

Climate Change

The state of Washington is working hard to address the impacts of climate change on its natural resources, communities and economies. The scientific community, participating in the Intergovernmental Panel on Climate Change (IPCC), has reached a strong consensus regarding the science of global climate change: The Earth's temperature is rising, and that rise is caused by carbon dioxide emissions and other greenhouse gases (GHG) from human activities. The answers to the frequently asked questions below can help state officials and citizens understand why it is important to act now.

Q: What is the difference between "global warming" and "climate change"?

A: "Global warming" often refers to the warming that can occur as a result of increased emissions of GHG in the atmosphere. Global warming can occur from a variety of natural and human causes.

"Climate change" refers to any significant change in measures of climate (such as temperature, precipitation, or wind) lasting for an extended period (decades or longer).

"Climate change" is often used interchangeably with "global warming." But according to the National Academy of Sciences, "the phrase 'climate change' is growing in preferred use to 'global warming' because it helps convey there are other changes in addition to rising temperatures."

Q: Is climate change really happening?

A: Yes. Climate change is already occurring. In February 2007, the IPCC reported to the United Nations that, *"Warming of the climate system is unequivocal and that it is more than 90% likely that the accelerated warming of the past 50-60 years is due to human contributions."*

According to the National Academy of Sciences, many indications of climate change have been occurring with more and more frequency.

- Mountain glaciers have retreated worldwide in the last few decades.

WHY IT MATTERS

Our state is vulnerable to a warming climate, especially our snow-fed water supplies and nearly 40 communities along our 2,300 miles of shoreline that are threatened by rising sea levels. In the last 10 years we've seen an increase in floods, droughts and wildfires.

The warming is largely the result of emissions of carbon dioxide, methane, nitrous oxide and other GHG from human activities.

Climate change and energy independence are a related set of local and global challenges. These challenges present opportunities to transition away from our dependence on fossil fuels to a clean and green economy.

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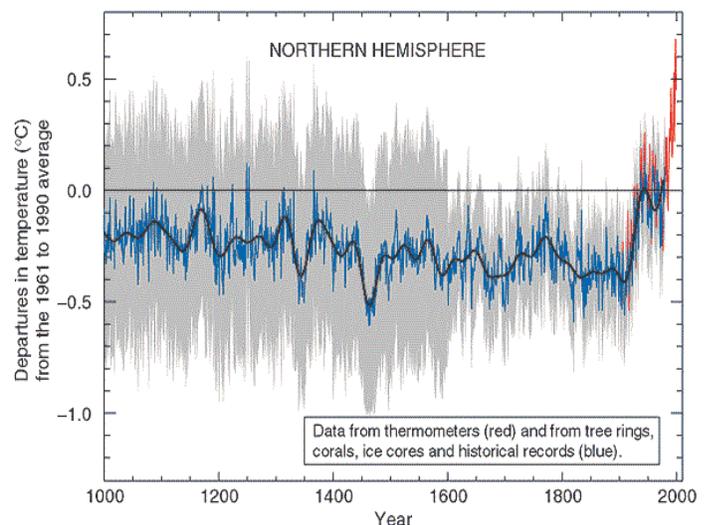
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- Ice caps in the Arctic and Antarctic are thinning and melting rapidly.
- Sea level has risen about 4 to 10 inches in the last century.
- Intense rainstorms and snowstorms have become about 10 percent more frequent in the U.S. and southern Canada during the 20th and 21st centuries.
- Major storms since the 1970s in both the Atlantic and Pacific oceans have increased in duration and intensity by about 50 percent, according to MIT researchers.
- The number of intense hurricanes has been increasing in recent years.

Q: Is climate change a natural occurrence?

A: In the past, the Earth has experienced periods of warmer and cooler climates, such as ice ages. But scientists have determined the average global temperatures have risen by more than 1 degree Fahrenheit over the last century. They analyzed the changes to natural factors such as the intensity of heat from the sun, the speed of the Earth orbiting around the sun and changes in natural processes within the climate system such as changes in ocean circulation, volcanic activities, and human activities like the burning of fossil fuels that change the composition of the atmosphere. They also analyzed changes in land use such as deforestation, reforestation, and urbanization.



In 1998, Michael E. Mann and his associates, Raymond S. Bradley and Malcolm K. Hughes, used tree rings, glaciers, corals, and other geologic records to reconstruct the Earth's surface temperature. Their research showed the temperature trend over the past 2,000 years is nearly flat and then takes a sharp upward turn in the 20th century. This temperature trend is known as the "hockey stick" because of its shape.

In 2006, the National Academies of Science (NAS) under the direction of Congress assessed the research done by Mann et al. The NAS supported the basic conclusion of Mann et al. and agreed the warming in the late 20th century, in the Northern Hemisphere, was unprecedented and far exceeded any natural variation that occurred during the last 2,000 years.

In 2007, the IPCC concluded there is a less than 10 percent chance natural variation is causing the current rise in temperature. The warming is largely the result of emissions of carbon dioxide, methane, nitrous oxide and other GHG from human activities.

Q: What is the largest source of greenhouse gases?

A: The IPCC reports that most emissions during the past 20 years are due to fossil fuel burning.

The rest (10 to 30 percent) is mostly due to land-use change, especially deforestation. The United States (U.S.) is the world's largest source of GHG. The U.S. has about 4 percent of the world's population, but contributes about 25 percent of the global GHG emissions.

The largest sources of GHG emissions in the U.S. are electricity generation, transportation and buildings. According to an analysis of the U.S. government forecasts, the nation's GHG emissions are projected to rise at an average annual rate of 1.2 percent or 35 percent increase in projected annual emissions by 2030, from 2005. In Washington state, nearly 50 percent of the GHG contributions are transportation related.

Q: Is heat from the sun causing global warming?

A: In 2004, a group of scientists published evidence in the October Volume of *Nature* that solar activity of the 20th century had been unusually high. However, the group concluded even if the sun caused all the global warming before 1970, at most 30 percent of the warming since 1970 is due to solar activity. They also concluded, *"We find no evidence for any earlier periods in the last two millennia with warmer conditions than the post-1990 period – in agreement with previous studies."*

In 2007, IPCC members also concluded they are 90 percent certain that recent GHG levels have more influence than solar activity on climate change.

Q: How does water vapor contribute to global warming?

A: The amount of water vapor in the atmosphere is a function of temperature -- the warmer the temperature, the more water vapor is stored in the atmosphere. As the climate warms from the burning of fossil fuels, the concentrations of water vapor increase. This moisture absorbs more heat and further raises the temperature. Water vapor is an important part of the natural atmosphere and the natural greenhouse effect. It accounts for 60 to 70 percent of the greenhouse effect. Water vapor is quickly removed as rain and only stays in the atmosphere for about 10 days. Carbon dioxide remains for 50 to 100 years. Human activities do not directly increase the concentration of water vapor in the atmosphere. However, the impacts of carbon emissions are amplified by water vapor.

Q: Since carbon dioxide is a "trace gas," doesn't it contribute a tiny fraction to the rise in the Earth's temperature?

A: Carbon dioxide is a trace gas, but it has a powerful effect on the Earth's heat balance. Humans have altered the natural production and absorption of carbon dioxide by burning coal, oil, natural gas and wood since the industrial revolution began in the mid-1700s. Carbon dioxide was the first GHG to increase in atmospheric concentration. Gases found trapped in cores of polar ice show that the levels of carbon dioxide in the atmosphere are now 35 percent higher than before the start of the industrial revolution.

The IPCC noted, *"The rate of increase over the past century is unprecedented, at least during the past 20,000 years."* The increase in global temperature is consistent with the level of increase in

carbon dioxide and other GHG in the atmosphere. Carbon dioxide remains in the atmosphere for 50 to 100 years. The IPCC report states *“most of the emissions during the past 20 years are due to fossil fuel burning, the rest (10 to 30 percent) is predominantly due to agriculture and land-use change, especially deforestation.”*

Q: Are temperature records reliable?

A: Western Europe has been recording temperature measurements as far back as the 17th and 18th centuries. By the early 20th century, almost all regions were recording temperature measurements except for the Polar Regions, where recording began in the 1940s and 1950s.

Q: Are temperature readings from thermometers located in urban heat islands reliable?

A: The IPCC report states, *“Urban heat island effects are real but local, and have negligible influence”*. When the IPCC and National Oceanic and Atmospheric Administration (NOAA) scientists analyzed temperature changes across the world, they accounted for temperature increases due to urbanization. They took thermometer measurements from the stations over the world’s land areas and combined them with measurements of sea-surface temperatures to produce a monthly estimate of global average temperatures. They found that average temperature trends recorded over the land were similar to those observed over the oceans.

Q: How can scientists predict the impacts of climate change when climate models are flawed?

A: The IPCC report states, *“Advances in climate change modeling now enable best estimates and likely assessed uncertainty ranges given the projected warming for different emission scenarios.”* To predict how the climate would respond to future global GHG emissions, scientists developed several scenarios and used models that include natural and human drivers such as solar radiation, volcanic activities, wind patterns, and projected trends in demographic, economic and technological developments. The results of these analyzed scenarios were consistent with actual climate changes events happening now (increases in rising sea levels, frequency of storms and extreme temperature events). Scientists continue to work on improving our understanding of the climate and our ability to predict it.

Q: What is the explanation for the cooling of the Earth in previous years?

A: There was a slight cooling of the Earth’s temperature between the 1940s and 1970s due to another consequence of human activity – a surge in aerosols and other airborne sun-blocking particles and human air pollution. These types of pollution were successfully controlled by actions taken in the 1980s. Since then the temperatures have gone up and many of the warmest years have occurred in the last 15 years. Analyses by IPCC, NOAA and the World Meteorological Organization show the decade of 1998 through 2007 is the warmest on record. The IPCC report states, *“It is virtually certain there has been an increasing trend in global surface temperature over the 20th century, although short-term and regional deviations from this trend occur”*.

Q: Is increased carbon dioxide good for plants, crops, animals and people living in cold climates?

A: In the short term, high northern parts of the globe could experience less extreme cold weather and a longer growing season for crops. However, in the long term the IPCC model indicates, *“The larger the changes and rate of change in climate, the more the adverse effects predominate.”* These adverse effects would be more severe in tropical and subtropical climates, affecting the world’s poorest and most vulnerable people.

On July 18, 2008, the U.S. Environmental Protection Agency (EPA) issued a new report on the threat of climate change on humans. According to the report *“Climate change will pose ‘substantial’ threats to human health in the coming decades. ... It is very likely that more people will die during extreme hot periods in future years – and that the elderly, poor and those in inner cities will be most at risk. ... Other possible dangers include more powerful hurricanes, shrinking supplies of fresh water in the West, and the increased spread of diseases contracted from food and water.”*

Q: What are the climate change impacts in Washington state?

A: Our state is vulnerable to a warming climate, especially our snow-fed water supplies and nearly 40 communities along our 2,300 miles of shoreline that are threatened by rising sea levels. In the last 10 years over 10 major disaster declarations were made involving:

- Extreme windstorms and heavy rain or snow.
- Droughts with severe impacts on fish, cities, farms and forests, including increased forest fires.
- Devastating floods like the Lewis County flood in December 2007.
- Intense wildfires burning thousands of acres of forests.
- Coastal erosion and landslides from more frequent and intense storms combined with higher sea levels.

In 2006, in a study for the Washington State Departments of Ecology and Community, Trade and Economic Development, a team of scientists and economists led by the University of Oregon reported, *“When electricity, water rates and availability, sea level rise and potential health effects are taken into account, virtually every sector of Washington’s \$268.5 billion economy may be affected by climate change.”*

Q: Is global warming a crisis?

A: Yes. If the warming of the Earth were only to increase to the mid-range of what scientists predict, it will still have devastating impacts on many sectors of the U.S. and world economies. A dozen of the nation’s most respected retired admirals and generals issued a report in 2007, *“National Security and the Threat of Climate Change.”* They concluded the consequences of climate change are grave and pose serious threat to America’s national security. They also reported that climate change, national security and energy independence are a related set of global challenges. The group recommended that the U.S. should commit to global partnerships

that help less developed nations build the capacity and resiliency to better manage climate change. On June 25, 2008, 16 U.S. intelligence agencies issued an assessment of the national security implications of changing climate, "National Intelligence Assessment on the National Security Implications of Global Climate Change to 2030." The report confirms the conclusions made by the military group.

Q: Can we afford to address the impacts of climate change?

A: The good news is scientists say we can lower carbon dioxide in the atmosphere if we quickly implement policies and strategies that reduce GHG emissions. Doing so will avoid the worst impacts of climate change even though current analyses by scientists suggests that even if we stopped increasing GHG emissions today, more warming will occur. There is a high upfront investment in many of the strategies used to reduce GHG emissions. However, many of these strategies provide cost savings from reduced energy and resource consumption.

The 2007 report by Washington's Climate Advisory Team found that implementing measures to reduce GHG emissions statewide could yield a collective net benefit to the state of more than \$900 million by 2020. In October 2006 the UK released a report on economics of climate change (Stern report). The author concluded that a shift to a low-carbon economy would bring huge opportunities.

EPA, in a recent report (June 12, 2008), quantified the value of addressing global warming pollution on communities that are extraordinarily vulnerable. EPA concluded that recent economic studies underestimated the societal costs of CO₂ emissions and the significant public benefit from air quality improvements.

Q: Will the costs of addressing climate change hurt consumers, American industry, and workers?

A: No. Investing in efforts to reduce GHG emissions will not stop economic growth or cause widespread poverty. In April 2008, the Pew Center concluded, "*the economic burden of mitigation policy, while measurable, is small.*" By 2020, the annual losses in real gross domestic products from implementing GHG market-based policy range from 0.5 percent to 0.7 percent and reach 1 percent to 1.2 percent by 2040. In dollar terms, this translates into losses of \$150 to \$300 per household in 2020, and about \$700 in 2040. The \$700 is about equal to the average loss for a household in 2006 because gasoline, heating oil and natural gas prices rose from 2005 levels.

The overall impact of climate change policy on employment, according to government projections, will be very small – a cumulative reduction of less than 0.05 percent over the next decade. This estimate does not take into account jobs created by new sectors that will arise in the low-carbon economy.

Q: Does China produce more greenhouse gases in a year than the United States?

A: By most estimates, China is now the world's single-largest emitter of carbon dioxide.

With its large population, rapidly expanding economy, and heavy reliance on coal, China saw a 50 percent growth in its GHG emissions in one decade (1994-2004). Together the U.S. and China emit approximately 35 percent of total global GHGs. Although China is a leading GHG emitter, its GHG emissions per person fall far below those of the U.S. and other industrialized nations. In 2005, Chinese emissions per capita were about 6 tons, compared to the U.S. 25 tons, and the world average of 7 tons. China's GHG emissions are driven by manufacturing products for exports. The share of China's GHG emissions attributed to its exports could be as much as one-third in 2005.

Due to health effects of pollution, pressures on its energy system, climate change policies, the Chinese national government has adopted a variety of policies and programs to reduce GHG emissions. A report released by the Natural Resources Defense Council found that China is aggressively cutting its carbon dioxide emissions. They have reduced their carbon dioxide emissions 17 percent since 1997 while their economy grew by 36 percent. China has enacted very stringent mandates focusing on energy efficiency and green building, clean renewable power and sustainable transportation.

Q: Can the U.S. do anything to make a difference?

A: Yes. The U.S. can make a difference by being the leaders in adopting effective climate change policies that change the behavior of consumers and businesses. The Chief Economist of the International Energy Agency (IEA) noted, *"A third of China's emissions come from manufactured goods exported to developed countries, including the U.S which is the top exporting destination."* Scientists and economists from IEA, World Energy Resources and other agencies and organizations warned that developed countries like the U.S., European Nations, and Japan must not only address their own historic and current emissions, but also the emissions that come from developing countries where they have outsourced the production of their consumer goods.

Q: Are cap-and-trade, carbon tax and other market systems just schemes by the government and big businesses to take more money away from the common person?

A: No. Well-designed market systems can provide the following benefits:

- Shield low- and moderate-income households from high prices.
- Generate revenue to help businesses and communities affected by climate change policies and climate change related disasters.
- Promote basic research on energy efficiency and alternative energy and fuel sources.

Q: Can Washington state meet its emission reduction goals?

A: The emission reduction goals set by Governor Gregoire in 2007 and subsequently adopted by the Legislature are ambitious. Washington state is leading the way on reducing GHG

emissions, growing the clean energy economy and reducing the state's reliance on imported fuel. It will not be cheap to slow down and reverse the impacts of climate change. However, taking action that is significant and meaningful in preventing climate change's most destructive impacts presents important opportunities. Using clean and green technologies would help the state transition from its dependence on fossil fuels and would save money spent by consumers on fuel and energy consumption. The billions of dollars spent on finding alternative energy sources is money well spent compared to the \$9 billion Washington state spent in 2006 (when the gas price was less than \$2) to import petroleum.

Also, as we invest more in clean and green energy, more green jobs will be created to balance any decline an existing job market may see due to the changes in the ways we produce and use energy.

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More information

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- Washington's Green Economy
www.ecy.wa.gov/climatechange/GreenEconomy.htm