesium, copper, sulfur, phosphorous, nitrogen) are diminished. This decrease in nutrient value can impact overall nutrition, which in turn impacts many aspects of human health.

There is research demonstrating that the ratio of carbohydrates to protein in crops is changing (with an increase in carbohydrates) and there is growing evidence that a diet higher in carbohydrates can negatively affect metabolism, potentially leading to weight gain that can affect a multitude of chronic illnesses [e.g., diabetes, heart disease, etc.].

#### Changing Precipitation Patterns, Extreme Temperatures and Extreme Weather Events

Variance in precipitation can lead to an increased pest and weed population, which amplifies the need for and use of pesticides, herbicides and fungicides. These chemicals are immediately harmful to those working in the agriculture industry (inhalation and skin exposure) as well as harmful to consumers who ingest the carcinogenic chemicals. Drought can also increase a mold that produces aflatoxin that has been shown to cause liver cancer.

Extreme precipitation events (drought, flood) as well as extreme temperature events (excessive heat leading to drought/excessive cold that freezes crops) can decrease food supply, leaving vulnerable populations most at risk for food scarcity, due to increased cost/decreased availability. Additionally, extreme weather events can impede the transportation of food across the country, leading to spoilage and waste.

Extreme precipitation that leads to runoff or flood can leach chemicals and toxins from land-based sources and deliver them into streams, affecting the health and safety of fish in the food supply. Heat that leads to the increasing

acidification of the ocean can negatively impact pathogens (e.g., increasing virulence, creating new pathogens) that contaminate marine life and affect human populations who are highly dependent on marine-based food sources.

Precipitation that causes runoff/flooding and extreme heat can also increase foodborne illness. Bacteria normally present on many food sources are shown to increase in extreme heat, for example, and food storage impacted by extreme heat can lead to spoilage that affects health. Water can also be easily contaminated which results in foodborne illness that causes a variety of gastrointestinal illnesses.

Poor nutrition and food insecurity can have a devastating impact on pregnant women and children. Poor nutrition and malnutrition results in birth outcomes (e.g., low birth weight) that have been connected with developmental disabilities. Marine-based foods can become concentrated with heavy metals (mercury, lead) that greatly affect fetal development. Climate change also increases the prevalence of algal blooms, which are associated with the accumulation of biotoxins in fish. These biotoxins have been shown to negatively affect the developing fetus.

### What Can We Do?

Certainly, mitigation of climate change is in our best interest. As research shows, proliferation of crops in high concentrations of CO<sub>2</sub> may produce more food, but the food's nutritional value is suffering. Foods with less nutrient density can lead to metabolic diseases or conditions that impact health in general. Extreme weather events due to climate change also cause a host of problems with our food sources, so reducing emissions remains the imperative. We must look to the primary sources (electricity, transportation, industry, commercial/residential, and agriculture) to develop solutions that use less and cleaner energy.

**Electricity:** As a global citizen, our governments need to reduce the amount of electric power that relies on fossil fuels. As consumers and caring citizens, we can advocate for legislation and regulation that moves us toward that clean energy goal!

**Transportation:** With regard to transportation, we can move toward fuel-efficient vehicles, hybrid vehicles and electric vehicles (which still are cleaner than vehicles that use fossil fuels), but we can also move to modes of public transportation and carpooling. We can make these changes personally, but we can also become advocates for legislation and regulations that support this transition!

**Industry/Commercial/Residential:** As consumers, we can demand changes within the industry and commercial sectors that mitigate emissions. At home, we can be responsible with our own use of energy sources that contribute to harmful emissions (e.g., reducing electric and natural gas use)!

**Agriculture:** We can also impact the agriculture industry through consumer choices that focus on less meat – thus, [less methane](#) – thereby reducing emissions while making healthier choices!

Also – we must protect and replenish our forests. Forests are one of the major protectors of our environment, soaking up vast amounts of CO<sub>2</sub> that would otherwise contribute to greenhouse gases. Advocate for managed forests...and go plant a tree!

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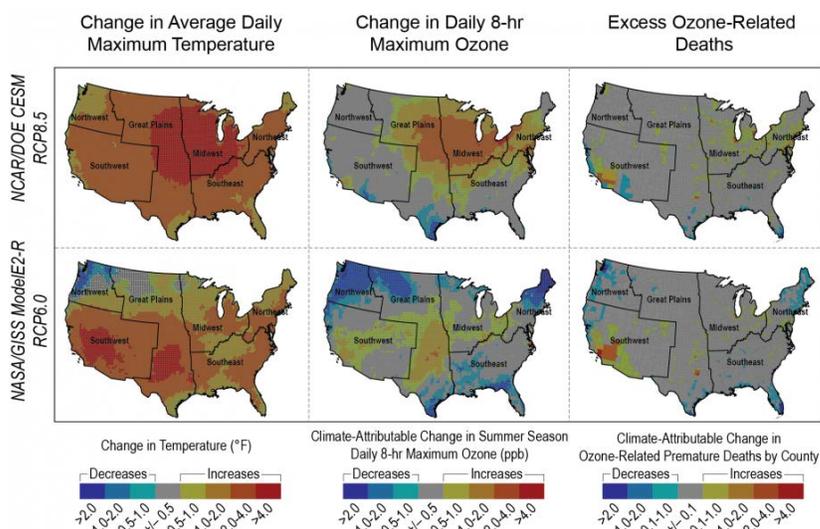
## RESPIRATORY ILLNESS

Sources: [The Impacts of Climate Change on Human Health in the United States \(2014\) \(Chapter 3\)](#); [The National Climate Assessment: Climate Change Impacts in the United States - Chapter 9 \(2014\)](#); and [A Human Health Perspective on Climate Change \(2010\) \(Chapter 1\)](#).

Air quality has a significant impact on respiratory health. Aeroallergens and indoor/outdoor air pollutions cause a variety of respiratory illnesses, including allergies and asthma. Carbon emissions are a significant contributor to poor air quality – responsible for direct negative impacts on human respiratory health and simultaneously for negative climate impacts that will compound respiratory issues. Climate change that causes temperature extremes and changing precipitation patterns *intensifies* poor air quality, essentially maintaining a vicious cycle that impedes good respiratory health.

### Contributing Factors Impacting Air Quality and Respiratory Illness:

- Increased CO<sub>2</sub> levels (accounting for almost 90% of greenhouse gases) caused by transportation, industry and electricity use fueled by fossil fuel combustion.
- Increased ground ozone, resulting from emissions from industrial and electric facilities, motor vehicle exhaust, gasoline vapors, and chemical solvents.
- Increased fine particulates – a mix of small particles and liquid droplets from various sources, including smoke, and industrial and automotive emissions (gas combustion).



The Impacts of Climate Change on Human Health In the United States, 2016

### Impacts on Respiratory Health:

#### Aeroallergens:

CO<sub>2</sub> accounts for almost 90% of all greenhouse gas emissions that contribute to climate change. Many plants proliferate and simultaneously increase in allergenicity in the presence of an increased level of CO<sub>2</sub>. This results in an increase in the frequency and severity of allergies and asthma. Additionally, changing precipitation patterns and temperature extremes resulting from climate change cause unprecedented presentations of allergies and asthma (e.g., illnesses appearing robustly in unexpected ways and regions). These precipitation and temperature changes (cooler, wetter conditions) can also increase molds and fungi that cause respiratory distress.

### Air Pollution:

Ozone is of great benefit in the stratosphere, where it protects earth from harmful ultraviolet solar rays, but it is harmful at ground level and a major contributor to air pollution. Ozone inflames the lining of the respiratory system and can exacerbate allergic reaction, asthma, bronchial illness, rhinitis, chronic obstructive pulmonary disease and emphysema. Ground ozone is worsened by the higher temperatures and changing precipitation patterns that result from climate change.

Fine particulates – a combination of extremely small particles and liquid droplets – easily invade the respiratory system, causing ills including decreased lung function, increased respiratory symptoms, and difficulty breathing. Fine particulates emanate from the same emissions that produce high levels of CO<sub>2</sub>, but their direct impact on changing the climate is unknown. Obviously, however, reducing CO<sub>2</sub> emissions would have a double benefit in also decreasing fine particulate matter.

The American Lung Association's annual report [State of the Air 2016](#) has detailed information on health risks and it provides city ratings.

### Indoor Air Pollution:

Indoor air quality is obviously impacted by outdoor air quality (transferred inside by heating and cooling systems, open windows, etc.) and thus susceptible to the presence of aeroallergens and air pollutants. Additionally, changing precipitation patterns and temperature extremes resulting from climate change can contribute to the growth of indoor air pests, including molds, dust mites and bacteria – all of which can cause or exacerbate respiratory illness.

### What Can We Do?

Many conditions are caused or exacerbated by poor air quality and the increasing presence of aeroallergens from proliferating crops. The air quality and agricultural changes we are witnessing are directly related to climate change. This, the best thing we can do to prevent respiratory ills is to mitigate climate change. This means reducing greenhouse gases by addressing the sources of emissions and demanding a move to using less and using cleaner energy. The main sources and some suggestions are below:

**Electricity:** As a global citizen, our governments need to reduce the amount of electric power that relies on fossil fuels. As consumers and caring citizens – we can advocate for legislation and regulation that moves us toward that clean energy goal!

**Transportation:** With regard to transportation, we can move toward fuel-efficient vehicles, hybrid vehicles and electric vehicles (which still are cleaner than vehicles that use fossil fuels), but we can also move to modes of public transportation and carpooling. We can make these changes personally, but we can also become advocates for legislation and regulations that support this transition!

**Industry/Commercial/Residential:** As consumers, we can demand changes within the industry and commercial sectors that mitigate emissions. At home, we can be responsible with our own use of energy sources that contribute to harmful emissions (e.g., reducing electric and natural gas use)!

**Agriculture:** We can also impact the agriculture industry through consumer choices that focus on less meat – thus, [less methane](#) – thereby reducing emissions while making healthier choices!

Also – we must protect and replenish our forests. Forests are one of the major protectors of our environment, soaking up vast amounts of CO<sub>2</sub> that would otherwise contribute to greenhouse gases. Advocate for managed forests...and go plant a tree!

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## TEMPERATURE EXTREMES AND RELATED ILLNESS

Sources: [\*The Impacts of Climate Change on Human Health in the United States \(2014\) \(Chapters 2 & 4\)\*](#); [\*The National Climate Assessment: Climate Change Impacts in the United States - Chapter 9 \(2014\)\*](#); and [\*A Human Health Perspective on Climate Change \(2010\) \(Chapter 5\)\*](#).

A temperature extreme is defined as a temperature out of the normal range for a number of days. With a global rise in temperature of 1.3 to 1.9 degrees Fahrenheit over the past 120 years, high temperature extremes are now to be expected, and the melting of glaciers and polar ice caps confirm the rise in heat. However, climate change impacts weather patterns and can also lead to extreme cold temperature events. There are certainly health ramifications for both, seen in directly related illnesses as well as with the complication of existing chronic illnesses. Scientists predict that heat-related deaths will rise, but that cold-related deaths will fall. It is not expected, however, that the reduction in cold-related deaths will offset those caused by heat.

### **Contributing Factors and Temperature Extremes:**

- Extreme high temperature events
- Extreme cold temperature events

### **Impacts on Health:**

#### Extreme Warm Temperature Events

Exposure to heat, especially for a protracted period of time, can result in heat-stroke, heat exhaustion, heat cramps and potentially, death. Heat also greatly impacts many pre-existing chronic conditions, like cardiovascular and respiratory illnesses. Additionally, individuals with mental health disorders requiring psychotropic drugs are at greater risk due to the fact that the drugs impair the body's ability to regulate temperature. Extreme heat has also been proven to negatively affect renal illness and diabetes, and it can lead to an increase in pre-term births.



#### Extreme Cold Temperature Events

Extreme cold temperature events have actually been decreasing over the past 120 years, but there are certainly cold weather events that are related to changing weather patterns as a result of warming that affects the jet stream and climate forces such as El Nino. Extreme cold temperatures, especially for protracted periods of time, can result in hypothermia and frostbite, and can impact pre-existing chronic cardiovascular and respiratory conditions.

#### What Can We Do?

The most important thing we can and must do to prevent temperature-related illness is to mitigate climate change by reducing our energy use and looking for cleaner sources. This means we must look at the primary sources of emissions and take steps toward reduction accordingly. Here are the five major sources and some suggestions:

**Electricity:** As a global citizen, our governments need to reduce the amount of electric power that relies on fossil fuels. As consumers and caring citizens – we can advocate for legislation and regulation that moves us toward that clean energy goal!

**Transportation:** With regard to transportation, we can move toward fuel-efficient vehicles, hybrid vehicles and electric vehicles (which still are cleaner than vehicles that use fossil fuels), but we can also move to modes of public

transportation and carpooling. We can make these changes personally, but we can also become advocates for legislation and regulations that support this transition!

**Industry/Commercial/Residential:** As consumers, we can demand changes within the industry and commercial sectors that mitigate emissions. At home, we can be responsible with our own use of energy sources that contribute to harmful emissions (e.g., reducing electric and natural gas use)!

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Additionally, we must be prepared to deal with the imminent consequences of extreme temperatures. Climate change is already alive and present in the U.S., creating numerous poor health outcomes. We must be prepared to deal with the impacts of extreme temperature-related illness (e.g., health care, shelter, emergency services, etc.).

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## VECTORBORNE AND ZONOTIC DISEASES

Sources: [The Impacts of Climate Change on Human Health in the United States \(2014\) \(Chapter 5\)](#); [The National Climate Assessment: Climate Change Impacts in the United States - Chapter 9 \(2014\)](#); and [A Human Health Perspective on Climate Change \(2010\) \(Chapters 8-9\)](#).

Vectorborne disease is transmitted by blood-feeding arthropods (ticks, insects, mites) who transmit pathogens among various hosts. Zoonotic disease is that which is transmitted from animals to humans through direct contact or as a result of a vector transmission. Many vectorborne diseases still prevalent in developing countries are not frequently seen in the U.S. (e.g., malaria, dengue, yellow fever). This is largely due to mitigation efforts, including vector control, vaccination, public health efforts to prevent spreading through detection and treatment, and environmental improvements. Nonetheless, some vectorborne and zoonotic diseases are still present and active in the U.S. and some are increasing in frequency and severity. Climate change impacting temperature events and precipitation events is already changing vector and zoonotic migration patterns, and this trend is expected to continue, potentially exposing a wider population than has been previously affected.

### **Contributing Factors and Vectorborne and Zoonotic Diseases:**

- Precipitation events
- Temperature changes
- Oceanic changes (rising sea level, varying salinity, acidification and extreme weather)

### **Impacts on Health:**

#### Precipitation Events and Temperature Changes

In the U.S., Lyme disease has been increasing and spreading regionally, as are other tick-borne diseases involving bacteria. Zoonotic illnesses that are active in the U.S. include rabies, plague, and hantavirus pulmonary syndrome, among others. Climate change impacts these diseases, and increases risk for emerging disease threats as precipitation and temperature patterns change resulting in altered migration patterns of insects and animals. Recent examples of emerging threats for the U.S. include the West Nile Virus and the Zika Virus – both of which can now find climate conditions in the U.S. that are conducive to their presence and spread. West Nile Virus, in fact, has spread completely across the U.S. after containment efforts failed and the virus thoroughly established itself in the avian population. Hantavirus Pulmonary Syndrome is an example of a zoonotic disease that is impacted by rainfall that affects the food sources for deer mice. Areas experiencing extreme precipitation may see a rise in this virus.

#### Oceanic Changes

Changes that include rising sea level, varying salinity, acidification and extreme weather events will affect the prevalence and severity of toxic organisms in the ocean. This can contaminate marine food sources and thus impact human health. Additionally, there will be a loss of biodiversity which can influence vectorborne diseases through the reduction in vector predators that typically keep vector populations in check.

#### What Can We Do?

In addition to mitigating climate change that will alter the patterns of vector and zoonotic diseases, preparedness is essential. Steps to prevent further spread of these diseases is essential and public health approaches to prevention must be employed. We can advocate for safe policies to mitigate disease while protecting the natural environment.



Additionally, we must continue to take steps to mitigate climate change by addressing the sources of emissions. Here are the sources of emissions and recommendations for reducing energy use within each:

**Electricity:** As a global citizen, our governments need to reduce the amount of electric power that relies on fossil fuels. As consumers and caring citizens – we can advocate for legislation and regulation that moves us toward that clean energy goal!

**Transportation:** With regard to transportation, we can move toward fuel-efficient vehicles, hybrid vehicles and electric vehicles (which still are cleaner than vehicles that use fossil fuels), but we can also move to modes of public transportation and carpooling. We can make these changes personally, but we can also become advocates for legislation and regulations that support this transition!

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## WATERBORNE ILLNESS AND FRESHWATER SCARCITY

Sources: [The Impacts of Climate Change on Human Health in the United States \(2014\) \(Chapters 4 & 6\)](#); [The National Climate Assessment: Climate Change Impacts in the United States - Chapter 9 \(2014\)](#); [A Human Health Perspective on Climate Change \(2010\) \(Chapter 10\)](#) and [Research Article: Four Billion People Facing Severe Water Scarcity](#).

In developing countries, waterborne pathogens greatly impact human health, causing many forms of gastrointestinal illness. The prevalence of this contamination of water in the U.S. is far less, but risks do exist. The U.S. has seen a shift from gastrointestinal illnesses to respiratory illness like Legionnaires Disease – which results from bacteria that accumulates in cooling ponds that transmit the virus through air conditioning systems.

Marine and freshwater contamination are responsible for many illnesses, and there is reason to fear an increase. As climate change impacts precipitation patterns, more toxins will enter water sources as a result of runoff, flooding or a rise in sea level. Contamination in freshwater complicates the growing problem of freshwater scarcity – an issue that is already a significant issue as recent research [shows the demand for freshwater has more than doubled the rate of population](#) increase globally.

### **Contributing Factors for Waterborne Disease and Water Scarcity:**

- Precipitation events
- Temperature changes

### **Impacts on Health:**

#### Precipitation Events and Temperature Changes

Waterborne disease that impacts freshwater supplies is much more of a global problem than it is for the U.S., and it is believed that extreme precipitation/lack of precipitation is a leading factor. Extreme precipitation events can cause flooding and runoff that carries bacteria into water sources, where rising temperatures then allow the bacteria to flourish. This can lead to a wide variety of gastrointestinal illnesses and contributes greatly to mortality in developing countries.

In the U.S., waterborne pathogens are more of a threat to respiratory illnesses, as bacteria are aerosolized through air conditioning systems or through breaking surf waters. Runoff and flooding, however, can also carry pathogens into water sources, contaminating food supplies and potentially causing skin and wound illnesses such as those caused by MRSA. In fact, water recreation – whether in fresh or salt water – can cause skin infections from various pathogens as well as diarrheal illness. Scientists have also associated the rise in ocean surface temperature with increasing cholera and wound infections.

Freshwater treatment plants can be impacted by drought, which has the potential to stress the system with higher concentrations of pathogens. Extreme weather events and flooding also have the potential to compromise sewage treatment facilities, which can contaminate freshwater sources.



## What Can We Do?

Our water quality is directly impacted by extreme weather events that cause runoff and/or flooding or drought. Additionally, extreme temperatures play a part in waterborne illness, and all water-impacting events are best addressed through the mitigation of climate change. In mitigating climate change, we must reduce greenhouse gas emissions by addressing the primary sources and looking for ways to reduce use and substitute clean energy. Below is a list of the sources with some recommendations for reduction:

**Electricity:** As a global citizen, our governments need to reduce the amount of electric power that relies on fossil fuels. As consumers and caring citizens – we can advocate for legislation and regulation that moves us toward that clean energy goal!

**Transportation:** With regard to transportation, we can move toward fuel-efficient vehicles, hybrid vehicles and electric vehicles (which still are cleaner than vehicles that use fossil fuels), but we can also move to modes of public transportation and carpooling. We can make these changes personally, but we can also become advocates for legislation and regulations that support this transition!

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[Practice Greenhealth Resources: Less Water](#)

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## **Resources for Learning, Raising Awareness and Taking Action**

### **Health Care Facility Resources**

[U.S. Climate Resilience Toolkit: Building Health Care Sector Resilience](#)

[Practice Greenhealth – Climate and Health Resources](#)

### **The Catholic Call to Action: Pope Francis and Laudato Si**

Laudato Si’ – Pope Francis’ Encyclical was released in 2015. Read the document [here](#).

### **The World’s Call to Action – The Paris Agreement – COP21**

The United Nations Framework Convention on Climate Change (UNFCCC) convened the 21<sup>st</sup> session of Conference of Parties (COP21) to discuss solutions for the mitigation of climate change.

[Learn](#) about the historic international agreement to limit global warming.

### **Resources for Learning**

[Climate Change Impacts in the United States – Chapter 9 \(2014\)](#)

[National Climate Assessment](#)

[The Impacts of Climate Change on Human Health in the United States: A Scientific Assessment](#)

[A Human Health Perspective on Climate Change](#)

[EPA – Climate Change](#)

[NASA Global Climate Change: Vital Signs of the Planet](#)

[NY Times – Short Answers to Hard Questions about Climate Change](#)

[World Health Organization \(WHO\) – Climate Change and Human Health](#)

[WHO – Climate Change and Human Health: Risks and Responses](#)

[CDC – Climate Effects on Health](#)

[The Obama White House: Climate Change](#)

[Practice Greenhealth Webinar Series on Climate and Health](#)

[Practice Greenhealth: Climate and Health Resources](#)

## **Definitions**

[EPA: Glossary of Climate Change Terms](#)

[NASA: What are Climate and Climate Change](#)

## **Resources for Individual Action**

[25 Ways to Reduce Your Carbon Footprint](#)

[Reduce What you Can, Offset What You Can't™](#)

[Carbon Footprint Ltd.](#)

[Georgetown University: Simple Tips to Reduce Your Carbon Footprint](#)

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## **Sources for: *Climate Change and Human Health in the United States***

[National Climate Change Assessment: Climate Change Impacts in the United States – Chapter 9 \(2014\)](#)

[National Climate Assessment: Full Report](#)

[The Impacts of Climate Change on Human Health in the United States: A Scientific Assessment](#)

[A Human Health Perspective on Climate Change](#)

[EPA – Climate Change](#)

[NASA Global Climate Change: Vital Signs of the Planet](#)

[World Health Organization \(WHO\) – Climate Change and Human Health](#)

[WHO – Climate Change and Human Health: Risks and Responses](#)

[CDC – Climate Effects on Health](#)

[The Obama White House: Climate Change](#)

[Fossil Fumes: A Public Health Analysis of Toxic Air Pollution from the Oil and Gas Industry](#)

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