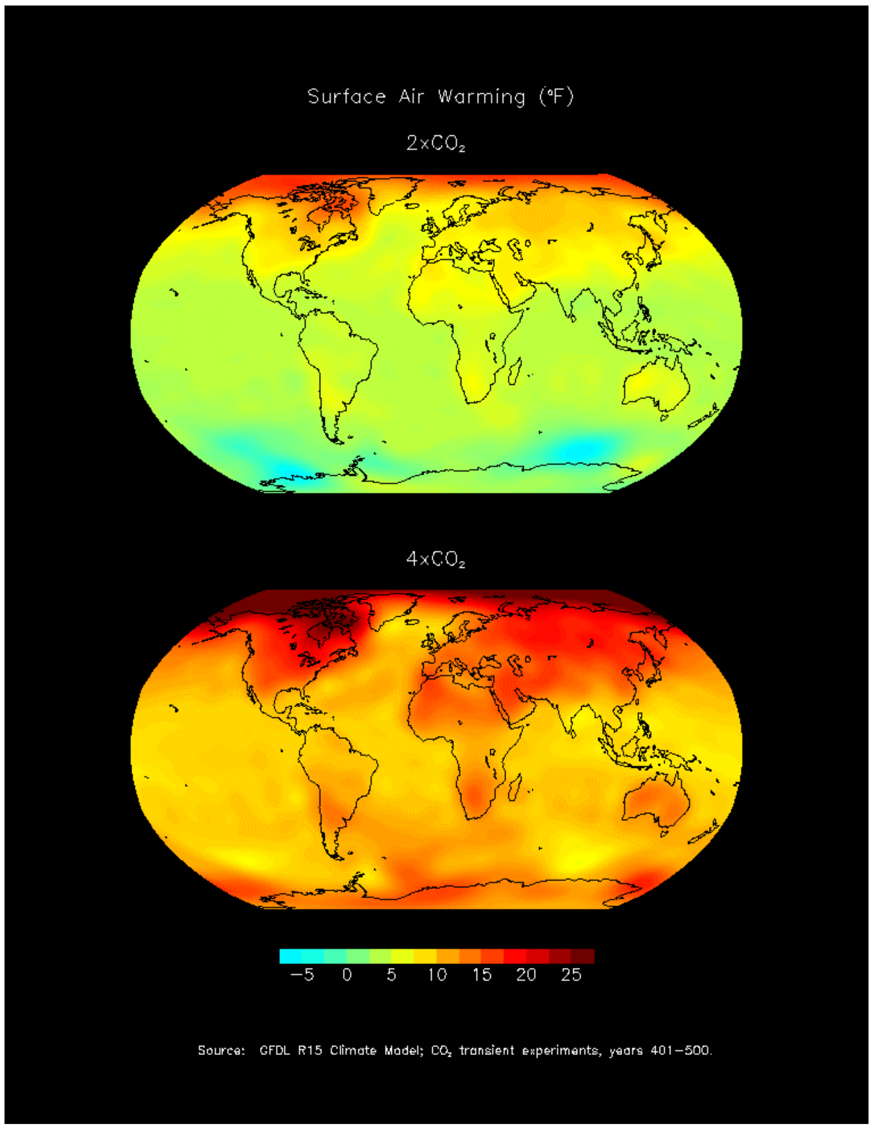
Climate Change:
Assessing Our Actions



Overseas Private Investment Corporation
October 2000

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A MESSAGE FROM THE OPIC PRESIDENT

Preserving the environment and building economies need no longer be seen as competing goals. Increasingly, new technologies are beginning to harness sustainable energies in ways that both protect the global environment and expand economic opportunity for global citizens. Indeed, if we are to endow future generations with the environment *and* the economic opportunity they deserve and require, this trend must continue. As a step in that direction, the Overseas Private Investment Corporation (OPIC) is issuing the enclosed report, *Climate Change: Assessing Our Actions*.

The report found that OPIC's power portfolio is driven predominantly by clean-burning, low-carbon natural gas (45 percent) and carbon-free hydro- and geothermal energy (27 percent). It concludes that OPIC-supported projects "are *not* a major contributor to global greenhouse gas emissions or climate change." Current carbon dioxide emissions from OPIC-supported projects represent 0.24 percent of global CO_2 emissions. In addition, OPIC projects tend to utilize highly efficient advanced technologies, more than 45 percent of them making use of combined cycle technology – the most efficient electricity-generating technology available.

For OPIC, the report is satisfying on several counts. First, it affirms our leadership role among bilateral investment finance and export credit agencies in assessing the environmental impact of the projects we support. Rather than calculating only the annual aggregate emissions of CO_2 from OPIC's thermoelectric power projects, the report takes into account the *cumulative* impacts of OPIC's *entire* thermoelectric portfolio.

Secondly, a third party verifier reviewed OPIC's methodology – the same methodology applied by the World Bank and other leading international financial organizations to make their calculations – and confirmed the validity of the results. Independent verification is the best support for OPIC's effort to undertake responsible environmental protection.

Lastly, the report represents OPIC's progress down a road less travelled. Since 1985, when Congress gave OPIC a specific environmental mandate, OPIC has evaluated the environmental consequences of each and every prospective project. Not only will OPIC reject support for projects that pose major or unreasonable adverse environmental impacts, but we actively look for opportunities to make a *positive environmental difference* through the projects we support.

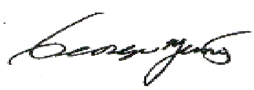
In 1998, OPIC began to calculate and report on annual aggregate emissions of carbon dioxide from its thermoelectric power projects, responding to the need for responsible environmental stewardship in the face of the growing importance of transboundary and global environmental impacts. And, throughout, OPIC has carefully monitored the projects in its portfolio to ensure ongoing compliance with World Bank-level standards.

In that context, *Climate Change: Assessing Our Actions* represents the latest and most advanced OPIC measure to track the environmental impacts of the projects it supports. We at OPIC see our commitment to natural gas as part of our role in helping the developing world make a transition to less carbon-intensive fuels. Without question, that is the single greatest contribution OPIC can make to the trend toward weaving together environmental and economic needs.

Yet this report is one of only many steps OPIC intends to take in that process. More needs to be done to harness and support renewable energy sources such as wind and solar power. OPIC looks forward to working with the renewable energy industry to develop innovative financing mechanisms which will help lead newer technologies into the marketplace.

In the meantime, we are issuing *Climate Change: Assessing Our Actions* as a demonstration of OPIC's commitment to the principle that economic development and environmental protection can go hand in hand.

Sincerely,



George Muñoz
President and Chief Executive Officer
Overseas Private Investment Corporation

Independent Review

OPIC is to be congratulated for its forthright effort to assess the global warming and other environmental impacts of the power projects that it finances and insures. The greatest growth in electric power is expected in developing countries and Eastern Europe, and so the greatest opportunity for avoiding the locking in of carbon dioxide, methane and air pollution emissions over the next half-century lies in the investments now being made there.

Before I begin, I have just two caveats. My analysis is based solely upon the report itself, and I did not independently examine the raw data, nor did I verify the types of projects that OPIC has supported.

First, the methodology used by OPIC for the analysis of its projects is a standard and generally accepted method for estimating CO_2 emissions from power plants. A rough estimate shows that the reported figures are of the right scale. The only additional related greenhouse gas emissions that might be significant are from methane. Methane is a much more potent greenhouse gas than CO_2 and is associated with leaks from aging gas pipelines, from coal mining, and oil and gas production. However, OPIC is either not invested at all (e.g. coal mining) or is not heavily invested in these sectors compared to thermoelectric power.

The report appropriately calculates CO_2 emissions three ways: total tons, as a percentage of global and of developing country emissions, and as an index of tons of carbon dioxide per Gigawatt of OPIC supported power capacity. The total tons provides a measure of the total contribution of OPIC projects to global warming, while the percentages place that in an overall context. The figure of 0.24% of world emissions, projected to grow to 0.43% by 2015 may seem small, but still represents a measurable contribution and should not be ignored. The third intensity measure may be the most useful in determining how OPIC projects compare with other investments. From the high efficiency and the mix of projects supported to date, OPIC projects have lower GHG emissions than the average constructed in the regions, but in the future this comparison should be quantified. OPIC might also utilize this index as a criterion and as a measure of progress for future projects. The relevant question is what will be OPIC's greenhouse gas policies towards future projects; should it consider adopting an incentive program for lowering emissions from future projects? As stated, the potential for emissions growth in developing countries justifies OPIC's efforts to support lower emitting power projects. OPIC might also wish to take more credit for the co-benefits of clean air that accompany their projects as well as the CO_2 reductions.

The proposal to develop a workshop for renewable supply options in the near future is commendable, and builds upon two ongoing trends. The first is the high success demonstrated by the Danish government in promoting Danish built wind turbines in countries such as India. The second is the emerging potential of some sort of a Clean Development Mechanism for low carbon energy projects in developing countries that will be decided at a meeting in the Hague this November.

The proposal to "reach out to the renewables industry" has real potential for identifying low carbon options for future OPIC projects. For example, wind turbines are the fastest growing source of energy supply on a percentage basis, and world installed capacity now exceeds 15,000 MW – nearly equaling OPIC's total installed capacity of 16,775 MW. The potential for OPIC to finance low carbon emitting options in the power sector could lower their projected increase in carbon dioxide emissions, and help establish a standard for others to follow. The pessimistic forecast of EIA and DOE for renewables could be correct for the US, but may not apply to the opportunities in developing countries that lack the extensive transmission and distribution system of the US. Also, the opportunities for renewables in deregulated markets is largely untested, and projections of their potential, even in the US, vary widely.

The US Senate position on the participation of developing countries in meaningful reductions must be seen in the following context: the UNFCCC and the Berlin Mandate both clearly state that developing countries have "differentiated responsibilities" and that industrial countries must be the first to proceed with reductions. That said, OPIC, whose sole focus is on the developing world, has the unique opportunity to play an important role facilitating the participation of the developing countries critical to the resolution of the climate problem.

Prof. William R. Moomaw
Director, International Environment and Resource Policy Program
The Fletcher School of Law and Diplomacy, Tufts University, Medford, MA

Executive Summary

- OPIC has undertaken a review of the cumulative annual greenhouse gas (GHG) emissions and climate implications of all OPIC finance and political risk insurance projects since 1990. This review is consistent with OPIC's long-standing commitment to the environment and sustainable development. OPIC's review concludes that the cumulative annual GHG emissions from OPIC-supported projects do not substantially contribute to global GHG emissions and associated climate change impacts. Current CO_2 emissions from OPIC-supported projects represent approximately 0.24% of global CO_2 emissions.

- OPIC attributes its conclusions to the fact that its 16,775 MW power portfolio relies primarily on less carbon-intensive natural gas and carbon-free renewable hydroelectric and geothermal rather than carbon-intensive coal and oil. OPIC-supported power projects, on a capacity basis, are approximately 45% gas-fired, 24% hydroelectric, and 3% geothermal, while coal- and oil-fired projects make up approximately 21% and 7%, respectively. In addition, OPIC-supported power projects tend to use highly efficient advanced technologies that emit fewer GHGs per unit of electrical output. For example, more than 43% of OPIC-supported fossil fuel-fired power projects incorporate combined cycle technology, the most efficient fossil-based electricity generating technology.

- Although OPIC-supported projects are not in themselves a substantial contributor to climate change, OPIC recognizes that renewables, such as wind and solar power, have a potentially important role to play in reducing global reliance on fossil fuels and their concomitant GHG emissions. Therefore, OPIC will seek to support these emerging power sources through better outreach to the renewable energy industry and by providing innovative financing.

- OPIC's methodology and conclusions have been independently validated by a noted climate change expert.

I. OPIC and Climate Change

Summary: OPIC is a bilateral development agency and a major source of financing and support for the development of U.S. private sector participation in a wide range of investments, including many independent power projects, in developing countries and emerging economies. OPIC-supported power projects serve a critical development objective and bring considerable economic and social benefits to developing regions. However, the power sector is a major source of the anthropogenic greenhouse gas (GHG) emissions that threaten the stability of the global climate system. OPIC understands the serious implications of GHG emissions and climate change and was the first bilateral finance, investment insurance or export credit agency to commit to tracking and reporting annual CO_2 *emissions. This report, however, goes beyond OPIC's annual GHG assessments, to evaluate the cumulative climate implications of all OPIC finance and political risk insurance projects since 1990. The results of this report demonstrate that OPIC is not a substantial contributor to global GHG emissions or to climate change. Annual* CO_2 *emissions from OPIC-supported power projects represent less than 0.24% of global* CO_2 *emissions. Although OPIC activities are not in themselves a substantial contributor to climate change, OPIC recognizes that renewables, such as wind and solar power, have a potentially important role to play in reducing global reliance on fossil fuels and their concomitant GHG emissions. Therefore OPIC will seek to support these emerging power sources through better outreach to the renewable energy industry and by providing innovative financing for such projects.*

OPIC is an independent government agency whose mission is to mobilize and facilitate the participation of United States private capital and skills in the economic and social development of less developed countries and areas, and countries in transition from nonmarket to market economies. In carrying out this mission, OPIC's finance and political risk insurance programs support a wide range of investments in some 140 developing countries. All OPIC projects support the U.S. economy, contribute to the economic and social development of the host country, protect the rights of workers, and safeguard the environment. All OPIC projects meet World Bank environmental, health and safety standards, and OPIC carefully monitors projects in its portfolio to ensure ongoing compliance with these standards.

Developmental Benefits of Power

The power sector represents 30% of the OPIC project portfolio. OPIC-supported power projects serve a critical development objective and bring considerable economic and social benefits to developing regions. Access to energy supply is fundamental to eradicating poverty and improving standards of living around the world, where nearly two billion people live below the poverty line without access to modern forms of energy, such as electricity. The availability of energy to provide water supply and sanitation or refrigerators for vaccines, for example, has a great impact on health. Freeing rural people, usually women and children, from the daily routine of collecting fuelwood or carrying drinking water over long distances makes them available for more productive work or for education, both of which are primary development objectives and lead to future income opportunities and increased standards of living.

CO_2 Emissions from Power Projects

However, while power projects have considerable economic and social developmental benefits, they are also responsible for a significant share of the anthropogenic emissions of greenhouse gases (GHG) that threaten the stability of the global climate system. The consumption of fossil fuels, which provides electricity, heat and steam to the industrial, commercial and residential sectors, and fuel to the transportation sector, is by far the largest contributor to global carbon dioxide (CO_2) emissions. Approximately 38% of total global energy consumption goes to supply power plants which are the largest emitters of CO_2, accounting for nearly 32% of total global CO_2 production.

Power plants produce electricity by converting chemical energy stored in fossil fuels into electrical energy. During the energy conversion process, fuel-bound carbon is oxidized to CO_2 and released to the atmosphere. Fossil fuels like natural gas, that have relatively high chemical energy contents and low carbon contents, produce the lowest emissions of CO_2, while coal generally produces the greatest CO_2 emissions. In addition, some power generation technologies, like combined-cycle plants, are more efficient at converting chemical energy into electrical energy and produce fewer CO_2 emissions per unit of electrical output. As a result, fuel and technology choices have a significant impact on the level of CO_2 emissions produced by power generation facilities, with natural gas and high efficiency combined cycle plants producing significantly lower CO_2 emissions than other fossil fuel-based plants. Renewable energy projects generally produce little or no CO_2.

Climate Change

Carbon dioxide and other atmospheric greenhouse gases have long been known to absorb infrared radiation and create a natural greenhouse effect that warms the Earth. The natural greenhouse warming of the atmosphere keeps the Earth approximately 60°F warmer than it would be without an atmosphere. However, humans have been emitting increasing quantities of these greenhouse gases since the advent of the fossil fuel-driven industrial age and now emit 25 billion tons of CO_2 annually. As a result, atmospheric CO_2 concentrations are now at their highest levels in more than 160,000 years and global mean temperature has increased approximately 1°F over the past century. There is a strong and growing scientific consensus that these steady additions of GHGs have tipped a delicate balance and begun to impact our climate and may be the dominant force driving recent warming trends. *(For more information on climate change, see Chapter III: An Introduction to Climate Change.)*

Given the link between GHG emissions and development, industrialized countries are responsible for the bulk of past GHG emissions. However, the rapid economic and population growth forecast for the coming decades, particularly in the developing world, is expected to substantially increase demand for energy and global GHG emissions. Global CO_2 emissions are projected to increase from 22.6 billion metric tons in 1997 to 29.9 billion metric tons in 2010 and 36.7 billion metric tons in 2020 (not taking into account the potential impact of the Kyoto Protocol, as discussed below). Developing countries as a group are expected to account for as much as 70% of this increase. Current forecasts suggest that growth in GHG emissions could double atmospheric concentrations of CO_2 by 2060 with a resulting temperature increase of as much as 2° to 6.5°F over the next century. Even the low end of such a temperature increase would be an unprecedented rate of warming and may alter patterns of precipitation and evaporation and lead to more severe weather, rising sea levels, and potentially adverse economic, ecological and human health impacts. *(For more information on GHGs, see Chapter IV: Global Production of Greenhouse Gas Emissions.)*

International Response to Climate Change

The potential adverse effects of "enhanced" greenhouse warming and climate change have been the focus of much international debate. Power plants and other major energy systems in particular have been the focus of attention from the Intergovernmental Panel on Climate Change (IPCC), the international organization tasked with assessing the risk of human induced climate change. International efforts to reduce GHG emissions and stabilize atmospheric GHG concentrations culminated in 1997 with the Kyoto Protocol to the UN Framework Convention on Climate Change (UNFCCC), which commits industrialized countries to legally-binding GHG emissions reduction targets. Although 83 countries have signed the Protocol, only 16 countries have ratified it to date. Given the critical role of energy in development and in improving living standards, the goal of the Protocol is not to limit access to energy, but to provide energy that is less carbon intensive. As different approaches to achieve emissions reductions are carefully evaluated and international negotiations continue, most countries have implemented programs similar to those in the U.S. that promote research, tracking and reporting of carbon emissions, voluntary mitigation measures, energy efficiency and renewable energy technologies. For the most part, governments and international organizations continue to support fossil fuel power plants. The U.S. government does not currently regulate CO_2 domestically and the EPA has not promulgated emission limits for CO_2. *(For more information on the international response to climate change, see Chapter V: International Response to Climate Change.)*

OPIC and Climate Change

OPIC has a longstanding commitment to the environment and sustainable development and recognizes the serious implications of climate change and the need to stabilize atmospheric GHG concentrations. OPIC continually strives to make its portfolio more climate friendly by proactively seeking renewable energy projects and by seeking to harmonize its approach to climate change issues with that of other U.S. Government entities. OPIC's actions with respect to climate change are generally consistent with the international response to climate change and clearly ahead of its foreign bilateral counterparts. In February 1998, in an effort to support global GHG management efforts, OPIC became the first bilateral finance, investment insurance or export credit agency to commit to tracking and reporting annual CO_2 emissions. OPIC's most recent annual GHG assessment demonstrates that OPIC-supported power projects continue to be heavily weighted toward climate-friendly natural gas and that these projects contribute only small amounts to global GHG emissions. *(For more information on OPIC's environmental polices, procedures and recent initiatives, see Chapter VI: OPIC and the Environment.)*

This report goes beyond OPIC's annual Greenhouse Gas Assessment Reports, to evaluate the cumulative (CO_2) climate implications of all OPIC finance and political risk insurance projects since 1990. OPIC conducted this analysis of its role in GHG production in accordance with prescribed methods of assessing GHG emissions. As will be seen in the following section, the results of the analysis demonstrate that OPIC is not a substantial contributor to global CO_2 emissions or climate change. Annual CO_2 emissions from OPIC-supported power projects, which produce the bulk of OPIC-related GHG emissions, represent approximately 0.24% of global GHG emissions. OPIC's power portfolio relies primarily on less carbon-intensive natural gas and carbon-free renewable energy sources rather than carbon-intensive coal and oil. In fact, natural gas (45%) and renewable energy (27%) drive 72% of the OPIC power portfolio. In addition, OPIC projects incorporate advanced technologies that reduce GHG emissions.

Renewable Energy

Although OPIC-supported projects are not in themselves a substantial contributor to climate change, OPIC recognizes that renewables, such as wind and solar power, have a potentially important role to play in reducing global reliance on fossil fuels and their associated GHG emissions. Renewable energy projects, particularly wind and solar, offer compelling environmental advantages when compared to conventional fossil fuel-based power generation, including little or no conventional pollutant and GHG emissions. However, renewable energy projects face serious challenges competing with conventional fossil fuel-fired power projects and have achieved only limited success in the marketplace. In addition to high capital costs, one of the most significant challenges facing renewable energy projects is the subsidy given by many governments to conventional forms of energy.

Another challenge facing renewable energy development is the remote, decentralized nature of many renewable energy projects. Very large conventional power projects, a gigawatt-sized fossil fuel-fired plant for example, can find investment capital at much lower interest rates and longer tenors than can hundreds of thousands of micro-hydro projects or wind installations of a few kW each. Banks and financing agencies are generally ill-equipped to manage myriad micro projects, so aggregation of demand is necessary if a "level playing field" is to be established in financing renewable energy projects. Such challenges led the U.S. Department of Energy (DOE) to conclude that over the next two decades it is unlikely that renewable energy can compete economically with conventional fossil fuel-based power generation. According to the U.S. DOE, "failing a strong world wide commitment to environmental considerations, such as the limitations and reductions of CO_2 emissions outlined in the Kyoto Climate Change Protocol, it is difficult to foresee significant widespread increases in renewable energy use" in the near to medium term[1].

However, there are indications that the market for renewables may be brighter than the above assessment would indicate. The wind industry, arguably one the biggest renewable energy success story, now has a global installed capacity of 14,000 MW and is growing at 35 to 40% per year. Last year, for the first time, more new wind capacity was brought on line than nuclear power. And the solar photovoltaics industry, which is now a $1 billion industry, is growing a 30% per year. The potential of renewables has not escaped the big conventional energy companies, including BP Amoco, ABB, Enron and others, all of which have made considerable investments in the renewable sector. ABB, for example, has divested much of its conventional power portfolio and announced a new 'Alternative Energy Solutions' program, with a target of $1 billion turnover per year by 2005.

And many developing countries and emerging markets are beginning to make modest commitments to including renewable resources in their energy mix as well. India has a Ministry of Non-Conventional Energy Sources and has developed several policies to promote renewables, including tax incentives, automatic environmental clearances and soft loans for certain renewable energy projects. Brazil has committed to invest substantial sums to increase the number of its non-hydro renewable energy installations. Several African countries have implemented policies to promote renewable energy technologies. In addition, there are specialized, off-grid applications where renewables may be more competitive because the costs associated with transmissions lines and other requirements increase the cost of conventional fossil fuel-fired power projects. These types of policies and projects demonstrate the opportunity for national and international efforts that support investment in these countries that contributes to meeting the climate challenge ahead.

It is in the interest of the U.S. to continue to encourage and assist developing countries in making these commitments to renewables. As an agency whose sole focus is on the developing world, OPIC has the opportunity to play a unique role facilitating the participation of countries whose involvement is critical to the resolution of the climate problem. OPIC routinely is involved in the investment process, working with both host governments and U.S. and foreign investors. However, there is a need to understand more fully both the needs of renewable energy developers and how developing countries determine their energy requirements and establish bid specifications for power projects.

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[1] International Energy Outlook 2000 (Washington, D.C.: Energy Information Administration, 2000) 93.

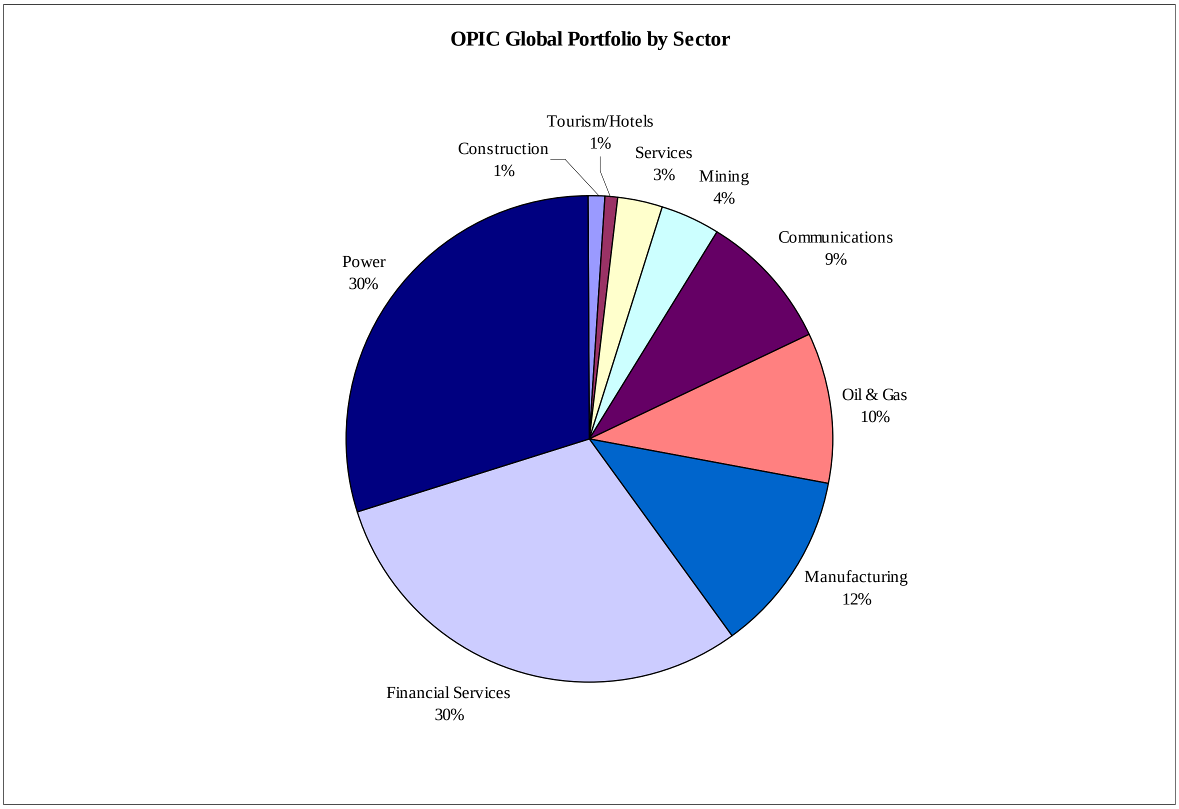
Therefore, to further explore the potential to support renewable energy projects, OPIC will organize or co-sponsor a workshop focused on the renewable energy industry in FY2001 to explore and evaluate the impact of innovative financing mechanisms. OPIC's goal will be to determine whether its finance and insurance programs can be more effectively utilized to support renewable energy projects.

II. Greenhouse Gas Emissions from OPIC-Supported Power Projects

Summary: In order to evaluate the cumulative GHG emission and climate implications of its programs, OPIC evaluated every project that received either finance or political risk insurance support since 1990. The results of this evaluation demonstrated that power sector projects produce the bulk of OPIC-related GHG emissions. Since 1990, OPIC has support 52 projects totaling 16,775 MW capacity. Annual CO_2 emissions from these projects are approximately 56.4 million metric tons per year and represent approximately 0.24% of global CO_2 emissions. In addition, OPIC supports a power portfolio that is dominated by less carbon-intensive natural gas (44%) and carbon-free renewable energy (28%) resources, while carbon-intensive coal (21%) and oil (7%) make up a smaller portion of the portfolio. In all, approximately 72% of OPIC's power portfolio is either less carbon-intensive natural gas or zero-carbon renewable, and 43% incorporates combined cycle technology – the most efficient fossil-based electricity generating technology. Even in 2015, when OPIC's portfolio is likely to peak in size and emissions, it will only contribute 0.43% to global CO_2 emissions. As a result, OPIC activities are not a substantial contributor to global CO_2 emissions

In order to assess the cumulative GHG and climate implications of its investment activities, OPIC evaluated the number and types of projects that have received finance or political risk insurance support since 1990. OPIC supports a wide variety of projects; as seen in Figure 2.1 the power and financial services sectors each account for approximately 30% of the OPIC portfolio. While the oil & gas sector makes up 10% of the OPIC portfolio, including production, processing and transportation activities, these projects generally result in only relatively minor GHG emissions. For example, OPIC has supported two new gas pipeline projects and two investments in large, pre-existing gas pipeline systems since 1990. While estimates of methane leakage from gas pipelines range from 0.5% to over 5% of throughput, the high quality flanges, valves and compressors incorporated into new pipeline projects and upgrades to existing pipeline systems can reduce these emissions by as much as 60% - 80%. As a result, GHG emissions from OPIC-supported gas pipeline projects are expected to be very small, especially when compared to power sector emissions. In addition, while hydrocarbon stocks are commodities that may be seen in terms of potential future emissions, IPCC guidance clearly indicates that GHG inventories are to include emissions – not potential future emissions. Therefore oil & gas projects were not included in the OPIC assessment. OPIC's portfolio contains no significant transportation projects and, for the most part, OPIC-supported industrial projects are only minor GHG emitters compared to a single large power plant. As a result, the bulk of OPIC-related GHG emissions are derived from its power sector projects.

Figure 2.1: OPIC Global Portfolio by Sector



Source: OPIC Annual Report, 1999

Methodology

Estimates of power plant CO_2 emissions involve a fairly simple mass balance equation based primarily on the quantity and type of fuel consumed and the heat rate (efficiency) of the generating technology. The World Bank, IPCC, and other organizations have published various methodologies to assess GHG emissions from power generation facilities. The methodology used in this assessment is adapted from the World Bank's *Greenhouse Gas Assessment Handbook: A Practical Guidance Document for the Assessment of Project-Level Greenhouse Gas Emissions*[2].

The equation used to calculate CO_2 emissions for each power project is presented in Table 2.1 below. The variables in the equation are: plant size (A), plant heat rate (B), and a fuel-related emission factor (C). The constant (D) incorporates a plant capacity factor and converts the emissions into units of tonnes of CO_2 per year.

2 World Bank, Global Environment Division, Greenhouse Gas Assessment Handbook: A Practical Guidance Document for the Assessment of Project-Level Greenhouse Gas Emissions (Washington, D.C.: The World Bank, September 1998) 19.

Table 2.1: Equation Used to Calculate Power Sector CO_2 Emissions

CO_2 emissions (tonnes/year) =

*A (MW) * B (Btu/Kwh) * C (g/GJ) * D (tonnes/g * GJ/Btu * kW/MW * hrs/yr)*

Plant-specific fuel consumption data was not used in this assessment. Conservative fuel consumption is built into the equation based on the plant size (A), heat rate and an assumed plant capacity factor of 85%. The capacity factor is simply the ratio of the amount of electricity a plant produces to the maximum amount of electricity a plant could produce if it were operated at full capacity for the entire 8,760 hours of the year. For this report, it was assumed that all plants operate at full capacity 85% of the year.

Each type of plant (generating technology) was assigned a heat rate (B). Plant heat rate is the total fuel heat input expressed in Btu divided by the net power leaving the power plant expressed in kWh. Heat rate is a measure of the generating technology's efficiency at converting chemical energy in the fuel into electrical energy and typically varies with plant load. The heat rates used in this report are presented in Table 2.2 below. The lower heat rate (higher efficiency) of combined cycle technology means that less fuel is required to produce a unit of electrical output and therefore less CO_2 emissions are produced.

Table 2.2: Heat Rates by Generating Technology

Generation Technology	Efficiency, (%)	Heat Rate, (Btu/KWh)
Combined-Cycle	0.47	7,266
Simple-Cycle	0.35	9,757
Engine	0.45	7,588
Steam Turbine	0.33	10,348

Each type of fuel was assigned an emission factor (C). The emission factor determines the amount of CO_2 that is produced per unit of energy content of the fuel consumed. The emission factors used in this assessment are presented in the Table 2.3 below. The factors demonstrate that natural gas combustion releases significantly less CO_2 than other fossil fuels and hydro and geothermal do not directly release CO_2.

Table 2.3: Emission Factors by Fuel Type

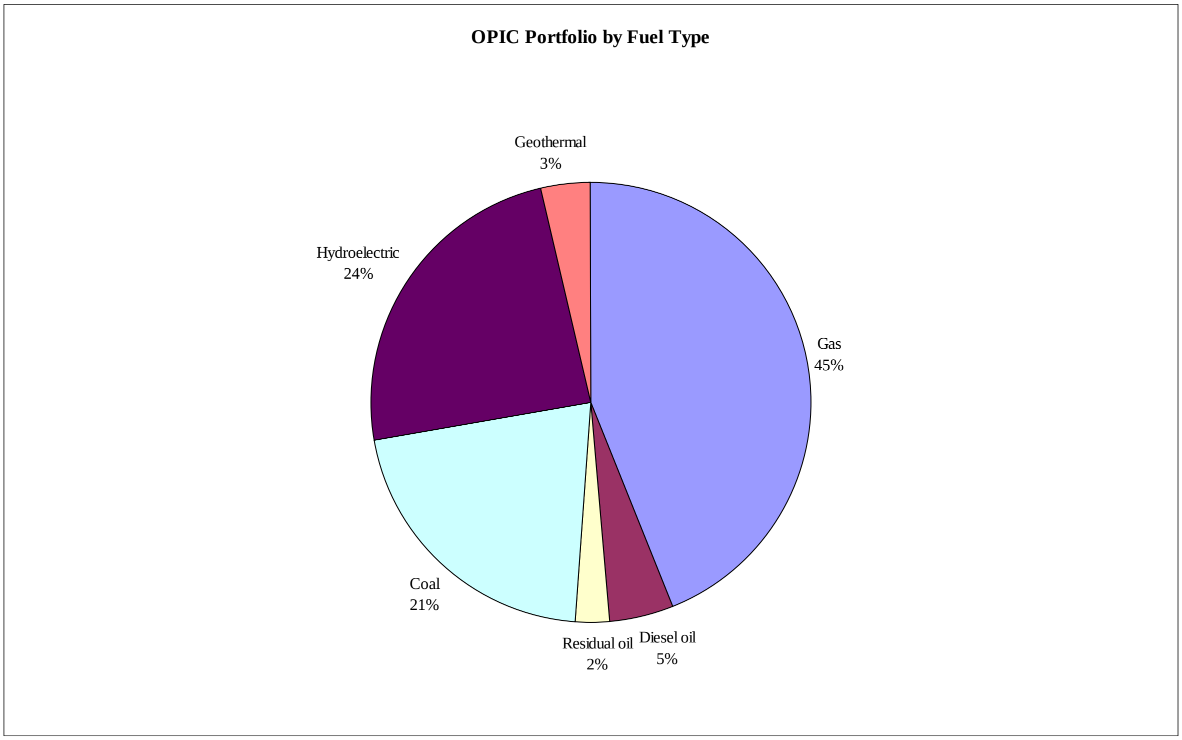
Fuel Type	Emission Factor, (g CO_2/G. Joule)
Coal	94,600
Residual Fuel Oil	77,350
Diesel Oil	74,050
Natural Gas	56,100
Hydro	0
Geothermal	0

In accordance with the *Greenhouse Gas Assessment Handbook* methodology, plant size and the appropriate emission factor and heat rate were inserted into the above equation to calculate CO_2 emissions from each plant. Because quantities of other GHGs emitted by power plants (e.g. NO_2 and CO) are significantly less in comparison to CO_2, their contributions were not factored into the analysis. This methodology was used to calculate CO_2 emissions from each power project that has received OPIC support since 1990. Here, "OPIC support" refers to the making of a loan or the issuance of an insurance contract. Projects for which a commitment did not result in a loan or an insurance contract were not included in this assessment. *(For a complete list of OPIC-supported power projects, see Appendix I: OPIC-Supported Power Projects.)*

OPIC Power Portfolio

OPIC supported 52 power projects with a total capacity of 16,775 MW between 1990 and 2000. As seen in the Figure 2.2, 19 gas projects with a total capacity of 7,363 MW account for 44% of OPIC's power portfolio based on capacity. Renewable energy projects, including 11 hydroelectric (4,080 MW) (for the most part all preexisting or run-of-river facilities) and 4 geothermal projects (585 MW), make up the second largest group at 4,665 MW, accounting for 28% of the power portfolio. Thus, the preponderance of OPIC-supported power projects, 72% by capacity, are fueled either by natural gas or renewable energy sources. The remainder of the portfolio consists of 4 coal-fired (3,534 MW) and 9 oil-fueled power plants (1,214 MW), representing 21% and 7% of capacity, respectively. In addition, approximately 43% (by capacity) of OPIC-supported fossil fuel-fired plants utilize combined-cycle technology, the most energy efficient type of fossil fuel-based power plant. Prior to 1990, OPIC supported only one power project involving the upgrade of a powerhouse at a preexisting hydroelectric facility.

Figure 2.2: OPIC Power Portfolio by Fuel Type



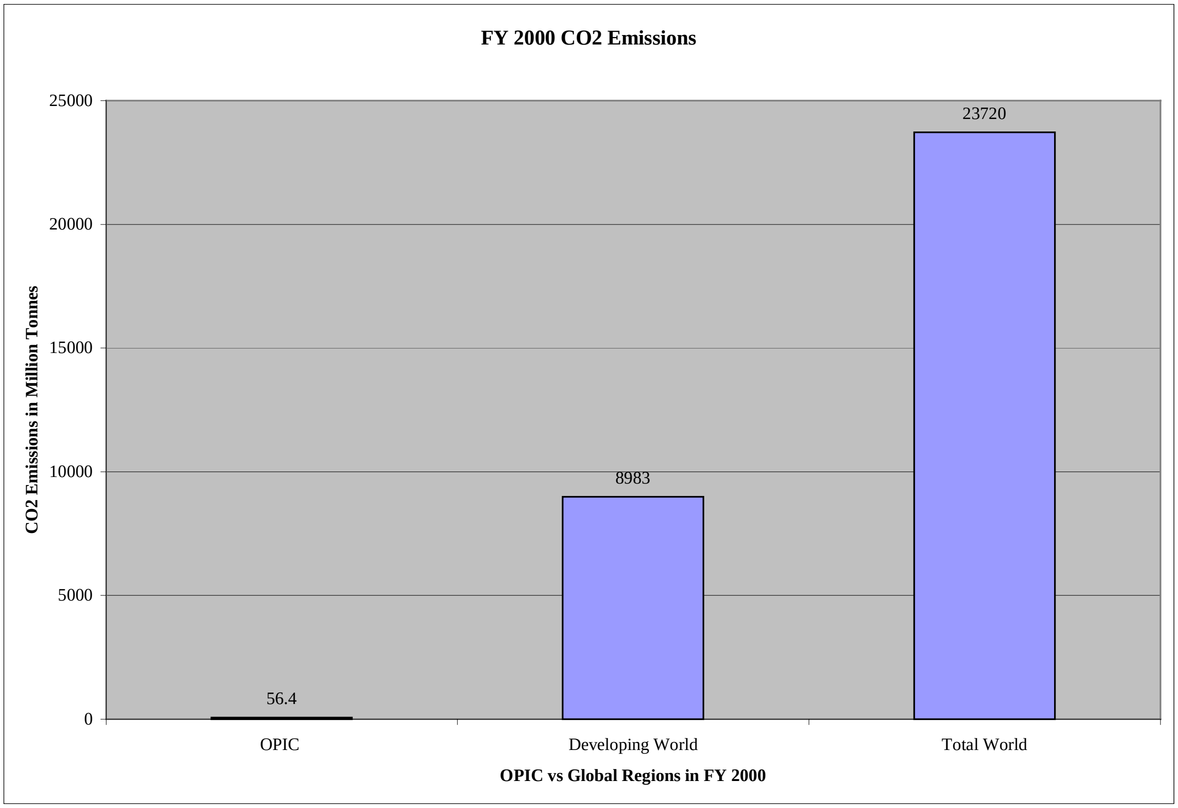
OPIC Power Portfolio CO_2 Emissions

Cumulative annual CO_2 emissions from these projects are approximately 56.4 million tonnes. Gas- and coal-fired plants release the bulk of these CO_2 emissions, with emissions of approximately 24.8 and 26.1 million tonnes, respectively. The remaining emissions are from oil-fired plants and total approximately 5.5 million tonnes per year. As percentages, CO_2 emissions from the OPIC portfolio are as follows: 56.2% coal-derived, 43.9% gas-derived and 9.7% oil-derived.

Carbon dioxide emissions from OPIC-supported power projects contribute relatively small amounts to existing CO_2 emissions in the developing countries where these projects are located or to global CO_2 emissions. As can be seen in Figure 2.3, annual CO_2 emissions from these projects represent only 0.63% of annual CO_2 emissions from developing countries, which total 9.0 billion tonnes, and less than 0.24% of annual global CO_2 emissions which total 23.7 billion tonnes[3].

[3] Pia Hartman at the U.S. Department of Energy's Energy Information Administration, correspondence with author, July 21, 2000.

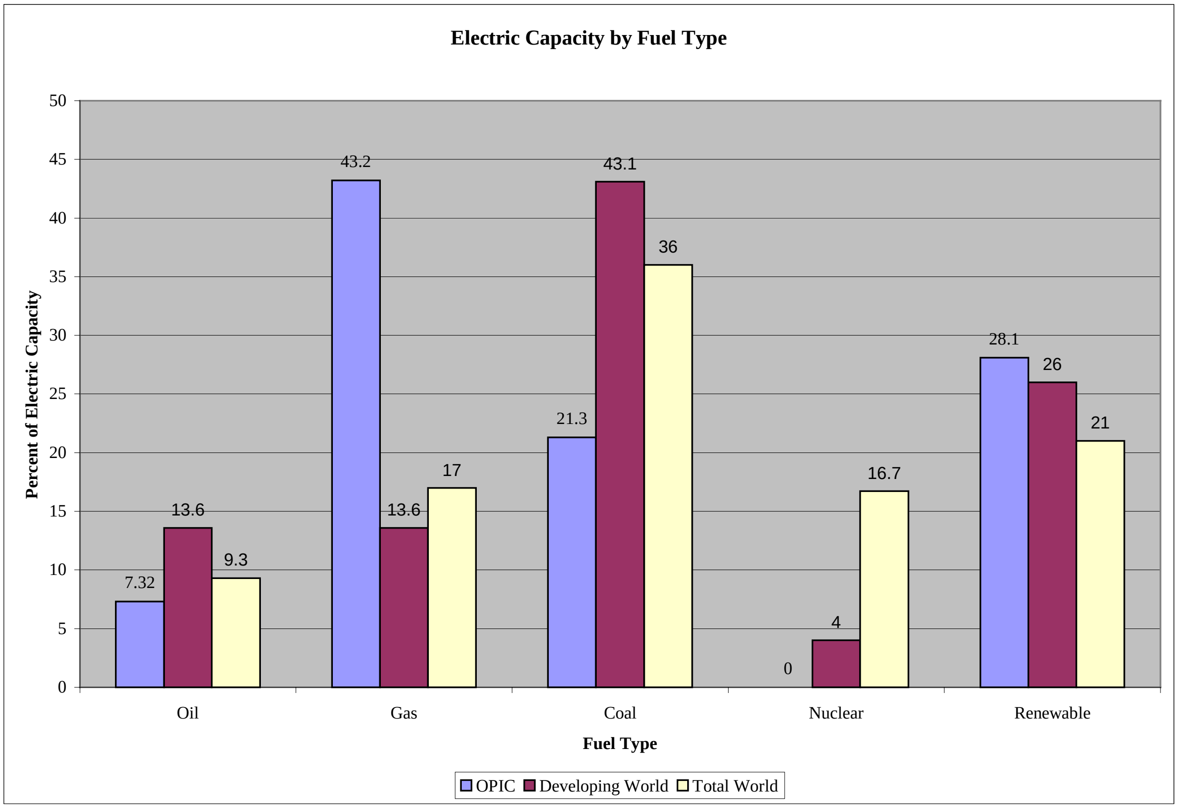
Figure 2.3: CO_2 Emissions from OPIC-Supported Power Projects vs CO_2 Emissions from Developing Countries and the World



In addition to relatively minor CO_2 emissions, the fuel mix of the OPIC power portfolio is largely weighted toward gas and renewable projects. As seen in the Figure 2.4, OPIC's fuel mix consists of significantly more gas (43% vs. 13.6% and 17%) and renewables (28% vs. 26% and 21%), and less coal (21% vs. 43.1% and 36%) and oil (7% vs. 13.6% and 9.3%) than the prevailing fuel mix of the developing world or the global electricity sector. **As a result, when compared with the current power sector fuel mix in these regions, OPIC's power portfolio may be seen as driving investment in gas and renewable projects - investments that are critical to reducing GHG emissions in these regions.** In fact, in "Natural Gas: Bridge to a Renewable Energy Future", the Renewable Energy Policy Project argues that natural gas can serve as a bridge to a renewable energy future[4].

4 Serchuk, Adam and Means, Robert, Natural Gas: "Bridge to a Renewable Energy Future," (Washington, D.C.: Renewable Energy Policy Project, May 1997.)

Figure 2.4: OPIC Portfolio by Fuel Type Compared with the Power Sector Fuel Mix in Developing Countries and the World

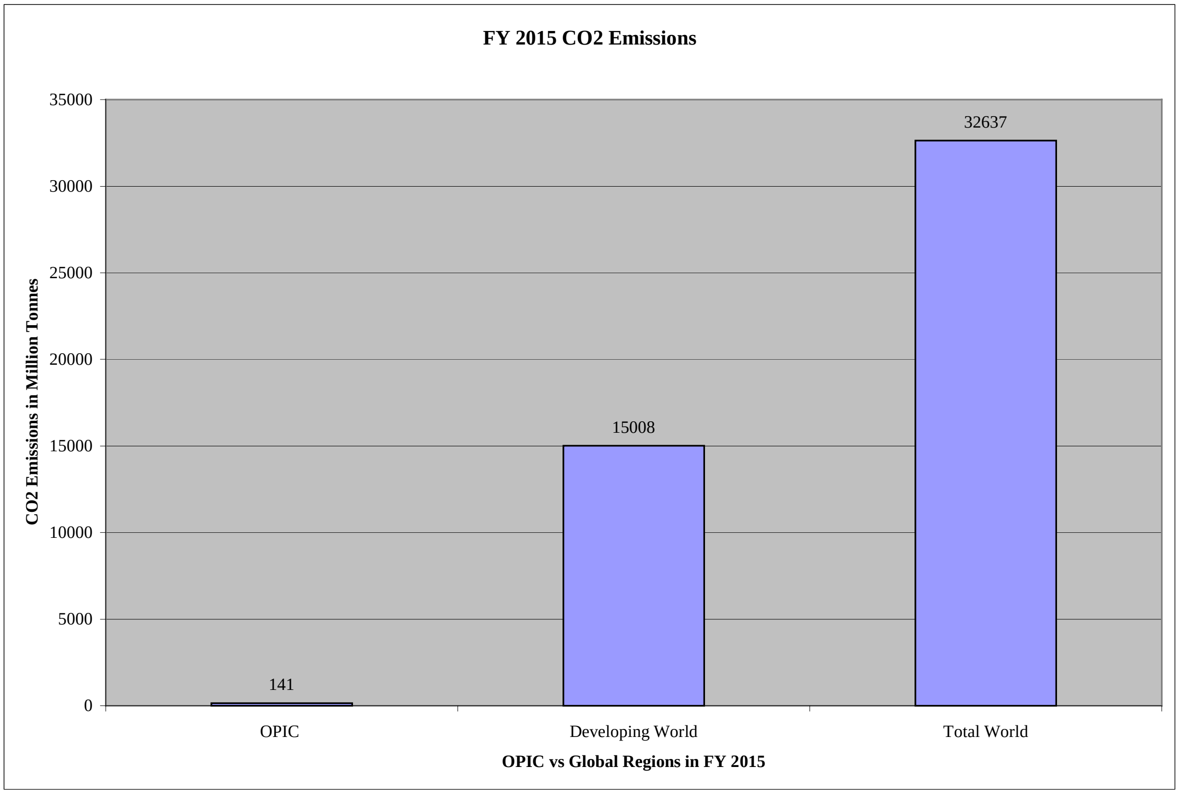


Future OPIC Portfolio Emissions

Predicting future growth rates and fuel mix trends of OPIC's portfolio is somewhat difficult. Increased electricity demand in the developing world might increase the growth rate of OPIC's power portfolio. On the other hand, economic upheaval or the implementation of international actions to mitigate climate change might significantly slow the growth of the portfolio. With respect to fuel mix trends, the enactment of international efforts to limit CO_2 emissions could significantly affect fuel mix away from carbon-intensive fuels and towards renewable projects.

If we assume that the growth rate and fuel mix of the portfolio remains constant and that each power plant will operate for 25 years, the size of OPIC's portfolio would peak at 42,000 MW by 2015. After 2015, for each unit of power capacity added to the portfolio, a 25-year old unit of capacity would be taken out of commission. CO_2 emissions would peak in 2015 at approximately 141 million tonnes per year. By that time, CO_2 emissions from developing regions and globally are expected to have increased to about 15 and 32.6 billion tonnes per year, respectively. Therefore, as presented in Figure 2.5, peak future emissions from OPIC's power portfolio would account for approximately 0.94% and 0.43% of CO_2 emissions from these regions.

Figure 2.5: Anticipated CO_2 Emissions from OPIC-Supported Power Projects vs. Total CO_2 Emissions from Developing Countries and the World in 2015



Given the size of the contribution of CO_2 emissions from OPIC's power portfolio to global CO_2 emissions both now (0.24%) and in the future (0.43%) and the implications of the portfolio fuel mix, OPIC's power sector activity is not a substantial contributor to global GHG emissions and global climate change. In addition, because the power sector is responsible for the vast majority of OPIC-related GHG emissions, it can be concluded that OPIC programs in general are not a substantial contributor to global climate change.

In many respects, this GHG assessment involves assumptions that tend to make its results conservative. For example, in providing project financing, OPIC typically participates in only up to 50% of the total costs of a new power project, while a somewhat higher participation may be considered in the case of the privatization or expansion of an existing plant. In addition, the term of OPIC involvement in the power sector is typically limited to loan terms of 12-15 years and insurance contracts of up to 20 years. And finally, OPIC often supports the privatization of power projects - and the privatization of existing power projects does not generally result in net incremental increases in emissions and often involve efficiency improvements or fuel-switching that result in net emissions reductions. Yet in this assessment, OPIC takes full responsibility for the projects' 25-year lifetime CO_2 emissions.

It is also important to consider that OPIC power sector activities generally achieve significant supplementary benefits for the environment when compared to other sources of finance or insurance. OPIC projects are required to meet high environmental performance standards that generally exceed host country environmental requirements. OPIC requires annual monitoring reports and third party independent compliance audits and conducts site visits to ensure ongoing compliance with all its environmental requirements. In addition, OPIC often is involved in the privatization of existing power plants. Such projects typically involve significant environmental performance improvements – often through the installation of expensive environmental control technologies like electrostatic precipitators or flue gas desulfurization units. **As a result, OPIC-supported power projects are generally among the cleanest, most efficient projects in the developing world**.

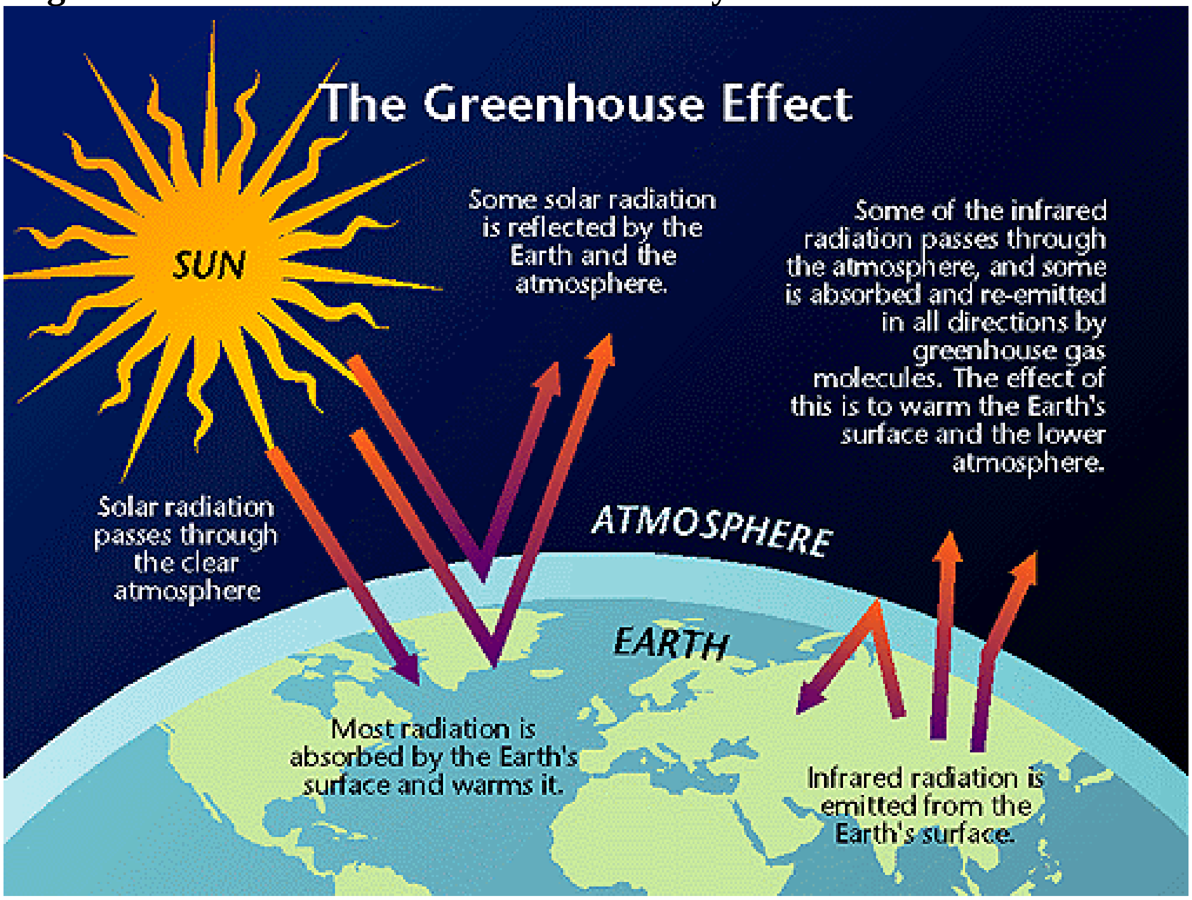
Although OPIC activities are not in themselves a substantial contributor to climate change, OPIC understands the serious implications of GHG emissions and climate change. OPIC recognizes that renewables, such as wind and solar power, have a potentially important role to play in reducing global reliance on fossil fuels and their associated GHG emissions. Renewable energy projects generally offer compelling environmental advantages when compared to conventional fossil fuel-based power generation, including little or no conventional pollutant and GHG emissions. However, renewable energy projects face serious challenges competing with conventional fossil fuel-fired power projects and have achieved only limited success in the marketplace. OPIC will seek to support these emerging power sources through better outreach to the renewable energy industry and innovative financing mechanisms.

III. An Introduction to Climate Change

Summary: Atmospheric greenhouse gases have long been known to absorb infrared radiation and warm the Earth. The natural greenhouse warming of the atmosphere keeps the Earth 60°F warmer than it otherwise would be. However, humans have been emitting increasing quantities of these greenhouse gases since the advent of the fossil fuel-driven industrial age and now annually emit 25 billion tons of CO_2*, the most important anthropogenic GHG. As a result, atmospheric* CO_2 *concentrations are now at their highest levels in more than 160,000 years. Ice core records and other data demonstrate a strong correlation between atmospheric* CO_2 *concentrations and global mean temperatures. During the past century, global mean temperatures have increased approximately 1°F degree. However, precisely how much of the recent warming is due to human influences and how much is due to natural climate variations is the focus of much current research. In addition, while recent studies indicate that human activities have begun to impact our climate and may be the dominant force driving recent warming trends, the extent and rate of future temperature changes and their potential impacts remains unclear. Current models suggest that forecast growth in GHG emissions could double atmospheric concentrations of* CO_2 *by 2060 with a resulting temperature increase of as much as 2° to 6.5°F over the next century. Even the low end of this estimate would be an unprecedented rate of warming and may alter patterns of precipitation and evaporation and lead to more severe weather, rising sea levels, and potentially adverse economic, ecological and human health impacts.*

The Earth is constantly heated by incoming shortwave radiation from the sun. This heating is offset by reflected infrared radiation leaving the planet. A portion of this reflected terrestrial radiation, though, is itself absorbed by gases in the atmosphere. As illustrated in Figure 3.1, the energy from this absorbed terrestrial radiation warms the Earth's surface and atmosphere creating what is known as the natural Greenhouse Effect. This strong infrared absorptivity is extremely robust and can be readily measured in the laboratory and from Earth orbiting satellites. Simply put, the atmosphere is like a "blanket" around the planet. The Earth is 60°F warmer than it would be without an atmosphere.

Figure 3.1: The Greenhouse Effect Naturally Warms the Earth's Surface



Source: Climate Change - State of Knowledge, OSTP 1997

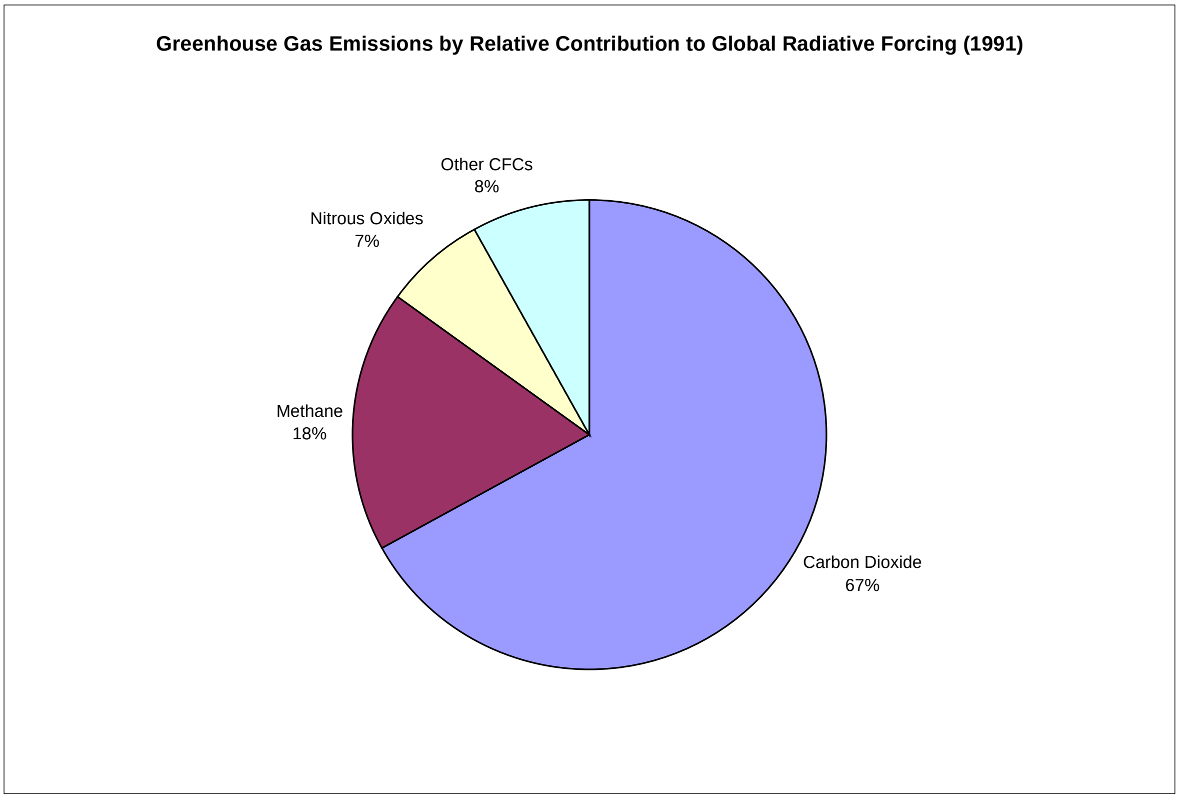
Greenhouse Gases

The gases responsible for the strong atmospheric absorption of infrared radiation are called greenhouse gases (GHGs). Water vapor and CO_2 are the most important GHGs and are responsible for the bulk of greenhouse warming. Both water vapor and CO_2 are naturally occurring as are other greenhouse gases including methane, nitrous oxide, and ozone. Human activities, however, add to the levels of most of these naturally occurring gases, and are the sole source of other powerful classes of GHGs, including chlorofluorocarbons (CFCs), hydrofluorocarbons (HFCs) and perfluorocarbons (PFCs), among others.

Greenhouse gases generally persist for long periods in the atmosphere. While many conventional air pollutants may persist in the atmosphere for only a matter of hours or days, many important GHGs persist for decades or even hundreds of years. For example, CO_2 has an estimated atmospheric persistence of 120 years and some CFCs may persist for as long as 400 years. As a result, these gases accumulate, become very well mixed in the atmosphere and have a global impact that is mostly independent of where they were emitted. GHG persistence has significant policy implications because the gases we emit today may impact the climate system for hundreds of years.

GHGs differ in their ability to absorb infrared radiation. Among the most infrared radiation-absorbent are the CFCs, HFCs and PFCs. Other powerful GHGs include nitrous oxide and methane. For example, a molecule of CFC-12 is 15,800 times, CFC-11 is 12,400 times, nitrous oxide is 270 times and methane is 21 times as effective in absorbing infrared radiation as a molecule of CO_2[5]. However, because atmospheric concentrations of these compounds are much less than concentrations of CO_2, they play a lesser role in greenhouse warming and climate change. Figure 3.2 depicts the relative contribution to greenhouse warming of various GHGs when both their radiation absorbing characteristics and their relative concentration are considered. As illustrated, CO_2 is the largest contributor to climate change, or radiative forcing, followed by methane and nitrous oxide, which together account for over 90% of total radiative forcing. Water vapor is not included because it is a feedback gas - meaning its concentration is mainly a function of other climate parameters, not emissions.

Figure 3.2: The Contribution of Selected Greenhouse Gases to Greenhouse Warming



Source: Greenhouse Gas Assessment Handbook, World Bank 1998

5 Robert G. Watts, ed., Engineering Response to Global Climate Change: Planning a Research and Development Agenda, (New York: Lewis Publishers, 1997) 6.

Increasing Atmospheric GHG Concentrations

The basic story of human-induced greenhouse warming remains simple. With industrialization and population growth, GHG emissions from human activities have continuously increased. These steady additions of GHGs now include more than 23 billion tonnes of CO_2 per year and have begun to tip a delicate balance, significantly increasing atmospheric GHG concentrations and creating an "enhanced" greenhouse effect[6].

Accurate measurements of atmospheric CO_2 concentration began in 1958 at the Mauna Loa Observatory in Hawaii. Information on atmospheric CO_2 concentrations prior to 1958 can be derived from the analysis of ice, and the bubbles of air within it, from various depths in Antarctica. Ice cores have been drilled through the Antarctic ice cap as deep as 3 km, indicating conditions over the past 160,000 years. Figure 3.3 presents results of an analysis of ice core data and more recent data from Mauna Loa and demonstrates that atmospheric concentrations of CO_2 have increased from approximately 280 to 350 parts per million by volume (ppmv), an increase of nearly 30%, since the beginning of the industrial revolution[7]. As a result, atmospheric CO_2 concentrations are now at their highest levels in more than 160,000 years. Other GHGs have increased as well, methane concentrations have more than doubled, and nitrous oxide concentrations have risen by about 15%.

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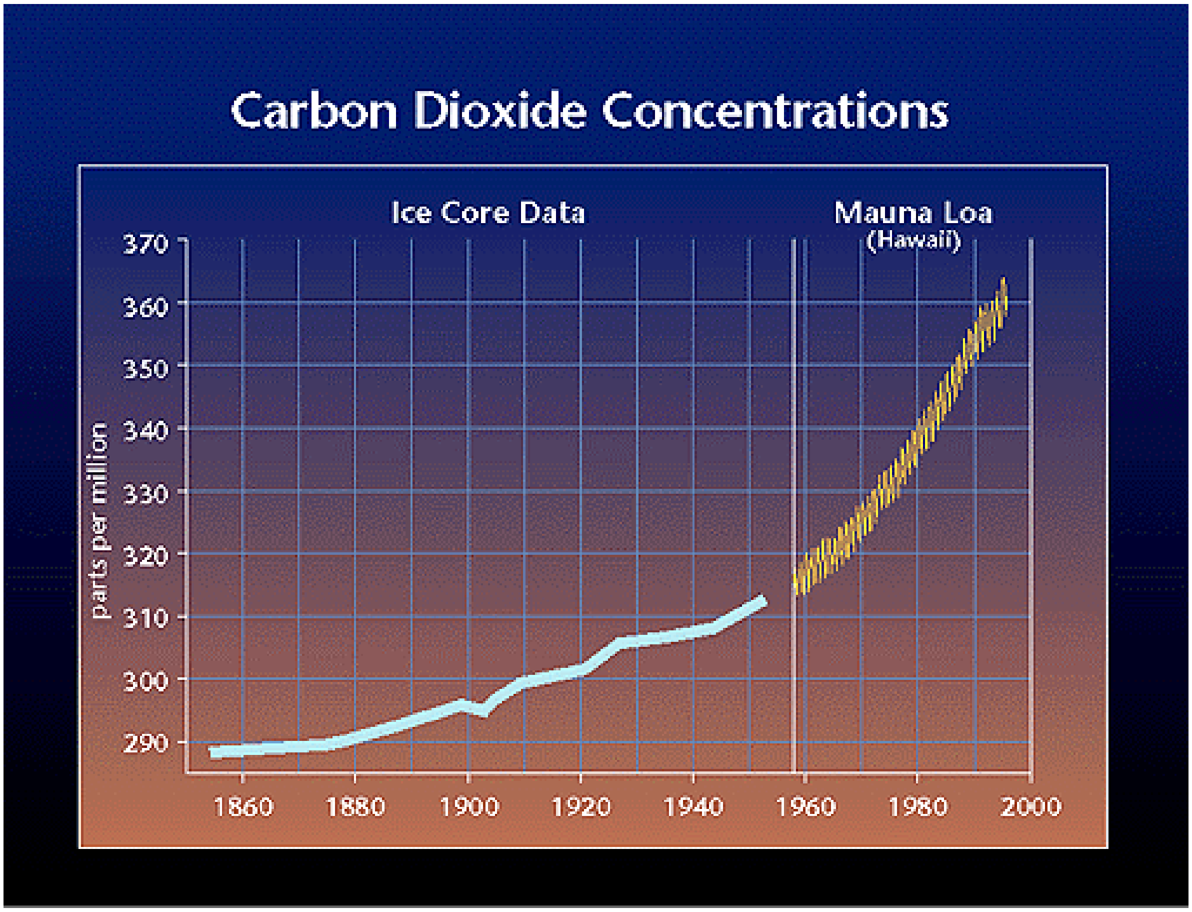
6 International Energy Outlook 2000 (Washington, D.C.: Energy Information Administration, 2000) 179.

7 Executive Office of the President, Office of Science and Technology Policy, Climate Change: State of Knowledge (Washington, D.C.: Office of Science and Technology Policy 1997) 4.

Figure 3.3: Concentration of CO_2 in the Atmosphere Since the Beginning of the Industrial Revolution

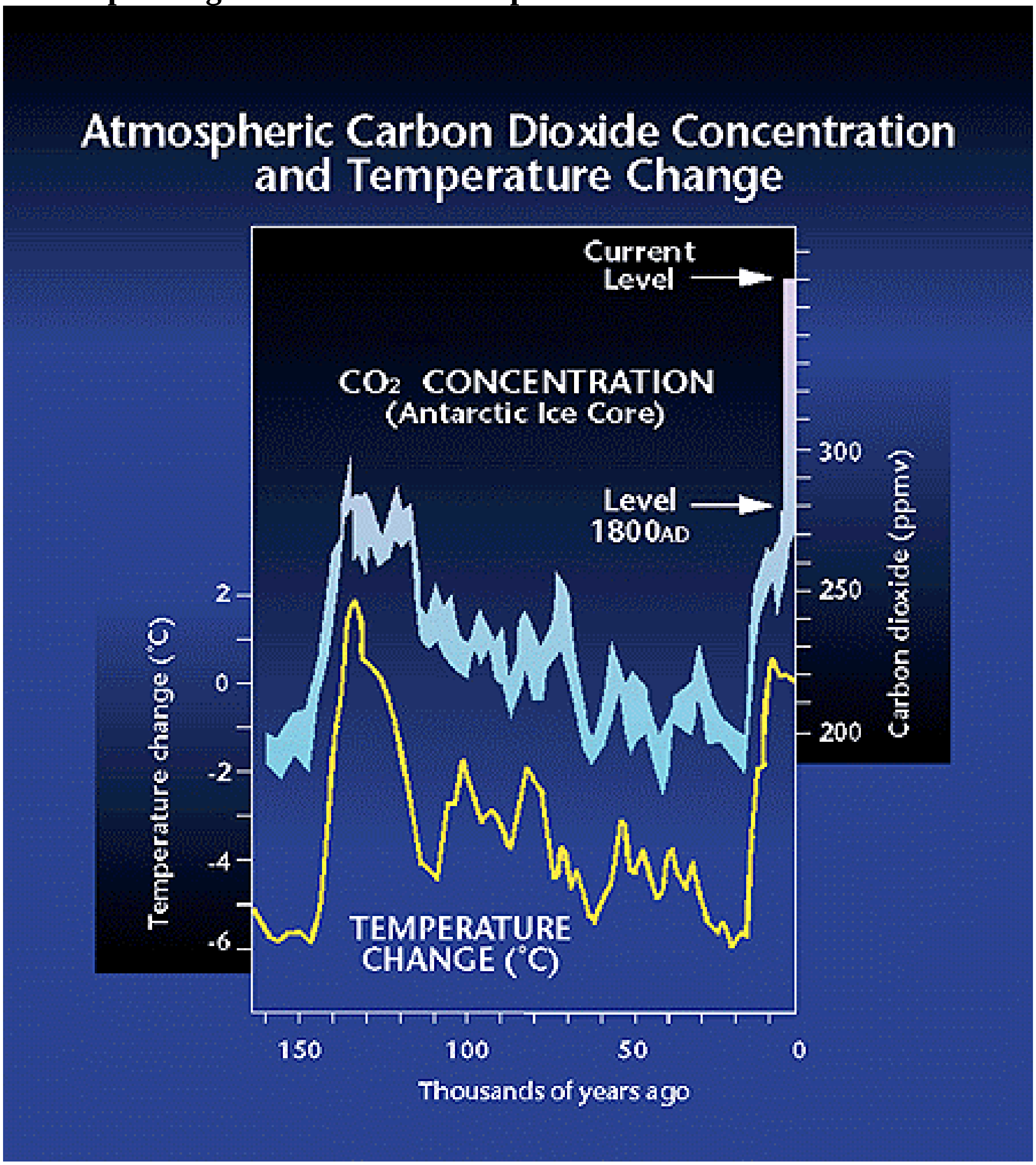


Source: Climate Change - State of Knowledge, OSTP 1997

Carbon Dioxide – Global Temperature Relationship

Information on remotely past climates is obtained by means of considerable ingenuity. Figure 3.4 illustrates the changes in the CO_2 concentration in air bubbles within ice from various depths (i.e., since 160,000 years ago) beneath Vostok, Antarctica along with the temperature during bubble formation. The temperature is estimated from the ratio of the amount of 'heavy' oxygen (with a molecular weight of 18) to that of normal oxygen, with a molecular weight of 16. The ratio depends on the global sea-surface temperature at the time the bubbles were trapped. The figure illustrates how fluctuations in CO_2 concentrations and global average temperatures have roughly mirrored each other over the last 160,000 years.

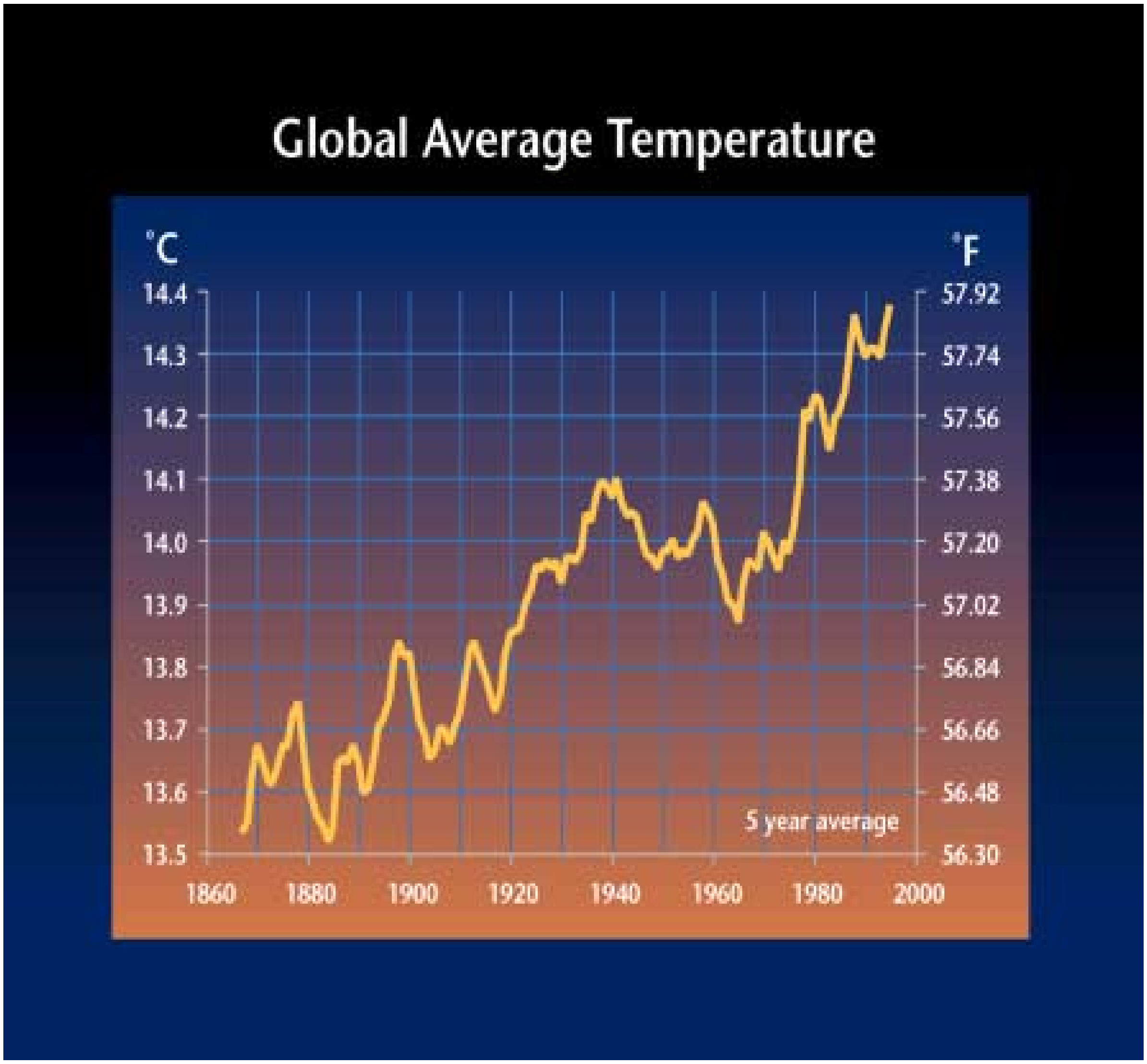
Figure 3.4: Atmospheric Carbon Dioxide Concentrations and Corresponding Global Surface Temperature Data from Remote Times



Source: Climate Change - State of Knowledge, OSTP 1997

Figure 3.5 illustrates more recent warming trends and demonstrates that global mean surface temperature has increased by as much as 0.6° -1.2°F since the late 19th century. These figures strongly suggest that increasing CO_2 concentrations provide a measurable direct addition to the atmospheric trapping of infrared radiation leaving the surface of our planet and an "enhanced" greenhouse warming. In effect, adding CO_2 and other GHGs to the atmosphere is like adding another "blanket" to the planet.

Figure 3.5: Global Average Temperature Since the Beginning of the Industrial Revolution



Source: Climate Change - State of Knowledge, OSTP 1997

Climate Feedback Mechanisms

The global climate system is complex and involves many positive feedback mechanisms that tend to amplify the warming caused by increasing CO_2 concentrations. As mentioned above, water vapor is by far the most dominant greenhouse gas. However, water vapor enters the climate system mostly as a "feedback" gas. In other words, atmospheric water vapor concentration is largely a function of global temperature and atmospheric holding capacity for water vapor increases exponentially with temperature. As a result, CO_2

induced warming is augmented by increased water vapor concentrations, creating a powerful positive feedback mechanism.

A smaller positive feedback involves the relationship between ice at the Earth's surface and its reflectivity (albedo) of solar radiation. In essence, if ice or snow cover melts, the surface left exposed (ground, vegetation, or water) is generally less reflective of incoming solar radiation. This leads to more absorption of the solar radiation, thus more warming, less ice, and so on. This "ice-albedo" feedback process further amplifies the calculated warming response of the climate caused by increased concentrations of CO_2 and infrared absorbing gases.

Natural vs. Anthropogenic Effects

While the greenhouse effect and global warming are generally accepted by most of the scientific community, the cause of global warming remains the subject of some debate. Many scientists attribute the current global warming to an "enhanced" greenhouse effect caused by the build up of atmospheric GHG concentrations caused by human activities. Other scientists suggest that natural factors are responsible, including primarily changes in the radiation flowing from the sun, which is thought to follow many complex cycles, and volcanoes, which temporarily cool the Earth by lofting a veil of fine sulfate droplets that reflect sunlight.

Resolving this puzzle – the balance between human and natural influences – has been something of a holy grail in atmospheric science, particularly because the answer could determine whether countries enact plans in coming years to reduce GHG emissions. Few contest the idea that some of the recent climate changes are likely due to natural processes - after all, significant climate changes have occurred since long before human activity is thought to have begun to play a role a century ago. The last two millenia, for example, were marked by relative warmth between 900 –1200 AD (the Medieval Warm Period) and worldwide cooling between about 1450 and 1850 (the Little Ice Age)[8].

However, recent studies have begun to clarify the magnitude of anthrogenic influences on the climate system. A new analysis of the climate of the last 1,000 years suggests that human activity is the dominant force behind the sharp global warming trend seen in the 20th century[9]. The study found that natural factors, like fluctuations in sunshine or volcanic activity, were powerful influences on temperatures in past centuries and when fed into a computer model simulating the flow of energy to and from the Earth, produced temperatures that match most of the ups and downs of the actual climate from the year 1000 to the mid 1800's. But the relationship among sunlight, eruptions and temperature broke down completely in the 20th century, when the study found that natural factors could account for only 25% of the warming since 1900. The only "radiative forcing" that

8 Linacre, Edward and Geerts, Bart, Climate and Weather Explained: An Introduction From A Southern Perspective (New York: Routledge, 1997) 338-339.

9 Crowley, Thomas J., "Causes of Climate Change over the Past 1000 Years, " (Science, July 14, 2000) 270-277.

remotely matched the jump in temperatures seen in the latter half of the century was the rise in GHG emissions. Although these results will continue to be refined, they demonstrate the significance of human impact on climate change and imply that future actions to address the issue may be required.

Anticipated Impacts

Current forecasts indicate that, unless effective international efforts to reduce CO_2 emissions are adopted, atmospheric CO_2 concentrations could reach twice the preindustrial level by 2060, with an associated average global temperature increase of 2° to 6.5°F by 2100. Even the low end of this range represents an unprecedented rate of change compared to the past 10,000 years. In fact, the difference in temperature from the last ice age to now is about 9°F[10]. By increasing the energy of the climate system, such a temperature increase may lead to more intense rainfall, and thus flooding, in some areas, but more frequent drought-like condition in other areas. Current rates of sea-level rise are expected to increase by a factor of two to five due to both the thermal expansion of the oceans and the partial melting of mountain glaciers and polar ice caps. Changes in precipitation and crop-pest relationships could adversely impact agricultural production. Increased temperatures may extend the range of insect-borne diseases, including malaria and dengue fever and adversely impact human health. And finally, changes in temperature and precipitation can disrupt natural ecosystems, such as forests, rivers, and wetlands.

[10] Executive Office of the President, Office of Science and Technology Policy, Climate Change: State of Knowledge (Office of Science and Technology Policy 1997) 1.

IV. Global Production of Greenhouse Gases

Summary: Carbon Dioxide is the most important anthropogenic GHG and its production can be used as an indicator for other GHGs. CO_2 results primarily from fossil fuel consumption and land use changes. Industrialized countries are responsible for the bulk of past CO_2 emissions. However, rapid economic and population growth in developing countries is expected to substantially increase demand for energy and significantly increase CO_2 emissions from these countries. As a result, as much as 70% of the growth in global CO_2 emissions over the next two decades will come from the developing world. Electricity generation is the largest source of CO_2 emissions. Fuel and technology choices have a significant impact on the level of CO_2 emissions produced by power generation facilities, with natural gas and high efficiency combined cycle plants producing significantly lower CO_2 emissions than other fossil-based plants and renewable energy projects generally producing little or no CO_2. International efforts to reduce GHG emissions and stabilize atmospheric GHG concentrations culminated in the Kyoto Protocol to the UNFCCC, which calls on industrialized countries to reduce GHG emissions in order to stabilize atmospheric concentrations of these gases. However, even if industrialized countries are able to achieve their reduction targets, future GHG emissions will still grow substantially due to rapidly increasing emissions from the developing world. Therefore, any success in stabilizing GHG concentrations will likely require the participation of developing countries and a major commitment to natural gas, renewable energy, energy efficiency and improved land-use management.

The major anthropogenic sources of GHG emissions worldwide are fossil fuel consumption, non-fossil methane emissions and land-use changes[11]. The consumption of fossil fuels, which provides electricity, heat and steam to the industrial, commercial and residential sectors, and fuel to the transportation sector, is by far the largest contributor to GHG emissions and accounts for approximately 73% of global GHG emissions. In fact, fossil-based electric power generation alone accounts for approximately 32% of global CO_2 production[12]. Non-fossil based methane (CH_4) from solid waste, rice production, agriculture and livestock account for approximately 14% of GHG production. And land use changes, principally deforestation, which release the CO_2 stored in forest organic matter and soils, account for approximately 11% of total GHG production. As seen in Figure 4.1, these three sources make up the bulk of GHG emissions and are believed to be largely responsible for the rapid rise in atmospheric concentrations of CO_2 and other GHGs since pre-industrial times.

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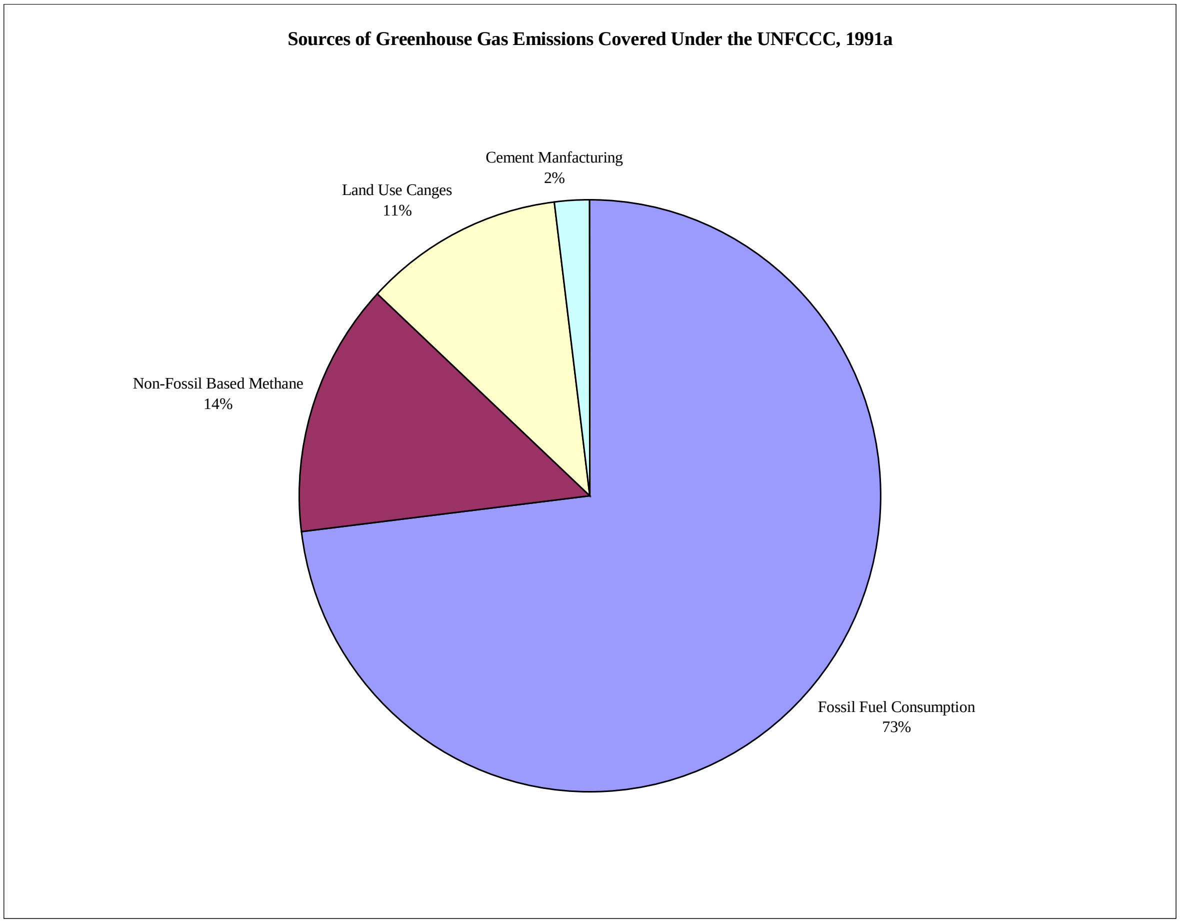
11 World Bank, Global Environment Division, Greenhouse Gas Assessment Handbook: A Practical Guidance Document for the Assessment of Project-Level Greenhouse Gas Emissions (Washington, D.C.: The World Bank, September 1998) 7.

12 Pia Hartman at the U.S. Department of Energy's Energy Information Administration, correspondence with author, July 7, 2000.

Figure 4.1: Sources of the Greenhouse Gases Covered Under the UNFCCC



Source: Greenhouse Gas Assessment Handbook, World Bank 1998

GHG Emissions and Development

Energy demand is closely associated with both population and economic growth. Because energy supply in most countries is largely based on fossil fuels, carbon emissions tend to grow rapidly with development, particularly among countries with relatively low levels of per capita income. For example, among low-income economies (excluding China), GDP grew at a rate of 2.8% per year between 1980 and 1994, while commercial energy consumption grew at a much higher rate of 4.7% per year[13]. The reasons for this are straightforward - the energy demands of industrial economies are far greater than those of agricultural economies. As developing countries transition from agricultural to industrial economies, fossil fuel consumption tends to increase rapidly. Moreover, with increasing per capita income household energy use grows because of the increased number of

13 United Nations Development Programme and the World Resources Institute, Promoting Development While Limiting Greenhouse Gas Emissions: Trends & Baselines (New York: United Nations, 1999) 3.

appliances. Energy consumption for transportation grows as the per capita ownership of private vehicles increases.

Among high-income countries, however, growth in energy consumption becomes increasingly "decoupled" from growth in GDP for a number of reasons. These economies often experience a shift from energy-intensive industrial sectors to less intensive service sectors. Moreover, the levels of energy use in certain sectors, such as households, become saturated as most consumers reach income levels at which further growth in consumption of energy-intensive appliances slows. Finally, technological advances regularly increase energy efficiency, holding down growth in energy demand even with growing economic activity. As a result of these factors, some OECD countries have exhibited stable or declining levels of CO_2 emissions in recent years.

Global CO_2 Emissions

Carbon Dioxide is the most important anthropogenic GHG, and its production can be used as an indicator for the other GHGs. Global CO_2 emissions have grown from 14.0 billion metric tons in 1970 to more than 22.6 billion metric tons in 1997; an increase of nearly 60%. Because fossil fuel consumption, and hence CO_2 emissions, are closely linked to economic output, past emissions of CO_2 and other GHGs were largely from developed economies. In 1990, 72% of the total CO_2 emissions from human activities came from industrialized countries[14]. The United States, with just 4% of the world's population, accounts for 22% of current global emissions.

In the coming decades, economic and population growth rates in developing countries are expected to significantly outpace those in the industrialized world. Over the next two decades, per capita incomes in the developing world are expected to more than double, and the regions' total population is projected to increase by 35%, accounting for 90% of the world's population growth[15]. As a result, per capita energy use for electricity generation and transportation in the developing countries, which is currently only 1/10 to 1/20 of the U.S. level, will increase rapidly[16].

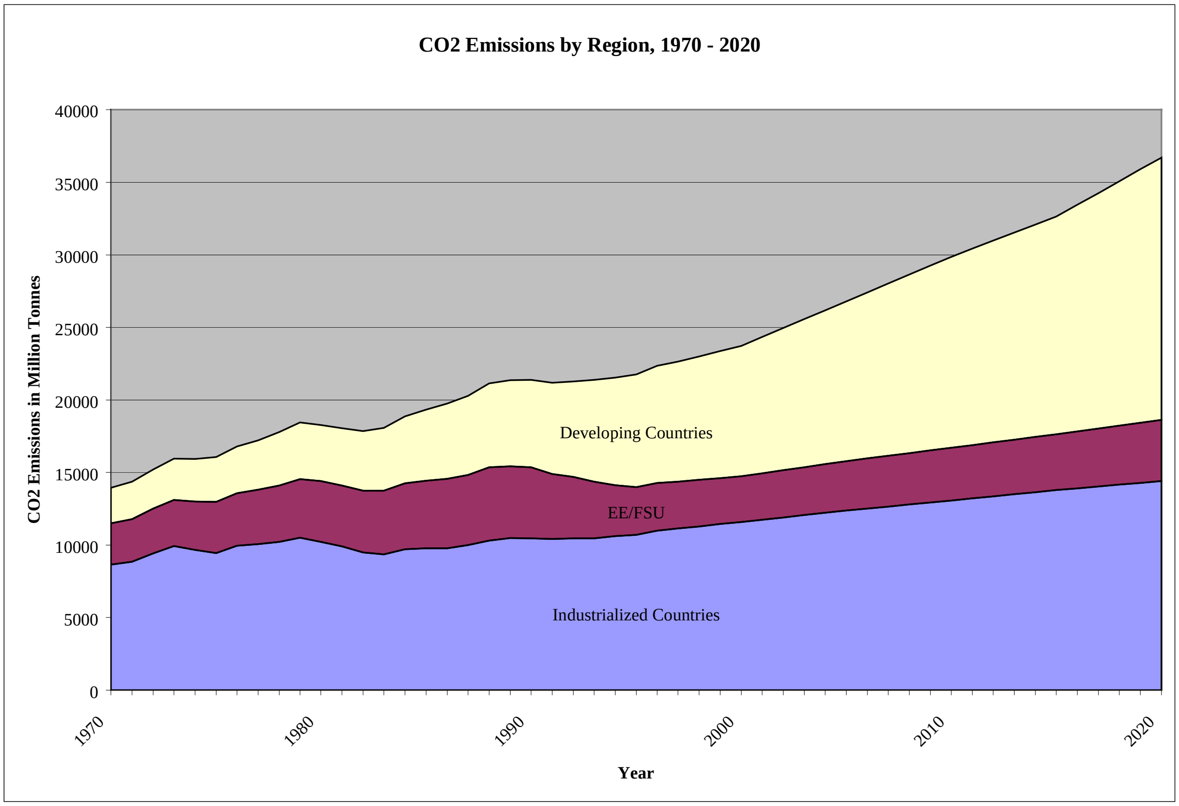
The International Energy Outlook 2000 (IEO2000) presents an assessment by the Energy Information Administration (EIA) of the outlook for international energy markets through 2020. Its projections anticipate various economic scenarios and are displayed according to three basic country groupings: industrialized regions, the developing countries and Eastern European/former Soviet Union (EE/FSU) countries, with additional details provided for each of these three regions. The report includes a "best estimate" reference projection along with high and low economic growth projections that represent possible alternative growth paths for the energy forecast. The EIA projections are generally consistent with other projections, including those by the International Energy Agency, Standard & Poor's

[14] International Energy Outlook 2000 (Washington, D.C.: Energy Information Administration, 2000) 179.
[15] International Energy Outlook 2000 (Washington, D.C.: Energy Information Administration, 2000) 160.
[16] Executive Office of the President, Office of Science and Technology Policy, Climate Change: State of Knowledge (Office of Science and Technology Policy 1997) page 6.

Platt's, Petroleum Industry Research Associates, and Petroleum Economics, Ltd. The following discussion is based on EIA2000 reference case projections.

Based on expectations of regional economic growth and energy demand, global CO_2 emissions are projected to increase from 22.6 billion metric tons in 1997 to 29.9 billion metric tons in 2010 and 36.7 billion metric tons in 2020 (not taking into account the potential impact of the Kyoto Protocol). Developing countries as a group are expected to account for approximately 70% of this increase. Emissions from these countries, which accounted for about 28% of the total global emissions in 1990, are projected to make up 44% of the total by 2010 and nearly 50% by 2020. Figure 4.2 illustrates the increasing contribution of carbon emissions from developing countries to global carbon emissions. Emissions from China, which are expected to rise from 2.9 billion metric tons in 1997 to 7.7 billion metric tons in 2020, constitute about 33% of the projected global increase. Emissions from the industrialized world are expected to rise by 3.3 billion metric tons between 1997 and 2020, led by an increase of 2.2 billion metric tons in emission from North America. In total, the industrialized nations account for just 23% of the projected increase in global CO_2 emissions over the two decades, with EE/FSU accounting for the remaining 7%.

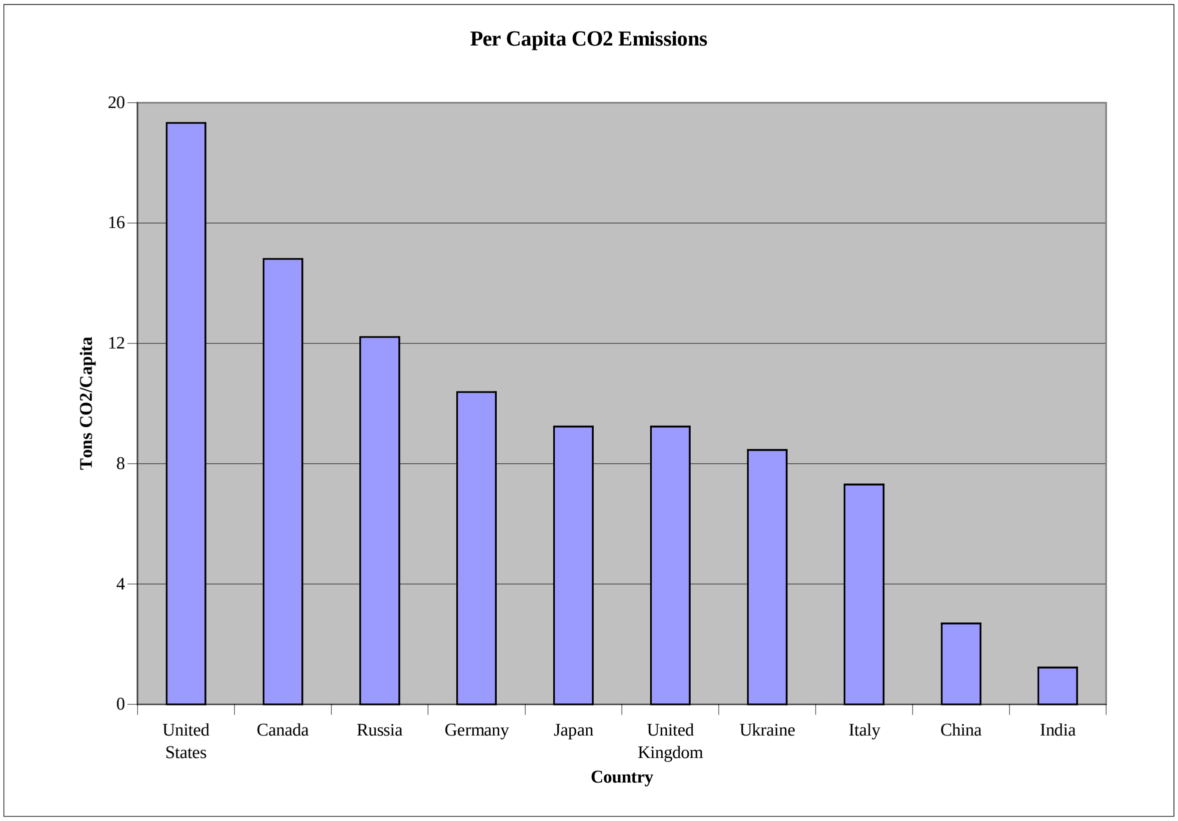
Figure 4.2: World Carbon Emissions by Region, 1970 – 2020



Source: International Energy Outlook 2000, IEA 2000

By 2020, developing countries are expected to surpass the industrialized countries in both energy demand and CO_2 emissions. On a per capita basis, however, CO_2 emissions from the industrialized nations are expected to remain far higher than those from most of the developing countries. Figure 4.3 compares per capita CO_2 emissions of the top ten emitting countries and illustrates that, despite the rapid growth in CO_2 emissions from developing countries, the significant gap between per capita CO_2 emissions in developed and developing countries will persist well beyond 2020.

Figure 4.3: Per Capita CO_2 Emissions of the Top Ten Emitting Countries



Source: Stopping the Hot Air, NRDC 2000

There are, of course, forecasts that anticipate significantly different development scenarios and that, as a result, do not predict the same growth rates for fossil fuel consumption and GHG emissions. Forecasts that anticipate a coordinated international effort to reduce GHG emissions generally predict considerably lower fossil consumption and GHG emission growth rates as a result of the rapid deployment of renewable energy technologies, demand side management and energy efficiency improvements.

Electricity Generation

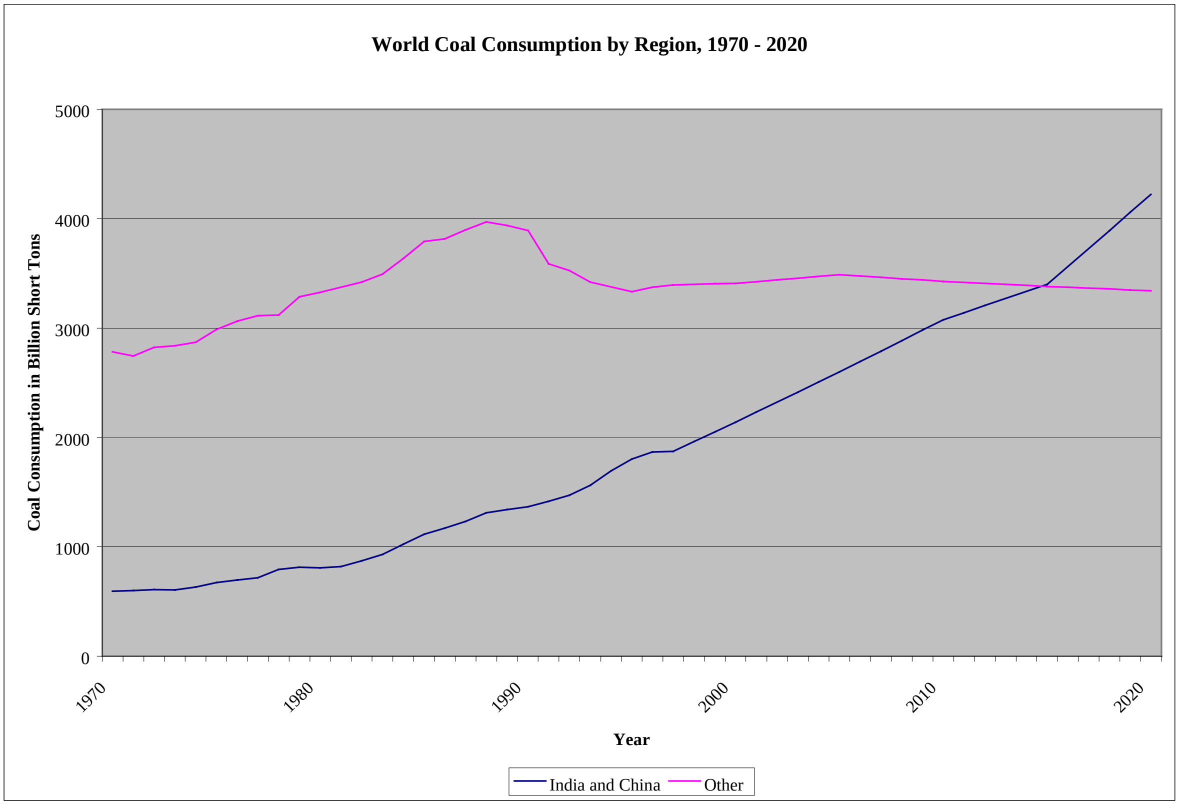
As mentioned above, electric power generation is the largest source of CO_2 emissions. Approximately 38% of total energy consumption goes to supply power plants[17], which account for nearly 32% of total CO_2 production. Power plants produce electricity by converting chemical energy stored in fossil fuels into electrical energy. During the energy conversion process, fuel-bound carbon is oxidized to CO_2 and released to the atmosphere. As a result, fossil fuels like natural gas, that have relatively high chemical energy contents and low carbon contents, produce the lowest emissions of CO_2. While fuels like lignite coal, that have relatively low chemical energy contents and high carbon contents, produce the highest emissions of CO_2.

[17] Pia Hartman at the U.S. Department of Energy's Energy Information Administration, correspondence with the author, July 7, 2000.

In addition, some power generation technologies are more efficient at converting chemical energy into electrical energy. Conventional boiler-based thermal power plants are generally around 33% efficient, while combined-cycle plants are generally around 45-50% efficient. As a result, fuel and technology choices have a significant impact on power plant CO_2 emissions. For example, CO_2 emissions from a gas-fired combined-cycle power plant may be as much as 60% less than emissions from a conventional coal-based power plant. Renewable energy technologies, which generally rely on solar or geothermal energy, produce little or no CO_2.

With worldwide electricity consumption expected to increase by 76% by 2020 compared to 1997 levels, fuel and technology choices will have a major impact on future CO_2 emissions. In the industrialized world, where natural gas is increasingly seen as the fuel of choice for new power plants, nearly 50% of the increase in CO_2 emissions between 1990 and 2020 will be attributed to an increase in natural gas use, while coal use will remain essentially flat. In the developing world, which will account for 61% of the growth in electricity production over the next 20 years, growth in gas consumption will be slower and heavy reliance on coal will continue, particularly in developing Asia. Coal accounts for 41% of the projected increase in CO_2 emissions in the developing world between 1990 and 2020, while oil accounts for 35%, and gas accounts for only 22%. The largest increases in CO_2 emissions are projected for China and India, where coal supplies are plentiful. As seen in Figure 4.4, those two countries alone will account for more than 90% of the projected rise in coal use worldwide over the next two decades.

Figure 4.4: World Coal Consumption by Region, 1970 – 2020

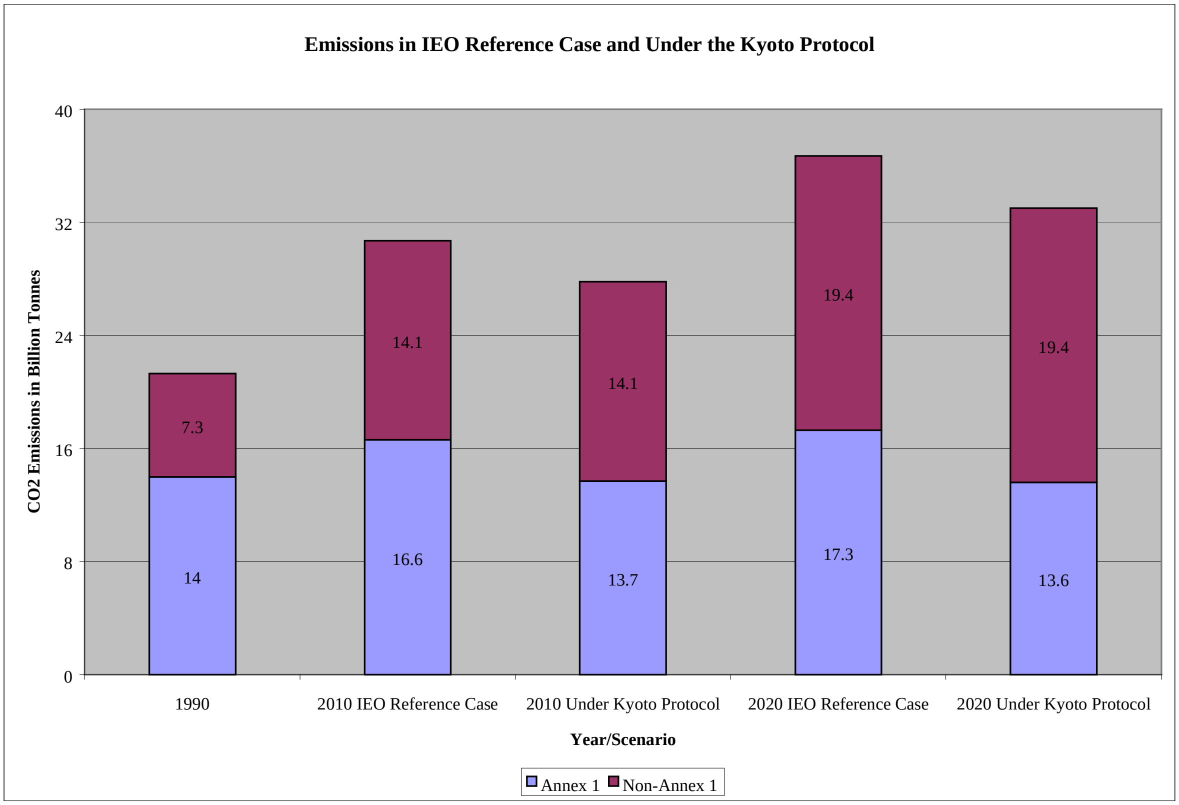


Source: International Energy Outlook 2000, IEA 2000

Implications for the Kyoto Protocol

The projected growth in CO_2 emissions described above has serious implications for implementation of the Kyoto Protocol. Under the Kyoto Protocol, which is intended to stabilize atmospheric GHG concentrations, developed countries (Annex I countries) would be required to limit GHG emissions to approximately 5% below 1990 levels by 2012. Assuming no coordinated Kyoto-like international actions are taken to reduce global CO_2 emissions, as seen in Figure 4.5 below, global CO_2 emissions are expected to exceed their 1990 levels by 40% in 2010 and by 72% in 2020. Given the significant CO_2 emissions increases anticipated from developing countries, even if Annex I countries were able to meet the emission limits or reductions prescribed in the Kyoto Protocol, worldwide CO_2 emissions still would grow by more than 31% and 55%, by 2010 and 2020, respectively. Therefore, the participation of developing nations and a shift to climate-friendly gas and renewable energy, along with major energy efficiency and agricultural and forest management improvements, will be needed to effectively reduce CO_2 and other GHG emissions and stabilize atmospheric concentrations of these gases.

Figure 4.5:World Carbon Emissions in the IEO2000 Reference Case and under the Kyoto Protocol



Source: International Energy Outlook 2000, EIA 2000

V. International Response to Climate Change

Summary: International efforts to reduce GHG emissions and stabilize atmospheric GHG concentrations culminated in 1997 with the Kyoto Protocol to the UN Framework Convention on Climate Change, which commits industrialized countries to legally-binding GHG emission reduction targets. Many governments (85) have signaled their commitment to addressing climate change by signing the Protocol (although only 16 countries have ratified it to date) and are working with key international institutions to evaluating complex policy options that have potentially significant economic and environmental implications for their countries. Given the critical role of energy in improving and maintaining living standards, the goal of these efforts is not to limit access to energy, but to provide energy that is less carbon intensive. As different approaches to achieve this goal are carefully evaluated and international negotiations continue, most countries have implemented programs similar to those in the U.S. that promote research, tracking and reporting on carbon emissions, voluntary mitigation measures, energy efficiency and renewable energy technologies. However, with the exception of a handful of European countries that have implemented some form of carbon/energy tax, governments have not banned or placed restrictions on fossil fuels or CO_2 emissions. OPIC's actions with respect to climate change appear to be consistent with the international response to climate change but clearly ahead of its foreign bilateral counterparts.

Many governments have signaled their commitment to addressing climate change by signing the UN Framework Convention on Climate Change (UNFCCC) and the Kyoto Protocol and are now working with key international institutions to evaluate complex policy options with potentially significant economic and environmental implications for their countries. Access to modern forms of energy is fundamental to development and the eradication of poverty in the developing world, but energy is also responsible for much of the GHG emissions that threaten the stability of the climate system. Therefore the goal of GHG reduction efforts is not to deny people access to energy, but to reduce the carbon intensity of development - which means a less carbon-intensive energy supply, reduced energy demand and improved carbon sinks.

Efforts to reduce the carbon-intensity of the energy supply generally focus on increasing the efficiency of power plants and promoting low-carbon fuels and renewable energy (wind, solar, hydro, geothermal, etc.). Efforts to reduce energy demand typically promote energy efficiency and conservation in the industrial, transport and residential sectors or demand side management. Efforts to encourage improved management of agricultural and forest lands and the protection of forests tend to enhance the Earth's natural capacity to assimilate carbon and mitigate the impact of CO_2 emissions. The Kyoto Protocol includes emissions trading, joint implementation and the clean development mechanisms that are designed to allow countries to work together across their borders to facilitate these outcomes. The most effective, economic approach to achieving these outcomes is the focus of the climate debate.

United Nations Framework Convention on Climate Change

The United Nations Framework Convention on Climate Change (UNFCCC) was adopted in 1992 with the goal of stabilizing greenhouse gas concentrations "at a level that would prevent dangerous anthropogenic interference with the climate system." Approximately 180 governments, including the U.S. and the European Community, have ratified the Convention, which entered into force in March 1994. The Convention contains the principle of "common but differentiated responsibilities," which designates that those nations contributing most to global warming take the lead in combating its effects. In keeping with this principle, the industrialized countries ("Annex I Parties") agreed to the voluntary aim of returning their emissions to 1990 levels by the year 2000. It also obligated Annex I countries, particularly OECD countries, to provide financial resources and to facilitate technology transfers for climate change initiatives in developing countries and "economies in transition" and established requirements for reporting on climate change policies, programs, and national emissions inventories.

Kyoto Protocol

The Kyoto Protocol to the UNFCCC was adopted in December 1997 after two years of debate and negotiation about the inadequacies of the UNFCCC and its voluntary mechanisms and the need for more meaningful requirements. Much of the inspiration for the Protocol came from the Intergovernmental Panel on Climate Change's Second Assessment Report, which concluded that, "the balance of evidence suggests a discernible human influence on global climate change." The Kyoto Protocol commits developed countries to legally-binding emission reduction targets for six greenhouse gases -- carbon dioxide, methane, nitrous oxide, hydrofluorocarbons, perfluorocarbons, and sulfur hexafluoride -- to be reached by the period 2008-2012. (CFCs are controlled under the Montreal Protocol.) These targets, which range by country from –5% to +10%, provide for a 5% emissions reduction from 1990 levels in aggregate.

The Protocol is noted for its three flexible, innovate mechanisms – joint implementation, emissions trading, and the clean development mechanism. The primary goal of these mechanisms is to encourage the least costly emissions reduction to be made wherever they are possible. For example, the CDM is intended to promote "win-win" actions in developing countries - that is, actions that enhance development prospects while reducing growth in GHG emissions. The Clean Development Mechanism would allow industrialized countries to finance emissions reduction or avoidance projects in developing countries and credit some or all of the reductions achieved against their own emission limitation targets. The rules governing the CDM have not yet been determined. Depending on how the rules are structured the CDM could be a cost-effective way for industrialized Annex I countries to meet their Kyoto Protocol goals and at the same time aid development prospects of developing countries by stimulating technological "leapfrogging" and generating new investments.

Although 83 countries have signed the Protocol, only 16 countries have ratified it to date. Fifty-five countries, including Annex I Parties accounting for at least 55% of developed country emissions, must ratify the Protocol in order for it to enter into force. Many countries are delaying ratification of the Protocol until operational details are finalized. Others, including the U.S., are upholding ratification until the "meaningful participation" of developing countries is achieved, a prerequisite for U.S. Senate approval as pronounced in the Byrd-Hagel Resolution[18]. The importance of meaningful participation of developing countries was highlighted in the previous section of this report.

Global Environment Facility

The Global Environment Facility (GEF) was launched in 1991 as an experimental facility and restructured after the Earth Summit in Rio de Janeiro, Brazil to provide funds on a grant or concessional loan basis to support projects that address biodiversity loss, climate change, degradation of international waters, and ozone depletion. The GEF is implemented jointly by the United Nations Development Programme (UNDP), the United Nations Environment Programme (UNEP), and the World Bank. UNDP provides technical support and is responsible for the development and management of capacity-building programs and manages the GEF Small Grants Program. UNEP is responsible for scientific and technical analysis, manages the Scientific and Technical Advisory Panel, and catalyses global, regional, and national environmental assessment and policy frameworks. The World Bank, the repository of the Trust Fund, manages investment activities, mobilizes private sector resources, and manages its own GEF project portfolio.

As the financial mechanism for the UNFCCC, the GEF helps developing countries implement the Convention. Specifically, the GEF supports projects that: (i) remove barriers to energy efficiency and energy conservation; (ii) promote the adoption of renewable energy by removing barriers and reducing transaction costs; (iii) reduce the long-term costs of low greenhouse gas emitting energy technologies; and (iv) support the development of sustainable transport. Since its inception in 1991, the GEF has provided access to over $2 billion in funding and has attracted additional funding for projects by helping them to overcome initial investment costs and reducing risks for investors. Around 40% of GEF funds have supported climate change activities.

World Bank Group

The World Bank Group (WBG) is a development institution whose goal is to reduce poverty by promoting sustainable economic growth in its client countries. WBG consists of five closely associated institutions: the International Bank for Reconstruction and Development (IBRD); International Development Association (IDA); International Finance Corporation (IFC); Multilateral Investment Guarantee Agency (MIGA); and the International Centre for Settlement of Investment Disputes (ICSID). The World Bank supports the implementation of the UNFCCC and the Kyoto Protocol through various policies and programs and through their role as an implementing agency of the GEF.

[18] Senate Resolution 98. U.S. Senate, June 12, 1997.

The energy sector has always been an important area of the World Bank's activities. Loan commitments in this sector totaled $2.54 billion in FY 1998 (IDA, IBRD, and IFC) and typically represent between 18 - 20% of total annual commitments of the WBG. Bank renewable energy and energy efficiency loans are often supported by GEF grants. To date WBG loans for renewable energy total $547 million and energy efficiently initiatives, once only component parts of power sector loans, are now addressed in their own right in lending operations. In addition, as an implementing partner of the GEF, the WBG also manages its own portfolio of GEF projects, including over $500 million in support of climate change projects.

In addition to lending and GEF activities, the WBG has a number of programs and initiatives addressing climate change and promoting renewable energy, energy efficiency and providing technical assistance. The longest established program is the Energy Sector Management Assistance Program, which provides technical assistance for the energy sector in six priority areas: energy and the environment; rural and household energy; renewable energy technologies; energy sector reform; energy efficiency; and international energy trade. Other programs include: the Prototype Carbon Fund; the Activities Implemented Jointly Program; the Solar Development Corporation; the Renewable Energy and Energy Efficiency Fund; the Small and Medium Scale Enterprise Program; the Asia Alternative Energy Group; and the Global Carbon Initiative, among many others.

Organization for Economic Co-operation and Development

The Organization for Economic Co-operation and Development (OECD) comprises 29 member countries, including the U.S., that work together to improve economic and social policy. The OECD considers global climate change to be a major challenge, with serious economic and environmental implications. The OECD is working to integrate climate policy objectives into transport, energy, and agriculture sector policies. Key contributions of the OECD include the Climate Technology Initiative, coordination of an annual Forum on Climate Change, analysis of the Kyoto Protocol, and inputs to the Conferences of the Parties. By helping member countries assess domestic and international policies to reduce greenhouse gas emissions, the OECD contributes to the effective implementation of the UN Framework Convention on Climate Change and the Kyoto Protocol.

The OECD has reported that, for the most part, current domestic policies in member countries are inadequate for meeting the targets of the Kyoto Protocol.[19] Several countries (Germany, Italy, Austria, Norway, Sweden, Finland, Denmark, and the Netherlands) have introduced some form of energy/carbon tax, while others are planning or considering such as tax. Although there is talk of domestic tradeable permit systems for CO_2, no such system is currently in use. Other measures employed or considered by member countries include voluntary agreements to reduce emissions, regulatory policies for materials,

[19] Organization for Economic Co-operation and Development, "OECD Perspectives on Climate Change Policies, " (OECD, October 26, 1999.)

buildings and products, green government procurement approaches, research, information and public awareness programs.

U.S. Government

The Climate Change Action Plan (CCAP) was launched in 1993 and was intended to satisfy U.S. commitments under the UNFCCC. The CCAP involves nearly 50 programs and initiatives aimed at reducing GHG emissions. These programs and initiatives generally involve win-win voluntary partnerships, are non-regulatory and address all sectors of the economy, from energy production to forestry initiatives.

Examples of the voluntary programs established by the U.S. government under the CCAP[20] include the DOE's Climate Challenge, which encourages major electric utilities to pledge to reduce their greenhouse gas emissions. The joint DOE/EPA Climate Wise program encourages firms to respond to the challenge of reducing greenhouse gas emissions by setting bottom-line emission targets that they can attain using the most cost-effective means available. The DOE Motor Challenge encourages motor system manufacturers, industrial motor users, and utilities to begin an aggressive program to install the most energy-efficient motor systems in industrial applications. Although the CCAP has achieved considerable success, "these voluntary programs alone are not capable of producing the reductions necessary to return U.S. emissions to 1990 levels."[21]

In anticipation of the December 1997 approval of the Kyoto Protocol, the U.S. announced a renewed effort to address climate change. The plan sets timetables and targets for reaching the 1990 emission levels by the period of 2008 to 2012, anticipates a review of U.S. progress and an evaluation of next steps beginning around 2004 and the implementation of a domestic emissions trading program beginning in 2008. The highlight of the plan is the 5-year, $6.3 billion Climate Change Technology Initiative (CCTI). The CCTI is a package of tax incentives and R&D investments designed to encourage energy efficiency and to help develop low-carbon energy sources and to reduce greenhouse gas emissions.

Complementing its domestic efforts, The United States Agency for International Development (USAID) is responsible for the management of U.S. overseas development assistance. USAID's energy sector strategy addresses climate concerns by promoting the use of renewables, energy efficiency, and clean energy technologies. Activities in the energy sector have been supported by around $180 million annually.

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[20] Nordhaus, Robert R. and Fotis, Stephen, "U.S. Implementation of Voluntary Actions and Programs, " Analysis of Early Action Crediting Proposals (Pew Center on Global Climate Change, October 1, 1998.)

[21] Nordhaus, Robert R. and Fotis, Stephen, 14.

VI. OPIC and the Environment

Summary: OPIC's environmental policies and procedures have long been among the most stringent of any bilateral finance, investment insurance or export credit agency. All OPIC-supported projects are subject to thorough environmental assessment and post-completion environmental compliance monitoring. The release of the new OPIC Environmental Handbook last year demonstrates a continued commitment to improve environmental policies and procedures, strengthen environmental performance and expand public participation. World Resources Institute has rated OPIC public consultation and disclosure policies the best among our foreign bilateral counterparts. OPIC has taken a lead role in efforts to promote common environmental standards among our counterpart agencies overseas and has created partnerships with other U.S. government agencies and non-governmental organizations (NGOs) to promote environmentally sound development. In response to the threat of climate change, OPIC was the first bilateral agency to commit to tracking and reporting CO_2 emissions from its power sector projects and to pledge support to projects that reduce or offset GHG emissions, particularly those certified by the U.S. Initiative for Joint Implementation.

OPIC has a long standing commitment to the environment. Since 1985, OPIC has been required by statute to assess the environmental impacts of prospective projects and to decline assistance to projects posing a "major or unreasonable hazard to the environment, health or safety" or resulting in the "significant degradation of a national park or similar protected area." OPIC is required to operate its programs in accordance with the intent of sections 117, 118 and 119 of the Foreign Assistance Act relating to environmental impact assessment, tropical forests, biological diversity and endangered species.

OPIC strongly supports these principles and is committed to ensuring that the projects it supports meet the highest level of environmental performance. All prospective projects receive a thorough environmental assessment and OPIC declines support to projects involving infrastructure or raw material extraction in primary tropical forests and other protected or ecologically fragile areas. In determining whether a project will pose an unreasonable or major environmental, health or safety hazard, OPIC generally relies on guidelines and standards adopted by international organizations such as the World Bank. All prospective projects having potentially significant environmental impacts must submit an EIA, undergo a 60-day public comment period, submit annual environmental monitoring reports and undergo at least one independent compliance audit within the first three years of project operation. And finally, OPIC monitors project compliance with contractual conditions throughout the term of the OPIC loan agreement or insurance contract. *(For a complete description of OPIC's environmental assessment procedures, please see the OPIC Environmental Handbook, at www.opic.gov.)*

Environmental Handbook

While OPIC's environmental policies and procedures have long been among the most stringent of any bilateral finance, investment insurance or export credit agency, in April 1999, following intensive discussions with its stakeholders, including U.S. businesses and environmental NGOs, OPIC adopted and issued in final form its Environmental Handbook. The handbook codifies OPIC's environmental standards and procedures as they have evolved since 1985, including strengthened environmental requirements, particularly with respect to transparency and public participation.

Public Consultation and Disclosure

OPIC is unique among its foreign bilateral counterparts in its comprehensive procedures for environmental information disclosure. In fact, according to a recent report of the World Resources Institute[22], OPIC is one of only two "leading ECAs" (the U.S. Export Import Bank is the other) to satisfy seven key environmental disclosure criteria. That is, OPIC publishes environmental guidelines, discloses screening criteria, publishes environmental assessment rules, releases project environmental assessments, solicits public comments, discloses projects approved, and reports on CO_2 emissions.

OPIC's public consultation and disclosure process involves posting on OPIC's web site a 60-day notice of environmentally sensitive projects for which OPIC is considering providing support. A list of such postings is maintained on the OPIC web site and members of the public may subscribe to OPIC's Environmental List Server to be automatically notified when OPIC posts a new prospective project. Members of the public may request copies of EIAs and submit comments for any posted projects. All public comments received by OPIC are considered in the assessment of posted projects. OPIC also strongly encourages investors to consult with locally affected people in the host country through the entire duration of their investment projects, and particularly in the preparation of environmental impact assessments and other planning documents.

In addition, OPIC reports annually to Congress and the public regarding its implementation of and compliance with internal, national, and international environmental policies, laws, treaties, and agreements to which its programs are subject. OPIC's Annual Environmental Report (AER) is a voluntary report, and is part of a package of OPIC environmental initiatives proposed by President Clinton at the United Nations General Assembly Special Session (UNGASS) on Sustainable Development in June 1997. The first part of the report summarizes the implementation of the policy changes that OPIC made to fulfill the initiatives announced at UNGASS. The second part reports on the environmental implications of the projects to which OPIC committed its support during the fiscal year, including CO_2 emissions from power projects. The third part describes OPIC's efforts to promote the development of common environmental standards among its counterpart organizations overseas and among private political risk insurers.

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[22] Maurer, Crescencia and Bhandariu, Ruchi, "The Climate of Export Credit Agencies, " Climate Notes (Washington, D.C.: World Resources Institute, 2000) 1-16.

Common Environmental Standards

OPIC has taken a lead role in efforts to harmonize environmental standards among bilateral finance, investment insurance and export credit agencies. OPIC has encouraged its foreign bilateral agency counterparts, as well as its private sector partners, to recognize the importance of the environment to the long-term viability of the projects they support and to integrate environmental considerations into their investment decision-making. Over the last year, OPIC continued its ongoing efforts to promote harmonization of environmental standards through meetings with our foreign bilateral counterparts in Germany, The German Investment and Development Company (DEG) and Kreditanstalt fur Wiederaufbau (KfW), as well as with representatives of the Japanese Export Import Bank (JEXIM) and the Export Development Corporation of Canada.

OPIC also took a leading role in the International Finance Corporation's review of environmental and social requirements among international financial institutions (IFIs) in private sector development projects. This effort entails collection of data on environmental, occupational health and safety, and social matters, public consultation and disclosure practices and their implementation by about 50 IFIs. This process will provide a baseline for further effective dialogue with OECD counterparts. The benefits of common environmental standards are widely recognized among OPIC's various stakeholders. OPIC looks forward to continuing its close collaboration with U.S. business, NGOs, Congress and the Administration, as it continues to address these and other environmental challenges.

Partnerships for the Environment

As part of its continuing efforts to promote environmentally friendly private investment in projects in developing countries, OPIC has established partnerships with U.S. government agencies and NGOs to enhance its ability to support environmentally friendly projects, including eco-tourism, low cost housing, and renewable energy.

As part of this effort, OPIC entered into a partnership with U.S. AID to complete OPIC's first loan commitment to a non-governmental organization, Washington, D.C.-based Counterpart International, Inc. and World Women in Defense of the Environment. Counterpart International, Inc. will use the $1 million in financing to establish a facility to on-lend OPIC funds to environmentally friendly projects and existing businesses to promote environmentally focused small-and medium-sized enterprises in the Philippines. The facility will be comprised of up to $750,000 in a direct loan from OPIC and up to $250,000 in grant monies from USAID that will be administered by OPIC. Proceeds of the OPIC loan will be used for investments in business ventures in the Philippines that meet OPIC's environmental and other policy criteria. Up to five investments are anticipated, involving activities such as organic fertilizer manufacturing, eco-tourism, and low cost housing using recycled materials.

OPIC also signed a Memorandum of Cooperation with the Department of Energy "affirming their intent to facilitate financing that will promote the development of sustainable energy projects in Africa." Accordingly, OPIC and DOE will design the "U.S.-Africa Sustainable Energy Program" to provide assistance to U.S. not-for-profit entities, NGOs, and U.S. small business entities or cooperatives interested in developing sustainable energy projects in Africa. The program will target projects that (i) support community-based sustainable energy development, (ii) increase energy access and bring clean energy systems to underserved/unserved areas using renewable technologies and natural gas-fired systems, (iii) reduce greenhouse gases through programs that promote enhanced supply, renewable sources, or demand-side management, and/or (iv) promote the application of clean energy technologies.

OPIC Climate Change Initiatives

As discussed earlier in this report, any effective international effort to reduce greenhouse gas emissions will require the participation of the developing world. The Senate's Byrd–Hagel Resolution therefore predicates U.S. Senate ratification of the Kyoto Protocol on meaningful participation of developing countries. The joint implementation, emissions trading and clean development mechanisms of the Kyoto Protocol are designed to encourage the participation of developing countries and achieve the most cost-effective emission reductions. As described in its Environmental Handbook, OPIC seeks to support the Byrd-Hagel Resolution and the Kyoto mechanisms by encouraging investment in projects involving Joint Implementation and by tracking and reporting CO_2 emissions from its power sector projects.

To encourage U.S. companies, particularly small business, to participate in efforts to reduce global greenhouse gas emissions, OPIC will provide customized pricing for small business projects intended to reduce such emissions, in particular those projects certified by the U.S. Initiative for Joint Implementation. These projects involve the sharing of technology and resources, particularly transfers from Developed to Developing nations, to limit and reduce GHG emissions. In addition, OPIC will continually strive to make its portfolio more climate friendly by proactively seeking renewable energy projects and by seeking to harmonize its approach to climate change issues with that of other U.S. Government entities.

In a effort to support the management of global greenhouse gas emissions, in February 1998 OPIC became the first bilateral finance, investment insurance or export credit agency to commit to tracking and reporting GHG emissions from its power sector projects. Tracking results are made available to the public and reported annually to Congress in OPIC's Annual Environmental Report (AER). OPIC's most recent tracking and reporting efforts are contained in the OPIC's 1999 AER

In 1999 OPIC-supported six new projects, with a combined 2,367 MW of power capacity. As in prior years, the power sector projects supported by OPIC in FY 1999 were largely weighted toward natural gas, the cleanest and most climate-friendly fossil fuel. These projects, measured in terms of MW capacity, were approximately 92% gas-fired and 8% oil-fired. Annual CO_2 emissions from these projects represent less than 0.03% of annual global CO_2 emissions. The results demonstrate that OPIC continues to maintain a responsible power portfolio.

VII. Conclusion

Climate change represents a serious global environmental challenge. Since the dawn of the industrial age, man has been emitting increasing quantities of heat-absorbing GHGs primarily through the consumption of fossil fuels. As a result, atmospheric concentrations of CO_2 - the most important GHG - are now at their highest levels in more than 160,000 years and global temperatures are rising. With emissions of CO_2 and other GHGs expected to increase - especially in developing regions - current forecasts suggest that atmospheric concentrations of CO_2 could double by 2060 with a resulting global average temperature increase of as much as 2° to 6.5° F over the next century. Such a rapid temperature increase could have potentially grave economic and environmental impacts.

This report demonstrates that OPIC-supported projects are not major contributors to global GHG emissions or climate change. Contrary to some assumptions, the OPIC power portfolio is predominately driven by clean burning low-carbon natural gas (45%) and carbon-free hydro and geothermal energy (27%). Current annual CO_2 emissions from OPIC-supported power projects represent approximately 0.24% of global CO_2 emissions. In addition, OPIC projects tend to use highly efficient advanced technologies, with more than 43% of OPIC fossil fuel-fired power projects using combined cycle technology - the most efficient electricity generating technology.

However, despite this good news about its own portfolio, OPIC understands that it has an important role to play in helping the developing world make the transition to less carbon intensive development. After all, reducing GHG emissions in developing regions - where as much as 70% of the increase in CO_2 emission over the next two decades will occur - will be critical to successfully stabilizing global atmospheric GHG concentrations.

In the near term, OPIC’s commitment to natural gas will be an important part of that transition process. In the longer term, OPIC recognizes that renewables, such as wind and solar power, will have an important role to play in reducing global reliance on fossil fuels and their associated GHG emissions. As an agency whose sole focus is on the developing world, OPIC has the opportunity to play a unique role facilitating the participation of countries whose involvement is critical to the resolution of the climate problem. OPIC therefore looks forward to exploring more fully both the needs of renewable energy developers and how developing countries determine their energy requirements and establish bid specifications for power projects in order to more effectively utilize its programs to support renewable energy projects.

Appendix I
OPIC-Supported Power Projects

Year	Project Name	U.S. Sponsor	Country	Fuel	E. Factor	Plant Type	Heat Rate	Size	CO2 Emitted
1990	Hopewell Energy Co.	Citicorp Scrimgeour Vickers	Philippines	gas	56100	simple-cycle	9757	200	827,049
1992	Puerto Quetzal Power Corporation	Enron Power Corp.	Guatemala	diesel	74050	engine-driven	7588	234	993,323
1992	Inter-American Energy Leasing	K&M Engineering Corp.	Columbia	gas	56100	combined-cycle	7266	100	307,950
1992	Belize Electric Co. Ltd.	Dominion Energy Inc.	Belize	hydro	0	hydroelectric	0	25	0
1993	Dominion Generating, S.A.	Dominion Energy, Inc.	Argentina	hydro	0	hydroelectric	0	450	0
1993	Central Termica San Nicholas, S.A.	AES Americas Inc.	Argentina	gas	56100	steam boiler	10348	325	1,425,361
				coal	94600	steam boiler	10348	325	2,403,551
1993	Batangas Power Corporation	Enron Power Corp.	Philippines	resid.	77350	engine-driven	7588	105	465,585
1994	Trakya Elektrik Uretim ve Ticaret	Enron Corp./Wing Int'l.	Turkey	gas	56100	combined-cycle	7266	480	1,478,161
1994	P. T. Paiton Energy Co.	Mission Energy Company	Indonesia	coal	94600	steam boiler	10348	1220	9,022,559
1994	Grenada Electricity Services	WRB Enterprises Inc.	Grenada	diesel	74050	engine-driven	7588	18	76,409
1994	Generacion de Vapor GENEVAP	LG&E Energy Systems, Inc.	Venezuela	gas	56100	simple-cycle	9757	315	1,302,603
1994	Dabhol Power Corporation	Enron Corp./Bechtel/GE	India	gas	56100	combined-cycle	7266	2184	6,725,634
1994	CMS Generation, S.A.	CMS Generation Co.	Argentina	hydro	0	hydroelectric	0	1320	0
1994	Ce Luzon Geothermal Power	Cal Energy/Kiewit Energy	Philippines	geo	0	geothermal	0	180	0
1994	CE Cebu Geothermal Power	California Energy Co.	Philippines	geo	0	geothermal	0	119	0
1995	Visayas Geothermal Power Comp	Magma Power Co/ Visayas	Philippines	geo	0	geothermal	0	231	0
1995	Termobarranquilla, S.A.	Energy Initiatives, Inc.	Columbia	gas	56100	combined-cycle	7266	750	2,309,627
1995	Tampo Centro Americana	TECO Power Services Corp.	Guatemala	diesel	74050	simple-cycle	9757	78	425,754
1995	Quezon Power	Ogden Projects Inc.	Philippines	coal	94600	steam boiler	10348	480	3,549,859
1995	P.H. Don Pedro, S.A.	Energia Global, Inc.	Costa Rica	hydro	0	hydroelectric	0	14	0
1995	Doga Enerji Uretim Sanayi ve Ticaret	Edison Mission Energy	Turkey	gas	56100	combined-cycle	7266	180	554,310
1996	Termovalle S.C.A. E.S.P.	KMR Corporation	Colombia	diesel	74050	combined-cycle	7266	199	808,902
1996	TermoCandelaria S.C.A. E.S.P.	KMR Corp./NationsBank	Colombia	gas	56100	simple-cycle	9757	316	1,306,738
1996	P.T. Energi Sengkang	Tenneco Inc.	Indonesia	gas	56100	simple-cycle	7266	135	415,733
1996	P.H. Rio Volcan S.A.	Energia Global, Inc./EFI	Costa Rica	hydro	0	hydroelectric	0	17	0
1996	Nejapa Power Company	Coastal Corporation	El Salvador	resid.	77350	engine-driven	7588	150	665,122
1996	Light Servicos de Eletricidade	AES Corp/Houston	Brazil	hydro	0	hydroelectric	0	942	0
1996	Jorf Lasfar Energy Co	CMS Generation	Morocco	coal	94600	steam boiler	10348	1356	10,028,352
1996	Himpurna California Energy	Cal Energy/Kiewit Energy	Indonesia	geo	0	geothermal	0	55	0

Year	Project Name	U.S. Sponsor	Country	Fuel	E. Factor	Plant Type	Heat Rate	Size	CO2 Emitted
1996	Empresa Guaracachi S.A.	EI Power	Bolivia	gas	56100	simple-cycle	9757	180	744,758
				diesel	74050	engine-driven	7588	36	152,819
1996	Empresa Electrica Valle Hermoso	Constellation Energy Int'l	Bolivia	gas	56100	simple-cycle	7266	181	556,466
1996	Empresa Electrica Corani S.A.	Dominion Energy, Inc.	Bolivia	hydro	0	hydroelectric	0	126	0
1996	CMS Ensenada S.A.	CMS Generation Co.	Argentina	gas	56100	combined-cycle	7266	128	394,176
1996	Central Termica San Miguel	LG&E International Inc.	Argentina	gas	56100	simple-cycle	9757	110	454,877
1996	CE Casecnan Water & Energy	Calif. Energy/Kiewit Energy	Philippines	hydro	0	hydroelectric	0	112	0
1996	Ave Fenix Energia, S.A.	NationsBank, N.A.	Argentina	gas	56100	simple-cycle	9757	168	694,722
1996	Aguaytia Energy del Peru	Aguaytia EnergyLLC/ TCW	Peru	gas	56100	simple-cycle	9757	141	583,070
1997	EMA-Power Kft.	EPEC Cogeneration Co.	Hungary	resid.	77350	steam boiler	10348	35	211,645
				gas	56100	steam boiler	10348	35	153,500
1997	EGENOR, S.A.	Dominion Energy, Inc.	Peru	hydro	74050	hydroelectric	0	225	0
				diesel	74050	engine-driven	7588	78	331,108
				diesel	74050	simple-cycle	9757	102	556,755
1997	EAL/ERI Cogeneration Partners	Teachers Insurance Assoc.	Jamaica	resid.	77350	engine-driven	9757	17	96,928
1997	Central Generadora Electrica San Jose	TECO Power Services/Coast.	Guatemala	coal	94600	steam boiler	10348	120	887,465
1998	TRI Energy Company Limited	Texaco/Citibank/Edison	Thailand	gas	56100	combined-cycle	7266	700	2,155,652
1998	Tecnoguat S.A.	Energia Global Int'l Ltd.	Guatemala	hydro	0	hydroelectric	0	14	0
1998	Subic Power Corporation	Enron Corp.	Philippines	resid.	77350	engine-driven	7588	111	492,190
1998	NEPC Consortium Power	Ogden Energy/El Paso	Bangladesh	gas	56100	engine-driven	7588	120	385,917
1998	Elektro Electricity Dist. System	Enron Corp.	Brazil	hydro	0	hydroelectric	0	5	0
1998	Dodson-Lindblom Hydro Power	Dodson-Lindblom Int'l.	India	hydro	0	hydroelectric	0	12	0
1999	Turboven Maracay Company	PSEG Americas	Venezuela	gas	56100	simple-cycle	9757	64	264,242
1999	Turboven Cagua Company	PSEG Americas	Venezuela	gas	56100	simple-cycle	9757	72	296,497
1999	Tipitapa Power Company	Coastal Power Nicaragua	Nicaragua	diesel	74050	engine-driven	7588	51	216,069
1999	EPSA/EDC	US Capital Markets Invest.	Venezuela	hydro	0	hydroelectric	0	817	0
1999				coal	94600	steam boiler	10348	33	244,053
1999	Empresa Produtora de Energia	Enron Corp.	Brazil	gas	56100	combined-cycle	7266	480	1,478,161
Total								16775	56,443,654

Overseas Private Investment Corporation
An Agency of the United States Government
1100 New York Avenue, N.W., Washington, D.C. 20527
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Internet: www.opic.gov