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Environmental Pollution
Prevention Project

A STRATEGIC APPROACH TO ENVIRONMENTAL PROTECTION
USAID/INDIA

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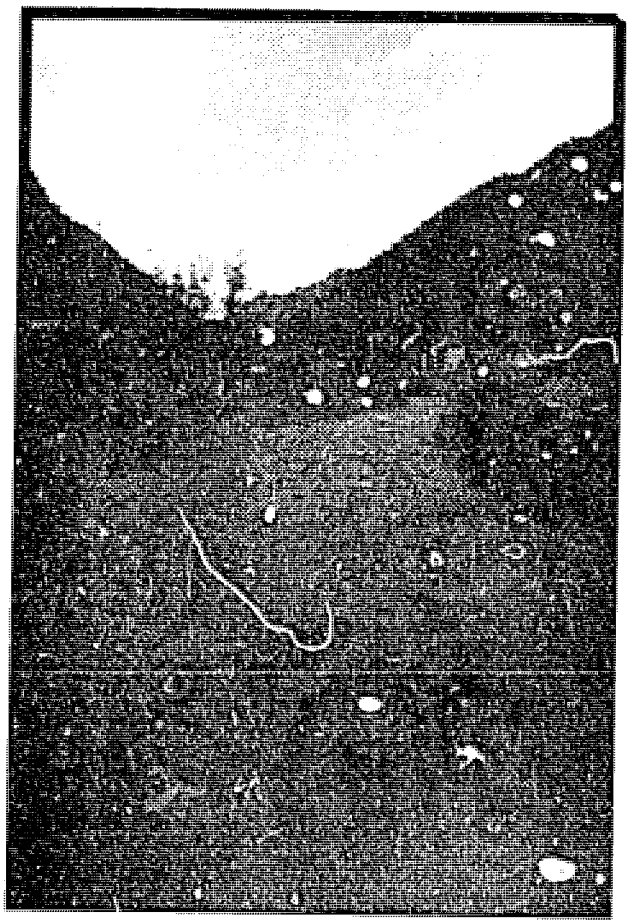
A Strategic Approach to Environmental Protection

USAID/India



Office of Technology Development and Enterprise
United States Agency for International Development
New Delhi, India

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PREFACE

This strategy was prepared in January, 1994 by USAID/India. It reflects the Government of India's Environmental Action Plan and other recent statements and programs designed to improve India's environment and more rational use of its natural resource. on a sustainable basis. It is a document which contributes to establishing a more consistent and comprehensive focus on India's environmental future - it is not the final word in any sense of that phrase but a milestone guiding USAID in its cooperation with India.

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ACRONYMS

ADB	Asian Development Bank
ANE	Asia/Near East Bureau of USAID
ASCI	Administrative Staff College of India
BHEL	Bharat Heavy Electricals Limited
BOD	biological oxygen demand
BSP	Biodiversity Support Program
CAC-MBI	command-and-control--market-based investment
CEA	Central Electricity Authority
CFCs	chlorofluorocarbons
CH_4	methane
CIDA	Canadian International Development Agency
CII	Confederation of Indian Industry
CIL	Coal India Limited
CNG	compressed natural gas
CO	carbon monoxide
CO_2	carbon dioxide
CPCB	Central Pollution Control Board
DANDIA	Danish International Development Agency
DFI	development finance institutions
DOP	Department of Power
DSM	demand-side management
EEC	European Economic Community
EIA	Environmental Impact Assessment
EMCAT	Energy Management Consultation and Training Project
EP3	Environmental Pollution Prevention Project
EPI	Environmental Protection Initiative
EPRI	Electric Power Research Institute
ESCI	Engineering Staff College of India
ETP	environmental treatment plant
FI	financial institution
FICCI	Federation of Indian Chambers of Commerce & Industry
FIRE	Financial Institutional Reform and Expansion Project

FRG	Federal Republic of Germany
G/ENR	Global Bureau/Environment and Natural Resources
GAIL	Gas Authority of India Limited
GAP	Ganga Action Plan
GDP	gross domestic product
GEEP	Greenhouse Gas and Pollution Prevention Project
GEM	Global Environmental Monitoring System
GHG	greenhouse gas
GOI	Government of India
GW	gigawatt
HIG	housing loan guarantee project
ICICI	Industrial Credit and Investment Corporation of India
IDBI	Industrial Development Bank of India
IIT	Indian Institute of Technology
IPPI	India Private Power Initiative
IRP	integrated resource plan
MBIs	market-based instruments
MDB	multilateral development bank
MINARS	Monitoring of Indian National Aquatic Standards
MNES	Ministry of Non-Conventional Energy Sources
MOEF	Ministry of Environment and Forests
MOT	Ministry of Transport
MW	megawatt
NAAQM	National Ambient Air Quality Monitoring Program
NGO	non-government organization
NIH	National Institutes of Health
NIS	New Independent States of the former Soviet Union
NIST	National Institute of Standards and Technology
NLC	Neyvelli Lignite Corporation
NO	nitric oxide
NO_2	nitrous dioxide
NOAA	National Oceanographic and Atmospheric Administration
NOIDA	New Okhla Industrial Development Authority
NORAD	Norwegian Development Agency
NO_x or N_2O	nitrous oxides
NPC	National Power Corporation
NTPC	National Thermal Power Corporation
O_3	ozone

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ODA	Overseas Development Agency (UK)
ODS	ozone depleting substance
ONGC	Oil and Natural Gas Commission
PACER	Program for the Acceleration of Commercial Energy Research
PCBs	Pollution Control Boards
PFC	Power Finance Corporation
PGR	Indo-U.S. Plant Genetic Resources Project
PV	photovoltaics
PVO	private voluntary organization
R&D	research and development
RHUDO	Regional Housing and Urban Development Office
SEB	State Electricity Board
SIDA	Swedish International Development Agency
SO_2	sulfur dioxide
SPCB	State Pollution Control Board
SSIs	small-scale industries
TERI	Tata Energy Research Institute
TEST	Trade in Environmental Services and Technology Project
toe	tons of oil equivalent
US-AEP	U.S.-Asia Environmental Partnership
USAID	U.S. Agency for International Development
USG	U.S. Government
USDOE	U.S. Department of Energy
USDOT	U.S. Department of Transportation
USEPA	U.S. Environmental Protection Agency
USETI	U.S. Environmental Technology Initiative
USETI	U.S. Environmental Training Institute
USTIES	U.S. Technology for International Environmental Solutions
WB	World Bank
WB-GEF	World Bank-Global Environment Facility
WWF	World Wildlife Fund

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USAID/India's environmental strategy, presented in this report, was prepared as a collaborative effort between the USAID Mission in New Delhi, India and several USAID offices working with Indian government and private institutions as well as the U.S. Environmental Protection Agency (US-EPA).

USAID/India wishes to acknowledge the Global Bureau's Environmental Pollution Prevention Project (G/ENR/EP3) for assembling and leading the expert team which conducted the strategy exercise and coordinated the report's production and revision; without this support the strategy exercise would not have been possible. The Mission also wishes to recognize the effective support of the Asia-Near East Bureau's Technical Resources Office (ANE/TR) in providing policy guidance and coordination in USAID/W as well as staff support in the field for the strategy exercise. Additional input in the field was provided by the Mission's Trade in Environmental Service and Technology Project (TEST), the Global Bureau's Office of Energy and Infrastructure (G/EI), and the G/ENR Biodiversity Support Program.

USAID/India particularly wishes to thank the Tata Energy Research Institute (TERI) of India for its valuable technical contributions to the strategy and for coordinating input from various Indian institutions.

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EXECUTIVE SUMMARY

THE STRATEGY

The USAID/India Strategic Framework, approved in December 1993, makes protecting the environment one of three primary objectives for Mission programs for the 1994 - 2000 period. Environmental protection is integrated with assistance to to help accelerate broad based economic growth and to achieve population stabilization to form an overall strategy focused in areas where USAID is likely to achieve the greatest impact in promoting sustainable development in India.

The environmental strategic focus of USAID/India reflects three broad developments:

1) the growing severity of India's environmental problems, with implications for its national economic and public health;

2) recognition of India's contributions to global environmental problems, particularly climate change; and

3) increasing USAID priority on environmental assistance, both at the country level and concerning the global issues of climate change and biodiversity preservation.

These developments combine to form a rationale for an expanded Mission environmental program strategy, but one which, like the overall strategy, must take account of funding and programming realities and focus on those areas where USAID can achieve the most beneficial environmental impact.

In its overall strategy, USAID/India has chosen to focus on three environmental improvement objectives: enhancing energy efficiency, improving air quality, and strengthening biodiversity. These objectives are driven in part by the Mission's desire to build on its portfolio of current projects in energy and the environment, and in part by recently announced plans for a new project to reduce greenhouse gas emissions, the Greenhouse Gas Pollution Prevention Project. In further elaborating its environmental strategy, the Mission has identified three functional areas for program focus:

- Clean Energy Generation, Rational Energy Use and Greenhouse Gas Reduction: through increased energy efficiency and the adoption of clean technologies

- Preservation of Biodiversity: through the conservation of economically valuable fauna and flora

- Transfer of Clean Pollution Preventing Technology and Training: through proactive environmental management practices in the private and public sectors.

The Mission believes that these functional areas best integrate the Agency's new environmental strategy with USAID/India's overall country priorities and the opportunities presented in its current project portfolio. More important perhaps, these areas define a strategy which positions the Mission to capitalize on and influence future environmental programming by USAID and other donors which increasingly recognize India's key status in global, regional and local environmental issues. For example, new USAID Asia regional and global programs open opportunities for India in pollution prevention, biodiversity and environmental training. Additionally, over US$ 1 billion in new energy efficiency and environment sector programs are in various stages of preparation by the multilateral development banks alone, representing a significant linkage opportunity for USAID.

The strategy introduces a stronger pollution prevention focus to Mission environmental activities. As defined in this strategy (and as is the norm in the U.S.), pollution prevention provides a framework to address not only issues associated with energy efficiency and climate change, but also with other pressing urban and industrial environmental problems in India today. Reduced emissions of greenhouse gases (GHGs) are given as much priority as, for example, the reduction of untreated sewage discharges and industrial hazardous chemical discharges; the consistent strategy approach is to find cost effective ways to minimize or eliminate pollutants at the source. Further, as a framework which emphasizes energy productivity and industrial resource efficiency, pollution prevention strongly supports the Mission's economic growth objectives, addressing India's environmental problems in a way that is relevant to policy makers in India and consistent with global efforts underway encouraging developing countries to follow environmentally sustainable growth strategies.

The strategy also strengthens the Mission's modest but important biodiversity focus. New activities will introduce an in situ conservation approach for economically valuable flora and fauna, linking with current ex situ gene banking systems supported by USAID/India. Further, the Mission will take a larger role in Asia regional biodiversity projects supported by USAID/W and new efforts by other USG agencies.

In terms of types of activities, technology transfer, limited financial incentives to leverage investments, and TA and training for the institutionalization of good environmental management practices are expected to be the key vehicles for implementing the strategy. Innovative financing issues and institutional strengthening are addressed within the context of India's environmental priorities. Lastly, the strategy examines ways in which USG agencies can coordinate their activities based on their comparative strengths, with particualr focus on new programs of the U.S. Environmental Protection Agency (USEPA) and Department of Energy (USDOE).

RELATIONSHIP OF STRATEGY TO CURRENT PORTFOLIO

Projects in the present USAID/India portfolio form a strong base on which to build a more ambitious Mission environmental program that focuses on pollution prevention and the link between Indian and global priorities. With the increasing emphasis on environmental concerns in India and in USAID in general, the Mission has responded with both projects and non-project activities to address critical environmental problems including urban and industrial air and water pollution control, inefficient energy production and use, clean coal technologies, and preservation of crop genetic stock. USAID/India projects have also been innovative in two important ways:

- seeking to maximize private sector efforts to address environment problems
- addressing the technological development and transfer dimension of environmental improvement.

These innovations are consistent with the overall assistance approach taken by USAID in India over the past several years, and are expected to be maintained as USAID elaborates its environmental portfolio further.

A number of projects, including TEST, PACER, FIRE, EMCAT, and PGR, have some flexibility to accomodate a strengthened environmental focus and perhaps new implementation activities. These projects focus wholly (e.g., TEST) or partly (e.g., the others) on environmental improvement or protection concerns, and are in various stages of their implementation and project lives.

Thus it is clear that the Mission will need an expanded portfolio to implement a stonger environmental mandate. Therefore, the strategy sets forth program recommendations which

involve preparing new projects. Given projected funding trends, the strategy also offers a program rationale for increased Mission and central USAID resources to address critical environmental problems in India.

The Environmental Strategy is expected to have two implementation mechanisms:

- a new project which, for purposes of this document, has been called the Greenhouse Gas Pollution Prevention (GEEP) project

- a series of cooperative and coordinated pollution prevention, environmental institution strengthening and biodiversity conservation activities within ongoing Mission projects.

Design of the GEEP project, already noted in Mission planning documents, begins immediately and will be based partly on information contained in the environmental strategy. Expected to form a major part of the strategy, GEEP is a significant new program in promoting pollution prevention by reducing GHG emissions. The Mission is working with the Indian government and counterparts to design this project under USAID guidelines for meeting the U.S. commitments to the multilateral Global Environment Facility (GEF). It follows the strengths and directions developed under other Mission projects, particularly those activities relating to innovative energy efficiency, and advanced environmental and energy technology transfer. Activities related to institutional strengthening and capacity building in the area of GHG emission mitigation will also be undertaken. The strategy develops the rationale for this project, including its relationship to new USAID environmental priorities.

The second implementation mechanism to accomplish the strategy objectives will be a series of targeted activities undertaken within ongoing Mission projects. The key projects to be included in this approach are TEST, EMCAT, PGR, FIRE, PACER, and the U.S. Asia Environmental Partnership (USAEP). These projects will emphasize pollution prevention and environmental management practices. New activities under these projects will only be implemented if they also directly foster the accomplishment of individual project goals.

CHAPTER 1
INTRODUCTION

USAID/India's Environmental Strategy, as presented in this document, is designed to spur initiatives which integrate India's evolving national environmental priorities with USAID's mandate to focus on the global environmental concerns of climate change and the preservation of biodiversity. It is conceived as a results-oriented environmental strategy emphasizing pollution prevention, energy productivity, the institutionalization of environmental management practices, and the conservation of economically valuable biodiversity.

The strategy examines ways in which U.S. agencies can coordinate their activities based on their comparative strengths. It also discusses elements of projects that may be developed to implement recommended actions that cannot be initiated through existing USAID projects. Finally, the strategy demonstrates how pollution prevention, general environmental management, and biodiversity are critical to the success of environmental protection in India.

Technology transfer and technical asssistance to institutionalize environmental management practices are expected to be the key vehicles for implementing this strategy. Institutional and innovative financing issues are addressed within the context of India's environmental priorities. The potential for leveraging USAID activities with other donors' initiatives is also explored.

1.1 BACKGROUND

An Overview of the Environment-Economy Interaction

India is the world's eighth-largest economy and one of its ten most industrialized nations. Its economy is expected to grow by an average of 5% per year during the Eighth Five Year Plan (1992-1997). The past two years of economic liberalization suggest that the country is moving towards a market economy and greater global integration. The industrial licensing system has been largely dismantled, foreign companies can invest and manage their interests freely, the rupee is now partially convertible, import tariffs for capital goods have been substantially lowered, and macroeconomic indicators have improved.

India's rapid economic, population, and industrial growth are causing increasingly severe environmental degradation and pollution problems which have local, regional and global

The Relative Size of India's Economy

Five of the world's twelve largest economies are found in the developing world. Of these, China, India, Russia, and Mexico have gross domestic products (GDPs) larger than that of Canada, which is currently the G7's seventh-largest economy. On a purchasing power parity basis, the Indian economy produced a GDP of a little over US $1 trillion in 1993, or about half that of China and one-sixth that of the United States. In 1993, India's GDP grew by 4.5%, its industrial production rose by more than 4%, and its consumer prices were up by around 7%.

importance. India has witnessed a significant degradation in environmental quality and is also a major and growing contributor to the world's output of greenhouse gases (GHGs). Further, its biodiversity is under constant threat from population pressures and growing industrialization. Increasing urbanization, transportation, industrialization, high-intensity agriculture, population migration, and the consumption of goods place constant pressure on the extraction, procurement and conversion of energy resources. In many urban areas, the lack of environmental controls has created high levels of pollution: sulfur dioxide, particulates, nitrogen oxide, and ground-level ozone levels are now considered excessive and a risk to public health.

While much has been done to spur economic growth recently, a serious constraint has been the availability of capital and technology needed to acquire an adequate infrastructure base on which to build the future. Infrastructure-related services include road networks, communication, public health, education and energy supplies. However, the adverse environmental impacts from poorly planned industrialization have reached unacceptable levels. Similarly, broad increases in the inefficient production and use of energy, and the quantity and quality of energy, including chronic shortages of power, are among the most pressing problems. Other problems include changing land use profiles and deforestation, both of which result in increased greenhouse gas emissions and risks to the nation's rich biodiversity.

A Deteriorating Environmental Profile

India is the world's sixth-largest producer of GHGs after the NIS, China, United States, Japan, and Germany. If current trends continue, India will overtake Japan and Germany's production of GHGs by the year 2010. India ranks behind the NIS as the second-largest GHG

producer among USAID-assisted countries and is the world's second-fastest growing source of GHGs after China.

Air Pollution. The environmental effects from growing fossil fuel use, principally coal, can only worsen as India seeks to meet the energy needs of its expanding economy.[1] India can realistically expect to add some 20,000 megawatts (MW) of new power capacity by 2000, against its current installed capacity of almost 75,000 MW. Coal will play a predominant role in this expansion. The major pollutants from coal exploitation, in addition to the principal GHGs, include particulate air emissions, coal mining runoff and wastes, and coal ash solid wastes which pose a large-scale disposal problem.

Exacerbating these critical air emissions problems, particularly in urban and industrial areas, will be the growth in the number and size of industrial facilities -- especially the increase in cement production, which will account for a significant source of CO_2 emissions and other pollutants from fossil fuel use.

Air quality data in India's major cities indicate that ambient levels of NO_x, SO_2, lead and suspended particulate matter are often higher than World Health Organization and Indian standards, especially in the summer months. Sulfur dioxide levels in nine of the country's 10 major cities exceed national standards, and other harmful substances such as ozone are not monitored. Major contributors include thermal power stations, industrial factories, vehicles and non-commercial fuels such as coal briquettes, animal dung and trash.

Water Pollution. India's rivers and streams suffer from very high levels of pollution from municipal waste, waste generated from industrial processes, chemical agents for fertilizers, pesticides for crop protection, and silt from degraded catchments. Untreated sewage and other non-industrial wastes account for four times as much pollution as industrial effluent. In the country's major cities, less than 5% of the total wastewater generated is collected and less than one-fourth of this is treated. A consequence of such pollution is high levels of waterborne diseases, which account for two-thirds of all illnesses in India and result in significant loss in productivity.

Soil Pollution. Soils covering 20% of the country are at least partially degraded from animal overgrazing, deforestation, improper irrigation practices, and poor land use patterns resulting

[1] Internal World Bank estimates indicate that India will continue to suffer from energy shortfalls. Commercial energy demand is projected to grow by at least 6% a year, with electricity needs growing by 13-15% in certain areas.

from inadequate planning and population pressures, including migration. Further, the government-sponsored trend towards intensive agriculture and overcultivation has resulted in nutrient-depleted soils. Paradoxically, India has achieved food self-sufficiency and built sizeable food stores partly as a consequence of the above trends.

Solid Waste Pollution. The amount of garbage being generated is increasing in most Indian cities. Per-capita solid waste generation is about 350 to 400 gms and, in large cities, exceeds 500 gms. Apart from household wastes, other waste material derived from the maintenance of streets and drains, animal wastes, and commercial wastes (particularly from stores and markets, building refuse and hospital refuse) adds to the volume of wastes, seriously affects their composition, and poses a public health problem.

Biodiversity. India's rich biodiversity heritage includes many economically valuable plants and animals. The biodiversity of all of India's ecosystems, however, is under stress from conversion to agriculture, hydroelectric power, overgrazing, mining, unsustainable logging and fuelwood collection, and the overharvesting of commercially valuable medicinal plants. A recent study concluded that an estimated 1,500 plant species are now endangered and some 3,000 more could be threatened in the future.

The Legal, Regulatory and Institutional Framework in the Environment Sector

The regulatory and institutional decision making framework for environmental protection is embodied in seven major acts of the Indian Parliament. Of these, four acts are central to regulation:

- The Water (prevention and control of pollution) Act of 1974, which established the Central and State Pollution Control Boards
- the Air (prevention and control of pollution) Act of 1977, which added air emissions to the boards' responsibilities

- the Environment Protection Act of 1986 and the Forest Conservation Act of 1980, which address biodiversity preservation.[2]

The Government of India (GOI) has several on-going and proposed environmental regulatory initiatives. Most of these are aimed at strengthening the command-and-control regime of environmental standards. New initiatives, especially in the form of financial incentives for technology acquisition, are being undertaken to promote end-of-pipe pollution control activities in industry.

The GOI's policy states that to achieve the objective of pollution control, maximum use will be made of a mix of instruments in the form of legislation and regulations, fiscal incentives, voluntary agreements, educational programs and information campaigns. The emphasis will be on the increased use of regulations and an increase in the development and application of financial incentives.

However, the major reasons for the poor performance of India's industries are 1) the country's old and inefficient capital stock, 2) rigid central planning that often shielded domestic industry from competition and new technology, and 3) a lack of practice and training in environmental management. Also, India's regulatory structure, made up of a central authority bound to state-level implementation authorities, has proved to be unsuccessful in translating laws and standards into compliance.

There is an urgent need to supplement the regulatory mechanism with economic instruments, including pollution charges, subsidies, enforcement incentives, marketable permits, and deposit/return schemes. The major thrust of these instruments should be to develop cost-effective strategies and technologies to reduce pollution and generate revenues to finance

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[2] Environmental *legislation* initiatives in India include:

- The Wildlife (Protection) Act, 1972, amended in 1983 and 1991
- The Water (Prevention and Control of Pollution) Act, 1974, amended in 1988
- The Water (Prevention and Control of Pollution) Cess Act, 1977, amended in 1991
- The Forest (Conservation) Act, 1980, amended in 1988
- The Air (Prevention and Control of Pollution) Act, 1981, amended in 1988
- The Environmental (Protection) Act, 1986
- The Motor Vehicle Act, 1938, amended in 1988
- The Public Liability Insurance Act, 1991
- A Notification on Coastal Regulation Zone, 1991.

monitoring and enforcement. Currently, there are few financial incentives for industries to adopt pollution prevention and control technologies.[3]

Policy responsibilities for pollution control are held by different departments and levels of government. Sectoral ministries, state governments, and local bodies and agencies responsible for the planning and implementation of development projects will be required to integrate environmental concerns more effectively in all policy areas. Local authorities play a key role in the abatement of pollution, and environmental concerns need to be built into the way they operate. Figure 1-1 shows the institutional structure for environmental protection in India.

Appendix A summarizes some of the relevant initiatives and provides a brief overview of environmental standards in India. Donor agencies' activities and major constraints to effective environmental management in India are highlighted in Appendix B.

1.2 INITIATIVES IDENTIFIED

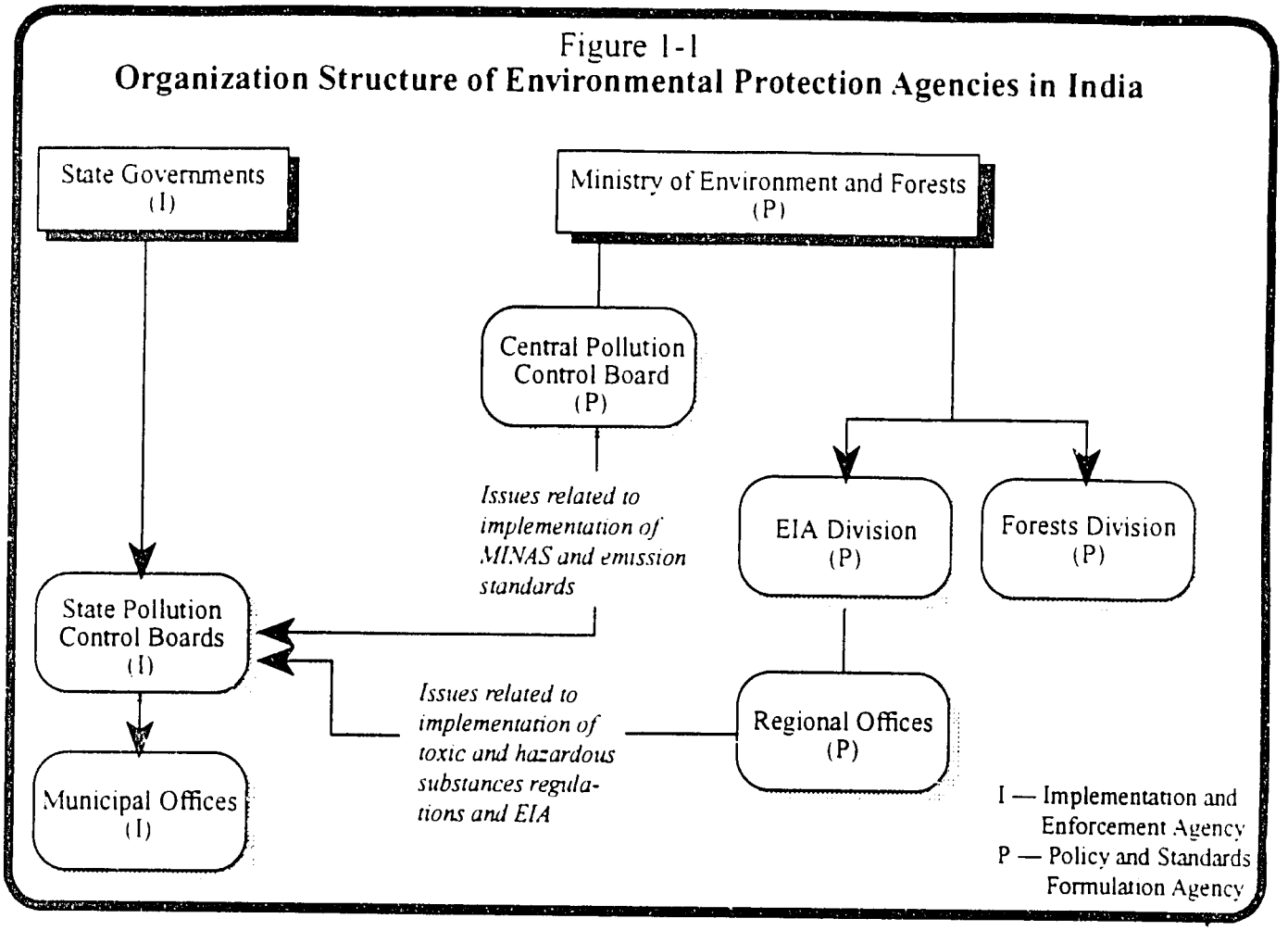
A review of India's environmental profile indicates that several initiatives are called for. These include:

Integration of Environmental Concerns into Policy. Policy responsibilities for pollution control are held by different departments and levels of government. Sectoral ministries, state governments, and local bodies and agencies responsible for the planning and implementation of development projects will be required to integrate environmental concerns more effectively in all policy areas. Local authorities play a key role in the abatement of pollution, and environmental concerns need to be built into the way they operate. Steps should be taken to strengthen governmental and institutional structures dealing with environmental management, especially within the ministries that oversee the energy, industry, water resources, transport and agriculture sectors, and those that develop specific programs for pollution prevention.

Changes in the Institutional Structure. Policy formulation, legislation and law enforcement influence each other. Legislation on particular activities needs to be amended to incorporate environmental criteria. Traditional instruments for monitoring and enforcement are over-

[3] A recent example of the application of economic instruments is the increase in energy costs, coupled with the availability of low-interest loans from financial institutions, which has led to a large-scale adoption of membrane technology in India's manufacture of caustic soda.

Figure 1-1
Organization Structure of Environmental Protection Agencies in India



Source: The Asian Development Bank. *Environmental Considerations in Energy Development*. Manila, Philippines: May 1992.

burdened. An integrated overview and organizational structure for decentralized environmental impact assessments and environmental law enforcement, based on cooperation with local authorities, should be sought.

Policies for Non-point Source Pollution. Although pollution from specific sources such as towns and industries has been addressed by Indian legislation, non-point source pollution from the run-off of agricultural inputs such as pesticides, insecticides, and fertilizers, has not. As non-point source pollution increases, a long-term policy should be formulated for pesticide use. This policy should include the introduction of environmentally acceptable pesticides

(particularly biopesticides and non-persistent biodegradable ones), integrated pest management, and the phasing out of pesticides that have proven to be toxic and persistent. A similar policy for fertilizer use should also be formulated.

Training Needs. Pollution control is inter-disciplinary. In India, formal degrees in environmental engineering/sciences are awarded by only a handful of universities/institutions. Graduates and post-graduates in the fields of chemical/civil engineering and sciences have not had formal training in pollution prevention, abatement and control. There is also a need to improve the capabilities of those employed at the state PCBs. It is necessary that uniform methods of analyzing pollutants and consent granting are adopted. Training is needed in the following fields: 1) operation and maintenance of water and air pollution control treatment units/devices, 2) management, routine operation and maintenance of environmental laboratories, 3) consent management including setting standards, and 4) specific subjects such as the management of hazardous waste, modelling, data processing and law enforcement.

Risk assessment, disaster management, hazard analysis, and hazard operation studies are not comprehensive, especially for chemical and petrochemical industries, refineries, etc. Professional training on environmental issues, recognized as necessary by government/statutory authorities for chemists, operators, technicians, managers, and others is not available. Courses leading to appropriate certification are a major professional deficiency.

1.3 USAID/INDIA OBJECTIVES AND THE STRATEGY FORMULATION PROCESS

The U.S. Agency for International Development has been active in the energy sector of India for over a decade. Its energy projects, and recently its environment programs, have enjoyed widespread success in meeting some important technical assistance needs of the Government of India (GOI) and its agencies, as well as in demonstrating private sector approaches to new energy and environmental investment.

However, USAID now needs to adjust its focus in response to the emergence of a different set of demands. Few government agencies or groups remain to be persuaded of the urgent need for building India's infrastructure in an environmentally sensitive manner and with the help of the private sector. Most of them need much technical assistance in developing their objectives, and in financing and implementing broad management reform programs that include a high priority for programs that will improve the nation's environmental profile and pursue rapid economic growth.

The USAID/India Strategic Framework, FY 1994-2000 (December 1993) makes environmental assistance one of three strategic objectives that the Mission will pursue during the 1994-2000 period. The environmental strategic objective, in support of the GOI's objective of "sustainable economic development with environmental protection," positions the Mission to build upon its past and current portfolio of technical assistance projects. Further, while elevating environmental objectives, the Mission will initiate a new set of associations with the GOI, its operating companies and other organizations. These relationships will help build a participatory environment with the GOI, its organizations and the country's citizens, who can continue to provide valuable input towards achieving the goal of reducing greenhouse gas emissions and preserving the country's biodiversity.

The Mission assembled a multi-disciplinary strategy team to refine its environmental strategy by evaluating, among other things, India's environmental concerns, the Mission's current project portfolio, and USAID's global environmental objectives. Towards this purpose, the team conducted a strategy formulation exercise with the USAID/India Mission from November 20 to December 11, 1993. The purpose of this exercise was to:

1. Conduct a series of discussions with key actors aimed at better understanding the characteristics of the energy-environment interface, the potential for achieving significant resource savings through pollution prevention, and the conservation of the nation's biodiversity heritage.

2. Recommend to USAID/India a short-term Mission strategy for developing a project in accordance with India's goals towards:

   a. *developing an enhanced capability of government, non-governmental and private organizations to practice environmental management;*

   b. *achieving reductions in greenhouse gas emissions and promoting sustainable energy use.*

The USAID/India Environmental Strategy is based on the broad objective of sustainable economic development with environmental protection, with the underlying assumption that India could benefit from the experiences of the industrialized countries. Further, the recent empirical evidence on the increase in atmospheric concentrations of greenhouse gases (carbon dioxide, methane, CFCs, and nitrous oxide) over the last century and the mounting threat to the region's biodiversity is well documented and accepted.

Greenhouse Gas Mitigation Strategies

The options available for mitigating GHGs, including carbon dioxide, chloroflorocarbons, methane, and nitrous oxide, typically fall into three categories: 1) energy use-related options, 2) land use and agriculture-related options, and 3) emissions control options. Generally, mitigation options take the form of reducing emissions or enhancing sinks for greenhouse gases. Major examples of mitigation approaches include:

- improved energy efficiency
- institution of demand-side management programs at electric utilities
- substitution of low-emitting fuels and energy technologies
- reduced rate of deforestation or increased rate of afforestation
- improved agricultural productivity within a sustainable framework
- improved management of nitrogen in agricultural systems
- emissions control in combustion exhaust
- the capture or prevention of methane and nitrous oxide emissions
- the collection and sequestering of CO_2 emissions from fossil fuel combustion and/or increased fuel efficiency of motor vehicles or improvements in mass transit.

Government policies for promoting the implementation of these techniques generally take one of three forms:

- incentives (e.g., prices, taxes, tax credits, and subsidies could be used to promote the use of specific technologies such as low-emitting fuels)
- requirements (e.g., institute product energy efficiency or exhaust emissions standards)
- direct provision (e.g., initiate federal stove distribution programs to distribute more efficient woodburning cookstoves directly to the populace).

The tools that will most likely be used to address the needs of the Indian environmental sector, regulatory apparatus, and the numerous organizations targeted for improved environmental compliance will include the following: pollution prevention techniques, institutional and regulatory assistance, technology transfer to promote energy efficiency on both the supply and demand sides, information dissemination, participatory actions with non-government

organizations (NGOs), and training. The potential for leveraging USAID activities with other donor initiatives is also explored.

The team and strategy development exercise were led by the G/ENR Environmental Pollution Prevention Project (EP3) and assisted by the USAID ANE/Asia Bureau, G/ENR Biodiversity Support Program (BSP), the USAID/India TEST Project, and the US Environmental Protection Agency. Additional input was provided by the Confederation of Indian Industry and the Industrial Credit and Investment Corporation of India.

The strategy formulation was conducted in two steps. The first consisted of reviewing background literature to assess the priority issues in India's environmental sector. The second step, which was conducted in India over a two-week period, included meetings with GOI officials, industry representatives, state government officials, academics, NGOs, and community groups. The team gathered data, probed long-term issues, and analyzed the potential for proactive environmental management to permeate the government and industry decision making process. The team also reviewed the Mission's comparative advantage in environmental program assistance, given its past record in developing and conducting a successful energy program. Finally, the team's preliminary findings and recommendations were reviewed by GOI agencies, industry leaders, and NGO representatives.

CHAPTER 2
ANALYSIS OF CURRENT ISSUES

2.1 INTRODUCTION

Rationale

This chapter examines the Mission's strategy for assisting environmental protection efforts in India in light of India's development goals and policy context[1] and USAID program objectives. USAID/India's current program objectives include accelerating broad-based economic growth, stabilizing the population, and protecting the environment.

The team focused on environmental protection within the context of sustained, accelerated and broad-based economic growth. The Mission's issue analysis and action plan are based on the premise that environmental protection can best be achieved through a set of initiatives that enhance overall economic productivity.

As part of its overall program design, the Mission has chosen to focus on three environmental improvement objectives: improving air quality, enhancing energy efficiency, and strengthening biodiversity preservation.[2] These objectives are driven in part by the Mission's desire to test the strategic viability of its portfolio of current projects in energy and environment.[3] Further, the Mission has planned for a new project specifically aimed at GHG emission reduction: the Greenhouse Gas and Pollution Prevention (GEEP) Project (see Appendix C).

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[1] The June 1993 Indian *National Report to UNCED*, prepared by the Ministry of Environment and Forests, summarizes India's strategy for environmentally sound sustainable development:

> "India will have to leap-frog over wasteful and polluting technologies and go to technologies which are the most environmentally sound, and are based on maximizing recycling and efficient use of resources - practices which are inherent in India's traditions."

[2] *USAID/India Strategic Framework, FY 1994-2000*, (Draft) December 1993, New Delhi, India.

[3] The twin goals of GHG emissions reduction and biodiversity preservation are derived from the global environment objectives of USAID/Washington.

Given the goals and objectives stated above, the team identified three key functional areas:

- ***Pollution Prevention and Greenhouse Gas Reduction:*** through increased energy efficiency and the adoption of clean technologies
- ***Preservation of Biodiversity:*** through the conservation of economically-valuable fauna and flora
- ***Transfer of Clean Technology and Training:*** through proactive environmental management practices in the private and public sectors.

Pollution prevention was selected as a central theme of these functional areas to confront the twin challenges of achieving sustainable development and protecting the environment (as explained in the text-box on the next page, pollution prevention includes clean production technology, product changes, process changes, and the reuse of input materials). In addition, the objective of preserving economically valuable biodiversity can be met through pollution prevention.

Issues Analysis

The team began its analysis of current issues by meeting with central and state government staff, industry associations, NGOs, and Mission staff. They then held one-on-one discussions where sector-specific issues were addressed. Several on-site visits were conducted to validate the team's initial observations and findings.[4]

The team then presented its interim findings to the Mission and a panel composed of representatives from industry, government, NGOs and academia. Next, they prepared a matrix prioritizing the key functional areas by four criteria. These criteria were developed by the team with substantial input from relevant Mission staff. Each functional area was scored and action items were recommended using a five-point grading scale. The four criteria are:

- contribution to overall environmental improvement
- potential for GHG emissions reduction

[4] These included visits to industrial areas, planning organizations, power plant stations, and financial institutions.

What is Pollution Prevention?

Pollution prevention is the use of waste materials, processes, or practices that reduce or eliminate the creation of pollutants or wastes at the source. It includes the judicious use of resources through source reduction, energy efficiency, and reduced water consumption. Source reduction typically occurs through the following improvements:

Product Changes
- Design for less environmental impact
- Increase product life

Process Changes
- Input material changes: material purification or substitution
- Technology changes: increased automation, improved operating conditions and equipment, new technology
- Reuse or reclamation of input materials (e.g., solvent recycling, volatile organic recovery)
- Improved operating practices: operating and maintenance procedures, management practices, waste and stream segregation, material handling, production scheduling, inventory control

While pollution prevention is most commonly applied to industrial practice, it has significant applications in the energy sector as well, where efficiency, source reduction and clean energy strategies are applied through the following improvements:

- Solid waste, runoff and air pollutant minimization in fuels production (e.g., better surface mining practices, coal beneficiation, coal bed methane recovery, oil well regulation)
- Transport efficiency and emissions minimization (e.g., high-efficiency vehicles, low-emission fuels)
- Advanced power generation technology
- Efficient lighting and appliances in the commercial and residential sectors.

In every sector, pollution prevention practices enhance productive efficiency via effective resource allocation and use.

What is Not Pollution Prevention?

The following are not pollution prevention measures because they are taken after the waste is created, i.e., they fit the typical definition of pollution control:

- Off-site recycling
- Waste treatment
- Concentrating hazardous or toxic constituents to reduce volume
- Diluting constituents to reduce hazard or toxicity
- Transferring hazardous or toxic constituents from one environmental medium to another.

Source: USEPA. *What is Pollution Prevention*, Washington, DC: 1993; RCG/Hagler Bailly, 1994.

- potential for biodiversity preservation
- potential for building on the Mission's experience within India's policy/institutional context.

Table 2-1 summarizes the results of this exercise.

Table 2-1
Ranking of Actions Identified Within Functional Areas

Functional Area/Subjects	Contribution to Overall Environmental Improvement	Potential for GHG Reduction[1]	Potential for Biodiversity Preservation	Previous Mission Experience	Composite Score Ranking
1. Pollution Prevention and Greenhouse Gas Reduction					
-fossil fuel use	high	high	na	high	3.25
-resource extraction	med	high	low	none	2.25
-fuel switching (gas use)	med	high	low	med	3.00
-transportation	med	high	na	none	2.00
-cogeneration	low	med	na	high	2.50
-renewables	high	high	low	low	3.00
-substitute ODS	high	med	na	none	2.00
-planning/organization	high	high	na	high	3.25
2. Conservation of Biodiversity					
-conserve economically valuable biodiversity	high	med	high	med	3.00
3. Transfer of Clean Technologies and Training					
-clean technology and chemicals in industry	high	med	na	low	2.50
-pollution prevention practices in new/ expanding industrial sectors	high	low	na	low	2.25
-joint-ventures of US and Indian firms	high	med	med	high	3.50
-training programs	high	med	low	high	3.25

Scoring Key:

high:	4	gains are direct, large, quantifiable and immediate (<5 years)
med:	3	gains are direct and significant, but not readily quantifiable and immediate (<5 years)
low:	2	gains are indirect and over a longer term (between 5 and 10 years)
na:	1	no direct impacts
none:	0	no impacts

[1] This category includes the gains from savings in primary energy realized by efficiency improvements.

The issues analysis concentrated on developing a list of subject areas in which Mission activities would most likely be able to meet the objectives of pollution prevention and GHG emissions reduction, the conservation of biodiversity, and the transfer of clean technology and training. These subject areas were determined by critically reviewing the environmental needs and conditions in each sector and by building a consensus among the providers and beneficiaries of USAID-funded expertise. They provide the Mission with an opportunity to make significant progress towards its program objectives with limited resource commitment.

The results of the issue analysis, which are summarized in Table 2-1, were used to develop and identify the actions recommended in the sections below. Each of these actions is discussed in greater detail in Chapter 3.

It is worth noting that of the 13 subject areas identified in Table 2-1, seven scored a 3 or above, indicating that the option would provide direct and significant gains, but that these gains are not immediate (will be realized in less than five years). These seven areas are: fossil fuel use reduction, renewable energy technologies, improved planning and organization, U.S.-Indian joint ventures for environmental services and products, training programs, the conservation of economically valuable biodiversity, and fuel switching. These areas also feature as critical components of USAID/India-sponsored environmental improvement projects.

The analysis also identifies several potential new subject areas that are likely to play an important role in India's environmental agenda (and with which the Mission has limited experience). These include managing resource extraction, improving transportation efficiency, acquiring clean production technology, and introducing pollution prevention methods.

2.2 POLLUTION PREVENTION AND GREENHOUSE GAS REDUCTION

The term "greenhouse effect" refers to the possibility that human activity will cause changes in the concentrations and composition of atmospheric gases, which will lead to a rise in temperatures and accompanying climate changes. Besides carbon dioxide (CO_2), three other trace gases -- nitrous oxides (NO_x), chlorofluorocarbons (CFCs), and methane -- contribute to the greenhouse effect. CO_2 emissions from fossil fuel combustion are estimated to contribute more than one-half of the greenhouse effect, with the remainder attributed to deforestation activities.

Greenhouse Gases: Carbon Dioxide, Methane, Chlorofluorocarbons and Nitrous Oxide

The earth absorbs radiation from the sun, primarily at the surface, and re-radiates this energy to space. A portion of the re-radiated energy is absorbed or "trapped" by gases in the atmosphere. The trapped energy acts to warm the earth's surface and atmosphere, creating what is known as the "greenhouse effect." Naturally occurring greenhouse gases include water vapor, carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), and ozone (O_3). Chlorofluorocarbons (CFCs), a family of man-made compounds, are also greenhouse gases. Although greenhouse gases occur naturally in the atmosphere (with the exception of CFCs), the recent atmospheric build-up of greenhouse gases appears to be largely the result of anthropogenic activities. This build-up has altered the composition of the earth's atmosphere, and can possibly affect the future global climate. Since 1800, atmospheric concentrations of CO_2 have increased about 25%, CH_4 concentrations have more than doubled, and concentrations of N_2O have risen approximately 8%. Furthermore, CFC emissions have increased at least 4% each year over the past few decades.

The combustion of liquid, solid, and gaseous fossil fuels is the major anthropogenic source of carbon dioxide. Some other non-energy production processes (e.g., cement production)[5] also emit notable quantities of CO_2 into the atmosphere. CO_2 emissions are also a product of forest clearing and biomass burning. Atmospheric concentrations are increasing at 0.4 to 0.7 percent per year.

Methane is produced through anaerobic decomposition in biological systems. Agricultural processes such as wetland rice cultivation, enteric fermentation in animals, and the decomposition of animal wastes emit CH_4, as does the decomposition of municipal solid wastes in landfills. Methane is also emitted during the production and distribution of natural gas and oil, and is released as a byproduct of coal production and incomplete combustion during biomass burning. The atmospheric concentration of methane is increasing at a rate of about 0.6 percent per year.

Anthropogenic sources of N_2O include increased emissions from soils as a result of deforestation, fossil fuel combustion, biomass burning, the use of nitrate and ammonium fertilizers, and the leaching of nitrogen fertilizers from soils into groundwater.

Chlorofluorocarbons, as well as other halogenated fluorocarbons such as halons, methyl chloroform, carbon tetrachloride, methyl bromide, and partially halogenated fluorocarbons, are man-made compounds. Many of these compounds not only enhance the greenhouse effect but also contribute to stratospheric ozone depletion.

India is a large consumer of commercial fossil fuel and biomass (e.g., dung cakes, woodchips, agro-residue fuels) and a large cement producer. It consumes 171.3 million tons of oil equivalent (toe) in fossil fuels; estimates for its biomass consumption range from 20-45 million toe. The Indian cement industry is also large and produces in excess of 50 million tons of clinker and cement per year.

[5] The production of one metric ton of cement releases 0.136 metric tons of carbon as CO_2. This figure does not include the production of CO_2 during combustion when calcining the limestone.

Table 2-2
Major Air Pollutants and Their Environmental Impacts

Gas	Greenhouse Effect	Stratospheric Ozone Depletion	Acid Deposition	Smog	Corrosion	Decreased Visibility	Decreased Self-Cleansing of Atmosphere
Carbon Monoxide (CO)							+
Carbon Dioxide (CO_2)	+	+/-					
Methane (CH_4)	+	+/-					+/-
NO_x: Nitric Oxide (NO) and Nitrogen Dioxide (NO_2)		+/-	+	+		+	-
Nitrous Oxide (N_2O)	+	+/-					
Sulfur Dioxide (SO_2)	-		+		+	+	
Chlorofluoro-carbons	+	+					
Ozone (O_3)	+			+			-

Key: + = direct contributor to environmental impact
- = not a direct contributor
+/- = disagreement in the scientific community about the gas's contribution

Source: *Scientific American*. "Managing Planet Earth": Special issue, September 1989.

It is estimated that over 96% of India's total current demand for commercial energy is met by fossil fuels. Coal and lignite account for almost 60% of this share, with petroleum products and natural gas providing 31.6% and 5.3%, respectively. These shares have remained relatively unchanged over the past five years and are predicted to change little over the next five.

India's hydrocarbon reserves are substantial and are expected to be developed more intensively, possibly with greater foreign participation. The country's coal and lignite reserves are estimated at 182 billion tons; its oil reserves at 638 million tons, and its gas reserves at 579 billion cubic meters. Coal production in 1991 amounted to more than 200 million tons; this figure is expected to nearly double by the year 2000.

India's per-capita consumption of commercial energy stood at 236 kg oil equivalent (kgoe), or approximately one-sixth that of the world average in 1990 (at present the number is estimated at 300 kgoe). The country's energy intensity, on the other hand, is considered to be high,[6] largely because of its inefficient energy-intensive industries. Further, the predominant use of coal, coupled with an old and relatively inefficient technology stock (with one unit input of energy, India produces approximately half of what can be produced in the OECD countries) results in a higher energy intensity. Another reason for this high intensity is the government's policy of providing cheap electricity for agricultural pumpsets and kerosene to substitute for scarce fuelwood to curb deforestation.

India currently operates a publicly installed electricity generation capacity of 75,000 MW; on-site industrial power systems represent another 10,000 MW. The Central Electricity Authority has estimated that an additional 120,000 MW of power will be needed over the next 15-20 years (however, under current projections, the capital requirements for these additions greatly exceed India's ability to meet them). Most of the power generation capacity added will be based on thermal power plants burning low-quality coal. This enormous increase in fossil fuel use will result in increases in CO_2 and trace gas emissions. Any attempt to make the power sector more efficient -- on both the demand and supply sides -- will make a very significant difference in the amount of GHG emissions. Each of the objectives outlined below for this functional area has a number of strategy elements that will be helpful in developing an action plan.

[6] Note that differences in the rates of urbanization and industrial structure account for part of the variation in energy intensity. India possesses a large share of energy-intensive industries, such as aluminum, steel, paper, textiles, chemicals and transportation, and therefore is more energy-intensive than say Egypt, Tunisia or Nepal.

Fossil Fuel Use

By improving the efficiency of energy supply and end-use equipment, the same service can be provided while using less energy (Table 2-3). This will lower GHG emissions per unit of energy delivered. On the energy supply side, this would imply improved electric power plants and reduced losses while transmitting and distributing power. On the demand side, this would imply, for example, the use of high-efficiency appliances. Also, improved wood burning stoves would result in reduced biomass use, and the use of energy-efficient lighting, motors, compressors and increased attention to cogeneration projects that extract more useful energy by utilizing waste heat from electric power generation would lower energy consumption.

Table 2-3
Ranges of Potential Savings in Selected Industry Subsectors

Subsector	Savings Range (%)	Savings Range (000' tons of oil equivalent)		Investment Range ($ million)	
Iron & Steel	30 - 40	2,700	4,600	1,050	1,500
Sugar	25 - 35	1,700	2,400	600	900
Fertilizer	10 - 20	800	1,500	540	750
Aluminum	15 - 25	500	700	420	480
Refineries	20 - 25	500	700	330	615
Cement	10 - 20	600	1,000	1,200	1,800
Textiles	20 - 30	400	600	225	375
Pulp & Paper	20 - 30	300	500	135	180
Total		7,500	12,000	4,500	6,600

Source: Government of India, Bureau of Industrial Cost and Prices, compiled from various energy audits in eight subsectors. Presented to the Asian Development Bank, November 1992.

The potential for both primary energy savings and GHG reductions is high given the opportunity to implement energy efficiency measures. The Mission's past energy projects, especially the preliminary demand-side management (DSM) plan it drew up for the Calcutta Electricity Supply Company, position it well to design targeted programs for more efficient

fossil fuel use. The actions recommended below represent a broad range of activities for the Mission's consideration:

Recommended Actions

- Update DSM master plan and identify priority sectors and key actors
- Promote energy-efficient manufacturers
- Conduct demonstration projects with utilities
- Coordinate with multilateral development bank projects in power planning
- Assist in providing technical and feasibility studies for retrofitting and repowering boilers
- Provide for coal beneficiation and flyash reuse demonstrations

Resource Extraction

Methane (a constituent of natural gas and a greenhouse gas) emissions are growing by about 1% per year worldwide, at roughly two to three times the pace of CO_2. Although there is debate on the sources of methane, coal mining, natural gas extraction, and biomass decomposition are considered to be the largest man-made sources.

Methane is valuable as a fuel. In India, it is possible to recover methane from coal mines and livestock manure management facilities (landfills are not prevalent). Using methane as a fuel will reduce its contribution to total GHG emissions. Further, burning it will prevent the emission of other GHGs by replacing the use of other fossil fuels. Methane emissions can be reduced by preventing leaks from natural gas and oil production, transmission, and distribution facilities.

There is substantial potential for reducing GHG emissions by curbing methane emissions and instituting methane extraction practices that are more sensitive to the environment. Improved extraction practices would also mitigate biodiversity impacts, such as coastal disturbances. We recommend that the Mission focus primarily on information dissemination and planning.

Recommended Actions

- Provide technical information on methane recovery systems in coal mines
- Develop environmental management practices at mining sites

Fuel Switching

Given the direct correlation between fossil fuel use and CO_2 and nitrous oxide emissions, programs that would address improving the efficiency of all fossil fuel combustion would result in reduced GHG emissions. Further, when considering CO_2 and other emissions, the use of natural gas provides a net benefit from a GHG reduction perspective.[7] Expanding the use of natural gas and promoting fuel switching away from coal offers a highly cost-effective element in a GHG reduction strategy.

The potential for GHG reductions is high given the savings realized from substituting coal or oil. However, India's gas infrastructure is limited and supplies are tight. There would be no direct biodiversity conservation impacts from oil substitution, but with increased gas drilling, sensitive areas may be affected. However, India's current fields are offshore and in relatively developed areas. The Mission is fairly new to this area, having worked only recently with India's gas sector on the issue of gas contracts for independent power.

Recommended Actions

- Perform a gas utilization study
- Expand natural gas use in the power and industry sectors
- Encourage gas infrastructure planning and term contracts

[7] Boilers fired with natural gas instead of coal reduce CO_2 emissions by approximately 50% per unit of energy output. Further, using natural gas in a boiler that will ultimately generate electricity reduces CO_2 emissions by 65% per unit of electricity produced.

Transportation

Using natural gas instead of gasoline or diesel fuel in vehicles reduces CO_2 emissions by about 30% on a per-mile basis; however, methane emissions are a negative factor, bringing down the gain to about 25% over gasoline. Also, helping institute energy efficiency standards for automobiles (and especially, bus and truck fleets) would improve overall energy use. Further, increases in efficiency will reduce emissions of carbon monoxide, non-methane hydrocarbons, nitrogen oxides, and trace gases from exhaust pipes. The positive impacts of increased visibility from transportation efficiency should also be considered.

The potential for GHG reductions is high given the direct savings realized from substituting natural gas for gasoline and diesel. However, India's gas infrastructure, particularly for compressed natural gas (CNG), is limited and supplies are tight. Although there would be no direct biodiversity conservation impacts from natural gas substitution, sensitive areas may be affected from increased gas drilling (current fields, however, are offshore and in relatively developed areas). The Mission is new to this area and currently has no transportation efficiency-related work.

Recommended Actions

- Promote CNG (alternate energy) fleets in metro areas
- Help institute auto efficiency standards
- Demonstrate efficiency gains from fleet management

Cogeneration

Cogeneration systems are an attractive option from both an environmental and energy efficiency perspective. A gas-fired cogeneration system requires approximately 25% less input energy than a comparable dual-fired coal/oil boiler steam system. In addition, cogeneration systems operate with significantly lower emissions. Overall, the economics of a cogeneration application determine its applicability -- the sugar industry in India's southern and western states has made a breakthrough by developing a progressive power purchase agreement with the utility. Now, sugar producers in these areas are encouraged to produce excess power and wheel to neighboring industrial estates.

The potential for GHG reductions is high given the primary energy savings and India's use of agro-based fuels. However, only some state electricity boards are open to utility buyback and wheeling to other industrials, which is often a prerequisite for good cogeneration economics. On the other hand, the recent breakthroughs towards advancing cogeneration in the sugar industry produced innovative contracts and efficient pricing, which led to committed projects. The Mission must build on this success in other parts of the country.

Recommended Actions

- Continue to foster a market for cogenerated power
- Provide technical information during design, procurement and agreement stages

Renewables

Technologies such as photovoltaic (PV), solar thermal, wind power, and micro hydroelectric power, which are low emitting by definition, should be encouraged. Assessments of renewable technology applications can be made as part of an integrated resource plan (IRP) at the utility or regional level. The Indian Ministry of Non-Conventional Energy is actively promoting this application and is now soliciting bids for a large-grid interactive PV system. Targeting U.S. companies, the Electric Power Research Institute, and the US Department of Energy to develop technology adaptations through existing USAID projects would be effective.

The potential for GHG reductions is high given the large savings in primary energy that result from the use of non-fossil or agro-based fuels. Also, overall environmental benefits could be high because certain renewables that are being developed in India for the power sector are relatively benign (e.g., wind turbines, grid interactive PV systems). However, some state electricity boards are more open than others to developing renewable systems. Similarly, independent power producers in this area need to be promoted. The Mission has limited experience in this area, but could easily participate in bringing about the increased adoption of renewables, especially grid-interactive systems.

Recommended Actions

- Assist in renewable energy technology selection within an IRP framework
- Help agencies in systems design, bidding and procurement procedures
- Promote technology ventures in specific applications (biomass, wind, and solar)

Substitution of Ozone Depleting Substances

The use of ozone depleting substances (ODS) can be reduced through a variety of substitute materials and technologies available in the United States. The choice (and cost) of alternatives should be carefully evaluated against a number of criteria, including their global warming potential, the level of emissions from the equipment to be used within Indian industry, and the transitional nature of some of the substitutes. USEPA's Safe Alternatives Program would be a starting point for an information exchange program. Further, USEPA has bilateral experience with country CFC, halon, and other emission reduction programs.

The potential for GHG reductions is moderate given the limited savings that result from the gradual substitution or elimination of ozone depleting substances. Overall environmental benefits could be high because India's projected use of aerosol sprays, refrigerants and foams is significant. However, many technology transfer and R&D programs are needed in order to develop and market the substitutes. The Mission has very limited experience in this area, but could make contributions with support from USEPA and the U.S. R&D community.

Recommended Actions

- Develop a refrigerant management program
- Conduct a joint R&D program for CFC-free refrigerators
- Prepare project proposals for funding through the Montreal Protocol

Planning and Organization

The planning function, which was previously largely a function of the public sector allocating its own capital and human resources, will take on an important new dimension as private capital and possibly non-resident Indian and other foreign capital is invested in the country's infrastructure industries. An example of this on-going activity is the development in the country's power system. The GOI's decision to introduce independent power production has resulted in a sea change among all actors at the central, state and private sector levels (see box).

The increased acquisition of new equipment and the creation of more diversity in the funding and ownership of new plant and equipment should inevitably lead to greater transparency and competition within most sectors of industry. However, the actual process of designing, promulgating and managing these changes will require the development of new and broader perspectives among the governments and traditional players within the industry. This will also necessitate the formation of a regulatory system that will oversee this transition and make certain that vital public interests are not overlooked.

Environmental issues originate from a broad array of industries. As was previously noted, the greenhouse g emitting energy-intensive industries are particular targets.

A number of institutions in India are active in environmental management, testing and monitoring, standard setting, energy efficiency, R&D projects, and training and capability development. However, the large size of each subsector, the fragmentation of effort among agencies, and a chronic lack of coordination among agencies, operating companies and even donors suggests a strong need to bring coherence to these activities. There are at least four major constraints: a lack of awareness on environmental and productivity issues, a general absence of information and expertise (at the government level) on the potential for change and improvement in each subsector, outdated plants and lack of incentives to replace them, and the absence of a strategic or guiding vision supported by a comprehensive implementation of the plans drawn up by the institutions.

Foreign Private Power Developers Active in the Indian Electricity Sector

Recognizing energy shortages to be a central problem in economic and industrial development, the GOI recently introduced major reforms to encourage domestic and international investments in the power sector. Since this initiative was launched a little over two years ago, the GOI has received over 68 proposals from private developers, both Indian and foreign, to install approximately 28,000 MW of new capacity. At present, 22 of the proposals are from U.S. companies, four of which are moving towards financial closure. It is expected that these plants will be operated according to world-class standards and will include state-of-the-art pollution control systems.

Similarly, the opportunities presented by the energy and environment interface -- technology development and commercialization of energy supply and demand technologies; renewable energy technologies, particularly solar, wind and biomass conversion; and electricity end-use efficiency potential -- are great. A recent study estimated this potential at between 22 and 39 GW by the year 2004-05.

USAID has substantial experience and a proven track record in fulfilling many of these needs. For example, the pioneering work done for the Department of Power (strategy promotion, technical assistance and training) has resulted in much progress towards attracting independent power producers to the sector. The training sessions should target all stakeholders and should emphasize the need to adopt technological, institutional and financial options to pollution prevention (including energy efficiency) that enhance productive efficiency and promote sustainable economic growth.

Recommended Actions

- Promote institutional reforms necessary to provide technical clarity, achievability, fairness and finality to MOEF, CPCB and SPCB industry guidelines and standards
- Provide technical assistance towards integrated resource planning involving new generation capacity, T&D, renovation and maintenance, demand-side management, and alternative energy sources
- Introduce environmental and externality concepts in the financial appraisal of new industrial investments

2.3 CONSERVATION OF BIODIVERSITY

The GOI has signed the Biodiversity Convention and undertaken a review of existing programs and legislation to ensure that India meets its responsibilities under the Convention. The Ministry of Environment and Forests has developed a National Conservation Strategy that includes biodiversity conservation as a central element. The integration of sustainable development with conservation is a primary objective of the National Conservation Strategy which includes, in addition to standard state-level protection of wildlife, priority activities involving private sector participation. These activities comprise the conservation of economically-valuable biodiversity, the decentralization of biodiversity management, and the involvement of local people and non-governmental organizations (NGOs) in conservation.

The Indo-US Plant Genetic Resources (PGR) Project is providing partial support for addressing one of the goals of the National Conservation Strategy: the protection of the narrow subset of India's biodiversity found in domesticated species (crops). The PGR Project is strengthening the *ex situ* (off-site storage) component of the Government of India's national crop germplasm conservation program. *Ex situ* conservation provides storage for genetic resources for easy access to breeders, but *in situ* (on-site) conservation is preferable for meeting conservation objectives. A complete crop germplasm conservation program includes both *ex situ* and *in situ* conservation, and covers wild crop relatives and other economically valuable species. To bring the PGR Project more in line with the National Conservation Strategy in terms of biodiversity covered, decentralization, and participation by the non-government and private sectors, the PGR should be expanded to include an *in situ* component that covers wild economically valuable plants as well as crops.

What is Biological Diversity?

Biological diversity encompasses all species of plants, animals, and microorganisms and the ecosystems and ecological processes of which they are part. It is an umbrella term for the degree of nature's variety, including both the number and frequency of ecosystems, species, or genes in a given assemblage. It is usually considered at three different levels: genetic diversity, species diversity, and ecosystem diversity. Genetic diversity is the sum total of genetic information contained in the plants, animals, and microorganisms that inhabit the earth.

Economic Values of Biological Resources

Direct Values

- Consumptive use value (non-market value of firewood, game, etc.)
- Productive use value (commercial value of timber, fish, etc.)
- Ecosystem service values (watersheds, forests, wetlands, etc.)

Indirect Values

- Non-consumptive use value (scientific research, birdwatching, etc.)
- Option value (value of maintaining options available for the future)
- Existence value (value of ethical feelings about the existence of wildlife)

Conservation of Economically Valuable Biodiversity

USAID/India's strategy will build on the Indo-US Plant Genetic Resources project for *ex situ* conservation of crop germplasm to include *in situ* conservation of traditional varieties and wild economically-valuable species. Specifically, the PGR will be expanded to include two new elements: 1) a pilot program supporting the "on-farm" conservation of traditional varieties and 2) a pilot program to conserve, use sustainably, and manage economically-valuable wild plants in their natural habitats. In addition, under US-AEP, USAID/India will support efforts to strengthen Indian NGO capacity to plan, implement, and assess enterprise-based conservation initiatives based on wild, economically valuable plants.

Recommended Actions

- Develop a pilot program to link *in situ* and *ex situ* gene bank system to promote the conservation of crop genetic resources
- Implement a pilot program for community-based *in situ* conservation of wild economically valuable plants
- Build NGO capacity to plan, implement, and assess enterprise-based conservation initiatives based on wild, economically-valuable plants

2.4 TRANSFER OF CLEAN TECHNOLOGIES AND TRAINING

The environmental impacts from producing, transporting and consuming energy are increasingly adverse and are affecting the broader welfare of the Indian people. At the same time, the country's energy shortages are constraining economic growth. The GOI has articulated the need for an integrated approach to environmental management, especially in the high-priority industry and infrastructure subsectors. Further, the GOI has stepped up spending for environmental protection and pollution control by almost 200% during the Eighth Plan, as compared to the Seventh Plan. Priority areas include the following:

- maintaining current levels of air emissions, especially CO_2 (a GHG) and SO_2
- developing cleaner technologies and energy-efficient devices
- promoting the use of low-lead or no-lead gasoline
- enforcing auto emissions standards at the factory and street levels
- conducting environmental audits focusing on pollution control and waste management.

Similar advances have been made in the legal and regulatory framework toward enhancing the willingness of industry to step up pollution control. During late 1993, the GOI announced several incentives for the acquisition of pollution control systems or devices. These include reductions in excise duties and import tariffs, accelerated depreciation allowances, and low-interest loans to finance capital improvements. Also, rules on willful acts of pollution now include prison terms and fines, and facility closure for non-complying facilities. However, enforcement is considered inadequate and when administered, is often on a random basis. There is, therefore, a need to move to targeted enforcement and to promote pollution prevention practices along with pollution control.

India has a diversified industrial structure with a sizable capacity in basic industries such as steel, aluminum, paper, chemicals and equipment manufacturing. The share of value added to the GDP by the industrial sector is expected to rise from 14.6% in 1984-85 to 20% by the year 2000, with an expected average annual growth rate of 8% during the same period. Also, expansion in the industrial sector is expected to be in the capital- and energy- intensive subsectors, which would offer the greatest potential for GHG mitigation.

According to government estimates, nearly 50% of the total value of national industrial output is accounted for by the over 2 million small-scale industrial units spread out across the country. These facilities are also accountable for 60-65% of India's industrial pollution. Many of these facilities are now using hazardous chemicals as part of their processes without the proper training on materials and discharge handling.

On a more optimistic note, about 40-50% of the medium- to large-scale facilities have installed some sort of emission control system and are concerned with the overall public risk their facilities pose. Opinion polls conducted by industry groups report that there is a heightened public awareness of the danger of negligence or poor investment practices. However, many facilities and their owners have yet to meet either international or national effluent standards.

The main objectives of USAID's technical assistance and training programs for improved environmental management and the transfer of clean production technologies should be to strengthen management and technical capabilities (such as technical assessments, technology demonstrations, and technology/financial evaluation of proposed projects), and to promote national-level coordination that leads to sustainable economic growth with environmental protection. Training programs should focus on environmental management techniques, specific environmental problems, database development, and exchange programs that promote the use of clean production technologies.

Adoption of Clean Production Technologies and Chemicals in Industry

Increased industrial and municipal releases point to the need for costly wastewater treatment facilities and landfills. Investments in these can be substantially reduced by the adoption of clean process and production technologies as well as safer alternative chemicals. The industrial sector offers a prime opportunity for the successful adoption of energy efficiency practices: it consumes close to half of India's commercial energy.

Clean Production: A Way for Indian Companies to Lessen Production-Related Discharges and Improve Productivity

The concept of cleaner production is not new but is receiving new recognition today. Indian industrialization, like others, is costly to public health and the environment. When end-of-pipe pollution controls are added to curb industrial discharges, less damage occurs. But these solutions are expensive and are often not optimal from an environmental perspective.

Clean production is a comprehensive, preventative approach to environmental protection. This requires organizations to be creative and investigate all phases of the manufacturing processes and life cycles. Cleaner production thus encompasses such actions as energy and raw materials conservation, elimination of toxic substances (as raw materials and as product constituents), and reducing the amount of wastes and pollutants created by products and processes, thereby lowering the amounts emitted to air, land and water.

An Example of a Clean Production Action: Reduction of Sulfide in Effluent from Sulfur Black Dyeing at Century Textiles and Industries Ltd., Bombay

A study of the available methods of sulfur black color dyeing and the treatment options was made. An investigation was also made into an alternative to sodium sulfide. It was found that an alkaline solution of glucose could bring about satisfactory conversion of sulfur dyes. However, the high cost of glucose was the main constraint in practice.

A market survey was conducted for procuring an equivalent chemical at a competitive price. This led to the identification of a by-product of the maize starch industry, hydrol, which contained about 50% of reducing sugars. Experiments revealed that 100 parts of sodium sulfide could be substituted by 65 parts of this alternative plus 25 parts of caustic soda. The dissolving and the affinity reactions are carried out in a single stage.

The substitution with hydrol was implemented with a redesigned mixing strategy. The dyeings obtained after this substitution were seen to be equivalent to conventional dyeings in depth of shades, fastness properties, etc, plus there were some other improvements in the quality of the dyed product. The process has been in use since April 1990 and has resulted in the reduction in the sulfide concentration of the effluent from 30 ppm to less than 2 ppm. The substitution resulted in a slight increase in the biochemical oxygen demand (BOD) load on the plant, but this increase was found not to be critical and was easily manageable with the existing biological treatment system.

Enabling Technology. Theoretical understanding of the chemistry involved and a search for suitable reagents.

Advantages. 1) The reduction of sulfide in the effluent, 2) improved settling characteristics in the secondary settling tank of the activated sludge unit, 3) less corrosion in the treatment plant due to reduced sulfide levels in the effluent, 4) the foul smell of sulfide in the workplace was eliminated.

Economic Benefits. No capital expenditure was involved in this substitution and in fact, the operating costs were found to be marginally lower. The saving in not having to install additional effluent treatment facilities was about US $20,000 in capital expenses and about US $3,000 in running expenses per annum. The substitution has not incurred any additional operating costs.

Source: United Nations Environment Programme, Industry and Environment Programme Activity Control. *Cleaner Production Worldwide*, Paris, France: 1993.

Large facilities such as refineries are prime targets for introducing clean production technologies because they typically use outmoded capital stock. Conservation, substitution, and eliminating product lines that are harmful to the environment can greatly reduce environmental impacts. This may also be achieved by relatively small capital projects, e.g., the Bharat Petroleum Corporation has undertaken projects to improve boiler efficiency, the manufacture of methyl tertiary butyl ether (as a substitute for the additive tetra ethyl lead, which produces harmful lead vapors), and the heat integration of crude distillation and vacuum units. At the small industry level, for example, the adoption of non-cyanide based metal plating formulations will reduce the need for the end-of-pipe treatment of cyanide waste from the country's metal finishing facilities.

The Indian regulatory process focuses on end-of-pipe pollution control, as does most of Asia and the developing world. The team evaluated the command and control regime under which current decisions are taken. The adoption of standards, equipment and practices is seen as a primary driver to furthering environmental goals and objectives. The existing system of incentives and charges for pollution control (see box) should be strengthened and modified to promote pollution prevention.

On the regulatory side, the team identified several methods to further promote the adoption of clean technologies. It found that both financial and economic incentives were inadequately articulated to most industry decision makers. The central and state governments can effectively promote the use of clean technologies through their state-sponsored industrial development offices (e.g., Maharashtra Industrial and Trade Company, the Tamil Nadu Industrial Development Company).

The team also observed the larger role that the multilateral development banks (MDBs) are now playing towards furthering environmentally prudent procurement practices. Today, MDB projects in India are being implemented under international standards and offer a model for others. Specifically, the World Bank has launched a major initiative towards building common waste treatment facilities for industry. Its project design allows for collaborative funding by MDBs, industry, and Indian financial institutions. The next phase would include institutional development and training programs specifically targeted to data and information requirements to sustain clean technology initiatives.

The potential for environmental improvements in this area is high owing to the typically high paybacks achievable on the replacement of India's old capital stock. GHG reductions are considered moderate through primary energy savings and improved management. Although

this is a new area for the Mission, it can access many potential applications through the GOI operating companies and financial institutions it has worked with in the past.

Incentives and Charges for Pollution Control

Subsidies

- reduction in excise taxes to 15% for pollution control equipment
- depreciation allowance enhancement to 50% from 30% for pollution control equipment
- reduction of maximum customs duty on pollution control equipment to 40% from 85%
- access to soft loans and grants for financing pollution control equipment and for upgrading processes
- income tax exemption for private contributions to environmental organizations.

Charges (Cess)

- effluent charges levied on the consumption of water at a rate of 0.75 paise (paise = .01 Indian rupees) to 2.50 paise per kiloliter for industrial use
- consent fees for environmental clearances of Rs 200 (as of 1/1/94, US $1.00 = Rs 31.25) to Rs 10,000, depending on the size of the proposed or operating unit
- monitoring fees on water samples for review of compliance, which varies depending on the parameters.

Enforcement Incentives

- for failure to comply with the Water Act and Air Act, fines up to Rs 10,000 and/or imprisonment up to three months may be imposed; continued violation can result in fines up to Rs 5,000 per day plus additional imprisonment
- for failure to comply with the Environmental Act, fines up to Rs 100,000 and/or imprisonment may be imposed
- for failure to comply with the Water Cess Act, fines of up to Rs 1,000 and/or imprisonment for up to six months may be imposed; any arrears are assessed at 12% interest per annum.

Recommended Actions

- Conduct and institutionalize total facility assessments
- Recommend standards to stimulate environmentally sound procurement
- Improve upon the existing regulatory structure and provide financial/economic incentives to promote clean production strategies
- Recommend additions to the GOI incentives/charges system

Pollution Prevention Practices in New and Rapidly Expanding Industrial Sectors

The government and the private sector have announced several priority areas for economic development. The industries that are expected to become the future backbone of the economy can be targeted for rapid adoption of pollution prevention practices. Distributing model pollution prevention plans may encourage manufacturers to evaluate new expansions and plant acquisitions as an integrated part of their procurement practices. These plans should be prepared for each identified sector, taking into account the applicability of practices and technologies to the market.

A major barrier to pollution prevention identified by the team was the lack of adequate information on specific process improvements and practices. An information clearinghouse can be assembled to increase access to pollution prevention and control technologies and their immediate applicability to the Indian context. Although this information may be readily available from the United States, its applicability and the cost of these technologies in India are not known. It is important, therefore, to develop an information strategy to distribute case studies and success stories related to pollution prevention and energy efficiency in India.

Recommended Actions

- Promote the development of pollution prevention practices for industrial facilities
- Provide pollution prevention advisory services

Joint Ventures between U.S. Firms and Indian Private and Selected Public Sector Companies on Environmental Services and Products

This element will focus exclusively on developing appropriate technology and information transfers that will take place quickly and efficiently. This will help direct investments and improve industrial practices. It will also result in the improved access of selected technologies by Indian industry and environmental businesses.

Recommended Actions

- Provide technical assistance and disseminate information
- Promote technology transfer across industry

Training Programs for Private and Public Organizations

Training Indian administrators, scientists, engineers and technicians is a critical element to improving the nation's environmental management capabilities. The training program should be designed with a view to transferring many of the basic concepts and problem solving techniques to competent Indian institutions or organizations.

The training and assistance activities will build capacity at Indian institutions to provide training on environmental practices for relevant professionals. These activities will help develop a cadre of professionals with expertise in pollution prevention approaches and other environmental management tools. They will also promote a basic approach to gathering and managing environmental information. Many similar programs are available through existing mechanisms. Some, like the industry-to-industry exchanges and the USETI, can be funded through coordination with the US-AEP. Others, like the train-the-trainers modules, can be funded via existing agreements between implementing agencies.

Recommended Actions

- Develop and transfer clean production technology characteristics for industry subsectors
- Conduct total facility assessment training
- Conduct pollution prevention practice training
- Conduct environmental management training
- Enhance training capacity at selected institutions
- Enhance laboratory testing and measurement capabilities

Conclusion

The set of recommended actions developed during the strategy formulation exercise provides a sound basis for addressing India's environmental concerns within the context of sustainable economic growth. This strategic approach to environmental protection is based on the Mission's strengths and reflects USAID's global focus on reducing greenhouse gas emissions and the preservation of biological diversity.

Table D-3 (Appendix D) provides a tentative implementation schedule for key elements of the environmental strategy along with a proposed budget for implementation. Chapter 3 identifies potential vehicles for implementation. Additionally, several issues that are expected to be critical during future project design and implementation are identified in Chapter 3.

CHAPTER 3
RECOMMENDATIONS

3.1 RECOMMENDATIONS FOR FOCUS AREAS

Based on the discussion and analysis of issues in Chapter 2, the team identified opportunities for USAID/India assistance to Indian counterparts for the 1994-2000 timeframe. The recommendations are grouped in a number of focus areas within each of the strategy's three functional areas: pollution prevention and GHG reduction, the preservation of biodiversity, and the transfer of clean technologies and training.

Each of these functional areas may apply to a number of subsectors. For example, the pollution prevention and GHG reduction functional area has applicability to the industrial, power, and transportation subsectors. Also, some activities (e.g., improved strategic planning and organization) are relevant to most functional areas and subsectors.

Table 3-1 displays the results of the team's analysis of the potential contribution of these major areas of opportunity and cooperation to overall productive efficiency, lower environmental impacts, and energy savings in India. This table also includes a consideration of the Mission's experience in providing related assistance.

Table 3-1
USAID/India Action Plan for Implementing Environmental Strategy

Functional Area: Pollution Prevention and GHG Reduction

USAID Focus Areas	Recommended Actions	Potential Environmental Benefits	Proposed Implementing Agents [USAID Project]	Critical Elements During Design
1. Fossil Fuel Use	a. update DSM master plan, identify priority sectors and key actors	GHG reduction, strategic planning	CEA, pvt/pub. utility, planning commission [IPPI]	consensus,tie-up w/ planning process, consult WB
	b. promote energy-efficient manufacturers	resource optimization, pollution prevention	ICICI, other DFIs, industry assoc., companies [TEST, FIRE]	address barriers to adoption, use MBIs
	c. conduct demonstration projects with utilities	GHG reduction, peak load savings	candidate utility, MDB, Indian FI, trade allies [EMCAT, PACER]	DSM economics, sector identification
	d. coordinate with MDB projects in power planning	pollution prevention, leverage large resources	NTPC, IDBI, CEA, SEBs [IPPI, EMCAT]	technology adaptation, data exchange
	e. assist in providing technical and feasibility studies for retrofitting and repowering boilers	pollution prevention	PFC, CEA, SEBs [EMCAT, IPPI]	coordinate with PFC-WB initiated program
	f. provide for coal beneficiation and flyash reuse demonstrations	pollution control and prevention	DOP, candidate utility, BHEL, USDOE, EPRI, [IPPI, PACER, US-AEP, TEST]	demonstration is critical, ensure counterpart sustainability

Table 3-1 (cont'd.)
USAID/India Action Plan for Implementing Environmental Strategy

Functional Area: Pollution Prevention and GHG Reduction

USAID Focus Areas	Recommended Actions	Potential Environmental Benefits	Proposed Implementing Agents [USAID Project]	Critical Elements During Design
2. Resource Extraction	a. provide technical information on methane recovery in coal mines	GHG reduction, improved planning	Ministry of Coal, NLC, CIL, USEPA, USDOE [TEST]	demonstration is critical, ensure sustainability
	b. environment management practices at mining sites	pollution prevention, resource optimization	ICICI, CIL, NLC, [TEST, EP3]	introduce as part of productivity improvement
3. Fuel Switching	a. perform gas utilization study	GHG reduction, improved gas planning	DOP, ONGC, GAIL, Planning Commission, CEA, NTPC, independents [EMCAT, IPPI]	introduce as part of integrated resources planning, coordinate w/ ADB gas rehabilitation and expansion project
	b. expand natural gas use in power and industry sectors	GHG reduction		
	c. encourage gas infrastructure planning and term contracts	promotes sector efficiency		

Table 3-1 (cont'd.)
USAID/India Action Plan for Implementing Environmental Strategy

Functional Area: Pollution Prevention and GHG Reduction

USAID Focus Areas	Recommended Actions	Potential Environmental Benefits	Proposed Implementing Agents [USAID Project]	Critical Elements During Design
4. Transportation	a. promote CNG (alternate energy) fleets in metro areas	GHG reduction, urban (inc. lead) air pollution reduction	MOT, USEPA, USDOE, Automobile companies [TEST]	approach on metro or regional basis, assemble task force, characterize mobile source emissions
	b. help institute auto efficiency standards	GHG reduction, public health		
	c. demonstrate efficiency gains from fleet management	promotes sector efficiency		
5. Cogeneration	a. continue to foster market for cogenerated power	market efficiency, GHG reduction	industry, SEBs, CEA [EMCAT, IPPI]	build on USAID success in Tamil Nadu, involve local industry groups
	b. technical information during design, procurement and agreements stage	promotes company and sector efficiency		

Table 3-1 (cont'd.)
USAID/India Action Plan for Implementing Environmental Strategy

Functional Area: Pollution Prevention and GHG Reduction

USAID Focus Areas	Recommended Actions	Potential Environmental Benefits	Proposed Implementing Agents [USAID Project]	Critical Elements During Design
6. Renewables	a. assist in technology selection within IRP framework b. help agencies in systems design, bidding and procurement procedures c. promote technology ventures in specific applications (biomass, wind, and solar)	GHG reduction, resource optimization promotes company and sector efficiency technology transfer opportunity	MNES, CEA, selected SEBs, ADB, WB-GEF, [TEST, US-AEP, IPPI]	technology acquisition is major issue, need for bankable feasibility studies for MDB financing
7. Substitute Ozone Depleting Substances	a. develop a refrigerant management program b. joint r&d program for CFC-free refrigerators c. project proposals for funding through Montreal Protocol	GHG reduction technology transfer opportunity improved compliance planning	MOEF, industry groups, USEPA [TEST, EP3]	identify major users and U.S. technology vendors, start with a pilot program for 1 or 2 substances

Table 3-1 (cont'd.)
USAID/India Action Plan for Implementing Environmental Strategy

Functional Area: Pollution Prevention and GHG Reduction

USAID Focus Areas	Recommended Actions	Potential Environmental Benefits	Proposed Implementing Agents [USAID Project]	Critical Elements During Design
8. Planning and Organization	a. promote institutional reforms necessary to provide technical clarity, achievability, fairness and finality to MOEF, CPCB, SPCB, and demonstration municipalities on industry and basic urban services guidelines and standards	improved investment and compliance planning	MOEF, CPCB, SPCB, PC, industrial authorities [TEST, FIRE, EP3] MOUD & NIUA [FIRE(D)]	build consensus, select key agent of change
	b. provide technical assistance towards integrated resource planning involving new generation capacity, T&D, renovation and maintenance, demand-side management, and alternative energy sources	technology transfer for pollution prevention and GHG reduction and resource optimization	DOP, SEBs, private utilities, WB, trade ailies [IPPI, EP3]; demonstration municipalities [FIRE(D)]	work closely with other MDB projects, supplement on-going efforts
	c. introduce environmental and externality concepts in the financial appraisal of new industrial investments	introduction of total environmental cost accounting, improved planning	PC, MOEF, other MDBs [EP3]; HUDCO & ILFs [FIRE(D)]	identify university or institution to be partner in data development, field work and ultimately, house model(s).

Table 3-1 (cont'd.)
USAID/India Action Plan for Implementing Environmental Strategy

Functional Area: Preservation of Biodiversity

USAID Focus Areas	Recommended Actions	Potential Environmental Benefits	Proposed Implementing Agents [USAID Project]	Critical Elements During Design
1. Conserve Economically Valuable Biodiversity	a. develop pilot program to link *in situ* and *ex situ* gene bank system to promote conservation of crop genetic resources.	habitat and biodiversity preservation, land use benefits	Swaminathan Foundation, NGOs, [PGR]	inst. roles, pilot design, full-time coordinator, need advisory committee and working group of stakeholders, study tours
	b. implement pilot program for community based *in-situ* conservation of wild economically valuable plants		NGOs, MOEF, communities, WWF-India, and BSF [PGR, US-AEP]	plan for sustainability
	c. strengthen NGO capacity to plan, implement, and assess enterprise-based conservation initiatives		WWF-India, BSP [US-AEP]	planning training that fits needs for each NGO

Table 3-1 (cont'd.)
USAID/India Action Plan for Implementing Environmental Strategy

Functional Area: Transfer of Clean Technology and Training

USAID Focus Areas	Recommended Actions	Potential Environmental Benefits	Proposed Implementing Agents [USAID Project]	Critical Elements During Design
1. Promote adoption of clean production technologies and chemicals in industry and the delivery of basic urban services.	a. conduct and institutionalize total facility assessments	GHG reduction, mitigating of other criteria pollutants	NPC, CII, pvt. companies [EP3]; HUDCO & ILFs [FIRE(D)]	site selection, perform financial analyses on investment options
	b. recommend standards to stimulate environmentally sound procurement	upgrade and acquire environmentally sound equipment	MOEF, NPC, NIST, CPCB, USEPA [EP3]; SPCB at demo states and NIUA [FIRE(D]	ensure standards are attainable by emitters, phase-in process
	c. improve upon existing regulatory structure to promote clean production strategies	strategic planning	MOEF, SPCB, USEPA [EP3] demo municipalities [FIRE(D)]	select key agent of change, build consensus
	d. recommend additions to the GOI incentives/charges system	develop market mechanisms to address solutions	MOEF, CPCB, EIA Division, USEPA [EP3]; demo states and municipalities [FIRE(D)]	evaluate hybrid regulatory/incentive structure (CAC-MBI[1]), recommend additional tools

[1] CAC-MBI implies a hybrid system consisting of elements from a command-and-control regulatory regime (laws and fines) with market-based instruments (user fees, waste exchanges and tradeable permits).

Table 3-1 (cont'd.)
USAID/India Action Plan for Implementing Environmental Strategy

Functional Area: Transfer of Clean Technology and Training

USAID Focus Areas	Recommended Actions	Potential Environmental Benefits	Proposed Implementing Agents [USAID Project]	Critical Elements During Design
2. Promote pollution prevention practices in new and rapidly expanding urban and industrial sectors	a. develop pollution prevention plans b. provide pollution prevention advisory services	improved planning technical and managerial improvements	Industry associations, NOIDA (and other industrial development authorities), sector organizations, CPCB [EP3, TEST]; NIUA, HUDCO, ILFs & demo states and municipalities [FIRE(D)]	focus on new and priority sectors, index plans to financial savings and productivity improvements, allow flexibility across sectors
3. Promote joint ventures between U.S. firms and Indian companies on environmental services and procedures	a. provide technical assistance and disseminate information b. promote technology transfer across industry	forming an environmental management industry commercializing pollution prevention practices	CII, FICCI, Indian FIs, [US-AEP, TEST, FIRE, EP3] HUDCO & ILFs [FIRE(D)]	build on existing successes examine use of market incentives to promote pollution prevention practices

Table 3-1 (cont'd.)
USAID/India Action Plan for Implementing Environmental Strategy

Functional Area: Transfer of Clean Technology and Training

USAID Focus Areas	Recommended Actions	Potential Environmental Benefits	Proposed Implementing Agents [USAID Project]	Critical Elements During Design
4. Establish training programs for private and public organizations	a. develop and transfer clean production technology characteristics b. conduct total facility assessment training c. conduct pollution prevention practice training d. conduct environmental management training e. enhance training capacity at selected institutions f. enhance laboratory testing and measurement capabilities	creating awareness, assembling key data, and expanding capabilities in environmental management	CII, FICCI, public organizations, university or professional teaching institutions (IIT, ASCI, ESCI) USETI [TEST, US-AEP, EP3]; NIUA [FIRE(D)]	focus on a developing an understanding with institution(s) to conduct training on a long-term basis on general and specific issues, consider geographic spread for classes, and leverage local initiatives where possible, highlight training for planners and implementors

3.2 IMPLEMENTATION SEQUENCE

Implementing the Mission's environmental strategy will require a series of actions on the part of USAID and other institutions such as USEPA. This section provides an overview of the steps[2] that are considered critical. The key steps to be taken in order to implement the recommendations in the action plan presented in Table 3-1 include the following:

1. Review objectives
2. Identify GOI counterpart(s)
3. Develop and design project in collaboration with counterpart(s)
4. Select project contractor and other U.S. agencies
5. Initiate project.

During the strategy formulation process, the Mission learned that a new project known as the Greenhouse Gas Pollution Prevention Project (GEEP)[3] was to be initiated during 1994. Also, the Mission articulated the need to coordinate its planned efforts in GHG reduction, clean technology, pollution prevention, environmental institution strengthening and biodiversity conservation activities within on-going Mission activities.

Review Objectives. First, in its overall planning efforts towards GEEP, the Mission must make a commitment to the strategy's objectives and specific focus areas. The first step in acquiring this commitment will be making a series of contacts, meetings and/or briefings in order to refine the objectives and focus areas. The groups to be targeted in this exercise will be potential beneficiaries and future sources of funding, and include industry associations, USAID/W and ANE/Asia Bureau projects, MDBs and other donors.

Identify GOI Counterpart(s). This step is critical to the overall success of the GEEP project. The GOI counterpart will be expected to initiate, direct, and troubleshoot on the selection of institutions, actions and direct efforts needed to improve the country's environmental profile. Also, through a program of cooperation, the counterpart should be expected to commit the necessary resources to achieve long-term objectives and sustain the USAID effort. Last, the chosen GOI counterpart will enable the limited resources of a USAID project to be greatly

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[2] This strategy document does not discuss USAID rules and procedures on procurement.

[3] Appendix C provides a preliminary description of GEEP, which is expected to be prepared under USAID's commitments to the GEF. The project should last four to five years under USAID funding, and follow-on activities are expected to be managed and funded by Indian counterparts with supplementary funding from other sources.

leveraged through existing GOI commitments to similar program areas (self- as well as other donor funding).

Develop and Design Project. The design of GEEP, already noted in Mission planning, should start immediately and benefit from information available in this strategy. GEEP is expected to be the keystone of the Mission's environmental strategy in India.

GEEP will focus on energy efficiency and urban and industrial pollution prevention in India, building on the past experience of other Mission projects. Its initial focus will be on 1) GHG emission reduction through energy efficiency and renewable energy and 2) capacity building and institutional reform required to support the relevant focus areas. The design of the project's functional and focus areas will take into account the World Bank/UNDP-administered/sponsored Global Environment Facility (GEF) goals. Specifically, GEEP is expected to target the following activities (not in priority order):

GHG Emissions Reduction

- Support for national energy efficiency efforts in the power and industrial sectors (focused on fuel switching, coal combustion and beneficiation, and other power plant improvements)
- Continued reform in industrial cogeneration (focused on bulk power markets and interconnection in the sugar and rice industries)
- Renewable energy development
- Demand-side management (DSM) demonstration activities

Institutional Reform and Capacity Building

- Institutional development (focused on national standards, procurement of environmentally sound technologies, and introduction of market-driven solutions)
- Training for industry, government and NGOs.

Global Environment Facility (GEF)

The GEF was created to provide new and additional donor financial resources to fund the "incremental costs" of achieving global environmental benefits in four areas: global warming (the area addressed by the present project), biodiversity, international waters, and ozone depletion.[4] The two largest areas of the GEF in terms of funding commitments, global warming and biodiversity, are also USAID's top priorities for environmental assistance. Furthermore, the present U.S. administration has designated the GEF as one of the two highest-priority international environmental initiatives for the United States (the other being the Montreal Protocol on reducing ozone depleting substances).

Funding for USAID/India's planned new Greenhouse Gas Pollution Prevention project is part of the USG $150 million commitment to the pilot phase of the GEF. Projects chosen by USAID to meet its commitments to the GEF are different from most USAID projects in that they use untied funding; thus, USAID procurements resulting from GEF projects must be open to international competition. In technical areas, USAID GEF projects are different in that they must be approved by the GEF under criteria stressing innovative technological and institutional approaches to achieving the targeted environmental benefits, and special economic/financial criteria whereby GEF grant resources are used to cover the incremental costs of the innovative approach compared to conventional approaches. In some cases a project may be considered eligible for GEF financing because of its importance in achieving significant GHG benefits at low cost and because of its high leveraging impact on other resources, even though it may difficult to show clear incremental cost justifications. In general, however, these features must be part of USAID GEF projects. Projects must also be in conformity with the host country's national development priorities and be approved by the host country government for submission to the GEF.

A follow-on project, "Environmental Protection Initiative" (EPI) is also envisioned. EPI, USAID's next major environmental initiative after GEEP, will include 1) urban/industrial pollution prevention and 2) an environmental management element. The first component will emphasize clean production technology and pollution prevention demonstration, commercial applications, and follow-on support activities in the urban and industrial sectors. The second component will consist of technical assistance in environmental assessment, regulation, training, and information transfer. Specific activities are not identified at this time, but the action plans presented in Table 3-1 provide a starting point for further discussion.

[4] A good discussion of the role of the GEF in implementing the Climate Change Convention and applying the incremental cost principle in GEF projects is found in Mintzer, "Implementing the Framework Convention on Climate Change," GEF Working Paper No. 4, 1993, Washington, DC.

In addition to the strategy's new project activities, a series of cooperative activities will be undertaken within ongoing Mission projects. The key projects included are TEST, PACER, EMCAT, IPPI, AEP, FIRE and PGR (these projects and their potential relationships to the strategy are described in Appendix B). Cooperation with all Mission projects will emphasize pollution prevention and environmental management practices (including the conservation of economically valuable biodiversity). New activities under these projects to support the environmental strategy objectives will only be implemented if they also foster the direct accomplishment of individual project goals.

To facilitate the timely design of GEEP so that it can be approved and funded by late FY 94, Mission and ANE/Asia Bureau resources and contract mechanisms should be engaged on an as-needed basis (for example, a buy-in to an existing global or ANE/Asia Bureau project may be considered). This would enable the project paper to be developed during the February to May 1994 time frame.

Select Project Contractor and Other U.S. Agencies. The GEEP project will require that a number of design and implementation activities take place rapidly. In order for the established deadlines to be met, it will be necessary to identify and select the most appropriate and talented team of project implementors. This process will begin immediately and be one of the objectives of the strategy review process. As now structured, GEEP project implementation will require a team of private U.S. and Indian firms and U.S. Government entities.

Initiate Project. The Mission will also investigate a number of methods to bring the appropriate team together, including international competitive (and non-competitive) bidding and buy-ins to existing projects. This process can begin as soon as the strategy has been approved and funding for the GEEP project has been confirmed. It is imperative that the project implementation contract team be identified and selected before FY 1994-95.

Agreements with the USEPA and USDOE are also considered integral to the success of GEEP. Work on these agreements will start as soon as the project design has been accepted by USAID, GEF and the GOI counterpart.

APPENDIX A
ENVIRONMENTAL STANDARDS, INCENTIVES AND MONITORING IN INDIA

This Appendix presents information on Indian environmental standards, incentives and the current state of environmental quality monitoring. Industrial pollution control is the dominant feature of Indian environmental protection, and information is presented on the major control initiatives. Lastly, this Appendix summarizes two new targetted national initiatives, the Ganga and National River action plans.

A.1 STANDARDS AND INCENTIVES FOR POLLUTION CONTROL

Environmental Quality Standards. The Ministry of Environment and Forestry (MOEF), under the 1986 Environmental (Protection) Act, sets nationwide environmental standards. These standards cover the maximum limit of pollutant concentrations in effluent and emission discharges. Although these standards cannot be relaxed, they can be made more stringent by the SPCBs. The Central Pollution Control Board (CPCB) has set up minimum national standards which are not statutory by themselves. However, when SPCBs adopt them, they become legal standards.

Mass-based standards have recently been adopted to encourage the minimization of waste, promote the recycling and reuse of materials, and to conserve natural resources, particularly water. Industry-specific load-based standards for water use and wastewater generation (quantum limits) have been adopted for several industries.

Fiscal Measures. At present, there are several fiscal incentives (including tax rebates) for installing pollution control equipment and for relocating polluting industries from congested areas.

Environmental Impact Assessments (EIAs) of Development Projects. EIAs are conducted under established procedures. They are a necessary part of obtaining clearances for projects requiring GOI approval. To ensure that environmental considerations are integrated in development projects at the planning stage, the MOEF has instituted procedures for the environmental clearance of projects before they can be approved for investment.

A.2 ENVIRONMENTAL QUALITY MONITORING

India is not yet able to manufacture advanced instruments for monitoring pollution from waste water, solids/semi-solids, and air pollution. Automation in treatment facilities is practically non-existent. Although ambient air quality is monitored by locally manufactured continuous and automatic gas analyzers, this equipment is often not reliable.

Air Quality Monitoring. The National Ambient Air Quality Monitoring Program (NAAQM) began in 1984 with 28 stations spread over 7 cities. Since then, a number of major cities and industrial towns have been included in the program: 290 stations in 99 cities are now covered by the NAAQM.

Significant observations based on 1990 data are given below:

- Violations of sulfur dioxide standards occurred at 11 NAAQM locations in Ahmedabad, Bombay, Madras, Gajraula and Howrah. The violations over the 24-hourly average standards were in the range of 5%. At locations in Madras, Calcutta and Howrah, the range of violations was 5-10%. The Naskarpara Pump House in Howrah was the only location where SO_2 (19%) violated the 24-hourly average standard by more than 10%.

- In 1990, at three locations, there were more than 80% violations for suspended particulate matter over the 24-hourly average standard.

Water Quality Monitoring. Inland water quality monitoring is currently being done under three major programs:

- Global Environmental Monitoring System (GEMS)
- Monitoring of Indian National Aquatic Resources (MINARS)
- Ganga Action Plan (GAP).

By March 31, 1992, there were 480 water quality monitoring stations in India, of which 51 were under GEMS, 402 under MINARS, and 27 under GAP. Nationwide, there are 422 stations on rivers, 26 groundwater stations, and 32 stations on lakes and creeks. Critical river stretches identified as heavily polluted are areas of the Sabarmati, Subernarekha, Godavari, Krishna, Indus (tributaries), Sutlej, Ganga (tributaries), Yamuna, Hindon, Chambal, Damodar, Gomati and Kali rivers. A coastal water quality monitoring network of 173 stations was established during the Seventh Plan over India's entire coastline, at varying distances

from the coast, to assess the quality of the coastal and estuarine waters. This program was jointly taken up by the Department of Ocean Development and Department of Environment.

A.3 INDUSTRIAL POLLUTION CONTROL

Environmental Management in Small-Scale Industries (SSIs). In India, there are over 2 million small-scale industries and about 2,000 industrial estates. Data on small-scale units in an organized industrial estate/cluster are collected through surveys. Based on these data, a subsidy of Rs. 25 lakhs[1] or 25% (whichever is less) is offered to clusters of SSIs for setting up common effluent treatment plants, subject to the state government making a matching contribution. This scheme will be extended to provide necessary technical support as well.

Environmental Management in Medium and Large-Scale Industries. The CPCB has selected 18 categories of major polluting industries for priority action. Information on the "pollution control status" of industries in these 18 categories has been collected, collated and compiled, and defaulting units have been identified. The MOEF initiated a 15-point action plan to control pollution in these industries and has directed SPCBs to ensure their compliance to standards.

Implementation and Enforcement of Standards. National and regional task forces have been constituted for implementing environmental standards in industries (e.g., fertilizer, iron and steel, thermal power plants, cement, pulp and paper, oil refineries). These task forces interact with the concerned industry representatives and SPCBs, and also inspect pollution control systems installed at sources, and monitor the progress of the standards' implementation.

The MOEF has proposed that environmental audits be instituted for the regular assessment of development projects. The CPCB has conducted environmental audits in selected units under the 18 categories of major water/air polluting industries. The objectives of these in-depth studies are to evaluate the performance of the pollution control systems and to identify good pollution prevention and control systems for demonstration.

Management of Hazardous Substances. A set of rules was prepared in 1989 to regulate the handling of hazardous chemicals, hazardous micro-organisms/genetically engineered organisms, and hazardous wastes. The GOI is now considering proposed amendments that make the rules more comprehensive.

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[1] 1 Lakh = 100,000; 1 Crore = 10,000,000; Rs. 31 = $ 1 (1993).

The Ministry of Transport has developed a set of rules on the transportation of hazardous chemicals by road under Motor Vehicles Rules, 1989. A few amendments indicating the responsibilities of the occupier/transporter/driver etc., have been drafted for inclusion in the proposed amendments to the Motor Vehicles Rules, 1989.

Guidelines on siting hazardous waste treatment and disposal facilities, and on identifying and assessing abandoned hazardous waste sites have been prepared. Off-site/on-site emergency preparedness plans are also required for preparing mitigation measures in terms of response time, resource mobilization, and effectiveness in case of accidents.

ECOMARK for Environment- Friendly Products. A scheme for the labelling of environmentally friendly products was passed on February 21, 1991. The scheme is to be operated on a nation-wide basis, and envisages the accreditation and labelling of household and other consumer products that meet certain environmental criteria and the quality requirements of the Indian Standards Institute. A national steering committee has been constituted to implement the ECOMARK scheme; it will be assisted by a technical committee that will identify products to receive the ECOMARK label and determine the criteria for awarding the ECOMARK. Criteria have now been developed for such product categories as toilet soaps and detergents.

Identification of Problem Areas. In consultation with the states, the central government has developed an action plan for controlling pollution and critical pollutants from heavily polluting industries and areas. In an attempt to address environmental problems in an integrated way, 19 "problem areas" have been identified and surveyed. Time-targeted action plans for these areas are being developed in consultation with the respective SPCBs.

Mechanisms will be developed to reduce the concentration of pollutants in these problem areas. Strategies will be formulated for areas with high pollution loads, and the accumulative effect of the various types of pollutants will be taken into account, including the pollution of ground water. Existing units in these areas will be targeted for effective action. New units will be required to comply with location-specific standards for stringent environmental quality objectives. These will include matching waste generators with waste buyers.

Detailed surveys have been conducted for almost all areas of the country to identify the sources of pollution and to develop a time-targeted action plan. The heavily polluting industries that have been identified in the GOI action plan are: 1) air pollution control: cement, thermal power plants, iron and steel, fertilizer, zinc smelter, copper smelter, aluminum smelter, and oil refinery and 2) water pollution control: distillery (i.e.,

fermentation), fertilizer, pulp and paper (large and small), basic drugs, dyes and dye intermediates, pesticide manufacturing, oil refinery, petrochemicals, tanneries, sugar and pharmaceuticals.

A.4 ACTION PLANS

Ganga Action Plan. The Ganga Action Plan (GAP) is one of India's major national activities in pollution control, prevention and the restoration of resources. The Ganga River is being polluted by a number of sources (e.g., sewage from cities and towns, industrial effluent discharges, run-off from agricultural fields, and such other non-point sources as mass-bathing, cattle-washing, and defecation, making Ganga water unfit for drinking without treatment.

The physico-chemical and bacteriological characteristics of Ganga water are monitored at 27 locations. Extensive efforts have already been made and considerable success has been achieved in restoring the water quality of the Ganga. The actions taken in the area of industrial pollution control included identifying 68 major polluting industries along the river. There has also been extensive follow-up in implementing the provisions of the Pollution Control Acts, which has resulted in the closure of some of the polluting units. The pollution control status in these 68 industries is presented in Table A-1. Additional industries are being identified, not only along the mainstream of the Ganga but also on its tributaries, and actions are being initiated to further control the pollution of this river.

Under GAP, a total of 261 schemes have been sanctioned at a cost of Rs. 347.22 crores (approximately US $100 million). The schemes include the interception, diversion and treatment of sewage, setting up electric crematoria, and low-cost sanitation and river-front facilities in the states of Uttar Pradesh, Bihar and West Bengal. Table A-2 identifies the major donors for GAP.

Table A-1
Pollution Control Under GAP

Status	No. of Industries In			Total
	UP	Bihar	WB	
ETP* operating	23	4	16	43
ETP being constructed	03	0	05	08
No ETP at site	05	0	02	07
Unit closed/locked out	03	1	06	10
Total	34	5	29	68

* Environmental treatment plant

Table A-2
External Assistance Received for GAP

Source of Assistance	Amount	Remarks
World Bank	SDR 25 M (equivalent to Rs.60 crores)	For priority pollution control works in UP and West Bengal
Royal Government of Netherlands	Dutch guilder 50 million (equivalent to Rs.60 crores)	For integrated sanitation projects at Kanpur and Mirzapur
Overseas Development Administration Government of UK	Technical assistance only	For providing technological and scientific inputs under the Ganga Action Plan

National River Action Plan. A National River Action Plan is being drafted for the abatement of pollution in the polluted stretches of major rivers that have been identified through CPCB surveys. When approved, it is proposed that the action plan be undertaken on a cost-sharing basis between the central and state governments.

APPENDIX B
USAID/INDIA PROGRAM ANALYSIS

Projects in the present USAID/India portfolio form a strong base on which to build a more ambitious Mission environmental program that focuses on pollution prevention and the link between Indian and global priorities. A number of the Mission's projects have the flexibility to accommodate a strengthened environmental focus and perhaps new activities. Further, USAID/India has, with its new strategy, the opportunity and rationale to take fuller practical advantage of USAID/W regional and global projects to help implement this strategy. Nevertheless, it is clear that the Mission will need an expanded portfolio in order to implement an increased environmental mandate. This appendix addresses these USAID programming issues.

B.1 RELATIONSHIP OF STRATEGY TO CURRENT PORTFOLIO

The environmental sector has become a growing focus of USAID/India in the past several years. With the increasing emphasis on environmental concerns in India and in USAID in general, the Mission has responded with both projects and non-project activities to address critical Indian environmental problems including urban and industrial air and water pollution, inefficient energy production and use, and the preservation of crop genetic stock.

The Mission's present portfolio includes some six projects -- FIRE, TEST, EMCAT, IPPI, PGR, and PACER -- which focus partly or wholly on environmental improvement or protection concerns. In addition, the Mission is seeking to increase its participation in the US-Asia Environmental Partnership. While relatively modest overall, these projects provide a sound platform for an expanded environmental strategy. They have also been innovative in two important ways:

- seeking to maximize private sector efforts to address selected environmental problems
- addressing the technological development dimension of environmental improvement in India.

Combining private sector approaches with technology development and transfer experience has been a hallmark of USAID/India's strategic approach within the context of India's economic development. This is expected to continue as an important part of an expanded USAID environmental strategy for India.

These projects are discussed below in terms of their relevance to the new environmental strategy, as well as their potential to undertake new activities of the strategy.

Trade in Environmental Services and Technology (TEST). This is the only current Mission project exclusively focused on addressing India's environmental problems, and is the most closely aligned with the pollution prevention focus of the new strategy. TEST is also relatively new. Its considerable remaining spending authority may give it sufficient flexibility to focus on key action elements of the new strategy.

Working through the Industrial Credit and Investment Corporation of India (ICICI), TEST provides technical assistance and seed funds to help launch Indo-U.S. private collaborations to produce environmental technologies and provide environmental services, in order to meet an increasing demand from Indian industry to upgrade pollution prevention and control technology and know-how. Started in FY 93, the project has signed two cost-sharing agreements between U.S. and Indian firms for industrial air pollution control technology, and has recently approved two vehicle emissions projects (catalytic converters and compressed natural gas conversion kits).

TEST tends to focus on "end-of-pipe" pollution control and abatement technology, and has tentatively identified opportunities to concentrate its efforts in the textile, tanning, and pulp and paper industries. TEST has not addressed the environmental services component of the project as yet, and it is in the services area that pollution prevention expertise from the United States can be utilized. For purposes of the new strategy, the Mission recommends that TEST seek to increase its emphasis in two areas:

- give equal consideration to pollution prevention approaches and "end-of-pipe" pollution controls
- include energy efficiency, as applicable, in pollution prevention technologies.

Further, the Mission believes that more attention to environmental services may bring more benefits related to the pollution prevention objectives of the strategy.

Energy Management Consultation and Training (EMCAT). This project provides technical assistance to enable Indian energy sector organizations, both public enterprises and private businesses, to better manage the generation, transmission and use of energy throughout the power sector. Activities focused on financial management and institutional capacity are given as much attention as energy efficiency measures. Begun in FY 92, the EMCAT Supply Component should produce energy efficiency benefits in power plant rehabilitation. Its End-Use Component will focus on ways to reduce existing demands for electricity through strategies such as demand-side management (DSM).

Although EMCAT is limited in its flexibility to apply new resources to the explicit environmental objectives of the new strategy, it fits well within the overall energy sector efficiency priorities of the Mission strategy, especially its relatively new end-use component. It also addresses energy sector strategies, such as privatization and management improvements, which are justifiable in their own right and beneficial for reasons other than efficiency and greenhouse gas reduction; this is directly consistent with the agency's new environmental strategy and the recommended approach for the new Mission strategy. The team recommends that EMCAT look for opportunities to directly address environmental objectives for the Indian power sector, including improved environmental impact assessment procedures for new plant development.

Plant Genetic Resources Project (PGR). This project is creating a system for the comprehensive collection of germplasm for a wide range of food crop cultivars and other plants from all over India. The germplasms are slated for classification and preservation in the world's largest plant gene bank, which is being constructed under the project.

Financial Institutional Reform and Expansion Project (FIRE). This new project seeks to tap the Indian capital markets to help improve urban environmental infrastructure. Among its other efforts, FIRE will work with USAID's Regional Housing and Urban Development Office (RHUDO) to use housing loan guarantee authority (HIGs) to demonstrate new financial models for the construction of urban water, sewage or solid waste treatment systems. Although its resources for environmental initiatives are limited, this project is innovative in its catalytic use of financial instruments to address critical urban pollution problems, and matches well with a set of Indian environmental priorities. No changes are suggested for the environmental aspects of FIRE because its current activities are consistent with the strategy.

Program for the Acceleration of Commercial Energy Research (PACER). This program provides financial assistance for applied research on technological innovations in the energy sector by supporting pre-commercial development activities by consortia of manufacturers,

research institutions and energy users. PACER has demonstrated a public-private consortia approach to research in the areas of conservation, energy storage, coal gasification and renewable energy through 17 projects in 5 years, and has helped launch several efforts that are now being commercialized. PACER's present lifespan and funding constraints will necessarily limit its ability to support new activities in the environmental strategy. However, any future PACER grants should be targeted on important energy efficiency and greenhouse gas emission reduction technologies to support these aspects of the strategy.

India Private Power Initiative (IPPI). The IPPI project, which is conducted jointly by USAID's Energy Efficiency Project, Private Sector Energy Development Project, and Energy Training Project, provides technical assistance, policy planning and regulatory development, and training to the Government of India and its agencies. The three-month, short-term assistance phase (June-August 1993) included:

- policy and regulatory planning
- transactions facilitation
- training.

The three-year, long-term assistance phase will involve establishing a coherent policy and regulatory framework for private power development, assisting the GOI and SEBs to work through their backlog of proposals, and helping establish the capability within the GOI and SEBs, through ongoing training efforts, to manage independent power development in an integrated and transparent manner.

US-Asia Environmental Partnership (US-AEP). This regional effort provides environmental fellowships and training, technology cooperation and environmental infrastructure services, and a regional biodiversity conservation network in a coalition of U.S. and Asian businesses, governments, and community groups working together to address Asian e vironmental challenges. To date, India has benefitted from the US-AEP with some training and fellowships, trade missions, the establishment of a business-cum-technology representation office in Bombay, and initial efforts to develop an energy-efficient and environmentally sound Indian refrigerator. USAID/India is seeking to increase its participation in the activities of US-AEP through the recruitment of a technical coordinator for the US-AEP program.

The use of innovative financing techniques for increased environmental investments in India is seen as accomplishing two primary objectives:

- increasing the impact of USAID assistance by "leveraging" other environmental spending from donor and Indian sources

- attracting more private capital to investments in environmental technology and services.

Financing techniques and their innovations can be important tools in the Mission's efforts to accomplish environmental objectives.

USAID and other donors have already begun to pioneer the use of innovative financing tools in this way. For example:

- USAID/India is using housing guarantee authorities (HIGs) to multiply investments in urban wastewater treatment under its new FIRE project

- US-AEP has begun an initiative to use limited development assistance funds to conduct pre-investment business planning on private sector environmental projects

- USAID overall has begun to consider "environmental credit authority" use in its new programs.

B.2 NEW PROJECT

In FY 94, USAID/India will launch an important new project for reducing greenhouse gas emissions related to its overall strategy objective of pollution prevention. This project is expected to form the Phase 1 component of a new environmental project, GEEP (see Appendix C). The Mission has begun to work with the GOI to design this GHG reduction project under agency guidelines for meeting USAID commitments to the multi-lateral Global Environmental Facility (GEF). The project fits directly with the new agency environmental strategy. While the design of this project is now just beginning, it is expected to:

- stimulate reductions in India's rate of growth of net greenhouse gas emissions
- provide catalytic financing and incentives in GHG reduction measures.

This new project represents the Mission's major initiative in this area. Other activities in the portfolio, as noted, have contributed valuable experience to the Mission's technical abilities to

maintain a robust program of activities in this area, notably its ongoing EMCAT and PACER projects.

B.3 RELATIONSHIP OF MISSION STRATEGY TO NEW AGENCY STRATEGY

The development of the new USAID/India environment strategy is part of an explicit objective to help address one of the key sets of impediments to India's development and to align Mission programs with the agency's overall increased emphasis on environmental assistance. In December 1993, USAID/W published a set of strategy papers that focus the agency's work on four central areas of sustainable development: environment, population and health, democracy, and broad-based economic growth. In making environmental protection one of its three fundamental program objectives in late 1993 (the others being population stabilization and accelerating broad-based economic growth), USAID/India has begun to take a leadership position in a key USAID country for all aspects of agency environmental strategy.

The new USAID strategy confirms the need for more ambitious environmental assistance under the foreign policy of the Clinton administration. Recognizing that the agency has undertaken a steadily growing environmental program and that its current assistance approaches are sound, the new strategy calls for changes:

- more strategic programs to address global threats, specifically, *climate change and loss of biodiversity*
- deliberate efforts to focus on environmental *priorities at the country level*
- a stronger commitment to *participation in environmental decision making by communities, NGOs and PVOs*
- improved systems for *measuring, and managing, the ultimate impacts* of USAID environmental assistance, rather than immediate inputs and outputs.

Detailed implementation guidance on these changes is forthcoming from USAID/W (as of mid-December 1993), but the basic guidelines provide a core set of principles by which mission and bureau environmental programs will be judged.

USAID/India's new environmental strategy and its associated action elements are consistent with and affirm new agency strategy. In terms of ***global priorities,*** India is a key USAID

country for both climate change and loss of biodiversity issues, and the Mission strategy calls for expanding the important efforts USAID has begun in these two areas. While it is not possible within budget constraints to carry out a comprehensive Mission program for India that addresses all aspects of agency strategy, the proposed strategy makes significant additional contributions in these areas.

The new project described in Appendix C for GHG emission reduction represents the Mission's major initiative in this area. Other activities in the portfolio, as noted, have contributed valuable experience to the Mission's technical abilities to maintain a robust program of activities in this area, notably its ongoing EMCAT and PACER projects.

B.4 RELATIONSHIP TO OTHER U.S. GOVERNMENT INITIATIVES

The Mission's strategy builds on and leverages several relevant environmental technology initiatives supported by the U.S. Government. These initiatives have valuable resources to offer the Mission in implementing its environmental strategy, and the Mission's environmental program can help contribute valuable information to these initiatives.

U.S. Environmental Technology Initiative (USETI)

In his State of the Union speech on February 21, 1993, President Clinton outlined a new environmental technology initiative to advance environmental protection through the use of innovative technologies and to enhance the development and commercialization of U.S. environmental technologies. Several of the technology demonstration, training and technical information activities planned through the USETI could complement the Mission's environment strategy. Funded for $36 million in FY 94 and currently envisioned to total $1.8 billion over nine years, the initiative includes four components:

- Environmental and Restoration Technologies
  - supports the development and commercialization of technologies that fit critical needs
- Clean Technology Use by Small Businesses

- helps small businesses to achieve regulatory compliance and competitiveness objectives through the use of pollution prevention

- Gaps, Barriers and Incentives

  - analyzes gaps in environmental technology development in order to stimulate technology innovation

- U.S. Technology for International Environmental Solutions (US-TIES)

  - promotes the application of U.S. technologies and expertise in solving international environmental problems (currently funded for $12 million in FY 94 and generally focusing on capacity-building and information dissemination); specific components of the program will include:

    - technical assistance and training
    - in-country demonstrations
    - packaging and dissemination of information on U.S. environmental technologies
    - technology evaluation/testing
    - pre-feasibility and feasibility studies
    - international markets and needs assessments.

U.S. Environmental Technologies Export Strategic Framework

In response to an Earth Day 1993 directive by President Clinton, Secretary of Commerce Ronald Brown, Secretary of Energy Hazel O'Leary, and Administrator of the Environmental Protection Agency Carol Browner worked with key agencies to formulate an environmental technologies export strategy. The activities contained in the resulting framework aim to foster sound environmental stewardship by the United States while increasing exports. The framework:

- engages U.S. businesses in the development of promising new markets by creating unified market-specific export assistance strategies

- creates expert networks abroad to provide support in key export markets

- identifies overseas market opportunities and channels them back to U.S. firms
- increases access to export financing for environmental technology firms
- establishes environmental technologies experts in regional "one-stop shops" to assist exporting firms domestically.

The strategic framework calls for fostering new partnerships with the private sector to expand opportunities for U.S. environmental goods and services overseas. Details of these partnerships are currently being developed in joint government-business dialogues. As the framework is implemented, the Mission may find enhanced opportunities to transfer appropriate U.S. environmental goods and services to India.

U.S. Environmental Training Institute

The U.S. Environmental Training Institute (USETI) is a public-private partnership that was launched by USEPA to provide decision-makers from industrializing countries with training in appropriate environmental technologies and management practices. The training and follow-up activities link participants with U.S. providers of environmental goods and services. Most USETI courses first bring participants to Washington, DC for a policy introduction to the subject and then travel to locations around the United States for on-site training covering the latest environmental technologies and management practices. The US-AEP provides scholarships for professionals from Asian countries to attend USETI courses.

Other U.S. Government Initiatives

The U.S. Department of Transportation (USDOT) and the Department of Energy (USDOE) have research activities on subjects of mutual interest to the United States and India. USDOT has initiatives related to the efficient use of transportation and USDOE has several activities related to energy efficiency and alternative fuels. In addition, the National Oceanic and Atmospheric Administration (NOAA) has related expertise in areas including meteorological monitoring and forecasting, while the National Institutes of Health (NIH) has experience in building laboratory capacity and joint health research activities. While these agencies were not specifically contacted in connection with this strategy, follow-up on potential collaboration for specific projects is recommended.

B.5 OTHER DONOR ACTIVITIES

Many bilateral and multilateral donors support environmental projects in India. Current programs include the following:

Indo-Australia. Australia supports a project on cleaning Hussain Sagar Lake in Hyderabad.

Indo-ADB. The Asian Development Bank (ADB) provided assistance for a project on the review of environmental laws in India. An agreement has been signed with the ADB for developing environmentally sound coal technology. A number of other projects are ongoing.

Indo-Canada. CIDA (Canadian International Development Agency) has agreed in principle to support the Eco-Development of Chilka Lake Project in Orissa. The project is being finalized. In addition, the GOI is seeking cooperation from CIDA in the areas of forestry, wildlife and conservation.

Indo-DANIDA. DANIDA is considering supporting a project to develop an Environmental Master Plan Study of South Kanara District in the State Karnataka. DANIDA currently supports a project on the environmentally sound development of three lake areas in Tamil Nadu. The Government of Denmark has also been approached to strengthen the Tamil Nadu Pollution Control Board and take up the study of pollution in Ooty Lake.

Indo-EEC. The EEC and India have collaborated primarily in the area of pollution control. An ambient air quality monitoring station in Delhi has been installed under EEC cooperation. India is now seeking cooperation with the EEC in the areas of clean technology, waste minimization, and industrial pollution control, with special reference to the dye and chemical industries.

Indo-France. In 1982, India and France signed an agreement to initiate cooperation on the environment. The GOI is seeking to develop activities related to clean technologies, technology transfer in sustainable development, waste minimization, and environmental audits and water quality monitoring.

Indo-FRG. The Indo-German project started in 1985 with the aim of strengthening the laboratories and training the staff of the CPCB and SPCBs. The project provides equipment and organizes training. The Germans also provide short-term consultancies covering 19 areas, such as laboratories management, analytical quality control, environmental impact assessment, and environmental planning. Phase I of the project ended in 1989, and Phase II is under

implementation. In Phase II, nine laboratories of the central/state boards are being strengthened. These laboratories are in Bangalore, Baroda, Bhopal, Calcutta, Delhi, Gandhinagar, Guwahati, Jaipur and Patiala. Another major project includes operating automatic ambient air quality monitoring stations, and mobile and stack monitoring units in Delhi.

Indo-Japan. During their annual consultations, the Japanese agreed to consider supporting the establishment of a national environmental management and training center in India. The Japanese are also planning loan assistance for the Yamuna Action Plan and Greening of Aravalli Hills Project.

Indo-Dutch. The Dutch are providing assistance to the Ganga Action Plan for executing schemes in Kanpur and Mirzapur, conservation, industrial counselling and institutional strengthening. The Dutch are also considering a number of new project ideas in the areas of global environmental problems and conservation under their Spearhead Program. They have also provided training on sampling and analysis under a project to monitor the Yamuna River. The Dutch have also agreed to strengthen the Kerala Pollution Control Board, and to provide pollution control assistance to the small-scale textile industry and to the Gujarat State Fertilizer Company.

Indo-Norway. Projects for Norwegian assistance in Orissa have been identified and are being formulated. A proposal for NORAD assistance to the Disaster Management Institute in Bhopal is also under consideration. NORAD has agreed to support the strengthening of the G.B. Pant Himalayan Institute and plans to start environmental projects in Karnataka, Rajasthan and Himachal Pradesh in addition to Orissa. Its other approved projects include pollution monitoring of the aluminum industry and dispersion modelling of air pollutants in Delhi, Dhanbad, Chembur, Visakhapatnam and Talcher. The main objectives are to transfer expertise on air quality modeling to scientists from the CPCB and SPCBs of Andhra Pradesh, Orissa, Maharashtra and Bihar. The model development and the training program will be implemented by the Norwegian Institute of Air Research

Indo-Sweden. SIDA has supported some seminars on administrative development in the forestry sector. It has also set up an Environmental Center in Hyderabad. Another project on assistance to paper and pulp mills is currently being considered.

Indo-UK. The British Government has offered assistance for a project on Environmental Forestry in Western Ghats (Karnataka). The ODA has also agreed to support environmental

forestry projects in Himachal Pradesh and Uttar Pradesh, as well as technical assistance in selected areas under the Ganga Action Plan.

The World Bank. The GOI entered into an agreement with the World Bank in July 1991 on a project for industrial pollution control. The agreement includes a line of credit of US $155.6 million over a period of five years. An estimated US $112 million is to be provided as counterpart funds by the Government of India, state governments, individual industrial units availing the loans, and financial institutions involved in the project. The main objectives of the project are to:

- strengthen the monitoring and enforcement abilities of the Pollution Control Boards of the heavily industrialized states in the country, i.e., Gujarat, Maharashtra, Tamil Nadu and Uttar Pradesh

- get individual industrial units to install appropriate pollution control devices, with a focus on the chemical and related industries (this will include process modernization for waste minimization and resource recovery, which have a positive impact on pollution reduction)

- assist in the establishment of central effluent treatment plants for clusters of small-scale industrial units

- introduce clean technologies to minimize the generation of wastes.

APPENDIX C
FY 1994 NEW PROJECT NARRATIVE -- USAID/INDIA: GREENHOUSE GAS AND POLLUTION PREVENTION (GEEP) PROJECT

February 1994 Draft

C.1 STRATEGIC CONTEXT

India's rapid population, economic and industrial growth are causing increasingly severe environmental degradation through rapid expansion of pollution emissions. Indian environmental degradation is significant for local, regional and global populations. Low efficiency in the generation, transmission, distribution, and utilization of energy is key to India's resource misuse and environmental deterioration. India is the world's fifth largest producer of Greenhouse Gases (GHGS), the world's second fastest growing source of those gases (after China), and the second most important source among countries with USAID programs. Greenhouse gases include Carbon Dioxide (CO_2), Nitrogen Oxide (NOX), Methane, Water Vapor, certain Halocarbons, and Ozone.

Greenhouse gas and other emissions are released in India in large part from fossil fuel energy generation, which contributes 70% of all India's electric power. This pollution will certainly worsen as India seeks to meet the legitimate energy needs of its expanding economy. Coal is the fuel source for more than 68% of fossil fuel power generation. India plans to add some 70,000 Megawatts (MW) of new power capacity in the next 10-12 years, doubling present capacity, primarily fueled by domestic coal. Important pollutants aside from the principal GHGS include sulfur dioxide emissions, coal mining runoff and wastes, and millions of tons of coal ash solid wastes (Flyash) which must be disposed of annually. India's domestic coal has one of the highest ash contents in the world, averaging between 40 and 50 percent by volume.

C.2 USAID STRATEGIC OBJECTIVE SUPPORTED

This project is part of an expanded and deliberate USAID/India strategic focus on environmental priorities at the country level, and is thus part of USAID/India's new strategic objective of protecting the environment. The GEEP builds on and advances basic project interventions in the Program for Acceleration of Commercial Energy Research (PACER), the

Energy Management Consultation and Training (EMCAT), and the India Private Power Initiative (IPPI) Projects.

The strategy is consistent with USAID's new global environmental strategy and its priority on global climate change. USAID/India's program strategy was approved in December, 1993 and the USAID/India environmental strategy is almost finished. The specific components of program strategy which will be addressed are increasing energy productivity and improving air quality. Therefore, the project is focused on key mission strategy components.

C.3 PROJECT PURPOSE AND OUTPUTS

The purpose of the GEEP project is to reduce the emission of greenhouse gases related to energy generation, transmission, distribution, and use in India. The impact of the GEEP project will be to reduce GHG emissions from fossil fuel electric power generation and increase the productivity of such generation. Benefits will accrue to the Indian and global environment.

The project will produce the following outputs to substantially reduce GHG emissions resulting from inefficient energy generation:

- promotion of efforts in the power and industrial sectors, focused on coal combustion and overall coal-fired power plant efficiencies
- pilot development of "Green" power tariffs which will provide incentives for higher efficiencies in power production from new private generation facilities
- expansion of renewable energy generation including biomass and industrial cogeneration.

At present, USAID/India sees the GEEP project as concentrating solely on energy efficiency in the electric power sector, as described above. However, during the final design stage, we will look at the costs and benefits associated with including other opportunities for GHG reduction. These other opportunities include incentives for landfill gas and coal-bed methane development.

C.4 PROJECT IMPACT/MEASURING RESULTS

Principal GEEP results will be measured by India's reduced rates of growth in overall GHG emissions by the power sector. Implementation of a number of the measures identified above will produce measurable impact in reducing actual emissions from target facilities, a key requirement of Global Environmental Facility (GEF) projects. Impact will also result from T.A. which will help to establish the viability of key institutions through training in their roles to insure sustainability of specific energy efficiency and GHG reduction practices in India as well as standards and policies which promote these improvements. The project will develop performance-based indicators in accordance with new agency guidance expected to be issued shortly.

C.5 RELATIONSHIP TO OTHER DONOR ACTIVITIES

While these activities build on USAID/India's existing programs in commercializing energy technology research, promoting power sector management reforms and efficiency, and increasing private sector investment in power generation and environmental service and technology transfer, a principal criterion in selecting GEF project activities will be their potential to serve as catalysts for leveraging expansion and follow-on activities which will be supported by other important donor organizations such as the World and Asian Development Banks. These organizations are currently implementing environmental and energy projects and, as in the case of USAID, are increasing their emphasis on environmental improvement.

Relevant efforts include: 1) the World Bank's GEF renewable energy development project with IREDA and its industrial pollution control project initiated in 1991 and its pending industrial energy efficiency project; and 2) the Asian Development Bank's environmentally sound coal technology project currently being planned. USAID's environmental program will be innovative and catalytic for leveraging additional resources from these donors. Existing lines of credit with the U.S. Export-Import Bank may also be leveraged. Leveraging is highly probable because the GEEP is directly related to initiatives currently being implemented and future plans of the World Bank and the Asian Development Bank (ADB) in the areas of energy efficiency, industrial pollution control, and clean coal mining and fuel use. Other bilateral donors are also supporting activities in these areas. Both banks have encouraged USAID to proceed rapidly and the ADB sees USAID's activities as precursors to their own.

C.6 PROJECT INTERVENTIONS AND MANAGEMENT REQUIREMENTS

The project will provide technical assistance, training and investment support funding. The technical assistance and training will strengthen Indian private and public sector institutions which are active in financing and implementing energy conserving investments, mostly in fossil fuel powered generation and power transmission, distribution and use, as well as coal mining and processing for fuel supply to power generation. Institutions working in the cogeneration of power with industrial processing will also receive technical assistance and training.

Finally, technical assistance and training will target organizations which are involved in the implementation of "Green" power incentives. Investment support funding in the form of loan guarantees, conditional grants (a mechanism requiring repayment only if innovative technology development succeeds commercially. This mechanism is currently being successfully used in several USAID/India projects), or other pre-project financing will be provided for private investments in energy productivity enhancement most likely to be channeled through an Indian development finance institution.

In addition, the project will actively network with other USAID organizations such as the Global Bureau and USAEP, as well as other U.S. Government agencies active in project-related areas. These include the Environmental Protection Agency, the Department of Energy, the Overseas Private Investment Corporation, the Export-Import Bank, and the Trade and Development Agency. It is not possible at this time to estimate the level of resources which will be drawn upon from those organizations, but those arrangements and funding level estimates will be specified during GEEP assistance proposal development and funding levels estimated precisely.

C.7 POLICY AGENDA FOR GEEP

The policy issues include fiscal policies to provide incentives for power tariff pricing policies to encourage conservation and innovation, power wheeling and banking policies (both issues deal with the sale of power through existing electric power grids which makes cogeneration commercially viable) to strengthen returns for renewable and cogeneration power, and policies to encourage higher energy use through demand-side management. GEEP resources will judiciously focus on these policy areas principally by supporting Indian private sector support in national policy dialogue.

APPENDIX D
SUPPORTING TABLES

Table D-1
Environmental Consequences of Energy Production

Principal Sources	Environmental Effects	Regions Affected
Oil and natural gas ▸ onshore drilling rig ▸ offshore oil and gas platforms ▸ gas processing plant ▸ on/offshore fabrication facility ▸ petroleum refinery ▸ petrochemical facility (multi-product)	1. Blowouts: uncontrolled releases of oil or gas; these tend to be more frequent in offshore drilling. 2. Brine: disposal of production waters. 3. Flaring/venting: methane is a greenhouse gas and a major constituent of natural gas. 4. Construction: routine plant and equipment activity. 5. Ecosystem: intensification of land, ocean and coastal zone usage often reduces the area available for agriculture, coastal areas, and natural habitats, including wetlands and forests. Socioeconomic: large resource projects create a demand for housing, infrastructure and people. Often the community can double or even triple in size, bringing about an expansion of infrastructure.	Western region-Southern Gujarat, Bombay High, Bassein fields, Godaveri basin, Assam fields
Coal ▸ underground mining ▸ surface mining	1. Emissions: potential for severe pollution of the land, water, and air with dust, methane, fires causing sulfur dioxides, and carbon monoxide. 2. Surface mining: damage to surrounding ecosystems, erosion, air quality, aesthetics and climate change. The activities related to the development of a coal mine, including road building, mine entries, dynamite use, buildings, and intensive use of transport (rail or truck), cause reductions in air and water quality and affect nearby communities.	UP, Bihar, Maharashtra, MP collieries, Neyveli fields

Table D-1
Environmental Consequences of Energy Production (continued)

Principal Sources	Environmental Effects	Regions Affected
Electric power production ▸ fossil fuel-based electricity generating facilities ▸ hydroelectric	1. Both coal- and oil-fired plants contribute air pollution (SO_2, CO_2, NO_x and other hydrocarbons), water pollution (heavy metals and thermal effects), and solid wastes. A facility using coal without emissions control is considered a major source of pollution. Oil-fired and gas-fired facilities usually generate lower emissions than a coal-fired facility, but still need emissions control to meet standards. 2. Natural gas-fired plants offer the lowest global warming effect of any fossil fuel plant, e.g., CO_2 emissions are half those of conventional steam plants. Gas is the cleanest combusting of the fossil fuels, emitting negligible SO_x, requires lower plant acreage, and has fewer water needs per kWh of electricity generated. 3. The size of hydro developments greatly influences the type and magnitude of social, environmental and health impacts. Social impacts tend to be the most complex problem; reservoir creation may require flooding and resettlement of communities, environmental impacts include changes in local ecology that affect wildlife, fisheries and possibly downstream activities, and health impacts due to propagation by water-borne disease vectors that could breed in the reservoirs.	Most metro areas and approximately 200 industrial estates.
Renewable energy ▸ solar ▸ biomass ▸ wind	Solar: direct impacts include land usage and toxicity of additives in heat transfer medium Indirect impacts include emissions during cell manufacture (copper, aluminum, steel, glass, fiberglass, and cement). Biomass: direct impacts include deforestation and emissions of particulates, CO, NO_x, ash, and organics. Indirect impacts include increased transportation of fuel as the fuel value of biomass is roughly half to two-thirds of that coal; effluent during biomass conversion to liquid fuels which pollute surface waters and groundwater; and the removal of large quantities of biomass can affect local soil and aquatic biota causing further changes in the ecology.	

Source: RCG/Hagler Bailly, Inc., January 1994.

Table D-2
Origin and Fate of Major Greenhouse Gases and Other Air Pollutants

Gas	Major Anthropogenic Sources	Anthropogenic/Total Emissions per Year (Millions of Tons)	Average Residence Time in Atmosphere	Average Concentration 100 Years Ago (PPB)	Approximate Current Concentration (PPB)	Projected Concentration in Year 2030 (PPB)
Carbon Monoxide (CO_2)	Fossil-Fuel Combustion, Biomass Burning	700/2,000	Months	?,N.Hem 40 to 80, S.Hem. (Clean Atmospheres)	100 to 200, N.Hem. 40 to 80, S.Hem. (Clean Atmospheres)	Probably Increasing
Carbon Dioxide (CO_2)	Fossil-Fuel Combustion, Deforestation	5,500/ ~ 5,500	100 Years	290,000	350,000	400,000 to 550,000
Methane (CH_4)	Rice Fields, Cattle, Landfills, Fossil-Fuel Production	300 to 400/550	10 Years	900	1,700	2,200 to 2,500
NO_x Gases	Fossil-Fuel Combustion Biomass Burning	20 to 30/ 30 to 50	Days	.001 to ? (Clean to Industrial)	.001 to 50 (Clean to Industrial)	.001 to 50 (Clean to Industrial)
Nitrous Oxide (N_2O)	Nitrogenous Fertilizers, Deforestation, Biomass Burning	6/25	170 Years	285	310	330 to 350
Sulfur Dioxide (SO_2)	Fossil-Fuel Combustion Ore Smelting	100 to 130/ 150 to 200	Days to Weeks	.03 to ? (Clean to Industrial)	.03 to 50 (Clean to Industrial)	.03 to 50 (Clean to Industrial)
Chlorofluoro-Carbons	Aerosol Sprays, Refrigerants, Foams	~ 1/1	60 to 100 Years	0	About 3 (Chlorine atoms)	2.4 to 6 (Chlorine atoms)

Source: *Scientific American*. [Note: ~ = approximately; ? = uncertainty.]

Table D-3
Recommended Action Programs:[1] Schedule and Budget
USAID/India Strategic Approach to Environmental Protection

Program	Composite Score Ranking	Start Date[2]	Duration (Years)	Cost ($000)
Pollution Prevention and Greenhouse Gas Reduction				
Fossil Fuel Use (Energy Efficiency)	3.25	Oct. 94	3	5,000
Planning/Organization[4]	3.25	Oct. 94	4	2,000
Fuel Switching (Gas Use)	3.00	Oct. 94	4	2,250
Renewables	3.00	Oct. 94	4	1,000[3]
Cogeneration	2.50	Oct. 94	4	1,500
Resource Extraction	2.25	Oct. 94	4	5,500
Transportation (Energy Efficiency)	2.00	Oct. 94	4	2,000
Substitute ODS	2.00	Oct. 94	4	500
Conservation of Biodiversity				
Conserve Economically Valuable Biodiversity[5]	3.00	June 94	3	1,500
Transfer of Clean Technologies and Training				
Joint Ventures of U.S. and Indian Firms	3.50	June 94	5	750
Training Programs[6]	3.25	June 94	5	2,250
Clean Technology and Chemicals in Industry[7]	2.50	June 95	5	9,550
Pollution Prevention Practices in New/Expanding Industrial Sectors	2.25	April 95	3	2,350

Notes to Table D-3

[1] Within major categories, the order of the projects is prioritized. The major categories are considered equivalent.

[2] The projects can start earlier if existing funding mechanisms are used.

[3] Soft money to complement ADB projects.

[4] Includes setting up and upgrading laboratory/research facilities and privatizing energy distribution systems.

[5] Includes in-situ conservation of economically valuable biodiversity and strengthening of NGO capacity.

[6] Includes, among others, improvements to environmental training capacity program implementation training, environmental policy training, policy/political level, and USETI training.

[7] Includes the promotion of, among others, total facility assessments, environmental action plans, clean technology demonstrations, recycling and re-use, pollution prevention plans, and pollution prevention consulting.

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Carbon Dioxide (CO_2)	Fossil-Fuel Combustion, Deforestation	5,500/ ~ 5,500	100 Years	290,000	350,000	400,000 to 550,000
Methane (CH_4)	Rice Fields, Cattle, Landfills, Fossil Fuel Production	300 to 400/550	10 Years	900	1,700	2,200 to 2,500
NO_x Gases	Fossil-Fuel Combustion Biomass Burning	20 to 30/ 30 to 50	Days	.001 to ? (Clean to Industrial)	.001 to 50 (Clean to Industrial)	.001 to 50 (Clean to Industrial)
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Source: *Scientific American*. [Note: ~ = approximately, ? = uncertainty.]

APPENDIX E
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