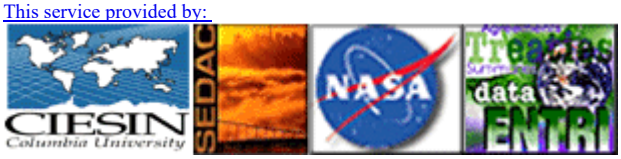
This service provided by:



Return to ENTRI homepage | Return to ENTRI Thematic Guide home page | Return to ENTRI Thematic Guide Section 3 home page

Climate Change: Treaties, Indicators, and National Responses

The purpose of this subsection on climate change is to provide you with an overview of treaties, key indicators, and related national response strategies. The discussion of the key indicators and their relationship to environmental treaties might be useful for:

- assessing specific investment projects and related institutional and policy options for limiting greenhouse gas emissions;
- identifying and strengthening national institutional capabilities to assess global implications of energy efficiency and other projects which affect emission levels; and
- conducting experiments to demonstrate the operational viability of alternative energy saving technologies.

Nature of Climate Change Issue

The scientific community has long noted the potential for human activities to contribute to global climate change. A broad international consensus regarding the issue has developed over the past several years and has been reported in the intergovernmental Panel on Climate Change assessment reports.

Several natural and human activities can change the balance between the energy absorbed by the Earth and that emitted in the form of long-wave, infrared radiation. These activities are both natural and human-induced, arising from industrial and land-use practices that release or remove heat-trapping "greenhouse" gases, thus changing the atmospheric composition.

Greenhouse gases include water vapor, carbon dioxide (CO2), methane (CH4), nitrous oxide (N2O), chlorofluorocarbons (CFCs), hydrochlorofluorocarbons (HCFCs), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and ozone (O3). While water vapor has the largest effect, its concentrations are not directly affected, on a global scale, by human activities (Executive Office of the President, 1993).

Human activities are increasing the atmospheric concentrations of greenhouse gases--which tend to warm the atmosphere--and in turn, in some regions, aerosols--which tend to cool the atmosphere. These changes in greenhouse gases and aerosols, taken together, are projected to lead to regional and global changes in climate and climate-related parameters such as temperature, precipitation, soil moisture, and sea level. Based on the range of sensitivities of climate to increase greenhouse gas concentrations reported by IPCC Working Group I and plausible ranges of emissions (IPCC 1992), climate models, taking into account greenhouse gases and aerosols, project an increase in global mean surface temperature of about 1-3.5 C by 2100, and an associated increase in sea level of about 15-95 cm. The reliability of regional-scale predictions is still low, and the degree to which climate variability may change is uncertain. However, potentially serious changes have been identified, including an increase in some regions in the incidence of extreme high-temperature events, floods, and droughts, with resultant consequences of fires, pest outbreaks, and ecosystem composition, structure, and functioning, including primary productivity (IPCC, 1995).

Human health, terrestrial and aquatic ecological systems, and socioeconomic systems (e.g., agriculture, forestry, fisheries, and water resources) are all vital to human development and well-being and are all sensitive to changes in climate. Whereas many regions are likely to experience the adverse effects of climate change--some of which are potentially irreversible--some effects of climate change are likely to be

beneficial. Hence, different segments of society can expect to confront a variety of changes and the need to adapt to them (IPCC, 1995).

Policymakers are faced with responding to the risks posed by anthropogenic emissions of greenhouse gases in the face of significant scientific uncertainties. It is appropriate to consider these uncertainties in the context of information indicating that climate-induced environmental changes cannot be reversed quickly, if at all, due to the long time scales associated with the climate system. Decisions taken during the next few years may limit the range of possible policy options in the future because high near-term emissions would require deeper reductions in the future to meet any given target concentration. Delaying action might reduce the overall costs of mitigation because of potential technological advances but could increase both the rate and the eventual magnitude of climate change, hence the adaptation and damage costs (IPCC, 1995).

International Environmental Treaties Related to Climate Change

In June 1992 in Rio de Janeiro, world leaders and citizens of 176 countries gathered to agree on ways of working together to preserve and enhance the global environment. Negotiations to develop the Framework Convention on Climate Change (UNFCCC) began in 1991 and, in June 1992 at the "Earth Summit", the Convention was opened for signature. It entered into force in March 1994 following ratification by 50 countries. The main objective of this important climate change treaty is to:

> achieve ... stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system. Such a level should be achieved within a time frame sufficient to allow ecosystems to adapt naturally to climate change, to ensure that food production is not threatened, and to enable economic development to proceed in a sustainable manner.

In addition to the UNFCCC, two other international environmental treaties address climate change indirectly (IUCC fact sheet 201). The amended 1987 Montreal Protocol on Substances That Deplete the Ozone Layer legally obliges its parties to phase out chlorofluorocarbons (CFCs) by the year 1996 (IUCC fact sheet 224). Although inspired by concern over the destruction of the ozone layer, this protocol is significant also for climate change since CFCs are greenhouse gases. Similarly, the 1979 Geneva Convention on Long-Range Transboundary Air Pollution and its protocols regulate the emission of noxious gases, some of which are precursors of greenhouse gases. These treaties, however, do not completely address the complex set of interrelated climate issues.

Linkages Between Climate Change Treaty and Key Indicators

Most OECD countries have adopted the Pressure-State-Response (PSR) framework for reporting state-of-the-environment and for national environmental performance reviews. This procedure has been modified and adopted by the World Bank for development of environmental indicators. The PSR framework is a convenient representation of the linkages among the pressures exerted on the land by human activities (pressure), the change in quality of the resource (state), and the response to these changes as society attempts to release the pressure or to rehabilitate land which has been degraded (response) (Dumanski, 1996).

The PSR framework is used here to explain the relationship among international treaties, key indicators, and national response strategies (Figure 1). The pressure indicators such as population pressure, percentage of forests cleared, and production of cement provide an estimate of the pressures exerted by human activities that lead to increased greenhouse gas emissions. Initially, these indicators have also served as indices for the Intergovernmental Negotiating Committee for a Framework Convention on Climate Change which eventually led to the development of the United Nations Framework Convention on Climate Change. The resultant changes in radiatively active trace gases in the atmosphere are key state indicators.

UNFCCC indicates the results of the negotiations of the Intergovernmental Negotiating Committee for a Framework Convention on Climate Change. As a framework treaty, the Convention sets out principles and general commitments which are to adopt national programmes for mitigating climate change; to develop adaptation strategies; and to promote the sustainable management and conservation of greenhouse gas "sinks" (such as forests).

The response indicators such as carbon tax levied by national governments are useful in evaluating the national-level programs and policies. In order to reduce greenhouse gas emissions, a few Conferences of Parties (COPs) have implemented programs prior to the enforcement of the FCCC. These programs might be quite useful to other countries as well. After the enforcement of FCCC, other countries have had the opportunity to learn about the outcomes of these programs. Though prepared for an international forum, these national reports should be essential reading for national policy-makers and the informed public. For example, performance indicators such as percentages of emission are useful to the FCCC Secretariat to review the progress made by the Parties in response to the compliance of the treaties. Under Articles 4 and 12 of the Convention, Parties are required to prepare national communications on their implementation of the Convention. Guidelines for the preparation of national communications and the process for their review were agreed on by the Intergovernmental Negotiating Committee for a Framework Convention on Climate Change by its decisions 9/2 and 10/1 and by the Conference of the Parties at its first session by its decisions 2/CP.1 and 3/CP.1 (see FCCC/CP/1995/7/Add.1).

Pressure Indicators of Climate Change

Population dynamics and distribution, areas of land clearance, and gross domestic product are the major pressures influencing greenhouse gas emissions.

Population Dynamics and Distribution

Population dynamics and distribution are indicators for understanding human interactions with the environment and in considering possible responses to global climate change. The National Research Council (NRC) has identified population dynamics as one of five priority areas of research for the US Global Change Research Program. It also pointed out the key role of georeferenced social data in two other priority areas, improving the understanding of land use change and assessing impacts, vulnerability, and adaptation to global changes (National Research Council, 1994).

This indicator can be developed from SEDAC's population data products and services: Integrated Population, Land Use, and Emissions Data for the U.S., an archive of Census-related products, global population database, Gridded Population of the World, and an interactive access to the U.S. Census Public Microdata Samples (PUMS) for 1980 and 1990 through the Ulysses tabulation system.

Gross Domestic Product

Gross Domestic Product (GDP) is the most widely used measure of national economic performance. Maintaining economic growth as defined by GDP is widely accepted indicator of economic success. Although various countries calculate GDP in slightly different ways, and the activities included or excluded in the measure can be debated, GDP remains a basic reference of economic performance. Thus, it is appropriate that the quantity of greenhouse emissions per unit of GDP be considered for use as a key indicator (NGRS, 1995)

Areas of Land Clearance

Forestry practices and land use changes result in about 24% of total greenhouse gas emissions mostly comprised of CO2 from clearing native forest, forest burning, and disturbance of soils during forest operations. The areas of forests permanently cleared each year therefore can serve as an important indicator of pressure influencing greenhouse gas emissions.

Incremental Emissions from Fossil Fuels

A key indicator of progress toward stabilizing emissions is the amount by which each nation's emissions increase from one year to the next--their incremental emissions. Clearly the greatest impact on climate stabilization will be for the largest incremental emitters to stabilize their emissions. But the further we go into the decade of the 1990s without stabilization, the more difficult it will be to meet the internationally accepted voluntary target (The World Bank, 1995). The World Bank calculated the incremental emissions for

1986-91 by fitting a linear trend to CDIAC emissions data . Where the trend was insignificant, the increment was set to zero. This process was repeated for both individual country data and world total emissions.

Emissions of gases such as CO2, CH4, and N20 due to anthropogenic activities are essential pressure indicators. The data presented in the CDIAC Estimates of Global, Regional, and Naitonal Annual CO2 Emissions from Fossil-Fuel Burning, Hydraulic Cement Production, and Gas Flaring: 1950-1992 include global, regional, and national estimates, along with the data used to make these estimates. These estimates were derived principally from fossil-fuel burning and cement production statistics from the UN Energy Data Base and the cement manufacturing data from the U.S. Bureau of Mines. Estimates of annual CO2 emissions for the years 1950 to 1990 are provided for over 200 individual countries.

State Indicators of Climate Change

The anthropogenic concentrations of the greenhouse gases, and among them carbon dioxide (CO2), methane (CH4) and nitrous oxide (N2O), have grown significantly since pre-industrial times. These trends can be attributed to human activities, mostly fossil fuel use, land-use change and agriculture. Concentrations of other anthropogenic greenhouse gases have also increased. An increase of greenhouse gas concentrations leads on average to an additional warming of the atmosphere and the Earth's surface. Many greenhouse gases remain in the atmosphere-- and affect climate for a long time (IPCC, 1995). UNFCCC Article 4.1(a) states that:

> All Parties, taking into account their common but differentiated responsibilities and their specific national and regional development priorities, objectives and circumstances, shall develop, periodically update, publish and make available to the Conference of the Parties, in accordance with Article 12, national inventories of anthropogenic emissions by sources and removals by sinks of all greenhouse gases not controlled by the Montreal Protocol, using comparable methodologies to be agreed upon by the Conference of the Parties.

Atmospheric concentrations of CO2, CH4, and N2O are key indicators in formulating policies for mitigating the effects of climate change.

Atmospheric CO2 Concentration

Because the infrared absorption properties of the greenhouse gases and their role in determining global climate are well understood, it is certain that the CO2 increase will alter the radiative forcing of the climate system. The ongoing measurements will provide a better understanding of the natural carbon cycle and thus serve as an indicator in the formulation of rational and informed policies concerning climate change and possible mitigation strategies.

Atmospheric CH4 Concentration

Globally-averaged methane mixing ratios are collected approximately weekly from various sites in the NOAA/CMDL cooperative air sampling network. Air sampling sites are distributed between 90 degrees S and 82 degrees N. The average increase in the globally-averaged methane mixing ratio over the period 1983-1993 is approximately 0.6% per year when referenced to the middle of the sampling record. The growth of methane over the past few years has slowed, probably due to a change in the anthropogenic source. Increased methane affects the Earth's radiation balance and the chemistry of the atmosphere.

Atmospheric Concentration Of Ozone

Gradual destruction of stratospheric ozone, which is attributed to the buildup of man-made compounds that deplete the ozone layer, continued during 1994. According to an executive summary of the 1994 Scientific Assessment of Ozone Depletion released jointly by the World Meteorological Organization and the United Nations Environmental Program, the rate of ozone destruction is expected to peak during the next few years and to begin decreasing early in the twenty-first century. The long-term decrease of total column ozone is presently 4-5 percent per decade at mid-latitudes in both hemispheres. Little negative trend in ozone is observed in the Tropics. [Ozone data are derived from data recorded by the SBUV instrument on the NASA

Nimbus-7 satellite from 1979 to mid-1990 and by the SBUV/2 instrument on the NOAA-11 satellite from January 1989 to September 1994.]. See also the Ozone subsection of this thematic Guide.

Response Indicators for Climate Change

By 1990, numerous international conferences had issued urgent calls for a binding global treaty addressing the problem of climate change (IUCC Fact Sheet 204). The United Nations Environment Programme(UNEP) and the World Meteorological Organization (WMO) responded by establishing an intergovernmental working group to prepare for treaty negotiations.

FCCC Article 4.1(a) states that:

> All Parties, taking into account their common but differentiated responsibilities and their specific national and regional development priorities, objectives and circumstances, shall take climate change considerations into account, to the extent feasible, in their relevant social, economic and environmental policies and actions, and employ appropriate methods, for example impact assessments, formulated and determined nationally, with a view to minimizing adverse effects on the economy, on public health and on the quality of the environment, of projects or measures undertaken by them to mitigate or adapt to climate change.

Response indicators on climate change can be developed by collating and evaluating the implementation of FCCC by the COPs as a measure to stabilize greenhouse gas emissions.

Energy-Related Greenhouse Gas Emissions

This indicator is the basic measurement for assessing the national performance of greenhouse abatement measures. The trend in national emissions should be a major measurement of the national-level response strategies.

Greenhouse Gas Emissions/unit GDP

The greenhouse gas emissions per unit of economic activity as measured by GDP provides an indicator of the success of policies aimed at maintaining or increasing economic well-being while at the same time, reducing greenhouse gas emissions per unit of productivity. The value of this indicator can be published from energy data, greenhouse coefficients, and GDP.

National-level Responses

Under Articles 4 and 12 of the Convention, Parties are required to prepare national communications on their implementation of the convention. Guidelines for the preparation of national communications and the process for their review were agreed on by the Intergovernmental Negotiating Committee for a Framework Convention on Climate Change.

Treaty Texts | Summaries | ENTRI