Polarization Degrees of Freedom

in Electronuclear Reactions

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Final Technical Report

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Date

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WORKSHOP ON THE PREPARATION OF CLIMATE CHANGE ACTION PLANS

WORKSHOP SUMMARY

SPONSORED BY:

U.S. COUNTRY STUDIES PROGRAM

THE CLIMATE INSTITUTE
MINISTRY FOR THE ENVIRONMENT
OF INDONESIA

JAPAN ENVIRONMENT AGENCY

BOGOR, INDONESIA
JANUARY 6–10, 1997

DISCLAIMER

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Welcoming Remarks

Ata Qureshi

On behalf of the Climate Institute and the other cosponsoring organizations, the Ministry for the Environment of Indonesia, the U.S. Country Studies Program, and the Japan Environment Agency, I am delighted to welcome you for this week-long international Workshop on the Preparation of Climate Change Action Plans. It is especially fitting that this important meeting is being held in the Republic of Indonesia. Indonesia has long had a leadership role in the international effort to address the challenge of climate change and the Climate Institute has for nearly a decade worked closely with the Indonesian Government to develop climate change responses. Beginning in 1989, we were privileged to work with Pad. Aca Sugandhy, Assistant Minister for Natural Resources Management of the Environment Ministry, in helping to prepare the 1990 IPCC First Assessment Report concerning impacts of climate change on human settlement, energy, transportation, industry, human health, and air quality. In 1991 and 1992 when the Climate Institute organized a series of ministerial level briefings on climate change in 22 nations, we were fortunate to work with our esteemed friend Aca Sugandhy to organize a very successful two-day meeting in Jakarta in November 1991. In recognition of the international leadership of Indonesia in establishing an effective national climate change committee the Climate Institute conferred its 1992 award for public policy leadership on Hen. Emil Salim, then Minister for Population and Environment of the Republic of Indonesia.

Beginning in May 1992 we were privileged to work again with the Environment Ministry and our respected colleague, Aca Sugandhy in preparing the first country studies of climate change vulnerability and national strategy options. Sponsored by the Asian Development Bank and the Governments of Japan, Australia, and Norway, those studies which were coordinated by the Climate Institute were carried out by teams of national experts in eight Asian nations—Indonesia, Philippines, Malaysia, Vietnam, India, Bangladesh, Sri Lanka, and my native land of Pakistan. Policy guidance for the Indonesian study was provided by the Indonesian Ministry for the Environment and the study was carried out by two highly regarded Indonesian NGOs, WALHI and Pelangi. This study found that climate change could cause significant displacement of population in Indonesian coastal communities, perhaps displacing as many as three million people, disrupt fisheries production, and cause significant economic loss in the greater Jakarta area. It also found that climate change could increase the risk of a number of vector-borne diseases.

These findings of significant adverse potential impacts of climate change were mirrored in the other seven Asian climate change country studies which I was privileged to be able to coordinate. In virtually all of the countries substantial economic losses seem highly likely for coastal communities, with wide-scale population displacement possible in Indonesia, Philippines, Vietnam , and Bangladesh and significant impacts, generally adverse on balance, on the agricultural sector in most countries. In August 1991, on the occasion of the Philippine national workshop, I was able to present the preliminary findings of the Philippines country study and the other seven country studies to President Fidel Ramos of the Philippines. President Ramos indicated his desire to convene an Asian leaders summit to address the climate change challenge following the publication of those first eight country studies and two other parallel studies being carried out respectively by the Thailand Environment Institute and the Chinese Economic Research Institute. In February 1995, President Ramos convened an Asian and Pacific Leaders Conference on Climate Change. This meeting drew together leaders from 33 nations includes the Prime Ministers of Pakistan and Vanuatu, the parliamentary speakers of Bangladesh and Pakistan, and the Chairs of the parliamentary environment committees of Indonesia, Philippines, Republic

of Korea, China, Russia, and India. Senator Heherson Alvarez, Chair of the Environment Committees of the Philippines, chaired the Manila Conference for which I served as conference organizer.

A major recommendation of the Manila Conference was that an international public and private sector partnership be created to accelerate the development of greenhouse-benign energy applications, especially renewables and energy-efficiency.

Since the Manila Conference the Climate Institute has organized two major meetings to advance Green Energy Partnership initiatives. In December 1995, jointly with the M.S. Swaminathan Research Foundation, we organized the Madras Workshop on Impacts of Climate Change on Food and Livelihood Security. A major focus of this workshop was cost-effective measures that might be taken in India to speed installation of renewable technologies such as solar, wind, and biomass in rural villages of India and South Asia.

In September 1996, on the occasion of its Tenth Anniversary, the Climate Institute organized a Washington Summit on the Protection of the World's Climate. The central focus of this meeting was on near and medium term options for green energy development in a dozen countries which together accounted for about 60 percent of global energy use and produced roughly the same proportion of global greenhouse emissions. Experts from these twelve nations—Brazil, China, France, Germany, India, Japan, Mexico, Netherlands, Philippines, Russia, U.K., and U.S.—all presented options for green energy development between now and year 2005.

A session, which I will be moderating in this workshop on Tuesday afternoon, will examine these same issues, especially how greenhouse-benign energy development might be factored into the development of climate change action plans. Such a process can, we believe, build on the momentum already established by a number of Asian nations including our Indonesian hosts, in developing public private partnerships to accelerate renewable and efficiency applications. I look forward to working with each of you in the time before the Kyoto COP3 in order that we can lay the groundwork for accelerated green energy development from this meeting only 11 months away, perhaps the most crucial opportunity we will have in this century to respond to the climate change challenge.

Introductory Remarks

Barbara S. Harvey
Deputy Chief of Mission, U.S. Embassy to Indonesia

Distinguished Participants:
I am pleased to have been asked to speak at the opening of this climate change workshop which provides an opportunity for our countries to work together to address this issue. The Ambassador, Stapleton Roy, regrets that he is unable to join you, but he is experiencing Indonesia's beautiful environment on land and in the sea in Sulawesi, which is famous for its coral reefs.

Last July the Second Conference of Parties under the UN Framework Convention on Climate Change met in Geneva at the Ministerial level. The Ministers endorsed the Second Assessment Report of the Intergovernmental Panel on Climate Change (IPCC) as currently the most comprehensive and authoritative assessment of the science of climate change, its impacts and response options now available. Particular attention was drawn to the following IPCC findings:

- The balance of evidence suggests a discernible human influence on global climate.
- Without specific policies to mitigate climate change, the global average surface temperature relative to 1990 is projected to increase by about 2 degrees centigrade by the year 2100.
- Average sea level is projected to rise by about 50 centimeters above present levels by 2100.
- The projected changes in climate will result in significant, often adverse, impact on many ecological systems and socioeconomic sectors, including food supply and water resources, and on human health.
- These impacts may well be irreversible.
- Finally, developing countries and small island countries are typically more vulnerable to climate change.

Fortunately, the IPCC has also concluded that:

- Significant reductions in net greenhouse gas emissions are technically possible and economically feasible by utilizing an array of technology policy measures that accelerate technology development, diffusion, and transfer.
- Significant opportunities are available in most countries to reduce net greenhouse gas emissions.

The United States believes that by working together, our countries can find and implement policies, programs, and measures that contribute to sustainable development, reduce net greenhouse gas emissions, facilitate adaptation to the consequences of climate change, and forge partnerships that contribute to economic growth in all our countries. It is the goal of the U.S. Country Studies Program to help achieve these objectives.

Over the last few years, the Country Studies Program has worked with all of you on the development of greenhouse gas emission inventories; assessments of the potential physical, economic, and social impacts of climate change and strategies for adapting to those changes; and identification and evaluation of potential measures for reducing greenhouse gas emissions and increasing the sequestration of those emissions.

More recently, the Program has begun working with you on the development of national action plans for addressing climate change. Building on the results of previous work, these plans should identify policies, programs, projects and other actions which countries are prepared to take—or would like to take if adequate resources are available—to mitigate or adapt to climate change.

Many of you have been working on your action plans for over a year now and we look forward to hearing the results of your efforts this afternoon. Others of you are beginning the process of developing your action plans. Wherever any of us is in the process, this workshop is intended to provide us all with the opportunity and information for further clarifying our goals, our needs for technical assistance, if any, and the process we are pursuing or will pursue for developing a national action plan.

Technical experts are here to help consider opportunities in the areas of energy efficiency and renewable energy, methane control, forestry, and adaptation; to help

conceptualize basic economic choices; and to advise on how to formulate the financial elements of a project. Representatives of the Climate Convention Secretariat and other international programs are here to provide information on the larger international context. There will be a special session of senior policy makers focused on the special intersection of sustainable development and climate change action plans. Most important, however, will be the free flow of information and experience among all participants. The relaxed atmosphere here at the Safari Garden, as mentioned earlier, should facilitate an exchange of information and experience.

This workshop, the Country Studies Program, and all our efforts are taking place as part of a major international effort to address the problem of human-induced climate change. Ministers at the Second Conference of the Parties instructed their representatives "to accelerate negotiations on the text of a legally-binding protocol or another legal instrument to be completed in due time for adoption at the Third Session of the Conference of the Parties" which will take place next December in Kyoto, Japan.

I'd like to share with you three basic U.S. ideas regarding next steps under the Convention:

First, we believe that next steps must be as cost-effective as possible. To accomplish this, more flexible approaches must be brought into the Convention's basic framework. This includes allowing Parties nationally to determine the most appropriate policies and measures to reach an agreed target, and allowing emissions trading and joint implementation between Parties to minimize the cost of reductions.

Second, we need to focus on appropriate steps over the medium term, while continuing to develop a longer term goal. Short term (that is, before 2010) targets would be unnecessarily burdensome to national and global economic growth and development and are unrealistic.

Finally, while recognizing that developed countries, which all acknowledge are a significant part of the problem of climate change, must be part of the solution, it is very clear that all nations, not just the developed countries, must play active roles in meeting the challenge before us.

Climate change has become a priority issue in the United States. We know this attitude is shared by most other nations, large and small. We must commit to work together with a greater sense of urgency if an agreement is to be reached in Kyoto by the end of the year, and if all of us are to prepare our inventories of greenhouse gases and national action plans in a timely fashion.

This workshop, the Country Studies Program, and the development of national action plans containing concrete measures to mitigate and adapt to climate change are exactly the kind of cooperative efforts that are needed to respond successfully to the problem of climate change. I wish you every success in your efforts.

Bolivia: Climate Change Action Plan Workplan

Achieved Objectives and Goals

The Bolivian Climate Change Program in the past two years has realized:

- 1990 GHG emission inventory for the energy and non-energy sectors.
- Climatic and nonclimatic scenarios analysis.
- Vulnerability and adaptation assessments for forests, agriculture and livestock, and water resources.
- Initial mitigation assessments for energy and agricultural sectors.
- Results of climate change studies Publishing Workshops.

Main Objective

- Development of a Climate Change National Action Plan, integrating all climate change issues, measures, planning processes, and programs to achieve specific adaptation and GHG mitigation goals in the energy and nonenergy sectors.

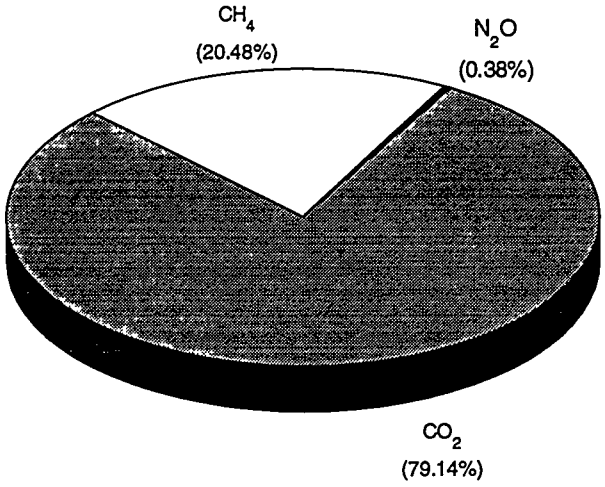
Balance General de Emisiones—Bolivia 1990

Fuentes	Emisiones (Gg) CO_2	CH_4	N_2O	NO_x	CO	NMVOCs
Emisiones Nacionales	56,190.14	597.99	1.047	54.44	1,282.34	24.52
Sector Energia	5,922.96	14.85	0.2	23.92	193.65	24.52
Combustion*	5,143.27	0.918	0.2	23.9197	193.653	24.52
Fuentes Estacionarias	2,903.59	0.158	0.15	5.3197	11.463	
Fuentes Moviles	2,239.68	0.76	0.05	18.6	182.19	24.52
Fugitivas*	779.69	13.93				
Petroleo y gas natural	779.69	13.93				
Sector Industrial	260.46					
Agricultura		457.80	0.057	2.058	86.451	
Ganado Domestico		428.57				
Produccion de arroz		25.85				
Quema de sabanas	2.932	0.036	1.311	76.695		
Quema de desechos agricolas		0.452	0.021	0.747	9.486	
Cambio en el uso de la tierra y silvicultura	50,006.72	114.54	0.79	28.46	1,002.24	
Cambios en bosques y otra biomasa leñosa	456.06					
Conversion de Bosques y Praderas	49,645.49					
Quema in-situ de bosques		114.54	0.79	28.46	1,002.24	
Abandono de tierras cultivadas	-94.83					
Residuos		10.80				

*Estimación basada en Metodologia "Bottom-Up"

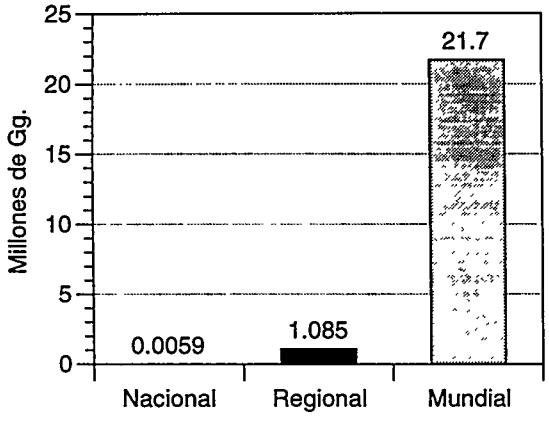
Contribucion Relativa de Gases (%) en Terminos de GWP

Gases	Emisiones (Gg) Peso Molecular	GWP 100 Años Horizonte	Potencial de Calentamiento	Contribución Relativa (%)
Dióxido de Carbono (CO_2)	56,513.93	1.00	56,513.93	79.14
Metano (CH_4)	597.04	24.50	14.627.48	20.48
Oxido Nitroso (N_2O)	0.847	320.00	271.04	0.38
Total			71,412.45	100.00



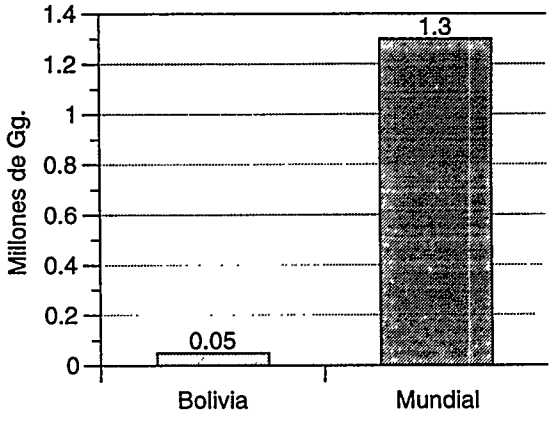
Comparacion de Emisiones de CO_2 del Sector Energetico

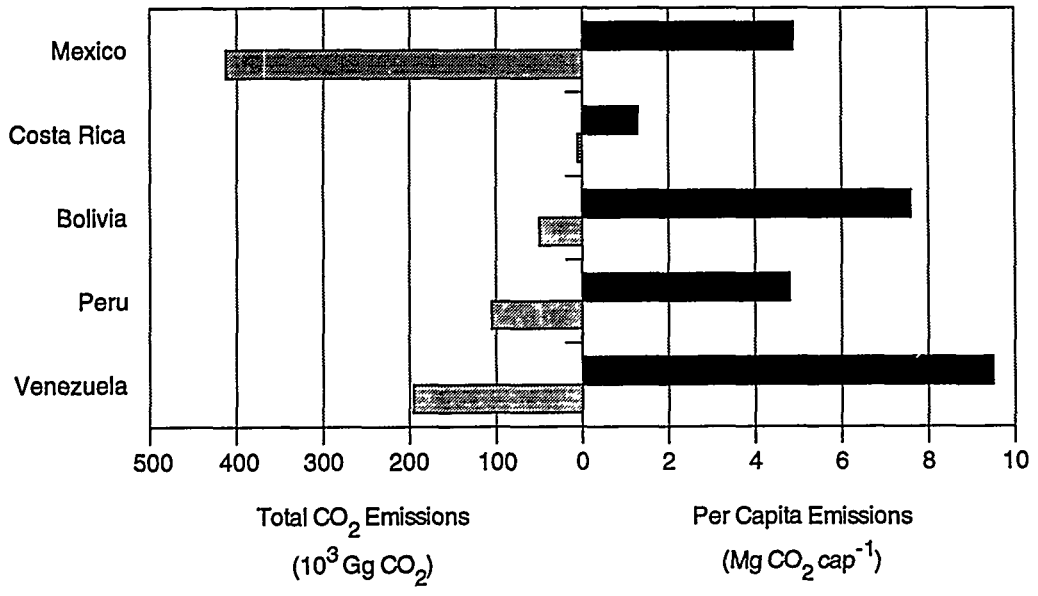
Emisiones mundiales = 21,700,000 Gg
Emisiones de América Latina = 1,085,000 Gg
Emisiones de Bolivia = 5,922.96 Gg



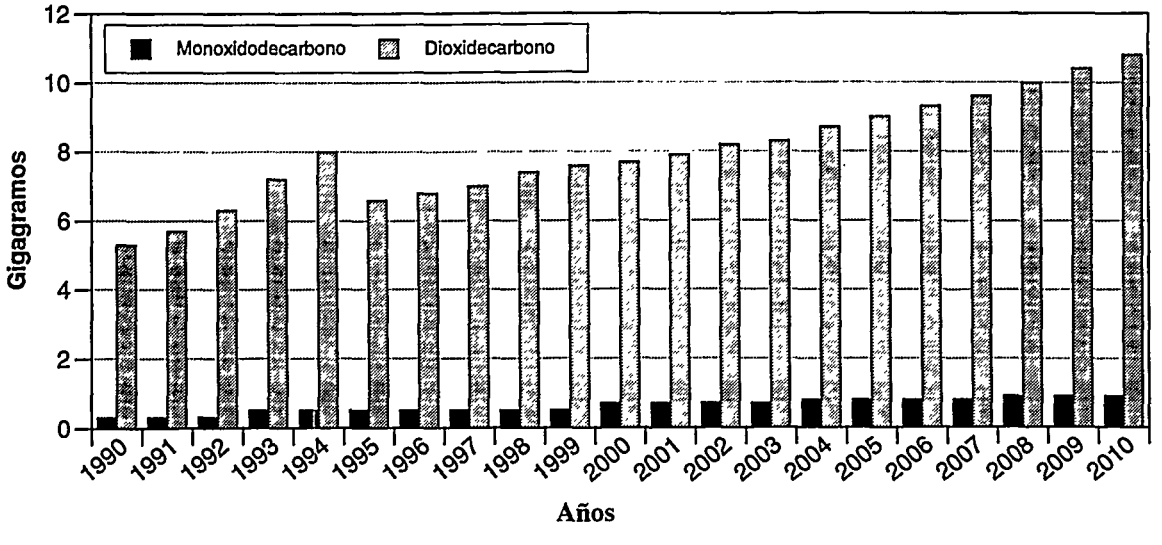
Comparacion de Emisiones de CO_2 del Sector Cambio en el Uso de la Tierra y Silvicultura

Emisiones mundiales = 1,300,000.00 Gg
Emisiones de Bolivia = 50,006.00 Gg





Total and Per-Capita CO_2 Emissions by Country (1990)



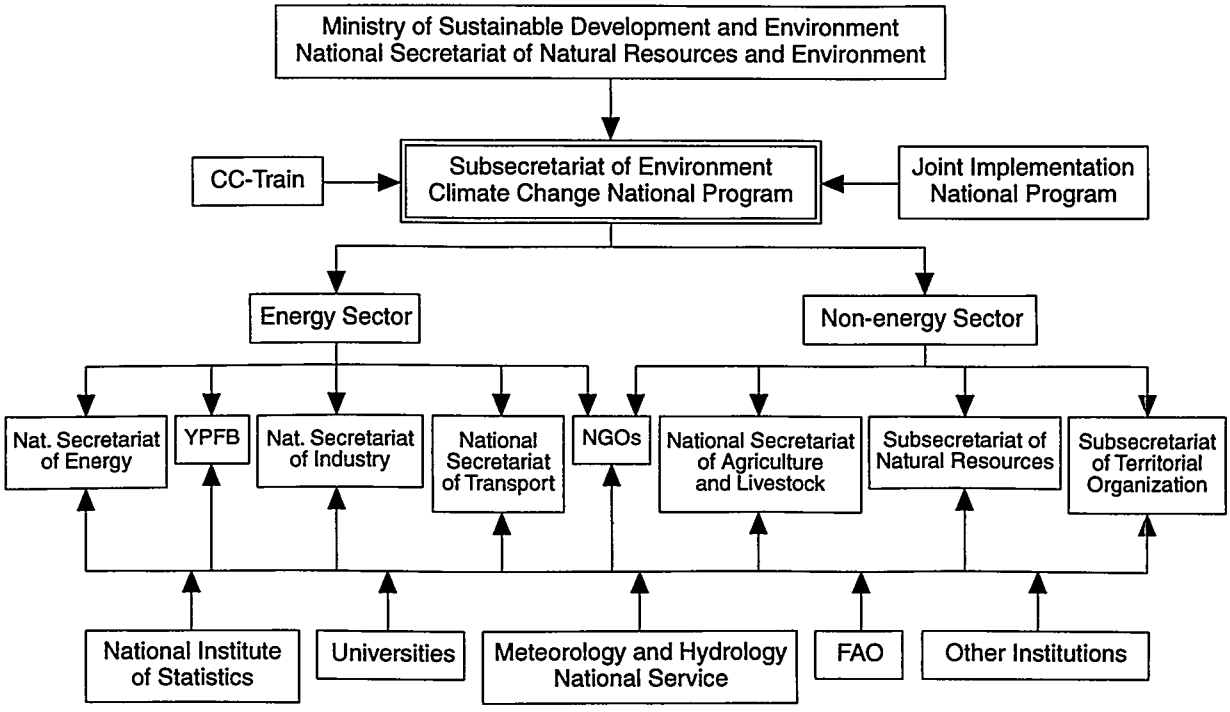
Sector Energetico—Bolivia: Emisiones de GEI, 1990–1920

Specific Objectives

- Evaluate capacity for adaptation and GHG mitigation measures, identified in the National Climate Change Program for the energy sector, agriculture, and forestry.
- Formulate implementation strategies for adaptation and GHG mitigation measures.
- Develop consensus among decisional government levels and other public, academic, and private institutions to achieve implementation of adaptation and mitigation measures, and to encourage a basic change in energy, forestry, and agricultural country policies that contribute to GHG reductions and sustainable development.
- Facilitate the exchange of information and technical assessment related to climate change technological measures and develop capacity of analytic tools management.
- Strengthen the Bolivian Climate Change Program to update the GHG emission inventories, vulnerability and adaptation assessments and GHG mitigation options assessments.

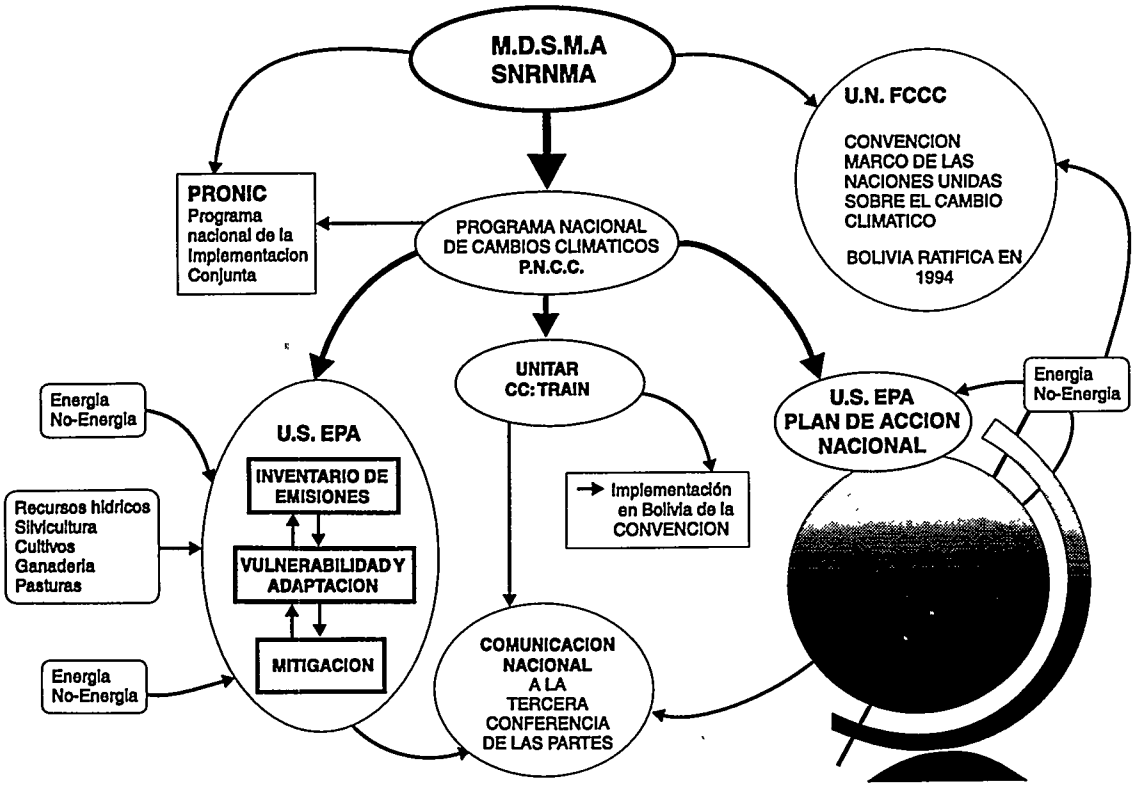
Elements of the National Climate Change Action Plan

- International training on National Action Plan development.
- Determination of Plan objectives for energy, transportation, land-use and forestry, and agricultural sectors.
- Preparation of a comprehensive Workplan.
- Evaluation and development of adaptation and mitigation sectoral measures and multi-sectoral measures in the field of technology evaluation.
- Comparative analysis and refinement of measures across sectors.
- Preparation of implementation strategies for adaptation and GHG mitigation measures, identified in the National Climate Change Program studies for energy, agricultural, and forestry sectors.
- Preparation and adoption of the National Plan.
- Preparation of public diffusion programs.
- Preparation of the National Communication.



National Climate Change Action Plan Process in Bolivia

Programa Nacional de Cambios Climaticos



Summary Schedule

ACTIVITIES	YEAR ONE / MONTHS											
	1	2	3	4	5	6	7	8	9	10	11	12
1. Workshop to support preparation of National Action Plan												
2. Determination of Plan Objectives and Sectors of Interest												
3. Preparation of Workplan												
4. Selection of workteam												
5. Training workshops for Sectors of interest												
6. Evaluation and development of mitigation and adaptation measures												
7. Workshops on technology evaluation and development of technology initiatives												
8. Technology evaluation and development of technology initiatives												
9. Visit of U.S. Country Studies Program experts												
10. Comparative analysis and refinement of measures across sectors												
11. Preparation of implementation strategies												
12. Presentation of National Action Plan Draft												
13. Preparation of National Communication												
14. Presentation of National Communication Draft												
15. Preparation of public diffusion programs												
16. Presentation of reports												
17. National and International Workshops												
18. National presentation workshop of National Action Plan												
19. Distribution of revised National Action Plan												
20. Presentation of final document of National Action Plan												
21. Presentation of final document of National Communication												

Support for National Action Plans (SNAP) for Bulgaria

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Introduction

The Government of the Republic of Bulgaria attaches great importance to environmental issues, bearing in mind the critical role of environmental protection in regard to the sustainable economic and social development of the country.

Bulgaria signed the United Nations Framework Convention on Climate Change (FCCC) in Rio de Janeiro in June 1992 and Bulgaria's National Assembly ratified it in March 1995.

The Republic of Bulgaria declared its target of keeping anthropogenic greenhouse gases (GHG) emissions levels in 2000 no higher than the levels of anthropogenic emissions in 1988, which was approved as the base year for the implementation of the FCCC in the country.

Bulgaria participated in phase one of the US Country Studies Program (CSP), where three major problems such as GHG inventories, vulnerability and adaptation to climate change, as well as mitigation were addressed. Results of phase one of the study have been used as a scientific, technical, and economic basis for the Bulgarian First National Communication on Climate Change and should serve as a sound basis for further studies and research.

Therefore, Bulgarian participation in phase two of the U.S. CSP will facilitate implementation of commitments under the FCCC by development of a National Climate Change Action Plan and technology assessments; both will form a consistent basis for the Second National Communication to the FCCC.

Introduction—Bulgaria as a Party to the FCCC

- The National target is to stabilize GHG emissions by 2000 at a level no higher than that in 1988.
- Phase one of the USCSP—Inventory of GHGs, vulnerability and adaptation, and mitigation.
- The first National Communication was prepared based on the results of the Bulgaria Study under the USCSP.
- Participation in SNAP will further facilitate implementation of commitments under the FCCC by developing the National Climate Change Action Plan and technology assessment. Both of them will be a consistent basis for the Second National Communication to the FCCC.

Objectives

The ultimate goal of the FCCC is to implement a global strategy to conserve the climate system for present and future generations. Pursuant to this goal, the overall objective of Bulgarian participation in SNAP is to facilitate the fulfillment of its commitments under the FCCC. This general objective will be achieved through preparation of the National Action Plan that will translate the FCCC requirements into a detailed program in compliance with national circumstances and consistent with national development planning, thus integrating climate change into the broader planning process.

Key Objectives of Bulgaria's Participation in SNAP

- Facilitate further fulfillment of Bulgaria's commitments under the FCCC.
- Screening of mitigation and adaptation options (policies and measures), and identification of those that are most efficient (technically and economically) and politically feasible.
- Incorporate policies and measures of different sectoral ministries into the planning process.
- Prepare the National Climate Change Action Plan and build consensus toward its implementation.
- Identify financial resources to ensure implementation of the NCCAP.

Screening of mitigation and adaptation policies and measures will be performed with emphasis on those analyzed in phase one of the study. The objective is to rank them considering the most technically and economically efficient ones, given the country's national circumstances.

Organizations Involved in the Development of the NCCAP

- Lead agency: Energoproekt
- Lead Government agencies: the Ministry of Environment and the Ministry of Energy
- Participating agencies: the Institute of Forestry (BAS), the National Electric Company, the Institute of Nuclear Research and Nuclear Energy (BAS), the National Institute of Meteorology and Hydrology (BAS), the Institute of Economics (BAS), the National Statistic Institute (BAS), and the Ecomonitoring club
- Climate Change Steering Committee: Key analysts and representatives from the Ministry of Industry, the Ministry of Transport, the Ministry of Agriculture, the Committee of Forests, and Ministry of Education
- State Climate Change Commission to the Council of Ministers

The mitigation and adaptation technologies should be incorporated in the planning processes of economic sectors. There, the climate change considerations should be assessed in regard to their technical, economic, and political feasibility.

After identifying and reaching an agreement on the priority measures, they should be included in the National Action Plan and strategies for their implementation should be designed. Consensus on its implementation will be built by raising the public awareness, environmental education improvement, and social support to the governmental initiatives in the field of climate change.

The final goal is not only to define the priority actions at different sectors of the national economy but also to identify the necessary domestic and international financial and public support for their implementation.

Organizations and Personnel Participating in the National Action Plan Development

The National Action Plan will be developed by a team of management, scientific, and technical experts who have taken part in phase one of the Bulgaria Country Study Project.

Energoproekt Research Institute once again will be a national coordinator. The Ministry of Environment and the Ministry of Energy will be lead governmental agencies.

Other participants, who will act as subcontractors to Energoproekt are:

- Forest Research Institute of the Bulgarian Academy of Science the (BAS)
- National Electric Company
- Institute for Nuclear Research and Nuclear Energy of the BAS
- Institute of Economy of the BAS
- National Institute of Meteorology and Hydrology to the BAS

The Climate Change Steering Committee was established in the first phase of the project with participation of key analysts and representatives from the Ministry of Industry, the Ministry of Transportation, the Ministry of Agriculture, the Committee on Forests, and the Ministry of Education. It will be an important organizational structure during the SNAP phase.

In addition, a State Climate Commission will be established by the Council of Ministers. The Commission will be chaired by the Minister of the Environment and

will involve, as deputy chairmen, the Deputy Ministers of the Environment and of Energy.

Project Elements (tasks)

The SNAP project consists of the following major elements (tasks).

Element 1. Preparation of a Detailed Work Plan

The workplan addresses the activities in SNAP under the succession of elements.

Element 2. Preparation of the National Climate Change Action Plan

Stage A. Prepare Action Plans at Sectoral Level

Task A.1. Conduct a Scoping Workshop with senior governmental officials, municipalities, private sector representatives, and nongovernmental organizations to discuss basic response measures to be incorporated in an action plan and technical options to be kept in focus during technical assessment.

Both mitigation and adaptation measures will be discussed at this stage, such as:

- For mitigation:
  - — **Electricity Generation:** Conventional power plants, IGCC, and advanced concepts such as cogeneration, district heating, and fuel switching, and renewable, including biofuels, hydro, and nuclear power plants.
  - — **Industry:** Energy audits, efficient boilers, heat recovery, industrial cogeneration, fuel substitution, efficient lighting, and efficient motor operation.
  - — **Transportation:** Introduction of improved vehicle standards, infrastructure projects, and municipal transportation.
  - — **Households and Services:** Efficient boilers, efficient lighting, improved standards for electrical appliances, and improved isolation.
  - — **Urban and Agriculture Waste Management:** Afforestation.
- For adaptation:
  - — Changing of current afforestation policy, reforestation of vulnerable forests with new species.

Task A.2. Development of policies and programs and assessment of their environmental impact in terms of GHG emissions reductions as well as their impact on the social and economic development of the country.

Task A.3. Analysis of the current forestry policy, identification of mitigation and adaptation measures, and analysis of technical and economic feasibility of measures. Further development and improvement of the two pilot afforestation projects identified in phase one of the study.

Task A.4. Update of the GHG inventory, including an inventory for the series of recent years for which statistical data are available and development of country-specific emission factors and improvement of IPCC methodology implementation.

Stage B. Synthesis Activity

Task B.1. Preparation of a Draft National Climate Change Action Plan

This stage of the study aggregates the results of previous stages at the level of the national economy, and it offers a cross-sector analysis of the proposed measures. The sectoral and multi-sectoral measures are evaluated with respect to their contribution in the National Action Plan.

Task B.2. Preparation of the National Climate Change Action Plan. The draft report will be presented to the senior officials. A workshops with senior governmental officials and nongovernmental organizations will be conducted to develop consensus on appropriate mitigation measures to be implemented. The recommendation will be considered and the National Action Plan should be refined.

Element 3. Technology Assessment

This element deals with the analyses of technological, economic, institutional, and social factors associated with the implementation of measures selected in Element #2. Feasibility analysis is accomplished by identification of options to overcome the implementation barriers.

The overall effectiveness of the plan will be assessed. As can be seen, this stage is much more diverse. Attention will be focused on the measures identified in the Bulgaria Country Study that were proven to be technically and economically feasible and to have great mitigation potential, including:

- Energy efficiency in industry, agriculture, households, and services
- New technologies in energy supply
- Extensive use of renewable energy

Project Elements

- **Element 1: Preparation of the detailed workplan**
- **Element 2: Preparation of the National Climate Change Action Plan (NCCAP)**
  Stage A. Preparation of plans at the sectoral level
  - **Task A1:** Conduct a scoping workshop to discuss potential measures for the NCCAP for mitigation: electricity generation (conventional plants, IGCC, cogeneration, district heating, fuel switching, and renewables), industry (energy audits, efficient boilers, heat recovery, industrial cogeneration, fuel substitution, and efficient lighting, and efficient motor operation), transport (improved vehicle standards, infrastructure projects, and municipal transport), households and services (efficient boilers, efficient lighting, standards for appliances, and improved insulation), and waste management for adaptation: changing the current afforestation policy.
  - **Task A2:** Development of policies and programs, and assessment of their environmental impact (in terms of GHG mitigation).
  - **Task A3:** Analysis of the current afforestation policy, identification of adaptation and mitigation measures, analysis of technical and economic feasibility, and further improvement of proposals for pilot afforestation projects identified in the phase one.
  - **Task A4:** Update of the GHG inventory, including an inventory for the recent years, implementation of country-specific emission factors, and a recent version of IPCC methodology.

  Stage B: Synthesis activity
  - **Task B1:** Prepare the draft NCCAP by aggregating at the national level the sectoral measures and conducting the cross-sectoral analysis.
  - **Task B2:** Report on the draft NCCAP, conduct a workshop to achieve consensus, refine the draft NCCAP.
- **Element 3: Technology assessment**
  - Analysis of technological, economic, institutional, and social factors related to identified in element 2 measures, including energy efficiency in industry, households, and agriculture; new technologies in energy supply; extensive use of renewables; the impact of the energy policies on the economy; and a cross-sectoral assessment.
  - Assessment of the overall effectiveness of the plan
  - Project financing and options to obtain funding
- **Element 4: Public awareness and educational activities**

- Impact of energy policies
- Cross-sectoral assessment of the measures

The Marcal-Macro model will be used for the analysis. It will be used also to carry out the sensitivity analysis of tax introduction and price changes, subsidies impact, and standards for energy production and buildings.

Great attention is devoted to the problem of financing the projects incorporated in the National Action Plan. This stage also addresses the Joint Implementation (JI) option.

Element 4. Public Awareness and Educational Activities

At the point of National Action Plan implementation, public acceptance and awareness plays a crucial role. For application of the mitigation scenarios in a reasonable time horizon, the collaboration of the entire society is necessary and highly recommended.

Raising public awareness in the field of environmental issues and climate change is the main direction of activities. This might include climate change issues within the context of the global environmental issues, mitigation measures and environmentally friendly personal behavior.

Technical Assistance Needed

The experience gained during the first phase of the study has clearly indicated that the following elements of technical assistance should be made available to the country team in order to ensure successful implementation of the second phase of the study.

- Provision of analytical tools and reference manuals for these tools, including the following software packages that have been used to a certain extent during the phase one of the study:
  - — MINERGG Software for GHG emission inventory
  - — GSM models including GISS, GFDL, and CCC
  - — GAP models for forestry adaptation
  - — DSSAT system, including CERES models for maze and wheat
  - — ENPEP software for integrated energy planning
  - — MARCAL-MACRO model for energy cost minimizing and selection of the best technological option available
  - — Macroeconomic and multicriteria decision models

The Bulgarian team will continue to apply these models in a way that is oriented to the key objectives of phase two of the project, preparation of the National Action Plan and the technology assessment.

Training on the key steps in National Action Plan development and on technology assessment will significantly improve the capacity of the team to deal with the problems much more effectively.

Although some National Communications and National Action Plans are already available to the team, further exchange of information within phase two of the projects, especially of other Communications and Action Plans of Annex I Parties of FCCC, are very useful.

Cooperation in the following fields will be of great importance to achieving the project goals:

- Mitigation analysis of the forest sector—with American Forests
- Adaptation assessment—with Hagler Bailly Consulting, Inc.
- DSM programs development and assessment—with Northeast by Northwest Consultant
- Renewable technologies evaluation—with NREL
- Country-specific emission factors—with ICF Kaiser

In addition to that, we are planning to cooperate with the new consultants to the USCSP such as IFREE and IIEC.

More detailed specifications of the technical assistance needs could be presented after the training workshop.

Technical Assistance

- Analytical tools and reference materials.
  - MINERGG Software for the GHG inventory
  - GCM models including GISS, GFDL and CCC
  - GAP models for forestry adaptation
  - ENPEP model for integrated energy planning
  - MARCAL-MACRO model for optimization and selection of the best technological option available
  - Macroeconomic and multi-criteria decision models
- Training on the key steps in developing the National Action Plan.
- Information on the NCCAPs and National Communications on Climate Change of other countries.
- International cooperation with LBL, American Forests, Hagler Bailly Cons., Northeast by Northwest, NREL, ICF, IFREE, and IIEC.

Egypt's Climate Change National Action Plan

Dr. Ibrahim Abdel Gelil
Chairman, OECP

Why Egypt Should Be Involved

- Egypt's large and tightly packed population makes it highly vulnerable to climate change.
- Egypt is already deficient in food production, agricultural land is only 5 percent of the total land.
- Egypt's water resources are limited and 90-percent dependent on the Nile, whose volumetric flow is highly sensitive to climate change.
- Egypt's Mediterranean coast and the Nile delta are vulnerable to sea level rise.

GHG Mitigation Options for Egypt

- Egypt's total CO_2 emissions amount to about 84 million tons per year (not a real carbon emitter)
- Energy use represents 85 percent of the total CO_2 emissions
- Mitigation strategies are an integral part of Egypt's energy policies
- No-regret options are already adopted or being developed

Time Line

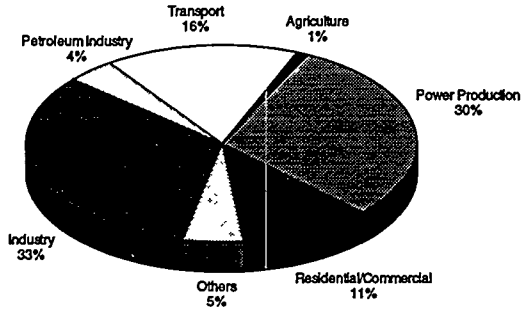
1992
- Signed the UNFCCC at the UNCED.

1993
- Participated in the UNEP Greenhouse Gas Abatement Costing Studies.

1994
- Ratified the Convention.
- Participated in the U.S. CSP.

1995
- Participated in the SNAP.
- Participated in the COP–1.
- Negotiated the GEF to fund the Climate Change Capacity Building Project.

1996
- Participated in COP–2.
- Started the Capacity Building Project, funded jointly with GEF.
- Participated in the CC: INFO/WEB with the UNFCCC Secretariat.



Sources of CO_2 Emissions in Egypt (%)

Egypt's Energy Policy Objectives

- Maintain self-sufficiency of petroleum products
- Develop hydrocarbon reserves
- Maintain oil export revenues
- Maximize the use of hydro resources
- Maximize the use of natural gas
- Promote renewable resources
- Promote energy efficiency
- Protect the environment

Win-Win Situation

Energy efficiency and fewer carbon fuels mean:

- Longer life for hydrocarbon resources
- Decreased costs for goods and services
- Improved economic competitiveness within globalized world economy
- Better investment decisions
- Global warming mitigation

Mitigation Technology Assessment

Seven Identified Technologies

1. Fuel-switching to natural gas in industry
2. Cogeneration in industry and commercial buildings
3. Combustion control systems
4. Waste-heat recovery systems
5. Efficient lighting systems
6. Use of wind energy in power generation
7. Condensate recovery systems

Criteria for Selection

- Meet energy policy objectives
- Negative cost to the economy
- Potential of local manufacturing
- Some are already implemented or demonstrated

Workplan Mandates for Each Technology

1. Evaluate economic costs
2. Evaluate mitigation potential
3. Evaluate technical, market, institutional, and social factors to promote diffusion
4. Identify and evaluate near-term opportunities to promote diffusion
5. Integrate technology assessment outcomes into the national plan

Barriers

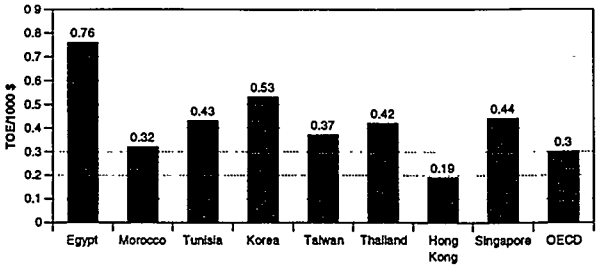
- Market distortions
- Lack of financial incentives
- Lack of financing mechanisms
- Lack of standards and regulations

Action Plan Objectives

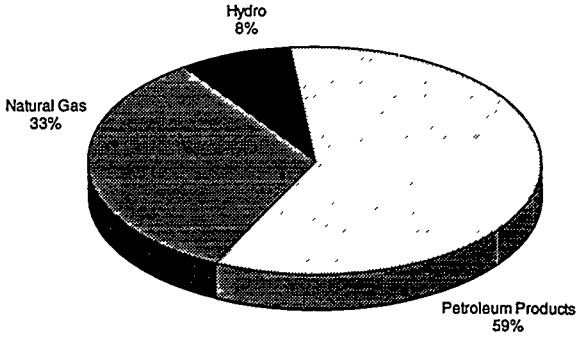
- Integrating climate change into national planning processes
- Raising national awareness and building national capacity to deal with climate change
- Design of priority policies and measures

Priority Sectors

- Energy
- Agriculture
- Water resources
- Coastal resources



Energy Intensity for Selected Countries 1990



Primary Energy Consumption Pattern in Egypt 1994–1995

Preparation of the National Plan

- Refinement of GHG inventory
- Development of base-case and future GHG projections
- Review of Framework of National Action Plan
- Identification of policies and measures already in force or planned
- Evaluation of environmental, economic, and social impacts
- Technology assessment
- Plan document

Ongoing Projects to Support the National Plan

- Pilot demand-side management (DSM) project in Alexandria
- Assessment of potential waste-to-energy
- Efficient energy technologies demonstration program
- Assessment of the potential of energy efficiency in the Egyptian transport sector
- GEF-funded capacity building project
- Assessment of the current level of energy efficiency of home appliances
- Pilot energy-efficiency program for SME in Alexandria

Public Awareness Is a Key to Public Support

- Presentations in seminars, conferences, and workshops
- TV and radio interviews
- Newspapers, journals
- Training of trainers: workshop for media representatives
- Involvement of nongovernmental organizations
- Public awareness materials in Arabic

Deliverables

- A National Climate Change Action Plan
- A report on assessments of a set of selected technologies
- A report on an assessment if additional resources that Egypt requires to implement the plan
- A seminar to present the results of technology assessments to different stakeholders
- A project final report

Future Policy Issues

- Energy efficiency standards (appliances, cars, buildings)
- Joint implementation
- Effect of Berlin mandate on trade

Strategies to Address Climate Change in Central and Eastern European Countries

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Introduction

This paper presents analyses based on information mainly from the national communications of nine Central and Eastern European countries that are undertaking radical transition from centrally planned to market driven economies. These so-called Economies in Transition (EIT) countries include Bulgaria, the Czech Republic, Estonia, Hungary, Latvia, Poland, Romania, the Russian Federation, and Slovakia, all of whom are Annex I Parties to the United Nations Framework Convention on Climate Change (UNFCCC). This paper is designed primarily to provide an overview of the policies and measures to address climate change that have been implemented, are under implementation, or are being planned.

In order to better understand the objective of policies and measures and the way they have been implemented in EIT countries the analysis has been supplemented by a review of the national circumstances and overall policy contexts in EIT countries that are relevant to climate change policies and measures problems. Therefore, during the presentation we shall discuss these issues together with a brief analysis of mitigation policies and measures by sector.

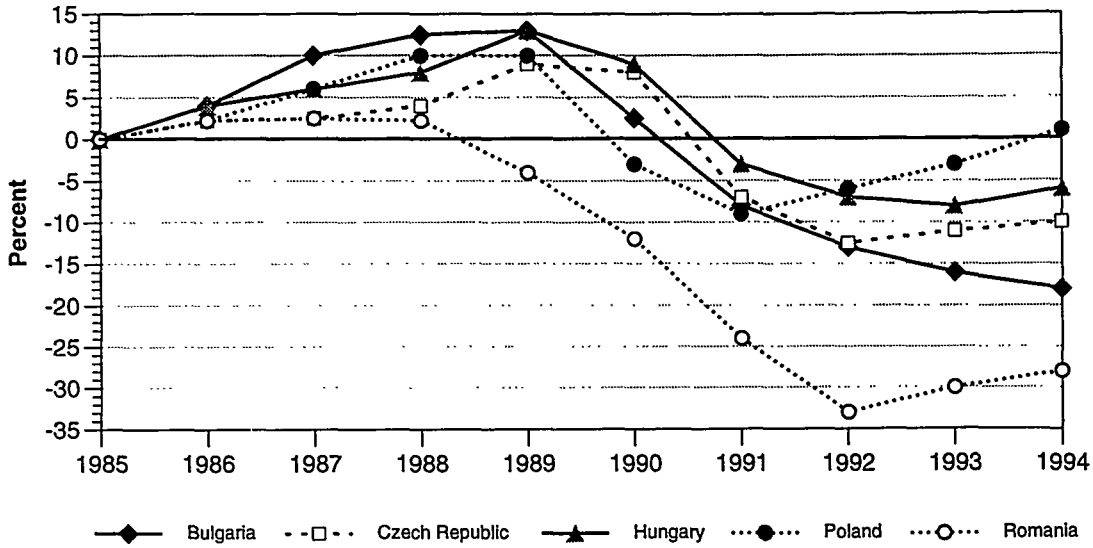
National Circumstances

In all EIT countries, the transition to free market economies has been characterized by deep economic crisis, the collapse of traditional foreign markets, and a decrease in domestic consumption and industrial output resulting in a drastic drop in gross domestic product (GDP) (Figure 1). An important consequence of this process for climate change was the decrease in the level of greenhouse gas emissions (GHG) in proportion to the drop in economic activity. For example, in Poland GDP dropped about 20 percent in the 1988–1991 period, while CO_2 emissions diminished by 22 percent for the same period.

Another important characteristic of the EIT countries was the high proportion of industrial output in the economy that resulted in high energy intensity of the economy and as a consequence in high energy consumption per unit GDP production. This affected the level of GHG emissions and the choice of the most appropriate, efficient, and cost-effective policies and measures to mitigate climate change.

EIT countries emphasized that major structural changes in the economies, particularly within the industrial sector, had taken place during the economic recession (Figure 2), that resulted in decreasing the share of industry in the GDP as compared with services. In this regard the economic pattern of EIT countries is getting closer to those of OECD countries. An important consequence of this was that the GHG emissions reduction during the crisis was driven not only by the economic collapse, but also by structural changes in the economy. Most of the EIT countries experienced economic growth in the last few years, and it is important to note that the economic and industrial recovery in Poland started in 1992 with 2.56 percent growth, while CO_2 emissions continued to decrease by at least 1 percent in the same period. That is believed to be a very important indicator of the effect of structural changes.

In their national communications, some of the EIT countries such as Hungary, Slovakia, Estonia, and Bulgaria expressed concern about scarce indigenous energy resources and the high share of energy imports, while in other countries such as Poland and the Czech Republic, energy resources were mainly fossil-fuel based with high



Source: World Bank

Figure 1. Gross domestic product indices for several EIT countries (constant prices)

carbon content. In general the fossil fuel component prevails in the structure of the primary energy supply (Figure 3). This is why it was difficult to implement mitigation measures targeting substantial change in the primary energy supply structure.

Despite the fact that EIT countries traditionally had a relatively high industrial share in GDP and high energy intensity of industrial output, only few of them are among the world's largest CO_2 emitters (Figure 4). They are characterized by high energy-related CO_2 emissions per unit GDP, while energy-related CO_2 emissions per capita are within the range of OECD member countries—12 tonnes CO_2—and OECD European member countries—8 tonnes. Some countries, although, such as Estonia, the Russian Federation, and the Czech Republic, are above this level (Figure 5 and Figure 6).

Climate Change Policy in the Overall Policy Context

- Choice of reference year.
- Are the provisions of Article 4.2(b) a binding target?
- Rebuilding infrastructure and economy as a key focus in EIT.
- Climate change policy is largely based on energy policy.
- Mitigation policies and measures: cost-effective, technically and politically feasible, and improve energy efficiency.

Climate Change Policy in the Overall Policy Context

Pursuant to Article 4.6, EIT countries that belong to the Annex I group of UNFCCC Parties have a certain degree of flexibility in choosing the reference year in order to enhance the ability of these Parties to address climate change issues. Four of the Parties used the provisions of this article and considerable emphasis was given in their communications to choose a reference year different from 1990. Bulgaria and Poland chose 1988, Romania chose 1989, while Hungary chose the period 1985–1987 rather than a single year. The reference years that were chosen corresponded to the highest level of economic activity and GHG emissions in the countries before the crisis. Four of the Parties, Slovakia, the Czech Republic, the Russian Federation, and Latvia chose 1990 as base year. One Party, Estonia, did not provide specific information on this issue.

Most of the Parties, including Bulgaria, Poland, the Russian Federation, and Slovakia, interpreted provisions

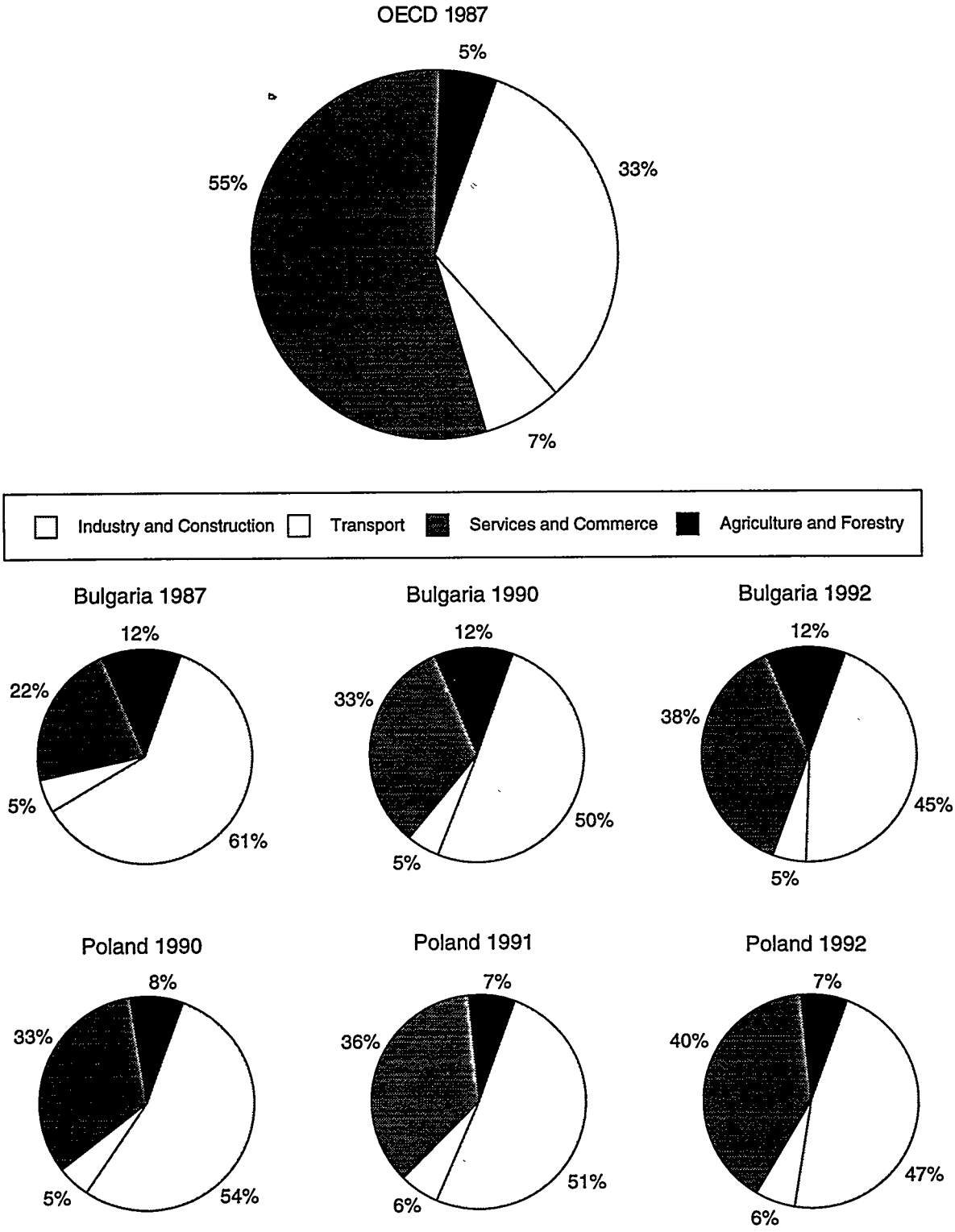
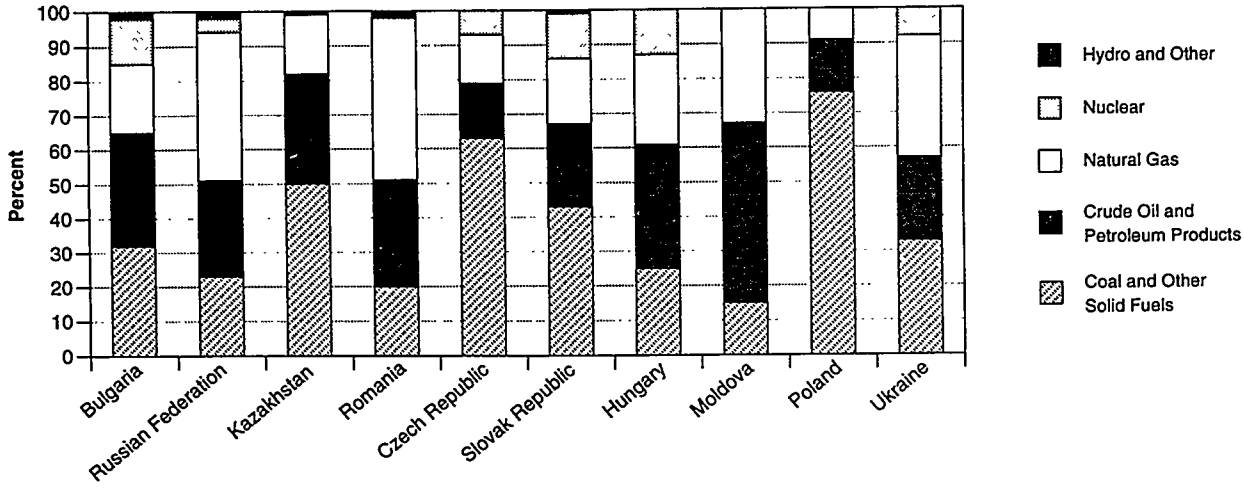


Figure 2. GDP structure of OECD, Bulgaria, and Poland Primary energy indicators and CO_2 emission indicators showing decrease of industry and construction and increase of services between 1987 and 1992.

of Article 4.2(b) as a binding target and clearly expressed their commitment to return the level of emissions in year 2000 to their 1990 levels.

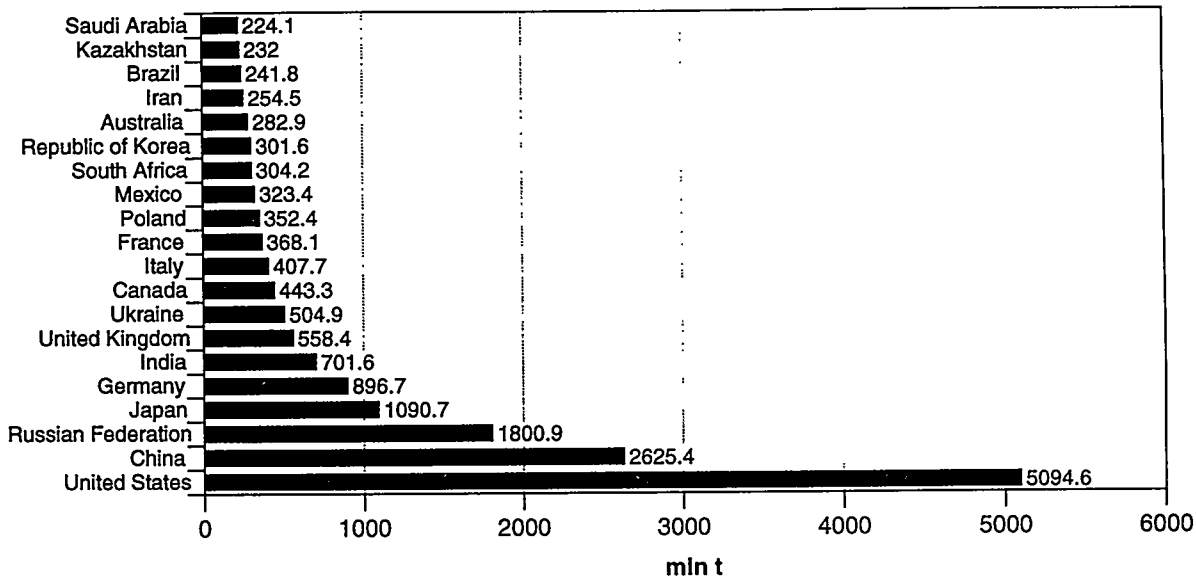
From an overall policy point of view, climate change was not a key concern in EIT countries. Rebuilding infrastructure and the economy was reported as the key policy focus in EIT countries in the transition period with priority given to privatization and establishment of capital markets in the situation of shortages of foreign investment. Solving urgent social problems such as unemployment, health care, and impoverishment was considered an integral part this process.

Even within the environmental policy agenda, EIT countries stressed issues with higher priority than climate change that needed to be solved in the near term, such as air pollution and transboundary pollution.



Source: IEA Statistic

Figure 3. Structure of primary energy supply for EIT countries (1993)

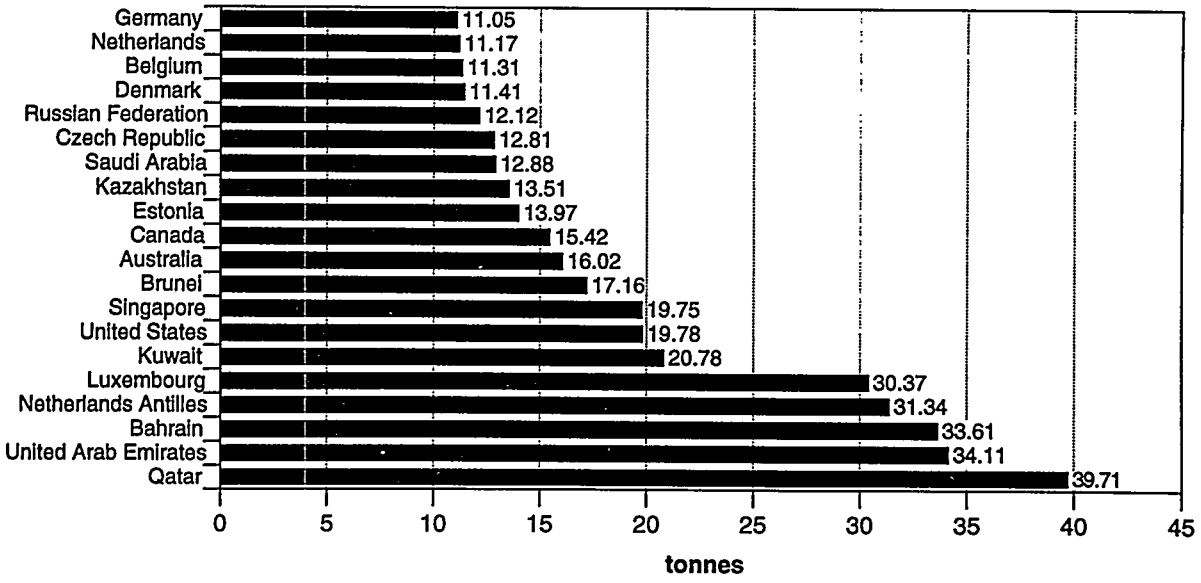


Source: IEA Statistic

Figure 4. World's largest emitters of energy-related CO_2 (1993)

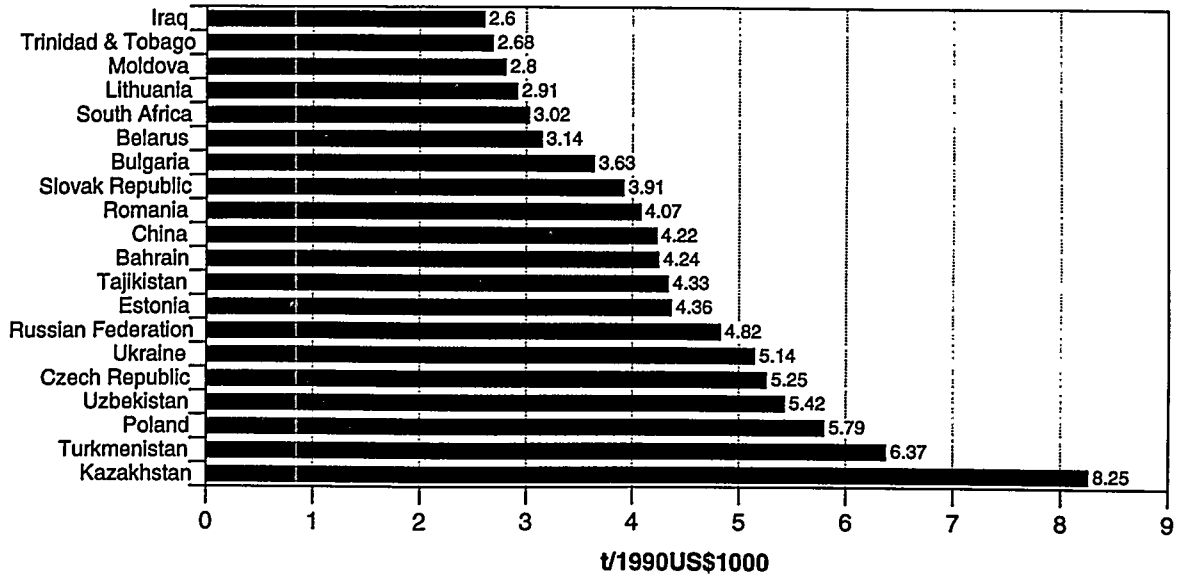
Because of this, many EIT countries recognized that climate change policy had to be integrated into the country's overall national economic, energy, and environmental strategy in order for it to have stronger impetus.

In general, EIT countries are implementing policy instruments and measures that are cost-effective, are technically and politically feasible, and will lead to more efficient use of energy and raw materials, enhance the



Source: IEA Statistic

Figure 5. World's largest emitters of energy-related CO_2 per capita (1993)



Source: IEA Statistic

Figure 6. World's largest emitters of energy-related CO_2 per GDP (1993)

competitiveness of industrial production, or improve air quality and living standards (quality of houses and apartments).

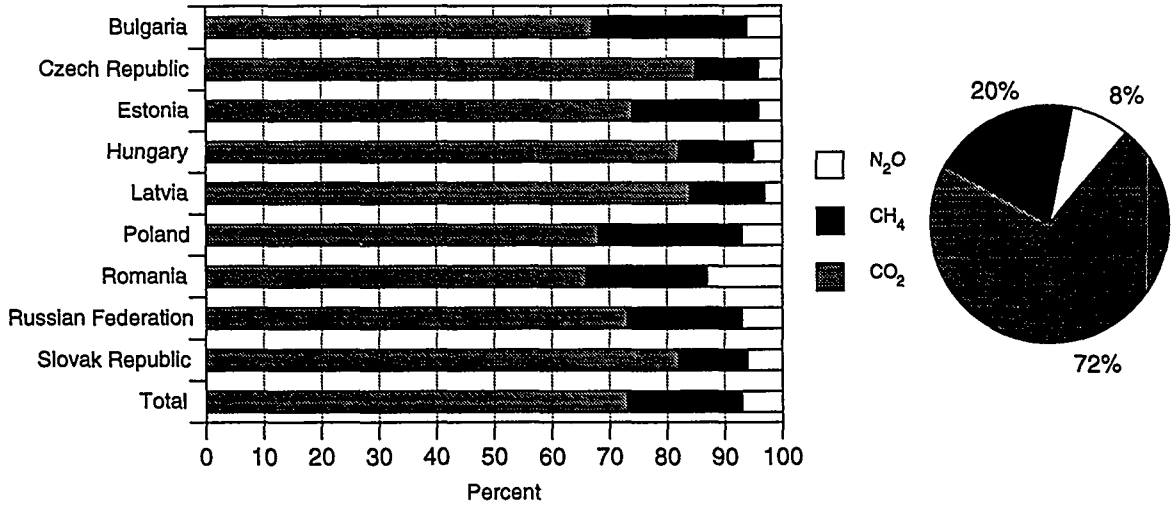
Policies and Measures To Limit Anthropogenic Emissions and Protect and Enhance Sinks of Greenhouse Gases

Pursuant to Article 12.2 of the UNFCCC all EIT countries had communicated mitigation policies and measures that had been adopted to implement Article 4.2(a) and 4.2(b). Identification of mitigation policies and measures was the key element of the National Communications, not only because of the importance for the Annex I Parties to meet the stabilization target, but also because policies and measures were an important link between other issues reported in the National Communications, such as inventory and projections of GHG emissions.

Data on 259 policies and measures for nine EIT countries was compiled in the database, with the policies and measures categorized by country, sector, gas, and type of policy instrument, including economic instruments, regulation and guidelines, voluntary agreements and actions, or information, education, and training.

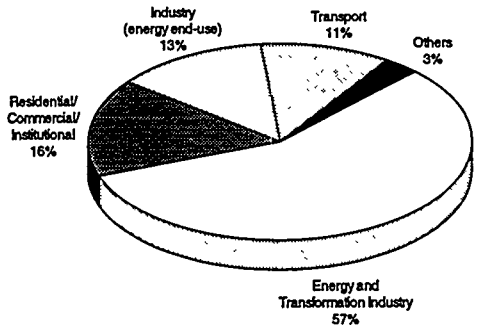
In implementing climate change policy, EIT countries applied a wide range of policy instruments similar to those implemented by Annex II Parties. These included economic instruments and incentives, regulations and guidelines, information, education and training, and research. Voluntary agreements, although reported in a few cases, had not been widely used. The most often used instruments were economic instruments that accounted for 60 percent of the cases.

The overall emission profile of EIT countries did not differ from that of Annex II Parties. As shown in Figure 7, carbon dioxide is the main GHG that accounted for 72 percent of the total anthropogenic emissions expressed by their 1994 global warming potentials (excluding land-use change and forestry), followed by methane (20 percent) and nitrous oxide (8 percent). Fuel combustion was the largest CO_2 source, with most emissions coming from energy and transformation industries (57 percent), residential, commercial and institutional (16 percent), industry as energy end-use (13 percent), transport (11 percent), and others (3 percent) (Figure 8). Therefore, the majority of measures targeted CO_2 emissions in the sectors where fuel combustion occurs. Policies and measures that addressed emissions of methane and nitrous oxide were analyzed in industrial processes, agriculture, and waste management sectors (Figure 9).



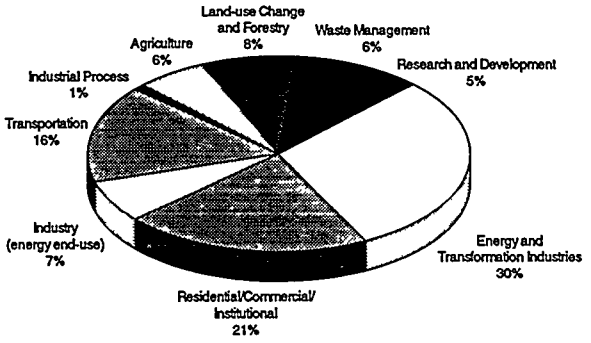
Source: National Communications and FCCC Data Base

Figure 7. Relative contribution of different GHG by EIT parties



Source: National Communications and FCCC Data Base

Figure 8. Anthropogenic CO_2 emissions from fuel combustion by EIT parties



Source: National Communications and FCCC Data Base

Figure 9. Sectoral distribution of mitigation measures by EIT parties

Energy and Transformation Industries

The energy and transformation sector was characterized by the largest share of CO_2 emissions from fuel combustion (about 57 percent), small amounts of N_2O emissions (about 1.9 percent) and CH_4 emissions (about 0.3 percent) in EIT countries in 1990. Within the sector the major part of CO_2 emissions was from electricity production. The total number of measures reported in the National Communications were within this sector, representing over 30 percent of all policies and measures mainly targeting CO_2 from energy combustion.

All EIT countries emphasized the importance of the liberalization of energy prices, the removal of subsidies, and the convergence of indigenous energy prices with international ones as important elements of their climate change policy and as fundamental steps toward decreasing the energy intensity of the economy and improving the competitiveness of industrial production. This policy would create, among others, incentives for both energy savings in all sectors of the economy, and accelerated penetration of environmentally friendly technologies, such as renewable technologies.

Upgrading of the overall regulatory framework and legislation, including regulation and legislation in the energy sector, was reported by EIT countries as an important element in the gradual harmonization of legislation and norms with those of EU member countries. The Czech Republic, Slovakia, Estonia, and Bulgaria reported that new regulations were expected to give strong impetus to the overall efficiency of the energy sector by creating economic incentives and institutional and financial mechanisms.

The trend of harmonizing environmental legislation and regulation in EIT countries was reported in the communications of almost all the Parties, including Poland, the Czech Republic, Slovakia, Hungary, Bulgaria, and Romania. Although greenhouse gases were previously not included in the environmental regulations of most EIT Parties, these new regulations promote the decommissioning of old coal-fired plants, fuel switching to natural gas, the use of renewable sources of energy, and implementation of new technologies.

Measures in the Energy and Transformation Industries

- Liberalization of energy prices.
- Carbon/energy taxation.
- Upgrading of energy regulatory and legislation framework.
- Harmonizing the environmental regulation and legislation of EIT Parties with EU.
- Renewable energy as the most environmentally friendly option for GHG mitigation.
- Energy savings in the energy supply system.
- Improving energy control and management practice, and new standards on energy equipment.
- Advanced energy technologies—natural gas combined cycle, cogeneration, and fluidized-bed combustion.
- Fuel switching and increased use of natural gas

All EIT Parties acknowledged renewable energy, including solar, wind, biofuels, and hydro resources as the most environmentally friendly option for GHG mitigation, and 6 percent of total measures reported on were renewables. However, most EITs emphasized that the technical and market potential of this option is still very limited with the exception of traditional renewable energy such as hydro energy.

Most of the countries had estimated high potential for energy savings in energy supply. Some of them, including Hungary, Poland, Bulgaria, and the Russian Federation, had communicated quantitative evaluations of this potential on the energy supply side, which varied substantially among countries, reaching a highest level of about 15 percent of the total primary energy supply in the Russian Federation. A mix of policy instruments has been implemented or is planned, such as abolishing energy subsidies, new regulations, and the establishment of special energy efficiency.

EIT Parties emphasized that almost half of the energy-saving potential and significant greenhouse gas emission reduction could be achieved by implementing relatively inexpensive measures, such as improving energy control and management practices, and also by implementing new standards on energy equipment. In reporting of policies and measures it was indicated that the first steps in this direction have already been made and planning concepts such as integrated resource planning (IRP) and demand side management (DSM) were just beginning to be implemented in most EIT countries.

Five EIT countries, Bulgaria, Hungary, Poland, the Czech Republic, and the Russian Federation, identified significant technical and market potential for new technologies particularly in the energy sector, such as natural gas combined cycle, cogeneration and fluidized bed combustion. EIT Parties considered the new technologies as one of the most cost-effective mitigation approaches, but in order to implement them it would be necessary to overcome major barriers such as the shortage of new domestic and foreign investment opportunities.

Another very effective mitigation policy reported by EIT Parties is increasing the share of natural gas. However, only the Russian Federation reported plans for a significant increase of the natural gas share in the primary energy balance from 41.4 percent in 1990 to 49–51 percent in 2000. The Czech Republic presented several projects and programs for fuel switching and the extension of natural gas supply networks. Bulgaria has put forth a program for supplying natural gas to households, which is expected to increase the share of natural gas in the Bulgarian primary energy supply. Other countries did not consider this option, probably due to the lack of investment opportunities, lack of access to a natural gas supply, or energy security reasons.

Four EIT Parties, Russia, Bulgaria, the Czech Republic, and Slovakia, considered nuclear energy as an option to mitigate greenhouse gas emissions. In general, the effectiveness of this measure was reported to be high, but countries express concern about nuclear safety issues and the political acceptability of nuclear energy.

Industry

Industry accounted for 13 percent of energy related CO_2 emissions, and less that 1 percent of the total CH_4 and N_2O emissions in EIT Parties in 1990. About 7 percent of the total policies and measures implemented by the EIT Parties targeted industrial energy end-use and CO_2 emissions.

With very few exceptions, measures within the industrial sector were implemented by economic instruments. These included energy price liberalization, tax relief on new technology development, energy audits, establishing special funds, or other economic incentives promoted by governments. In many cases, the energy efficiency measures implemented in this sector were reported to be cost-effective. For example, the Slovakian Government allocated 100 million Slovakian crowns for a program to save energy in industry. That resulted in 2.3 PJ energy saved, about 1 percent of the final energy consumption in 1993 at a cost of energy saved less than the subsidies for heat.

Substantial reductions in CO_2 emissions were expected from the improvement of existing manufacturing technologies, implementation of state-of-the-art manufacturing technologies, and energy-saving measures implemented within the industrial sector in all EIT coun-

Measures in Industry (Energy End-Use)

- Liberalization of energy prices
- Fuel switching
- Energy efficiency
- Implementation of state-of-the-art manufacturing technologies

tries. Most Parties have identified a high potential for energy conservation within the industrial sector, including the Russian Federation, 5.480–6.390 PJ; Bulgaria, 44 PJ; and Hungary, 12.5 PJ. Poland reported 507 Gg CO_2 already saved by improving specific manufacturing technologies.

Residential, Commercial, and Institutional

The share of CO_2 emissions from residential, commercial, and institutional sectors in EIT Parties in 1990 varied substantially from country to country within the range of 9 percent to 23 percent. All EIT Parties had reported policies and measures in this sector and about 21 percent of the total number of policies and measures reported in the National Communications were in this sector. All the policies and measures in this sector targeted CO_2 emissions, although many of them would reduce other greenhouse gases emissions as well.

All Parties recognized the positive impact of the liberalization of energy prices on the energy consumption pattern in this sector. Although energy prices to households remain subsidized in most EITs, subsidies will be reduced only gradually to avoid social problems. The Czech Republic and Bulgaria emphasized the importance of the new energy legislation and institutional building at national and regional levels in promoting energy efficiency. All other policies and measures identified by the Parties were aimed at issues such as energy-efficiency improvement in the building sector (the Czech Republic, Poland, Bulgaria, and Slovakia), increasing and upgrading the heat supply system (Russia, Poland, Latvia, Bulgaria, the Czech Republic), efficiency improvement in appliances and behavioral change (the Czech Republic, Bulgaria, and Slovakia). A broad mix of instruments have been applied in this sector, including tax exemptions, subsidies, partial refunds of interest from loans, energy-efficiency demonstration projects, regulations and guidelines, information, education, and public awareness. Among them, information, education, and public awareness are expected to play an important role in changing consumer behavior toward more energy-efficient consumption patterns.

Measures in Residential, Commercial, Institutional

- Liberalization of energy prices.
- Building sector—improving insulation, heat conservation, retrofitting of buildings, insulation standard for new buildings.
- Improving efficiency of centralized heating system.
- Improving efficiency of appliances.

Transportation

Transport emissions in EIT countries accounted for 11 percent of energy-related CO_2 emissions, less than 0.3 percent of the total CH_4, and 1.9 percent of the total N_2O emissions in 1990. Although these shares are about two times smaller than those of Annex II Parties, this sector is expected to grow very fast as a result of changes in the economic system, and social and behavioral patterns. EIT countries recognize that to limit this growth, implementation of consistent policies and measures is urgently needed. For example, the Czech Republic reported combined measures in transportation that are expected to stabilize emissions from this sector at the 1990 level in the period 1998–2000, while without measures the emissions would increase by 14 percent over the same period. Most of the EIT Parties identified a variety of policies and measures in transportation and, in total, 16 percent of all measures addressed this sector.

Transportation measures in EIT Parties aimed primarily to conserve and expand (to the extent possible) the use of public transport, to increase fuel efficiency, to optimize transportation flows, and to improve air quality. Measures in this sector targeted primarily CO_2, although in most cases they reduce N_2O and precursors as well. In this sector regulations and guidelines prevail as an implementation instrument, followed by taxes and subsidies, while information and raising the public awareness were rare. All countries recognized the role of liberalization

Measures in Transportation

- Liberalization of energy prices.
- Optimization of the national transportation infrastructure.
- Improving fuel efficiency of vehicles.

of fuel prices as an important tool to prevent the rapid growth of fuel consumption and emissions in this sector.

Most of the EIT Parties, the Czech Republic, Slovakia, Latvia, Hungary, and Bulgaria, reported measures to optimize the national transportation infrastructure by giving preferences to the railway and, in relevant cases, to water transport and measures to strengthen the role of public transportation in cities by improving city infrastructure and making public transportation convenient for passengers.

Since few EIT Parties are vehicle producers, the key focus with regard to improving transportation fuel efficiency is behavior change, for example strict speed limits to promote efficient driving, mandatory maintenance and annual check ups of vehicles, and import duties and taxes to promote the use of smaller and more environmentally friendly cars.

Six Parties, Bulgaria, the Czech Republic, Slovakia, Hungary, Poland, and Latvia, had presented estimates of the effects of measures to limit the growth of transportation emissions. Only Latvia expected the level of emissions from the transportation sector in 2000 to be 6–25 percent less that in 1990, while all other EIT Parties that provided estimates on the transportation sector expected growth of emissions in this sector unless additional measures are implemented.

Fugitive Emissions

Although the contribution of this sector to the total CH_4 emissions was high (68.2 percent), EIT Parties reported a few measures aimed to decrease fugitive methane emissions. Slovakia recognized reducing the leakage from the natural gas distribution system as an important measure because leakages are the largest source of methane in the energy sector. The Russian Federation and Poland reported projects for coal-bed methane utilization, but they are at the very early stage of implementation.

Industrial Processes

Only two Parties provided information on policies and measures to reduce emissions from industrial processes. Hungary reported a comprehensive program to reduce volatile organic compound (VOC) emissions from industry and the Czech Republic has implemented eco-labeling to reduce non-methane volatile organic compound (NMVOC) emissions.

Measures in Agriculture

- New norms for fertilizers application.
- Guidelines and training to improve management practice.
- Biomass use as substitute for fossil fuel.

Agriculture

The agricultural sector accounted for about 19 percent of CH_4 emissions (mainly from livestock), 30 percent of N_2O emissions (mainly from fertilizer application) and less than 1 percent of CO_2 emissions (mainly from combustion activities). Six EIT Parties, Bulgaria, Slovakia, Latvia, Poland, Hungary, and the Czech Republic, had reported measures in this sector. About 6 percent of the total policies and measures addressed this sector. Most of the measures were implemented through regulations and guidelines, financial support, training, and raising the public awareness.

Four EIT Parties, Slovakia, Bulgaria, Poland, and Latvia reported measures aimed to reduce N_2O emissions from agriculture. The most common approach was to introduce new norms for fertilizer application as an element of the process of harmonization of EIT norms with EU standards. Two EIT Parties, Slovakia and Latvia, reported guidelines and training for farmers to improve management practices aimed at reducing CH_4 emissions from agriculture.

Significant potential for CO_2 reduction from combustion in agriculture was pointed out by the Parties that identified measures in the agricultural sector, especially if biomass is used as a substitute for fossil fuels. Two countries, the Czech Republic and Hungary, provided measures to support more extensive use of biomass and to increase public awareness of this problem.

Land Use Change and Forestry

Land-use change and forestry was reported as a net sink by seven EIT Parties, Bulgaria, the Czech Republic, Estonia, Hungary, Latvia, the Russian Federation, and the Slovak Republic. Six of them, Bulgaria, Hungary, Poland, Latvia, the Russian Federation, and the Slovak Republic, communicated measures to enhance their forest

Measures in Land-Use Change and Forestry

- Enhancing forest sink capacity, improving forestry management practice, and forestry adaptation policy.

sink capacity that accounted for 8 percent of total measures. Enhancing forest sink capacity was seen by most EIT countries as a priority for greenhouse gas mitigation policy.

Five EIT Parties, Bulgaria, Hungary, Poland, Slovakia, and the Russian Federation, provided details on their policy for afforestation focusing on improving forestry management practice, including the gradual change of coniferous plantations unable to resist global warming, improving the forest age structure, increasing forest density, and preventing forest fires.

Some EIT Parties (the Russian Federation, Slovakia, and Bulgaria) noted that an important issue in formulating forestry mitigation options is linking it to forestry adaptation policy. If not, these options might fail to succeed due to the process of global warming.

Waste Management

Waste management accounted for 12 percent of CH_4 emissions by EIT Parties. Five EIT Parties, Bulgaria, the Czech Republic, Latvia, Poland and Slovakia, presented information, policies and measures in this sector that accounted for 6 percent of total policies and measures.

Most of the countries provided information on improving waste management practices, but they also have made steps toward separate collection of waste, projects on waste incineration plants, upgrading legislation on waste management, and establishing a waste management department.

Measures in Waste Management

- Improving waste management practice, separate collection of waste, building of waste incineration plants, and building new landfills.

Measures Implemented in International Cooperation

Several activities were reported as successful in the field of international cooperation, including participation of the countries in the U.S. Country Study Program on Climate Change and projects on a bilateral basis. *All EIT Parties that have reported participated in the U.S. Country Study Program on Climate Change,* working mainly on GHG inventory, mitigation policies and measures, as well as on adaptation. This program not only provided the countries with methodologies, software, and training, but also created significant opportunities for the exchange of information on analytical techniques and technologies, approaches, and results among the countries themselves.

Summary Conclusions

All nine EIT Parties have provided descriptions of mitigation policies and measures. While the policies and measures targeted primarily CO_2 emissions, Bulgaria, the Slovak Republic, Romania, Poland, and Latvia addressed all greenhouse gases. Hungary, the Czech Republic, and the Russian Federation gave information on CO_2 and CH_4.

Most of the Parties, Bulgaria, Hungary, Poland, the Czech Republic, the Russian Federation, Latvia, and Slovakia, followed the guidelines in presenting their policy and measures in the National Communications. However, the presentation of information varied substantially from country to country and within each country from measure to measure. For most policies and measures there was a lack of information on the status of implementation, the effect of individual measures, and monitoring progress, while another part of the measures was just mentioned.

Most of the policies and measures implemented by EIT countries were cost-effective and no-regret measures, because it was considered very difficult to allocate additional financial resources for climate change in a situation of deep economic crisis and lack of foreign investment. This approach is consistent with the guidelines, which state that the actions to mitigate climate change do not need to have as a primary objective the limitation of greenhouse gas emission.

Fossil fuel combustion was the major source of greenhouse gas emissions for EIT Parties and within this source the share of emissions from the energy and transformation sector was predominant. Most of the policies and

measures that were reported addressed this sector. Policy objectives for this sector included increasing the efficiency of the energy supply by implementing new technologies, increasing the share of renewables and natural gas, promoting energy efficiency, improving management practices, maintaining the share of nuclear energy in the electricity supply, and upgrading centralized heat supply systems. Increasing efficiency in energy end use sectors, including residential, commercial, industrial, and transportation, was the area where the highest potential for energy saving and GHG mitigation was identified and many measures implemented.

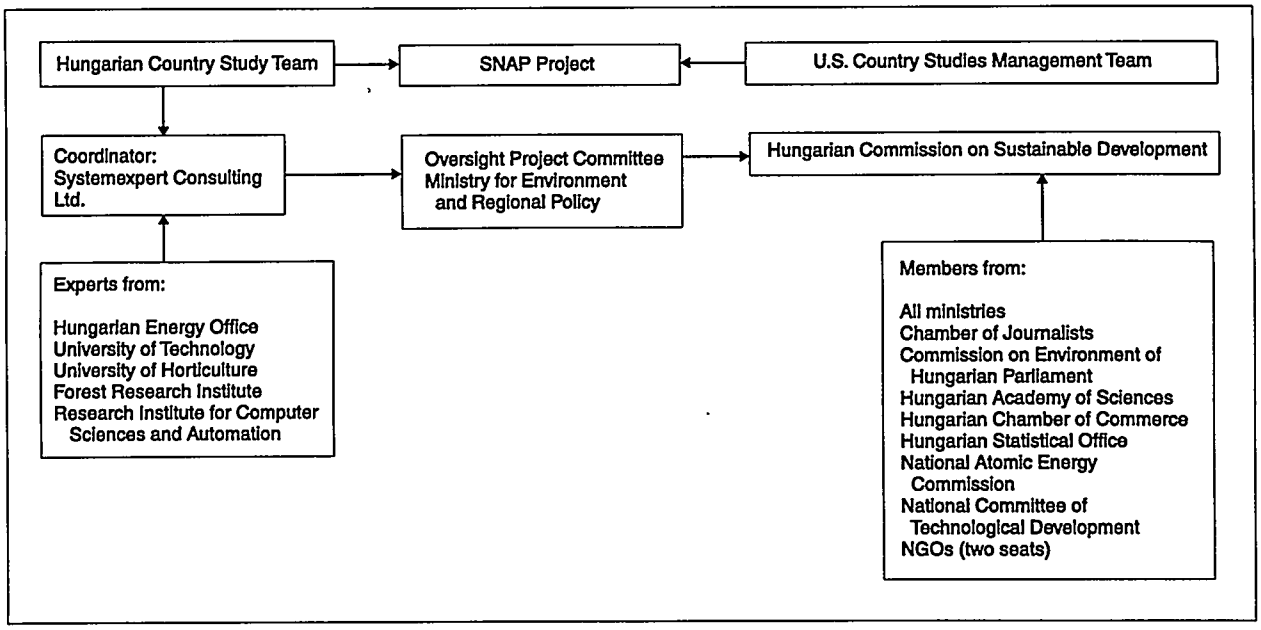
EIT Parties recognized the transportation sector as the most rapidly growing sector and a broad range of policy instruments such as taxes, subsidies, improvement guidelines, and infrastructure projects have been implemented in this sector. The main aim was to maintain to the extent possible the existing share of public transport. The other sectors, industrial processes, agriculture, and waste management, were given much less attention.

Enhancing sink capacity was considered as an important mitigation measure in most of the communications of EIT Parties. Countries reported options for substantial improvement of forestry management practices and afforestation, including a series of pilot projects.

Workplan of a Climate Change Action Plan for Hungary Under the Terms of the U.S. Country Study Initiative

Systemexpert Consulting Ltd.

Institutional Approach



Objectives and Scope of the Project

Development of a Comprehensive, Long-Term Action Plan

- Practical
- Achievable
- Supported by the government and people

Sectors Covered by the Action Plan

- Energy
- Forestry
- Industry (including mining)
- Agriculture

Energy

Supply Side Measures

- Construction of small scale hydro power plants (5–10 MW)
- Construction of new cogenerating units and gas turbines
- Increase of nuclear capacities
- Fuel switch in the power plants (coal/gas)
- Efficiency improvement of energy transportation, reduction of transmission and distribution losses
- Use of renewable energy sources

Demand Side Measures

- Improvement of public lighting
- Updating energy technologies in different economic sectors
- Improvement of energy management and thermal insulation of buildings
- Reduction of energy consumption of vehicles

Links with Ongoing Governmental Programs

National Energy Efficiency Improvement and Energy Conservation Program launched in 1991 aiming at:

- Reduction of dependency on imported fuels
- Conservation of domestic energy resources
- Postponing the construction and installation of new base-load power plants
- Adjustment of the Hungarian energy policy to EU and OECD/IEA recommendations

Tasks

- Schedule of actions under different scenarios of economic development
- Developing consensus and support for priority mitigation and adoption measures
- Feasibility analysis
- Evaluating of action plan scenarios from the viewpoint of GHG emissions and costs

Forestry

Results of the Country Study Project

Four Scenarios Until 2050:

- Likely trend scenario
- Programmatic scenario
- Achievable scenario
- Technical potential scenario

Links with Ongoing Governmental Programs

National Afforestation Program Launched in 1990:

- Reforestation: 150,000 ha/year until 2000 (at present 1.6 million ha is covered by forests)
- Creation of jobs
- Enhance CO_2 sink capacities

Tasks

- Schedule of actions under different scenarios of economic development
- Developing consensus and support for priority mitigation and adoption measures
- Feasibility analysis taking into consideration the changing ownership structure
- Evaluating of action plan scenarios from the viewpoint of GHG emissions and costs

Other Sectors

Industry

- Extraction and utilization of CH_4 from closed mines
- Reduction of VOC emissions

Links with ongoing governmental programs
National VOC Emission Reduction Program to be launched

Agriculture

- Economical and environmentally sound use of biomass (feeding, soil nutrition, energetic use)
- Application of meliorative technologies

Tasks

- Schedule of actions under different scenarios of economic development
- Developing consensus and support for priority mitigation and adoption measures
- Feasibility analysis
- Evaluating of action plan scenarios from the viewpoint of GHG emissions and costs

Further Tasks

- Cross sectoral analysis (application of macro models: ENPEP, EnFOM, MARKAL, COMAP)
- Development of a multisectoral action plan
- Dissemination of results to GOs, NGOs, media

Project duration: 2 years

Indonesia's National Action Plans on Climate Change

Dr. Rtm Sutamihardja

Agriculture Sector

Background

Anthropogenic sources of greenhouse gases (GHGs) from nonenergy sectors are mainly land-use change and forestry, and agriculture. Methane (CH_4) and carbon dioxide (CO_2) are important GHGs emitted from nonenergy sectors. Methane mainly originates from livestock, by enteric fermentation, manure management, and rice cultivation.

The total land area of Indonesia is 190.95 million hectares (ha), of which 58.5 million ha are devoted to agriculture, and about 50 million ha of it are for upland crops, while the wetland rice covers an area of 8.227 million ha, or 4.8 percent of the total land area. However, the harvested area of wetland rice in Indonesia (1990) was about 9.377 million ha, of which 55 percent is located in Java island. The total production of wetland rice was 42.75 million tons, of which around 60.4 percent was produced in Java island, where the irrigation system is well developed.

Nowadays, out of 8.277 million ha of land devoted to wetland rice production, irrigated wetland rice occupies the largest area, which is around 5.1 million ha, followed by rainfed tidal swamp, and swamp rice.

Based on data on harvested wetland rice areas and their rice production in Indonesia, the wetland rice harvested area in Indonesia is increasing at a rate of 106 thousand ha/year. The harvested area of wetland rice was 4.781 million ha in 1950 and 9.377 million ha in 1990, for an average increase around 1.8 percent per year.

The types of fertilizer used in Indonesia include urea, phosphate, ammonium sulphate, and potassium chloride. Most of these fertilizers are used in food crops, mainly for wetland rice, and estate crops. Nitrogen fertilizers considered as sources of N_2O are urea and ammonium sulphate. The usages of fertilizer in 1990 were 3,120,833 tons of urea and 632,044 tons of ammonium sulphate. There are no data available on the use of organic fertilizer (manure) in Indonesia. This type of fertilizer is widely used where the domestic livestock population is high, as in Java island.

Livestock in Indonesia is classified into four groups, for example, large ruminants (dairy cattle, nondairy cattle, and buffalo); small ruminants (goats and sheep); nonruminants (horses and pigs), and poultry (chickens and ducks). The domestic livestock population in Indonesia is presented in Appendix 2, and the distribution according to type in each region is shown in Appendix 3. Sixty percent of the ruminant population is found in Java island.

Greenhouse Gas Emissions

Methane

Methane (CH_4) is an important greenhouse gas (GHG). In terms of its radiative forcing, methane is the second most important GHG after carbon dioxide (CO_2). The total global annual emission of CH_4 is about 515 Tg, 70 percent of which is from anthropogenic sources. Out of the 70 percent, 40 percent, or 205 Tg, is from agriculture-related activities, namely biomass burning, animal wastes, rice cultivation, and enteric fermentation.

Rice fields are considered one important source of methane emissions into the atmosphere, as are the world's growing population of domestic livestock. Methane concentration in the atmosphere may steadily increase in the future. Since the increasing population requires more food, development of agricultural lands will be extended even to the areas that require large quantities of fertilizer inputs, while the existing cultivated lands are subjected to greater burdens of industrial development and expansion.

The main sink for atmospheric methane is its reaction with tropospheric radicals. It is estimated that 85 percent of methane emitted into the atmosphere is destroyed by

OH radicals. The other process that removes methane is dry soils, through oxidation by methanotrophic bacteria.

Methane is the most important GHG produced by the agricultural sector, which is responsible for the emission of 3,649.2 Gg, representing 72.15 percent of the national methane emissions. Management of domestic livestock and animal manure contributes 23.7 percent of the methane emission from agricultural activities.

Rice cultivation is the largest emitter of methane with 2,758.0 Gg, which represents 75.6 percent of methane emissions from agriculture. Field burning of agricultural waste generated around 26.8 Gg of methane, which represents 0.007 percent, which may be considered a negligible source.

Livestock is generally considered important by Indonesian farmers to support their household income. In the farming system, agricultural by-products serve as livestock feed and, on the other hand, animal waste is utilized as organic fertilizer to increase crop production.

Estimated methane emissions from domestic livestock in 1990 from enteric fermentation and manure management are 763.Gg and 100.6 Gg respectively. The greatest methane emitter was nondairy cattle, which generated 479.0 Gg, representing 55 percent of the total methane emissions from domestic livestock.

Wetland rice is a major source of methane emissions in food crop agriculture, and the direct measurement of methane emissions in Indonesia was started in 1992. Most of the studies were aimed to know the effect of widely grown rice varieties, soil type, water management, organic matter application, and growing season on methane emission rates from wetland rice agriculture.

Based on methane emission factors obtained by direct measurements, the total estimated methane emission from rice fields with different irrigation types is 2,758.0 Gg. While based on default value, methane emission from rice fields is 3,826.2 Gg.

GHG Emission from Agriculture in Indonesia, 1990 (Giga gram)

Source	CH_4	N_2O	CO	NO_x
Wetland rice	2,758.00	—	—	—
Fertilizer use	—	24.70	—	—
Crop residue burning	26.80	0.63	546.40	22.83
Domestic livestock	864.40	—	—	—
Total	3,649.20	25.33	564.40	22.83

The burning of agricultural residues in the rice fields also generates methane emission to the atmosphere in the amount of 26.8 Gg. And the use of fertilizer in agriculture contributes nitrous oxide emissions in the amount of 24.70 Gg.

Methane Sinks

Results from a study conducted by Murdiyarso and Husin (1995) show that all land-use types being studied consumed methane or act as sinks for methane. Methane sink strength in all land-use types falls in the range between 0.01 and 0.12 mg/m^2-hr or between 2.4 and 28.8 g/ha-day, with an average of 14.4 g/ha-day. The dry land area in Indonesia that has the potential to absorb methane is estimated at about 142 million ha. Based on these data, it is estimated that Indonesian dry soils can consume approximately 746 Gg/year of methane.

Vulnerability Assessment

Using the GISS transient climate model, the scenarios of the climate in the decades of 2010, 2030, and 2050 are estimated. The changes from the current climate (1973–1992) as simulated in scenarios by the three GCMs and by the Transient Model of GISS are presented in Appendix 3 and Appendix 4. A big decrease in both grain and biomass yields obtained is simulated using the climate scenarios of the decades 2010, 2030, and 2050 (see Appendix 5).

Except for solar radiation in the decades 2010, all the climatic variables as simulated by the three GCMs increase from the current condition. Higher increases in solar radiation and temperature were produced by the GISS model and higher increases in rainfall were produced by the UKMO model. The smallest increase is in solar radiation for the Mojosari area, which increased by 0.11 MJ/m^2 or 0.9 percent as simulated by the GFDL and the highest is in rainfall for Pusakanegara that increased by 59.1 mm, or 91.7 percent, as simulated by the UKMO model.

The DSSAT crop model predicted lowland rice yield quite well for different management options with a coefficient of determination value of 87 percent. Limited experimental data with standard management practices for a sufficient span of time restrains the model validation for the changing climate.

The rice crop model predicted a yield reduction of about 1 percent annually in East Java and less in West Java because of possible climate change in the future. Because high temperature and CO_2 concentration favor

rice growth, development of more tolerant varieties probably can compensate the yield losses due to climate change in the future. Higher yield losses are predicted because of interannual climate variability. Because the dry spell threat is more imminent and frequent, to improve preparedness a short-term climate prediction for the tropical region is urgently needed.

Action Plan

One approach to reducing methane emissions from flooded rice cultivation is to modify the growing practices. The modifications include fertilizer applications and water management. The reduction of methane emissions from domestic livestock generally focuses on options of improving production efficiency.

Rice Cultivation

Two of the most promising approaches under introduction are changes in nutrient management and water management practices.

Nutrient Management. Fertilizer applications, especially nitrogen fertilizer, are sources of N_2O emissions, for example urea and ammonium sulphate. Some methods of fertilizer applications being introduced are:

a. **Balance Fertilizer.** Fertilizer application is based on the plant requirements related to soil fertility. Recommendation of balance fertilizer is to avoid the excessive use of fertilizer, especially nitrogen fertilizer.
b. **Urea Briquette.** Instead of the crystal form, urea is applied in the form of a briquette. It has some advantages, such as slow release and more efficiency, reducing fertilizer cost by a lower dosage of nitrogen fertilizer. Therefore it will reduce N_2O emission.

Water Management. Improvement of water-use efficiency was launched nationally in mid-1996. Farmers used to flood the rice crop excessively, even though techniques for efficient water use were introduced some years ago. Intermittent draining of ricefields during the growing period or between cropping seasons likely will reduce methane emissions from rice cultivation.

Livestock

Improved Nutrition. Nutrient improvement in livestock has been practiced, especially in dairy farming, by providing additional protein animal feed. This improvement will reduce emission amounts by enhancing animal nutrition, including weight gain, milk production, and reproductive performance.

Genetic Improvement. Artificial insemination and embryo transfer have been practiced to improved genetic characteristics for the purpose of producing better offspring. The increased reproductive efficiency will significantly reduce methane emission.

Manure Management. Manure management systems influence methane emissions. Recovery of methane produced by manure management is preferred for household purposes. On a small scale, some dairy farms produce compost by mixing the manure with bacteria.

Energy Sector

Background

Energy consumption in Indonesia is growing fast in line with the development of the national economy. During 1990–1993, emissions of CO_2 gas from the energy sector increased from 150 million tonnes to 200 million tonnes in 1993. Total methane emissions from the oil, gas, and coal subsectors reached 550 kilotonnes in 1991 and increased to 670 kilotonnes in 1994. This amount of CO_2 and methane from the energy sector was 26 percent and 10 percent respectively of Indonesia's total emissions.

Based on the last two decades of Indonesia's economic growth experience as a developing country, the high economic growth rate of Indonesia in the future may continue until reaching the newly industrialized country level, which is more than 6 percent annually in the next decade. This high economic growth rate will also add to the level of GHG emissions in the future.

As a developing country, Indonesia is one of the fast growing countries. The GDP growth in the year 1995 was more than 7 percent, therefore the growth rate of energy consumption in this country also rose, in accord with the economic growth.

In terms of the controlling of GHG emissions due to energy utilization, the mitigation scenario tries to limit Indonesia's GHG at 10 percent in the year 2010 and 20 percent in the year 2020 below the emission levels of business as usual (BAU).

GHG emissions of the energy sector are as follows: CO_2 emission from the utilization of energy in Indonesia increased from 150 million tonnes in 1990 to around

200 million tonnes by the year 1993. Oil combustion accounted for approximately 60 percent of the total CO_2 released, followed by natural gas (30 percent), and the remainder was released from utilization of coal.

Mitigation Options

Residential Sector

In this sector, the options that can be applied to reduce energy consumption are:

- Substitution of electronic ballasts of fluorescent lamps for convention ballasts
- Substitution of compact fluorescent lamps (CFL) for incandescent light bulbs
- Substitution of solar home systems (SHS) for kerosene lamps
- Improvement of efficiency for refrigerators
- Improvement of efficiency for air-conditioning
- Substitution of LPG stoves for kerosene stoves

Industrial Sector

GHG mitigation options in the industrial sector in Indonesia are identified as using variable speed motors, and cogeneration of heat and power for captive power.

Motors are the dominant appliances in the industrial sector. There is a big energy-saving potential through industrial motor efficiency improvement. Motors are assumed to consume 75 percent of total industrial electricity consumption. Variable-speed motors will replace ordinary motors step by step; all new motor installations are assumed to use variable-speed motors. In the year 1995, variable-speed motors, it was assumed, already accounted for 10 percent of total motor installations. In the year 2010 this will reach a 25 percent share, finally accounting for 50 percent in the year 2020.

Electricity consumption can save 12 percent by utilizing variable-speed motors. With 20 hp average motor utilization in Indonesia, availability 60 percent (5256 hours p.a.), the capacity factor 80 percent, and the load factor 60 percent this condition requires 37.64 Mwh p.a. electricity with ordinary motors. By utilizing variable-speed motors, that condition only requires 33.20 Mwh p.a. or 12 percent saving.

Cogeneration and diesel combined cycle are waste-heat recovery technologies. Cogeneration is a conversion technology that produces electricity, heat, and steam simultaneously. This system can improve efficiency from 30 to 80 percent. Heat and steam is generated by utilizing waste heat from conventional power generation. Usually industries that use diesel just throw away waste heat to the atmosphere directly, whereas waste heat can be used for heating hot water or producing steam. Theoretically, heating hot water utilizes 80 percent of the total waste heat from industry, however generating steam can utilize only 60 to 70 percent.

Due to the complicated modifications needed for cogeneration installation, in the year 1995 cogeneration utilization in the industrial sector accounted for only 5 percent. In the future, new industrial design is assumed to use cogeneration. The share of cogeneration in the industrial sector is assumed to reach 25 percent for the year 2010 and increase to 40 percent for the year 2020. In terms of energy consumption, fuel for power generation can save about 2.5 percent in the year 1995, 12.5 percent in the year 2010, and 20 percent in the year 2020.

Commercial Sector

According to a study by the Research Agency of Bandung's Institution of Technology it is shown that:

- Energy consumption in hotels is 49 percent for air-conditioning systems, 17 percent for lighting systems, 19 percent for utilities systems, 8 percent for transportation systems, 2 percent for laundry systems, and others 5 percent.
- Energy consumption in office buildings is 56 percent for air-conditioning systems, 15 percent for lighting systems, 17 percent for utilities systems, 15 percent for transportation systems, and others 3 percent.
- Energy consumption for public buildings (such as hospitals) is 57 percent for air-conditioning systems, 19 percent for lighting systems, 16 percent for utilities, and 3 percent for laundry systems.

Power Generation

Power generation technology is growing, and developing power plant technology is adapted to be more environmentally friendly. Power plant technology options in the BAU scenario, such as gas combined cycle, coal fired with flue gas desulphurization and denitrification, nuclear, coal fluidized bed combustion, gas turbine, and other conventional power plants, have been taken into consideration. The technology mix results for the BAU scenario are purely based on the economic perspective; only this scenario model finds the minimum cost. The efficient technologies, such as nuclear power plants and coal fluidized bed combustion, don't come into the solution due to the high cost requirement for these plants.

In the mitigation scenario, advanced power plant technologies, such as integrated coal gasification combined cycle, pressurized coal fluidized bed combustion, and fuel cells, are added to the model.

With regard to alternative sources of energy, Indonesia has 75 GW of hydropower and 16 GW of geothermal. Actually, Indonesia also has a big reserve of natural gas, but the natural gas is far away from the demand, therefore these resources are not utilized maximally for domestic use.

Transportation Sub-Sector

Transportation is an important factor in the development of Indonesia, with a population growth rate of 10 percent per year. The number of vehicles in the year 1994 was 11,446,000, which consisted of: personal cars, 1,888,000; buses, 592,000; trucks and lorries, 1,292,000; and cycles, 7,675,000.

By 2005, the predicted number of vehicles will be 24,877,169, including: personal cars, 3,634,753; buses, 1,305,582; lorries and trucks, 2,813,262; and cycles, 17,107,596.

Total consumption of fuel in the year 1994 was $51,749.72 \times 10^6$. Predicted total consumption of fuel in the year 2005 with the BAU scenario is $73,809.20 \times 10^6$. Depending on energy mitigation in the transportation sector in Indonesia, the main priority is to change oil fuel to gas fuel for mass transportation. The policy is to decrease the use of oil fuel by 10 percent minimum, and increase the uses of gas fuel by 10 percent.

Energy Sector Action Plan

From the result of the BAU scenario, by introducing the CO_2 constraint result, the Markal model calculates the optimal solution, an optimum energy system cost that produces less CO_2 emission.

Reduction of CO_2 emissions by 10 percent in the year 2005 and 20 percent in the year 2020 of its level in the BAU scenario will change the final energy mix. The demand for coal as a dirtiest final energy will be reduced by 8 percent in the year 2005 and 30 percent in the year 2020, compared to the BAU scenario result.

Some demand-side management and energy conservation measures are already introduced in the BAU scenario; in the mitigation scenario this program will be more interesting. In order to lower final energy demand in industry and residential use, it is necessary to advance the achievement of these programs.

The mitigation result for power generation is very different from the result for the demand sectors. The total fuel input for power generation grows tenfold during the 30-year period, from 700 PetaJoule in the year 1990 to 7000 PJ in the year 2020 for the BAU scenario. For the mitigation scenario, as a result of utilization of more efficient power generation, the fuel input for power generation will decrease by 5 percent in the year 2005 and 13 percent in the year 2020 from the level in the BAU scenario. Total fuel input for the mitigation scenario in 2020 will be about 63000 PJ.

The fuel input mix for power generation will also greatly differ. For the BAU scenario, coal will be the dominant fuel input, accounting for more than 75 percent, but for the mitigation scenario the domination will disappear. Coal and gas will have a similar share (25 percent) followed by hydropower and diesel fuel with more than 10 percent share respectively. Nuclear will play a part, but still with a limited share (2.5 percent).

The total primary energy demand of Indonesia for the mitigation scenario will be lower than that in the BAU scenario, a reduction of 5 percent in the year 2020. The primary energy supply mix will also be different. In the BAU scenario, primary energy dominated by coal and oil accounts for 25 percent respectively, followed by natural gas (16 percent). For the mitigation scenario, oil will be the largest source, accounting for 47 percent; followed by natural gas (19 percent); the coal share remains at 13 percent; biomass, 10 percent; and the remainder is supplied by hydropower, geothermal, and nuclear.

The projected total CO_2 emissions for the energy sector will grow at the rate of 7.4 percent annually from 150,600 Gg in the year 1990 to 1,264,500 Gg in the year 2020 for the BAU scenario. The most probable target for CO_2 mitigation is a 10-percent reduction from the BAU scenario CO_2 level in the year 2010 and interpolated until a 20-percent reduction is reached in the year 2020. The CO_2 level for the mitigation scenario will grow one-percent less than the BAU scenario (6.5 percent) from 150,600 Gg in the year 1990, 374,800 Gg in the year 2005, and will reach 1,006,800 by the year 2020.

Forestry Sector

Background

Forests are the most important CO_2 uptake sinks. Forest land in Indonesia expands to around 140 million ha. The forest areas, stretching from Aceh to Irian Jaya, from

coastal areas up to the peaks of mountains over 5,000 meters above sea level, have different types of ecosystems. The most common type of Indonesian forest is the tropical rain forest, which covers about 60 percent of the total forest area. Forest products in Indonesia comprise the most important export commodities after crude petroleum, with an export value of approximately US$2.5 billion in 1987. Moreover, the forests also have important roles within the country as construction materials, biomass fuels, and so on.

In spite of this great stock of forest in Indonesia, forest destruction has been continuing at a quite rapid pace, due to natural disasters such as forest fire, as well as human activities. In REPELITA III (the Five Year Development Plan), the deforestation rate has been estimated to range from 700,000 to 1,200,000 hectares per year. Since 1950, over 49 million hectares of forests have been converted into agricultural land or affected by mass tree cutting. This figure represents 34 percent of the total forest area in Indonesia.

The total effective natural forest cover is about 108.57 million ha (Indonesian Forestry Action Plan, 1991). Of this 108.57 million ha, about 60 million ha are considered to have management potential. Of this 60 million ha, about 30.4 million ha are unlogged.

Greenhouse Gases Emission

The emission of GHGs from the forestry sector is mainly due to land-use changes, commonly called deforestation and production activity. Two types of processes that yield GHG emissions following deforestation are biomass burning and decomposition. The latter may last over several years, depending on the type of forest. Forest fires also contribute significantly to GHG emissions.

Deforestation

The common definition of deforestation is the change in land-use status from forest to some other land-use status, usually agriculture. However, the term deforestation is sometimes confused in the literature with degradation of forest due to unwise use, but as long as the land is still occupied by forest it has not been deforested. Deforestation is not a new phenomenon that is unique to the tropics. It has occurred over many centuries in the northern hemisphere. Most of the world's farmland was once forest, and without deforestation it would have been impossible to feed the human population of the earth. Nonetheless there has been an increasing worldwide concern for tropical deforestation in recent years. The apparent rate of deforestation in the tropics in the past several decades is the source of this concern.

Comprehensive and accurate data on deforestation in Indonesia is hardly available, largely because there is no single clear definition of the term and also because of the lack of a dependable monitoring system. However, according to an FAO study in 1990, from the available data during period 1980 to 1990 the rate of deforestation in Indonesia was about 1.32 million ha per year. The deforestation is mainly due to mismanagement, illegal land use, population pressures, and inadequate legal frameworks for the country's production, protection, and so forth. Shifting cultivation and transmigration were the major types of activities that reduced the forest area.

Grassland and Forest Burning

Burning of grassland is sometimes practiced for certain purposes. Among other purposes, the farmers burn the grassland to induce the growth of young shoots for grazing grounds of cattle. The young shoots also attract some game such as deer and wild buffalo. The traditional hunters usually get advantage from this phenomenon. The grassland burning is sometimes for removing the nests of wild pigs and rats. Based on surveys conducted in West Kalimantan, South Sumatra, and North Sumatra, it was estimated that 0.06 percent total area of grassland was burnt every year. Total area of grassland in Indonesia was about 10.2 million ha. Thus the average area of grassland burned was 6,100 ha per year.

Forest burning is commonly practiced in opening forest for timber estate plantation, transmigration, and agroforestry, and as land preparation. However, since 1995 this practice has been restricted by government. In logging activities for plantation forests, as 60-year rotation of teak (*Tectona grandis*) and 30-year rotation of pine (*Pinus mercusii*) showed, after logging most small branches were used by the farmer for fuel, while branches with diameter of less than 5 cm, as well as roots, leaves, and fruits, were left in the field, subject to decomposition. Based on the common practice of shifting cultivation and land preparation for transmigration area, it can be assumed that in opening the forest for other uses (non-logging practice), about 10 to 15 percent of total biomass will be used for fuel, while about 20 to 40 percent of the total biomass will be decomposed.

Forest Fire

Forest fire mostly occurs every year. Previous to the fires of 1997, the biggest forest fire occurred in 1982, in east Kalimantan (during the extreme El Niño). The fired area

was 3.2 million hectare. This fire was difficult to control because of the unusually long dry season and the presence of coal in the soil. Based on forest-fire data from 1984 to 1993, it was shown that the average size of forest fires was about 32.3 thousand ha per year. The area of forest fire that occurred in 1991 was more than 110 thousand ha while the others were less than 50 thousand ha. Year 1991 as well as 1994 were recorded as the years with the longest dry seasons. Dry season rainfall in 1991 (another El Niño year) was about 52 percent of normal. If the data of 1991 is excluded from the analysis, the average area of forest fire is then about 22.7 thousand ha per year, much lower than that reported by FAO (1990).

Emission of CO_2 due to deforestation has been studied by the Japan Environmental Agency (1992). The estimation of cumulative gross carbon emissions during 1990–2030 was carried out using two scenarios. The first scenario assumed that during this period the forest area to be cleared was 27 million ha; thus the rate of deforestation was 0.675 million ha per year. The second scenario assumed that the rate of deforestation during the period is the same as the rate of deforestation during the period of 1982 to 1990, that is, 1.315 million ha. The results of the estimation of cumulative carbon emission during the period 1990 to 2030 were 1.2 and 2.4 million tonnes of C for the low and high scenarios respectively.

Forest activities that contribute to carbon emission and uptake were considered, such as selective cutting with natural regeneration in production forests (TPTI); timber estates in Java and outside of Java; deforestation; reforestation and people plantation in private and community forests. Secondary parameters (database) being used in the calculation of GHG emission and sinks were mostly referred to the Department of Forestry of the Republic of Indonesia.

Details of GHG emissions and sinks are presented in the documents of the Greenhouse Gases Inventory of Indonesia by the Indonesia Country Study Program (US–EPA). In brief, the results show that during 1990, forest activities produced carbon emissions of 416.6 million tonnes of CO_2, while carbon dioxide uptake was 1.237,6 MT CO_2. These figures give a negative net carbon dioxide balance of 922.9 MT CO_2.

Carbon Uptake

The potential sinks of GHGs, particularly for CO_2, are forest, coral, and sea water. However, the capacity of the coral in uptaking CO_2 is not known well since the studies concerning this are lacking. On the other hand the estimation of CO_2 uptake by sea water at the present stage is also difficult, even though it is obvious that sea water uptakes CO_2. A study conducted by Quay et al. (1992) in the Pacific Ocean showed this phenomena. They found that average net oceanic CO_2 uptake was 2.1 GT of C per year. This suggested that the ocean is the dominant net sink for anthropogenically produced CO_2. As the study on sink strength of the ocean is very limited, the discussion on sinks will be focused on the forestry sector.

Mitigation options in the forestry sector can be divided into three categories: maintaining existing carbon sinks, reducing emissions, and expanding carbon sinks. Intelligent government policy can keep deforestation to a minimum. Subsidies that undervalue forest resources should be cut, for instance. Overall, the best mitigation options in this sector appear to be sustainable forest management, afforestation, reforestation, and agroforestry.

However, these first may still serve as potential climate change measures, particularly as carbon storage.

Forest acts as sink of GHGs particularly for CO_2, occur in the growing forest. Thus, three types of forest activities that potentially act as sinks are forest plantation, reforestation/aforestation, and agroforestry.

Forestry Sector Action Plan

Standpoint for Basic Strategy

Indonesia will play its proper role in combating the effects of climate change without further delay based on best available knowledge as long as this is a global problem which must be dealt with in an equitable manner. Initially, the highest priority should be put to review existing policies with a view to minimizing conflicts with goals of climate change strategies.

Formulation of Strategies for Reducing CO_2 Emissions by Land-Use Changes. Forest land-use changes that result in the release of CO_2 include the development of estate crops, transmigration and related infrastructure, shifting cultivation, forest fire, illegal logging, mining, urban development, and so forth. The response actions to be formulated are as follows.

a. **Developing a detailed forest inventory and monitoring system.** The first priority of the response actions should be given to the development of detailed forest inventory and monitoring systems in order to enable accurate estimation of CO_2 emissions. Considering the global importance of the forests in Indonesia, such inventory and monitoring systems should be established by making use of available advanced

technology such as the Geographical Information System (GIS), remote sensing systems, and so forth.

b. **Making a so-called sustainable land-use plan.** Based on the accurate estimation of CO_2 emissions, a comprehensive sustainable land-use plan should be made, taking into account the reduction of CO_2 emissions as well as protecting the sustainability of the environment. In order to use this plan practically, all kinds of development activities should be determined based on this land-use plan. The existing deforestation activities, including logging, transmigration, shifting cultivation, and so forth, all need to be reviewed based on the sustainable land-use plan mentioned above.

Basic Strategy for Enhancing the Role of CO_2 Sinks.

- Strategic action on data research, monitoring, and analysis of forests:
  - To establish an adequate database of the nature, extent, and character of the forest lands and resources, for example, utilizing remote sensing systems and GIS
  - To establish an appropriate ecological monitoring system considering the characteristics of the Indonesian forest
  - To examine and to establish the methodology for measurement of CO_2 uptake by Indonesian forests in accordance with forest ecological methodology
- Strategic action on forest management:
  - To establish realistic forest management planning and to implement a program with a genuine environmental orientation considering the role of forests as CO_2 sinks.
  - To improve forest-fire management such as fire detection, forest-fire protection systems and methods, rehabilitation of fire-burned areas, survey and rehabilitation of grasslands, establishment of forest meteorology stations, as well as training for a more qualified personnel.
- Strategic action on regreening and reforestation:
  - To promote vital "regreening" and "reforestation" programs not only in remaining critical areas to be planted but also in potential areas such as degraded land or alang-alang grassland
  - To improve silvicultural technology such as development of proper cultivar, soil rehabilitation, appropriate land selection, and improvement of agronomical techniques
  - To establish improved systems for regreening and reforestation
  - To promote improved sustainable forestry activities, which are harmonized with agriculture and community life, such as agroforestry
- Strategic action on industrial timber plantations:
  - To establish a forest inventory system in order to monitor and evaluate growth and yields
  - To prepare and to implement a detailed long-term plantation plan in order to meet future industrial or domestic wood demand and in order to increase biomass as a carbon sink
  - To implement research programs such as tree improvement, fire protection, growth and yield, control of pests and diseases, tending, silvicultural techniques, and agroforestry
  - To promote community participation in plantation activities

The Existing Plan of Actions

The management authority for the development of the forestry sector is the Department of Forestry. The existing plan of actions of the Department of forestry, in accordance with the strategic actions mentioned above is as follows.

Aforestation and Reforestation. Aforestation is the planting of private lands (nonforest areas) with perennial crops, while reforestation is replanting the forest with trees. In the selection of tree types for these two activities, three factors need to be taken into consideration, namely, (1) the characteristic properties of the trees in conserving soil and water, (2) the economic and social aspects of the trees, and (3) the rate of growth and yield. The trees that have high economic value, good ability to conserve soil and water, and high growth rate are recommended. In other words, the main choices of tree stocks are the multipurpose, fast-growing, high-yield tree species.

The dominant species used for aforestation programs are *Paraserianthes falcataria,* fruit trees, and potential local species. For reforestation programs, the species used could be divided into two types, that is, fast-growing species and slow-growing species. The dominant fast-growing species are *Acacia mangium, Eucalyptus* spp., and *Gmelina arborea,* and the dominant slow-growing species are *Dipterocarpus* spp., *Tectona grandis, Swietenia* spp., and *Peronema canecens.* During 5-year development V (Pelita V, 1989–1994), the total area of reforestation was about 359,344 ha, while aforestation was 2,566,567 ha.

The timber estate plantation program was started in 1985. In REPELITA VI (1994/95 to 1998/99) the area targeted for timber estate plantation was 1.25 million hectares. Until 1993/94 the total area of timber estates in Java was about 1.8 million ha. Most of species planted are teak *(Tectona grandis),* followed by *Pinus* spp., *Agathis* sp., and mixed forest. Outside Java, the area was about 776,669 ha. The species planted were *Acacia mangium, Eucalyptus* spp., *Paraserianthes falcataria,* and *Gmelina arborea.* Slow-growing species were also planted, that is, *Shorea* spp., *Swietenia* spp., and *Peronema canescens.*

In the selection of tree species, two important factors that need to be considered are tree growth rate and the cutting cycle or rotation of tree species. These two factors are especially important in estimating the amount of fixed carbon and in examining the carbon content of each species of tree.

Agroforestry. In the agroforestry program, the farmer is encouraged to grow forest trees in parts of the farm that are not suitable for agriculture to provide fuel and structural materials for farm use, to add forest products to the list of cash crops, and to add to the quality of the farm environment. The dominant type of trees planted by the farmer in this system are rubber, coconut, and palm oil, which covered areas of 2.88 (83 percent), 3.47 (94 percent), and 0.56 (41 percent) million ha respectively. The yields of wood of these trees three commodities were about 25, 75, and 25 m^3 per ha. Furniture made of wood of these trees is environmentally friendly as old trees are being recycled into a rich timber resources. The Government of Indonesia is developing technologies and encouraging farmers to use wood of these trees, particularly for rubber and coconut, so that the income of the farmers can be increased. Van Noordwijk et al. (1995) found that three main benchmark areas in North Lampung for the period 1986 through 1994 may have a net sink of 3.1 tonne C per hectare per year, as woodland-rubber agroforests matured.

Natural Regeneration. In order to increase the production and export of logs, in REPELITA I (1969–1974) the Indonesian Government developed the Forest Concession System (HPH). In 1978, the government agreed to issue 683 HPH, which covered an area of 67.5 million ha. Until March 1990, the total area that has been approved for HPH was 58.9 million ha. The silvicultural system used in HPH is TPTI, a system that is a modification of selective cutting, with regulation of harvest based on a diameter limit and regeneration activities. The main principles underlying TPTI are:

- The cutting cycle is 35 years and hence the area is divided into 35 harvesting blocks of equal size.
- Trees of commercial species with a minimum diameter of 50 cm are allowed to be harvested, and 100-percent timber cruising (surveying) is done prior to harvesting.
- Commercial trees per hectare with diameters of 20 to 50 cm, at least, must be left as nucleus trees for the next cutting cycle.
- The annual allowable cut (ACC) as regulated by the Ministry of Forestry accounts for only cuttable trees.
- Maintaining forest regeneration after harvesting is required, including activities such as girdling and poising strangler an enrichment planting.

Although enrichment planting is strongly suggested in TPTI, due to practical requirements of plantation, natural regeneration still plays a prominent role in the reforestation of logged-over tropical forest. The trees left after logging, including young trees or sampling and poles, are expected to constitute the natural regeneration of logged-over forest.

The predominant factors in increasing carbon uptake were tree plantation (reforestation and regreening) and timber estates in Java and outside Java. Two important programs dealing with the mitigation option on forestry are forest management and rehabilitation, and protection of the forest. Forest management includes the activities related to efficiency and implementation of management of forest protection and forest conservation. Several activities of the Government of Indonesia that could be used as mitigation options in the forestry sector, especially on rehabilitation and protection, are:

- Rehabilitate protection forest-social forestry
- Reduced shifting cultivation
  - Permanent agriculture
  - Population resettlement—with transmigration
  - Concession holders developing the villages surrounding their concession areas (HPH Bina Desa)
  - Reforestation program—target 1,000,000 ha/5 years
  - Timber estate—total target: 6.2 million ha
  - Regreening program—target: 1,465,000 ha/5 yrs
  - Social forestry—target: 250,000 ha/5 years
  - Private forestry—target: 250,000 ha/5 yrs (Hutan rakyat)

Japan's Action Report on Climate Change (Brief Summary)

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Background

At the Rio Conference in 1992, Japan signed the United Nations Framework Convention on Climate Change (FCCC); Japan ratified the Convention on May 5, 1993. Japan's first national communication on climate change, named *Japan's Action Report on Climate Change*, was submitted to the interim FCCC Secretariat in September 1994. The communication focused on inventories, policies and measures, projections and discussions about finance, technology, and international cooperation. In-depth review of the Japanese national communication was carried out by an internationally organized review team in July 1995, and the in-depth review report was published in June 1996.

Japan's Inventory of Sources and Sinks

The emissions in the fiscal year 1990 were estimated for carbon dioxide, methane, and nitrous oxide. Sinks were estimated for carbon dioxide only, and among the IPCC guidelines listed sinks, only managed forests were considered to be relevant for Japan. The estimates were made according to the IPCC guidelines.

Carbon dioxide is produced through the burning of fossil fuels, wastes, chemical reaction of limestone and so forth, and organic decomposition of wastes. Based on the IPCC guidelines, CO_2 emissions have been calculated for these categories: fuel combustion related energy, industrial processes, and waste incineration. In fiscal year 1990, the total CO_2 emissions amounted to 1,173,000 Gg CO_2 (320 million tons of carbon). Nearly 92 percent of Japan's CO_2 emissions belong to the fuel-combustion category, and in this category, emissions from industry are considered to be the main contributors. It should be noted that within this category, emissions from agriculture and forestry are included.

The industrial processes category, counting for about 4 percent of the total emissions, includes emissions from the chemical reaction of limestone consumed in the iron, steel, cement, and quicklime manufacturing processes. The inventory does not include emissions generated during manufacturing of aluminum and other materials. The emissions from wastes are divided into two subcategories: emissions from landfill, and emissions from incineration of mainly municipal and industrial wastes.

As already mentioned, only sinks from managed forests seem to be relevant for Japan. No calculations were made concerning carbon dioxide emissions in the following categories: forest clearing through land development, grassland convention, and abandonment of managed forests.

Measures to Mitigate Climate Change

There are several policy instruments such as regulations, economic instruments (tax, subsidies, loans), voluntary agreements, and education. In the review of the 15 national communications made by the FCCC Secretariat, it is mentioned that economic instruments and incentive are the measures usually taken. Japan put priority on subsidies, taxation measures, and loans, while the energy and carbon dioxide taxes are presently in the study stage.

Measures to Reduce Carbon Dioxide Emissions

The Japanese measures and policies focus mainly on the three major GHG gases (CO_2, NH_4, and N_2O). Using the global warming potentials (GWPs) of these gases, CO_2 is the main contributor to the CO_2 equivalent concentrations and accounts for 96 percent of the concentration. Emissions from the industrial, energy, transportation, and residential/commercial sectors account for about 90 percent of the total CO_2 emissions. The following is a short overview of the measures that have been taken to reduce these CO_2 emissions.

Industry

- Efforts to establish and administrate standards based on the Law Concerning the Rational Use of Energy
- Taxation measures, interest subsidies, and low-interest loans for investment in energy-saving plant and equipment
- Efforts to develop technology that contributes to energy conservation
- Facilitation of independent efforts by the private sector

Energy

In the energy sector, primary energy sources such as oil and gas are used to produce secondary energy such as electricity and city gas in a way that improves energy-efficiency and promotes the formation of an energy supply structure that reduces carbon dioxide emissions.

- Efforts to promote development of solar technology and other renewable energy
- Efforts to improve the efficiency of electric power generation by thermal power plants
- Efforts to promote the introduction of energy sources that produce little or no CO_2 emissions. These energy sources include nuclear power, LNG, and hydropower. The Government is taking measures to support development in these fields through low-interest financing and special taxation measures

Transportation

Emissions from motor vehicles are being curbed by setting and strengthening fuel-efficiency standards on gasoline passenger cars and promoting the introduction of low-emission vehicles using national treasury subsidies and special taxation measures.

Efficiency of freight transport is being increased by improving services; promoting the use of railway and coastal shipping by means of interest-free loans, and special taxation measures; and by promoting consolidated cargo transportation for intracity distribution.

The use of public transportation is being promoted by increasing railway transport capacity and stimulating bus transportation.

Residential and Commercial

- Subsidies and additional financing to ordinary loans for energy-conserving houses and commercial buildings
- Subsidies to promote commercialization of energy-saving technologies
- Taxation measures, interest subsidies, and low-interest loans for utilization of unused energy sources at the district level
- Subsidies for the drawing-up of holistic urban environmental plans and feasibility studies

Other Measures

Among Japan's targets, it is mentioned that forests and green areas in cities should be properly protected. There are several plans for promoting sustainable forest management, effective use of wood resources, designation of nature conservation areas and conservation, and management of greenery in urban areas.

Regarding measures to realize an environmentally proactive lifestyle that overlaps multiple sectors, Japan is setting interest subsidies and tax reductions for the promotion of recycling technologies.

Projections for the Year 2000

In the report, projections of the efforts of greenhouse gas countermeasures are made regarding CO_2, CH_4, and N_2O. The projection of CO_2 is based on the Long-Term Energy Supply and Demand Outlook and other national plans. This projection assumes that all energy conservation measures incorporated in the Outlook will be fully implemented and that control measures in the Industrial Processes category and measures to reduce emissions from municipal wastes will be fully implemented. The total CO_2 emissions in fiscal 2000 are estimated to rise to 330 million tons of carbon.

Without energy conservation measures, emissions from fuel combustion are going to increase by approximately 30 million tons of carbon. In the categories of

Industrial Processes and Wastes, the reduction in emissions will be about 2 million ton of carbon.

On a per capita basis, the emissions in fiscal 1990 and 2000 are nearly the same. It seems that the per capita stabilization target is achievable. However, even if the effect of the measures are taken into account, the total carbon dioxide emissions will increase, particularly in the transportation, commercial, and residential sectors.

Assuming about 7-percent reduction in municipal wastes during 1900–2000, it will, on the one hand, meet its methane target, and on the other hand, exceed its N_2O target by about 8 percent.

In-depth Review

The in-depth review of Japanese national communication was carried out between June and December 1995 and included a visit to Tokyo by the in-depth review team in June 1995. The team included experts from the Republic of Korea, Bangladesh, the United States, and the International Energy Agency.

In general, Japan provided information to support its national inventory estimates which is consistent with the minimum requirements of the IPCC and the Convention reporting guidelines. However, a few significant deviations from the guidelines were identified, namely on the reporting of CO_2 emissions from biomass burning, the sectoral breakdown of fuel combustion sources, and CO_2 removals by managed forests. The indepth review process was very useful and facilitative in clarifying areas of discrepancy with the existing inventory and reporting guidelines. Several priority areas for future work were identified and agreed on between the review team and the Japanese experts.

Table 1. National Greenhouse Gas Inventory in Fiscal 1990 (Gg)

Source and Sink Category	Greenhouse Gas (and confidence in estimation)					
	CO_2 (High)	CH_4 (Medium)	N_2O (Low)	NO_x (High)	CO (Low)	NMVOC (Low)
Total National Emissions	1,173,000	1,380	48	1,898	2,809	2,060
I. All Energy (Fuel Combustion—Fugitive)	1,075,000	125	22	1,844	2,792	560
A. Fuel Combustion	1,075,000	25	22	1,844	2,792	340
Energy & Transformation Industries	82,000	2	5	388	126	40
Industry (including Agriculture/Forestry)	489,000	8	4	393	306	20
Commercial/Institutional	123,000	0.5	NE	16	5	NE
Residential	139,000	0.5	0.1	38	25	NE
Transport	215,000	14	13	1,009	2,330	280
Other	9,000	NE	NE	NE	NE	NE
Biomass Burned for Energy	18,000	NE	NE	NE	NE	NE
B. Fugitive Fuel Emissions	NE	100	NE	NE	NE	220
Oil and Natural Gas Systems	NE	NE	NE	NE	NE	220
Coal Mining	NA	100	NA	NA	NA	NE
II. Industrial Processes	53,000	NE	15	1	NE	60
A. Chemicals	NE	NE	15	1	NE	60
B. Nonmetallic Mineral Products	43,200	NE	NE	NE	NE	NE
C. Other	9,800	NE	NE	NE	NE	NE
III. Solvent Use	NE	NE	NE	NE	NE	1,440
IV. Agriculture	NE	790	5	NE	NE	NE
A. Enteric Fermentation	NA	330	NA	NA	NA	NA
B. Animal Wastes	NA	190	NA	NA	NA	NA
C. Rice Cultivation	NA	261	NE	NA	NA	NA
D. Agricultural Soils	NA	NE	4	NA	NA	NA
E. Agricultural Waste Burning	NA	6	1	NE	NE	NE
F. Savanna Burning	NA	NA	NA	NA	NA	NA
V. Land Use Change & Forestry	IE*	NE	NE	NE	NE	NE
A. Forest Clearing & On-Site Burning of Cleared Forests	NE	NE	NE	NE	NE	NA
B. Grassland Conversion	NE	NA	NA	NA	NA	NA
C. Managed Forests	IE*	NA	NA	NA	NA	NA
D. Abandonment of Managed Lands	NE	NA	NA	NA	NA	NA
VI. Waste	45,000	465	6	53	17	NE
A. Landfills	1,000	446	NA	NA	NA	NA
B. Wastewater	NA	6	NE	NA	NA	NA
C. Other	44,000	13	6	53	17	NE
International Bunker Oil	31,000	NE	NE	NE	NE	NE
Total Removals (Managed Forests)	90,000	NA	NA	NA	NA	NA

Code		Meaning
NA	=	Not applicable
NE	=	Not estimated
IE	=	Estimated but included elsewhere
*	=	Estimated taking into account removals in sink data

Table 2. Carbon Dioxide Emissions in Fiscal 2000

Category	Emissions
Energy	3.1×10^4 tons of carbon (1.1×10^9 Gg CO_2)
Industrial Processes	0.1×10^4 tons of carbon (0.05×10^9 Gg CO_2)
Waste	0.1×10^4 tons of carbon (0.05×10^9 Gg CO_2)
Total	3.3×10^4 tons of carbon (1.2×10^9 Gg CO_2)

Table 3. Energy-conservation Measures and the Effects in Reducing Carbon Dioxide Emissions

Sector	Energy-Conservation Measures	Carbon Dioxide Reduction
Industry	• Based on the law, strengthening energy efficiency standards for businesses aiming at reducing energy-consumption unit requirements by 1% or more per year. • Providing low-interest financing and tax incentives to promote the introduction of energy-saving equipment such as waste heat recovery boilers. • Developing and disseminating energy-saving technologies such as ceramic gas turbines.	Approximately 10 million tons of carbon
Commercial and Residential	• Based on the law, strengthening energy-efficiency standards for building contractors in order to improve building insulation. • Providing low-interest and premium financing to encourage the dissemination of energy-saving buildings and residences. • Improving the energy consumption efficiency of air conditioners, televisions, and other products by strengthening energy-efficiency standards for manufacturers. • Promoting the dissemination of energy-saving appliances and equipment by requiring labels indicating the energy consumption efficiency of individual air conditioners, televisions, and other products. • Promoting the dissemination of energy-saving appliances and equipment. • Developing and disseminating energy-saving technologies such as lightweight insulating materials. • Promoting effective regional energy use by subsidizing such business activities as regional heat supply using unutilized energy sources.	Approximately 10 million tons of carbon
Transport	• Based on the law, strengthening energy-efficiency standards for manufacturers in order to improve automotive fuel mileage • Improving the efficiency of cargo transport through such measures as selecting the appropriate transportation mode and practicing combined shipping policies. • Improving the efficiency of the transportation system and easing traffic congestion by constructing roads and parking lots.	Approximately 10 million tons of carbon

Table 4. Methane Emissions (Fiscal 2000)

Category	Emissions
Energy	1.2×10^2 Gg
Agriculture	8.9×10^2 Gg
Waste	1.4×10^2 Gg
Total	11.5×10^2 Gg

Table 5. Nitrous Oxide Emissions (Fiscal 2000)

Category	Emissions
Energy	25 Gg
Industrial Processes	15 Gg
Agriculture	5 Gg
Waste	7 Gg
Total	52 Gg

Appendix A: Responding to the Vulnerability in Asia and the Pacific

(Sixth Asia Pacific Seminar on Climate Change, 4–8 November 1996, Suva, Fiji)

Tuiloma Neroni Slade
Chairperson
the Sixth Asia-Pacific Seminar on Climate Change
Ambassador and Permanent Representative of Samoa to the United Nations
Vice-chairman of AOSIS

The Sixth Asia Pacific Seminar on Climate Change was held in Suva, Fiji from 4–8 November, 1996, hosted by the Environment Agency of Japan, the Government of Fiji, and the University of the South Pacific in cooperation with the Secretariat of the United Nations Framework Convention on Climate Change (UNFCCC), the United Nations Economic and Social Commission for Asia and the Pacific (ESCAP), the South Pacific Regional Environment Program (SPREP), the Secretariat of the South Pacific Forum (SPF), the United States Country Studies Program, and the Ministry of Foreign Affairs of Japan.

Attendance

The seminar was attended by experts from 26 countries, including Australia, Bangladesh, China, Cook Islands, Federated States of Micronesia, Fiji, India, Japan, Kiribati, Malaysia, Maldives, Marshall Islands, Mongolia, New Zealand, Niue, Pakistan, Papua New Guinea, Solomon Islands, Sri Lanka, Thailand, Tonga, Tuvalu, the United States of America, Vanuatu, Vietnam, and Western Samoa. The seminar was also attended by representatives of ESCAP, the Global Environment Facility (GEF), SPREP, the United Nations Development Program (UNDP) and the Secretariat of the UNFCCC. The representatives from the Tokyo Metropolitan Government and the Yamanashi Prefectural Government of Japan also attended the seminar. The seminar's participants were unanimous in their deep gratitude to the sponsors for enabling such a well organized and valuable exchange of concepts and experiences relating to climate change and related topics.

Major Objectives of the Seminar

The major objectives of the seminar were to exchange information, experiences, and views on climate change among countries of the region and to facilitate the steps to address the climate change problems in the region. To this end, the seminar was convened to:

- Discuss and facilitate the preparation process of the national communications among the countries of the region, through the exchange of experiences and discussions on the status of implementation of the preparation of initial communications from parties not included in Annex I
- Review the outcomes of a series of studies on vulnerability assessment and adaptation strategies in the South Pacific, and to discuss the possibility of applying the results to other parts of the region
- Discuss possible regional mechanisms to facilitate access to the latest scientific and technological information on climate change
- Exchange information on the progress of activities implemented jointly (AIJ) and ways to facilitate the process in the region

Conduct of the Seminar

The seminar commenced with an opening address by Mr. Hironori Hamanaka, Director General, Global Environment Department, the Environment Agency of Japan, and a welcome speech by the Rt. Hon. Vilisoni Cagimaivei, the Minister of Urban Development, Housing, and the Environment, the Government of Fiji. The keynote address entitled "Recent progress of the international ne-

gotiations on the Berlin Mandate process" was delivered by H.E. Mr. Tuiloma Neroni Slade, Ambassador and Permanent Representative of Samoa to the United Nations and the Vice-chairman of AOSIS. The seminar then elected Ambassador Slade as Chairperson, Mr. Nasome (Fiji), Professor Mimura (Japan) and Dr. Fitzgerald (USA) as Vice-chairpersons.

GHG Inventories and National Communications

Reviewing the present status of the preparation of national communications in the countries of the region on the basis of responses from questionnaires sent to participants, the participants discussed the difficulties encountered and lessons learned, and shared experiences in the preparation of national communications among the countries of the region. The participants at the outset pointed out that exchanges such as these are important in providing a common platform for countries to discuss the requirements contained in the Framework Convention on Climate Change on national communications from both Annex I and non-Annex I Parties.

The participants stressed the need to fully take into account their economic and social development concerns and respective capacities. It was noted that implementation by non-Annex I Parties of the requirements under the Convention is dependent on the effective implementation by developed country Parties of their commitments under the Convention related to financial resources and transfer of technology. It was also noted that the timing of submission of the initial communications is within three years of entry into force of the Convention for a Party or of the availability of financial resources and that Parties that are less developed countries may make their initial communications at their discretion.

The participants discussed and grouped their concerns in five areas, namely: institutional, human resources, data and information, technical, and financial. They advanced the following broad conclusions recognizing the interlinkages that exist among these five areas.

Many felt that for small island countries whose contribution to global greenhouse gas emissions is minimal, adaptation is a priority. The participants noted that the guidelines provide flexibility for the preparation of initial communications from non-Annex I Parties. The participants also noted that they need assistance to comply with these guidelines. It was emphasized that non-Annex I Parties need technical and financial assistance for enabling activities that would result in sustainable capacities to comply with the guidelines.

It was strongly suggested that each country consider designating one full-time individual, and where circumstances permit, a technical team responsible for climate change studies and information exchange for the preparation of initial communications. The team approach would also help build and maintain institutional memory. In addition, interagency coordination among all relevant sectors was encouraged. Many participants pointed out that high-level political awareness and interest at all levels is crucial for taking necessary actions.

Some participants emphasized the requirements for strengthening institutions in non-Annex I Parties. It was recommended that strengthening of institutions be achieved through transfer of technologies, materials, equipment, access to the latest information methods, and techniques such as e-mail and the Internet.

It is important that technical experts come from within the country, or at any rate from the same geographic region. Where experts outside the region are needed, their primary role should be to develop and strengthen endogenous capacity. A key element is training of local experts in the application of the methodologies and in developing the ability to use and adapt models for the preparation of national communications.

It was widely felt that there are gaps in activity data, and that each country collect, store and aggregate such data and have it available at a single national center. It was pointed out that further research for generating country-specific conversion factors for priority gases need to be addressed on a priority basis. It was felt that it is desirable to identify regional mechanisms to support the work and act as a repository of data and information, and to provide technical support.

Networking at local, national, and regional levels among all relevant actors was considered important for facilitating the exchange of experiences, data and information. Tools such as access to and wide participation through the Internet could be a cost-effective means for the provision of technical support. It was also felt that regional mechanisms should be identified to provide technical support through the better use of existing regional institutions and national expertise from other countries of the region.

Finally, participants emphasized the current and future need for financial assistance and were informed of the new procedures for expedited project approval in GEF. Some countries have received support for studies

that will provide inputs to the national communications. But it was stressed that additional support may be needed for the preparation and periodic updating of national communications, in accordance with the approved guidelines. Financing for the agreed full costs for the preparation of initial communications is to be provided by GEF, upon request, to the non-Annex I Parties.

Vulnerability Assessment and Adaptation Strategies

The participants reviewed the present status of vulnerability assessment and planning for adaptation in the preparation of national communications in the countries of the region. It was noted that developing countries in general, and small island countries and countries with low- lying areas in particular, will have adaptation burden such as increased cooling requirements, the need to switch to different crops and crop patterns, the loss of livelihood dependent on marine resources, the loss of economic infrastructure, and resettlement of people due to sea level rise.

The participants discussed the concept, framework, procedures, and constraints of adaptation strategies. It was recognized that a no-regrets strategy, which can be defined as measures beneficial even if climate change and sea level rise projections do not eventuate, is a good way to start adaptation planning. It is also effective to incorporate adaptation measures into existing social and economic development policies, such as land use planning, environmental conservation, resource management planning, and sustainable development. Integrated coastal zone management, in particular, was recognized as an adaptation strategy to deal with the environment and climate change in order to achieve economic sustainability in coastal and small island countries.

In reviewing adaptation strategies currently underway in some of the countries in the region, the participants identified the following constraints: lack of data and information, lack of methodologies for vulnerability assessment applicable to countries in the region, limited human resources, and poor coordination within and between agencies.

The participants concluded that:

- There is a need for human resources development with respect to dealing with climate change issues, particularly those pertaining to adaptation strategies.
- There is an urgent need for information and data relating to climate change and sea level rise to make informed decisions with respect to adaptation options. There is a serious need for collecting, handling, maintaining, storing, and accessing data relating to climate change and sea level rise in the region.
- There is a need for local, national, and regional institutional arrangements and for strengthening these to facilitate development of policy and activities pertaining to climate change and sea level rise.
- There is a need for local, national, subregional, and regional vulnerability assessments. There is a perceived need for development of a common methodology with the subregional and regional focus.
- There is a perceived need for a stronger commitment for public awareness and education at all levels, particularly through a process of identifying adaptation strategies.
- Adaptation policy options should be integrated into national sustainable development policies.
- Article 4.4 of the UNFCCC is significant in seeking assistance for adaptation measures.

Regional Cooperation on Climate Change

Given the global nature of environmental issues like climate change, the need for global cooperation was stressed.

The participants took note of the regional activities on climate change being undertaken by UNDP, ESCAP, SPREP, and the University of the South Pacific (USP).

The participants appreciated the initiative of the government of Japan to host the Third Conference of the Parties of UNFCCC. They also welcomed the offer of the Yamanashi Prefectural Government of Japan to host the Seventh Asia Pacific Seminar on Climate Change sometime in the northern summer of 1997 in Yamanashi Prefecture.

Appendix B: Workshop on Asian Cities for Climate Protection Campaign

(19–21 November 1996, Omiya City, Saitama, Japan)

Saburo Kato
Chairperson
Workshop on Asian Cities for Climate Protection Campaign

The workshop on Asian Cities for Climate Protection Campaign was held on 19–21 November 1996 in Omiya Sonic City, Omiya City, Saitama, Japan. It was organized by Saitama Prefecture, the International Council for Local Environmental Initiatives (ICLEI), and the Environment Agency of Japan (EAJ), with the support of the Ministry of Foreign Affairs of Japan and the Sai-no-Kuni Saitama Environmental Development Council.

Attendance

The workshop was attended by experts from 39 cities mainly in Asia and the Pacific. From Japan, experts of 30 prefectural and municipal governments attended the workshop. From abroad, experts of Ansan in Korea, Bangkok in Thailand, Berlin in Germany, Hamilton in New Zealand, Hanoi in Vietnam, Kuala Lumpur in Malaysia, Mumbai in India, Shenyang in China, and Suva in Fiji attended. Representatives of the Korean Local Authorities Foundation for International Relations (KLAFIR), Credit Guarantee Corporation of Saitama, the National Environmental Training Institute, Earth Day Japan, and People's Forum 2001, Japan, also attended the workshop. As the secretariat, experts of Saitama Prefecture, the ICLEI World Secretariat, the Asia Pacific Secretariat, and EAJ attended the workshop.

Major Objectives

The major objectives of the workshop were to follow up the Saitama Summit and to further develop the Asian Cities for Climate Protection (CCP) Campaign. Through the discussions at the workshop among municipalities participating in the Campaign as well as the ICLEI members in Asia and the Pacific, the *Guidelines for Local Action Plans for Climate Protection in Asia* will be finalized to help local governments in Asia and the Pacific develop action plans for climate protection.

Forum on Global Warming—Challenge of Global Citizens to Stop Climate Change

A special symposium, entitled the "Forum on Global Warming—Challenge of Global Citizens to Stop Climate Change," was held in the morning of the first day, with more than five hundred in the audience. It was commenced with opening addresses by Messrs. Yoshihiko Tsuchiya, Governor of Saitama Prefecture and Kenji Tanaka, Director General, Planning and Coordination Bureau, EAJ, followed by the welcome address by Mr. Noboru Asako, Speaker, Saitama Prefectural Assembly.

Messrs. Hikaru Kobayashi, Director, Control and Cooperation Division, Global Environment Department, EAJ and Philip Jessup, Director, CCP Campaign, ICLEI World Secretariat made keynote addresses on "The International Challenge of Climate Change" and "The CCP Campaign: Challenge by Local Governments' Initiatives," respectively. Professor Takashi Onishi, of Tokyo University, delivered the main address entitled "Actions by Citizens and Enterprises for Climate Protection."

Conduct of the Workshop

The workshop elected Mr. Saburo Kato, Senior Executive Director, ICLEI Asia Pacific Secretariat as Chairperson.

Presentations on the status quo of the CCP Campaign and on the summary of the Saitama Summit were made respectively by Ms. Tanya Imola, CCP Campaign Coordinator, ICLEI World Secretariat, and Mr. Ken-ichi Nakano, Deputy Director General, Environment Department, Saitama Prefecture. Overviews of Japanese action plans on climate change, the CCP Campaign in North America and in Europe were also presented respectively by Mr. Hikaru Kobayashi, Director, Control and Cooperation Division, Global Environment Department, EAI, Ms. Imola and Dr. Klaus Müschen, Head of the Energy Planning Division, Berlin.

CCP Tool Kit and Draft Guidelines for Local Action Plans for Climate Protection in Asia

The participants took note with appreciation of the brief explanation of the CCP toolkit applicable for worldwide cities and the draft guidelines for local action plans for climate protection specifically developed for Asia and the Pacific, which were felt very useful for developing local action plans for climate protection.

Comments on the toolkit and the draft guidelines included:

(a) A simpler worksheet approach may also be developed to prepare inventories.
(b) The importance of public awareness and education, cross-sectoral approach, and economic instruments should be further emphasized.
(c) Mitigation measures for methane from landfill sites should be placed as one of the priority options. Composting should also be considered as a good mitigation measure in waste management.
(d) Reporting of implementation of action plans should be integrated as the sixth step of the planning process.
(e) A survey of the present stage(s) at which local authorities are in the planning process may also be very useful in promoting the exchange of information and experiences among members of CCP Campaign.
(f) It was clarified that the time frame to develop local action plans would be within three years after joining the Asian CCP campaign and that the local governments have flexibility to set the target year of their action plans. These should be specifically mentioned in the guidelines.
(g) Taking into account the situation of many countries of Asia and the Pacific, a description of vulnerability assessment and adaptation measures should also be incorporated in the draft guidelines.
(h) Better communication and coordination between the national and local governments should be established on the climate change problem.
(i) The target groups for the guidelines should be the local governments in Asia and the Pacific, including Japan.

It was confirmed that the local governments in industrialized nations participating in the CCP Campaign have flexibility in setting the targets in their local action plans, taking account of their local circumstances, although they are encouraged to set a target of 20-percent reduction of GHG emissions from 1990 levels by the years 2005–2010. Local governments in developing countries have more flexibility in setting the targets, depending on their local and national circumstances.

It was pointed out that a series of national and/or regional workshops on Asian CCP Campaign should further be undertaken in this region to build the capacity of the local governments in developing local action plans as well as to review the progress of and exchange experiences on the campaign.

Technical Discussions

It was pointed out that CO_2, CH_4, and N_2O are the priority items, particularly in developing countries, and that appropriate methodologies applicable to the countries of the Asian and Pacific region should further be elaborated. It was emphasized that some actions could be taken even in the process of elaborating the local emission inventories.

Various measures on energy-efficiency improvements, such as the following, were introduced by the participants as possible options to be included in the guidelines for climate protection in Asia and the Pacific:

- District heating networks
- Combined generation of electricity and heating and/or cooling
- Energy-saving or audit systems for public and commercial buildings and households
- Better insulation of public and commercial buildings, and households
- Active recycling, reduction, and reuse of wastes, and methane capture

- Better transportation management through such means as promotion of eco-driving, park and ride systems, use of nonmotorized vehicles like bicycles, better maintenance and inspection system, more fuel-efficient vehicles, cargo transport improvement, and so on
- Improvement of life styles through, e.g., household eco-account books and environmental education

Better use of solar heating, photovoltaic power generations, wind power and biomass were considered crucial for the promotion of renewable energy. Natural gas and other low GHG-emitting fuels were also recommended to be widely used.

The importance of vulnerability assessment and adaptation strategies in the region, especially in South Pacific, was stressed by the participants. Regional cooperation on these topics was also considered crucial.

Future Actions

The participating governments of the workshop were encouraged to join the Asian CCP Campaign, if they have not yet done so. Considering that at present only seven local governments are the members of the Asian CCP Campaign, the workshop expressed its strong desire that many local governments in Asia and the Pacific, particularly the signatories to the Asian CCP Campaign, would become members of the Asian CCP Campaign at their earliest convenience.

It was felt that more active dissemination of information on the Asian CCP Campaign, such as case studies of success stories, should be undertaken to facilitate the participation in the campaign.

It was emphasized that better understanding and cooperation by national governments are very important. Regional cooperative activities in this field may also involve governments in a more direct manner. In this connection, it was noted with appreciation that USEPA and EAJ had initiated to provide technical and financial support with the CCP campaigns in respective countries. The local governments in respective countries were requested to consider the best use of such support to expand their campaign activities.

It was also stressed that capacity building through training, workshops, and so forth are crucial in promoting the Asian CCP Campaign. Technology transfer and better involvement of the private sector, especially through activities implemented jointly (AIJ), were considered important.

Participants of the workshop were requested to send comments on the draft, if any in addition to those expressed during the workshop, to the ICLEI Asia Pacific Secretariat by December 31, 1996. The draft guidelines should also be sent to the signatories for their comments. Based on the comments during the workshop and thereafter, the ICLEI Asia Pacific Secretariat will finalize the guidelines by March 31, 1997, and accordingly send them to the participants and others as appropriate. The participants were requested to consider the ways to make best use of the guidelines and identify the needs for further support.

Specific methodologies appropriate for Asia and the Pacific should be developed and included in the CCP Toolkit. More case studies should be collected and included in the CCP Newsletters and the CCP Toolkit. In this connection, the local governments participating in the Asian CCP Campaign were encouraged to provide information on the progress of the implementation on the campaign to the ICLEI World Secretariat. Japanese local governments were recommended to more actively translate their experiences into English and provide them to the ICLEI World Secretariat.

It was emphasized that a series of national and/or regional workshops should be undertaken to build capacity for developing local action plans and so forth.

The participants took note with appreciation the progress on the establishment of the Environmental Information Center on Climate Change, reported by Saitama Prefecture as the follow up of the Saitama Summit, and welcomed the Saitama's initiative to make arrangements for opening an Internet home page on climate change for the next year.

It was felt that collaboration should be promoted with the CCP Campaign in the other regions—North America, Europe, Africa, the Middle East, and Latin America.

It was agreed to change the name of the Asian CCP Campaign to the Asia Pacific CCP Campaign to expand the geographical coverage.

The participants discussed the possible inputs to COP3, which will be further discussed and decided at the Fourth Local Government Leaders' Summit.

It was pointed out that local governments could influence the international negotiations by demonstrating, prior to COP3, their initiatives to attain more stringent

targets, and that COP3 could also have positive influence on local governments in facilitating their climate protection initiatives.

The workshop participants were unanimous in their deep gratitude to the organizers of the workshop for enabling such a well-organized exchange of information and experiences relating to the follow up of the Saitama Summit and the Asian CCP Campaign.

Report on Climate Change to the Environment Agency/Japan: What We Should Do Now

Advisory Panel on Global Environmental Issues

On November 1, 1996, the Subpanel on Climate Change, which was established under the Advisory Panel on Global Environmental Issues for the Director General of the Environment Agency, submitted the Interim Report on Climate Change to Mr. Sukio Iwatare, the then Director General of the Environment Agency/Japan. This document, including a number of specific recommendations, is expected to provide valuable input for Japan's environmental administration, as Japan will host the Third Session of the Conference of the Parties (COP3) to the United Nations Framework Convention on Climate Change (UNFCCC) in Kyoto in December 1997. The Report is also expected to help stimulate open discussions on climate change issue among the general public.

The Subpanel, chaired by Professor Akio Morishima of Sophia University, met 20 times since its first meeting in July 1995. In developing its findings, it took into account the views of various sectors of Japanese society, including academics, industry representatives, local governments, environmental NGOs, and the general public through special hearing sessions and opinion polling. It also considered the views of relevant ministries and agencies within the government.

Background

The UNFCCC was adopted in 1992, with the ultimate objective of stabilizing concentrations of atmospheric greenhouse gases (GHGs) at a level that would prevent dangerous anthropogenic interference with the climate system. Under the Convention, all the Parties have commitments, such as plans to develop GHG inventories, to formulate national plans containing measures to mitigate climate change. In addition, developed country Parties committed themselves to adopt national policies and take corresponding measures aiming to return by the year 2000 to earlier levels of anthropogenic GHG emissions, and to report relevant information to the Conference of the Parties. In 1995, the Conference of the Parties, at its First Session in Berlin, concluded that the provisions of developed country Parties' commitments were not adequate, and decided to begin a process to consider appropriate actions beyond 2000, with a view to adopting a protocol or another legal instrument at COP3. This decision is called as the Berlin mandate. Accordingly, COP3 will be the critical meeting to decide actions addressing climate change in the next century.

Basic Ideas

The report was prepared on the basis of the following ideas:

- The latest scientific knowledge should be reflected in the policymaking process.
- Consideration of climate change should be incorporated into economic activities.
- The need for further development of innovative technologies should not be used as an excuse for the delay of actions.
- The positive attitude of people to play their individual roles and cooperate with others is essential for getting maximum effects of policies and measures.
- It is important for the national government to play a primary role in developing visions and rules.
- It is critical for a country like Japan, which is dependent on world resources and peace, to strengthen its climate protection policies and measures not only for getting better business opportunities but also for maintaining its development.

International Measures To Arrest Climate Change

The following points are the summary of the main thrusts of this report, which has a rich content including 100 pages. The views expressed in the report do not necessarily reflect those of the Government of Japan nor the Environment Agency.

Implication of the Berlin Mandate Process in Climate Protection

The Berlin Mandate process is important but will not provide final solution for the global warming problem, even if the best efforts be made until the end of 1997. Japan, therefore, should have a broad scope for policies and measures to be taken in the 21st century, not limiting its discussions to measures to be decided at COP3.

Responsibility of Developed Countries to Meet Their 2000 Targets

Attaining the existing common target of developed countries (to reduce emissions of carbon dioxide (CO_2) and other GHGs to 1990 levels by the year 2000) is the important milestone and intermediate goal to mitigate global warming as it was so declared at the COP2. Because developing countries must be more seriously involved in the future in the effort to reduce global GHG emissions, it is crucial that developed countries demonstrate their efforts by achieving their commitments in 2000. From this viewpoint, it is of grave concern that many developed countries encounter difficulties in achieving their 2000 target.

Post-2000 Targets

As tentative benchmarks for ultralong term internationally shared objectives, it would be worthwhile to consider the stabilization of atmospheric concentration of GHGs with CO_2 equivalent in a range not exceeding 550 ppmv (or 520 ppmv for CO_2 alone if it be assumed that the concentrations of other GHGs do not change in the future). Such ultralong-term objectives should be challenging in nature and be periodically reviewed and revised, based on the latest scientific knowledge.

As a medium-term target for developed countries that have ratified the Convention, it would be worthwhile to consider reducing by a certain (single digit) percentage the aggregated emissions of the developed nations as a whole and for a specific time period such as 10 years. Setting such a target, it must be recognized that even several percent reduction must be quite challenging for many developed countries, including Japan, in view of the difficulties in achieving 2000 target.

Burden-sharing among Developed Countries and Targets for Individual Countries

If the approach on differentiated targets be adopted, developed countries should first decide the aggregated reduction target for all the developed countries, and then within that framework, continue negotiations on possible methods for differentiation among developed countries. It is, however, difficult to take full consideration of the circumstances of respective countries, and therefore policies and measures should have flexibility in achieving such specific targets.

It should be clearly understood that the discussions on options between differentiated and unified (flat rate) targets are those on possible means to achieve the climate protection objective, and such discussions should not influence the substance of the objective.

Policies and Measures by Developed Countries

In addition to the international commitments to achieve the target, common commitments for specific policies and measures among developed countries will have significant benefits. For example, if each country independently adopts its own policies and measures, countries that take stronger measures might be less competitive. On the contrary, common commitments among developed countries could eliminate this problem and ensure adequate competition. If all countries implement similar, effective policies and measures, the achievement of the target would become more certain. However, if common commitments limit the discretionary power of national authorities, and the common international measures do not fit the circumstances of a specific country, they could cause inefficiencies and disadvantages for the country. To attain a compromise between possible pros and cons associated with international agreement on concrete measures, it is suggested that certain flexibility should be given to the policies and indicators for policies and measures so that they can easily evaluate their efforts in an internationally comparable manner.

The Need to Consider the Situation of Developing Countries

Developed countries have the responsibility to promote transfer of technology to developing countries to cope with climate change and have been considering how to actively use existing Official Development Assistance (ODA) to this end. However, it is pointed out that the achievement so far has not been satisfactory and a better framework is needed. It would be necessary to expand the functions and size of the Global Environment Facility (GEF) for this purpose. It would also be essential to transfer technologies as well as financial resources through the private sector, particularly with the opportunities for foreign investments.

Domestic Policy

The report also describes policies and measures to be taken in Japan. The Subpanel reviewed the performance and problems of previous domestic measures, concluded that there is much room for further improvement, and made various specific proposals.

Initiatives Toward COP3

It is necessary for Japan to take initiatives and make the utmost effort for the adoption of an environmentally effective international agreement at COP3, to be held in December 1997 in Kyoto, Japan.

Targets for Japan

The present efforts for CO_2 reduction are not sufficient and should be strengthened, considering the amount of CO_2 emissions since 1990. It should be adopted, as the objective for Japan, to strengthen efforts for returning GHG emissions at 2000 to 1990 levels, to set a suitable target that would oblige Japan to make comparable or more stringent efforts than those in other countries toward the reduction of GHG emissions after 2000.

Revision of the Action Program to Arrest Global Warming

The present Action Program to Arrest Global Warming is not sufficiently effective. The program should be revised to adopt more stringent targets and improve its implementation mechanisms.

Actions to be Taken by Individual Stakeholders

The role of the local governments is crucial for climate protection actions, because GHG emissions are mainly dependent on activities undertaken at the local level. It is expected that citizens and corporations voluntarily make active efforts to reduce GHG emissions, even though they require an additional economic burden.

Regulatory Measures and Economic Instruments

The national government should actively consider the possibility of introducing regulatory measures. As for economic instruments, a specific proposal on carbon tax should be prepared, and based on such a proposal, nationwide deliberation should be stimulated on this specific topic.

Cooperation with Developing Countries

Concrete perspectives should be developed to transfer technologies to the countries in Asia and the Pacific, and other regions. Regarding technology transfer, transfer of not only the newest production technologies but also basic technologies such as those for plant maintenance should be emphasized.

Draft Submission of México Under the United Nations Framework Convention on Climate Change: Climate Action Report

Introduction and Overview

In June 1992 in Río de Janeiro, world leaders and citizens of 176 countries gathered to agree on ways on working together to preserve and enhance the global environment. The Earth Summit aroused the hopes and dreams of people around the world and set in motion ambitious plans to address the planet's greatest environmental threats. We shared a common vision: to provide a higher quality of life for ourselves and our children.

At the Earth Summit, México joined other countries in signing the Framework Convention on Climate Change, an international agreement whose ultimate objective is to:

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

México—and the international community—has confronted the threat of global climate change because most scientists agree that the threat is real. There is no doubt that human activities are increasing atmospheric concentrations of greenhouse gases, especially carbon dioxide, methane, and nitrous oxide. Models predict that these increases in greenhouse gases will cause changes in climate locally, regionally and globally, with potentially adverse consequences to ecological and socioeconomic systems. The best current predictions suggest that the rate of climate change could far exceed any natural changes that occurred in the past 10,000 years. Of course, there are uncertainties regarding the magnitude, timing and regional patterns of climate change. But any human-induced change that does occur is not likely to be reversed for many decades—or even centuries—because of the long atmospheric lifetimes of the greenhouse gases and the inertia of the system.

This document, the Climate Action Report, represents the first formal Mexican communication under the Framework Convention on Climate Change, as required under Articles 4.2 and 12. It is a snapshot—a description of México's current Program. It does not seek to identify additional policies or measures that might ultimately be taken as México continues to move forward in addressing climate change, nor is it intended to be a revision of México's Climate Change Action Plan. It is not a substitute for existing or future decision-making processes—whether administrative or legislative—or for additional measures developed by or with the private sector. Meeting the formal reporting requirements in the Climate Convention, this document is also intended to identify existing policies and measures, and thus to assist in establishing a basis for considering future actions.

This document has been developed using the methodologies and format agreed to at the Ninth Session of the Intergovernmental Negotiating Committee for a Framework Convention on Climate Change. We assume that this communication, like those of other countries, will be reviewed and discussed in the evaluation process for the Parties of the Convention. We hope that the measures detailed here provide useful examples of possible directions for the future.

This chapter briefly describes the climate system science that sets the context for México's action, and then provides an overview of México's program, which is the focus of the remainder of this report. In particular México includes information in this report on: national circumstances, providing a context for action, an inventory of México's greenhouse gas emissions, mitigation programs, international activities, and a brief discussion of the future direction of México's effort.

The Science

The scientific community has long noted the potential for human activities to contribute to global climate change. A broad international consensus regarding this issue has been developed over the past several years (and has been reported in the Intergovernmental Panel on Cli-

mate Change assessment reports); this summary is drawn from that consensus view. As the actions being taken by México ultimately depend on our understanding of the science, it is appropriate to review this information here.

The driving energy for weather and climate comes from the sun (Figure 1). The Earth intercepts solar radiation (short-wave and visible parts of the spectrum). About one-third of that radiation is reflected, and the rest is absorbed by different components of the climate system, including the atmosphere, the oceans, the land surface, and biota. The energy absorbed from solar radiation is balanced, in the long term, by outgoing radiation from the Earth-atmosphere system. This terrestrial radiation takes the form of long-wave, invisible infrared energy. The magnitude of this outgoing radiation is determined by the temperature of the Earth-atmosphere system.

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

Greenhouse gases include water vapor, carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), chlorofluorocarbons (CFCs), hydrochlorofluorocarbons (HCFCs), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and ozone (O_3). While water vapor has the largest effect, its concentrations are not directly affected, on a global scale, by human activities. Although most of these gases occur naturally (the exceptions are CFFCs, HCFCs, HFCs, and PFCs), human activities have contributed significantly to increases in their atmospheric concentrations.

Many greenhouse gases have long atmospheric residence times (several decades to centuries), which implies that the atmosphere will recover very slowly from such emissions, if at all.

Internationally accepted science indicates that increasing concentrations of greenhouse gases will ultimately raise atmospheric and oceanic temperatures and could alter associated circulation and weather patterns. Large computer-driven climate models predict that the equilibrium change in the average temperature off the globe's atmosphere as a consequence of doubling of CO_2 or its equivalent is unlikely to lie outside the range of 1.5 to 4.5 °C (2.5 to 8 °F), with a best estimate of 2.5 °C (4.5 °F). The sea level rise associated with such doubling has been estimated to range between a few centimeters and one meter (about 2 inches to 3 feet), with a best estimate of approximately 20 centimeters (8 inches). Because of the large thermal inertia of the Earth system, the equilibrium warming from added greenhouse gases is not reached until many decades after these emissions are released into the atmosphere. While current analyses are unable to predict with confidence the timing, magnitude or regional distribution of climate change, the best scientific infor-

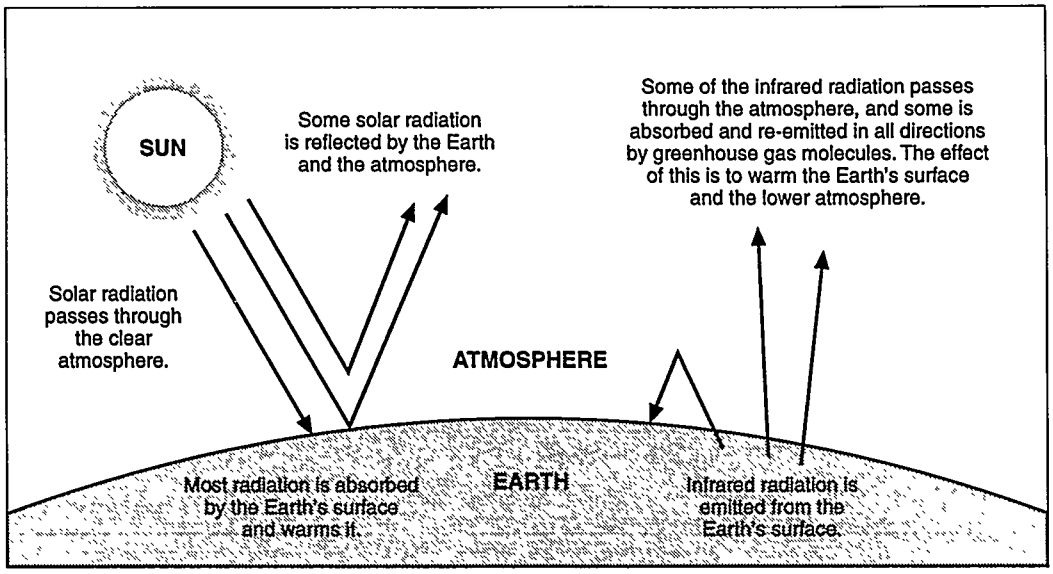


Figure 1. The Greenhouse Effect

mation indicates that such changes are very likely to occur if greenhouse gas concentrations continue to increase.

Inventory of Greenhouse Gases

The Mexican effort to produce a Greenhouse Gases Emissions Inventory within the México Country Study is being supported by the United Nations Environmental Program (UNEP) and the U.S. Country Studies Program (CSP). It is well acknowledged by the Mexican government, through the National Institute of Ecology (INE), that good and detailed greenhouse gases inventories are an excellent tool for integrated environmental management. The richness of the data collected and organized for the inventories has a potential for utilization that goes well beyond the immediate satisfaction of the commitment assumed by México with the Framework Convention on Climate Change, to produce a National Inventory for the base year of 1990.

The preliminary Greenhouse Gas Inventory within the Country Study has been built through the cooperative effort of several research institutions under the coordination of INE with the collaboration of the Center for Atmospheric Sciences of the National University (CCA, UNAM). The interest of INE, the other participant national institutions and the National University for producing a detailed inventory was initially supported by the U.S. CSP and by UNEP. It was understood that the additional UNEP funding would boost the Mexican effort within the Country Study, a major effort funded by the USCSP involving the development of emission scenarios and vulnerability studies, besides the National Inventory of GHG. It was agreed that UNEP funds would be used to produce an Inventory to Tier 1 of the adopted IPCC methodology halfway through the course of the Country Study in order to comply with UNEP's funding calendar. However, some teams have gotten sufficient results to reach Tier 2 estimates (using more detailed information, methodologies and emission factors) for some or all of their assignments.

Responsibility for coordination of the inventory work was assigned to the National Institute of Ecology with the collaboration of the Center for Atmospheric Sciences (CCA-UNAMI). The inventory of emissions of CO_2 by the energy sector and other industrial processes, was the responsibility of the Electricity Research Institute (IIE), as well as the integration of other parts of the inventory into a Mexican software package (MINERG). Another group within the IIE was assigned the inventory from landfills. The National Institute for Research on Forestry, Agriculture and Livestock (INIFAP) with the support of the Center for Ecology (CE-UNAM) was assigned the responsibility for the calculation of emissions from land use change. The inventory of methane and nitrous oxide from agriculture was also responsibility of CCA-UNAM. Non-energy emissions from the oil industry were responsibility of the Mexican Petroleum Institute (IMP). All teams had to report to IIE to integrate the results into the software and the coordination at CCA responsible of the final report.

The gases included in this inventory are Carbon Dioxide (CO_2), Methane (CH_4), Nitrous Oxide (N_2O), Nitrogen Oxides (NO_x), Carbon Monoxide (CO), and Non Methane Volatile Organic Compounds (NMVOCs). Table 1 provides the summary of greenhouse gas emissions. The different sources of emission in the energy sector (Table 2) constitute the most important anthropogenic source in México. Emissions come mainly from the use of fuel, land use, agriculture and fugitive emissions generated by oil and gas production.

Most of the emissions presented here were calculated using the IPCC Draft Guidelines for National Greenhouse Gas Inventories.

Impacts and Adaptation/Vulnerability to Climate Change

The possible effects of Climate Change on our ecosystems, economy, and health are expected to be of a very diverse nature. In some cases, the forecasted variations in precipitation and temperature can improve the situation of a certain area, while in others the same situation can have disastrous consequences. The vulnerability of our country was assessed as a part of the México Country Study with the following results:

Agriculture

Nowadays, corn is cultivated all over the country, even where soils are not suitable for it, which explains the big losses suffered by the producers. Low yields (less than 1 Ton/Ha) found in more than half the territory are a consequence of this. The zones with the highest production yields are those located inside the irrigation areas (Sinaloa, Sonora, Peninsula de Baja California, and the irrigation districts of Santiago, Jalisco).

Climate Change Scenarios were developed using arbitrary increases of temperature and rainfall as well as two General Circulation Models (GCMs), the GFDL (Geophysical Fluid Dynamics Laboratory) and the CCCM (Canada Climate Center Model). The GFDL

Table 1. Summary Report for National Greenhouse Gas Inventories

Source Categories	CO_2 Emissions Bottom-Up	CO_2 Emissions Top-Down	CH_4 (Gg)	N_2O	NO_x	CO	NMVOC
1. Total National Emissions	398,425	433,721	3,890	9	1,822	14,292	1,047
2. All Energy							
(Fuel Combustion + Fugitive)	275,020	310,316	1,286	3	1,790	12,588	1,047
Fuel Combustion	275,020	310,316	247	3	1,790	12,588	1,047
Fugitive Fuel Emission			969				
Coal Mining			69				
3. Industrial Processes	11,621	11,621					
4. Agriculture			1,889	5.5			
Domestic Animals			1,853				
Agricultural Soils				5.5			
Rice Paddies			35				
5. Land Use Change and Forestry	111,784	111,784	195	1,832	1,704		
Forest Clearing	188,479						
Managed Forest	–76,690						
6. Waste			526				

Gg = 1×10^9 grams

Table 2. National Greenhouse Gas Emissions by Energy Sector

Source	CO_2	CO	CH_4	NO_x	N_2O	NMVOCs
Stationary						
Industry	7,073	16	17	95.6		
Residential/Commercial	4,242	549	22	76.2	1.2	
Electricity Generation	6,741	23	1.3	185		
Subtotal	**18,056**	**568**	**25**	**356.8**	**1.2**	
Mobile						
Particular	4,819	506	21	271	0.62	78
Urban	4,056	27	0.76	12.5	0.13	34
Goods	2,616	155	4.8	204	0.45	21
Aviation	560	15.8	0.32	22.0	2.50E-	2.8
Railroad	197	16	0.16	48.3	5.37E-	3.4
Maritime	198	0.55	6.23E-	14.1	1.02E-	
Subtotal	**9,446**	**691**	**22**	**572**	**1.2**	**104**
Total Emissions	**27,502**	**1,259**	**24**	**929**	**2.5**	**105**

Model shows yield decreases (Atlacomulco excepted) due to the high level of precipitation that it predicts, which causes a nutrient washing. According to this model, 75 percent of the surface is not suitable for corn growth, 8.4 percent is moderately suitable, and 15.9 percent is suitable. The CCCM Model foresees positive and negative yield variations, depending on the zone. For example, for Atlacomulco, Coatepec and Tuxpan, it predicts favorable conditions for corn production. Thus, it turns out that 75.5 percent of the country is not suitable, 22 percent is moderately suitable, and only 2.5 percent is suitable.

Human Settlements

Vulnerability of human settlements to climate change depends on climatic and non-climatic factors. Their combination can either mitigate or worsen this phenomenon's effects.

Amongst the main non-climatic factors, we can point out population increase, urbanization, industrialization and the presence of diseases. According to applied models, climatic factors will include sea level rise as well as precipitation and temperature increases. Their main consequences will be coastal zone flooding, more frequent heat islands in certain urban settlements, longer drought periods and more humid and warm seasons. These variations could generate changes to human settlement's distribution and socio-economic response.

The more vulnerable of them will be those located in zones suffering already from great environmental stress due to high demographic concentrations, excessively rapid urbanization processes, high incidence of diseases, or a noticeably general environmental deterioration. Such is the case of big urban zones of the country or those with poor services endowment and deficient sanitary conditions.

According to this, the Distrito Federal and Estado de México have a high vulnerability level, while Guanajuato and Jalisco have a medium-high vulnerability level. The vulnerability for the rest of the country is medium-low and low.

Desertification and Meteorological Drought

The results of this study show that the country's vulnerability to changes in temperature and precipitation tends to increase, mainly because of the conditions created by socioeconomic activities. Therefore, in the future it would be very important to plan these activities with the participation of all sectors of the society, including politicians and decision takers. Otherwise, the complex process of desertification will reach irreversible proportions.

Forest Ecosystems

Climate Change will not affect all vegetation types in the same way. It turns out that the most sensitive vegetation communities are those established in places with temperate climates, this is the case of coniferous, mesofilous and helm oak forests, pasture, and some xerophylous brushwoods with temperate affinities. In all cases, the most sensitive vegetation type is the pasture.

The results of climate change modeling predictions indicate that about 50 percent of the country will be affected by climate change and, as a matter of fact, according to the GFDL model this figure could increase up to 60 percent.

Hydrological Zones

The hydrological vulnerability of a given zone is determined by a combination of the zone's geographic situation with its human aspect (population density, water storage and transportation capacity, generation of hydrologic energy, volume of water used for domestic activities, agriculture and livestock) as well as by the risk of losing the zone's ecological balance.

In accordance with this criteria, the more vulnerable zones of the country are the Pánuco basin, the Lerma-Chapala-Santiago basin and the Baja Californian Peninsula. The first two are vulnerable because of their population density, the third one is the driest zone of the country and the one with less drainage.

Industry and Energetic Systems

It is important to emphasize that, because these sectors are two of the main greenhouse gas producers, they will be affected directly by all measures addressed to reduce those emissions. This situation could be reflected in their contribution to the country's economy.

These sectors' adaptation capacity varies depending on the economic situation, and the capacity to obtain resources (technological as well as financial) of each company. For example, big companies (as heavy industries) could be more vulnerable in spite of their economic capacity because of their need for greater volumes of fuel and raw materials. Geographic localization can also be a very important adaptation factor, so that industries located in big industrial concentration centers (e.g., Monterrey, Guadalajara) will be more vulnerable because of resource shortages.

Other important vulnerability factors are sea level rise (Industrial and energy generating facilities as well as energy provisioning and distribution terminals and connection infrastructure installed near the sea will be more vulnerable), temperature rise (Its consequence will be the redistribution of rainfall patterns. In this case, vulnerability will be reflected on the volume and frequency of water supplies. Because of this water shortage, its price will rise affecting directly the cost of electric energy and fossil fuels. The temperature rise will also mean a vulnerability factor for those enterprises requiring cooling and freezing processes), variations on water temperature and distribution (it will have great repercussions in land use and population distribution. This will hurt all companies that depend on raw materials produced by vulnerable enterprises such as textile and food industries, paper manufacturers and timber dealers).

Coastal Zones

Sea level is predicted to rise 20 cms from now to the year 2030, and about 60 to 100 cms to the year 2100 as a result of global warming. This problem applies to the Gulf of México because of its economic and ecological importance:

1. 70 percent of the rivers, lagoons, estuaries and coastal tropical marshlands are located in this region as well as:
2. 6 of the 10 most important fishing ports of the country
3. 3 of the 5 industrial ports of México and
4. More than 80 percent of crude oil and 90 percent of national gas production
5. The Gulf of México provides important habitats for a wide biodiversity

Results show that the most threatened zone is the Deltaic Complex of Tabasco.

National Circumstances

México's Climate

The wide climate variety of our country, going from warm to semi-cold and from humid to semi-arid, is determined by its geographic situation and its height diversity (Table 3).

Table 3. Mexico's Climate

Climate	Present-Day Surface (%)
Warm-humid	5.86
Warm-subhumid 2	3.67
Warm-subhumid 1	17.70
Semi-warm-humid	2.10
Semi-warm-subhumid 2	0.38
Semi-warm-subhumid 1	6.58
Temperate-humid	0.56
Temperate-subhumid 2	2.67
Temperate-subhumid 1	3.13
Semicold	2.31
Dry-warm	11.00
Semidry-warm	10.50
Dry-temperate	11.60
Arid-warm	6.07
Arid-semiwarm	11.37
Arid-temperate	4.72

Temperatures fall as height increases, which causes a great diversity of latitudinal temperature zones as Table 4 shows:

In the mountainous areas, windward slopes and the south and center of México, annual precipitation goes from 1500 to 3500 mm, other areas to the south get more than 610 mm. Dry conditions prevail to the north of the country, the Mexican high plateau receives less than 305 mm of precipitation annually. The driest zones can be found to the northwest on the Pacific coast, with merely 50 mm per year.

México's Population Trends

In the past years, México's population growth characteristic has been a trend to increase in absolute numbers. This tendency is expected to be maintained in the years to come: a continuous population growth in absolute numbers, but at a slower pace (Figure 2). From the point of view of regional distribution, most and least vulnerable zones can be defined according to two different variables: absolute population concentration and population density (inhabitants/km^2 rate).

Table 4. Diversity in Latitudinal Temperature Zones

Zone	Temperature (°C)	Localization
Warm Lands	22	Basin of the Balsas and the valley of Chiapas
Semiwarm Lands	18–22	East slopes of the Sierra Madre Occidental and Oriental
Temperate Lands	12–18	Mexican high plateau
Cold Lands	5–12	Areas about 1,830 m above sea level
Frozen Lands	–5	Areas about 3,650 m above sea level

Concerning population concentration, the most populated areas of the country are located in a central fringe that includes—from west to east—the states of Jalisco, Michoacán, Guanajuato, Estado de México, Distrito Federal, Puebla, and Veracruz. The states of Oaxaca and Chiapas to the south, and Nuevo León to the north can be added. In each and every one of them, more than 3 million inhabitants are concentrated; jointly, they constitute 62.2 percent of the country's total population.

Considering population density, a similar but maybe more defined vision is obtained. A big central group where the largest population concentrations by surface unit (more than 100 inhabitants/km^2) can be found stands out. The Federal District and the Estado de México are highlighted with a population density of more than 300 inhabitants/km^2, while Aguascalientes, Guanajuato, Morelos, Tlaxcala and Puebla have population densities of about 100–300 inhabitants/km^2, this way, a central fringe that goes from Colima, Michoacán and Jalisco in the west to Veracruz in the Gulf of México is completed.

Urbanization Process

A characteristic quality of urban population is its fast growth (in 1990 urban population represented 61 percent of the national population), and it increases faster than total and rural population. In this case, the definition of vulnerable areas is directly related to two variables: the fast-paced growth rhythm (growth rates) and the urban/total population percentage.

Using the urban population growth rate, is very important to identify the states with the highest population growth rhythms. The combination of high urban growth rates and high urban population percentages identifies noticeable urban concentration areas, which will be the more vulnerable to climate change. The higher urban growth rates (over 5.1 percent) are registered in the cen-

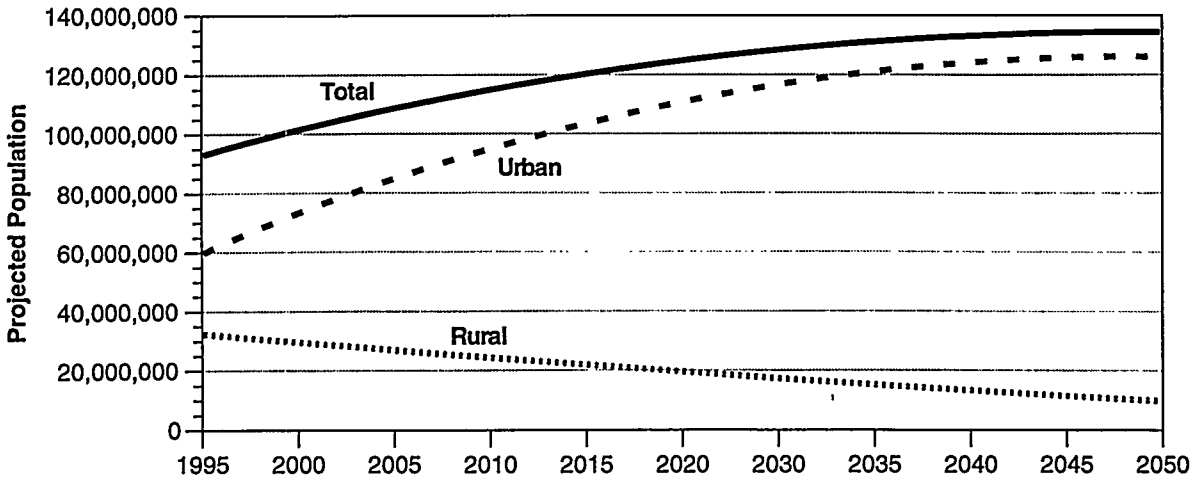


Figure 2. Projected population 1995–2050, National, Urban and Rural population

tral portion of the country, where Hidalgo, Zacatecas, Guanajuato, Querétaro, and Estado de México are located. To the south of the country, Quintana Roo, Tabasco, and Yucatán are highlighted by their high urbanization rates, as well as Oaxaca and Chiapas, showing high population concentrations in absolute numbers. In the southern zone, the state of Baja California Sur is the more vulnerable.

According to the urban/total population percentage, the largest urban concentrations (more than 60 percent of the total population) are found in some states of the central region: Jalisco, Colima, Guanajuato, Estado de México and the Federal District, as well as in all of the northern border states.

México's Natural Resources

Land Resources

The Mexican Republic areal surface (1,972,500 km^2) is divided into 15 physiographic zones:

1. The Baja California Peninsula
2. The plain of Sonora
3. Sierra Madre Occidental
4. Northern Sierras and plains
5. Sierra Madre Oriental
6. Great Northamerican plains
7. Pacific coastal plain
8. North Gulf plain
9. Center Plateau
10. Neovolcanic axis
11. Yucatan peninsula
12. Sierra Madre del Sur
13. Coastal plain of the South Gulf
14. Sierras of Guatemala and Chiapas
15. Central American cordillera

Within this vast territory, 54.73 percent of the surface is occupied by arid zones (including semi-arid and very arid zones). Due to this, it turns out that:

- There are no areas inside the country that are not affected by drought.
- Three low drought areas can be found.
- In the Pacific coast 16°–20°, drought is very intense.
- To the northwest, drought is very severe.
- In the Baja California Peninsula, to the northwest of Sonora and to the centereast of Coahuila, drought is higher.

As a consequence of this drought, erosion becomes more latent in the country, thus, hydrological erosion occurs.

Agriculture

México's soil cannot be considered suitable for agriculture, the greater part of it (59.6 percent) is not suitable for rainfed corn production, which is one of the main crops of the country; 32.8 percent is moderately suitable, and only 7.6 percent can be considered suitable. Nevertheless, it is one of the country's most important activities, since the largest part of the working population (5,300,114 inhabitants) is involved in corn production (Table 5).

Woods

As a result of México's wide climate diversity, it has a very varied vegetation, 18 life zones have been identified going from humid woods to tropical and subtropical deserts (Table 6).

Table 5. Sown Surface and Agricultural Production, 1993

Seed	Sown Surface (thousand ha)	Sown Surface (%)	Production (thousand tons)	Production (%)
Rice	61	0.55	159	0.68
Bean	2,021	18.28	1,092	4.71
Corn	8,079	73.08	18,309	78.98
Wheat	894	8.08	3,621	15.62
Total	**11,055**	**100.00**	**23,181**	**100.00**

Table 6. Mexico's Life Zones

Life Zone	Surface (%)
Subhumid Temperate Cold Wood	1.78
Humid Temperate Cold Wood	0.53
Desertic Temperate Warm Brushwood	0.73
Temperate Warm Thorny Steppe	5.99
Dry Temperate Warm Wood	4.04
Subhumid Temperate Warm Wood	0.55
Subtropical Desert	7.10
Subtropical Desert Brushwood	7.55
Subtropical Thorny Wood	21.76
Subtropical Dry Wood	20.35
Subtropical Subhumid Wood	5.27
Subtropical Humid Wood	1.35
Subtropical Rainy Wood	0.00
Tropical Desert	0.13
Tropical Desert Brushwood	1.02
Tropical Thorny Forest	1.01
Tropical Very Dry Wood	4.03
Subhumid Tropical Wood	4.40
Tropical Dry Forest	12.41
Tropical Humid Forest	0.00

Hydrology

Our country is divided in 12 hydrological zones, placed from south to north, Zone II having the highest precipitation levels, followed decreasingly by Zone III, Zone VII, Zone IV, and Zone I. México's main rivers are:

1. Río Bravo
2. Río Grijalva
3. Río Usumacinta
4. Río Coatzacoalcos
5. Río Pánuco
6. Río Balsas
7. Río Lerma-Santiago

Energy Resources

México's large fossil fuel resources are predominantly oil and natural gas. Total reserves in 1995 were 63,200 million barrels of oil equivalent: 79 percent crude oil and condensates, 21 percent natural gas—mostly associated (68.4 Bcf). Heavy crude constitutes an estimated 42 percent off the reserve. Coal reserves amount only to 662.9 million tonnes.

The current evaluated hydroelectric potential amounts to a generation capacity of 82,319 GWH, of which only 34 percent is presently exploited. It is estimated that this production level could be doubled.

The geothermal resource is significant, with 500 sites identified. Proven reserves amount to a power capacity of 1,080 megawatts, which could be doubled by the year 2000.

There are 10.6 thousand tonnes of identified uranium reserves. The country has been little explored.

The abundant availability of hydrocarbons will make them the predominant energy source in México for a long time.

[*Source:* Programa de Desarrollo y Restructuración del Sector de la Energía 1995–2000, Secretaría de Energía.]

México's Economy

Government and the Market Economy

Public-sector participation in the GDP had climbed from 15 percent in 1975 to as much as 25 percent in 1983, not counting oil revenues. Since then, the government's presence in the economy has been on a steady decline, dropping to 17 percent by 1990. Changes in the composition of the external sector also indicate rising private-sector participation in the economy.

In 1990 private enterprise accounted for 85 percent of all import spending (up from 60 percent in 1981) and 60 percent of exports (up from 18 percent in 1981). In 1990 the private sector supplied 80 percent of the employment and 75 percent of production in México. For the same year, private-sector investment represented 72 percent of total investment, with the public sector accounting for the balance.

During president Carlos Salinas' administration, the privatization of state enterprises formed one part of the government's program to promote private business. Other measures included the withdrawing of state monopoly rights from such sectors as the paper industry, communications and road construction. In addition, the state deregulated agricultural commodities, petrochemicals and trucking.

While applauding these market-oriented reforms, right-wing critics charged that Salinas did not go far enough to rid México of the development state and open the way for a totally market-based economy. They lobbied for the substantial modification of Articles 25 through 28 of the constitution, which define the state's

role in "strategic" and "primary" industries. Also enshrined in the constitution is the concept of *rectoría*, which obligates the state to "plan, conduct, coordinate, and orient all national economic activity."

State-run firms received nearly $3.3 billion in government subsidies in 1990. More than 90 percent of these subsidies were concentrated in just five companies: the National Staple Products Company (CONASUPO), the Federal Electricity Commission (CFE), the Mexican Institute of Social Security (IMSS), the Mexican National Railroads (FERRONALES), and the Mexican Fertilizer Company (FERTIMEX). It would be unfair, however, to call state enterprises inefficient simply because the are not profitable and drain the government's budget. CONASUPO was established not to make profit but to distribute food at subsidized prices to the poor and to buy from small farmers at guaranteed prices. Similarly, the electricity company has a history of extending electric wires into rural areas, not because it is profitable but as a public service.

Composition and Growth

Starting from 1940 and up to the 80s, the Mexican economy grew at a sustained annual average rate of better than 6 percent. During this same period, the country registered the birth of its industry, and the economy worked following the "importation substitution" model.

In the mid-seventies, some structural economic problems—that portended the exhaustion of the economic model—began to be noticed. Nevertheless, the important oil field discoveries made from 1972 on, and the high prices of hydrocarbons in the world market because of the oil crisis of 1973, gave a big push to México's economy, thanks mainly to the revenues obtained from crude oil exportation. Under these conditions, the GDP kept up a high growth rate, while the government contracted a big public debt.

The fall of oil prices in the late 70s and early 80s made the Mexican economy fall into a crisis that exploded in 1982, when the peso suffered an important devaluation and México almost had to declare itself insolvent to pay its debts.

During the 80s, with a growing inflation rate, the country became immersed in a deep crisis, with average growth rates of less than to 2 percent. It was then that the government adopted a new economic model based on a larger opening to the external markets and a hurried retreat of the public sector from direct productive activities, leaving the operation of the internal economy to the free game of the market's forces.

In the process, México entered the GATT, signed the NAFTA with the United States of America and Canada and joined the OECD. All these has made the economy more dependent on the behavior of the global economy.

Under these circumstances, in an atmosphere not quiet favorable and an difficult internal situation with: low internal saving rates and productivity; increasing unemployment, reduced income levels; a very important hidden economy that, it seems, cannot continue growing without harming the formal economy; deteriorated educative and training programs and a poor scientific and technological development; in addition to the aggravation of the crisis resulting from the late 1995 devaluation of the peso; it seems impossible for the national economy to grow again at high rates.

If an economic depression scenario is set forth for the remainder of the century—a situation very likely to happen—in the year 2000 the GDP would be equal or inferior to that of 1990, in the year 2010 it would be scarcely superior to the latter, and for 2025 it would double it, staying far behind from the expected for developing countries (Figure 3).

A division of the GDP's evolution by main economic activity from 1980 to 1993 shows that the most participative and dynamic sector of the economy is the tertiary, represented by services and commerce, followed by the manufacturing sector, with a growth rate slightly inferior, while the agricultural, mining and construction sectors are almost bogged down. In 1990, the tertiary sector represented the 61.3 percent of the GDP; the secondary represented 30.7 percent and the primary, 8 percent.

As can be seen in Table 7, the growth trends favors, in the first place, the secondary sector, and in the second place, the tertiary, whilst the primary sector is expected to continue reducing its participation in the GDP.

For its part, the manufacturing industry specifically shows as its most important sectors—taking into account their share of the manufacturing GDP—the food, metal-mechanic, machinery and equipment and the chemical and petrochemical industries.

México's Energy Production and Consumption

Table 8 details the national energy balance for the years 1990 to 1993.

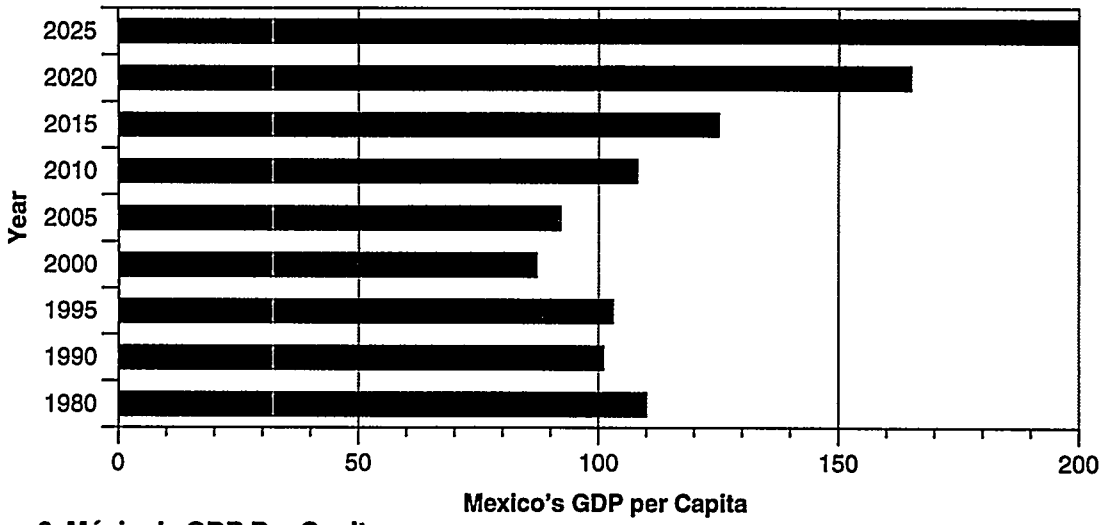


Figure 3. México's GDP Per Capita

Energy Production

Hydrocarbons dominate the primary energy production in México—in 1994, 90.7 percent. About half the oil production (2,685 thousand barrels per day in 1994) is currently exported. Energy production is complemented with biomass (3.7 percent—fuelwood and bagasse), hydro, nucleo and geo electricity (3.6 percent) and coal (2 percent).

Except for very brief periods when net imports occurred—the last one between 1970 and 1974—México's production had been sufficient to supply the internal demand. The large oil discoveries in the seventies made México a major producer and exporter.

Until 1970 power generation was dominated by hydroelectricity, but its relative importance started to decline steadily versus the hydrocarbon based thermal generation. In an effort to diversify, coal, nuclear, and geothermal generation were introduced, in addition to more hydroelectric developments. Nevertheless, their aggregate participation decreases from 29 percent in 1960 to about 9 percent today. In 1993, the structure of the thermal generation was fuel oil (65 percent), gas (14.7 percent, coal 10.5 percent), geothermal (4.8 percent), nuclear (3.9 percent), and diesel (1.1 percent).

Table 7. GDP by Economic Sector (%)

Year	Primary Sector	Secondary Sector	Tertiary Sector
1980	8.2	32.8	59.0
1990	8.0	30.7	61.3
1995	6.9	33.4	59.6
2000	5.2	35.2	59.6
2005	4.7	35.6	59.7
2010	3.9	36.4	59.7
2015	3.6	36.6	59.8
2020	2.9	37.3	59.8
2025	2.6	37.5	59.9

Source: Banco de México

Energy Consumption

The availability of oil and gas has certainly influenced the pattern of development throughout the years. In 1994, hydrocarbons accounted for 85.6 percent of the total internal primary energy supply. The energy sector, oil industry, and power generation, retained 30 percent.

The total internal energy supply (Figure 4) shows an accelerated increase between 1976 and 1981 over the earlier trend. It levels off during the following four years, to apparently resume afterwards the growth trend existing prior to 1976. This behavior reflects the development of the oil production capacity up to 1982, the acceleration of the economy due to the oil boom and the ensuing stagnation due to the economic crisis from 1982 on.

Table 8. Mexico: 1990–1993 National Energy Balance

Energy supply	1990		1991		1992		1993	
	10^{15} cal	%	10^{15} cal	%	10^{15} cal	%	10^{15} cal	%
Domestic Production								
Hydrocarbons	1,850.52	87.44	1,913.84	86.82	1,907.61	85.02	1,907.73	85.35
Biomass (bagasse and fuelwood)	89.85	4.25	92.18	4.18	91.22	4.07	93.45	4.18
Hydraulic	60.16	2.84	55.58	2.52	65.87	2.94	65.48	2.93
Coal	35.64	1.68	32.36	1.47	30.06	1.34	32.54	1.46
Geothermal	13.21	0.62	13.90	0.63	14.65	0.65	14.67	0.66
Nuclear	7.42	0.35	10.97	0.50	10.00	0.45	12.68	0.57
Subtotal Domestic Production	**2,056.89**	**97.19**	**2,118.83**	**96.12**	**2,120.41**	**94.46**	**2,126.55**	**95.14**
Imports	62.23	2.94	88.10	4.00	115.91	5.17	101.86	4.56
Inventory Changes	(2.82)	(0.13)	(2.62)	(0.12)	8.37	0.37	6.67	0.30
Exports	(756.11)	(35.73)	(804.86)	(36.51)	(816.62)	(36.40)	(831.40	(37.20)
Others (spills, flaring . . .)	(34.26)	(1.62)	(40.05)	(1.82)	(43.91)	(1.96)	(41.76)	(1.87)
Total Internal Energy Supply	**1,325.93**		**1,359.40**		**1,383.15**	**1,361.91**		
Energy Consumption								
Transformation								
Oil Sector	190.05	14.33	184.12	13.54	187.36	13.56	157.28	11.55
Electric Sector	214.08	16.15	219.94	16.18	222.28	16.09	227.86	16.73
Coke	1.47	0.11	1.59	0.12	1.52	0.11	1.46	0.11
Transformation Subtotal	405.60	30.59	405.65	29.84	411.16	29.77	386.59	28.39
End Use								
Industrial[a]	390.97	29.49	395.12	29.07	398.37	28.84	388.92	28.56
Transport	320.60	24.18	342.01	25.16	345.06	24.98	352.82	25.91
Residential and Commercial	181.88	13.72	189.19	13.92	199.77	14.46	206.05	15.13
Others	26.89	2.03	27.37	2.01	26.91	1.95	27.52	2.02
End Use Subtotal	**920.33**	**69.41**	**953.75**	**70.16**	**970.11**	**70.23**	**975.31**	**71.61**
Total	**1,325.93**	**100.00**	**1,359.40**	**100.00**	**1,381.27**	**100.00**	**1,361.91**	**100.00**

Note: Figures between parenthesis represent negative values.
[a]Includes energy uses and feedstocks.

The same combined oil boom and economic crisis "hump" is seen in the behavior of the GDP. Figure 5 shows the relative growth indicators of internal energy supply and GDP, as well as the energy intensity, which is seen to increase over the period. It is 30 percent higher than what is achieved in Western Europe.

Consumption in the Energy Sector. The evolution of the energy consumption is shown in Figure 6. It is seen that since 1990 power generation has overtaken the oil sector, which grew rapidly during the development in the seventies but then leveled as an oil production plateau was established.

Electricity demand is expected to continue to increase steadily, in response to population growth and a resumed economic growth. The participation of independent power producers, as well as the development plans of the state power company, side mainly with the use of more fossil fuels although there are some hydro and geothermal projects. Thus emissions will increase, however

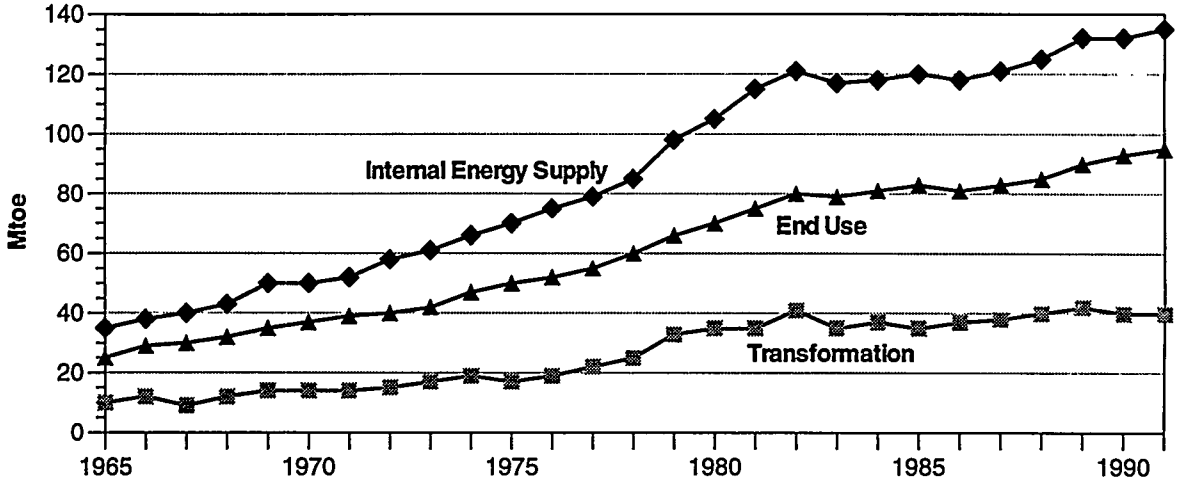


Figure 4. México: Internal Supply, Transformation and End Use

somewhat mitigated by the stated policy of substituting natural gas for fuel oil in order to meet environmental standards.

End Use Energy Consumption. Figures 7 and 8 exhibit the consumption by sector and by fuels. Most significant is that the transport sector has become the prime consumer, with the ensuing growing consumption of gasoline.

- **The Industrial Sector.** Up to 1979 the industrial sector was the leading consumer of end use energy. The industrialization process resulting from an import substitution policy, led to an average annual growth rate of energy consumption of eight percent between 1970 and 1980. As a consequence of the 1982 economic crisis, the growth rate slowed down to 1.4 percent up to 1988 and then increased to 2.1 percent from 1989 to 1993.
- **The Transport Sector.** Oil products are almost exclusively the energy source for this sector. They are used in a rather inefficient manner, with serious environmental impacts, especially in the large urban areas. The sector's development has favored road transport (it now accounts for 91.6 percent of the energy consumed), weakening the position of railroads and effectively halting their expansion during the last

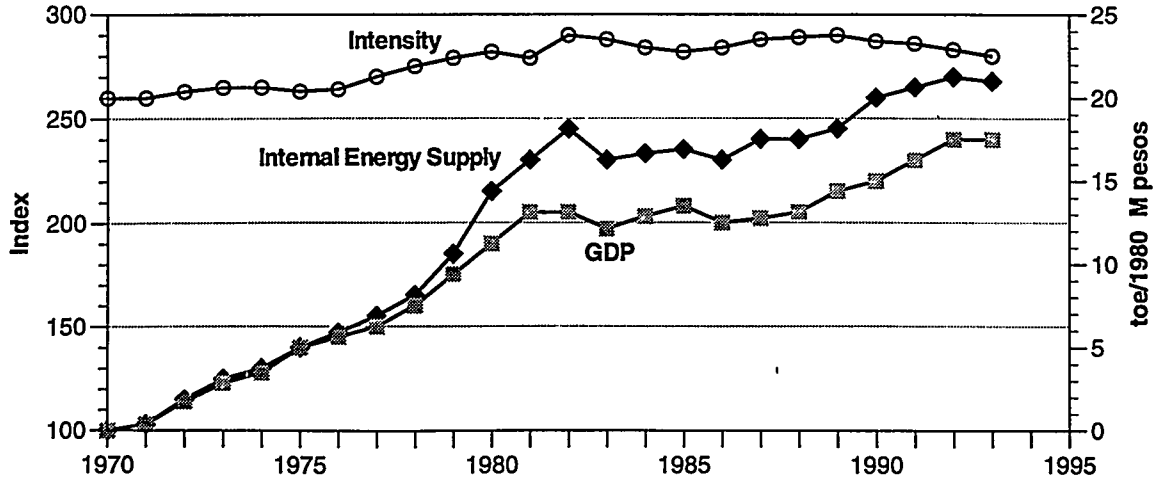


Figure 5. México: Energy consumption and GDP growth index; Energy intensity

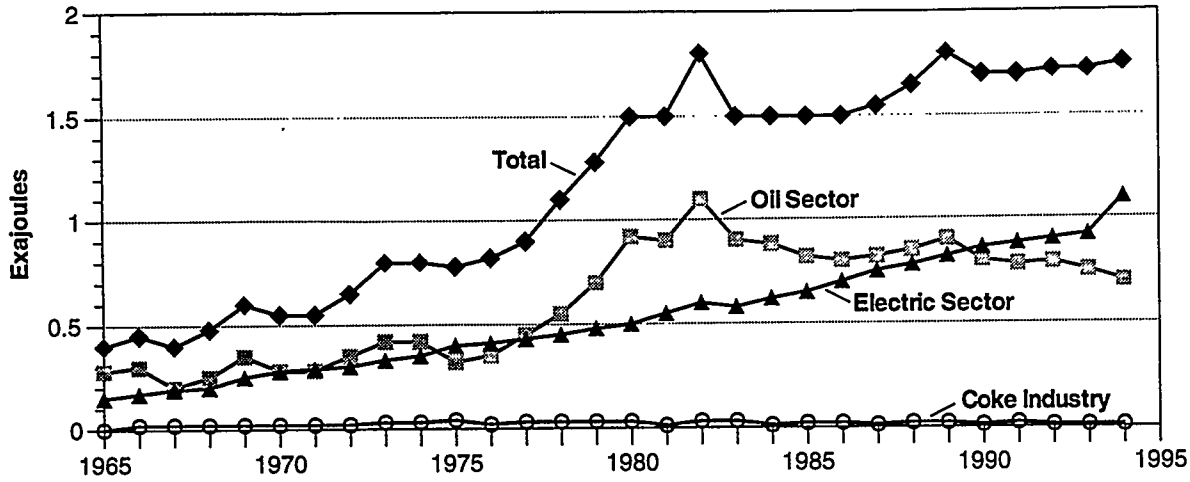


Figure 6. México: Energy Sector; Energy Consumption

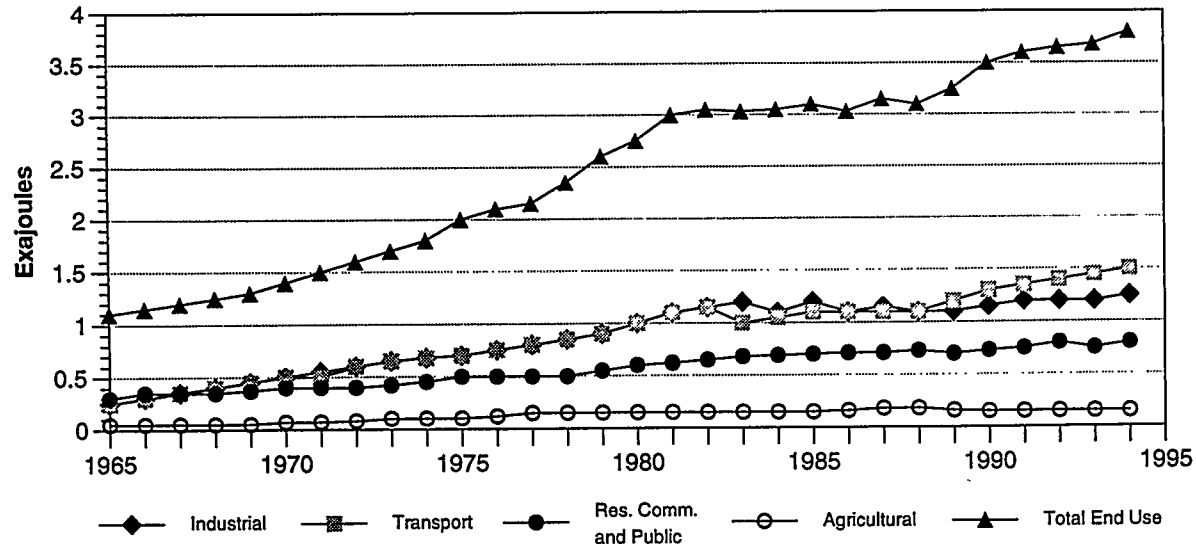


Figure 7. México: End Use Energy; Energy Consumption by Sector

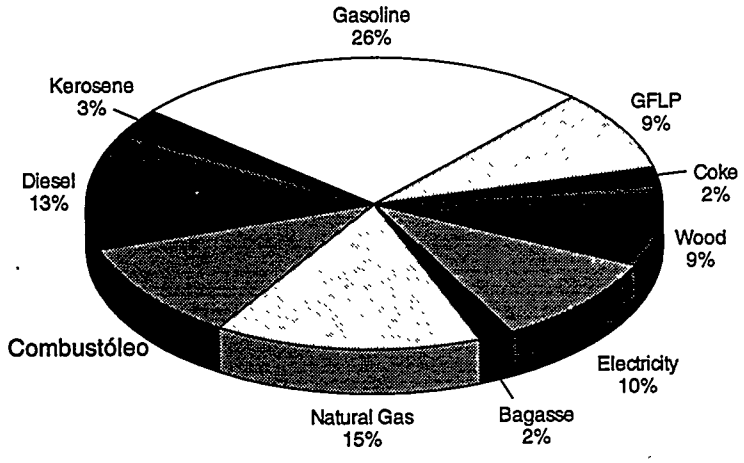


Figure 8. End use energy consumption by Source

43 years. Total consumption for transport went from 27.3 percent of the end use consumption in 1965 to 39.8 percent in 1993. This represents an average annual growth of 6.1 percent.

- **The Residential, Commercial and Public Sector.** As a whole, it is the third largest end use consumer, the most important part being the residential consumption. This has been growing steadily due to the overall population growth and the continued shift in its structure from rural to urban—the ratio of urban to rural population has gone from one in 1960 to almost three in 1993. Urbanization has resulted in a leveling of the consumption of fuelwood against a growth in the use of commercial energy, mainly LPG and electricity.
- **The Agricultural Sector (Farming, Livestock and Forestry).** This sector is the least demanding of the energy consuming sectors. Its share of the final energy consumption went from 4.1 percent in 1965 to 2.6 percent in 1993; the average annual growth in this period was 2.9 percent. Diesel and electricity are the main energy sources.

México's Governing Institutions

México's population is subject to two hierarchies or government levels: The Federal Government, which has authority over all of the inhabitants of the national territory, and the Local or State Governments, that only can exert its authority inside the limits of each component federative entity. State governments are also divided into Municipal governments.

The Mexican constitution indicates that the supreme power of the Federation is divided in its exercise of Legislative Power, Executive Power and Judicial Power. This power division is completed by its balance, which is achieved by means of a limitation and control system that the powers apply to each other (Figure 9).

The Legislative Power

This power, denominated Congreso de la Unión or General has as its main function the creation of laws. It is composed by two collective or collegiate bodies called Cámara de Diputados and Cámera de Senadores, in which lies the execution of the above mentioned function. Every resolution taken by the Congress has the nature of Law or Decree. The functions of The Congress clarify even more the idea of balance and control between powers, since the President (Executive Power) requires the Congress to lay down the laws, and vice-versa. Furthermore, the action of the President is controlled by the auditing of the expenses account and the obligation of presenting an annual report.

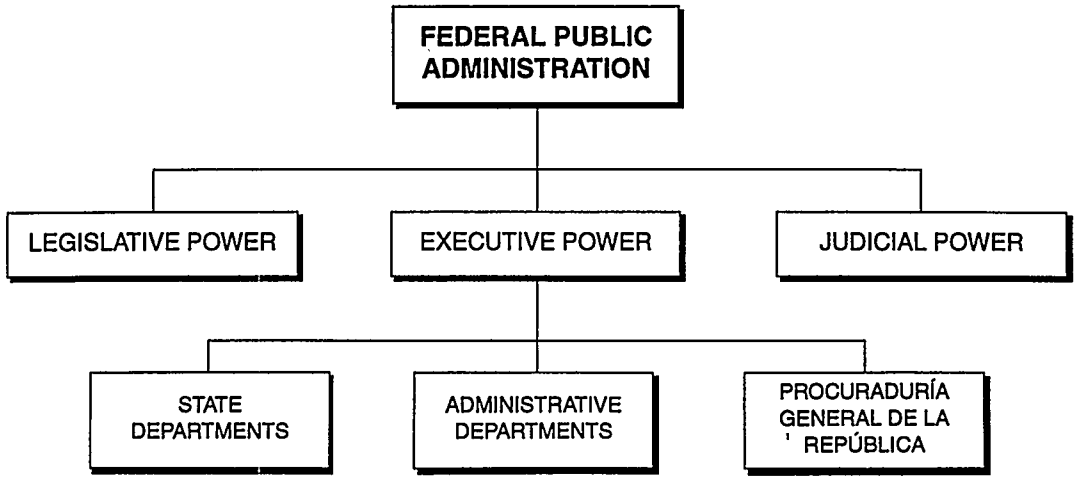


Figure 9. México's Governing Institutions

Executive Power

The Mexican Constitution places in the President of the United States of México the exercise of this power. The activity of the President tends to promote and protect the interests of the State and the people, executing the respective laws and looking after its observance. State Departments are established in the constitution as parts of the organization of the executive power. They are determined in the Organic Law of the Federal Public Administration. Their function is, generally speaking, to attend to the development and fulfillment of the public, interest.

The law establishes in article 32 the functions to be fulfilled by the Secretaría de Medio Ambiente, Recursos Naturales y Pesca (SEMARNAP). Amongst them, to promote the protection, restoration and conservation of the ecosystems and natural resources of the country by creating and applying the national policy on ecology, a clean environment (saneamiento ambiental), water, environmental regulation of urban development and fishery development stand out.

Climate Change is specifically mentioned in the XVI fraction of this article: "(It is responsibility of the Secretaría de Medio Ambiente, Recursos Naturales y Pesca to look after the following subjects: . . .) To conduct the national policy on climate Change and the protection of the ozone layer."

Judicial Power

The Judicial Power works through the Suprema Corte de Justicia, the Tribunales Colegiados de Circuito, the Tribunales Unitarios de Circuito, the Juzgados de Distrito and the Jurado Popular Federal. To make easier the execution of their functions in some subjects, the Tribunales Locales, located in every federative entity, act as assistants of these authorities of the Federal Judicial Power. The action of this power has as purpose to put into effect the law, in order to do so, it has the capacity to watch its observance by the private civilians as well as by other authorities, the balance between authorities being maintained this way.

Mexico's Policies Related to Climate Change

Energy Policies

The growing concern over the deterioration of the environment has given rise to policies, actions and a legislative package in the last few years. The framework is provided by the 1988 General Law of Ecological Equilibrium and Environmental Protection. Without being specifically directed towards the climate change issue arising from the increasing emissions of greenhouse gases, they have already resulted in a certain moderation of some of these emissions, through their influence on the energy policy.

Indeed, the environmental standards legislated have set stringent limits on the emissions of SO_2, NO_x, CO, particulates and particular, with a certain range according to the type of end user and the geographical location; in this respect the country is divided into "critical zones," "zones with sociopolitical sensitivity" and "zones of potential restriction." To comply with this, energy policy has been directed to the improvement of the fuels supplied for internal combustion, to the substitution of natural gas for fuel oil and to promote energy savings and the efficient use of energy.

The major emphasis has been on the reduction of the sulfur content in the different fuels, arising from the heavy crude processed, and on the introduction of unleaded gasoline; this is in order to support the decree that made compulsory the catalytic converter in all new automobiles sold from 1991 on. In addition, oxygenate compounds are added to the gasolines sold in the critical areas.

In the context of the GHG issue, these measures have already resulted in a reduction of the emissions of CO and NO_x below the acceptable standards in the Metropolitan Area of México City, where about 25 percent of the country's commercial energy is consumed.

The stated policy of achieving a 70 percent shift from fuel oil to natural gas in the power and industrial sectors consumptions will represent, at the consumption levels of 1993, a CO_2 emission reduction of 3.8 million tonnes of carbon equivalent to about four percent of the current emission level.

Greenhouse Gas Inventory

Central to any study of climate change is the development of an emission inventory that identifies and quantifies a country's primary sources and sinks of greenhouse gases. The inventory process is important for two reasons:

1) It provides a basis for the ongoing development of a comprehensive and detailed methodology for estimating sources and "sinks" of greenhouse gases
2) It provides a common and consistent mechanism that enables all signatory countries to the United Nations' Framework Convention on Climate Change to estimate emissions and to compare the relative contributions of different emission sources and greenhouse gases to climate change.

Moreover, systematically and consistently estimating emissions at the national and international levels is a prerequisite for evaluating the cost-effectiveness and feasibility of pursuing possible mitigation strategies and adopting emission-reduction technologies.

Recent Trends in México's Greenhouse Gas Emissions

Carbon Dioxide Emissions

In 1990, total carbon dioxide emissions have been calculated both in a top-down (433.721 TG) and in a bottom-up (398.425 TG) fashion. The most important source is the energy sector (275.02 bottom-up; 310.316 top-down) (Figure 10).

Other industrial processes and sources of CO_2 such as grassland and agricultural waste burning for agricultural soils shall be included in the next update of the inventory. Nevertheless, at this stage of the national inventory, the main sources are evident; therefore, mitigation analysis may be performed.

The Energy Sector

Fossil fuels constitute 90 percent of the internal energy supply in México. Biomass contributes almost six percent. Total emissions of CO_2 from the combustion of these fuels have been around 90 million ton C per year in the last few years. This is shown in Figure 11, where the contributions by sectors are also plotted (note the logarithmic scale).

The per capita contribution has been of the order of one ton C per inhabitant during the period 1980–1993.

The transport sector is seen to be the leading emitter since 1965. Except for a very minor electricity consumption, it depends completely on oil products. The power sector has had the largest increase rate, as a consequence of the rapid growth of fossil fuel thermal generation. It presently occupies second place, slightly ahead of the industrial sector. PEMEX's contribution leveled and even decreased slightly after 1982 as a production plateau was established, exploration activities were reduced and refining and petrochemical production increased slowly.

The residential and the commercial sectors increase their contribution steadily, the last one to catch up was the agricultural sector.

It should be noted that the use of biomass, namely non commercial fuelwood, hardly increased its contribution throughout the period. This is due to the urbanization process and the increased penetration of commercial fuels and electricity in the urban areas.

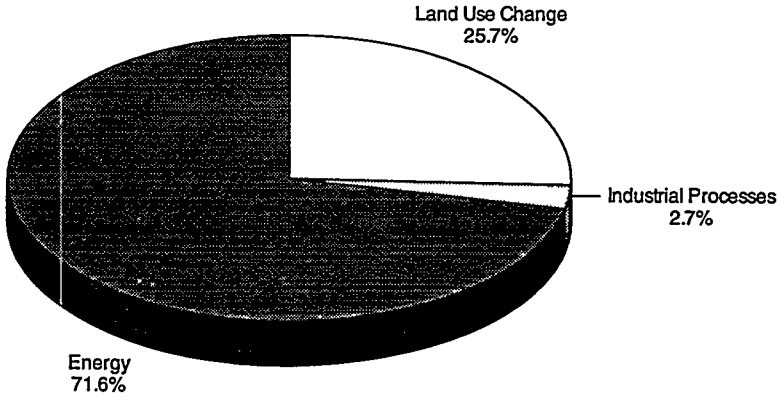


Figure 10. Carbon Dioxide Sources

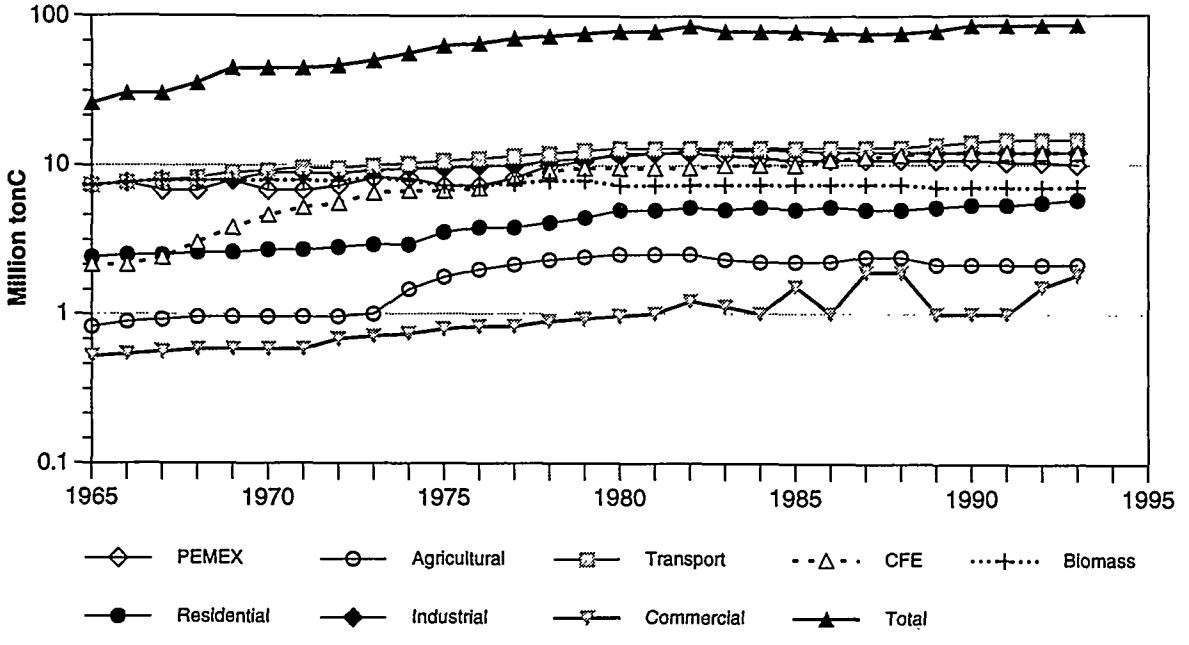


Figure 11. México: Historical Emissions of CO_2, 1965–1993

Industrial Processes

Cement Production. The non-energy CO_2 emissions due to cement manufacturing amounted to 3.5 MtonC in 1993. The average value in the three previous years was 3.2 MtonC. The values are not included in Figure 11.

Changes in Forest Management and Land Use

When humans use and alter the biosphere through changes in land use and forest-management activities, they alter the natural balance of trace-gas emissions and uptake. These activities include clearing an area of forest to create cropland or pasture, restocking a logged forest, draining a wetland, or allowing a pasture to revert to a grassland forest.

Mexico's Preliminary National Inventory of Greenhouse Gas includes a study based on an in-depth review of the existing information on forest cover, deforestation rates, areas afforested or currently regrowing, as well as on forests' carbon-related biological characteristics. The analysis covers tropical-evergreen forests, deciduous forests, deciduous-temperate-coniferous forests, broadleaf-closed forests, and open forests.

Two estimates, high and low, are derived about greenhouse gas emissions from land use change. The high deforestation rate, implies that 820,000 ha were deforested and affected by forest fires in 1990. The low deforestation is estimated at 37,000 ha/year.

The analysis indicates that net emissions from forestry and land use changes reach between 9.3 and 30.5 MtonC (Figure 12) (million tons of carbon), depending on the assumed deforestation rates.

Methane Emissions

Methane is a greenhouse gas with (on a molecular basis) a twentyfold warming potential larger than carbon dioxide. Agriculture is the largest source of it with a share of 48.49 percent (1.88 Tg), followed by fugitive emissions from oil industry and a small portion from coal mining contribution with 26.65 percent (0.969 Tg), waste accounts for the 13.51 percent (0.551 Tg), fuel contribution adds a 6.31 percent and finally, land use change adds a 5.00 percent.

Landfills

In México, landfills contribute 0.468 Tg which represent 12.34% of methane emissions in the country. Of

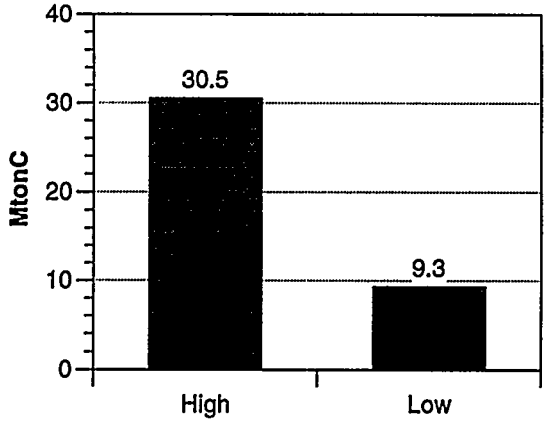


Figure 12. Carbon Dioxide emissions from above-ground burning depending on two different deforestation estimates

these, 41.6% are concentrated in the Federal District, the remaining 58.4% is distributed in the rest of the country, but again is concentrated in the next major cities.

Agriculture

Greenhouse gas emissions from agriculture (not including energy use) arise mainly from manure and enteric fermentation of livestock (1.85 Tg of methane), specific crops (35 Gg of methane from rice paddies), use of fertilizers (5.55 Gg of N_2O) and a family of greenhouse gases from the prescribed burning of on-site crop refuses. Only methane from livestock and rice paddies and nitrous oxide from use of fertilizers are reported. Other gases and sources will be included in the next release of the inventory.

Fossil Fuel Combustion

Historical emissions of NO_x are shown in Figure 13 (logarithmic scale). In 1993, they amounted to 1.89 Mton. The main contributor is the transport sector, followed by the industrial sector, the power and the oil sector.

Mitigation: The Action Plan

Carbon Dioxide

Energy-Demand Strategies

Efficient use of energy is the most cost effective strategy to mitigate GHG emissions from the energy system. Although present in the country's official energy plans since 1976, until recently no nationally structured effort for investment was directed towards this goal by the public sector, which is responsible for the energy supply and management by constitutional mandate. Historically, the energy sector had been systematically oriented to meet the naturally increasing demand of a developing country, without being concerned about managing the increase in demand.

A limited effort in demand management was instituted in 1979 by the public utility Comisión Federal de Electricidad, by offering information to consumers on energy savings. This program was strongly reinforced by the creation of another instance in 1988, the Trust Fund for Energy Saving of the Electric Sector (FIDE).

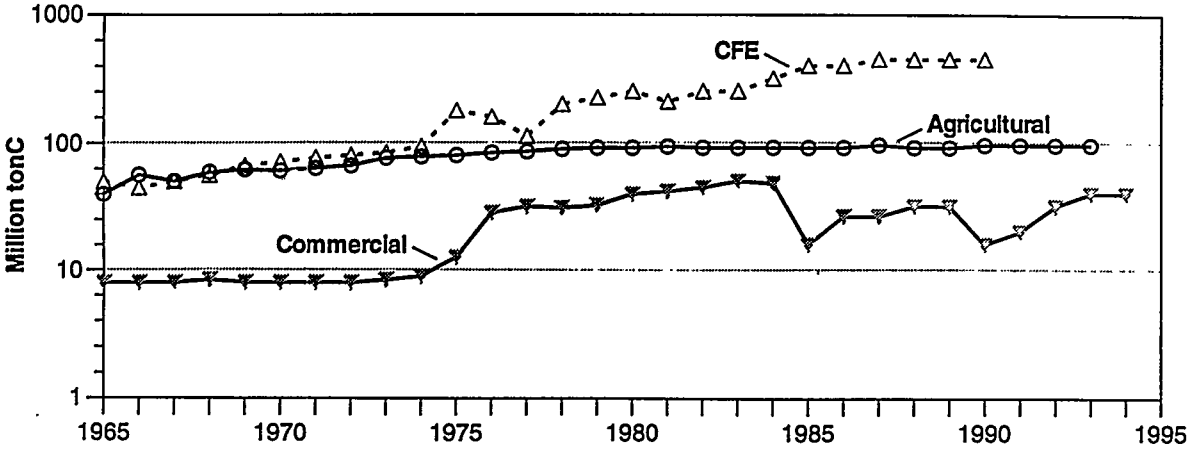


Figure 13. México: Historical emissions of NO_x, 1965–1993

Through it, funds are provided to induce industry and business to develop electricity saving schemes and demonstration projects.

In 1989 the National Commission for Energy Saving (CONAE) was created by presidential decree as an intersecretarial organization in charge of implementing rational use of energy programs. One of its main tasks is the development of the Mexican Standards of Efficiency that the laws relating to energy have made mandatory. These standards will cover both industrial and end use (appliances) equipment. At present ten standards have been enacted.

Energy-Supply Strategies

The strategy in the energy supply that will have a strong impact on GHG emissions is the substitution of natural gas for fuel oil in the main consumer sectors, namely, industry and the power sector.

A wider perspective for the use of natural gas has been opened by modifying the law regulating the oil industry, to allow private participation in the transport, storage and distribution of natural gas. This will certainly promote its use in the residential and commercial sectors.

Another aspect arises from the modification of the regulatory law of the electric sector, aimed at facilitating and promoting cogeneration systems both for self-supply in industry and for independent power production for the national network. Cogeneration, as a mechanism that increases the efficiency in the use of fuels, contributes to moderate the growth in GHG emissions. A study by CONAE concludes that by the year 2003 cogeneration could supply between 4200 MW and 11,000 MW, in a low and high scenario, respectively.

Joint Implementation

The aim is to return developed countries and countries in transition individually or jointly to their level of emissions of 1990 by the year 2000. Although the meaning of jointly in the context of art. 42 of the Convention refers to countries belonging to Annex 1, after the Conference of the Parties of Berlin, the concept of Joint Implementation was extended to include countries not belonging to Annex 1. A pilot phase extending to the year 2000 was established to try and experiment with projects involving developed and developing countries.

The incentive for joint implementation lies in the difference between incremental costs of GHG abatement in developed and developing countries. Incremental costs will be much higher in the former than in the latter. As such, the same amount of money invested in a developing country would produce much larger reduction of emissions (mitigation) than in a developed nation. The question of sharing these reductions is being debated in different forums and entails consideration of concepts like differentiated responsibilities, equity, etc. The matter of crediting such reductions—that, the possibility of subtracting the reductions from a country's GHG inventory—has been postponed until after the year 2000, when it is assumed that general criteria for joint implementation will have been tested.

Joint Implementation programs would greatly facilitate reductions in both developed and developing countries, as well as any further reductions beyond the year 2000, as investing in GHG reduction measures in developing countries could significantly reduce the costs of these efforts.

México has been working toward satisfying its commitments to the Convention through a very ambitious project involving the preparation of the National Inventory of Greenhouse Gases. Assistance has come from the U.S. Country Studies Program, UNEP and GEF-WB. The project has reviewed future emission scenarios involving different assumptions about growth, control measures, changes in technology, etc. Studies have been carried out to assess the vulnerability of the country to climate change.

Research and Public Education

Atmospheric Constituents Important to Climate Change

While human activities have long influenced a community's local environment, over the past few decades observations of increasing concentrations of greenhouse gases and aerosols in the atmosphere have shown that human activities are significantly influencing the global environment. Reconstruction of past climate change, analyses of volcanically induced changes in recent years, and theoretical models suggest that the changes in atmospheric composition will lead to global warming. The measured rise in global temperatures, however, is less than and different in timing from the rise expected from greenhouse gas increases alone, suggesting the additional influence of sulfate aerosols, ozone depletion, and other factors. These complexities emphasize the importance of understanding all human influ-

ences, as well as the natural variations that may be either offsetting or enhancing the warming that is expected from greenhouse gases in both the short and the long terms.

Carbon Dioxide. The atmospheric concentration of carbon dioxide has increased by about 30 percent since preindustrial times. This increase is responsible for more than half of the enhancement of the trapping of infrared radiation due to human activities. Over the past two ears, there has been an apparent pause in the rate of increase in CO_2 concentrations. It is speculated that enhanced sinks for carbon are responsible for the recent slowdown, but the exact cause remains unexplained. Lately, the rate of increase appears to be returning to prior rates observed in the 1980s.

Recent evidence suggests that in the short term, at least, the CO_2 sinks provided by lands in the temperate zone may be larger than previously thought. Anomalies in the surface temperature and precipitation may have allowed terrestrial ecosystems to accumulate more carbon during 1991–93 than normally would have been the case. New research is ongoing to monitor CO_2 exchange between the atmosphere and vegetation and soils.

Chlorofluorocarbons. Because CFCs destroy lower stratospheric ozone, which is also a greenhouse gas, the net effect of CFCs as greenhouse gases is less potent than previously believed. The indirect offset of the hydrochlorofluorocarbon substitutes, however, may be smaller than that of the CFCs. Observations show the rate of increase of CFCs in the atmosphere to be slowing, consistent with international emission controls. Stratospheric ozone depletion, however, continues because of the long residence time of CFCs in the atmosphere. And in 1993, the observed springtime ozone depletion in the Antarctic was the largest ever recorded. Because the depletion of ozone in the lower stratosphere has a negative radiative-forcing effect on the climate system, characterization of these ozone trends and processes is a requirement for improved understanding and interpretation of surface temperature trends.

Very-Long-Lived Greenhouse Gases. Laboratory and modeling studies have shown that the lifetimes of fully fluorinated ("perfluorinated") carbons (PFCs)—potent greenhouse gases—exceed millennia. Understanding the chemistry and lifetimes of PFCs (such as CF_4, C_2F_6, C_6F_{14}) is critical to predicting climate change, because some have been proposed as CFC substitutes, while others are emitted as trace products of industrial processing, including aluminum production.

Methane. The atmospheric lifetime of methane—an especially potent greenhouse gas—has recently been determined to be 25 percent longer than previously thought, which raises its global warming potential. However, following the guidelines set by the Intergovernmental Negotiating Committee (UNINC 1994), México uses the 1990 IPCC global warming potential values in its emissions inventory.

Over the last few years, the rate of increase of atmospheric methane has slowed. In 1992, the rate of increase was sharply reduced, but current measurements indicate that the rate of increase of atmospheric methane is returning to the earlier values measured before the slowdown. Continued research is planned to understand whether the reduced rate was due to decreased human emissions or to an enhancement of sinks.

Ozone. Calculations suggest that increases in ozone in the upper troposphere substantially augment radiative forcing. Field measurements have shown that a significant amount of tropospheric ozone over the temperate north Atlantic Ocean is derived from transported emissions of North American precursors (nonmethane hydrocarbons and reactive nitrogen compounds). Although the precursors of tropospheric ozone are increasingly being controlled in industrialized countries, more research is necessary to understand the global contribution of tropospheric ozone to radiative forcing.

Aerosols. Emissions into the atmosphere of aerosols (airborne particles or collections of particles) and of gases that chemically react to form aerosols can have direct effects both on the global radiation balance and on global atmospheric chemistry. These direct effects can then have subsequent effects on climate and surface radiative fluxes (e.g., of ultraviolet radiation), which could offset and mask a portion of the greenhouse warming.

Research on the radiative effects of sulfate particles formed in the lower troposphere, mainly as a result of emissions from coal and oil combustion and from industrial processes, is important to understanding whether they may be counterbalancing the enhanced greenhouse warming of carbon dioxide, as hypothesized. For aerosols emitted by biomass burning, the effect is less certain and depends on the amount of black carbon in the aerosol. Recent studies suggest that the hemispheric

asymmetry in this century's warming may be due—at least in part—to the higher concentrations of aerosols in the Northern Hemisphere.

Aerosols ejected into the stratosphere from volcanic eruptions can have very significant short-term effects on climate. Observed climatic responses to the Mt. Pinatubo eruption have included tropospheric cooling, stratospheric warming, and an overall drop of about 0.5 °C (1 °F) in the global average surface temperature. During 1993, measurements from satellites and the surface showed that these volcanic aerosols are finally settling out of the atmosphere, leading to a return of the global average temperature to levels typical of the 1980s, and to a small recovery from the sharply increased rate of ozone depletion in the lower stratosphere, which studies suggest was caused by volcanic aerosols.

Understanding the Carbon Cycle

There is a natural cycling of carbon in the environment, causing a large exchange of carbon among the atmosphere, the land vegetation and soils, and the oceans and marine biosphere. Evidence from ice-core data suggests that this natural cycle was roughly in balance, with only minor variation, from about 10,000 years ago until recently. Over the past two centuries, however, the concentration of carbon dioxide has risen from preindustrial levels at an increasing rate. Although the anthropogenic emissions are only about 5 percent as large as the natural fluxes, the rising concentration indicates that emissions from changes in land use (e.g., deforestation, biomass burning and agricultural expansion) and from fossil fuel combustion (i.e., the use of coal, oil and natural gas) have become increasingly larger than can be accommodated by natural removal processes. Projections of these trends unabated suggest that the atmospheric CO_2 concentration may reach double its preindustrial value by the middle of the next century, leading to an average global temperature increase of 1.5–4.5 °S (2.5–8 °F).

Research shows that interannual fluctuations in climate can modify natural removal processes, such as carbon uptake and release from respiration. Other studies suggest that mid-latitude forests may be taking up more carbon than previously estimated and that this natural removal process could be enhanced with reforestation and land management practices.

Terrestrial and Marine Ecosystems

There is a particular interest in studying the exchange of carbon among the land vegetation and soils, the oceans and marine biosphere and the atmosphere. Understanding the carbon balance is critical for predicting future concentrations of carbon dioxide in the atmosphere and, hence, greenhouse warming. Recent regional measurement of CO_2 uptake by forest vegetation suggests that the net uptake of carbon worldwide could account for "missing" carbon in the global carbon budget. Confirmation of these results with other natural vegetation studies would support the use of forest management (including reforestation) as an interim mitigation strategy.

Effects on Agriculture. Prospective shifts in precipitation patterns could cause dramatic changes in world agricultural regions and in the availability of water resources, disrupting long-established patterns of land use. Recent research has shown that for a moderate scenario of climate change, projected to accompany a doubling of greenhouse gases, the global agricultural production may not be seriously threatened. At the regional level, however, agricultural production losses, particularly in developing countries, are likely to be severe.

Although the growth rate of some plants has been shown to increase in the presence of additional CO_2, altered precipitation patterns due to climate change could threaten the viability of agricultural regions. Also, increasing population pressures and misguided land-management practices may cause shifts in flora and fauna greater than those that have occurred in response to natural climatic fluctuations.

Effects on Forests. Studies are currently being conducted to determine how climate change may affect tree growth. Potentially altered precipitation patterns and changes in regional hydrology due to climate change may threaten forest health. Elevated CO_2 has also been shown to influence host-pest relationships in a way that can reduce forestry yields.

Effects on Biodiversity. New research in this area will focus on the potential effects of climate change on the species diversity, genetic diversity and habitat diversity of managed and unmanaged ecosystems, and, in turn, how changes in biodiversity will affect the functions of ecosystems.

Effects on Aquatic Ecosystems and Fishery Resources. Research is under way to study the effects of climate on the reproductive dynamics of fishery resources, such as sardine, anchovy, and mackerel. Environmental condi-

tions in lakes and freshwater fisheries are being developed and validated.

Regional Effects. Efforts have been initiated to evaluate the potential effects of climate change at the regional level. Recent modeling efforts have successfully simulated winter precipitation at the local scale for a high-elevation, high-water-yielding mountain watershed in western Colorado (United States) by coupling regional and local-scale atmospheric models to watershed models. These models also simulated the increase in temperature surrounding several federally managed reservoirs in the western U.S. watersheds that might result from doubling of atmospheric CO_2. After coupling global, regional, and local-scale models for watersheds with three-year current climate records, the models predicted an average temperature increase of 3.8 °C (6.8 °F) in areas surrounding several reservoirs in the model watersheds with doubled CO_2 in the environment. Water temperatures were also predicted to increase.

Coastal areas are particularly vulnerable to climate change. Warming of the oceans, coupled with land-surface warming in high latitudes, may melt icecaps and glaciers, which would raise the level of the sea. The amount of sea level rise could be tens of centimeters over the next century (several times the rate of rise in the recent past). In addition, climate change may increase the frequency of severe storms and hurricanes and, hence, the potential for increased natural disasters.

International Activities

Bilateral Technical and Financial Cooperation

Country Studies

México has followed a tradition of active participation in international forums in which topics related to the environment and the climate are discussed. For several years, our country has made efforts to coordinate studies aimed at understanding the causes of environmental problems, particularly those related to global climatic changes and its possible societal impact, in order to be better prepared to cope with them in the future.

These organizational efforts have contributed to increase México's participation in international symposiums. However, we have had difficulties, especially related to financial support. Because of these financial constraints, the U.S. Country Studies Program was welcomed with enthusiasm, and México presented the project titled "Country Study: México," which was later approved.

The project's goal is to provide support and information to policy makers so that strategies can be redirected in order to face the effects of Climate Change. These analyses are intended to show the possible impacts on different productive activities and resources, as well as the new alternatives and challenges that our country's development will confront with respect to their corresponding emissions of greenhouse gases.

México's County Study comprises analyses in three major areas:

- Inventory of Emissions of Greenhouse Gases
- Scenarios, both physical and of emissions of Greenhouse Gases
- Study of Vulnerability of the Country to Global Climate Change

Inventory of Emissions of Greenhouse Gases. The National Greenhouse Gas Inventory shows that México's CO_2 emissions due to fossil fuel combustion are of the order of 85.4×10^6 MTC (Metric tonnes) of carbon. Methane emissions arising from urban waste disposal sites amounts to 385.9×10^3 MT per year. Emissions of this gas resulting from agriculture and livestock amounts to 35,000 and 1.804×10^6 MT respectively, with a very small contribution from rice cultivation. Fugitive methane emissions from the oil industry vary from 4.35×10^5 MT to 1.07×10^6 MT, this variation comes from the utilization of different emission factors. Land use change provides from 49 to 129.3 million tonnes of CO_2, depending on the deforestation rate.

Scenarios, both physical and of emissions of Greenhouse Gases. In this area, temperature and precipitation maps under the assumption of CO_2 doubling have been produced using different General Circulation Models (GCMs), such as the GFDL (Geophysical Fluid Dynamics Laboratory) and the CCCM (Canada Climate Center Model). An effort was made to obtain results in regional scenarios with these models.

Emission scenarios were built with the help of the "Bottom up" and "Top down" models and future projections of land use change. All of the results obtained led to an increase in the energy consumption resulting in an increase of GHG emissions. The increasing emissions of GHG are due to the assumption of continuous growth of the industrial, agricultural and economic activity of the country.

Study of Vulnerability of the Country to Global Climate Change. In order to implement mitigation actions, future scenarios were used to forecast the resulting situation of the country under climate change conditions. This study included vulnerability assessments of all major areas affected by this phenomenon: agriculture, human settlements, hydrological zones, desertification and meteorological drought, industry and energetic systems, forest ecosystems and coastal zones.

U.S. Country Study Program Workplan on Study for the Development of Ukrainian Climate Change Action Plan

Introduction

The United Nations Framework Convention on Climate Change (UNFCCC) commits parties to the Convention to develop national programs, plans, and measures to respond to climate change. One of the key responses that countries can make is to prepare a national action plan and to adopt measures that can reduce atmospheric accumulation of greenhouse gases (GHGs), and thereby delay the predicted impact of GHG on global climate.

The United States is designing a new program to offer to qualified countries financial and technical support for the development of national climate change action plans. The support for national plans will help countries prepare to meet their obligations under the UNFCCC and will also help them to conduct in-depth assessments of opportunities to promote technology transfer.

Ukraine is one of the 55 countries that are currently participating in the U.S. Country Study Program. The main objectives of the Ukrainian Country Study are:

- To facilitate the implementation of commitments arising from the United Nations Framework Convention on Climate Change to do a GHG inventory
- To identify the sources and sinks of GHG in the country, and to establish a GHG emission inventory
- To project future GHG emissions under various scenarios of macroeconomic development
- To conduct a vulnerability and adaptation options assessment
- To identify, analyze, and rank mitigation strategies
- To conduct public education and outreach activities

Ukraine, as one of the largest European countries (604 thousand square kilometers of territory, 52 million population), has one of the highest-in-the-world per-capita rates of GHG emissions.

According to the results of the Country Study the most harmful gas emissions for ecology in Ukraine are CO_2 emission, 659.47 Tg (CO_2 emission, 711.45 Tg, and CO_2 sinks, 51.98 Tg) and CH_4 emission, 10.12 Tg in 1990.

Total annual GHG emissions were 243.35 MMTCE, including CO_2, 179.86 MMTCE; and CH_4, 60.69 MMTCE.

Ukraine's share in the total CO_2 volume emitted by the former USSR is about 29 percent.

Annual CO_2 emissions per capita were 3.5 Mg carbon in 1990. That significantly exceeds corresponding values for European countries and the former USSR.

Therefore, the additional mitigation measures assessment was of great importance for the Ukraine. The ranking of mitigation options shows that the energy sector and forestry have the greatest prospects for GHG abatement. Ukraine is one of the least energy-efficient countries in the world. The energy consumption per unit of gross domestic product in Ukraine is 2 to 3 times higher than in industrially developed countries. Consequently, Ukraine has a great potential for energy conservation. Energy saving measures will greatly contribute to GHG emissions reduction. A set of these measures can be implemented in a short time and the benefits could be expected to accrue in the near term.

This Study involved a large number of Ukrainian energy and environmental offices in its analysis, and allowed local experts to gain extensive experience and training during the conduct of the study, such that they will be able to perform similar analysis in the future without foreign assistance.

The Country Study will provide an information and analytical basis for developing and implementing a national strategy and programs to address climate change.

As is well known, the existing financial resources for Ukraine to conduct research on climate change, which covers many research fields, are quite limited. Therefore, it is necessary to get additional funds for conducting in-depth technology assessments for mitigation and adaptation, and for promoting the diffusion of technologies.

Objectives

The main objective of the national action plan is to identify the priority of climate change problems and to look for methodologies for addressing climate change.

The specific objectives of this project are:

- To prepare the national action plan to reduce the impacts of climate change by considering the GHG emissions inventory that resulted from the Country Study on Climate Change in Ukraine
- To identify technologies for mitigating climate change issues, particularly in the energy sector as a main source of GHG emissions and in forestry as a sink of CO_2
- To encourage energy efficiency in the industrial sector, and in residential and commercial buildings
- To conduct public education and outreach activities
- To encourage the efforts of reforestation to improve that sink of carbon dioxide

Relationship to Country Study and Other Activities

The preliminary activities to support implementation of the plan and the integration of measures with other programs occur simultaneously with action plan preparation. Since climate change is not a top development priority for Ukraine as a transition country, the effectiveness of climate change plans depend in large part on the degree of integration of climate change measures with other high priority development plans and programs. The climate change planning process will be consistent with existing government programs and will contribute to the developed plans. In order to integrate climate change plans into other development plans and programs, the national planning agencies and sectoral agencies will be involved in the planning process.

1. The project will be as the follow-up research of the Ukrainian Country Study on Climate Change.
2. A considerable number of other activities and studies that relate to climate change, carried out in the last few years, show that a comparatively huge potential for GHG reduction exists in Ukraine, and a large body of data, models, and experience have been accumulated. The Ukrainian Country Study will provide further refinement of data and improvement of models. All of these efforts will make a solid foundation for conducting indepth technology assessments for mitigation, and in preparing for the formulation of the national action plan.

Organizations and Personnel Participating in the Study

The Agency for Rational Energy Use and Ecology (ARENA–ECO) has been directed by the Ministry of Environmental Protection to coordinate and to manage the Country Study on Climate Change in Ukraine. Besides taking into account that the energy sector provides more than half of GHG emissions, and energy saving is the main and most economically beneficial option for climate change mitigation, ARENA–ECO consequently would be expected to play a leading role in the development of the national section plan.

All the technical groups described in the table on the next page are working in parallel.

The multidisciplinary nature of this study requires a lot of highly qualified personnel from different disciplines and organizations for a robust analysis. Therefore, relevant personnel from ministries, research institutions, and nongovernmental organizations will be involved in the study.

Participating Organizations

1. The Agency for Rational Energy Use and Ecology, as lead agency, will be responsible for the coordination of the whole project and for the integration of the results coming from the different groups.

   The project coordinators have been submitting quarterly progress reports to the CSMT. These reports describe the activities undertaken for the three-month period, primary results or accomplishments, any problems encountered, plans for activities in the next three-month period, and other pertinent information. These reports include summaries of the expenditures of the project funds for each budget category and expected expenditures for the next three-month period.
2. The Ministry of Environmental Protection and Nuclear Safety, as a lead governmental agency for the development of the National Action Plan, will be responsible for the coordination and implementation strategy. The Ministry will also provide technical support and allocate the following personnel to the project.

Project Groups

The Project Coordinator

Dr. N. Raptsoun, Deputy Chairman,
State Committee for Energy Conservation

The Project Coordinator Assistant

Objectives and Subjects

- Planning and coordination of every stage and element of the Project
- Coordination of the activities of all groups
- Control of fulfillment of the SNAP
- Communication with CSMT
- Concluding agreements and control of their fulfillment
- Preparing and holding workshops
- Personnel management
- Financial management

CoordinatingTeam

Project Coordinator
Technical coordinators on inventory, mitigation, and adaptation
Agency leaders involved in action selection

Objectives and Subjects

- Coordination of the groups A, B, C, and D
- Integration of the results
- Holding of workshops
- Preparing detailed workplans
- Preparing quarterly reports
- Preparing the draft and final National Action Plan
- Carrying out workplan tasks
- Working out contracts (technical tasks)
- Control of contract fulfillment

Group—Scientific Consultants

Manager: Prof. Michail N. Kulik, IESP

Objectives and Subjects

- Consultations on the Study
- Basis for choosing methods
- Assessment of validity of conclusions
- The draft and final National Action Plan review
- Assistance in fulfillment of contracts on activities according to the workplan
- Granting of highly qualified expert services on all matters of interest for the Project Coordinator
- Help the Coordinating Team to draw the most qualified specialists into Project activities

Group—InformationTechnologies

Manager: Mr. Vladimir I. Laskarevskii

Objectives and Subjects

- Providing united information communication, stored information safety, its wholeness, processing, transference, and acceptance
- Supplying equipment, installation, setup, support, and training
- Preparing, issuing, and duplicating the documents
- Informing the Project Coordinator continuously about legitimacy reports concerning the customs, currency, import matters, and other legal standards needed for contract fulfillment related to supplying equipment and materials

Macroeconomy Group

Objectives and Subjects

- Presentation of national economy scenarios and assessment of their validity
- Analysis of the macroeconomic impacts on GHG reduction
- Identifying a list of macroeconomy data
- Identifying and presenting data sources
- Describing social, legal, and national Ukrainian economic strategy
- Establishing economic priorities for variable macroeconomic scenario planning

Group A—Energy Supply

Objectives and Subjects

- Data collection and processing in accordance with input and output forms
- GHG emissions forecasting in energy
- Development of energy supply mitigation measures
- Choosing measures for the Climate Change Plan
- Participating in the National Strategy elaboration
- Participating in workshops

Group B—Energy Demand

Objectives and Subjects

- Data collection and processing in accordance with input and output forms
- GHG emissions forecasting in energy
- Development of energy demand mitigation measures
- Choosing measures for the Climate Change Plan
- Participating in the National Strategy elaboration
- Participating in workshops

Group C—Methane

Objectives and Subjects

- Data collection and processing in accordance with input and output forms
- Methane emissions forecasting
- Development of mitigation measures
- Choosing measures for the Climate Change Plan
- Participating in the National Strategy elaboration
- Participating in workshops

Group D—Forestry and Land Use

Objectives and Subjects

- Data collection and processing in accordance with input and output forms
- Forecasting GHG uptakes and emissions in the forestry sector
- Identifying the steps to GHG reduction and their validity
- Development of mitigation measures in forestry
- Choosing measures for the Climate Change Plan
- Participating in the National Strategy elaboration
- Participating in workshops

3. The Institute of Energy Saving Problems, as a lead scientific agency, is providing basic information on scientific research, mainly on energy mitigation options to reduce GHG emissions.
4. The State Committee of Hydrometeorology (SCH), as a lead agency for adaptation measures, will be responsible for coordination of the associated problems.
5. The Ministry of Energy and Electrification (MEE), as lead agency for Groups A and B, is responsible for the integration of energy mitigation options. MEE is providing information needed to perform the analysis, such as data on energy technologies, the current energy supply and demand situation, and the projected development of the energy system over the study period. It also is providing information on electric generation, transmission, and distribution systems as well as emission factors of the thermopower stations.
6. The Ministry of Forestry has contributed to the study, providing information, experts, and literature search. Forestry, deforestation rates, and land-use patterns are the main areas that will be covered by the Ministry.
7. The Ministry of Industry, as a participating agency, is providing information for governmental planning processes in energy-demand sectors and mitigation options.
8. The Ministry of Economy and the Institute of Economy are providing technical expertise on the macroeconomic analysis. They have designed a long-term macroeconomic model to analyze the consistency of different scenarios of economic development. This model will also be used to guarantee the consistency between the macroeconomic impacts, resulting from the different mitigation and adaptation strategies, and the initial macroeconomic assumptions.
9. The State Committee of Oil and Gas (SCOG), as participating agency, is assisting in the estimation of methane emissions from oil and gas production, natural gas distribution, refining activities, and so forth. SCOG and its associate research institutions are providing specific information on studies dealing with methane emissions from the oil and gas industry, technologies used, and mitigation options.
10. The Ministry of Coal Industry is providing information dealing with methane emissions from the coal industry. It has also been contributing estimating calculations that are or will be implemented in the future to control GHG emissions.

Interagency Advisory Commission

Because the study should be consistent with the Government policymaking process on climate change, policymakers in relevant government agencies will be involved in an advisory capacity. This commission will oversee the overall project and will give valuable access to government data that are needed for technical analysis.

The Interagency Advisory Commission will typically meet three to four times per year, though more often in the beginning or when necessary. Governmental officials are actively involved in all stages of the study, will oversee and estimate products and outputs, and will provide top level expertise and advice. The National Plan to Address Climate Change should be thoroughly discussed within this Commission.

Project Elements (Tasks)

- Establishment of an Interagency Advisory Commission, Consultative Team, and working groups, and preparation of a detailed workplan.
  - — Review of the results of climate change studies.
  - — Review of all relevant documents (the National Energy Program, the National Environmental Plan, the National Program on Energy Conservation, and sectoral development plans).
  - — Identification of all governmental agencies and nongovernmental groups that should participate in the planning process.
  - — An initial scoping meeting with senior representatives from key government agencies and nongovernmental organizations.
- Preparation of the National Climate Change Action Plan:
  - — Consultative workshops with senior government officials and key nongovernmental organizations to identify priority response measures for consideration in plan development, identify needs for indepth technology assessments, and identify needs for refinement of the GHG emissions inventory.
  - — Development of alternative response options policies in the energy sector:
    - To improve the capacity and role of existing institutions related to the development of climate data information

  - To increase the efficiency of fossil fuels usage in industry, transportation, and other activities that produce GHG emissions
  - To develop a document model of energy-efficiency strategies
- — Development of alternative response options policies in the nonenergy sector:
  - To select one or two forestry projects for implementation, building on the country study results
  - To improve forestry management to increase the function of CO_2 absorption
- — Hold a workshop to present results of the evaluation of alternative policies and programs and of technology assessment to senior officials and nongovernmental institutions to develop consensus on appropriate measures for inclusion in the national plan.
- — Preparation of a draft National Plan and circulate drafts for review.

  Preparation of the final National Plan and submit it to the UNFCCC Secretariat.

- Conduct case studies and technology assessments on selected technologies:
  - — To select technologies in terms of the results of the Ukrainian Country Study and the recommendations by ministries for detailed evaluation, according to Ukraine's specific situation. The technologies applied in the following major areas should be highlighted:
    - The energy end-use technologies in energy-intensive industrial sectors, residential and transportation sectors
    - The technologies employed in the energy supply sectors
    - Renewable and new energy technologies
    - Methane recovery technologies
    - Reforestation and forest management measures
  - — Evaluation of the technical, market, institutional, and social factors that will influence the use and diffusion of each technology.
  - — Identification and evaluation of near-term opportunities to promote diffusion of the technology, and carry out prefeasibility studies for specific new initiatives to promote diffusion.
  - — Evaluation of implementation costs for technology dissemination.
  - — Presentation of technology assessment results and recommendations to the Government.
  - — Presentation of proposed technologies to the potential implementation partners.
- Outreach and education activities will include:
  - — Sharing experiences of plan development and technology assessments with other countries and international organizations at international workshops.
  - — National outreach and education activities to develop support for implementation of the national plan and for technology initiatives.

Products and Summary Schedule

The project started in September 1996 as a consequent phase of the Ukrainian Country Study. The duration for implementing this project will be two years.

The detailed schedule for plan preparation is given in Figure 1.

Technical Assistance Needs

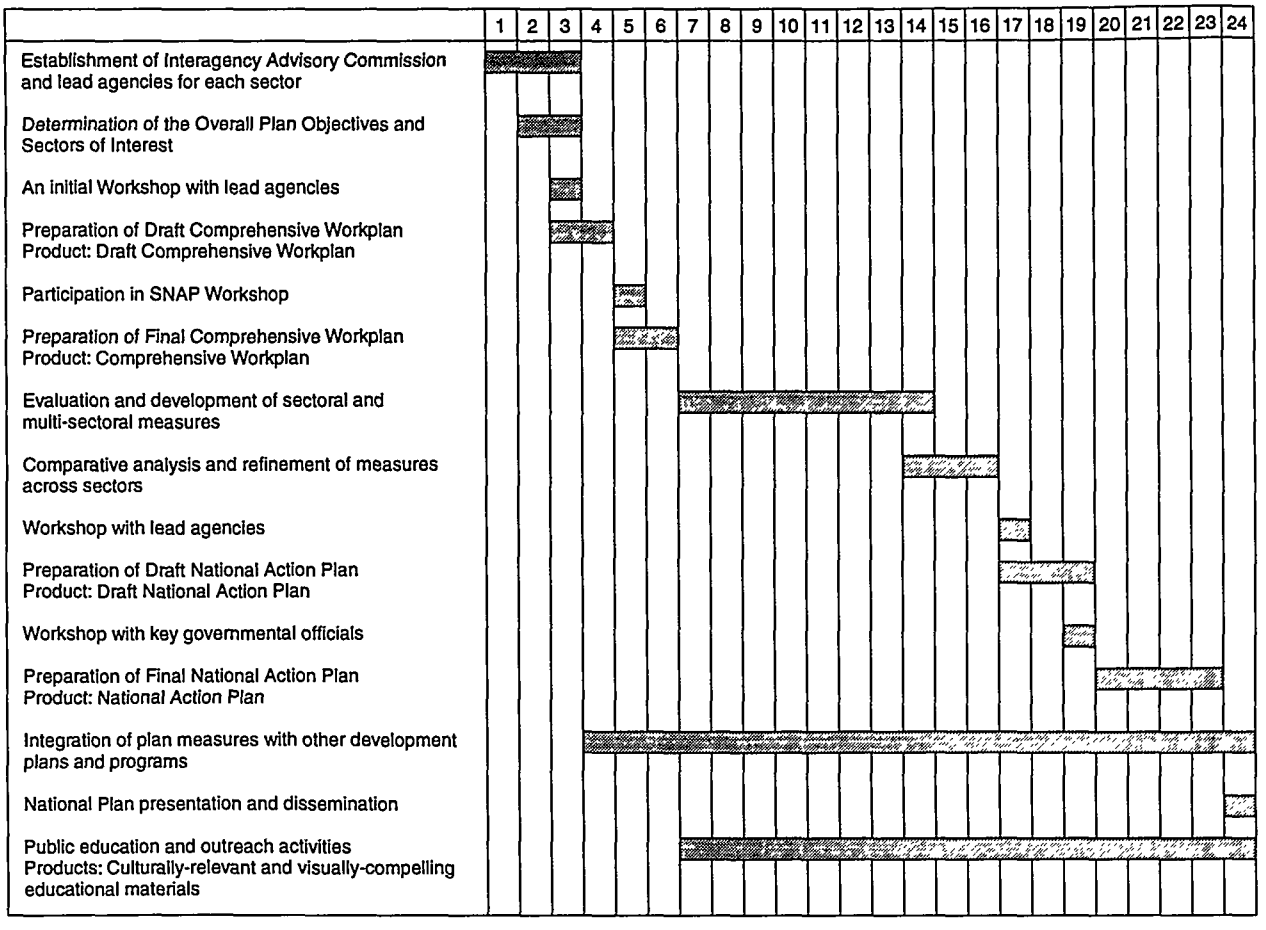
Technical assistance will be required in the following items:

1. Provision of methodological tools for evaluation of alternative policies, programs, and technologies.
2. Training on the key steps in national plan development and for technology assessment.
3. Assistance from U.S. and international experts with the preparation of the national plan.
4. Provision of guidance documents on national plans and technology assessments and examples of plans from other countries.
5. Exchange of information with other countries preparing national plans through participation in international workshops on national plans, distribution of copies of plans prepared by other countries, and supporting the exchange of experts between countries in a region.

Follow-Up Activities

Ukraine is currently examining the question of its future participation in the intergovernmental activities relating to the UNFCCC. It is anticipated that the collective expertise that is brought together for this project would be extremely useful in carrying out analysis to facilitate

Figure 1. Products and Summary Schedule



Ukraine's future participation in the convention processes.

A National Action Plan for GHG emissions reduction and adaptation options implementation will be developed and submitted to the Government for consideration. Public education concerning climate change problems is the essential element of National Action Plan implementation. The different forms of public education will be used, for example, training courses, issues of brochures, TV programs, articles, and so forth.

Participation in the U.S. Initiative on Joint Implementation, which is a pilot program to reduce net GHG emissions and establish an empirical basis and framework for approaches to joint implementation.

Remarks at the Opening of the Panel on Accelerating Greenhouse-Benign Energy Applications

Ata Qureshi

In less than 11 months representatives of the nations who are parties to the Framework Convention on Climate Change will assemble in Kyoto, Japan, for the Third Conference of the Parties to this vitally important treaty. This COP3 may provide an opportunity to begin to slow the steady growth in greenhouse emissions which affects our global climate.

Current trends are quite disturbing. We know from the scientific work prepared by the Intergovernmental Panel on Climate Change (IPCC) that a stabilization of atmospheric concentrations of the most significant greenhouse gas, carbon dioxide, would require a reduction of about sixty percent from current global emissions of CO_2. We are currently nowhere near achieving these reductions. In fact few industrialized countries seem likely to achieve the climate treaty' goal of stabilizing their national greenhouse emissions at 1990 levels by year 2000. Emissions growth is generally even more rapid in developing countries where population growth and industrialization is swelling their proportion of global greenhouse emissions.

As we proceed to Kyoto it is crucial that the nations of the world seek cooperative approaches to limit greenhouse emissions rather than trying to fix blame for shortcomings in realizing the climate treaty's ambitious goals.

The nations of theAsia and Pacific region specifically endorsed such an approach in February 1995 in the Manila Declaration signed by participants from 33 nations. The Manila Asia and Pacific Leaders Conference on Climate Change convened by President Fidel Ramos of the Philippines strongly endorsed the concept of an international public-private partnership to accelerate applications of greenhouse-benign energy such as solar, wind, biomass, geothermal, and energy efficiency. An underlying concept paper prepared by a dozen experts from Asia and North America identified a number of practical measures to drive the cost of greenhouse-benign energy below that of conventional fossil fuel energy.

A major element of this strategy is to scale up investment in renewable technologies so that their price is competitive with fossil-fuel systems. Prof. Jose Goldemberg of the University of Sao Paulo in Brazil has calculated that for every doubling of volume of solar photovoltaic applications we have witnessed about a 25-percent drop in costs of photovoltaic energy. Significant drops in kilowatthour costs of other renewable energy forms such as wind power have also occurred as the scale of investments has increased and as technological applications have improved.

About two billion people in the world today lack access to electricity. The great majority of these people are located in rural areas of developing countries, often many miles from existing electric power grids. Renewable forms of electricity such as solar, wind, or biomass may provide the most economically attractive means of providing electricity to such countries even under current market conditions. Yet multilateral and bilateral development financing sources and private energy lenders have provided only a very small proportion of their energy investments to such off-grid renewable applications.

There are some modestly encouraging signs that this pattern may be changing. The World Bank is contemplating a major Solar Energy Initiative and similar increase in renewable energy investment is possible at such important regional institutions as theAsian Development Bank and the Inter-American Development Bank. These increased investments, especially if focused on off-grid rural areas, can have a doubly beneficial effect. First they can make the benefits of electricity, especially lighting and television, available to many communities that would have no realistic prospect of being connected to the conventional power grid. Second by scaling up the volume

of renewables investment they can help lower unit cost, making off-grid renewable applications more economically attractive. In so doing this may also succeed in attracting private financing to those applications.

Another innovation that would help accelerate applications of greenhouse-benign technology would be a reorientation of governmental investment in energy research and development. Chris Flavin and Nicholas Lenssen of the Worldwatch Institute have calculated that over the past decade the annual investment by industrial country governments in energy R&D has averaged about $8 billion and that less than 10 percent of this investment has gone to renewables and less than 10 percent has gone to end-use efficiency. Only a very small portion of this sizable investment has gone to improve off-grid renewable applications that could benefit the roughly two billion people who lack electricity. A shift over the next few years of OECD country investment in energy R&D so that the greatest proportion is invested in renewables and end-use efficiency can provide a powerful impetus to the commercialization of greenhouse-benign energy.

Our panel today will discuss opportunities for such increased investment in greenhouse-benign energy to be made a major part of the climate negotiations agenda of COP3 and in the years beyond. With the strong panel that we have assembled I believe that we will stimulate discussions of how greenhouse-benign energy development can be factored both into climate change action plans and into international climate negotiations.