**Global Warming and Climate Change *(NY Times)***

Global warming has become perhaps the most complicated issue facing world leaders. Warnings from the scientific community are becoming louder, as an increasing body of science points to rising dangers from the ongoing buildup of human-related greenhouse gases — produced mainly by the burning of fossil fuels and forests.

[Global emissions of carbon dioxide jumped by the largest amount on record in 2010](http://www.nytimes.com/2011/12/05/science/earth/record-jump-in-emissions-in-2010-study-finds.html?_r=1&scp=6&sq=global+warming&st=nyt), upending the notion that the brief decline during the [recession](http://topics.nytimes.com/top/reference/timestopics/subjects/r/recession_and_depression/index.html?inline=nyt-classifier) might persist through the recovery. Emissions rose 5.9 percent in 2010, according to an analysis by the Global Carbon Project, an international collaboration of scientists. The increase solidified a trend of ever-rising emissions that scientists fear will make it difficult, if not impossible, to forestall severe [climate change](http://topics.nytimes.com/top/news/science/topics/globalwarming/index.html?inline=nyt-classifier) in coming decades.

However, the technological, economic and political issues that have to be resolved before a concerted worldwide effort to reduce emissions can begin have gotten no simpler, particularly in the face of a global economic slowdown.

For almost two decades, the United Nations has sponsored global talks, known as the [United Nations Framework Convention on Climate Change](http://unfccc.int/2860.php), an international treaty signed by 194 countries in 1992 to cooperatively discuss global climate change and its impact.

The conferences operate on the principle of consensus, meaning that any of the participating nations can hold up an agreement. In recent years, the meetings have often ended in disillusionment. The conflicts and controversies discussed are monotonously familiar: the differing obligations of industrialized and developing nations, the question of who will pay to help poor nations adapt, the urgency of protecting tropical forests and the need to rapidly develop and deploy clean energy technology.

The negotiating process itself has been under fire from some quarters, including the poorest nations who believe their needs are being neglected in the fight among the major economic powers. Criticism has also come from a relatively small but vocal band of climate-change skeptics, many of them sitting members of the United States Congress, who doubt the existence of human influence on the climate and ridicule international efforts to deal with it.

**2011 Global Talks in Durban**

The 2011 conference, held in Durban, South Africa, ran from Nov. 28 to Dec. 11. [Delegates from about 200 nations gathered together](http://www.nytimes.com/2011/11/28/science/earth/nations-meet-to-address-problems-of-climate-change.html?_r=1&scp=3&sq=durban&st=cse) to try to advance the world’s response to intensifying climate disasters.

One of the issues still left unresolved was the future of the [Kyoto Protocol](http://unfccc.int/kyoto_protocol/items/2830.php), the 1997 agreement that requires major industrialized nations to meet targets on emissions reduction but imposes no mandates on developing countries, including emerging economic powers and sources of global greenhouse gas emissions like China, India, Brazil and South Africa.

The United States is not a party to the protocol, having refused to even consider ratifying it because of those asymmetrical obligations. Some major countries, including Canada, Japan and Russia, have said they will not agree to an extension of the protocol next year unless the unbalanced requirements of developing and developed countries are changed. That is similar to the United States’ position, which is that any successor treaty must apply equally to all major economies.

Expectations for the meeting were low, and it [ended with modest accomplishments](http://www.nytimes.com/2011/12/12/science/earth/countries-at-un-conference-agree-to-draft-new-emissions-treaty.html?scp=1&sq=Climate%20Talks%20Yield%20Limited%20Agreement%20to%20Work%20Toward%20Replacing%20Kyoto%20Protocol%20&st=cse): the promise to work toward a new global treaty in coming years and the establishment of a new climate fund.

The deal on a future treaty renewed the Kyoto Protocol for several more years. But it also began a process for replacing the protocol with something that treats all countries — including the economic powerhouses China, India and Brazil — equally. The future treaty deal was the most highly contested element of a package of agreements that emerged from the extended talks among the nations here.

The expiration date of the protocol — 2017 or 2020 — and the terms of any agreement that replaces it will be negotiated at future sessions.

The delegates also agreed on the creation of a fund to help poor countries adapt to [climate change](http://topics.nytimes.com/top/news/science/topics/globalwarming/index.html?inline=nyt-classifier) — though the precise sources of the money have yet to be determined — and to measures involving the preservation of tropical forests and the development of clean-energy technology. The reserve, called the Green Climate Fund, would help mobilize a promised $100 billion a year in public and private financing by 2020 to assist developing countries in adapting to climate change and converting to clean energy sources.

**2010 Global Talks in Cancún**

Last year’s U.N. conference on climate change in Cancún, Mexico, produced only modest achievements but ended with the toughest issues unresolved. The package that was approved, known as the Cancún Agreements, set up a new fund to help poor countries adapt to climate changes, created new mechanisms for transfer of clean energy technology, provided compensation for the preservation of tropical forests and strengthened the emissions reductions pledges that came out of the U.N. climate change meeting in Copenhagen in 2009.

The conference approved the agreement over the objections of Bolivia, which condemned the pact as too weak. But those protests did not block its acceptance. Delegates from island states and the least-developed countries warmly welcomed the pact because it would start the flow of billions of dollars to assist them in adopting cleaner energy systems and adapting to inevitable changes in the climate, like sea rise and drought.

But left unresolved was where the promised aid from wealthy nations — $100 billion in annual climate-related funds — would come from.

**The U.S. and Climate Change**

The United States has been criticized at the U.N. gatherings for years, in part because of its rejection of the Kyoto framework and in part because it has not adopted a comprehensive domestic program for reducing its own greenhouse gas emissions. President Obama has pledged to reduce American emissions 17 percent below 2005 levels by 2020, but his preferred approach, a nationwide [cap-and-trade](http://topics.nytimes.com/topics/reference/timestopics/subjects/g/greenhouse_gas_emissions/cap_and_trade/index.html?inline=nyt-classifier) system for carbon pollution, was passed by the House in 2009 but died in the Senate the next year. United States emissions are down about 6 percent over the past five years, largely because of the drop in industrial and electricity production caused by the [recession](http://topics.nytimes.com/top/reference/timestopics/subjects/r/recession_and_depression/index.html?inline=nyt-classifier).

In January 2011, the [Environmental Protection Agency](http://topics.nytimes.com/top/reference/timestopics/organizations/e/environmental_protection_agency/index.html?inline=nyt-org) began [imposing regulations related to greenhouse gas emissions](http://www.nytimes.com/2010/12/31/science/earth/31epa.html?sq=epa&st=cse&scp=2&pagewanted=print). The immediate effect on utilities, refiners and major manufacturers was minor, with the new rules applying only to those planning to build large new facilities or make major modifications to existing plants. Over the next decade, however, the agency plans to regulate virtually all sources of greenhouse gases, imposing efficiency and emissions requirements on nearly every industry and every region.

**The E.U. Gets Tough With Airline Emissions**

In December 2011, the [European Union](http://topics.nytimes.com/top/reference/timestopics/organizations/e/european_union/index.html?inline=nyt-org)’s highest court [endorsed the bloc’s plan to begin charging the world’s biggest airlines for their greenhouse gas emissions from Jan. 1, 2012](http://www.nytimes.com/2011/12/22/business/global/court-upholds-europes-plan-to-charge-airlines-for-carbon-emissions.html?ref=global-home), setting the stage for a potentially costly trade war with the United States, China and other countries.

A group of United States airlines had argued that forcing them to participate in the potentially costly emissions-trading system infringed on national sovereignty and conflicted with existing international aviation treaties.

But in [a final ruling](http://curia.europa.eu/jcms/upload/docs/application/pdf/2011-12/cp110139en.pdf) , the [European Court of Justice](http://topics.nytimes.com/top/reference/timestopics/organizations/e/european_court_of_justice/index.html?inline=nyt-org) in Luxembourg affirmed an opinion issued in October by its advocate general, who had rejected their claim.

The court’s decision came amid increasing pressure from some of the biggest trading partners of the 27-member bloc to suspend or amend application of the legislation to expressly exclude non-E.U. countries — at least initially. Failing that, several governments have vowed to take their own legal action or retaliate with countervailing trade measures.

Although airlines initially will receive most of the permits they will need for free, the European Union estimates that ticket prices could rise by as much as €12, or nearly $16, on some long-haul flights to cover the cost of additional permits required.

Airlines for America, an industry lobby group and one of the plaintiffs in the case, said that its members would be required to pay more than $3.1 billion to the E.U. between 2012 and 2020. It said its members would comply with the system “under protest,” but would also review options for pursuing the case in Britain’s High Court, which had referred the original complaint to the European court in 2009.

The European initiative involves folding aviation into the Union’s six-year-old Emissions Trading System, in which polluters can buy and sell a limited quantity of permits, each representing a ton of carbon dioxide. The legislation mandates that airlines account for their emissions for the entirety of any flight that takes off from — or lands at — any airport in the 27-member bloc.

The goal, European officials have said, is to speed up the adoption of greener technologies at a time when air traffic, which represents about 3 percent of global carbon dioxide emissions, is growing much faster than gains in efficiency.

**Steps Toward a Response**

The debate over climate questions pales next to the fight over what to do, or not do, in a world where fossil fuels still underpin both rich and emerging economies.

With the completion of the [United Nations Framework Convention on Climate Change](http://unfccc.int/essential_background/convention/items/2627.php) at the Earth Summit in 1992, the world’s nations pledged to avoid dangerously disrupting the climate through the buildup of greenhouse gases, but they never defined [how much warming was too much](http://www.nytimes.com/2005/02/01/science/earth/01warm.html).

Nonetheless, recognizing that the original climate treaty was proving ineffective, all of the world’s industrialized countries except for the United States accepted binding restrictions on their greenhouse gas emissions under [the Kyoto Protocol,](http://unfccc.int/kyoto_protocol/items/2830.php) which was negotiated in Japan in 1997. That accord took effect in 2005 and its gas restrictions expire in 2012. The United States signed the treaty, but it was never submitted for ratification in the face of overwhelming opposition in the Senate because the pact required no steps by China or other fast-growing developing countries.

It took until 2009 for the leaders of the world’s largest economic powers to agree on a [dangerous climate threshold](http://www.nytimes.com/2009/07/09/world/europe/09prexy.html): an increase of 2 degrees Celsius (3.6 degrees Fahrenheit) from the average global temperature recorded just before the Industrial Revolution kicked into gear. (This translates into an increase of 1.3 degrees Fahrenheit above the Earth’s current average temperature, about 59 degrees.)

The Group of 8 industrial powers also agreed in 2009 to a [goal of reducing global emissions 50 percent by 2050](http://www.g8italia2009.it/G8/Home/Summit/G8-G8_Layout_locale-1199882116809_Atti.htm), with the richest countries leading the way by cutting their emissions 80 percent. But they did not set a baseline from which to measure that reduction, and so far firm interim targets — which many climate scientists say would be more meaningful — have not been defined.

At the same time, fast-growing emerging economic powerhouses, led by China and India, opposed taking on mandatory obligations to curb their emissions. They said they will do what they can to rein in growth in emissions — as long as their economies do not suffer.

In many ways, the debate over global climate policy is a result of a [global “climate divide.’'](http://dels.nas.edu/climatechange/) Emissions of carbon dioxide per person range from less than 2 tons per year in India, where 400 million people lack access to electricity, to more than 20 in the United States. The richest countries are also best able to use wealth and technology to insulate themselves from climate hazards, while the poorest, which have done the least to cause the problem, are the most exposed.

**Background**

Scientists learned long ago that the earth’s climate has powerfully shaped the history of the human species — biologically, culturally and geographically. But only in the last few decades has research revealed that [humans can be a powerful influence](http://www.aip.org/history/climate) on the climate, as well.

A growing body of scientific evidence indicates that since 1950, the world’s climate has been warming, primarily as a result of emissions from unfettered burning of fossil fuels and the razing of tropical forests. Such activity adds to the atmosphere’s invisible blanket of carbon dioxide and other heat-trapping “greenhouse” gases. Recent research has shown that methane, which flows from landfills, livestock and oil and gas facilities, [is a close second to carbon dioxide as an impact](http://www.nytimes.com/2009/10/15/business/energy-environment/15degrees.html) on the atmosphere.

That conclusion has emerged through a broad body of analysis in fields as disparate as glaciology, the study of glacial formations, and palynology, the study of the distribution of pollen grains in lake mud. It is based on a host of assessments by the world’s leading [organizations of climate and earth scientists.](http://dels.nas.edu/climatechange/)

In the last several years, the scientific case that the rising human influence on climate could become disruptive has become particularly robust.

[Some fluctuations in the earth’s temperature](http://dotearth.blogs.nytimes.com/2009/04/03/cool-spells-in-a-warming-world/) are inevitable regardless of human activity — because of decades-long ocean cycles, for example. But centuries of rising temperatures and seas lie ahead if the release of emissions from the burning of fossil fuels and deforestation continues unabated, according to the [Intergovernmental Panel on Climate Change](http://www.ipcc.ch/), a group that shared the [2007 Nobel Peace Prize](http://nobelprize.org/nobel_prizes/peace/laureates/2007/) with former Vice President Al Gore.

In addition, a report released by the I.P.C.C. in November 2011 predicted that global warming will cause more dangerous and “unprecedented extreme weather” in the future.

Despite the scientific consensus on these basic conclusions, enormously important details remain murky. That reality has been seized upon by some groups and scientists disputing the overall consensus and opposing changes in energy policies.

For example, estimates of the amount of warming that would result from a doubling of greenhouse gas concentrations (compared to the level just before the Industrial Revolution got under way in the early 19th century) range from 3.6 degrees to 8 degrees Fahrenheit. The intergovernmental climate panel said it could not rule out even higher temperatures. While the low end could probably be tolerated, the high end would almost certainly result in calamitous, long-lasting disruptions of ecosystems and economies, a host of studies have concluded. A wide range of [economists](http://www.bepress.com/ev/vol4/iss3/) and [earth scientists](http://dotearth.blogs.nytimes.com/2008/01/24/earth-scientists-express-rising-concern-over-warming/) say that level of risk justifies an aggressive response.

Other questions have persisted despite a [century-long accumulation of studies](http://www.aip.org/history/climate/) pointing to human-driven warming. The rate and extent at which sea levels will rise in this century as ice sheets erode remains highly uncertain, even as the long-term forecast of [centuries of retreating shorelines](http://www.nytimes.com/2007/02/04/weekinreview/04basic.html?_r=1) remains intact. Scientists are struggling more than ever to disentangle how the heat building in the seas and atmosphere will affect [the strength and number of tropical cyclones](http://dotearth.blogs.nytimes.com/2008/04/12/hurricane-expert-reassesses-climate-link/). The latest science suggests there will be more hurricanes and typhoons that reach the most dangerous categories of intensity, but [fewer storms overall.](http://dotearth.blogs.nytimes.com/2008/05/19/warming-and-storms-uncertainty-and-ethics/)

**Questions**: Separate Sheet of Paper (or on back)

1. What is the most common source of fossil fuels? How much did fossil fuel emissions rise in 2010? What do scientists fear as a result?
2. Explain the purpose of the 1997 Kyoto Protocol. What role did the United States have in the Kyoto Protocol?
3. Why has the US been criticized when it comes to climate change? What has President Obama promised?
4. Why have China and India not been willing to cooperate with reducing their global emissions?
5. Compare the emission rates of India and the United States. Why do you think there is such a difference between the two countries?
6. Give two major reasons why the world’s climate has been “warming.” What is the IPCC and what have they predicted about global warming in the future?
7. How much do scientists believe Earth’s temperature will increase if greenhouse gas concentrations double?
8. What do scientists predict will happen to the weather as a result of global warming?