United States
Environmental Protection
Agency

Office of Economy
and Environment
(2175)

EPA 236-B-00-001
March 2000
Internet Version

AN ANNOTATED SUMMARY OF CLIMATE CHANGE RELATED RESOURCES

U.S. Environmental
Protection Agency
Office of Policy
Washington, D.C., USA

March, 2000

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INTRODUCTION

The purpose of this annotated summary is to provide the reader with a tool for identifying the range of available resources pertaining to climate change. The information contained in this resource guide is intended to assist researchers and decision makers, particularly those from developing countries, in their efforts to develop, implement, and evaluate climate change programs and conduct climate change studies (e.g., emission inventories, mitigation assessments, vulnerability and adaptation analysis).

While a wide variety of analytic and assessment tools, guidelines, and information resources are available, these resources are dispersed among numerous public and private entities throughout the world, making it difficult for potential users to identify and access relevant materials. Furthermore, because decision makers in developing countries face significant challenges in pursuing development objectives, efforts to address climate change are typically evaluated in light of how they may affect sustainable development goals and near-term local environmental conditions. Therefore, the annotations in this resource guide identify which environmental protection or sustainable development objective might also be addressed by each climate change resource.

The materials summarized are generally recognized as authoritative sources, particularly the data sources. These materials are defined broadly and include guidance documents, reference tools (e.g., data sources, information networks, model descriptions), financial or technical assistance programs, collaborative opportunities, and selected case studies or examples. Some of the resources are broadly applicable to climate change; for example, many of the organizations that are listed may be rich sources of information on a variety of specific topics. Therefore, users of this guide are encouraged to review the listings in each of the various sections to become familiar with the variety of resources available.

The resource guide is organized by several broad categories into the following sections:

- policy and general climate change resources
- climate change data and research resources
- resources for developing GHG inventories
  - guidelines
  - data and information
  - examples
- mitigation resources
  - general
  - methane
  - energy
  - forests

- R cities and urban areas
- R implementation and assistance programs

> impacts and adaptation resources
- R general
- R guidelines
- R assessment tools and models.

> international and national governmental climate change organizations

> list of non-governmental climate change organizations

To help users of this resource guide identify particular resources, the following topic words are used to characterize and categorize resource items, and may be used in an electronic word search to find additional resources addressing each topic:

List of Topic Keywords

Climate Change Topics

mitigation technologies	climate data
industrial manufacturing	agriculture
building energy conservation	forests
energy efficiency	water resources
energy systems planning	human health
renewable resources	ecology/ecosystems
greenhouse gas emissions	coastal resources/sea level rise
transportation	fisheries
carbon sequestration	wildlife
adaptation	storms/extreme events
agricultural methane	economic welfare
solid waste	climate change policy

Environmental Linkage Topics

air pollution and air quality	biodiversity
water pollution and water quality	deforestation
land use	sustainable development
land degradation	stratospheric ozone

Work on An Annotated Summary of Climate Change Related Resources was carried out by a Stratus Consulting Inc. under EPA contract number 68-W6-0055 and delivery order 332.

An electronic version of this document may also be obtained from the U.S. EPA's global warming web site at the following address:
http://www.epa.gov/globalwarming/publications/reference/resource_guide.html

For further information regarding this guide or to provide comments and suggestions for future editions, please contact:

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Additional copies of this document may be obtained by contacting the National Service Center for Environmental Publications. Be sure to identify the document number: EPA 236-B-00-001 and title: An Annotated Summary of Climate Change Related Resources.

To order by mail, send written request to:

U.S. Environmental Protection Agency
National Service Center for Environmental Publications
P.O. Box 42419
Cincinnati, OH 45242-2419
USA

By phone: within the U.S. 1-800-490-9198
outside the U.S. +1-513-489-8190

By fax: 1-513-489-8695

By internet: http://www.epa.gov/ncepihom/orderpub.html

POLICY AND GENERAL CLIMATE CHANGE RESOURCES

POLICY AND GENERAL CLIMATE CHANGE RESOURCES

United Nations Framework Convention on Climate Change (UNFCCC)
Conference of the Parties

The Conference of the Parties (COP) is a group representing countries that have ratified the UNFCCC, an international agreement to take climate change into account in matters such as agriculture, energy, natural resources, and coastal resources. Their ultimate objective is to stabilize greenhouse gas concentrations at a level that would prevent dangerous human interference with the global climate. COP meets annually to develop international policies and agreements, as well as to discuss progress towards implementing goals outlined in the UNFCCC. The COP works to promote and cooperate in research, systematic observation and development of data archives related to the climate system; to share information; and to cooperate in education and training related to climate change. COP members are also dedicated to assisting developing countries with costs of adapting to adverse effects of climate change, and to facilitate the transfer of environmentally sound technologies to developing countries.

Climate Change Topics

> greenhouse gas emissions
> adaptation, multiple sectors

Environmental Linkages

> air pollution and air quality

Application: The COP targets its material to policy makers and researchers, with information ranging from general and introductory to highly technical and specific. The COP and the general UNFCCC website provide the most current information on intergovernmental policies and agreements on greenhouse gas stabilization. Resources available include information and data on global warming; emissions data; a large bibliography of technical reports, books, journal articles, and conference reports; country information on ratification of international agreements, such as the Kyoto Protocol; and selected lists of UNFCCC party-member activities on climate change.

Sponsor/Contact:

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D-53153 Bonn
Germany
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website: http://www.unfccc.de
e-mail: secretariat@unfccc.de

POLICY AND GENERAL CLIMATE CHANGE RESOURCES

Kyoto Protocol

The Kyoto Protocol, adopted at the United Nations Framework Convention on Climate Change (UNFCCC) Conference of the Parties-3 (COP3), is an intergovernmental agreement that established numerical targets for the reduction of greenhouse gas emissions. The text contains quantified emissions targets for participating countries, information on methods for reducing emissions, and details on emissions trading and clean development options for meeting emissions commitments.

Climate Change Topics

> climate change policy
> greenhouse gas emissions
> adaptation, multiple sectors

Environmental Linkages

> air pollution and air quality

Application: The Kyoto Protocol is a helpful reference for those interested in climate change-related policy, as it is one of the foundation documents for international emissions reduction agreements. Although no numerical targets were set for economically developing countries, provisions about clean development may be of interest. These provisions state that developed countries can provide financial aid or otherwise assist a developing country in reducing emissions, and the developed country may then count that emissions reduction as a part of its emissions reduction commitment. This may present a financially attractive emissions reduction option for developing countries. This document is available in English, Arabic, Chinese, French, Russian and Spanish.

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UNFCCC
P.O. Box 260124
D-53153 Bonn
Germany
Tel: +49-228-815-1000; Fax: +49-228-815-1999
website: http://www.unfccc.de/resource/convkp.html
e-mail: secretariat@unfccc.de

POLICY AND GENERAL CLIMATE CHANGE RESOURCES

Intergovernmental Panel on Climate Change (IPCC)

The IPCC was established in 1988 by the World Meteorological Organization and the United Nations Environment Programme to assess the available scientific, technical, and socioeconomic information in the field of climate change. IPCC provides independent scientific and technical advice to the United Nations Framework Convention on Climate Change (UNFCCC) (see UNFCCC entry in Policy and General Climate Change Resources section). It is divided into the following three working groups:

> Working Group I assesses the scientific aspects of the climate system and climate change;

> Working Group II addresses the vulnerability of socioeconomic and natural systems to climate change, negative and positive consequences of climate change, and options for adapting to it; and

> Working Group III assesses options for limiting greenhouse gas emissions and otherwise mitigating climate change.

Each working group produces technical papers and research summaries relevant to the group focus, and within guidelines established under the UNFCCC.

Climate Change Topics	***Environmental Linkages***
> climate science	> air pollution and air quality
> greenhouse gas emissions	> water quality
> adaptation, multiple sectors	> land use

Application: IPCC reports are designed for policy makers, scientists, and other experts who are interested in the latest technical scientific, economic, and policy information on climate change. The reports are particularly helpful for users assessing impacts and mitigation strategies, designing climate change policies, and developing research studies. Technical reports produced by IPCC have covered topics such as mitigation technologies and policies, climate models, the science of climate change, implications of greenhouse gas stabilization, and implications of CO_2 emissions limitations. IPCC has also published two assessment reports, known as the First Assessment Report and Second Assessment Report, that are standard reference works summarizing scientific information, socioeconomic impacts, and response strategies for climate change. Most documents can be downloaded for free from the website or ordered (prices vary) from the IPCC Secretariat. IPCC also maintains the Data Distribution Centre (see listing for Intergovernmental Panel on Climate Change Data Distribution Centre), which distributes up-to-date climate scenarios for performing climate change impact assessments.

Sponsor/Contact: IPCC; World Meteorological Organization Building
7bis Avenue de la Paix; CP 2300
CH-1211 Geneva 2, Switzerland
Tel: +4122730-8208; Fax: +41-22-730-8025
website: http://www.ipcc.ch
e-mail: ipcc_sec@gateway.wmo.ch

POLICY AND GENERAL CLIMATE CHANGE RESOURCES

Sustainable Development and Global Climate Change: Conflicts and Connections

This book contains papers written by some of the world's most recognized climate scientists, presented at a 1995 conference sponsored by the Center for Environmental Information. Introductory papers describe IPCC findings and their implications for sustainable development. Other papers examine mechanisms for assessing the linkages and the conflicts between sustainable development strategies and emerging findings about impacts, adaption, and mitigation of global climate change effects. The book is organized in four volumes: *The Climate Change Phenomenon and Sustainability* (three papers); *Sustainability and Climate Change: Impacts, Adaptation, and Mitigation Options* (six papers); *Sustainable Development and Climate Change: Economic Assessment* (four papers); and *Sustainable Development and Climate Change: Science for Policy in the Face of Uncertainty* (seven papers). Each volume also contains a transcript of questions and answers discussed at the conference.

Climate Change Topics	***Environmental Linkages***
> mitigation	> sustainable development
> adaptation	> land use
> economic welfare	> land degradation
> health effects	> deforestation

Application: This book presents recent research on topics related to climate change mitigation and climate-related policy options. The second volume of this book, *Sustainability and Climate Change: Impacts, Adaptation, and Mitigation Options*, addresses a particularly important climate change issue: mitigating the effects of global climate change. The volume presents the following papers:

> "Ecosystem Adaptation — Terrestrial Systems," by Stephen Hamburg — reviews climate changes in terrestrial ecosystems over a 100 year time frame.
> "Impacts on Agriculture and Food Supply," by David Wolfe — examines the potential effects of climate change on the world's food supply.
> "Health Impacts," by Jonathan Patz — analyzes the potential effects of climate change on health and the possible implications for sustainable development strategies.
> "Marine and Coastal Systems — Impacts and Adaptation," by Victor Kennedy — examines potential climate change effects in coastal areas and strategies for mitigation and adaptation.
> "Mitigation Options — Energy Supply," by Denny Ellerman — offers a brief survey of the alternatives for reducing greenhouse gas emissions on the supply side.

Sponsor/Contact: Center for Environmental Information
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Rochester, NY 14604 USA
Tel: +1-716-262-2870; Fax: +1-716-262-4156
website: http://www.awa.com/nature/cei/
document at: http://www.awa.com/nature/cei/proceed95/
e-mail: cei@servtech.com;

POLICY AND GENERAL CLIMATE CHANGE RESOURCES

Common Questions about Climate Change

The United Nations Environment Programme and the World Meteorological Organization prepared this document. It provides a general background on several climate topics as well as answers to some of the most commonly asked questions about climate change. Questions include whether or not recent trends are consistent with climate warming, which human activities are contributing to climate change, what further climatic changes are expected to occur, and what effects these changes may have on humans and the environment.

Climate Change Topics

> mitigation
> adaptation
> storms/extreme events
> background on climate change
> outreach

Environmental Linkages

> air pollution and air quality
> water pollution and water quality
> resource conservation

Application: This is a good background source on the science of climate change, presenting key issues, climate trends, and implications. The document's greatest application is that it can be used as a communication tool to inform the public, community interest groups, and business and government leaders about the science of climate change.

Sponsor/Contact:

United Nations Environment Programme
P.O. Box 30552
Nairobi, Kenya
Fax: +254-2-623410

GCRIO User Services
61 Rt 9W, P.O. Box 1000
Palisades, NY 10964 USA
e-mail: help@gcrio.org

Document at: http://www.gcrio.org/ipcc/qa/cover.html

POLICY AND GENERAL CLIMATE CHANGE RESOURCES

Climate Change 1995: Impacts, Adaptations and Mitigation of Climate Change: Scientific-Technical Analyses

IPCC's Working Group II published this scientific report on the potential impacts of climate change, adaptive responses, and measures that could mitigate future emissions. Its comprehensive coverage of the issues important to understanding climate change impacts make it an indispensable resource. The report further reviews the technical and economic feasibility of a range of potential adaptations and mitigation strategies. Its chapters cover a wide range of physical and ecological systems, human health, and socioeconomic sectors and activities. The sensitivity of systems and their potential for adaptation to changes in mean climate, changes in extreme weather events, changes in variability, the rate of climate change, and the effects of elevated CO_2 concentrations on vegetation are discussed, as are many of the practices and technologies that increase carbon storage and reduce greenhouse gas emissions.

Climate Change Topics

- greenhouse gas emissions
- mitigation technologies
- adaptation
- carbon sequestration
- human health
- economic welfare
- agriculture
- fisheries

Environmental Linkages

- air pollution and air quality
- resource conservation
- land use

Application: Researchers will find scientific, technical, and economic information that can be used as a basis for understanding possible regional and country-specific impacts. For example, the section on assessment of mitigation options discusses mitigation options in the energy supply, industry, transportation, human settlements, agriculture, and forestry sectors. The report discusses the advantages and disadvantages of various technology and policy mitigation options in each sector.

Sponsor/Contact: IPCC Secretariat
c/o WMO
C.P. 2300
CH-1211 Geneva 2, Switzerland
Fax: +41-22-733-1270
website: http://www.ipcc.ch

Note: This document is available from the IPCC Secretariat for US $80.

CLIMATE CHANGE DATA AND RESEARCH RESOURCES

CLIMATE CHANGE DATA AND RESEARCH RESOURCES

Intergovernmental Panel on Climate Change (IPCC) Data Distribution Centre (DDC)

The DDC was established by the IPCC to facilitate the timely distribution of consistent and current scenarios of climate change and related environmental and socioeconomic factors for use in impacts assessments. The two sections of data on this website include climate baselines, nonclimatic baselines, emissions scenarios, GCM experiments, and nonclimatic scenarios. The scenario data in the first section are commonly used to construct and apply climate change scenarios for climate change impacts assessments. The second section, the GCM archive, contains monthly mean data and information on the models used to generate the data.

Climate Change Topics

> climate data
> impact assessment factors

Environmental Linkages

> air pollution and air quality
> water resources
> land use

Application: Users can access the data available from this website to perform vulnerability and adaptation assessments or other quantitative modeling activity. One of the GCMs featured on the DDC website is HadCM2. The HadCM2 experiments include a long (multi-century) control simulation, a series of four historical climate change experiments with high and low scenarios with and without the effects of sulphate aerosols. Each of these four climate change experiments feature identical scenarios but different initial model conditions. The data and information provided on this website can also be used for environmental modeling applications beyond just climate change, including changes in water resources and land use.

Sponsor/Contact: IPCC-World Meteorological Building
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1211 Geneva 2, Switzerland
Fax: +41-22-733-1270
website: http://ipcc-ddc.cru.uea.ac.uk/ipcc_ddc.html

CLIMATE CHANGE DATA AND RESEARCH RESOURCES

IPCC Second Assessment Report Bibliographic Reference Database

The IPCC Global Change Research Information Office (see listing for U.S. Global Change Research Information Office) compiled an online database of bibliographic citations in the three volumes of the Second Assessment Report (SAR, see listing for Climate Change 1995: Impacts, Adaptations and Mitigation of Climate Change: Scientific-Technical Analysis in Policy and General Climate Change Resources). They are provided by the Cambridge University Press as a public service. The website allows users to search for citations according to keywords, and displays complete citations for each reference.

Climate Change Topics

> greenhouse gas emissions
> mitigation technologies
> adaptation
> carbon sequestration
> human health
> economic welfare
> agriculture
> fisheries

Environmental Linkages

> air pollution and air quality
> resource conservation
> land use

Application: This database is one of the most complete bibliographies of climate change-related literature, and is therefore helpful for users who are doing research on all aspects of climate change. It does not provide links to the documents themselves, only complete citations. Familiarity with the SAR is helpful to direct searches to particular chapters of interest, but it is not necessary. For example, a search for titles containing the word “mitigation” resulted in matches with references from 25 different chapters. Users can then focus on chapters that are most relevant to their research, such as mitigation technologies in the transportation sector.

Sponsor/Contact: website: http://gcrio.gcrio.org/ipcc/bibsource/html
e-mail: help@gcrio.org

CLIMATE CHANGE DATA AND RESEARCH RESOURCES

International Geosphere-Biosphere Program (IGBP)

The IGBP, established by the International Council for Science in 1986, acquires basic scientific knowledge about the interactive processes of biology and chemistry of the Earth as they relate to global change. The program places priority on those areas that deal with key interactions and significant changes that most affect the biosphere, and those that are most susceptible to human perturbations. Topics covered by the IGBP include atmospheric science, terrestrial ecology, oceanography, hydrology, and links between the natural and the social sciences.

Climate Change Topics

> climate science
> multiple sector impacts
> climate data
> carbon sequestration

Environmental Linkages

> air pollution and air quality
> water pollution and water quality
> land use

Application: The IGBP provides scientific information for input to the policy process. IGBP research is divided into eight core projects, one of which is the Global Change and Terrestrial Ecosystems (GCTE) project. This project includes experimental studies and long-term studies at selected sites, as well as modeling projects linking global biogeochemical models and GCMs for application in climate impact studies. Users can obtain publications from IGBP online or by ordering from the IGBP Secretariat.

Sponsor/Contact: IGBP Secretariat
The Royal Swedish Academy of Sciences
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S-104 05 Stockholm, Sweden
Tel: +46-8-16-64-48; Fax: +46-8-16-64-05
website: http://www.uni-bonn.de/idhp
e-mail: sec@igbp.kva.se

Note: All information is available in English; some information is also available in French, Spanish, and Dutch.

CLIMATE CHANGE DATA AND RESEARCH RESOURCES

National Center for Atmospheric Research (NCAR) Data Center

NCAR, sponsored by the U.S. National Science Foundation, maintains a large collection of atmospheric, oceanographic, and meteorological data, including GCM data, for use in scientific climate research. The collection includes long- and short-term data from NCAR surface and satellite research and links to other research data held elsewhere. The website contains a data management application (CODIAC) that allows the user to search for data according to geographic area, time scale, and topic area. Data categories include aircraft, chemistry, electrification, models/analyses, radar, satellite, sounding, and surface. This system equips scientists with the means to identify relevant data, view and browse data, and download or request data output. The website also contains ordering information for large datasets, software libraries helpful for analysis of meteorological datasets, general documentation for NCAR programs and research, and guidelines for using the data.

Climate Change Topics

> adaptation
> climate data
> storms/extreme weather events

Environmental Linkages

> air pollution and air quality

Application: The Climate Analysis Section of the Data Center contains observational datasets and analyses on a variety of sources in support of modeling efforts and climate research. Topics include earth radiation, moisture budgets, surface temperature, ocean surface temperature, and cloud cover. Analysts performing sectoral vulnerability assessments can use data on this website as inputs for impact models such as agriculture, water resources, or human health that require data on climate trends.

Sponsor/Contact: NCAR Data Center
150 Table Mesa Dr.
Boulder, CO 80307 USA
Tel: +1-303-497-1000
website: http://www.ncar.ucar.edu/info/facilities.html#data

Note: NCAR charges a fee to obtain some of the larger, CD-ROM-based datasets. Ordering information is available on the website.

CLIMATE CHANGE DATA AND RESEARCH RESOURCES

Socioeconomic Data and Application Center (SEDAC)

The Center for International Earth Science Information Network (CIESIN) at Columbia University has been designated by the U.S. National Aeronautics and Space Administration (NASA) to operate and maintain SEDAC, one of the data centers in the Earth Observing Data and Information System (EOSDIS). SEDAC's mission is to develop and deliver information products and services that integrate social and natural science data in ways useful for decision making. The SEDAC website provides access to a range of interactive applications, data resources, information resources, and discussion lists pertaining to integrated socioeconomic and scientific data.

Climate Change Topics

> greenhouse gas emissions
> human health
> climate data
> adaption
> mitigation

Environmental Linkages

> air pollution and air quality
> land use
> land degradation

Application: Users can apply data from this website in quantitative and qualitative research on topics such as population and land use changes resulting from climate change. Users can then use this research as a foundation for mitigation and adaptation policies. Some current projects and services include providing socioeconomic and environmental data and information from institutions and data centers around the world; providing data sets and interactive services to support research in population, land use, and similar fields; creating visualization and analysis tools to make integrated assessment models more accessible; providing access to international environmental treaties; and providing a store of information products in the areas of UV radiation, ozone, and human health impacts of UV exposure. One of SEDAC's current projects, the Integrated Population/Land Use Data Project, is an effort to link a range of demographic and other socioeconomic data products with remote sensing data related to land cover and use. Population dynamics and distribution have been consistently identified as key elements in improving the understanding of land use change and assessing impacts, vulnerability, and adaptation to global change. This resource can assist in assessing climate change impacts and developing appropriate climate management policies.

Sponsor/Contact: Center for International Earth Science Information Network
Columbia University/Lamont-Doherty Earth Observatory
PO Box 1000; 61 Route 9W
Palisades, NY 10964 USA
Tel: +1-914-365-8988; Fax: +1-914-365-8922
website: http://sedac.ciesin.org
e-mail:ciesin.info@ciesin.org

CLIMATE CHANGE DATA AND RESEARCH RESOURCES

U.S. Global Change Research Program (USGCRP)

USGCRP supports research to improve climate change forecasts, the understanding of potential vulnerabilities, and society's capabilities to respond to such events. The program coordinates global change research through 10 U.S. Federal Agencies and sponsors research through the Global Change Research Information Office (GCRIO), the Global Change Data and Information System (GCDIS), and a number of other institutions in the United States.

Climate Change Topics	***Environmental Linkages***
> climate data	> air pollution and air quality
> adaptation	> water pollution and water quality
> background on climate change	> resource conservation

Application: USGCRP participates in research coordinated through IPCC and other international organizations, and provides convenient access to many sources of information on climate change prepared by USGCRP and other organizations. These sources include a monthly global change seminar series, a variety of publications, and several educational programs. The seminar series archives provide brief, non-technical summaries of key climate and global change issues. The Global Change and Environmental Education Resources section of the USGCRP website contains over 50 links to climate change education programs developed worldwide. The links include collections of research papers on climate change; information on fellowships, grants, and funding opportunities; and education programs for children.

Please also see descriptions of GCRIO and GCDIS provided in the International and National Governmental Climate Change Organizations and Climate Change Research and Data Resources sections, respectively.

Sponsor/Contact: USGCRP
website: http://www.usgcrp.gov
e-mail: webmaster@usgcrp.gov

CLIMATE CHANGE DATA AND RESEARCH RESOURCES

U.S. Global Change Research Information Office (GCRIO)

GCRIO provides access to data and information on global change research, mitigation/adaptation strategies and technologies, and global change-related educational resources on behalf of the various U.S. federal agencies and organizations such as the U.S. Environmental Protection Agency and Department of Energy that are involved in the U.S. Global Change Research Program (USGCRP). GCRIO provides an information clearinghouse for selected key documents and reports generated or sponsored by the U.S. government or by specific U.S. federal agencies (see USGCRP entry in Climate Change Research and Data Resources section). GCRIO offers outreach services to both domestic and international audiences to showcase relevant activities and results of the USGCRP and to increase the awareness of the availability of data and information resources of the participating federal agencies. The GCRIO website provides access to selected bibliographic data bases; web sites at the participating federal agencies; relevant environmental data, catalog, and library systems; and a special section that deals with environmental education and research funding opportunities.

Climate Change Topics
> climate data

Environmental Linkages
> resource conservation

Application: Besides searching the database, users can also make specific inquiries to GCRIO. The "Ask Dr. Global Change" page on this website allows users to ask specific global change questions, answered by experts at GCRIO. It is a useful source for general climate change information as well as technical, specific information on current global change research and technologies. GCRIO is helpful for users interested in surveying available technological and scientific information as well as global change programs created by other organizations.

Sponsor/Contact: GCRIO User Services
PO Box 1000; 61 Route 9W
Palisades, NY 10964 USA
Tel: +1-914-365-8930; Fax: +1-914-365-8922
website: http://www.gcrio.org
e-mail: help@gcrio.org

CLIMATE CHANGE DATA AND RESEARCH RESOURCES

Carbon Dioxide Information Analysis Center (CDIAC)

CDIAC, part of the Environmental Sciences Division at Oak Ridge National Laboratory, is the primary global climate change data and information analysis center for the U.S. Department of Energy. CDIAC activities include obtaining, evaluating, and archiving climate and GHG data; compiling and distributing data packages and computer models; distributing reports; and acting as the information center for the U.S. Global Change Research Program (USGCRP, see Climate Change Research and Data Resources section). CDIAC's scope of work covers a wide variety of topics related to the greenhouse effect and global climate change. These topics include concentrations of CO_2 and other GHGs; the role of the terrestrial biosphere and the oceans in the cycles of GHGs; emissions of CO_2 into the atmosphere; long-term climate trends; the effects of elevated CO_2 on vegetation; and the vulnerability of coastal areas to sea level rise.

Climate Change Topics

> greenhouse gas emissions
> carbon sequestration
> climate data

Environmental Linkages

> air pollution and air quality

Application: Users seeking sources of data on topics related to global climate change will be interested in CDIAC's *Trends Online: A Compendium of Data on Global Change* (accessible at http://cdiac.esd.ornl.gov/trends/trends.htm). This document provides synopses of frequently used time series of global climate change data at the national, regional, and global level. Topics include 1) historical and modern records of atmospheric concentrations of GHGs; 2) isotopic measurements of atmospheric GHGs; 3) estimates of global and national CO_2 emissions; 4) global emissions estimates for CFC-11 and CFC-12; 5) long-term climate records (temperature, precipitation, and clouds), for scales ranging from individual sites to the entire globe; 6) records for atmospheric aerosols; and 7) carbon content of the terrestrial biosphere, and carbon fluxes to the atmosphere from land-use changes. Entries in this document include tables, graphs, discussions of methods used, trends in the data, and references to literature providing further information. All data described in *Trends Online* are available upon request, on digital media from CDIAC at no cost.

Sponsor/Contact: CDIAC
Oak Ridge National Laboratory
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website: http://cdiac.esd.ornl.gov
e-mail: cdiac@ornl.gov

CLIMATE CHANGE DATA AND RESEARCH RESOURCES

Australia's Environmental Resources Information Network (ERIN)

Sponsored by Environment Australia, ERIN's primary responsibilities are environmental information management, including the development of a comprehensive and accessible information base, and the analysis and presentation of information, including maps and analyses for Australian government and environmental programs. Specifically, a database has been developed that provides technical environmental information such as maps, species distributions, documents, and satellite imagery, covering environmental themes ranging from endangered species to drought and pollution.

Climate Change Topics	***Environmental Linkages***
> greenhouse gas emissions	> land use
> climate data	> deforestation
> industrial manufacturing	> land degradation
> ecology/ecosystems	

Application: ERIN contains technical information helpful for assessing environmental impacts and developing environmental conservation and management policies, including impact assessments related to climate change. While the information was gathered from Australian studies, it can be useful as a guide for regions with similar climates and other biophysical characteristics. ERIN also publishes a biannual newsletter that highlights new data or analyses, such as a database of information on the impacts of mining activity. An example of information on ERIN is the Australian national pollutant inventory, which includes information on emissions to air, land, and water. Users can apply this information as an example of a national pollutant inventory that they can look at to see what type of information should be included. This national pollutant inventory provides an example of the type of information that users should include when developing their own pollutant inventories.

Sponsor/Contact: ERIN Unit
GPO Box 787
Canberra, ACT 2601, Australia
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website: http://www.environment.gov.au/epcg/erin/
e-mail: info@erin.gov.au

CLIMATE CHANGE DATA AND RESEARCH RESOURCES

Global Change Data and Information System (GCDIS)

GCDIS is a cooperative activity of U.S. agencies such as the U.S. Department of Energy and the U.S. Environmental Protection Agency participating in the U.S. Global Change Research Program (USGCRP). The GCDIS website contains links to U.S. and international data sources, libraries and documents, educational resources, other global change websites, global change software, and U.S. agency requests for proposals. GCDIS includes multi-disciplinary data relevant to both the United States and other global regions from atmospheric science, ecology, and oceanography, as well as economics and sociology. Information topics in the database include atmosphere, ecology/biology, geology, human dimensions, hydrology, land surface, oceans, paleoclimate, snow and ice, and solar physics. The data are generally technical or scientific, so the site is best utilized for specific information or data needs (e.g., determining the response of woody plants to increased atmospheric CO_2), rather than general inquiries on broad topics.

Climate Change Topics

> multiple sector impacts
> climate change data

Environmental Linkages

> air pollution and air quality
> land use
> deforestation

Application: Software programs that may be useful for analyzing climate change data are available through the GCDIS website. These programs are free to download, and are relevant to data acquisition, data analysis, and data presentation for assessments of global climate change. These data processing programs can be helpful for users performing scientific climate-related research such as baseline studies to determine potential vulnerabilities and impacts of climate change. They can also be applied to various country-specific settings. Examples of climate-related research and data, such as studies of the impact of increased CO_2 levels on plant growth, are included on the site, as are links to other software programs and libraries.

Sponsor/Contact: Global Change Data and Information System
Oak Ridge National Laboratory
Oak Ridge, TN 37831-6036 USA
website: http://www.gcdis.usgcrp.gov
e-mail: webmaster@www.gcdis.usgcrp.gov

CLIMATE CHANGE DATA AND RESEARCH RESOURCES

Global Change Master Directory (GCMD)

The U.S. National Aeronautic and Space Association's (NASA) GCMD is a comprehensive directory of descriptions of data sets relevant to U.S. and international global change research. The GCMD database includes descriptions of data sets covering climate change, the biosphere, hydrosphere and oceans, geology, geography, and human dimensions of global change. The mission of the GCMD is to assist the scientific community in the discovery of and linkage to earth science data, as well as to provide data holders with a means to present their data to the earth science community. The GCMD offers dataset descriptions in a standard format, the Directory Interchange Format (DIF), facilitating searches for dataset information with standardized descriptions of data and accepted keywords.

Climate Change Topics	***Environmental Linkages***
> climate data	> biodiversity
> ecology/ecosystems	> land use

Application: Users can apply the scientific data from this web page to conduct vulnerability analyses (using data such as the impact that changing atmospheric concentrations of CO_2 may have on particular crops) or baseline analyses such as emissions inventories. Users can also use the information on this website to see how other researchers have designed experiments to answer similar scientific questions. For example, one of the new datasets on the GCMD website describes and summarizes the data from a study on the impacts of CO_2 enrichment on carbon sequestration in native grasslands. CO_2 concentrations, which are increasing at unprecedented rates, will have a direct effect on plant production and plant communities and indirectly feed back into a number of soil biotic systems that influence long-term ecosystem characteristics, including aspects of carbon and nitrogen cycling. Two experiments were conducted to address how elevated CO_2 affects the plant production, physiology, soil microbiology, gas exchange of trace gases, and cycling of carbon and nitrogen in grasslands.

Sponsor/Contact: Tel: +1-301-794-3002
website: http://gcmd.gsfc.nasa.gov
e-mail: gcmdus@gcmd.gsfc.nasa.gov

RESOURCES FOR DEVELOPING GHG INVENTORIES:
GUIDELINES
DATA AND INFORMATION
EXAMPLES

RESOURCES FOR DEVELOPING GHG INVENTORIES: GUIDELINES

Atmospheric Emission Inventory Guidebook

This guidebook is published by the European Environment Agency and is designed to provide a comprehensive guide to the state of the science of GHG emissions inventory methods for a wide variety of GHG emission-generating activities. The guidebook discusses methods appropriate for national, regional, and local GHG emissions inventories. For each sector covered, the guidebook presents a list of activities considered part of the sector; the sector's predicted contribution to total GHG emissions; a description of acceptable methods as well as more detailed (and thus more costly) methods; lists of potential data sources; emissions factors; chemical species profiles; uncertainty estimates; and other methodology criteria. All data included (emissions factors, percent contributions, etc.) are data calculated for countries participating in the European CORINAIR program, a study of GHG emissions and other air pollutants in 31 European nations/regions.

Climate Change Topics

> greenhouse gas emissions
> emissions inventories
> multiple sector impacts

Environmental Linkages

> air quality and air pollution

Application: This guidebook presents detailed examples for the development of an GHG emission inventory program. Of particular interest in this document is the number and detail of categories presented. The 11 main categories include combustion in energy and transformation industries, nonindustrial combustion plants, combustion in manufacturing industry, production processes, extraction and distribution of fossil fuels, solvent and other product use, road transport, other mobile sources and machinery, waste treatment and disposal, agriculture and forestry, and nature. In addition, each of these categories is further divided into several subcategories; for example, the production processes category includes 40 subcategories for various types of industrial production.

Sponsor/Contact:

European Environment Agency
Kongens Nytorv 6
DK-1050 Copenhagen, Denmark
Tel: +45-33-36-72-03; Fax: +45-33-36-71-99
website: http://www.eea.eu.int/
e-mail: eea@eea.eu.int

Note: The guidebook is available in CDROM format from the EEA or at http://www.eea.eu.int/aegb/

RESOURCES FOR DEVELOPING GHG INVENTORIES: GUIDELINES

Greenhouse Gas Mitigation Assessment: A Guidebook

This book describes guidelines prepared by the U.S. Country Studies Program for evaluating options to mitigate greenhouse gas emissions and for addressing the risks posed by climatic change induced by human activity. These guidelines were developed to provide developing countries and countries with economies in transition with reference materials for conducting national mitigation assessments. The book delineates a step-wise methodology for evaluating GHG mitigation options for the energy, industrial, transportation, forestry, agriculture, and waste management sectors. It also describes the application of common analytical tools and models. The guidelines serve to assist countries 1) in making decisions about appropriate scope and methods, 2) in guiding assessment activities and providing instructions on elements of a mitigation assessment, and 3) in determining which analytical tools are best suited to their needs and how to use them.

Climate Change Topics

> greenhouse gas emissions
> mitigation

Environmental Linkages

> air pollution and air quality
> land use
> deforestation

Application: This book is a useful tool for analysts conducting GHG mitigation assessments, especially in developing countries. For each sector, the book includes an introduction to the sector, an overview of potential mitigation options, guidance for developing a baseline scenario, processes for evaluating mitigation options and their cost-effectiveness, and discussion of potential mitigation policies. The book also includes guidance on reporting the results of a mitigation assessment.

Sponsor/Contact: Kluwer Academic Publishers Group
P.O. Box 322
3300 AG Dordrecht, The Netherlands
Tel: +31-78-639-23-92; Fax: +31-78-639-22-54
website: http://www.wkap.com
e-mail: Services@wkap.nl

Notes:
1) This book is available from the publisher (contact information provided above). The cost is NLG 176.00, US $107.00, £70.50. The ISBN number is 0-7923-3781-6.
2) Citation for this book: Saythe, J. and S. Meyers. 1995. *Greenhouse Gas Mitigation Assessment: A Guidebook*. Kluwer Academic Publishers, The Netherlands.

RESOURCES FOR DEVELOPING GHG INVENTORIES: GUIDELINES

IPCC Guidelines for National Greenhouse Gas Inventories

The IPCC developed guidelines as a means of establishing a standard methodology for compiling national emissions inventories. The guidelines consist of three volumes: reporting instructions, a workbook, and a reference manual, covering the following six main inventory topics: energy, industrial processes, solvent and other product use, agriculture, land use change and forestry, and waste. They include simple, default methods and assumptions covering the major sources and sinks of greenhouse gases, and also discuss more detailed methods. Users can choose various methods and levels of detail depending on their needs and capabilities.

Climate Change Topics

- greenhouse gas emissions
- multiple sector impacts
- assessment guidelines
- industrial emissions

Environmental Linkages

- air pollution and air quality
- land use

Application: The guidelines provide step-by-step directions for assembling, documenting, and transmitting completed national inventory data. The workbook contains suggestions for planning and developing a national inventory, including instructions for calculating emissions of carbon dioxide and methane. The reference manual provides information on methods for estimating emissions for a broader range of greenhouse gasses and a complete list of sources for each. For example, this document describes two methodologies for estimating CO_2 emissions, including formulas, tables, and emissions factors.

Sponsor/Contact: IPCC Technical Support Unit
Hadley Centre
Meteorological Office
London Road
Bracknell RG12 2SY, United Kingdom
Fax: +44-1344-856-912

RESOURCES FOR DEVELOPING GHG INVENTORIES: GUIDELINES

Guidelines for the Voluntary Reporting of Greenhouse Gases

The U.S. Energy Information Administration developed guidelines to help U.S. companies measure and record their voluntary actions to reduce greenhouse gas emissions (or to increase carbon sequestration). These guidelines also contain valuable information that can be applied to emissions reduction projects in general. The guidelines consist of a general overview and two technical volumes. The general overview presents the process of analyzing emissions and emission reduction/carbon sequestration projects, and addresses issues such as minimum reporting requirements, time parameters, and international projects. Volume I contains detailed guidance for the electricity supply, residential and commercial buildings, and industrial sectors. Volume II presents sector-specific guidance for the transportation, forestry, and agricultural sectors. Volumes I and II provide conversion tables and default emissions factors for various fuels and electricity, as well as an index of the relative effects on climate of different greenhouse gases.

Climate Change Topics	***Environmental Linkages***
> greenhouse gas emissions	> air pollution and air quality
> multiple sector impacts	> deforestation

Application: Evaluating the performance of voluntary mitigation programs is important for estimating net changes in GHG emissions and for overall project justification. For example: a small trucking firm that carries 250 million ton miles (360 million metric ton kilometers) per year estimated its emissions per ton mile. The firm initiated an efficiency program that involved rerouting and driver training, and reduced unit emissions by 10%. At the same time, the firm experienced an increase in business of 50 million ton miles (72 million metric ton kilometers) per year (a 20% increase). Without the efficiency program, the increase in business would have increased total annual emissions from 5 million to 6 million pounds (2.25 million to 2.7 million kg) of CO. However, with the efficiency program in place the firm's total annual emissions would instead be 5.4 million pounds (2.43 million kg). Thus, this efficiency program resulted in an annual net reduction of 0.6 million pounds (0.27 million kg) of CO emissions.

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1000 Independence Avenue, SW
Washington, DC 20585 USA
Tel: +1-202-586-8800; Fax: +1-202-586-0727
website: http://www.eia.doe.gov
document at: http://www.eiainfo.eia.doe.gov/oiaf/1605/guidelns.html
e-mail: infoctr@eia.gov

RESOURCES FOR DEVELOPING GHG INVENTORIES: GUIDELINES

Monitoring, Evaluation, Reporting and Verification (MERV) of Climate Change Mitigation Projects: Discussion of Issues and Methodologies and Review of Existing Protocols and Guidelines

The Energy Analysis Program at Lawrence Berkeley Laboratory developed this paper, which reviews the issues and methodologies involved in the MERV of mitigation activities. MERV activities can include the installation and operation of equipment, measures, and systems; measurement protocols, data collection, and analysis; institutional development; estimation of baseline conditions; and calculation of positive project impacts. MERV guidelines can 1) increase the reliability of data for estimating GHG benefits; 2) provide real-time data so that mid-course corrections can be made; 3) introduce consistency and transparency across project types; and 4) enhance the credibility of projects with stakeholders. The paper reviews existing MERV protocols and guidelines that have been developed by governments, nongovernmental organizations, and international agencies. The reviews comment on the relevance and completeness of these protocols and identify several topics that future protocols and guidelines need to address.

Climate Change Topics

- greenhouse gas emissions
- energy efficiency
- renewable resources
- forestry

Environmental Linkages

- air pollution and air quality
- deforestation
- land use

Application: Readers of this paper will gain insight into designing and structuring effective MERV programs that apply measurement techniques and methods consistently across sectors, are technically sound and based on scientific principles, and are readily verifiable, objective, free from bias, relevant, transparent, and cost-effective.

Sponsor/Contact: Energy Analysis Program
Environmental Energy Technologies Division
Lawrence Berkeley National Laboratory
Berkeley, CA 94720 USA
Tel: +1-510-486-5396
website: http://www.lbl.gov/EAP/
document at: http://eande.lbl.gov/EA/PUBS/eappubs.qry?function=Find&num=1274

RESOURCES FOR DEVELOPING GHG INVENTORIES: DATA AND INFORMATION

Air Pollution Emissions Overview

This website, sponsored by the U.S. Environmental Protection Agency Office of Air Quality Planning and Standards, provides extensive information on air pollutants (not including CO_2) that may be harmful to human health. These pollutants, called criteria pollutants, include carbon monoxide, lead, nitrogen dioxide, ozone, particulate matter, and sulfur dioxide. Reducing emissions from these criteria pollutants often results in reduced greenhouse gas emissions as well. The website covers sources for criteria pollutants, and information on measuring, reporting, and using emissions data. It also contains links to sources for emissions data, air quality modeling, and software programs that assist in analyzing pollution data. This information can be used to perform emissions inventories for both criteria pollutants and greenhouse gases.

Climate Change Topics

> greenhouse gas emissions
> greenhouse gas inventories

Environmental Linkages

> air pollution and air quality

Application: This website may be helpful for users who are developing emissions inventories, and are looking for background information on criteria pollutants or specific emissions data from various types of pollution sources. Although the website does provide some information on greenhouse gasses, most of the material relates to other air pollutants. Thus this website would be particularly helpful for users who are looking to address the co-benefits between reducing both greenhouse gas emissions and criteria pollutant emissions.

Sponsor/Contact: U.S. Environmental Protection Agency
Office of Air Quality Planning and Standards
401 M St., SW (6101)
Washington, D.C. 20460 USA
website: http://www.epa.gov/oar/oaqps/emissns.html

RESOURCES FOR DEVELOPING GHG INVENTORIES: DATA AND INFORMATION

Compilation of Air Pollutant Emissions Factors

The Compilation of Air Pollutant Emissions Factors, also know as AP-42, is a database run by the U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards, to support air emissions research and air quality policy analysis. The fifth edition of AP-42 contains information on over 200 mobile and stationary sources of pollution applicable to the United States and other countries. This information includes brief descriptions of the processes that create the pollution (e.g., oil combustion); potential sources of air emissions from the processes; and common methods used to control these air emissions. Sources covered include external combustion, solid waste disposal, stationary internal combustion, evaporation loss, petroleum industry, organic chemical process industry, liquid storage tanks, inorganic chemical industry, food and agriculture industries, wood products industry, mineral products industry, metallurgical industry, and greenhouse gas biogenic. The website also contains links to other extensive scientific databases as well as links to emissions estimation tools.

Climate Change Topics

> greenhouse gas emissions
> mitigation technologies
> energy efficiency

Environmental Linkages

> air pollution and air quality

Application: Analysts can use emissions data to examine GHG emissions control strategies, determine the applicability of permitting and control programs, and assess the effects of mitigation strategies. For example, emissions factor data are useful for estimating pollutant emissions from particular sources, such as emissions of greenhouse gases alternative fuel types and energy producing facilities.

Sponsor/Contact:

InfoCHIEF; MD-14
U.S. EPA, Office of Air Quality Planning and Standards
Research Triangle Park, NC 27711 USA
Tel: +1-919-541-5285; Fax: +1-919-541-5680
website: http://www.epa.gov/ttn/chief/ap42.html
e-mail: info.chief@epamail.epa.gov

RESOURCES FOR DEVELOPING GHG INVENTORIES: DATA AND INFORMATION

Emissions and Cost Estimates for Globally Significant Anthropogenic Combustion Sources of NO_x, N_2O, CH_4, CO, and CO_2

This U.S. Environmental Protection Agency (U.S. EPA) report presents the results of a study to develop emission, efficiency, and cost estimates for important greenhouse gas emission sources. The report includes performance and cost estimates for a variety of emission control technologies. The study covers five greenhouse gases and precursors: carbon dioxide (CO_2), carbon monoxide (CO), methane (CH_4), nitrogen oxides (NO_x), and nitrous oxide (N_2O). Although the primary focus of this report is on U.S. emissions, the results may be of interest and relevance for assessing similar approaches and technologies in other countries.

Climate Change Topics

> greenhouse gas emissions
> emission factors

Environmental Linkages

> air pollution and air quality

Application: The report provides data useful in preparing emission inventories or analyzing potential mitigation options. The report includes emission factors for 80 combustion sources in seven categories: utility, industrial, fuel production, transportation, residential, commercial, and kilns/ovens/dryers. It also presents quality ratings for each emissions factor, which indicate the overall quality of the supporting data.

Sponsor/Contact: U.S. EPA
Air and Energy Engineering Research Laboratory
Research Triangle Park, NC 27711 USA
Tel: +1-919-541-2821; Fax: +1-919-541-5227
website: http://es.epa.gov/program/epaorgs/ord/aeerl.html

Notes:
1)This document can be ordered for US $23.00 through the U.S. National Technical Information Service (Tel: +1-703-487-4650). The order number is PB 90-216 433/AS. The project summary can be accessed free at http://www.epa.gov/clariton/clhtml/pubord.html
2) Citation for this document: United States Environmental Protection Agency. 1990. *Emissions and Cost Estimates for Globally Significant Anthropogenic Combustion Sources of NOx, N2O, CH4, CO, and CO2.* Air and Energy Engineering Resource Laboratory. NTIS document number PB 90-216-433/AS.

RESOURCES FOR DEVELOPING GHG INVENTORIES: DATA AND INFORMATION

Future Emissions and Concentrations of Carbon Dioxide: Key Ocean/Atmosphere/Land Analyses

Prepared by Australia's Commonwealth Scientific and Industrial Research Organization (CSIRO), Division of Atmospheric Research, this report presents results from 20 different global CO_2 concentration models developed at 18 research institutions worldwide. It includes three types of models: 1) forward projections, calculating the atmospheric CO_2 concentrations resulting from specified emission scenarios; 2) inverse calculations, determining the emission rates that would be required to achieve stabilization of CO_2 concentrations via specified pathways; and 3) impulse response functions, calculations required for determining a gas's potential to affect climate change. The report also includes documentation of the specifications, the models used, the results obtained, and the key uncertainties in the calculations. Some preliminary interpretations of the results are included as well.

Climate Change Topics

> greenhouse gas emissions
> carbon sequestration
> climate data

Environmental Linkages

> air pollution and air quality
> water pollution and water quality

Application: This report gives the reader background on recent efforts to model future global CO_2 concentrations. The results from these models demonstrate the large uncertainty in the understanding of the relationship between greenhouse gas emissions and global CO_2 concentrations. However, conclusions can be drawn from the analysis of these models. First, continuing increases in fossil carbon emissions will lead to continuing increases in atmospheric CO_2. Second, even stabilizing emissions at 1995 levels will lead to increasing CO_2 concentrations, which means that major reductions in CO_2 emissions are required in order to stabilize atmospheric CO_2 levels. The report recommends stabilization of CO_2 concentrations at 650 ppmv (approximately double the 1970s concentrations), which will require substantial decreases in the current rate of increase in emissions. In the future it will require actual reduction in emissions.

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website: http://www.csiro.au
e-mail: enquiries@csiro.au

Note: Get this document in PostScript format at http://cdiac.esd.ornl.gov/ftp/db1009/report/ or it can be ordered from CSIRO (ISBN 0 643 05356 9).

RESOURCES FOR DEVELOPING GHG INVENTORIES: EXAMPLES

Australian National Greenhouse Gas Inventory

The Australian Government has posted its entire greenhouse gas inventory, along with a detailed description of methodologies, emission factors, activity data, previous inventories, and data trends. The website also contains fact sheets on emissions from the energy (mobile and stationary sources), agriculture, waste, industrial, and forestry and land clearing sectors.

Climate Change Topics	***Environmental Linkages***
> greenhouse gas emissions	> air pollution and air quality
> greenhouse gas inventories	

Application: Information provided on this website may be helpful for users who are developing greenhouse gas emissions inventories, perhaps as a part of their commitments to the UNFCCC. Although similar to the U.S. Inventory, the Australian Inventory may be of particular interest to users in developing countries because it has focused on several topics which may be of interest to developing countries, such as the country's large proportion of non-CO_2 emissions sources and its high population growth. The inventory devotes significant consideration to the agriculture, land use change, and forestry sectors in its inventory, which may be of interest to countries where these are significant parts of the economy.

Sponsor/Contact: Australian Greenhouse Office
GPO Box 621
Canberra ACT 2601
Tel: +612-6274-1859; Fax: +612-6274-1390
website: http://www.greenhouse.gov.au/inventory/index.html
e-mail: greenhouse.assessment@greenhouse.gov.au

RESOURCES FOR DEVELOPING GHG INVENTORIES: EXAMPLES

Update of the Netherlands' Second National Communication on Climate Change Policies

This website, developed by the National Institute of Public Health and the Environment, contains an update of the Second National Communication on Climate Change Policies, which was prepared for the Conference of Parties under the Framework Convention on Climate Change. It contains updated data, methodologies, and references, as well as information that was unchanged since the initial Second National Communication. The Dutch government has been at the forefront of greenhouse gas emissions inventories for many years, and this document contains some of the most up-to-date information on emissions inventories.

Climate Change Topics

> greenhouse gas emissions
> greenhouse gas inventories

Environmental Linkages

> air pollution and air quality

Application: Information provided on this website may be helpful for users who are developing greenhouse gas emissions inventories, perhaps as a part of their commitments to the UNFCCC. This inventory can be used both as a reference for methodologies, or as an example of format and documentation that should be included in an emissions inventory or National Communication. Examples of new information in this Update include changed estimates of CO_2 sequestration; revised emissions factors; and using data from energy consumption at large plants, rather than aggregated fossil fuel emissions factors.

Sponsor/Contact:

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Air and Energy Directorate/640, Climate Change Division
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The Hague, The Netherlands
Tel: +31-70-339-4690; Fax: +31-70-339-1310
website: http://www.natcom2.rivm.nl
e-mail: peters@dle.dgm.minvrom.nl

RESOURCES FOR DEVELOPING GHG INVENTORIES: EXAMPLES

U.S. Greenhouse Gas Inventory

This global warming-related website, developed by the U.S. Environmental Protection Agency, provides introductory information on greenhouse gas inventories, including the purposes of developing inventories and information on their content and methods. The website also includes the Inventory of U.S. Greenhouse Gas Emissions and Sinks for 1990-1997, the final version of the Inventory of U.S. Greenhouse Gas Emissions and sinks, 1990-1996, and Chapter 3 of the 1997 U.S. Climate Action Report, which can be downloaded or printed.

Climate Change Topics

> greenhouse gas emissions
> greenhouse gas inventories

Environmental Linkages

> air pollution and air quality

Application: Information provided on this website may be helpful for users who are developing greenhouse gas emissions inventories, perhaps as a part of their commitments to the UNFCCC. The documents on this website contain detailed descriptions of methodologies used to calculate U.S. emissions estimates, along with activity data and emissions factors. They can also be used as references for the type of information and documentation that should be included in an emissions inventory. Appendices to the reports contain methodologies for estimating emissions from fossil fuel combustion, stationary sources, mobile sources, and methane produced from coal mining, natural gas, petroleum, enteric fermentation, manure management, and landfills.

Sponsor/Contact: U.S. Environmental Protection Agency
401 M St., SW
Washington, D.C. 20460 USA
website: http://www.epa.gov/globalwarming/inventory/index.html

MITIGATION RESOURCES:
GENERAL
METHANE
ENERGY
FORESTS
CITIES AND URBAN AREAS
IMPLEMENTATION AND ASSISTANCE PROGRAMS

MITIGATION RESOURCES: GENERAL

U.S. EPA States Guidance Document: Policy Planning to Reduce Greenhouse Emissions

This publication is a guide to help policy makers compile a practical and comprehensive action plan for addressing greenhouse emissions. The guide was created to assist U.S. states in developing climate change action plans and could be a useful guide for other countries that are developing similar plans. The guide addresses complex and uncertain scientific issues in developing policies that potentially affect multiple economic sectors. It is organized into three sections: 1) information to help establish a focal point for the initiation of climate change programs, 2) description of specific sources and sinks of greenhouse gases across all societal sectors, and 3) discussion of organizational and analytical topics relating to climate change program design.

Climate Change Topics

> greenhouse gas emissions
> energy efficiency
> mitigation

Environmental Linkages

> air pollution and air quality

Application: This guide presents approaches and examples useful for developing realistic goals and evaluation criteria for an emissions reduction program. The guide addresses how to overcome constraints and obstacles to implementation is a particular strength of the guidance. Several examples detail issues faced by states in developing climate change policies. For example, a coalition of state agencies and area experts developed the Vermont Comprehensive Energy Plan, which will change Vermont's energy use patterns, resulting in anticipated reductions of 12% for greenhouse gas emissions, 18% for acid rain precursors, and 27% for per capita nonrenewable energy use.

Sponsor/Contact: U.S. Environmental Protection Agency
Office of Policy, Planning, and Evaluation
State and Local Outreach Program
Washington, DC 20460 USA
Tel: +1-202-260-2090
website: http://www.epa.gov/oppe/oppe.html

Note: This guide can be obtained from U.S. EPA. The document number is EPA230-B-95-002. A fee may be charged for the document. Those interested in this guide may also be interested in the *States Workbook: Methodologies for Estimating Greenhouse Emissions* (from U.S. EPA's Office of Policy, Planning, and Evaluation, Climate Change Division), which contains guidelines and suggestions for compiling an inventory of greenhouse emissions and sinks.

MITIGATION RESOURCES: GENERAL

Technologies, Policies and Measures for Mitigating Climate Change: IPCC Technical Paper I

This Technical Paper provides an overview and analysis of technologies and measures to limit and reduce greenhouse gas (GHG) emissions and to enhance GHG sinks under the United Nations Framework Convention on Climate Change (UNFCCC). The paper focuses on technologies and measures for the countries listed in Annex I of the UNFCC, while noting information as appropriate for use by non-Annex I countries. Technologies and measures are examined over three time periods, with a focus on the short term (present to 2010) and the medium term (2010-2020), but also include discussion of longer term (e.g., 2050) possibilities and opportunities. For this analysis, the authors draw on materials used to prepare the IPCC Second Assessment Report and previous IPCC assessments and reports. Broader measures affecting national economies are discussed in a final section on economic instruments. It should be noted that the choice of instruments could have economic impacts on other countries.

Climate Change Topics	***Environmental Linkages***
> greenhouse emissions	> air pollution and air quality
> carbon sequestration	> resource conservation
> economic welfare	> deforestation
> mitigation	> water pollution and water quality

Application: This report describes current strategies for the mitigation and sequestration of greenhouse gases. The report focuses on Annex I countries while analyzing a wide range of potential GHG reduction measures such as market-based programs; voluntary agreements; regulatory measures; research, development, and demonstration (RD&D); taxes on GHG emissions; and emissions permits/quotas. The report addresses technological and economic incentive options for reducing GHG emissions in numerous sectors, including buildings, transport, industry, energy supply, agriculture, forest, and solid waste and wastewater disposal. Each option presented is evaluated on the basis of three criteria: *technical potential*, the amount by which a technology or policy could reduce GHG emissions or improve energy efficiency; *economic potential*, the portion of the technical potential that could be achieved cost-effectively; and *market potential*, the portion of economic potential that currently can be achieved under existing market conditions.

Sponsor/Contact: IPCC-World Meteorological Organization Building
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website: http://www.ipcc.ch

Note: The English versions of IPCC's Technical Papers are available on the IPCC website. Spanish and French versions are also published and can be obtained from IPCC.

MITIGATION RESOURCES: GENERAL

Services, Transportation, Agriculture, Industry, and Residential (STAIR) Spreadsheet Model

STAIR is a spreadsheet model developed by Lawrence Berkeley National Laboratory (see LBL entry in Mitigation Resources: Energy section), that can be used to analyze long-term energy supply and demand for various sectors in developing countries. Organized into several spreadsheets, STAIR provides an accessible and useful framework that can aid energy assessment and analyze energy intensive sectors. Users can identify and track changes through linkages, perform sensitivity tests, and simulate the effects of various climate scenarios and other user-defined scenarios.

Climate Change Topics

> energy efficiency
> transportation
> agriculture
> industrial manufacturing

Environmental Linkages

> air pollution and air quality

Application: STAIR allows users to evaluate the effects of different policy scenarios on energy supply and demand, for example, reducing greenhouse gas emissions by using alternative, low-emissions fuels. The main spreadsheet estimates energy supply and demand on the national level; a cost spreadsheet estimates the capital requirements for supplying electricity; and one or more spreadsheets exist for each main energy-use sector: services, transportation, agriculture, industry, and residential. The sectoral spreadsheets consider principal energy end uses and factors that determine their future evolution in order to estimate energy use for each sector. For each sector there is a choice of sectoral modules that vary in data requirements and level of analytical detail.

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website: http://www.lbl.gov

MITIGATION: METHANE

Coalbed Methane Outreach Program (CMOP)

The CMOP, run by the U.S. Environmental Protection Agency (EPA), encourages coal mines to recover and use coal bed methane (CBM) as a profitable energy source. This program provides information and technical assistance to help organizations and industry overcome regulatory, institutional, and technological barriers to CBM development. CMOP is currently cooperating with organizations in coal producing countries such as Australia, China, Czech Republic, Poland, Russia, Ukraine, and the United Kingdom.

Climate Change Topics

> greenhouse gas emissions
> methane emissions mitigation

Environmental Linkages

> air pollution and air quality

Application: The Coalbed Methane Outreach Program may be helpful for users involved in coal mining and associated industries, either as participants or regulators. Project activities include evaluating CBM drainage and use technologies, assessing project finance mechanisms, and identifying CBM markets. For example, CMOP assisted China's State Administration of Coal Industry in developing a national assessment of CBM mitigation and use. Included in the report are evaluations of potential CBM application in direct industrial and residential use, natural gas pipeline systems, power generation options, ventilation air use options, gas storage, and natural gas vehicles. The CMOP website is also a valuable resource, providing downloadable copies of U.S. EPA technical reports, contact information for companies active in CBM development and use, contact information for organizations promoting CBM development internationally, and archived copies of CMOP's quarterly newsletter.

Sponsor/Contact:

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MITIGATION: METHANE

Livestock Analysis Model (LAM)

LAM is a PC-based model that can be used to estimate current and future cattle and buffalo production. The model can assist in developing estimates of baseline and future livestock methane emissions based on supply and demand for livestock products (milk, meat, and draft power).

Climate Change Topics

> greenhouse gas emissions
> agricultural methane

Environmental Linkages

> air pollution and air quality

Application: LAM may be helpful for users interested in projecting future livestock and dairy production and assessing future methane emissions in their country or region. The model also allows users to evaluate the impact of policies or interventions to reduce emissions. For example, providing improved nutrients to rural dairy cows would increase milk production per lactation, reduce the inter-calving interval between lactations, and increase feed digestibility. Users could then enter these new digestibility characteristics into LAM, which would simulate the changed population and methane emissions that would result from the implementation of this intervention. The model is data-intensive, requiring inputs on current dairy, meat, and draft power demand and production, current size of herds, production targets, and characteristics of feed and care for the livestock (for estimating methane production). LAM requires Excel 5.0 to run.

Sponsor/Contact: U.S. EPA
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Washington, D.C. 20460 USA
website: http://www.epa.gov/rlep

MITIGATION: METHANE

Landfill Methane Outreach Program (LMOP)

LMOP, run by the U.S. Environmental Protection Agency, is a voluntary assistance and partnership program that helps facilitate and promote the use of landfill gas as a renewable energy source. These landfill gas to energy (LFGTE) projects are designed to be both environmentally beneficial, through mitigating methane emissions, and economically beneficial, allowing communities to harness an inexpensive and otherwise unused energy source. LMOP's international component offers a range of outreach, education, and technical assistance to developing countries.

Climate Change Topics

> greenhouse gas emissions
> agricultural methane

Environmental Linkages

> air pollution and air quality

Application: LMOP may be a helpful resource for users who are interested in learning more about the technical and economic feasibility of LFGTE project development, such as local governments or other groups interested in alternative energy sources. LMOP has assisted international projects, including LFGTE project feasibility studies in Brazil, the Philippines, Thailand, and Mexico; workshops associated with environmental conferences in Poland, Thailand, Ukraine, Mexico, and China; and onsite engineering support provided to landfill gas utilization projects. The LMOP website is also a valuable resource, containing downloadable LFGTE handbooks and technical guidelines.

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MITIGATION: METHANE

Ruminant Livestock Efficiency Program (RLEP)

RLEP, a program run by U.S. Environmental Protection Agency, is dedicated to helping producers voluntarily reduce emissions of methane and other greenhouse gasses from ruminant livestock production. RLEP promotes improved livestock management practices that reduce methane emissions by 25 to 75 percent, while making animals more productive as well. Activities include improvement of feed and feed supplement using local resources, improving the efficiency and productivity of feed production, and improving herd genetics.

Climate Change Topics

> greenhouse gas emissions
> methane emissions mitigation

Environmental Linkages

> air pollution and air quality

Application: RLEP may be helpful for users interested in lowering livestock methane emissions, such as government agencies or rural development organizations. Projects are currently being developed in Bangladesh, Brazil, India, Mexico, Nepal, Tanzania, Ukraine, and Zimbabwe. In Zimbabwe the national government and development organizations have been exploring the potential of using sunflower seed cake protein supplements to improve animal production efficiency and reduce methane emissions.

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MITIGATION RESOURCES: ENERGY

Centre for the Analysis and Dissemination of Demonstrated Energy Technologies (CADDET)

CADDET collects, analyzes, and disseminates information on demonstration projects in energy efficient and renewable energy technologies. Working within the framework of the International Energy Agency (IEA), CADDET's objective is to provide impartial information about proven technologies to help accelerate their adoption in the marketplace. CADDET functions as two separate operations: CADDET Energy Efficiency and CADDET Renewable Energy. Each organization maintains a website that it uses to share information on energy technologies. The CADDET Energy Efficiency website provides access to a searchable database of articles, brochures, and other publications about energy efficient technologies and their uses. The CADDET Renewable Energy website provides technical information, newsletters, and brochures about renewable energy technologies. The site also contains several case studies of recent renewable energy technology applications.

Climate Change Topics	***Environmental Linkages***
> energy efficiency	> air pollution and air quality
> renewable resources	> resource conservation

Application: CADDET **Energy Efficiency** provides a database of over 1,600 energy saving technology applications that can assist in the design and development of energy-saving projects and programs. Examples cover a wide range of applications, project sizes, and community types. For example, the website includes discussions of a relatively small campaign to encourage the use of energy efficient household appliances in Malmö, Sweden, and a large-scale community heating project in the United Kingdom. Projects in the database are searchable by technology, industry, and country.

The CADDET **Renewable Energy** site provides information on full-scale commercial projects operating in member countries, currently Australia, Belgium, Denmark, Finland, Japan, The Netherlands, Norway, Sweden, the United Kingdom, the United States, and the European Commission (DGXVII — Energy). The CADDET program covers the full range of renewable energy technologies, including tidal/wave, wind, waste, photovoltaic, geothermal, biomass, solar/thermal, and hydro. An example of a recent project detailed on CADDET is the construction of the world's first off-shore wind farm.

Sponsor/Contact: CADDET Centre for Renewable Energy

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MITIGATION RESOURCES: ENERGY

Energy Efficiency and Renewable Energy Network (EREN)

EREN, an information network for energy efficiency and renewable energy technologies, is run by the U.S. Department of Energy (DOE). The website provides links to DOE sites and to other U.S. and international government, educational, commercial, and organizational sources. The linked web pages provide general information, and are helpful for users looking for an introduction to available technologies. The links are to organizations and institutions supporting renewable energy and energy efficiency technologies and programs rather than actual distributors of products.

Climate Change Topics

> renewable resources
> energy efficiency
> mitigation technologies
> transportation
> solid waste

Environmental Linkages

> air pollution and air quality
> resource conservation

Application: Renewable energy and energy efficiency resources are identified here that relate to a variety of users and affected groups, including institutions and organizations specializing in alternative fuels; developers of alternative energy sources such as geothermal, solar, wind, and hydropower; and managers of utilities, transportation systems, and manufacturing facilities. For example, under the topic of alternative fuels, visitors will find example applications of renewable resources and energy efficiency projects in the transportation and power generation sectors. Users with questions about alternative fuels or any other renewable energy and energy efficiency topic may find the "Ask an Energy Expert" page on this website helpful to make specific inquiries about technologies.

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website: http://www.eren.doe.gov
e-mail: doe.erec@nciinc.com

MITIGATION RESOURCES: ENERGY

Energy Technology Systems Analysis Program (ETSAP)

ETSAP, sponsored by the International Energy Agency, is a research program that encourages the development of integrated energy and environmental policies. The program consists of teams from 35 developing and industrialized countries, who are using the MARKAL model (see MARKAL-MACRO entry in Mitigation Resources: Energy section) to quantify the costs and benefits of emissions reductions at a national and multicountry level. Teams also examine the role of technology in affecting changes in energy consumption, production patterns, and emissions profiles. ETSAP maintains databases of its research results.

Climate Change Topics	*Environmental Linkages*
> mitigation technologies	> air pollution and air quality
> energy systems planning	> water pollution and water quality
> greenhouse gas emissions	> resource conservation

Application: ETSAP has an outreach program designed to help participants develop a MARKAL energy systems models for integrated energy system decision-making, and to assist participants in responding to UNFCCC requirements. The program helps users analyze local or national energy systems, compile energy technology databases, examine alternative scenarios for future energy system development, and calculate emissions by sources of greenhouse gasses. With this information, it then helps users project future national emissions inventories and identify the most cost-effective policies to deal with local environmental pollution and climate change.

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website: http://www.ecn.nl/unit_bs/etsap
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MITIGATION RESOURCES: ENERGY

Energy Technology Options (ETO) Model

ETO is a multisector linear-programming model developed by researchers from Dehli University (India) and Lawrence Berkeley National Laboratory (USA) for evaluating energy system options. ETO is used to identify the least-cost options for providing energy services, evaluate the resulting levels of CO_2 associated with each option, and estimate the impact of reducing emissions on the nation's capital and foreign exchange requirements. ETO allows the user to either maximize potential carbon reduction or minimize potential costs and negative economic impacts. The model results can help the user identify policies and measures that would need to be implemented on the national and international levels to make a major contribution to restraining the growth of carbon emissions.

Climate Change Topics

- energy efficiency
- industrial manufacturing
- agriculture
- transportation
- urban, residential, commercial energy use

Environmental Linkages

- air pollution and air quality

Application: ETO allows the user to include analysis of a variety of energy-using activities in major end-use sectors: agriculture, manufacturing, transport, urban and rural residential, and commercial. For example, the model divides the manufacturing sector into steel, cement, aluminum, petrochemicals, paper, fertilizer, and textiles. Each energy-intensive industry is further divided into several manufacturing processes. Energy efficiency improvement options range from retrofitting techniques or simple measures with small investments to major technology conversions with large investment requirements. Other options include improved belts, better motors, and power factor correction.

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website: http://www.lbl.gov

MITIGATION RESOURCES: ENERGY

Energy and Power Evaluation Program (ENPEP)

ENPEP is a set of models for integrated energy analysis that can be used to assess greenhouse gas mitigation strategies. Using a user-supplied macroeconomic analysis, ENPEP develops an energy demand forecast, carries out an integrated supply/demand analysis for the entire energy system, evaluates the electric system component of the energy system in detail, and determines the impacts of alternative scenarios. ENPEP explicitly considers the impacts that the power system has on the rest of the energy system, on the economy as a whole, and on pollutant and GHG emissions. ENPEP can be used at the local, regional, or national levels and can cover short (1-3 years) to long (50 years maximum) time horizons.

Climate Change Topics

> mitigation planning
> energy use planning
> economic welfare

Environmental Linkages

> air pollution and air quality

Application: Using ENPEP, researchers can perform total energy system analyses, detailed electric system analyses, and emissions analyses under various control scenarios. ENPEP data requirements include base-year energy balance and energy prices, energy technology costs and performance, and international energy price projections. Energy system structure and data input are adaptable to local conditions, and the model can be expanded with data development. Case studies with one or more ENPEP modules have been conducted in many countries. Recent applications include Malaysia, China, Colombia, Indonesia, Nepal, Turkey, Romania, Peru, and the United States.

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Notes:
1) The model has the following computer requirements: IBM 386 (math co-processor recommended); 2MB RAM, 30MB hard drive, VGA color monitor, and DOS 3.1 or higher.
2) IAEA offers annual ENPEP training courses. Courses are also occasionally offered by the U.S. Department of Energy, the U.S. Agency for International Development, and the World Bank.
3) The following document may be useful to those interested in ENPEP: Jusko, M.J. et al. 1987. *Energy and Power Evaluation Program (ENPEP) Documentation and User's Manual*. Energy and Environmental Systems Division, Systems Analysis, Development and Evaluation Group, Argonne National Laboratory.

MITIGATION RESOURCES: ENERGY

Global Energy Marketplace (GEM)

GEM is a searchable on-line database sponsored by the U.S. Environmental Protection Agency and created by the Center for Renewable Energy and Sustainable Technology (CREST). GEM contains annotated web links to over 2,500 websites on the subjects of energy efficiency and renewable energy. The links are supplied by organizations in countries all over the world. GEM entries include studies, reports, publications, economic analyses, product directories, discussion groups, country profiles, mitigation assessments, and other beneficial resources related to energy efficiency and renewable energy resources. The database provides general information on topics as well as links to companies and institutions offering technical services and products. In addition, the database continues to grow. Users are encouraged to suggest new resources to include in the database.

Climate Change Topics

> energy efficiency
> renewable resources

Environmental Linkages

> air pollution and air quality

Application: The GEM database is divided into the following categories: energy efficiency, renewable energy, sustainable living, energy systems, regions, and types of information (education, research, policy, economics, products, services). Each category is further subdivided by sector (e.g., the energy systems category is divided into cogeneration, general, utilities, and village power). Examples of database entries include plans for reducing greenhouse gases in Uganda, a description of the development and construction of a small-scale energy plant in Nepal, the website of a company that designs and builds hydro powerplants in Brazil, and an electronic journal dedicated to current and historic issues of sustainability on the Pacific Rim.

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MITIGATION RESOURCES: ENERGY

Greenhouse Gas Energy Technology Information Exchange (GREENTIE)

GREENTIE is an initiative of the International Energy Agency (IEA) and the Organization for Economic Cooperation and Development (OECD). It was established in 1993 to improve the awareness of, and facilitate the access to, suppliers and experts of "clean technologies," particularly technologies that help mitigate the emissions of greenhouse gases. The GREENTIE directory contains information on over 7,700 suppliers of greenhouse gas mitigation technology and technical expertise. Data in the directory is supplied by an international information network based in 35 countries worldwide. Each entry in the database is classified into one of two categories: technical expertise and economic activities. The main technology categories include energy supply, energy end use, and agriculture and forestry practices. The economic activities are classified by geographic area and industrial sector. Information from GREENTIE is distributed through the Internet, on a CD-ROM for Windows, and through Technology Directories, electronic reports on specific technologies. This information is useful to those interested in surveying or obtaining the latest economic and technological measures on GHG mitigation.

Climate Change Topics

- greenhouse gas emissions
- energy efficiency
- renewable resources

Environmental Linkages

- air pollution and air quality
- resource conservation
- deforestation
- land use

Application: Useful examples of efficient and renewable energy supply technologies, identification of programs providing technical assistance, and implementation information is found at this website. Specific technologies addressed include biomass-fired power generation, photovoltaics, geothermal electric, pelletized biomass combustion, biogas by anaerobic digestion, small-scale hydro, solar ponds, solar thermal electric technologies, wind energy conversion systems, tidal energy, ocean wave energy, and landfill gas recovery and utilization techniques. The following may be of particular interest for activities in developing countries, *The Association for Energy Development & Planning* (energy infrastructure enhancement and management at a local level), *The Earth Centre* (offers training in development of sustainable energy and waste systems), and *The Fraunhofer Institute for Solar Energy Systems* (technical assistance and technologies for renewable energy supplies in newly industrialized and developing countries).

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website: http://www.greentie.org/home.htm
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MITIGATION RESOURCES: ENERGY

Handbook of Climate Change Mitigation Options for Developing Country Utilities and Regulatory Agencies

This handbook, developed by the U.S. Agency for International Development and the U.S. Energy Association, provides an overview of best practices for generating, transmitting, distributing, and consuming electric power in developing countries. This resource is designed as a screening tool to help users identify alternative best practices currently being utilized by utility operators, evaluate characteristics of these practices, compare the GHG emissions effect and cost-effectiveness of these practices, and locate resources and contacts to obtain more detailed information. It focuses on the technical and financial resources available to implement these practices, as well as the implications that these practices may have for climate change.

Climate Change Topics

- greenhouse gas emissions
- mitigation technologies
- energy efficiency
- renewable resources

Environmental Linkages

- air pollution and air quality

Application: This handbook is helpful for developing country utilities and utility regulators who are assessing GHG emissions and mitigation options, as well as general issues related to the energy sector. The handbook addresses best practices for different types of generation systems, utility management policies, and regulatory reform policies. For each of these best practices, the handbook provides descriptive characteristics, information on its impact on climate change, issues associated with implementing the action, and resources and contacts for further information. This handbook is intended as a screening tool for potential utility management and operating practices; it does not provide methodologies for preparing baseline emissions inventory, defining a response strategy, or projecting the impact of alternative power sector actions on GHG emissions trends.

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MITIGATION RESOURCES: ENERGY

International Renewable Energy Network and Information Center (IRENIC)

The IRENIC website is sponsored by the National Renewable Energy Laboratory with funding from the U.S. Environmental Protection Agency and the U.S. Department of Energy. It is becoming a primary global source of technical, analytical, application, and policy information about renewable and efficient energy technologies for the international community. It describes these technologies, explains how to develop projects using these technologies, and provides expert assistance and examples. A primary focus of this website is to provide the data and analytical tools that can help people in developing countries and task managers at the World Bank and other organizations include sustainable energy technologies in their projects. This resource is helpful for users looking for general information on developing energy-related projects, as well as for those with specific technical assistance needs.

Climate Change Topics

> greenhouse gas emissions
> mitigation technologies
> energy efficiency
> renewable resources

Environmental Linkages

> air pollution and air quality
> resource conservation

Application: Information provided on this website covers the entire energy project cycle. For the project conception phase, IRENIC has gathered information and data sources to help identify potential renewable energy or energy efficiency projects, including databases for project ideas and technologies. For the project evaluation phase, the website provides information as well as links to interactive tools for evaluating projects. For the project completion phase, the website provides information on getting loans and grants to help finance a renewable energy or energy efficiency project. It also provides procurement specifications for obtaining renewable energy equipment. An example of resources available on this website is an online tool called Project Assistant that will help users estimate the cost of providing power to remote areas. To do this, the user defines the demand on the power supply (i.e., whether the primary uses of electricity are lights, refrigerators, televisions), from which the program can estimate times of increased demand for electricity.

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website: http://www.nrel.gov/business/international/irenic_home.html

Note: The Center provides information on funding resources for renewable energy and energy efficiency-related projects.

MITIGATION RESOURCES: ENERGY

Inventory of Technologies, Methods, and Practices for Reducing Emissions of Greenhouse Gases

This report provides a broad inventory of GHG mitigation technologies and options. The inventory describes current energy technology characteristics, energy efficiency options, and alternative end-use technologies for use in evaluating mitigation measures. The inventory, a supplement to IPCC's Second Assessment Report, was created by IPCC's Working Group II.

Climate Change Topics

- greenhouse gas emissions
- mitigation technologies
- energy efficiency
- renewable resources

Environmental Linkages

- air pollution and air quality
- land use
- deforestation

Application: The inventory provides information and background on 105 technology options for reducing GHG emissions. The coverage of each technology includes a basic description, performance characteristics, capital and operating costs, environmental characteristics, and infrastructure requirements. The inventory is organized by the following technology categories: energy supply (further subdivided into fossil fuel, renewable energy, nuclear, and energy transfer); energy end use (further subdivided into transportation, buildings, and industrial); agricultural and forestry practices; and other techniques.

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Note: This document can be accessed free of charge at http://www.energyanalysis.anl.gov/1-vol1.htm

MITIGATION RESOURCES: ENERGY

Lawrence Berkeley National Laboratory (LBL) Energy Analysis Department

Lawrence Berkeley National Laboratory (LBL) is part of the U.S. Department of Energy's (U.S. DOE) national laboratory system, and its Energy Analysis Department is a principal center of energy-related research in the United States and abroad. The department's goal is to develop and disseminate information on energy issues to other agencies, industry, and governments, as well as to international institutions. Providing technical assistance in designing energy systems and in formulating environmental and energy policies is a critical part of its mission. The department's areas of expertise include energy efficiency standards; global warming in urban areas; building energy data; compilation and analysis; government and industry programs; electricity markets and policy; end-use forecasting and market assessment; international energy; and greenhouse-gas mitigation.

Climate Change Topics

> energy efficiency
> building energy conservation
> mitigation technologies
> cities and urban areas

Environmental Linkages

> air pollution and air quality

Application: Developing effective energy codes and standards can reduce GHG emissions, enhance economic efficiency, increase consumer welfare, and avoid urban/regional pollution. LBL's Energy Analysis Department has extensive experience assisting developing countries in the creation and application of such standards. The department helps planners develop the skills necessary to develop, administer, and continually adjust energy efficiency standards. Current department projects include *Appliance and Lighting Standards Assessment*, in Ghana (1998-present); *Commercial Building Standards Compliance*, in the Philippines (1996-present); and *Development and Implementation of Commercial Building Standards*, in Mexico (1993-present). The department has also worked closely with the governments of Australia, China, Colombia, Denmark, Egypt, the European Union, France, Indonesia, Malaysia, the Netherlands, Pakistan, the Russian Federation, Singapore, South Korea, Sweden, Switzerland, and Thailand.

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MITIGATION RESOURCES: ENERGY

MARKAL-MACRO

The MARKAL-MACRO model is an assessment tool designed for integrated economy, energy, and environmental analysis and planning by combining a macroeconomic growth model (MACRO) with a model of the energy sector (MARKAL). This integrated version models energy-economy-environmental interactions, linking capital, labor, and energy inputs into the economy. It can cover local, regional, and national scales, and medium-term to long-term time horizons.

Climate Change Topics

> mitigation planning
> energy use planning
> economic welfare

Environmental Linkages

> air pollution and air quality

Application: With MARKAL-MACRO, users can perform macroeconomic analyses, total energy system analyses, detailed energy systems analyses, and environmental analyses of changes in pollution levels. This planning tool is data intensive, requiring inputs on GDP, energy balance, and energy prices and projections. It also requires a basic understanding of energy optimization, macroeconomic modeling, and some technical training on software use. It can be applied wherever there is sufficient data on the energy sector and the economy, and has been used successfully in the United States, Sweden, Switzerland, and The Netherlands to develop least-cost energy strategies and examine the consequences of policy responses on energy sector economies.

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website: http://www.bnl.gov

Note: This model has the following computer requirements: minimum IBM 386 (486 or Pentium preferred), 8 MB RAM, 30 MB hard drive DOS 5.0, and GAMS and MINOS.

MITIGATION RESOURCES: FORESTS

COPATH Spreadsheet Model

COPATH is a set of connected spreadsheets that are used to estimate a forest area's existing carbon stock and to track its carbon flows under a variety of land use options. COPATH takes its name from the initials of the names of its component modules (carbon uptake, other land uses, pasture, agriculture, and harvest). The model has two main components — BASIS and FORECAST. BASIS takes specific information about the forest and computes carbon storage, emissions, and sequestration for a user-defined base year. FORECAST predicts the extent of future carbon emissions and uptake from the forest sector based on assumptions about the future state of forest resources and the consumption of forest products. COPATH was developed at Lawrence Berkeley National Laboratory (see page 63) with support from the U.S. EPA.

Climate Change Topics

> forestry
> carbon sequestration

Environmental Linkages

> deforestation
> land use
> land degradation

Application: The FORECAST component of COPATH can be used to predict carbon emissions and sequestration under various land use policies. FORECAST has four modules: AGRIC, PASTURE, HARVEST, and OTHER. Each module predicts the effects of a different land use scenario: conversion of forest to agriculture, conversion of forest to grazing land, various forest harvesting policies, and other land use options, respectively. The total emissions and sequestration for each module are extracted and summed to obtain the totals for each forest type, or life zone. The process is repeated for each life zone and then summed for the country as a whole.

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Notes:
COPATH can be obtained on diskette from Lawrence Berkeley National Laboratory.
COPATH is designed for use in Symphony or Lotus 1-2-3. It requires a PC (or compatible) system with at least a 286 microprocessor.

MITIGATION RESOURCES: CITIES AND URBAN AREAS

Building Energy Efficiency

Overcoming barriers and providing incentives for improving energy efficiency is a common problem throughout the world. This report, prepared by the U.S. Office of Technology Assessment, examines strategies for efficient energy use in buildings. Significant energy savings in buildings are possible through the use of commercially available, cost-effective, energy efficient technologies. The report aims to enhance adoption rates of these technologies. Interviews with industry representatives, property managers, homeowners, and others are used in this report to explore why adoption rates are low in the United States.

Climate Change Topics

> building energy conservation
> energy efficiency
> buildings and structural energy efficiency

Environmental Linkages

> air pollution and air quality
> resource conservation

Application: Improving the use and penetration of energy efficient technologies, particularly in buildings and structures, is an important policy problem. This report can assist in designing and evaluating the performance of efficiency programs by providing insight on barriers to adoption that have been experienced in the United States. The report offers suggestions for how these barriers can be overcome, and provides guidance on program design.

Sponsor/Contact: The sponsoring agency for this document, the U.S. Office of Technology Assessment, was closed in September 1995. The report can be purchased from:

U.S. Government Printing Office, Superintendent of Documents
Mail Stop: SSOP
Washington, DC 20402-9328 USA

This document is available free at http://www.wws.princeton.edu/~ota/ns20/alpha_f.html

MITIGATION RESOURCES: CITIES AND URBAN AREAS

U.S. Environmental Protection Agency State and Local Climate Change Program

The State and Local Climate Change Program is one of the U.S. EPA's Climate Change Action Plan programs. It is a capacity-building program focusing on state and local government decision-makers. The program provides technical and financial assistance to state and local officials, and the organizations that support state and local functions, to 1) increase the level of understanding of the economic and environmental impacts of climate policies; 2) assess the risks of climate change; 3) understand state/local contributions to greenhouse gas (GHG) emissions; 4) evaluate and assess options to address and reduce emissions; 5) identify the co-benefits of mitigation policies to increase adoption of innovative policies and programs; 6) implement cost-effective policies and measures that result in GHG reductions; and 7) share results and educate stakeholders to increase transferability of technologies and policies. The program's website offers access to many of the program's resources, including an electronic newsletter; a state climate database; results of inventories and action plans; guidance documents; information sheets on the impacts of climate change at the state level; and contacts for U.S. regional and state climate change programs.

Climate Change Topics

> economic welfare
> greenhouse gas emissions
> mitigation technologies
> climate data

Environmental Linkages

> air pollution and air quality
> resource conservation

Application: Visitors to the State and Local Climate Change website will find a readily accessible compendium of information on U.S. state and local GHG emissions and reduction strategies. The database contains GHG emission inventories and action plans, actions to reduce GHG emissions, data on historical emissions from fossil fuels, and population and economic information. An example included on the site is the Pennsylvania (U.S.) State Action Plan, which recommends expanding information provided to local farmers about sustainable farming practices that are energy efficient and also beneficial to the local environment. The recommendation calls for developing cost-effective designs for small-scale on-farm digesters that would collect methane and turn it into a usable energy source. The plan also recommends that the state government provide financial assistance for the design of such systems.

Sponsor/Contact: U.S. Environmental Protection Agency
State and Local Climate Change Program
401 M Street, SW
Washington, DC 20460-0003 USA
Tel: +1-202-260-4314
website: http://www.epa.gov/oppeoee1/globalwarming/actions/national/ccap/state/

MITIGATION RESOURCES: IMPLEMENTATION AND ASSISTANCE PROGRAMS

Global Environment Facility (GEF)

The GEF provides grants and concessional funding to developing countries for projects and programs that protect the global environment and promote sustainable economic growth. GEF projects and programs are managed through three implementing agencies: the UN Development Programme, the UN Environment Programme, and the World Bank. In addition, the Framework Convention on Climate Change and the Convention on Biological Diversity have designated the GEF as their funding mechanism on an interim basis. The program has four main focal areas: climate change, biological diversity, international waters, and stratospheric ozone. Activities concerning land degradation, primarily desertification and deforestation, as they relate to the four focal areas, are also eligible for funding. GEF projects must be country driven, incorporate consultation with local communities and, where appropriate, involve nongovernmental organizations in project implementation. Currently, 156 countries participate.

Climate Change Topics

- mitigation
- adaptation
- ecology/ecosystems
- economic welfare

Environmental Linkages

- air pollution and air quality
- water pollution and water quality
- biodiversity
  - land degradation
- deforestation
- stratospheric ozone

Application: GEF can help developing countries obtain financial assistance and finding in-country examples of climate change projects. Since 1994 GEF has provided nearly US $2 billion for implementation of climate change projects. Countries may be eligible for GEF funds if 1) they are eligible for financial assistance through the financial mechanism of either the Climate Change Convention or the Convention on Biological Diversity; or 2) they are eligible to borrow from the World Bank or receive technical assistance grants from UNDP through a Country Programme. In addition, a country must be a party to the Climate Change Convention or the Convention of Biological Diversity to receive funds from the GEF in the relevant focal area. Examples of projects funded through GEF include US $3 million provided to several countries for *Alternatives to Slash and Burn*; US $9.5 million provided to southeast Asian countries for *Asia Least-Cost Greenhouse Gas Abatement Strategy (ALGAS)*; and US $10 million provided to Pakistan for *Waste to Energy: Lahore Landfill Gas Recovery and Use*.

Sponsor/Contact: Global Environment Facility Secretariat
1818 H Street, NW
Washington, DC 20433 USA
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website: http://www.gefweb.com
e-mail: gef@gefweb.org

MITIGATION RESOURCES: IMPLEMENTATION AND ASSISTANCE PROGRAMS

National Renewable Energy Laboratory (NREL) International Supporting Activities

NREL, operated by the U.S. Department of Energy, supports international programs promoting renewable energy and energy efficient technologies. NREL's international activities include assessment of renewable energy resources, analysis and modeling of available renewable technologies, training on the use of renewable energy technologies, and policy and regulatory support on the integration of renewable resources in electric utility restructuring. NREL has supported energy-related projects in more than 20 nations worldwide, including Argentina, Brazil, Chile, China, Egypt, Ghana, India, Indonesia, Mexico, Russia, and South Africa. The NREL International Programs website provides details on international programs and contact information for NREL's international staff.

Climate Change Topics

> mitigation technologies
> energy efficiency
> renewable resources

Environmental Linkages

> air pollution and air quality
> resource conservation
> water pollution and water quality

Application: NREL sponsors a variety of programs supporting renewable energy and energy efficient technologies and applications, including programs related to rural electrification, water pumping, education, alternative transportation fuels, cooking fuels, and desalinization. NREL's international programs include:

> *Climate Change and Air Pollution Mitigation* — a program to use renewable energy and energy efficient technologies to reduce greenhouse gases, acid rain, ozone precursors, particulates, and air toxins
> *Environmental Outreach Education* — a program to develop information products that emphasize the environmental benefits of renewable energy and energy efficient technologies and practices
> *Environmental Security* — a program to prevent social and economic instability resulting from reliable domestic power sources
> *Pollution Prevention* — a program to promote technologies for waste and landfill gas management, biomass conversion to power and chemicals, pollution remediation, and environmentally responsible chemical processes.

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Golden, CO 80401 USA
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website: http://www.nrel.gov/business/international/
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Note: Many NREL programs provide funding and/or training to participants.

MITIGATION RESOURCES: IMPLEMENTATION AND ASSISTANCE PROGRAMS

U.S. Initiative on Joint Implementation (USIJI)

The USIJI, part of the U.S. Climate Change Action Plan, encourages organizations in the United States and other countries to implement projects that reduce, avoid, or sequester greenhouse gas emissions. The USIJI provides technical assistance and public recognition to approved projects that:

> encourage development and implementation of cooperative, mutually voluntary, cost-effective projects between U.S. and foreign partners aimed at reducing or sequestering emissions of greenhouse gases
> promote a broad range of projects to test and evaluate methods for measuring, tracking, and verifying costs and benefits
> establish an empirical basis to contribute to the creation of international criteria for joint implementation
> encourage private-sector investment and innovation in the development and dissemination of technologies for reducing or sequestering emissions of greenhouse gases
> encourage participating countries to adopt more complete climate action programs, including national inventories, baselines, policies and measures, and appropriate specific commitments.

Climate Change Topics

> greenhouse gas emissions
> carbon sequestration
> mitigation

Environmental Linkages

> air pollution and air quality

Application: Groups and organizations interested in the USIJI program or in obtaining project summaries, application information, technical reports, or general information will find the USIJI website a good place to start. A key resource of the website is the database of summaries of approved projects. These summaries provide examples of the types of projects that USIJI supports and highlight the benefits of participating in projects sponsored by USIJI or similar organizations. One example is the Rio Bravo Conservation and Management Area Carbon Sequestration Pilot Project, located in northwest Belize (Central America), which combines land acquisition and a sustainable forestry program to achieve carbon mitigation. The project has two components: purchase of endangered forest land, and development of a sustainable forestry management program that will increase the level and rate of carbon sequestered. The project's goal is to demonstrate an optimal balance between cost-effective carbon dioxide sequestration, economically sustainable forest yield, and environmental protection.

Sponsor/Contact: U.S. Initiative on Joint Implementation
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Washington, DC 20585 USA
Tel: +1-202-586-3288; Fax: +1-202-586-3485
website: http://www.ji.org/usjii/usjii.htm
e-mail: csmt@igc.apc.org

MITIGATION RESOURCES: IMPLEMENTATION AND ASSISTANCE PROGRAMS

U.S. Agency for International Development (USAID) Climate Change Initiative

In 1997, the United States committed more than $1 billion over five years to a USAID program called the Climate Change Initiative. The initiative establishes and supports programs to collaborate with developing nations and countries in transition to reduce the threat of climate change. USAID's goals are to 1) decrease the rate of growth in net emissions, 2) increase developing and transition country participation in the goals of the U.N. Framework Convention on Climate Change, and 3) decrease vulnerability to the threats posed by climate change. Currently, USAID is focusing its efforts in nine countries and three regions: Brazil, Central Africa, Central America, Central Asia, India, Indonesia, Mexico, Philippines, Poland, Russia, South Africa, and Ukraine. These countries and regions were selected because of their contribution (and estimated future contribution) to global greenhouse emissions or their governments' receptivity to taking concrete action.

Climate Change Topics

- greenhouse gas emissions
- industrial manufacturing
- energy efficiency

Environmental Linkages

- air pollution and air quality
- resource conservation

Application: Through USAID, interested parties in developing countries can find examples of past and current projects and financial and technical support for climate change projects. For example, programs to assist urban areas are a key part of the program. The Sustainable Cities Initiative enhances environmentally sound economic growth through broad-based partnerships to promote efficient resource use in cities. The program invests in energy efficiency and clean-energy technology and leverages funding from international financial institutions and foundations. An example of a project under their program is in Ahmedabad, India, where USAID and the U.S. Environmental Protection Agency are supporting an effort to address some of the critical environmental challenges faced by the city. As part of the project, USAID worked with Ahmedabad Electric Company (AEC) to design and implement three pilot programs to test and install high efficiency power generation equipment. As a result, AEC invested over US $1 million in energy efficiency, resulting in reduced energy demand and lower CO_2 emissions.

Sponsor/Contact:

U.S. Agency for International Development Information Center
Ronald Reagan Building
Washington, DC 20523-0016 USA
Tel: +1-202-712-4810; Fax: +1-202-216-3524
website: http://www.info.usaid.gov
e-mail: pinquiries@usaid.gov

Note: The USAID Climate Change Institute provides funding for climate change projects, primarily in the focus countries and regions identified above.

MITIGATION RESOURCES: IMPLEMENTATION AND ASSISTANCE PROGRAMS

U.S. Country Studies Program (U.S. CSP): Implementation and Assistance Programs

The U.S. CSP was created prior to the United Nations Conference on Environment and Development, also known as the Earth Summit, in Rio de Janeiro, Brazil, in 1992. The program assists developing and transition countries as they establish a process for developing and implementing national policies and measures; develop information to further national and international discussions; and support the principles and objectives of the U.N. Framework Convention on Climate Change. The program offers financial and technical assistance, including workshops, guidance documents, analytical tools, and consultations with technical experts. Fifty-five countries currently participate in the program. Projects include developing inventories of anthropogenic emissions of greenhouse gases, assessing vulnerabilities to climate change, evaluating response strategies for mitigating and adapting to climate change, formulating national climate change action plans, and performing technology assessments.

Climate Change Topics

- mitigation technologies
- adaptation
- greenhouse emissions
- climate data

Environmental Linkages

- air pollution and air quality
- land use
- resource conservation

Application: The U.S. CSP has helped countries develop assessment reports in the following areas: GHG emissions inventory; assessment of vulnerability and adaptation to climate change; and GHG mitigation options. This program can assist countries that are developing their own climate change research programs. For example, the China Country Study will improve China's scientific and institutional capacity to assess its vulnerability and adaptation needs and to formulate national response and mitigation strategies. Many of the country reports can be obtained in hard copy form through the U.S. CSP. A few reports are available in electronic format.

Sponsor/Contact:
U.S. Country Studies Program
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1000 Independence Avenue, SW
Washington, DC 20585 USA
Tel: +1-202-586-3288; Fax: +1-202-586-3485 or +1-202-586-3486
website: http://www.gcrio.org/CSP/uscsp.html
e-mail: csmt@igc.apc.org

IMPACTS AND ADAPTATION RESOURCES:
GENERAL
GUIDELINES
ASSESSMENT TOOLS AND MODELS

IMPACTS AND ADAPTATION RESOURCES: GENERAL

Climate Change Convention Information Exchange Program (CC:INFO)

CC:INFO is an information service, sponsored by the UNFCCC, that summarizes UNFCCC programs and activities of member countries. It includes a directory of organizations that are concerned about climate change; a forum that matches requests for technical or financial assistance with suitable organizations that can provide it; profiles of activities and ratification information on each participating country; a database of technologies used in projects associated with UNFCCC; links to the home pages of countries participating in the national climate convention; and information on Activities Implemented Jointly.

Climate Change Topics

> mitigation programs
> adaptation programs

Environmental Linkages

> land use

Application: CC:INFO is a source of information for users who are developing climate change adaptation or mitigation programs and want some background information on other countries' experiences. For example, for users searching for a specific type of support, CC:INFO contains a list of organizations involved with climate change, providing information on the location; type of organization (e.g., governmental, nongovernmental, international); the resources it provides (e.g., technical, information, financial); contact information; and examples of projects that it has supported. One of the featured organizations is the African Development Bank, a resource for users seeking financial assistance for mitigation projects. The Bank provided US $275 million for natural resources conservation and rehabilitation projects in 13 African countries between 1978 and 1993.

Sponsor/Contact: website: http://www.unfccc.de/

IMPACTS AND ADAPTATION RESOURCES: GENERAL

Climate Change and Human Health

This book, prepared on behalf of the World Health Organization (WHO), the World Meteorological Organization, and the United Nations Environment Programme, examines the potential human health hazards of global climate change. One of the most serious effects of global climate change is the potential for increased prevalence of vector-borne diseases. Earlier this century, infectious diseases appeared to be in broad retreat, at least in developed countries. But many infectious diseases (malaria, yellow fever, etc.) are now resurgent in many parts of the world. According to analysis by WHO, efforts to control malaria are meeting with less and less success. In many regions where malaria transmission had been almost eliminated, the disease has made a comeback, surpassing earlier recorded levels in some cases. Increases in temperature and humidity may have increased the survivability of mosquitos (one of the main transmitters of malaria) and the plasmodium parasite (the cause of malaria). Further climate change could intensify this trend.

Climate Change Topics	***Environmental Linkages***
> human health	> water borne diseases
> agriculture	> wetlands
> extreme weather events	> tropical and subtropical ecosystems
> sea level rise	

Application: This book can be used to gain an understanding of issues related to climate change and its potential effects on human health. Beginning with the historical and economic context of the climate change issue and the most recent science of greenhouse gas accumulation and its effects on climate, the book proceeds to explore the potential health effects caused by changes in temperature patterns, changes in transmission of vector-borne diseases, changes in agricultural activity, increased frequency of extreme weather events, sea-level rise, and increased ground-level exposure to ultraviolet radiation.

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Note: This book is available from WHO Publications (Tel: +41-22-791-2476). The publication number and order number are WHO/EHG/96.7 and 1930091, respectively. The cost is Sw.fr. 30.00/US $27.00; in developing countries: Sw.fr. 21.00.

IMPACTS AND ADAPTATION RESOURCES: GENERAL

Regional Impacts of Climate Change: An Assessment of Vulnerability — Summary for Policy Makers

Description: The Intergovernmental Panel on Climate Change (IPCC) produced a series of Assessment Reports, Special Reports, Technical Papers, methodologies, and other products that have become standard works of reference, widely used by policy makers, scientists, and other experts. This Special Report, produced by Working Group II of the IPCC, builds on the Working Group's contribution to the Second Assessment Report (SAR), and incorporates more recent information made available since mid-1995. It was prepared in response to a request from the Subsidiary Body for Scientific and Technological Advice (SBSTA) of the UN Framework Convention on Climate Change (UNFCCC). It addresses the degree to which society and the natural environment are vulnerable to the potential effects of climate change. Unlike past IPCC reports that focused on impacts on sectors this report focuses on impacts to regions such as Africa and Latin America. The report establishes a common base of information regarding the potential costs and benefits of climatic change, including the evaluation of uncertainties, to help the Conference of Parties determine what adaptation and mitigation measures might be justified.

Climate Change Topics	***Environmental Linkages***
> multiple sector impacts	> land use
> economic welfare	> biodiversity
	> resource conservation

Application: This report assists climate change researchers in characterizing regional vulnerability to climate change and in identifying potential policy needs. The report consists of vulnerability assessments for 10 regions: Africa, Arid Western Asia (including the Middle East), Australasia, Europe, Latin America, North America, the Polar Regions (the Arctic and the Antarctic), Small Island States, Temperate Asia, and Tropical Asia. It also includes several annexes that provide information about climate observations, climate projections, vegetation distribution projections, and socioeconomic trends. As an example of available information, some of the regional vulnerabilities described for Africa include potential ecosystem degradation due to continued population growth, habitat conversion, and increasing stress on available water supplies. Furthermore, climate changes could threaten marginal agricultural regions where rainfall and irrigation are limited and subsistence demands continue to rise. Coastal regions are vulnerable to sea level rise, which threaten both ecosystems and human developments.

Sponsor/Contact: IPCC-World Meteorological Organization Building
41 Av. Guiseppe-Motta, Case postale No. 2300
1211 Geneva 2, Switzerland
Fax: +41-22-733-1270
website: http://www.ipcc.ch

IMPACTS AND ADAPTATION RESOURCES: GENERAL

Vulnerability and Adaptation Assessments: An International Handbook

The U.S. Country Studies Program developed a handbook that provides comprehensive guidance on methods for evaluating the potential impacts of climate change and possible adaptation strategies. The handbook complements the *Technical Guidelines for Assessing Climate Change Impacts and Adaptations* prepared by the IPCC, and builds on the IPCC's analytical framework. The handbook offers "step-by-step" instructions on the application of specific assessment methods for the following sectors: agriculture, grasslands and livestock, forests, water resources, coastal resources, human health, fisheries, and wildlife. The book also offers guidance on the creation of country-level climate change scenarios, and provides detailed descriptions selected assessment methods and their limitations, data requirements for the methods, and interpretation of results. Over 50 of the developing countries and countries with economies in transition participating in the U.S. Country Studies Program used an earlier version of this handbook as a tool for their vulnerability and adaptation studies.

Climate Change Topics

> multiple sector impacts
> adaptation

Environmental Linkages

> air quality and air pollution
> water quality and water pollution
> land use
> deforestation
> biodiversity

Application: For each sector, the guide describes the most practical and widely used techniques for carrying out an analysis. In presenting these techniques, the guide details a structured and systematic process for an analysis, including identification of data requirements, available analytical tools (e.g., computer programs and models), and potential advantages and disadvantages. The guide focuses on reasonable methods that can be used within the resource limitations of a country's overall climate program. In addition, more sophisticated supplementary techniques are presented for those with available time and resources.

Sponsor/Contact:

Kluwer Academic Publishers Group
P.O. Box 322
3300 AG Dordrecht, The Netherlands
Tel: +31-78-639-23-92
Fax: +31-78-639-22-54
website: http://www.wkap.com
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Selected Sources:

Benioff, R., S. Guill, and J. Lee (eds.). 1996. *Vulnerability and Adaptation Assessments: An International Guidebook.* Dordrecht, The Netherlands: Kluwer Academic Publishers.

Note: This book is available from the publisher (contact information provided above). The cost is NLG 387.00, US $235.50, GBP 154.95. The ISBN number is 0-7923-4140-6.

IMPACTS AND ADAPTATION RESOURCES: GUIDELINES

UNEP Handbook on Methods for Climate Change Impact Assessment and Adaptation Strategies

The United Nations Environment Programme (UNEP) developed a handbook of methods to help those conducting research on the potential impacts of climate change on the environment, society, and economy. The methods described can assist in the design of assessments of climate change impacts and adaptation strategies. The handbook also provides contact and reference information.

Climate Change Topics

- impacts assessment methods
- adaptation assessment methods
- all major sectors (agriculture, health, water, etc.)

Environmental Linkages

- air pollution and air quality
- resource conservation
- water pollution and water quality

Application: The handbook includes five types of approaches to impact analysis: historical studies of past effects of climate variations on human and natural systems; analogous comparisons between historical climatic events and anticipated events due to human-induced climate change; present day studies of weather-related impacts; models of the relationship between climatic variables and impacted sectors; and expert judgment to develop a consensus opinion. For adaptation analysis, the handbook discusses general background issues as well as particular methodologies for asserting adaptation measures. Of the above methods, the handbook primarily focuses on modeling applications. The descriptions of methods include the time and spatial scale covered, data needs, cost, time required, level of expertise needed, and advantages/disadvantages of the method. The methods described in this handbook to identify future vulnerabilities may also identify sectors that are currently at risk or impacted by human use and need to be addressed, such as unsustainable land or water use, or unhealthy air pollution levels.

Sponsor/Contact:

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Alex Alusa
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Note: Contact Jan Feenstra for ordering information. Also available from the website:
http://ohrid.cca.vu.nl/english/o_o/instituten/IVM/projects/research/ClimateChange/Handbook.htm

IMPACTS AND ADAPTATION RESOURCES: GUIDELINES

IPCC Technical Guidelines for Assessing Climate Change Impacts and Adaptations

The IPCC Working Group II developed a set of guidelines to assess the potential impacts of climate change and evaluate appropriate adaptations. The guidelines cover the entire assessment process, including 1) defining the problem, 2) selecting the method, 3) testing the method, 4) selecting the scenarios, 5) assessing biophysical and socioeconomic impacts, 6) assessing autonomous adjustments, and 7) evaluating adaptation strategies. The document outlines processes for completing impact and adaptation assessments, identifies methods, and discusses strengths and weaknesses of these different methods. IPCC developed this document to increase users' understanding of the details of performing an impacts and adaptation assessment, including data needs, time frame of the assessment, and specific methods to complete each step.

Climate Change Topics

- multiple sector impacts
- adaptation

Environmental Linkages

- air pollution and air quality
- land use
- water pollution and water quality

Application: These guidelines provide useful insight into the approaches and methods for estimating impacts and adaptation strategies. It also contains case study examples of other studies, qualitative and quantitative analyses, and models that may be helpful to complete steps of the assessment. To assist users in completing some of the quantitative analysis associated with assessments, it also contains an annotated guide to data sources on topics such as population, economic development, emissions, and natural resources.

Sponsor/Contact: Department of Geography
University College London
26 Bedford Way
London, WC1H 0AP United Kingdom

Note: To obtain a copy of this report, write to the above address.

IMPACTS AND ADAPTATION RESOURCES: GUIDELINES

Seven Step Assessment of the Vulnerability of Coastal Areas to Sea Level Rise — The IPCC Common Methodology

This methodology incorporates expert judgment and data analysis of socioeconomic and physical characteristics to estimate a broad spectrum of impacts from sea-level rise, including the value of lost land and wetlands. Information from this methodology can be used as a basis for further physical and economic modeling. The user follows seven steps: 1) delineate the case study area; 2) inventory study area characteristics; 3) identify the relevant socioeconomic development factors; 4) assess the physical changes; 5) formulate response strategies; 6) assess the vulnerability profile; and 7) identify future needs. The methodology does not address how to complete these steps, but it does provide guidance to information that should be covered.

Climate Change Topics

- coastal resources
- adaptation
- economic welfare

Environmental Linkages

- land use

Application: The framework and methodology can assist users in developing a vulnerability profile and a list of future policy needs for physical and economic adaptation. This approach is most useful as an initial, baseline analysis for country-level studies where little is known about coastal vulnerability. However, because of the broad scope of this methodology, it requires extensive data on a range of biophysical and socioeconomic characteristics and may require significant investment of time and financial resources.

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Agricultural Economic Models

Economic models of agriculture simulate the effects of climate change on both producers and consumers of agricultural products, including potential effects on market prices and production, consumption, income, and farm value. Because climate change affects agriculture yields and the costs of production, it also affects the price and quality of products, which, in turn, can lead to further market-induced changes. These models are data intensive and depend on access to detailed data regarding price, quantities, resource use, and other information on agricultural production. If extensive data are unavailable, users can adapt data from regions with similar economic and agricultural profiles or use more qualitative models, although the results may not be as precise.

Climate Change Topics

> adaptation
> agriculture
> economic welfare

Environmental Linkages

> land use
> resource conservation

Application: The range of economic approaches includes economic regression models, microeconomic models, and macroeconomic models. Different models embody different assumptions about the nature of changes and human responses. Model types include mathematical programming models of farm, regional, and national level responses and econometric models that examine statistical relationships between climate and agriculture at regional, national, and international levels. By quantifying the economic impacts and benefits, these models help analysts evaluate whether the costs of adaptation strategies (e.g., changes in crop management, irrigation infrastructure, cultivars) are comparable to their benefits. Using output from these models, policy makers can develop strategies to minimize the economic impact of climate change on the agricultural sector.

Selected Source:

Parry, M.L., C. Rosenzweig, A. Iglesias. 1998. Chapter 8: Agriculture. In J. Feenstra, I. Burton, J. Smith, and R. Tol (eds.). 1998. *Handbook on Methods for Climate Change Impact Assessment and Adaptation Strategies, version 2.0*. United Nations Environment Programme, Nairobi, and Institute for Environmental Studies, Vrije Universiteit, Amsterdam.

IMPACTS AND ADAPTATION RESOURCES: ASSESSMENT TOOLS AND MODELS

Agriculture Impact Models — Crops

Description: Agricultural crop models are used to evaluate the impact that climate change may have on crops. Crop models simulate yields, under a variety of conditions (e.g., varying growing season, location, management). Specific models exist for many staple crops such as alfalfa, rice, potato, maize, wheat, barley, sunflower, sugarcane, tomato, and pasture. These models are computer-based and generally quite data-intensive, requiring data on the site's soils, climate, and management, as well as expertise on growing characteristics of the crops of interest.

Climate Change Topics	***Environmental Linkages***
> adaptation	> land use
> agriculture	> land degradation
	> resource conservation

Application: Users can apply information from these models to estimate changes in crop yield as well to identify potential adaptation strategies, such as changing cultivars or planting dates or adding irrigation and fertilizer, that may reduce negative impacts. Models such as the ICASA/IBSNAT suite of models combine crop, soil, and weather databases, management programs, and crop models and application programs to simulate multi-year outcomes of crop management strategies. Under this suite of models, programs have been developed for linking crop models to mapping programs, creating a visual representation of the data.

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ICASA/IBSNAT
2500 Dole Street
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Fax: +1-808-956-3421
website: http://grss.sherman.Hawaii.edu/dssat
e-mail: ibsnat@hawaii.edu

IMPACTS AND ADAPTATION RESOURCES: ASSESSMENT TOOLS AND MODELS

Training Materials for Vulnerability and Adaptation Assessments (CC:TRAIN)

This computer tool walks the user through the main steps required to complete a climate change vulnerability and adaptation assessment. Using either default settings or data entered by the user, CC:TRAIN creates a model of climate change impacts for a selected area. CC:TRAIN allows the user to model climate impacts on maize, coastal inundation, coastal erosion, malaria incidence, river discharge, riverine flooding, and water balance. The output is presented as both maps and charts. CC:TRAIN does not include economic models, but users can apply information generated from this application as input for economic models. The user can enter default settings and the application will act as a tutorial, walking through a hypothetical vulnerability and adaptation assessment for a fictional country. The user can also enter data on a site of interest and the application will model climate change impacts, creating a site-specific vulnerability and adaptation assessment. Applying CC:TRAIN as an analytical or modeling tool will require background knowledge of the site's geography, land use, climate, economy, and population. Otherwise, only a general understanding of climate change issues is required.

Climate Change Topics	***Environmental Linkages***
> multiple sector impacts	> land use
> adaptation	> water pollution and water quality

Application: The program is menu-driven, with choices for global temperature change scenarios, regional patterns of climate change, scale patterns by global temperature change, and present climate adjustments by temperature change. It requires an IBM-compatible computer with a Windows 95 (or newer) operating system. Running the impact model for various sectors using default settings generates a map showing gradients of the severity of potential impacts across the country. Users can change the model parameters, such as the climate scenario, climate change pattern, and selected months on which the model is run, and observe how the potential range and severity of impacts shift.

Sponsor/Contact: UNITAR
Palais de Nations
CH-1211, Geneva 10, Switzerland
Tel: +41-22-788-1417; Fax: +41-22-733-1383
website: http://www.geic.or.jp/cctrain

Note: Free to download from website.

IMPACTS AND ADAPTATION RESOURCES: ASSESSMENT TOOLS AND MODELS

COSMIC (Country-Specific Model for Intertemporal Climate)

COSMIC is a PC-based model that produces country-specific climate scenarios. Developed in the United States by the University of Illinois at Urbana-Champaign and the Electric Power Research Institute, it allows the user to choose between 7 sulfate emissions scenarios, 10 greenhouse gas stabilization scenarios, stabilization scenarios, and outputs from 14 GCMs. The model is capable of calculating changes in mean global temperature and sea level on an annual basis out to 2200.

Climate Change Topics

> greenhouse gas emissions
> climate data

Environmental Linkages

> air pollution and air quality

Application: COSMIC may be helpful for users who need estimates of numerous climate variables for impact or vulnerability assessments. The model allows users to calculate monthly temperature and precipitation estimates, annual global mean surface temperature, and annual sea level rise for any year between the present and 2200 for 158 countries. Only country average outputs are given. This should not be a limitation for small countries, but could be for larger countries. Output data generated from this model (in ASC II format) can be used as input into models of impacts on sectors such as agriculture and water resources. COSMIC requires an IBM-compatible computer with a Windows95 operating system, 16 megabytes of RAM, and 12 megabytes of hard disk space.

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Grasslands and Livestock Impact Models

Grassland and livestock impact models estimate a broad range of potential impacts resulting from climate change, including direct effects on animal health, growth, and reproduction; impacts on pasture and forage crops; changes in distribution of disease and parasites; changes in grassland plant species; changes in plant production; and changes in forage quality. The three primary impact models, biophysical models, decision support systems, and integrated models, simulate livestock and grassland production under a range of climate conditions. Biophysical models simulate ecological and physiological processes, decision support systems help the user examine the potential effects of various management decisions, and integrated models simultaneously model biophysical changes and behavioral responses of producers.

Climate Change Topics	***Environmental Linkages***
> range and grassland productivity	> land use
> livestock	> land degradation
> agriculture	> grasslands

Application: Modeling range and grassland changes can help identify adaptation strategies to minimize adverse effects of climate change. These models require significant data inputs and may require specialized training. Users should select models based on data needs and expertise, regional characteristics, and particular assessment needs. An example of the impact models available is SPUR2, which simulates beef cattle production, plant herbivore interactions, and carbon and nitrogen dynamics for the plant-soil system. It simulates multiple sites, rotational type grazing, and herd dynamics. It can be applied in Asia, North America, and South America. Another example is CENTURY, a biogeochemical model that simulates the cycling of nutrients and energy within an ecosystem.

Selected Sources:

Baker, B. 1998. Chapter 9: Rangeland and Livestock. In J. Feenstra, I. Burton, J. Smith, and R. Tol (eds.). *Handbook on Methods for Climate Change Impact Assessment and Adaptation Strategies, version 2.0*. United Nations Environment Programme, Nairobi, and Institute for Environmental Studies, Vrije Universiteit, Amsterdam.

Hanson, J.D., B.B. Baker, and R.M. Bourdon. 1992. SPUR2 Documentation and User's Guide. U.S. Department of Agriculture, ARS, Great Plains Systems Research Technical Report-1, Fort Collins, CO, USA.

Metherall, A.K., L.A. Harding, C.V. Cole, W.J. Parton. 1993. CENTURY Soil Organic Matter Model Environment Technical Documentation, Agroecosystem Version 4.0. Great Plains System Research Unit, Technical Report No. 4. U.S. Department of Agriculture, ARS, Fort Collins, CO, USA.

IMPACTS AND ADAPTATION RESOURCES: ASSESSMENT TOOLS AND MODELS

Human Health Impact Models

Description: Human health impact models relate climate change to changes in disease occurrence and mortality. They can model vector-borne diseases such as malaria, schistosomiasis, yellow fever, and dengue fever, or environmental effects such as heat stress, pollution-related respiratory disease, and UV-B radiation. They aid in identifying areas of high risk, and are particularly useful for areas currently with or at risk of diseases like malaria or dengue fever. Models help users identify a range of health-related impacts, including the present and future ranges and severities of diseases. Users can apply information from these models to identify policy needs and geographic areas of potential vulnerability where control measures and education efforts should be focused. Users can select models based on available data and resources, incidence of disease, and local characteristics.

Climate Change Topics	***Environmental Linkages***
> human health	> water quality (malaria)
> adaptation	> land use

Application: Health assessments are commonly based on simulations by one or more impact models. Three primary types of models are available to researchers: conceptual, empirical, and numerical. Each of these has varying data, time, and financial requirements, and appropriate uses. Conceptual models, including ecological risk assessments, describe the interactions among the various factors contributing to the severity of a major current health problem. Empirical models include modeling historical and geographic analogues, and require the least amount of time and data of the three types of health models. These analogue models assist the user in predicting the impact of similar events or epidemics in the future. Numerical models, including applications such as DENSiM and MIASMA, are the most complex and data intensive. They model the interactions between climate change scenarios and various human health factors.

Selected Sources:

Conceptual model:
Focks, D.A., E. Daniels, D.G. Haile, and J.E. Keesling. 1995. A simulation model of the epidemiology of urban dengue fever: Literature analysis, model development, preliminary validation, and samples of simulation results. *American Journal of Tropical Medicine and Hygiene* 53, 489-506.

Empirical model:
Bouma, M.J. and H.J. van der Kaay. 1996. The El Niño Southern Oscillation and the historic malaria epidemics on the Indian subcontinent and Sri Lanka: An early warning system for future epidemics? *Tropical Medicine and International Health* 1, 86-96.

Numerical model:
Martens W.J.M. 1997. *Health Impacts of Climate Change and Ozone Depletion: An Ecoepidemiological Modelling Approach.* Doctoral thesis, University of Maastricht.

IMPACTS AND ADAPTATION RESOURCES: ASSESSMENT TOOLS AND MODELS

IPCC Special Report on Emissions Scenarios (SRES)

IPCC's SRES project was created to generate a set of four climate change scenarios to update IPCC's IS92 climate scenarios. The goal of the SRES project is to provide a basis for analysis of potential future climatic changes and associated impacts. The new scenarios are being developed through a three step process in which 1) key input assumptions are reviewed and provided to modelers; 2) modelers develop emissions scenarios based on the input assumptions provided; and 3) the modelers' results are reviewed and the four new scenarios are developed, either by selecting a representative model or by averaging model results. The first two steps have been completed and a large number of scenarios (global and regional) have been received from modelers. The final step, development of the four new emission scenarios, is in progress and should be completed in 1999.

Climate Change Topics

> climate modeling
> greenhouse gas emissions

Environmental Linkages

> air pollution and air quality

Application: To develop its four new climate change scenarios, the SRES project has collected 428 scenarios developed by 176 different organizations. They model changes for approximately 50 regions throughout the world. A Microsoft Access database has been developed to store and organize the results of all the scenarios. In addition to the scenario data, the database contains information on the source of the scenario and the assumptions used in the scenario. The entire database can be downloaded free of charge from the world wide web at http://www-cger.nies.go.jp/cger-e/db/ipcc.html

Sponsor/Contact:

IPCC Technical Support Unit of Working Group III
National Institute of Public Health and the Environment
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website: http://www.rivm.nl
e-mail: info@rivm.nl

Note: The final SRES report is scheduled to be completed in 1999. Progress reports are available on the world wide web at http://sres.ciesin.org/

Once the SRES project is complete this document should be updated accordingly.

IMPACTS AND ADAPTATION RESOURCES: ASSESSMENT TOOLS AND MODELS

The Climate Impacts LINK Project

The Climate Impacts LINK Project, funded by the UK Department of the Environment, Transportation, and Regions, provides data and information on climate models and climate change experiments in order to promote the application of climate change research and implementation. In addition, the LINK project provides scientific and technical support.

Climate Change Topics
> adaptation
> climate data

Environmental Linkages
> air quality
> water quality
> land use

Application: From the LINK website, users can access climate change scenarios, general circulation models (GCM), and data from research that has applied these models and scenarios. For example, researchers can download GCM results illustrating projected changes in temperature, precipitation, CO_2 concentrations, other greenhouse gases, and sulfates. The web page features information on the technical development of the model, descriptions of the variables used, outcomes of multiple runs of the models using different climate change scenarios, and documentation of publications and experiments that have used the model. This information is helpful for scientists and researchers interested in running GCMs or in applying output.

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IMPACTS AND ADAPTATION RESOURCES: ASSESSMENT TOOLS AND MODELS

MAGICC (Model for the Assessment of Greenhouse Gas Induced Climate Change) / SCENGEN (Scenario Generator)

MAGICC and SCENGEN are two PC-based software programs that enable users to develop regional climate change scenarios. Developed by researchers at the Climatic Research Unit of the University of East Anglia in the United Kingdom and the National Center for Atmospheric Research (NCAR) in the United States, these software programs are user-friendly, flexible tools for examining the effects of different emissions assumptions on the results of currently available general circulation models (GCMs). MAGICC couples gas cycle, climate, and ice-melt routines using available output from GCMs, and allows users to assess the global-mean temperature and sea level changes that might arise from future emissions of GHGs and of non-GHGs. MAGICC is a global climate model that is commonly used in conjunction with the companion model, SCENGEN, which generates global and regional scenarios of climate change using the patterns of relative temperature and precipitation changes from a number of GCMs. SCENGEN contains several databases from available GCM outputs, and uses these data to generate cross-model comparisons of the GCMs using consistent emissions and temperature warming scenarios.\

Climate Change Topics

> greenhouse gas emissions
> climate data

Application: Users developing vulnerability or adaptation assessments may find these models helpful for developing scenarios of temperature and sea level may change in their region. Users can also evaluate the effects that different policies may have on temperature and sea level. MAGICC can be used to compare the implications of greenhouse gas emission scenarios. The software requires an IBM-compatible personal computer with 80386 processor and math coprocessor or equivalent, and is available for a small handling fee from the address below.

Sponsor/Contact: Dr. Mike Hulme
Climate Research Unit
School of Environmental Science
University of East Anglia
Norwich, NR4 7TJ, United Kingdom
Tel: +144-1603-593162
e-mail: m.hulme@uea.ac.uk
website: http://www.cru.uea.ac.uk/~mikeh

Vegetation Models

Biophysical vegetation models predict the consequences of changes in climate and site variables (e.g., precipitation, temperature, soil type, plant species) on ecosystem attributes such as survival and growth of various species or the productivity of the entire ecosystem. Information generated from these models can help identify potential economic vulnerabilities, such as whether the species composition of a region's forests may change from a valuable commercial species to a less valuable species, and determine necessary and appropriate adaptation measures.

Climate Change Topics	*Environmental Linkages*
> forests	> deforestation
> sequestration	> land use
	> resource conservation

Application: Vegetation models can assist users performing a vulnerability assessment of the forest sector. The computer-based models require extensive data on inventories and forest structure and characteristics such as water and energy balance of plants or plant types, physiological range of the plants, precipitation, and temperature. With these models, generally the more detailed data they require, the greater the model's reliability in predicting changes in the vegetation species composition and range across space and time. These models range in expertise required, but generally require background knowledge of forestry. An example of these vegetation models is the gap model, which simulates the establishment, growth, and death of a large number of individual trees within a fixed area. They are typically applied to mixed-species forests, since they can project the outcome, over time, of the interaction of many different species. They are especially useful for estimating changes in species composition under altered disturbance regimes, such as more or less frequent storms or fires. Another type is the biogeochemical model, such as CENTURY, which simulates the cycling of nutrients and energy within a forest (or other) ecosystem. Biogeography models such as MAPSS that project the response of ecosystem boundaries and migration to climate and productivity changes can simulate the range and extent of aerial changes.

Selected Sources:

Shugart, H.H. 1984. *A Theory of Forest Dynamics.* Springer Verlag, New York.

CENTURY Model:
Metherall, A.K., L.A. Harding, C.V. Cole, W.J. Parton. 1993. CENTURY Soil Organic Matter Model Environment Technical Documentation, Agroecosystem Version 4.0. Great Plains System Research Unit, Technical Report No. 4. USDA-ARS, Ft. Collins.

MAPSS Model:
Neilson, R.P. 1995. A model for predicting continental scale vegetation distribution and water balance. *Ecological Applications* 5, 62-385.

Impact Models of Water Resources

Water resource models simulate climate change effects such as the frequency of droughts on runoff conditions. Typically these models link climate changes to hydrologic changes such as stream flow and evaporation from lakes and reservoirs. It is also important to consider how hydrologic changes might affect natural and human systems. In some cases, economic water system models can be linked to provide insight on changes in water use, wetlands, water quality, aquatic ecosystems and socioeconomic (water quality and water management) impacts.

Climate Change Topics

- adaptation
- water storage
- aquatic and wetland ecosystems
- water use
- water storage requirement

Environmental Linkages

- water pollution/water quality
- fisheries
- resource conservation
- minimum streamflow

Application: Users can apply model results to estimate changes in water availability, demand, and quality and to examine adaptation measures. Some type of hydrological modeling input is required. Users with some background knowledge of hydrology and climate change can run most of the models. Users should select the particular method based on their water resource modeling expertise, data availability, the availability of resources, and their particular hydro climatic questions. WatBal, an example of a water resource impact model, evaluates the response of river basins to climate change by modeling drought, annual yields, and large-scale flooding.

Selected Sources:

Yates, D.N. 1996. WatBal: An integrated water balance model. *International Journal of Water Resources Development* 12(2), 121-139.

Strzepek, K.M. 1998. Chapter 6: Water Resources. In J. Feenstra, I. Burton, J. Smith, and R. Tol (eds.). 1998. *Handbook on Methods for Climate Change Impact Assessment and Adaptation Strategies, version 2.0*. United Nations Environment Programme, Nairobi, and Institute for Environmental Studies, Vrije Universiteit, Amsterdam.

IMPACTS AND ADAPTATION RESOURCES: ASSESSMENT TOOLS AND MODELS

WWW-Server for Ecological Modeling at the University of Kassel

The WWW-Server for Ecological Modeling, maintained by the University of Kassel (Germany), is a resource for anyone seeking information about ecological and agricultural models or modeling. The site provides access to a wide array of regional simulation models, model descriptions, simulation-software, data sources, and other modeling information. The website describes models of climate change effects, crop growth, path of chemicals through the food chain, and land management. The site contains the Register of Ecological Models (REM), a meta-database for existing mathematical models in ecology. For each model, the database provides general model information, technical information, manuals, data, mathematical information, and references. The WWW-Server also provides access to simulation models, descriptions of these models, software that can be downloaded, and other sources of data and information about modeling.

Climate Change Topics	*Environmental Linkages*
> agriculture	> land use
> forests	> deforestation
> ecology/ecosystems	> biodiversity

Application: The REM provides detailed information on more than 500 existing mathematical models related to ecology, agriculture, and forestry. These model descriptions provide an introduction to a variety of ecological models and demonstrate how the models can be used to assess impacts from a variety of environmental stresses, including climate change. Each model description includes information on the data used in the model, the mathematical specification of the model, and information to contact the model's author. For example, the REM database contains a detailed description and ordering information for ForGro, an integrated and closed-system Forest-Soil-Atmosphere model. ForGro describes the flow of water, carbon and nutrients in the forest ecosystem. Processes in the model include photosynthesis and respiration, phenology, hydrology, nutrient cycling, forest growth, and forest structure development. ForGro includes hydrological submodels for calculating snow fall, canopy water dynamics, forest floor water dynamics, and soil water dynamics. This model could be used in combination with a climate change model to model possible effects of climate change on patterns and rates of forest growth.

Some model descriptions also include links to download software to run the models.

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e-mail: benz@wiz.uni-kassel.de

INTERNATIONAL AND NATIONAL GOVERNMENTAL CLIMATE CHANGE ORGANIZATIONS

INTERNATIONAL AND NATIONAL GOVERNMENTAL CLIMATE CHANGE ORGANIZATIONS

Asia-Pacific Network for Global Change Research (APN)

APN is an intergovernmental network that promotes global environmental change research and links between science and policy-making in the Asia-Pacific Region, increases developing country research participation, and strengthens ties between scientists and policy makers. Funded by the Environmental Agency of Japan, the U.S. Global Change Research Program, and matching support from participating countries, the network supports research activities on global climate change and related physical and social processes. Priority topics include climate change and variability, coastal processes and impacts, terrestrial ecosystem change, acid deposition, and agriculture effects on the environment. In general, the research sponsored by APN is relatively technical and regional rather than site specific. The website contains information from APN-sponsored research as well as other regional research.

Climate Change Topics	*Environmental Linkages*
> coastal resources/sea level rise	> water pollution and water quality
> ecology/ecosystems	> land use
> agriculture	> resource conservation
> climate data	> coastal resources

Application: The website contains links to data sources that can be used for technical scientific or economic research. Examples of research projects funded by APN in 1999 include land use in temperate Asia, the impact of El Niño and La Niña on Southeast Asia, the development of a regional climate model for Asia, and the effects of increased atmospheric CO_2 on rice varieties. Although APN is not simply a funding agency, it does provide a limited amount of financial support for research and workshop activities that match the objectives of the APN.

Sponsor/Contact: APN Secretariat
3-1-13 Shibakoen
Minato-ku Tokyo 105-0011, Japan
Tel: +81-3-3432-1844; Fax: +81-3-3432-1975
website: http://www.rim.or.jp/apn/index2.htm

Note: For research funding information, contact the APN Secretariat, or visit the website.

INTERNATIONAL AND NATIONAL GOVERNMENTAL CLIMATE CHANGE ORGANIZATIONS

Canadian Global Change Program (CGCP)

CGCP, founded in 1985 under the Royal Society of Canada, integrates natural and social science research to provide resources that can be used to assess impacts and formulate mitigation policies. Although the program has a Canadian focus, it addresses and provides information on issues that may be relevant to other regions. CGCP compiles research from the natural sciences, social sciences, and humanities to assess the significance of climate change research in a policy context, plan further interdisciplinary research, and communicate global change information to decision makers and the general public. CGCP disseminates this information through workshops, presentations, and publications, much of which is available on the website.

Climate Change Topics

- mitigation
- adaptation
- ecosystems
- multiple sector impacts

Environmental Linkages

- air pollution and air quality
- forestry

Application: The scientific and economic information available from this program can assist users who are developing climate change-related assessments, conducting applied analyses of economic and ecological effects, and analyzing mitigation strategies. For example, the type of research available from this program includes the use of economic instruments to reduce greenhouse gas emissions, the impact of global change on marine fisheries, and the economic opportunities in forestry and agriculture associated with climate change adaptation.

Sponsor/Contact: Canadian Global Change Program
c/o Royal Society of Canada
P.O. Box 9734
Ottawa, Ontario K1G 5J4 Canada
Tel: +1-613-991-5639; Fax: +1-613-991-6996
website: http://www.cgcp.rsc.ca/english/html_documents/eindex.html
e-mail: WCSRC@CARLETON.CA

Note: Many of the publications are available in English, Spanish, and French.

INTERNATIONAL AND NATIONAL GOVERNMENTAL CLIMATE CHANGE ORGANIZATIONS

Center for Global Environmental Research (CGER)

CGER is a governmental organization sponsored by the National Institute for Environmental Studies, Environment Agency of Japan. It promotes the integration of global environmental research from interdisciplinary, multi-agency, and international perspectives to improve scientific understanding of human impacts on climate. It also provides a basis for developing mitigation and adaption policies by providing research-support facilities such as databases and a supercomputer, by conducting its own long-term monitoring of the global environment, and by disseminating the resulting data.

Climate Change Topics	***Environmental Linkages***
> greenhouse gas emissions	> air quality and air pollution
> carbon sequestration	> land use
> climate data	> resource conservation
> multiple sector impacts	

Application: CGER provides scientific researchers with access to data from studies and information on climate models and scenarios. The center also publishes documents and reports of its studies (available from the website or the center address below), including both scientific and policy-oriented analyses. Some current projects promoted by CGER in the East Asia and West Pacific regions include an integrated scientific and policy research program, a long-term global environment modeling program, satellite-driven ozone layer observations, and a land-use monitoring program that integrates remote-sensing image processing with geographic information systems information.

Sponsor/Contact:
Center for Global Environmental Research
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website: http://www-cger.nies.go.jp
e-mail: cgercomm@nies.go.jp

INTERNATIONAL AND NATIONAL GOVERNMENTAL CLIMATE CHANGE ORGANIZATIONS

Climate Change Training Program (CC:TRAIN)

The United Nations Institute for Training and Research (UNITAR) developed the CC:TRAIN to help developing countries implement the UNFCCC. CC:TRAIN offers training to researchers and officials from developing countries and provides technical support and guidance on climate change. Past workshops addressed a variety of topics, including implementing the UNFCCC; preparing national GHG inventories; identifying and analyzing mitigation options; assessing vulnerabilities to climate change impacts and adaptation options; and preparing national implementation strategies. Currently, 17 countries in Africa, Latin America, the Caribbean, and the South Pacific actively participate in CC:TRAIN.

Climate Change Topics

> greenhouse gas emissions
> mitigation technologies
> vulnerability assessment
> adaptation

Environmental Linkages

> air pollution and air quality

Application: CC:TRAIN developed a training package, *Climate Change and the UNFCCC: Challenges and Opportunities*, to assist in the organization of 2-4 day workshops on climate change and the UNFCCC. The package contains modules on the science of climate change, the impacts of climate change, challenges and opportunities of the UNFCCC, financial support available from the UNFCCC, methodologies used in climate change analysis, and training available from the UNFCCC. The training package includes a Workshop Package Guide with detailed instructions on how to use the package and how to organize workshops. A complementary introductory video on the science and impacts of global climate change is also available through the CC:TRAIN program. CC:TRAIN materials are available in English, French, or Spanish, and this package can be accessed free of charge at http://www.geic.or.jp/cctrain/geic-index.html.

Please also see the entry for *Training Materials for Vulnerability and Adaptation Assessments (CC:TRAIN)* in Impacts and Adaptation Resources: Assessment Tools and Models section.

Sponsor/Contact:

CC:TRAIN Program
UNITAR, Palais des Nations
1211 Geneva 10, Switzerland
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website: http://www.unitar.org/cctrain/
e-mail: cctrain@unitar.org

INTERNATIONAL AND NATIONAL GOVERNMENTAL CLIMATE CHANGE ORGANIZATIONS

United Nations Environment Programme (UNEP) Collaborating Center on Energy and Environment (UCCEE)

UCCEE is a research and technical support center established to incorporate environmental aspects into energy planning and policy worldwide, with special emphasis on supporting developing countries. The center supports research by local institutions, coordinates projects, and disseminates information. UCCEE activities include 1) initiation of and participation in UNEP-sponsored projects directed at energy-environment studies at the national or regional level; 2) research and methodological development on energy-environment issues and climate change mitigation; and 3) technical support of the Global Environment Facility (GEF) and UNEP programs on energy and climate.

Climate Change Topics

> energy efficiency
> mitigation technologies
> sustainable development

Environmental Linkages

> air pollution and air quality

Application: Researchers, especially in developing countries, can obtain advice or technical assistance from UCCEE in performing climate change analysis for their country or region. One of the main activities of UCCEE is climate change mitigation analysis, including support and execution of mitigation programs with countries. UCCEE can also provide assistance and expertise in power-sector restructuring, transport and the environment, demand side management, fuel cycle analysis, externalities, and environmental economics.

Sponsor/Contact:

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DK 4000 Roskilde, Denmark
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website: http://www.uccee.org/

INTERNATIONAL AND NATIONAL GOVERNMENTAL CLIMATE CHANGE ORGANIZATIONS

European Network for Research in Global Change (ENRICH)

ENRICH, sponsored by the European Commission, is a network of climate scientists and research programs designed to promote cooperation on global change research. ENRICH's objectives are to foster collaboration and promote support for global change research in Western Europe, Central and Eastern Europe, NIS, Africa, and other developing countries; to promote a pan-European contribution to the international global change research programs; and to improve information exchange between researchers. ENRICH acts as a central clearinghouse for research, providing access to numerous information and data sources, such as links to climate, global change, and ozone research networks.

Climate Change Topics

- climate data
- ecology/ecosystems
- multiple sector impacts

Environmental Linkages

- air pollution and air quality
- land use

Application: This network provides technical information that is helpful for users performing analyses such as emissions inventories or impacts analyses. ENRICH also provides a means for researchers in different countries or programs to coordinate their efforts and build on each other's research.

Sponsor/Contact:

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website: http://www.enrich.hi.is/enrich/index.html

INTERNATIONAL AND NATIONAL GOVERNMENTAL CLIMATE CHANGE ORGANIZATIONS

Food and Agriculture Organization (FAO) of the United Nations

The mandate of the FAO is to raise nutrition levels and living standards and improve agricultural productivity. For many developing countries the FAO will have valuable data, models, and information useful for climate change impact assessment.

Climate Change Topics	***Environmental Linkages***
> impacts	> land use
> adaptation	> land degradation
> renewable resources	> sustainable development
> agriculture	
> forestry	

Application: Users can acquire data, models, and information for climate change impact assessment from FAO. For example, FAO has developed models, such as CROPWAT, which look at agricultural water needs and can be used to examine effects of climate change on regional agricultural production.

Sponsor/Contact: FAO
Viale delle Terme di Caracalla, 00100 Rome, Italy
Tel: +39-06-570-51; Fax: +39-06-570-53152
website: http://www.fao.org

INTERNATIONAL AND NATIONAL GOVERNMENTAL CLIMATE CHANGE ORGANIZATIONS

German Advisory Council on Global Change
(Wissenschaftlicher Beirat der Bundesregierung Globale Umweltveränderungen, WBGU)

WBGU, established by the German federal government in 1992, is responsible for reviewing research findings on all aspects of global change and deriving policy recommendations for the federal government. The recommendations focus on national-level policies that countries can implement to adapt to global-level crises. Although WBGU produces reports for the German government, the analyses address global issues, and the research and policy recommendations could be applicable to research around the globe.

Climate Change Topics	***Environmental Linkages***
> greenhouse gas emissions	> air pollution and air quality
> adaptation, multiple sectors	> water pollution and water quality
> economic welfare	> land use

Application: Policy-makers and researchers can download or order all of WBGU's annual and special reports from its website. Report topics include global risks, water, soil, emissions targets for climate protection, and strategies for reducing CO_2 emissions. These reports cover current research and the state of knowledge on the topic, risks and vulnerabilities on a global and national scale, and policy and strategy recommendations.

Sponsor/Contact: WBGU Secretariat
P.O. Box 12 01 61
D-27515 Bremerhaven, Germany
Tel: +49-0-471-4831-723; Fax: +49-0-471-4831-218
website: http://www.wbgu.de
e-mail: wbgu@awi-bremerhaven.de

Note: Documents are available in print at a cost or for free to download from the website.

INTERNATIONAL AND NATIONAL GOVERNMENTAL CLIMATE CHANGE ORGANIZATIONS

United Nations Environment Programme (UNEP) Information Unit for Conventions (IUC)

IUC is a division of UNEP (see entry for UNEP in International and National Governmental Climate Change Organizations section) that works to promote public understanding of and support for conventions on climate change and other environmental issues. IUC provides details on upcoming environmental conventions and distributes information on convention proceedings. IUC also provides access to a variety of environmental publications, including a quarterly bulletin on the latest issues related to climate change and several resources providing background information on climate change and its potential effects.

Climate Change Topics

> background on climate change
> agriculture
> human health

Environmental Linkages

> air pollution and air quality
> water pollution and water quality
> land use

Application: IUC's Climate Change Information Kit, a collection of information downloadable from the web, provides detailed background on the basic issues of climate change, including greenhouse gases, the greenhouse effect, potential changes in climate, and the potential time frame for climate change. The kit provides information on the potential effects of climate change on agriculture, biological resources, sea level, water resources, human health, and extreme weather events. It also discusses potential strategies for reducing GHG emissions and details the activities of the UNFCCC.

Sponsor/Contact: UNEP Information Unit for Conventions
website: http://www.unep.ch/iuc/
e-mail: iuc@unep.ch

INTERNATIONAL AND NATIONAL GOVERNMENTAL CLIMATE CHANGE ORGANIZATIONS

Inter-American Institute for Global Change Research (IAI)

IAI is an intergovernmental organization established to foster increased understanding of global change in North, Central, and South America. Its website contains information on past and current research sponsored by IAI, as well as notifications of funding opportunities. IAI promotes research beyond the scope of national programs by sponsoring studies, both biophysical and socioeconomic, based on scientific issues important to the region as a whole. IAI's research priorities include climate variability in the Americas; comparative studies of ecosystems, biodiversity, land use, and water resources; changes in composition of the atmosphere; and integrated assessments and research applications.

Climate Change Topics	*Environmental Linkages*
> multiple sector impacts	> biodiversity
> adaptations, multiple sectors	> land use
> climate science	> water quality
> climate data	> deforestation

Application: This resource focuses on the Americas, particularly Central and South America. IAI can assist researchers who need information on funding opportunities or information on the current status of research projects and data availability. The website also contains summaries of the state of knowledge on climate-related topics such as El Niño, ozone, and UV radiation. IAI is developing a data information service so that scientific organizations in the Americas can share data holdings and develop joint research efforts. IAI covers various sectors and climate change issues, including coastal issues, land use, agriculture, forestry, human health, and ecosystems.

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Av. Dos Astronautas, 1758
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website: http://www.iai.int
e-mail: iai@dir.iai.int

Note: Information on the website is currently available in English, and soon will be available in French, Portuguese, and Spanish as well.

INTERNATIONAL AND NATIONAL GOVERNMENTAL CLIMATE CHANGE ORGANIZATIONS

International Human Dimensions Programme on Global Environmental Change (IHDP)

IHDP, established by the International Social Service Council in 1990, is an international, interdisciplinary, nongovernmental social science program dedicated to promoting and coordinating research aimed at describing, analyzing, and understanding the human dimensions of global environmental change. To accomplish its goals, IHDP links researchers, policy-makers and stakeholders; promotes collaboration between national and regional research committees and programs; identifies new research priorities; provides a focus and framework for interdisciplinary research; and facilitates the dissemination of research results. IHDP places particular emphasis on expanding and strengthening the network of national human dimensions committees and programs and on enhancing the IHDP's capacity to support them.

Climate Change Topics

- multiple sector impacts
- climate data
- emissions reductions
- adaptation

Environmental Linkages

- air pollution and air quality
- water pollution and water quality
- land use
- sustainable development
- pollution prevention

Application: Users can apply scientific information from IHDP to develop mitigation strategies and impacts assessments for multiple sectors. IHDP studies are particularly useful for policy applications because they interpret impacts determined by scientific studies in the context of their effects on humans. Scientific projects currently supported by the program include land-use and land-cover change, global environmental change and human security, institutional dimensions of global environmental change, and industrial transformation. Users can download IHDP publications for free from the website or order hard copies from the address below.

Sponsor/Contact:

IHDP
Walter-Flex-Strasse 3
53113 Bonn, Germany
Tel: +49-228-739050; Fax: +49-228-739054
website: http://ibm.rhrz.uni-bonn.de/ihdp
e-mail: ihdp@uni-bonn.de

INTERNATIONAL AND NATIONAL GOVERNMENTAL CLIMATE CHANGE ORGANIZATIONS

National Renewable Energy Laboratory (NREL): General Information and Website

NREL is the leading center for renewable energy research in the United States. The laboratory, a national laboratory of the U.S. Department of Energy, works with utilities, regulatory agencies, the World Bank, and international trade groups to ensure that renewable energy technologies reach the marketplace as quickly as possible. NREL helps government agencies, international institutions, and private companies with renewable energy and energy-efficiency applications that address climate change, air pollution, and other environmental issues. NREL works with these organizations to assess and verify emissions from alternative technologies and to develop and implement new policies and projects. NREL offers a suite of analytical tools, training programs, and technical assistance in collecting accurate data, supplying tools for assessing alternative energy sources, providing training, and offering policy and regulatory support. NREL also maintains a website that provides information on renewable energy research and programs.

Climate Change Topics

> energy efficiency
> renewable resources
> mitigation technologies

Environmental Linkages

> air pollution and air quality
> resource conservation

Application: The site provides links to sources of data on renewable energy, including the Alternative Fuels Data Center, the Renewable Resource Data Center, and the Renewable Electric Plant Information Center. The site also provides access to publications and other information on the latest research and technology, including an introductory information page called *Clean Energy 101*. Users interested in the development of sustainable rural power will find the Renewables for Sustainable Village Power program of interest, especially as it addresses potential electricity opportunities in rural villages through the application of renewable energy technologies. The program is currently operating in 13 countries (Argentina, Brazil, Chile, China, Dominican Republic, Ghana, Guatemala, India, Indonesia, Mexico, Russia, South Africa, and the United States). The objective of this program is to develop and implement applications that demonstrate the technical performance, economic competitiveness, operational viability, and environmental benefits of renewable rural electric solutions compared to conventional options of line extension and isolated diesel generators.

Sponsor/Contact: National Renewable Energy Laboratory
1617 Cole Boulevard
Golden, CO 80401-3393 USA
Tel: +1-303-275-3000
website: http://info.nrel.gov

Note: NREL often provides training at their Golden, Colorado, USA, facility. Details on international training and programs can be found on the NREL website at http://www.nrel.gov/international/contacts/default.asp

INTERNATIONAL AND NATIONAL GOVERNMENTAL CLIMATE CHANGE ORGANIZATIONS

System for Analysis Research and Training (START)

START, a program sponsored by the International Geosphere-Biosphere Program (IGBP, see Climate Change Research and Data Resources section), (see listing for this program), the World Climate Research Program (WCRP, see International and National Governmental Climate Change Organizations section), and the International Human Dimensions Global Environmental Change Program (IHDP, see International and National Governmental Climate Change Organizations), was established to develop networks of scientists and institutions to conduct research on global climate change. START assesses the causes and impacts of regional changes, and provides relevant information to policy makers and governments. The START mission is to enhance scientific capacity in developing countries by strengthening and connecting existing institutions, by training global climate change scientists, and by providing them with improved access to data, technology, and research results. START assists in regional implementation of global science programs and helps developing regions design and implement global climate change programs of regional relevance. START currently has regional networks in South Asia, Southeast Asia, temperate East Asia, the Mediterranean, Africa, and Oceania.

Climate Change Topics

- multiple sector impacts
- climate data
- ecology/ecosystems

Environmental Linkages

- land use
- land degradation
- biodiversity
- deforestation
- desertification

Application: Scientists developing global climate change studies who are in search of region-specific data can access the START program for region-specific information, training, and assistance. Topics covered by START programs include regional climate variability and change, changes in atmospheric composition, land use/cover change and its impacts, impacts of global change on terrestrial ecosystems and biodiversity, and the impacts of global change on coastal zones and oceans.

Sponsor/Contact:
International START Secretariat
2000 Florida Ave. NW, Suite 200
Washington, DC 20009 USA
Tel: +1-202-462-2213; Fax: +1-202-457-5859
website: http://www.start.org
e-mail: START@agu.org

INTERNATIONAL AND NATIONAL GOVERNMENTAL CLIMATE CHANGE ORGANIZATIONS

United Nations Development Programme (UNDP)

UNDP supports programs aimed that foster sustainable development and poverty reduction in developing countries. Environmental protection, including GHG mitigation, is an important aspect of several UNDP activities. Through the Global Environment Facility (see GEF entry in Mitigation Resources: Implementation and Assistance Programs section), UNDP has sponsored more than 150 projects to protect biodiversity, mitigate climate change, and prevent pollution of water resources. Other areas of UNDP concern include food security and sustainable agriculture, water resources and the aquatic environment, sustainable energy, forest resources, and dryland management.

Climate Change Topics

- economic welfare
- sustainable development
- energy efficiency
- renewable resources
- human health
- coastal resources
- multiple sector impacts

Environmental Linkages

- air quality and air pollution
- water quality and water pollution
- land use
- land degradation
- deforestation

Application: UNDP provides financial and technical assistance to developing countries for environmental and climate change projects. One UNDP effort is a set of programs to achieve sustainable management of forests in developing countries. For example, in Cameroon, UNDP has collaborated to introduce sustainable forestry management policies and practices that benefit local communities as well as the local environment. The project is supporting a national forest program, a new forestry policy, and matching legislation. UNDP has provided training in forest resource assessments and the use of computers. In addition, a public awareness campaign is helping to develop a participatory approach to forest management that reflects the interests of the community, industry, and the government.

Sponsor/Contact:

United Nations Development Programme
One United Nations Plaza
New York, NY 10017 USA
Telephone: +1-212-906-5315; Fax: +1-212-906-5364
website: http://www.undp.org
e-mail: hq@undp.org

Note: UNDP provides funds and assists in locating sources of funding for environment and climate change projects in developing countries.

INTERNATIONAL AND NATIONAL GOVERNMENTAL CLIMATE CHANGE ORGANIZATIONS

United Nations Environment Programme (UNEP)

As the environmental branch of the United Nations, UNEP's mission is to provide leadership and encourage environmental partnerships by "inspiring, informing, and enabling nations and people to improve their quality of life without compromising that of future generations." UNEP is concerned about climate change and provides information and research, educational materials, training, and a variety of environmental programs related to climate change issues. UNEP's climate-related programs include:

- World Climate Impacts and Response Strategies Program (WCIRP), which supports activities to assess the impacts of climate change and variability and to identify potential responses to reduce vulnerability.
- Global Resource Information Database (GRID), which offers technical assistance for climate-related projects.
- Drylands Ecosystem and Desertification Control (DEDC) Program, which supports research on the assessment and mitigation of land degradation, especially desertification.
- World Conservation Monitoring Center (WCMC), which facilitates access to information on the status, value, and management of biological resources, many of which could be affected by climate change.

Climate Change Topics	***Environmental Linkages***
> mitigation technologies	> air pollution and air quality
> multiple sector impacts	> water pollution and water quality
> human health	> land use
> ecology/ecosystems	> biodiversity
> sustainable development	> deforestation
> climate data	

Application: UNEP's GRID program serves a scientific basis for climate change decision making. GRID works to bring the environmental data needs of developing countries to the attention of the global change research community. GRID also assists developing countries understanding how to interpret climate and environmental data. GRID also provides technical training and assistance, and can help locate sources of financing for climate-related projects in developing countries.

Sponsor/Contact:

UNEP
Chief, Information and Public Affairs
P.O. Box 30552
Nairobi, Kenya
Tel: +254-2-62-1234/3292; Fax: +254-2-62-3927/3692
website: http://www.unep.org
e-mail: ipainfo@unep.org

Note: UNEP and its programs can help finance international climate change programs, either through direct support or by helping to find other funding sources.

INTERNATIONAL AND NATIONAL GOVERNMENTAL CLIMATE CHANGE ORGANIZATIONS

The World Bank

The World Bank, through its Global Climate Change Program, supports a variety of climate change mitigation projects. The Bank's primary goal is to promote economic development and reduce poverty among its client countries; however, the Bank is also committed to supporting the United Nations Framework Convention on Climate Change (UNFCCC). Current climate programs include the Activities Implemented Jointly (AIJ) Program, to stimulate foreign investment in projects that reduce GHG emissions; the National Strategy Studies Program, to educate policy makers on the benefits of participating in jointly implemented environmental programs; and the Prototype Carbon Fund, to support sustainable development in developing countries.

Climate Change Topics	***Environmental Linkages***
> energy efficiency	> air pollution and air quality
> renewable resources	> water pollution and water quality
> mitigation technologies	> land use
> building energy conservation	> deforestation

Application: The International Finance Corporation (IFC), a member of the World Bank Group, supports energy efficient and renewable-based electrical systems by helping developing countries estimate needs, analyze costs, and secure financing. Assistance is provided through IFC's many environmental activities, including the Renewable Energy and Energy Efficiency Fund (REEF); the Photovoltaic Market Transformation Initiative (PVMTI), implemented in India, Kenya, and Morocco; the Poland Efficient Lighting Project (PELP); the Hungary Energy Efficient Co-Financing Program; and a Small and Medium-Scale Enterprise (SME) Program to support smaller scale ventures in sustainable energy, currently operating in Bangladesh, the Dominican Republic, Mongolia, Poland, and Egypt.

Sponsor/Contact:
The World Bank
1818 H Street, N.W.
Washington, DC 20433 USA
Tel: +1-202-477-1234
website: http://www-esd.worldbank.org/cc/
e-mail: ClimateChange@worldbank.org

Note: The World Bank provides financing for a variety of environmental projects in developing countries.

INTERNATIONAL AND NATIONAL GOVERNMENTAL CLIMATE CHANGE ORGANIZATIONS

World Conservation Monitoring Center (WCMC)

WCMC was established by the United Nations Environment Programme (UNEP), the World Conservation Union, and the World Wide Fund for Nature (WWF) to work closely with organizations to increase access to the information on the world's living resources. WCMC information services provide and facilitate access to information on the status, value, and management of biological resources that could be affected by changes in climate. WCMC capacity building services help other organizations gather, manage, interpret, and use such information. WCMC data management services include secure data storage, data sharing, and management of data on behalf of other conservation agencies and networks.

Climate Change Topics	***Environmental Linkages***
> ecology/ecosystems	> land use
> wildlife	> land degradation
> forests	> deforestation

Application: Information from WCMC on biological resources, current threats, and vulnerabilities could be useful in developing impact assessments. This collection includes WCMC's National Biodiversity Profiles, a database of information on the state of biological diversity in a number of countries (several of which are available on WCMC's website). Each country's profile contains an overview, a description of the country's environmental characteristics, details on current protection efforts, a summary of protections needed, and a list of opportunities for international cooperation. For example, the profile for Kenya indicates that Kenya is home to 32 endangered species not found in any other nation, and climate change could further threaten these species.

Sponsor/Contact:
World Conservation Monitoring Center
Information Officer
219 Huntingdon Road
Cambridge, CB3 0DL, United Kingdom
Tel: +44-1223-277314; Fax: +44-1223-277136
website: http://www.wcmc.org.uk/
e-mail: info@wcmc.org.uk

INTERNATIONAL AND NATIONAL GOVERNMENTAL CLIMATE CHANGE ORGANIZATIONS

World Meteorological Organization (WMO)

WMO is a United Nations organization that sponsors and coordinates global meteorology and climate research. In addition to providing weather forecasts and related information, several WMO programs are engaged in long-term climate research. They include:

> Atmospheric Research and Environment Program (AREP), which coordinates research on the structure and the composition of the atmosphere and its physical characteristics.
> Global Climate Observing System (GCOS), which documents and monitors global climate conditions.
> Hydrology and Water Resources Program (HWRP), which performs research on issues related to sustainable development and the mitigation of water-related disasters.
> World Climate Program (WCP), which assists countries in applying climate information and knowledge to sustainable development.
> World Climate Research Program (WCRP), which performs research to improve predictions of climate change and to determine the extent of human influence on climate.

Climate Change Topics

> climate data
> climate modeling

Environmental Linkages

> air pollution and air quality
> water pollution and water quality
> land use

Application: WMO offers a variety of information on possible changes in climate variability as a result of climate change. For example, within WCRP, the Climate Variability and Predictability (CLIVAR) program focuses on the study of climate variability and predictability and the response of the climate system to human activity. The specific objectives of CLIVAR are to 1) describe the sources and nature of climate variability on various time scales; 2) extend the range and accuracy of seasonal and interannual climate prediction; and 3) understand and predict the response of the climate system to increases of greenhouse gases and aerosols. CLIVAR publications and datasets are available through WCRP, which can be accessed at http://www.dkrz.de/clivar/hp_nf.html

Sponsor/Contact:

WMO — Information and Public Affairs Office
41, avenue Giuseppe-Motta
1211 Geneva 2, Switzerland
Tel: +041-22-730-8314; Fax: +041-22-733-2829
website: http://www.wmo.ch
e-mail : ipa@www.wmo.ch

LIST OF NONGOVERNMENTAL CLIMATE CHANGE ORGANIZATIONS

Alliance for Responsible Atmospheric Policy

The Alliance is a coalition of companies that produce and use CFCs, HCFCs, and HFCs, and was organized in 1980 to coordinate industry participation in development of reasonable international and U.S. government policies regarding ozone protection and global climate change.

2111 Wilson Blvd.
Suite 850
Arlington, VA 22201 USA
Tel: +1-703-243-0344; Fax: +1-703-243-2874
website: http://www.arap.org

American Council for an Energy Efficient Economy (ACEEE)

The American Council for an Energy-Efficient Economy (ACEEE) is a nonprofit organization dedicated to advancing energy efficiency as a means of promoting both economic prosperity and environmental protection. Funding support for ACEEE comes from foundations, government organizations, research institutions, and utilities.

1001 Connecticut Ave. NW
Suite 801
Washington, D.C. 20036
Tel: +1-202-429-8873
website: http://www.aceee.org

American Forests

American Forests is a non-profit conservation organization working since 1875 to ensure a sustainable future for our nation's forests. American Forests has been working for over 10 years to improve understanding and application of the relationship between trees and greenhouse gases.

P.O. Box 2000
Washington, D.C. 20013
Tel: +1-202-955-4500
website: http://www.amfor.org

Business Council for Sustainable Energy

The Council was formed in 1992 and consists of leading companies and industry trade associations in the energy efficiency, natural gas, renewable energy, and electric utility industries. The organization advocates policies that promote the nation's economic, environmental and national security goals.

1200 18th St. NW
9th Floor
Washington, D.C. 20036
Tel: +1-202-785-0507; Fax: +1-202-785-0514
website: http://www.bcse.org
e-mail: bcse@bcse.org

Center for Clean Air Policy

Founded in 1985 by a bipartisan group of state governors, the Center for Clean Air Policy seeks to promote and implement innovative solutions to major environmental and energy problems while balancing both environmental and economic interests.

U.S. Office
750 First St. NE
Suite 1140
Washington, DC 20002, USA
Tel: +1-202-408-9260
Fax: +1-202-408-8896
website: http://www.ccap.org

European Office
Na Pankraci 101/1291
140 00 Praha 4
Czech Republic
Tel: +42-02-427393
Fax: +42-02-90054983

Center for Environmental Information

The Center for Environmental Information (CEI) is a private, nonprofit, educational organization, founded in Rochester, New York, in 1974. CEI provides information and communication services, publications, and educational programs.

55 St. Paul St.
Rochester, NY 14604-1314 USA
Tel: +1-716-262-2870; Fax: +1-716-262-4156
website: http://www.rochesterenvironment.org

Center for Renewable Energy and Sustainable Technology (CREST)

CREST is dedicated to the promotion of renewable energy, energy efficiency, the environment, and sustainable development. One of CREST's primary functions is to explore and demonstrate the use of advanced information and communication technologies in these fields. CREST also sponsors ReInState; as part of the Global Energy Marketplace (GEM), ReInState focuses on information and opportunities in each US state.

1612 K. St. NW
Suite 410
Washington, DC 20006 USA
Tel: +1-202-293-2898; Fax: +1-202-293-5857
website: http://solstice.crest.org/

Climate Action Network (CAN)

The CAN Directory provides a list of non-profit organizations worldwide working on different aspects of the climate change issue. The CAN Newsletter provides commentary on international negotiations taking place under the U.N. Framework Convention on Climate Change.

website: http://www.climatenetwork.org

Climate Institute

The Climate Institute works to protect the balance between climate and life on earth by facilitating dialogue among scientists, policy makers, business executives and citizens.

website: http://www.climate.org

Committee for the National Institute for the Environment

The Committee's mission is to improve the scientific basis for making decisions on environmental issues, and administer the National Library for the Environment.

1725 K St. NW
Suite 212
Washington, DC 20006-1401 USA
Tel: +1-202-530-5810; Fax: +1-202-62804311
website: http://www.cnie.org
e-mail: cnie@cnie.org

Econet

EcoNet serves organizations and individuals working for environmental preservation and sustainability. EcoNet builds coalitions and partnerships with individuals, activist organizations, and non-profit organizations to develop their use of the electronic communications medium. EcoNet is funded as a project through the Tides Center.

website: http://www.igc.org/igc/gateway/enindex.html

Edison Electric Institute (EEI)

EEI is the trade association representing shareholder-owned electric utilities.

website: http://www.eei.org

Electric Power Research Institute (EPRI)

The mission of the Electric Power Research Institute (EPRI) is to discover, develop, and deliver high value technological advances through networking and partnership with the electricity industry. Approximately 700 electric utility members fund EPRI's annual budget of $500 million.

3412 Hillview Ave.
Palo Alto, CA 94304 USA
Tel: +1-650-855-2000
website: http://www.epri.com

Environmental Alliance for Senior Involvement (EASI)

The Environmental Alliance for Senior Involvement (EASI) presents a springboard for senior citizens to be actively involved in focusing the direction in which their community, their nation, and their world will be headed in the future. EASI is funded through grants.

8733 Old Dumfries Rd.
Catlett, VA 20199 USA
Tel: +1-540-788-3274; Fax: +1-540-788-9301
website: http://www.easi.org
e-mail: easi@easi.org

Environmental Defense Fund (EDF)

EDF is a not-for-profit environmental advocacy group with four main goals: stabilizing the Earth's climate; safeguarding the world's oceans; protecting human health; and, defending and restoring biodiversity. The site includes a reference sheet titled 20 Simple Steps to Reduce Global Warming and EDF's Find Out About Your Electricity calculator.

257 Park Avenue South
New York, NY 10010 USA
website: http://www.myworld.com

Global Climate Coalition

Established in 1989 to coordinate business participation in the scientific and policy debate on the global climate change issue, the Global Climate Coalition (GCC) is an organization of private companies and business trade associations representing more than 230,000 firms.

1275 K St. NW
Washington, DC 20005 USA
Tel: +1-202-682-9161
website: http://www.globalclimate.org

Global Warming: Focus on the Future

Global Warming: Focus on the Future is the official web version of the award-winning exhibit, Global Warming: Understanding the Forecast, which closed on Labor Day, 1997 after a five-year, nine-city tour. The website encourages visitors to learn about the history of the issue, examines why the recent changes to the atmosphere are a problem, and empowers them to help solve the problem by giving specific examples of ways they can help to reduce emissions of gases that cause Global Warming.

website: http://www.enviroweb.org/edf

Greenhouse Gas Technology Verification Center

The Greenhouse Gas Technology Verification Center is an independent testing organization (sponsored in part by USEPA) with a mission to provide a credible third-party verification capability to vendors, buyers, and other stakeholders that need reliable GHG technology performance data.

P.O. Box 13825
Research Triangle Park, NC 27709 USA
Tel: +1-929-806-2306; Fax: +1-919-806-2306
website: http://www.sri-rtp.com

Greening Earth Society

Greening Earth Society is a not for profit organization created by Western Fuels Association. The Society's message is that CO_2 is required for life on earth and that the earth is getting greener thanks to increasing CO_2 levels.

4301 Wilson Blvd, Suite 805
Arlington, VA 22203 USA
Tel: +1-703-907-6168; Fax: +1-703-907-6161
www.greeningearthsociety.org

Institute of Global Environment and Society

This is a private, non-profit research organization in the State of Maryland, which provides information on the differences between climate and weather in addition to general climatic information.

4041 Powder Mill Rd., Suite 302
Calverton, MD 20705-3106
Tel: +1-301-595-7000
Fax: +1-301-595-9793
website: grads.iges.org/home.html

International Council for Local Environmental Initiatives (ICLEI)

ICLEI encourages cities to reduce local emissions of carbon dioxide, other greenhouse gases that contribute to global warming (climate change), and related air pollutants.

City Hall East Tower 8th Floor
Toronto, Ontario M5H 2N2 Canada
Tel: +1-416-392-1462; Fax: +1-416-392-1478
website: http://www.iclei.org
e-mail: ccp@iclei.org

International Energy Agency (IEA) Greenhouse Gas Research and Development Programme

IEA is a private organization funded by a number of governments and industries. IEA provides general information about climate change and its causes, as well as papers on reducing greenhouse gas emissions and newsletter updates.

Stoke Orchard, Cheltenham
Gloucestershire, GL52 4RZ
United Kingdom
Tel: +44-0-680753; Fax: +44-0-680758
website: http://www.ieagreen.org.uk
e-mail: mail@ieagreen.demon.co.uk

Minnesotans for an Energy Efficient Economy (ME3)

ME3 is a coalition working to improve the quality of life, the environment, and the economy of Minnesota by promoting energy efficiency and the sound use of renewable energy. This particular link is for ME3's climate change resource page.

Minnesota Building, Suite 600
46 East Fourth St.
St. Paul, MN 55101 USA
Tel: +1-651-225-0878; Fax: +1-651-225-0870
website: http://www.me3.org/issues/climate
e-mail: info@me3.org

National Association of State Energy Officials (NASEO)

NASEO, founded in 1986, is a nonprofit corporation whose membership includes energy officials from state and territory energy offices, as well as affiliates from the private and public sectors. NASEO is the state energy officials' Washington Voice on national energy issues.

1414 Prince St., Suite 200
Alexandria, VA 22314 USA
Tel: +1-703-299-8800; Fax: +1-703-299-6208
website: http://www.naseo.org
e-mail: info@naseo.org

National Environmental Trust

The National Environmental Trust is functioning as the resource for several major public education campaigns about environmental issues.

website: http://www.environet.policy.net

National Safety Council's Environmental Health Center

The mission of the National Safety Council is to educate and influence society to adopt safety, health, and environmental policies, practices, and procedures that prevent and mitigate human suffering and economic losses arising from preventable causes. This particular link provides information from the publication "Reporting on Climate Change: Understanding the Science."

1025 Connecticut Ave. NW, Suite 1200
Washington, D.C. 20036 USA
Tel: +1-202-293-2270; Fax: +1-202-293-0032
website: http://www.nsc.org/ehc/guidebks/climtoc.htm

Natural Resources Defense Council

NRDC is a non-profit environmental membership organization which brings together scientists and lawyers to protect the world's natural resources and improve the quality of the human environment.

40 West 20th St
New York, NY 10011 USA
Tel: +1-212-727-2700
website: http://www.nrdc.org
e-mail: nrdcinfo@nrdc.org

Northeast Recycling Council (NERC)

NERC's mission is to ensure the long-term viability of recycling in the Northeast while maximizing its full environmental and economic benefits. NERC's goals are to: 1) increase demand for recyclable materials and recycled products; 2) increase the supply of high-quality secondary materials; 3) maximize the overall efficiency of the recycling infrastructure; and, 4) further recycling-related job development in the collection, processing, and manufacturing sectors.

139 Main St., Suite 401
Brattleboro, VT 05301 USA
Tel: +1-802-254-3636; Fax: +1-802-254-5870
website: http://www.nerc.org
e-mail: nerc@sover.net

Ozone Action

Ozone Action is a Washington, DC based non-profit public interest organization focused exclusively on global climate change and stratospheric ozone depletion.

1700 Connecticut Ave. NW, Third Floor
Washington, DC 20009 USA
website: http://www.ozone.org

The Pew Center on Global Climate Change

Established in 1998 by the Pew Charitable Trusts, the Pew Center on Global Climate Change undertakes economic and scientific studies, conducts public education, promotes climate change solutions globally, and works with businesses to develop solutions to reduce greenhouse gasses while sustaining a healthy economy.

2111 Wilson Blvd., Suite 350
Arlington, VA 22201 USA
Tel: +1-703-516-4146; Fax: +1-703-841-1422
website: http://www.pewclimate.org

Physicians for Social Responsibility (PSR)

PSR is committed to the elimination of nuclear weapons of mass destruction, the achievement of a sustainable environment, and the reduction of violence and its causes. PSR has made global climate change a priority issue and its Web site reflects that commitment. The status of the national and international negotiations, as well as PSR's position on the issue are highlighted through a discussion of current PSR initiatives, press releases, and reports.

1101 14th St. NW, Suite 700
Washington, D.C. 20005 USA
Tel: +1-202-898-0150; Fax: +1-202-898-0172
website: http://www.psr.org
e-mail: psrnatl@psr.org

Resources for the Future (RFF)

RFF is a nonprofit and nonpartisan think tank located in Washington, DC that conducts independent research – rooted primarily in economics and other social sciences – on environmental and natural resource issues. RFF also provides "Weathervane" — a digital forum on global climate policy discussed by invited guests.

1616 P St. NW
Washington, D.C. 20036 USA
Tel: +1-202-328-5000; Fax: +1-202-939-3460
website: http://www.rff.org

Sierra Club Global Warming Campaign

This Sierra Club site features publications, news, and activities for people concerned about global warming. Sierra Club receives funding from donations made by a 550,000 member pool and various foundations.

85 Second St., Second Floor
San Francisco, CA 94105-3441 USA
Tel: +1-415-977-5500; Fax: +1-415-977-5799
website: http://www.toowarm.org

Trees For The Future

With more than 8,000 supporting members in North America and Europe cooperating with thousands of local leaders in the developing communities of Asia, Africa and Latin America, Trees for the Future is a non-profit, people-to-people, action program initiating environmental projects around the world.

P.O. Box 7027
Silver Spring, MD 20907-7027 USA
Fax: +1-301-565-5012
website: http://www.treesftf.org

Union of Concerned Scientists (UCS)

The common threads of global sustainability and global security weave the Union of Concerned Scientists' work on agriculture, arms control, energy, global resources, and transportation into a unified vision: achieving a secure and sustainable world today without sacrificing the environment of tomorrow. Funding for UCS comes from individual contributions and private foundations.

Two Brattle Square
Cambridge, MA 02238 USA
Tel: +1-617-547-5552; Fax: +1-617-864-9405
website: http://www.ucsusa.org
e-mail: ucs@ucsusa.org

Western Fuels Association

Western Fuels operates on a not-for-profit basis to provide coal for the generation of electricity by consumer-owned utilities throughout the Great Plains, Rocky Mountain, and Southwest States, and in Louisiana. Its 22 members and owners are rural electric generation and transmission cooperatives, municipal utilities, and other public power bodies.

website: http://www.westernfuels.org
e-mail: wfa@westernfuels.org

Woods Hole Research Center

The Woods Hole Research Center addresses issues of environment through scientific research and education and through applications of science in public affairs. Climate change is at the core of their research, and they specialize in global forests because of their controlling influence on climate. The Research Center is a private organization.

P.O. Box 296
Woods Hole, MA 02543-0296 USA
Tel: +1-508-540-9900; Fax: +1-508-540-9700
website: http://www.whrc.org/whrc.htm
e-mail: info@whrc.org

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Worldwatch is a nonprofit public policy research organization dedicated to informing policymakers and the public about emerging global problems and trends and the complex links between the world economy and its environmental support systems.

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The Wuppertal Institute is a not-for-profit institute and receives core funding from the regional government of North Rhine-Westphalia in Germany. It also receives funds through contract work. The Wuppertal Institute is devoted to climate change issues and often takes on the role of a mediator to provide links between politics, economics, science and the public, organizing forums for dialogue and engaging in mediation procedures.

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