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Environmental Protection Under Power Sector Reform in Developing Countries

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ENVIRONMENTAL PROTECTION UNDER POWER SECTOR REFORM IN DEVELOPING COUNTRIES

Final Report

Prepared for:

U.S. Agency for International Development
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FOREWORD

The 1990s has seen a dramatic shift away from the state-owned monopoly model towards corporatized, privatized, and restructured power sectors in developing countries. While most developing countries (and development agencies such as USAID) have embraced sector reform as a net benefit for sustainable development, little critical attention has been paid to the environmental implications of the reforms undertaken.

The clear presumption has been that market discipline will lead to improved environmental performance, that the "invisible hand" will also be a "green" hand. While this may be true as economies shift from inefficient public sector management to private delivery mechanisms, it is not clear that market forces will always reward the environmentally preferable choice. Absent appropriate regulatory or price incentives (such as including externalities), market forces may reward investments that maximize short-run profits, rather than those that optimize life cycle costs and benefits. Investments in energy efficiency, renewable energy, hydropower and nuclear power, for example, all stand to suffer when short-run marginal costs determine investment decisions.

The purpose of this report to examine the relationship between specific reforms and decisions that affect the environment. To do so, it disaggregates the different reforms and traces the ways that each one affects the behavior of actors in the power sector.

Because the package of reforms and the reform process that each country implements is unique, the net effect that reforms have on environmental performance is country-specific. Still, the reform packages that most developing countries adopt are likely to *improve* the environmental performance of the sector which, in its non-reformed state, is often dismal.

Although a few countries have made their reforms long enough ago to get some post-reform data, in most cases, power sector reform is still a work in progress. Consequently, statistical approaches to answering the basic question were not feasible. This report broadens the debate and clarifies the issues, but is by no means the last word. As the post-reform evidence accumulates around the globe, definitive trends may emerge from which to revisit the relationships discussed in this report.

Equally important are the report's answers to the question of what, if anything, must be done by in-country reformers or development assistance organizations. One thing is clear: Regardless of their environmental implications, reforms will move ahead. If power sector reformers and other stakeholders are at least sensitized to their potential environmental implications, direct and indirect, the reform process can be guided in directions so that the outcome maximizes

environmental benefits and minimizes any adverse effects. This report will hopefully stimulate in-country discussion and consideration of interventions at key points in the reform process to ensure environmental progress.

Jeff Seabright
Director, Office of Energy, Environment & Technology

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The project team expresses its appreciation to Carl Duisberg, Carla Koppell, and Jeff Seabright of USAID's Office of Energy, Environment, and Technology, Center for Environment, for funding this study and for their helpful direction throughout its development.

DEDICATION TO MOLLY KUX

This report is dedicated to Molly Kux, who was a tireless pioneer on environment and development at USAID. Molly never missed an opportunity to press her colleagues in the Office of Energy on the environmental implications of our support for power sector privatization. And she was not satisfied with the simplistic reply that resource use is more efficient when managed by the private sector. This report seeks to begin to answer the central question Molly posed to us all.

ENVIRONMENTAL PROTECTION UNDER POWER SECTOR REFORM IN DEVELOPING COUNTRIES

INTRODUCTION

The power sectors of many developing countries have traditionally been publicly owned and dominated by a central planning philosophy. In some nations, the government has also controlled upstream sectors (fuel extraction and transport) and downstream sectors (major industries). Because most governments have also viewed the provision of electric power as a public service, they have made universal electrification a national policy objective and provided subsidized electricity services to rural and low-income customers.

These prevailing structural characteristics and philosophies have created problems for many countries' power sectors. Two of the most critical problems are that:

- countries have been unable to attract private investment because of managerial inefficiency, political interference, and inadequate cost recovery
- the infusion of cash to shore up foundering public utilities has raised many governments' deficits and international debt.

Power sectors around the world are being reformed and restructured in an effort to improve their economic efficiency, stimulate private investment, and lower the cost of electricity. Developing countries are making these reforms in the context of rapid economic and population growth, which creates strains on their power sectors: many of these nations also face electricity shortages while struggling to meet rapidly rising demand.

In this setting, some issues are inevitably left out of the reform process or pushed aside. Environmental considerations are among those overlooked, often because policy makers have higher priorities or assume that reforms will automatically lead to environmental improvement.

This summary report, along with the complete study, *The Environmental Implications of Power Sector Reform in Developing Countries*,[1] explains the effects of various power sector reforms on

[1] This 1997 report, which was prepared by Hagler Bailly, is available from the Center for Environment within USAID's Office of Energy, Environment, and Technology.

the environment, and delineates some of the policy options available to these countries to protect their environments. While both reports primarily focus on air emissions, many of their findings and recommendations can be applied to such impacts as thermal discharges from plant cooling water; land use impacts from infrastructure siting; fuel extraction, transport, storage, and disposal; ash disposal; and radioactive waste and spent nuclear fuel disposal.

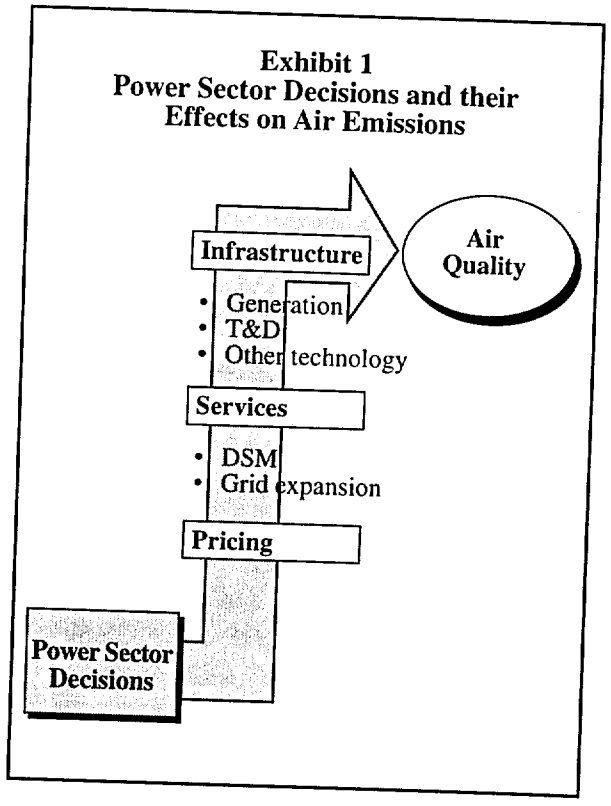
Policy makers in the United States and other OECD countries are debating whether their countries' power sector reforms will help or hurt the environment. However, the risks and opportunities are greater among developing and emerging economies, where the total growth in electricity generation is projected to exceed that of OECD countries by 2015. The reform process in developing countries provides a window of opportunity for improving their power sectors' environmental performance.

HOW POWER SECTOR DECISIONS AFFECT AIR EMISSIONS

The decisions that utilities, governments, and electricity consumers make affect environmental quality in a variety of complex and interacting ways (Exhibit 1). These decisions include the:

- type and operation of generating capacity
- transmission and distribution investment
- expansion of electricity services
- electricity price signals
- demand-side management efforts
- technology commercialization investments.

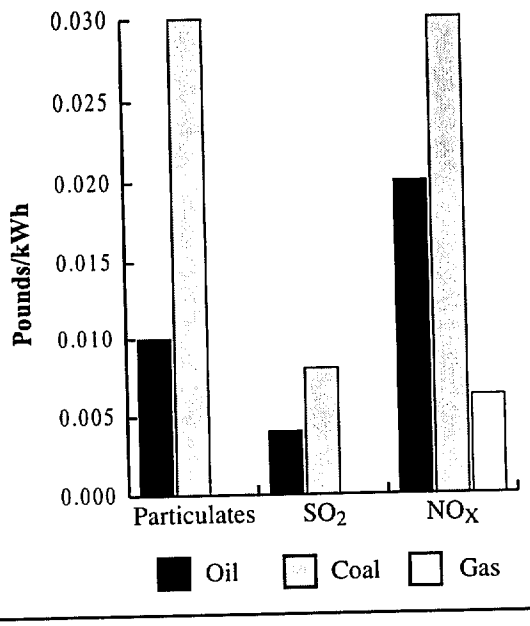
Exhibit 1
Power Sector Decisions and their Effects on Air Emissions



Generation

The fuel and technology chosen to generate electricity is the most fundamental decision affecting power sector emissions. Non-thermal power plants have no air emissions, while thermal plant emissions depend on the fuel employed. Exhibit 2 shows typical air emissions for three types of thermal generation: oil, coal and gas.

Exhibit 2
Typical Uncontrolled Air Emission Factors for Thermal Generation



Three other power plant generation decisions influence air emissions:

- design characteristics (e.g., thermal efficiency, burner design)
- operating practices (plants that operate continually may have the highest absolute level of emissions, but low emissions on a per-kilowatt hour basis, while plants serving peak loads often emit higher levels of pollutants per kWh of electricity produced)
- maintenance (poor maintenance causes plants to operate less efficiently and thus emit more pollutants).

Because many power plants in developing countries are older thermal units that are inefficiently operated and maintained, they are about 5% less efficient, on average, in converting fuel to power than plants in OECD countries.

Transmission and Distribution

Energy losses in transmission and distribution (T&D) systems result in more fuel being burned to provide the same amount of power to customers. These energy losses stem from under-investment in infrastructure and inefficient operation. Average T&D losses in developing countries are approximately 18%, while losses in OECD countries range from 5% to 10%.

Electricity Service Expansion

Grid power is often not reliable in developing countries and many households and small firms are not connected to the grid. This has forced industries, businesses, villages, and homes to generate their own electricity using diesel, kerosene and other polluting fuels. The pollution created by these sources is exacerbated because: 1) many industrial generators are located close to

population centers where their emissions have greater potential health impacts and 2) many countries' environmental laws are not enforced for unconnected generating units.

However, a relatively new group of technologies now offers unconnected communities and industries modern energy services with minimal environmental impacts. For example, renewable energy generation is an option that was pioneered in Europe and the United States, but could have wide application in developing countries as so-called "distributed generation resources." These technologies allow utilities to avoid expensive investments in grid expansion.

Electricity Price Signals

The price of electricity affects consumers' demand for power. In many developing countries, electricity prices are subsidized to reflect political or social goals, such as rural electrification or domestic food production. The prices urban customers pay for electricity often subsidize rural customers, or large commercial or industrial customers subsidize residential ones. Also, electricity bill collection is often subject to corruption or widespread nonpayment, and consumers may continue to receive service even when they don't pay their bills.

These two factors influence electricity consumption patterns, which in turn affect generation emissions. Consumers can only make accurate decisions about their electricity use when prices reflect the true marginal costs of supply and consumers reasonably believe that they will have to pay their bills.

Electricity prices rarely reflect the environmental costs of power production in developing countries. Although these prices may reflect investments in pollution control equipment, residual emissions still cause health and ecological damages that are not accounted for in electricity prices. And even when prices do reflect full costs, pollution may not decrease as much as it could because consumers do not reduce their demand: they either lack the information to do so, or do not have access to the capital they need to invest in more efficient technologies.

Demand-Side Management

Demand-side management consists of one or more activities that reduce the total quantity of power that a customer uses or shift the time when power is used. When these shifts reduce thermal generation, air emissions decrease. Electric load characteristics affect which power plants in the system are used at any given time as a function of their varying costs of operation. The influence that saving energy (or shifting its use to another time of day) can have on reducing air emissions depends on the type of plant that would have otherwise been generating the power. For example, if diesel oil plants are used for peaking and peak load is caused by air conditioning, then using more efficient air conditioners will help reduce diesel emissions.

Technology Choice

The technologies available to generate, transmit, distribute, and consume electricity are becoming more efficient, which has positive implications for air emissions. One example is jet technology, which produces highly efficient gas generation. Continued improvement in the sector's environmental performance often requires extensive investment in research and development (R&D).

Although some developing countries such as Brazil conduct their own R&D programs, most new technologies have been developed in OECD countries and exported. Because the technology choices available reflect the priorities and conditions of OECD nations, they may not necessarily be the most appropriate alternatives for developing countries. Whether or not appropriate environmental technologies are produced for developing nations will depend on the level of R&D investment OECD countries make in them.

The technology choices a country makes will have long-term environmental effects. Most power sector investments are made on a large scale and, because of their expense, are "locked in" for use over a period of many years. The slow turnover of power plants, transmission and distribution systems commits the power sector to associated emission levels for long periods.

TYPES OF POWER SECTOR REFORM AND THEIR IMPLICATIONS FOR AIR EMISSIONS

Reforming the management, ownership, and operations of the power sector can take many forms. Often preceded by enabling legislation, the five main types of reforms being undertaken in developing countries are:

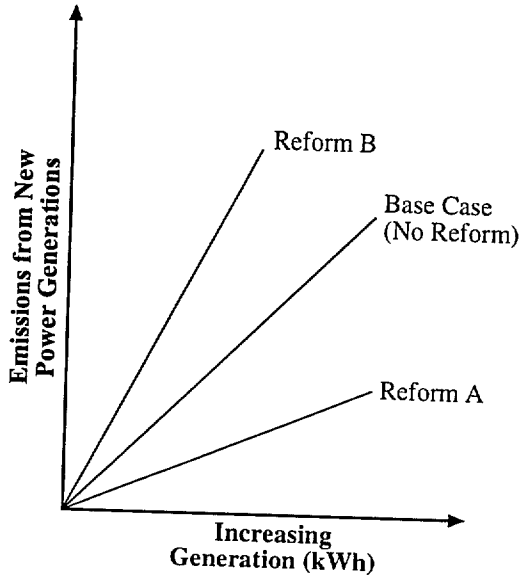
- commercialization
- privatization
- independent regulation
- restructuring
- wholesale and retail competition.

These five reforms and their implications for the environment (specifically air emissions) are discussed in more detail below. Each type of reform is compared to a base case that is typical of many developing countries. Here, a publicly owned and managed utility is losing money, unable to keep pace with growing demand, and has a poor quality of service. The environmental advantages and disadvantages of each reform type are discussed relative to this base case. As the power sector expands, for example, a package of reforms could result in greater or lesser emissions than would have occurred if the base case had prevailed (Exhibit 3).

Commercialization

After enacting any needed legal changes, many countries begin the power sector reform process by commercializing the national power sector while leaving it in public ownership. This is often done by bringing in private managers to operate the sector under contract. Most countries view this as a first step toward privatization and other reforms.

Exhibit 3
Hypothetical Emissions Paths Under Alternative Power Sector Scenarios



Commercialization results in several changes in the management and operations of a state-owned enterprise. Typically, all subsidies are removed, including state guarantees for borrowing, and enterprises become subject to the same tax laws, prices, and accounting rules as private sector companies.

Staff levels are also usually reduced and new operating capital is raised. In addition, most commercialized power utilities separate their accounting for generation, transmission, and distribution costs. Finally, planning targets are usually removed and investment decisions made on the basis of profitability and cost recovery.

This last element is critical to the success of commercialization, and has the most direct implications for the environment. Typically, cost recovery is achieved by reforming electricity tariff structures so that they more accurately reflect the true costs of service. In addition, many utilities step up bill collection efforts, including metering investments, and take steps to reduce energy losses through theft.

Commercialization generally produces positive environmental benefits through reduced operating wastes, increased environmental compliance, and prices that better reflect the cost of service.

The overall effects of commercialization on the environment are generally likely to be positive. Managerial improvements mean better information on the costs and environmental implications of investment choices. Stricter cost accounting systems are likely to produce reductions in operational waste, which can translate into fewer emissions. General managerial improvements may also produce an increased ability to comply with environmental regulations, to the extent they exist.

Commercialization is also likely to produce a greater range of generation options that can be considered as the power sector seeks to address growing demand in a least-cost manner. The

deployment of small-scale renewable resources close to where power is generated, for example, might be a cost-effective alternative that is also environmentally friendly.

One final environmental benefit of commercialization is that it improves incentives for demand-side management. Because a commercialized utility is governed by cost recovery, it has an incentive to reduce kWh sales when the marginal costs of generating power exceed revenue collection potential. In such cases, utilities should be willing to pay an amount up to the difference between revenues and costs in order not to have to supply power at a loss. Where there is significant unmet demand for power, the utility may be able to sell that same power to another customer who is willing to pay full costs. Therefore, an investment in demand reduction would not necessarily result in lost revenues.

Privatization

This set of reforms, which is usually motivated by the need for investment capital, involves transferring at least some portion of power sector assets into private ownership. Privatization includes several steps to make the enterprise more attractive to investors — subjecting it to corporate laws and commercialization, and then breaking the enterprise down into smaller, economically viable units for sale.

The types of privatization include sales to strategic investors (undertaken by Chile, Argentina, Brazil, Hungary, and Australia), initial public offerings (used by the United Kingdom and Chile), vouchers to the public (used by the Czech Republic and Russia for portions of their power systems), cooperatives (popular in the United States, Canada, and Scandinavia), debt-equity swaps, and joint ventures (formed in Argentina, Australia and Chile, and proposed in Central and Eastern Europe).

Regardless of the method, privatization generally lessens government influence and often reduces any commitment that previously existed to achieve social objectives. Private firms have fewer obligations to share information with the public.

Once the power sector is privatized, government regulation can balance public policy and private financial goals. The political and environmental policy situation in a country at the time power sector assets are being sold affects whether the privatized sector will be more or less responsive to environmental concerns than it was before privatization. Often, an independent regulatory body (as discussed below) is crucial to incorporating environmental concerns and may allow public participation in power sector decisions.

The environmental effects of privatization can be positive or negative, depending on such factors as the strength of the regulatory body, and the political and environmental policy situation in a country.

Consideration of the environmental attributes of the enterprise to be privatized can add time and complexity to the process, however. Most officials prefer to complete the privatization as quickly

as possible and are thus reluctant to introduce "extraneous" considerations. Occasionally, foreign investors request an environmental audit, but unless national regulations allocate responsibility for improvements, this is unlikely to have any real influence.

Privatization does offer one important environmental benefit. Often the investment capital that is raised during the sale of assets can be used to replace or upgrade poorly operating equipment or to hire outside expertise to improve management. These types of investments are more likely to occur as part of sales to strategic investors or in joint venture arrangements.

Even before they privatize their assets, many countries allow the private development of new generation. Power purchase agreements (PPAs) for independent power producers (IPPs) are a key component of schemes in which private developers retain ownership of generation facilities. The most important provision of the PPA is the price at which the utility agrees to buy power from the private developer.

Depending on the extent to which these agreements' provisions are geared to environmentally-friendly generation options, PPAs can facilitate or impede these options' market penetration. Because most of the IPPs to date have been thermal, most of the PPAs that are used as models are geared toward thermal projects.

The effects of IPPs on air emissions depend largely on the nature of the new IPP capacity and the extent to which it either displaces alternative sources of energy (such as diesel self-generation) or serves previously unmet demand. In the former case, air emissions could potentially be reduced, whereas in the latter, they would increase if thermal generation options were chosen.

At the opposite end of the spectrum is hydropower. Many developing countries have relied heavily on this option, but it is relatively unattractive to new private investors because of its long construction time and the large initial investment required. In addition, some of hydropower's benefits (such as water supply for irrigation) cannot be fully captured by the private sector. The displacement of hydropower by new gas- or oil-fired generation could have negative implications for air emissions.

Although not as common in developing countries as hydropower, nuclear power faces similar issues. Like hydro, it requires long construction times and large investments. It does have advantages in terms of air emissions, but poses other environmental and health risks. Its high capital costs and risks make it difficult to attract private capital for new investment. Moreover, in many countries, governments are reluctant to privatize their nuclear capacity. As they privatize, some countries of the former Soviet Union are struggling with the issue of what to do with existing nuclear capacity, given the equally high costs of shut-down and safe disposal of radioactive components and byproducts.

Independent Regulation

Commonly associated with privatization is the creation of an independent regulatory body to separate the regulatory and policy roles of the government from the new commercial and operational responsibilities of the power sector. The regulatory authority typically sets allowable retail tariffs, licenses the construction and operation of new power sector assets, and oversees the operation of the monopoly components of the system (transmission and distribution), as well as its competitive aspects. A 1996 survey of power sector investors worldwide revealed that most consider the presence of an independent regulatory body a requirement for investment.[2]

The creation of an independent regulatory body offers an important way to leverage environmental improvement, although comon forms of regulation do not create incentives for utility demand-side management.

Regulatory responsibility also varies with the prevailing political and economic philosophies in a country. In some cases, the regulatory body's role might be to set prices at marginal cost levels and then allow the market to operate freely. In cases where policymakers perceive significant remaining market barriers, an independent regulatory entity could be responsible for eliminating or offsetting these barriers. Overall, the regulatory body must balance the financial health of the company with various policy objectives.

Different types of price regulation prevail in different countries or market conditions:

- In the United States, *rate-of-return regulation* has dominated in the past. Under this approach, utilities are allowed to earn a specified return on their capital investments.
- Under *price cap regulation*, profits are based on total sales. Included in this model is a provision for yearly adjustments to account for inflation. This type of regulation creates incentives for maximizing kilowatt hour sales and thus discourages utility-sponsored energy conservation, a negative result for the environment. Recently, however, regulators have been experimenting with various approaches that seek to create positive utility incentives for end-use efficiency or other performance objectives.
- *Revenue targets* focus on revenue control instead of price control. Regulators set an allowed level of revenues based on actual costs. This type of regulation allows for rate adjustments to reflect increases or decreases in kWh sales levels. This gives utilities more neutral incentives with respect to energy conservation.

Restructuring

Restructuring is the process of altering the structural characteristics of the electricity industry. Vertical unbundling is the most common form of restructuring, in which vertically-integrated

2 Hagler Bailly Consulting. *Privatization Options for the Power Industry*. Prepared for USAID, March 1996.

utilities are separated into distinct companies that provide generation, transmission, distribution and retail services. This model was pioneered by the United Kingdom and Chile in the 1980s. Since then, a number of developing countries have unbundled or are in the process of unbundling their power sectors. Often, the first step is to allow the independent generation of power.

The primary reason for restructuring generally, or unbundling specifically, is to create economic incentives for the separate entities to operate efficiently and prevent one function from subsidizing another. By severing managerial relationships and introducing transparent cost accounting, each entity's role and responsibility become better defined and managers can be held more accountable.

A number of variations are possible within the unbundling framework. For example, distribution services are often horizontally divided into separate geographical areas. Some countries have separated electricity distribution from retail services, while others have kept them within the same company.

Under an unbundled system, how much a power plant is used depends on whether the decision is based on actual costs, indexed charges under long-term contracts, or competitive bids. In power systems where generation priorities are based on marginal costs, existing plants have an advantage over new sources because their prices do not have to incorporate new investment costs. Whether this is a positive or negative effect for the environment depends on the emission characteristics of the new versus the existing power plants.

Unbundling results in identifying high-cost customers and locations where the system-wide benefits of distributed resources are large, but the distribution company's ability to capture these benefits is uncertain.

When a power system is integrated, investment planning can be readily coordinated among all components. When the system is unbundled, coordination becomes more difficult. For instance, investments in customer DSM may be planned by the distribution company independently of new generation investments, which are planned by the generation company.

When transmission access is opened up, the increased opportunities for inter-regional electricity exchange have environmental implications. Generators with low operating costs may experience increases in output, while those with higher costs may experience decreases. Whether this raises or lowers air emissions depends on the individual plants affected.

In addition to affecting the use of existing generation, transmission access can stimulate new investment in power generation, especially renewable resources. Because renewable resources are location-specific, developers depend on access to transmission lines, which gives them the ability to supply renewable power to areas where it is more valued than it is locally. Increases in the deployment of renewable power resources may depend on whether transmission pricing schemes treat renewables fairly.

Competition

The "wires" portion of the electricity sector (transmission and distribution services) is still commonly considered a natural monopoly. However, competition for selling power to the grid (wholesale competition) and/or providing electricity to end-use consumers (retail competition) may be introduced into the system.

Wholesale competition. Wholesale competition can take the form of IPPs that bid for long-term contracts (called power purchase agreements) with power purchasers. Bidding systems have variations, but in most cases, the transmission utility issues a solicitation for bids and awards the contract to the lowest bidder, without regard to fuel source. This type of bidding and selection typically emphasize only the short-term costs of capacity, and not life-cycle costs.

Argentina, Chile and other countries employ another form of wholesale competition: a spot or short-term market, in which multiple generators (called merchant plants) bid to be dispatched by an independent system operator. Under this system, competitive pressures ensure that prices approximate marginal costs. However, large generators may have undue influence over price in spot markets.

Spot markets tend to discourage long-term planning and investment. To deal with this situation, Chile has established a central body that can commission additional capacity using public funds if private investment is not forthcoming.

The generation characteristics favored by competitive markets are:

- short lead time
- dispatchability (power on demand)
- high capacity factor
- quick capital recovery.

In general, the environmental implications of wholesale competition depend on the extent to which those generating technologies whose cost and performance characteristics make them attractive to developers under competition are also relatively clean. The rules of the market also affect environmental outcomes. The more environmental criteria are incorporated in weighing bids among competitors, the better the environmental outcome.

The environmental effects of wholesale competition can be positive or negative, depending on the technologies developers choose, and on whether market rules require that environmental costs are considered.

In spot markets, renewable generation options are less likely to be developed than in market structures with long-term contracts. This is because renewable projects bidding into spot markets are more difficult to finance than those with long-term power

purchase agreements (PPAs). Capital markets prefer generation projects with low capital costs and short lead times, unless long-term contracting assures an adequate return on investment.

It is much easier for thermal plant developers to secure financing under spot market conditions because they have more control over when they sell power to the spot market (they can wait to sell when prices are high). Renewable generators rely on intermittent supply that cannot generate power on demand.

Although thermal plants emit more pollutants than renewable options, those operating in the spot market have an incentive toward high-efficiency plants that allow them to sell as much power as possible and maximize revenues. Thus, thermal power plants operating in a spot market may be as environmentally friendly as those operating under long-term contracts. Moreover, market rules may require that environmental control costs be added to other costs in bids to sell power.

Retail competition. Some countries, including Norway, the United Kingdom and parts of the United States, are experimenting with retail competition, especially for industrial and large commercial customers. Retail competition is usually first opened up for such customers and then phased in for smaller customers.

Retail competition creates incentives to minimize short-term rates, which reduces the retail supplier's interest in DSM and R&D investments, except where a competitive advantage might be gained.

There are many different ways to introduce retail competition. One is for independent power generators to pay for direct access to transmission and distribution networks. This allows them to compete for large retail customers regardless of their location. Another is for retail service providers to buy power from generators, contract to use T&D networks, and then sell power to consumers.

In general, when competition is introduced to what was previously a monopoly, retail suppliers must pay attention to the rates that competitors are offering, as well as how much customers are willing to pay. Suppliers are concerned with having the lowest tariffs in order to retain and attract customers.

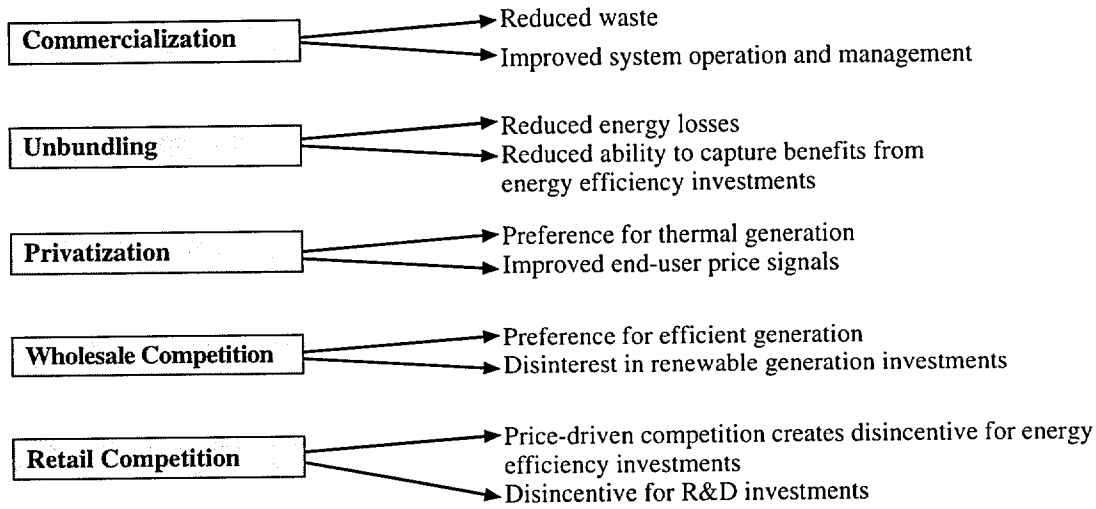
In an unbundled sector with a spot market, independent competitive retailers pass generation costs through to final consumers. This gives suppliers little incentive to engage in any activities that reduce their generation costs if these activities also raise their rates. Many studies of countries where utility-sponsored DSM programs were present before these reforms have found that such programs are reduced or eliminated in the post-reform environment.

When prices are close among retail competitors, some suppliers may choose to retain or attract customers by offering a package of energy services, including DSM, as a means of differentiating themselves. So far, however, end-use consumers in countries with retail competition seem more likely to seek out a lower-cost supplier than to request energy management services.

Retail competition could also stimulate the emergence of energy service companies (ESCOs) to serve customers who want to lower their electricity costs. This development is dependent on a receptive regulatory environment. To date, no ESCO market has emerged in countries that have already instituted retail competition.

Exhibit 4 depicts several of the conceptual relationships between individual reforms and environmental performance.

Exhibit 4
Determinants of Environmental Performance



LESSONS FROM THREE COUNTRIES

To understand how power sector reforms actually operate, the experiences of the United Kingdom, Argentina, and India are examined here. These countries have undertaken varying levels of reform and have different backgrounds, priorities, and political, economic, and regulatory environments.

The starting point for reforms is an important precondition in determining their environmental outcome. These three countries' power sectors had very different characteristics prior to reforms. However, all their power industries suffered from some level of managerial and operational inefficiencies; these were most severe in India.

Exhibit 5 summarizes the reforms implemented (or in progress) in each country. The United Kingdom has taken its power sector reforms the farthest, and is an example often emulated by other countries considering extensive reform. However, it has some characteristics that may not be found in other countries, especially in the developing world. Argentina represents an intermediate case, where reforms were sometimes modeled after UK or Chilean reforms, but also adapted to local conditions. While India is still in the early stages of reforming its power sector, it provides important lessons about the reform process.

Exhibit 5
Summary of Countries' Reforms to Date

	UK	Argentina	India (State of Orissa)
Commercialization	✔	✔	✔
Privatization	✔	partial	IPPs
Independent regulatory body	✔	✔	✔
Unbundling	✔	✔	horizontal
Wholesale competition (spot)	✔	✔	
Wholesale competition (contract)	✔	✔	
Retail competition	✔		

United Kingdom

Power Sector Preconditions and Objectives. Before reform, the United Kingdom's electric system was wholly government-owned and vertically-integrated, with a national grid for transmission and boards for regional distribution. Its reform objectives included: 1) reducing the government's role by fostering private ownership, management and competition, leading to increased operating efficiencies, and 2) maximizing public revenues through privatization. Although privatization was a key aspect of the overall reform, the political decisions on restructuring were made when the industry was still government-owned.

Part of the backdrop for reforms was the mandatory use of British coal in coal-fired generation plants, at above world market prices. In addition, a European Union directive prohibited the burning of natural gas for power generation to ensure sufficient supply for industrial, commercial, and residential use. These rules had a significant effect on the mix of generating fuels used, and consequently on power plant air emissions.

The Reform Process. The UK began unbundling generation from transmission and distribution functions in the mid-1980s. Each entity was then privatized, with the exception of nuclear generation, which remained partially in state hands.

The power sector is regulated by an independent regulator, the Office of Electricity Regulation (OFFER), which sets retail prices using a "rate cap" formula. OFFER also imposed an account fee (an alternative to a wires charge) on small customers, effective from 1994 to 1998, to fund energy efficiency programs. The funds are administered by OFFER, but overseen by the Energy Savings Trust, a government agency.

Wholesale competition was also introduced, in which the National Grid Company is responsible for operating a power pool that determines which plants will supply electricity to the pool. Generators bid to supply power at half-hour intervals and are then paid at the level of the highest accepted bid for that period, regardless of operating costs or individual bids.

Although electricity must be sold through the pool, about 80% of sales involve bilateral long-term contracts that eliminate or reduce the effect of the pool price on the actual prices paid. In these "contracts for differences," wholesale buyers and sellers agree to pay each other the difference between the contract price and the pool price.

The UK is also experimenting with retail competition for large customers, who are eligible to buy power directly from the pool, a licensed supplier, or any regional distribution utility. Complete retail competition is expected to be phased in between April and September 1998. Distribution companies are expecting to spend more money on advertising and customer service once full competition exists.

Along with these structural reforms, the UK's overall economic liberalization has affected the fuel sector. The prohibition against the use of natural gas in generation facilities was removed, allowing the introduction of gas-fired power generation. In addition, subsidies encouraging the use of domestic coal were reduced.

Another regulatory change was the requirement that the power pool purchase some percentage of its power from non-fossil-fuel sources, including nuclear and renewable sources.

The Environmental Effects of Reform on the Generation Mix. Among the three countries examined here, the UK has experienced the most significant shift in new generation since reforms began. The lifting of the prohibition on burning natural gas for power generation, coupled with the reduction in domestic coal subsidies, caused a "dash for gas" by generation companies and IPPs.

The power pool's obligation to purchase a percentage of its power from nuclear or renewable sources has also had a strong impact on the development of the renewable power market,

including hydropower, wind, biomass, waste-to-energy conversion, landfill gas and sewage gas projects. However, this obligation will be removed in 1998, causing uncertainty over future renewable supply additions.

Because of both the "dash for gas" and the increase in renewable generation, the UK has lowered its air emissions relative to the pre-reform period. However, as older nuclear generation begins to be phased out, baseload coal generation may experience a resurgence.

The Environmental Effects of Reform on End-Use Energy Efficiency. Falling electricity prices and an absence of utility incentives have slowed end-use energy efficiency improvements in the UK relative to the pre-reform period. Supply costs are passed through to consumers in full, and the regulatory price formula encourages suppliers to sell as much electricity as possible, discouraging them from offering energy management services.

Today, large customers choose suppliers based primarily on price. Some ESCOs exist in this market, but their activities are generally focused on finding the lowest-cost supplier rather than producing energy savings through performance contracting.

The collection of the account fee from small customers is also due to be discontinued in 1998, which will likely further reduce end-use efficiency activities. However, OFFER may extend the collection of this modest fee for two more years to promote continued savings. It has not proposed extending the account fee to other customers, however, preferring instead to allow a competitive energy services industry sufficient time to develop.

Last, the Department of the Environment will continue to fund several energy efficiency programs through the Energy Savings Trust, to help meet the UK's commitment to reduce its carbon emissions.

Argentina

Power Sector Preconditions and Objectives. Prior to reform, Argentina's power sector was entirely state-owned and included three large, vertically-integrated utilities, two transnational hydropower companies, one nuclear entity, two dozen provincial distribution utilities, and about 700 electric cooperatives.

The power sector was characterized by political interference in tariff setting, lax maintenance practices resulting in low generation availability, and high distribution losses (up to 30%) combined with theft. Hydropower accounts for nearly 40% of Argentina's generating capacity and during the 1980s, several planned hydropower projects ran into large delays and cost overruns, which contributed to Argentina's growing external debt.

In 1988, the situation reached the crisis stage when a serious drought coincided with numerous power system operation and maintenance problems. This situation helped precipitate the following objectives for Argentina's reforms:

- attraction of private investments to ensure a reliable power supply in the long term
- fair and reasonable rates and protection for end-users
- enhanced economic efficiency of the power sector
- limitation of the government's role.

The Reform Process. Argentina began reforms in 1991 by separating generation, transmission and distribution functions, and creating a wholesale electric spot market. Assets were transferred to separate companies that had been partially privatized by their competitive sale to foreign and domestic investors. The majority of generation and transmission companies have been privatized, while most distribution companies remain in state hands.

Competition for generation services is unrestricted, but the T&D functions remain regulated monopolies subject to innovative regulatory rules to ensure the presence of competitive elements. An independent regulatory agency sets transmission tariffs based on economic costs plus a rate of return comparable to other business activities of similar risk or to distribution companies.

Both transmission and distribution companies are required to provide open access to third parties after publishing relevant rates. Utilities are free to sign supply deals with distribution companies and large end-users within certain constraints: contracts must be made public and distribution companies may not own transmission facilities.

These reforms were accompanied by a number of changes in environmental policy. The law governing privatization explicitly addresses air and water emissions. The independent regulatory body is charged with overseeing and monitoring compliance with environmental standards, which, beginning in 1994, included a requirement that all participants in the wholesale spot market set up an environmental management plan. In addition, emission standards for particulates, SO_2 and NO_x (which are more strict than World Bank standards) were established in 1993 and strengthened in 1995.

The Environmental Effects of Reform on the Generation Mix. The substitution of natural gas for fuel oil in power generation has been a policy goal in Argentina since the 1980s. This goal only began to be realized, however, after power sector reforms. Natural gas demand increased partly because of the companion restructuring occurring in the natural gas sector, which encouraged the construction of new natural gas transport pipelines.

This switch has contributed to reduced air emissions in Argentina. Progress in operation and maintenance practices has also had a positive effect on thermal generation efficiency and

emissions per kWh generated. In addition, some utilities have begun to rehabilitate and upgrade existing plants, which should lead to more emissions benefits.

The Environmental Effects of Reform on End-Use Energy Efficiency. In response to the removal of most electricity tariff distortions and subsidies, some large industrial customers in Argentina have begun to make their processes more energy efficient. These actions were largely influenced by the liberalization of the Argentinean economy after the conclusion of the Mercosur trade agreement. Smaller enterprises, residential and agricultural customers have shown no significant change in end-use energy efficiency. Utility DSM programs are still absent.

Outside the reform process, the federal government has begun some energy efficiency activities, mostly supported by the European Union or the Inter-American Development Bank. Its energy efficiency policy focuses mainly on improving the competitiveness of the market for energy services; no major regulatory initiatives are planned.

India

Power Sector Preconditions and Objectives. India's power sector has been largely government-owned. The Ministry of Power oversees and coordinates national power policy, administers and regulates the industry, and approves state requests for investments. With minor exceptions, State Electricity Boards (SEBs) are the regional distributors of power in the country.

India's power sector faces many challenges, the first of which is a shortage of capacity. The country's per-capita electricity consumption is one of the lowest in the world, but its demand growth is one of the highest. An extensive rural electrification program has nominally connected 86% of its villages to the grid, but large parts of the population still lack access to electricity.

Electricity prices are heavily cross-subsidized, with industry paying the most and agriculture the least. The power sector's average cost recovery was only 78% in 1993 and some studies estimate that average electricity tariffs are at least 50% lower than the long-run marginal cost of electricity supply. In effect, this results in a huge government subsidy to the power sector.

In addition, the government reports average T&D losses of 20%, with that number reaching almost 50% in some states. Some studies estimate that power theft is as high as 13%, only 60% of supplied power is being billed, and only 40% of billings are collected.

The main objective of reform in India was to introduce private capital into the power sector's operation and relieve the burden of financing from the government. Reform was also intended to give the SEBs more independence in their investment decisions.

India also has one of the world's most extensive policy frameworks to encourage renewable generation. The government offers tax concessions, below-market financing, and attractive terms for accessing the transmission grid to promote renewable energy development. Renewables have their own cabinet-level ministry and a separate agency to implement policies. It is not clear how these initiatives will be affected by the broader reforms.

The Reform Process. Compared to the UK and Argentina, India is in an early stage of reform. Given the capital constraints on its power sector, however, privatization is a priority. In 1991, the Ministry of Power revised laws to allow the introduction of independent power producers to own and operate generation assets (except nuclear). IPPs were also allowed to sell power directly to consumers.

After the initial influx of IPPs and foreign investment into the power sector, the central government was no longer willing to jeopardize India's access to world financial markets by offering further sovereign guarantees for IPP projects. The World Bank and other agencies have also begun making future loans contingent upon power sector reforms. Because of this, the focus has shifted somewhat from the central government and towards the SEBs.

Several states, led by Orissa, have begun to reform their electricity boards. Orissa has undertaken horizontal unbundling, corporatization, and commercialization, and plans to privatize its SEB eventually. It has also established the independent Electricity Regulation Commission to ensure the competitive procurement of power, grant operating licenses, set rates, resolve disputes, and establish and ensure operating standards and service reliability.

The Environmental Effects of Reform on Generation Mix. The introduction of IPPs in India has produced a number of positive outcomes for the environment, including:

- stringent environmental reviews for foreign-financed IPPs due to their high visibility
- establishment of more effective management models, construction and operation standards, resulting in higher generation efficiencies and availability as well as lower emissions
- avoidance of further increases in the use of polluting individual diesel generators
- development of a private environmental management services industry
- use of renewable power generation (in 1997, the central government announced a requirement that 10% of all new installed generating capacity come from renewable sources).

The negative impacts from introducing private power result from increased emissions due to new generation, even if emissions/kWh decrease. Critics also claim that privatization reduces the monitoring and control of emissions. However, while private power developers may seek to minimize expenditures that affect their bottom line, they are also likely to face greater scrutiny than have public utilities.

The Environmental Effects of Reform on End-Use Energy Efficiency. With the exception of a few DSM programs sponsored by donor agencies, no significant end-use efficiency programs are being implemented by Indian utilities. Detailed energy efficiency studies have been undertaken in various states to identify the potential for energy savings, but the absence of incentives, combined with a general shortage of capital and a bureaucratic planning process, have led SEBs to virtually ignore end-use efficiency efforts. Reducing electricity subsidies is a national policy objective, but actual progress has been slow.

Exhibit 6 summarizes how the reforms undertaken by the three case study countries have affected several of their environmental indicators.

Lessons for Developing Countries

The experience of these three countries shows the importance not only of the power sector reforms themselves in influencing environmental indicators, but also of the context in which the reforms take place.

Regardless of power sector organization, structure, regulatory model or reforms, power plant emissions standards and their enforcement are a key factor in determining environmental performance. A clear assignment of authority, adequate funding mechanisms, and institutional capacity among regulatory bodies are necessary for successfully implementing and enforcing environmental legislation. In the UK and Argentina, environmental policy was revised along with reform. Emission standards were strengthened, although not necessarily their enforcement.

Besides environmental controls, operation and maintenance improvements play an important role in reducing emissions per kilowatt hour. The absolute level of improvement depends on how poor a power sector's emissions performance was before reform.

Exhibit 6
Environmental Effects of Reform Packages in Case Study Countries
(+ = positive effect, - = negative effect, 0 = intermediate or mixed effect)

Environmental Indicator	United Kingdom	Argentina	India
Operation of existing plants	No data	Improved (+)	Improved (+)
New generation mix	Predominantly gas displacing coal (+)	Predominantly gas displacing oil and hydro (0)	Mix of fossil fuels with improved environmental controls (+)
Deployment of non-hydro renewables	Regulatory obligation for minimum amount acquired (+), little otherwise (-)	Rural distribution concessions target renewables (+); none acquired on spot market	Renewables promoted through policies and subsidies (+); possible inconsistency with future reforms
T&D losses	No data	Reduced (+)	Reduced (+)
Demand response to electricity price changes	Rates generally decreased (-)	Rates to some classes increased, others decreased (0)	Price reform reducing subsidies (+) but implementation is lagging behind other reforms
Utility-sponsored end-use efficiency	Decreased (-)	Little prior to or after reforms (0)	Little prior to or after reforms (0)

Generation Mix. The three case studies demonstrate the danger of relying too heavily on one country's experience as a model. For example, several circumstances external to the reform process in the UK make its experience unique with regard to reduced air emissions associated with the "dash for gas":

- previous requirements for the use of domestic coal at above-world-market prices
- previous prohibition of the use of natural gas for power generation
- newly available and economically priced natural gas from offshore exploration.

Argentina also experienced a move toward natural gas-fired generation after instituting reforms. Like the United Kingdom, it has access to plentiful and inexpensive supplies of natural gas. Most developing countries, however, do not share this characteristic.

IPPs in India also showed some preference for natural gas generation because of its short lead time and high return on investment. However, the net emissions implications of IPPs in India are not always clear. In some cases, IPPs serve electricity demand that was previously unmet. In others, new generation capacity may be replacing diesel generators, which emit higher levels of particulates and other pollutants than natural gas-fired generation.

In general, these experiences show that the availability and price of different fossil fuels is likely to significantly influence the air emissions of the power sector in any given country. Whether this influence is positive or negative depends on the particular characteristics (generation mix, emissions standards and enforcement, etc.) of the power sector in that country.

End-Use Energy Efficiency. In general, the experience of these three countries indicates that end-use energy efficiency activities are likely to be reduced, or at least not increased, in the immediate post-reform period.

In a competitive market, price appears to be much more important than other factors in determining the choice of electricity supplier. Energy efficiency services and performance contracting are not widespread in the case study countries.

Price competition affects end-user efficiency in at least one other significant way: to the extent some customer segments see their electricity costs going down as a result of competition, their incentive to improve end-use efficiency is reduced.

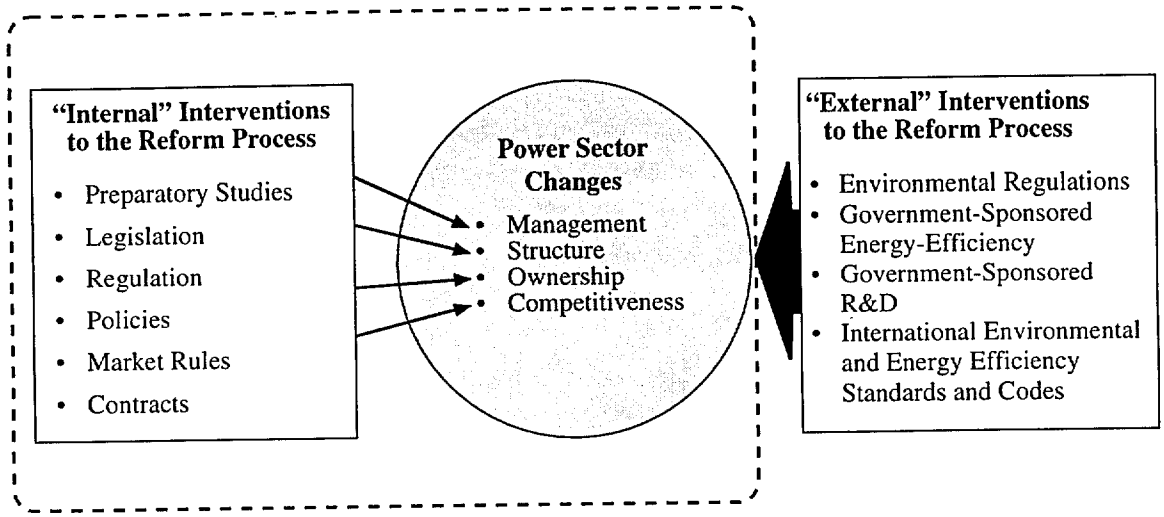
POLICY OPTIONS TO IMPROVE ENVIRONMENTAL PERFORMANCE

As the case studies and evidence from other countries show, the relationship between power sector reform activities and their effects on the environment is not always clear. Often, the most important distinctions are not which reforms are chosen, but how they are implemented.

Theoretical knowledge and the practical experience of countries that have implemented reforms show that environmental priorities can be incorporated at different points in the reform process (Exhibit 7). An idealized process might involve the following steps:

1. Enact enabling legislation for reform
2. Create an independent regulatory authority
3. Restructure the sector, including establishing rules for competitive wholesale and retail markets
4. Commercialize and corporatize
5. Privatize assets.

Exhibit 7
Points of Intervention to Promote Improved Environmental Performance



Although environmental priorities can be protected and encouraged throughout the process, it is easier to explicitly incorporate environmental performance requirements early on — specifically in reform legislation and in establishing an independent regulatory authority. For example, an independent regulator can issue site licenses for new generation, require that prices in wholesale markets include emission controls, and generally seek a balance between environmental performance and economic viability.

In reality, it is often difficult to focus the attention of legislators and regulators on the sector's environmental performance during the early stages of the process. It is thus important to consider all the major potential points of intervention. When adapted to local institutional and political conditions, each of the reform categories — commercialization, privatization, unbundling, and competition — offers potential for environmental gains. The recommendations made here are designed to help developing country governments maximize those gains.

Policy Options within the Reform Process

Because the institutional capacity for developing and enforcing environmental regulations is relatively weak in many developing countries, creating internal incentives for the electricity sector to expand in an environmentally-sustainable manner would avoid undue dependence on environmental regulation.

Independent Regulation

Create an independent regulatory body before privatizing. Regulatory bodies typically have the means to influence decisions that affect the power sector's environmental performance indirectly. These include the terms power sector asset sales, retail tariffs, the implementation of public mandates (e.g., rural electrification, DSM), new plant licenses, and how the industry's unbundled components interact (by, for example, developing rules governing wholesale power markets). They can also play a more direct role by monitoring compliance with environmental performance standards, coordinating with the national environmental agency, and establishing incentives to improve environmental performance (e.g., tariffs that incorporate environmental costs). To the extent possible, these agencies should be free of political intervention and pressure from power sector institutions.

Adopt tariff structures that provide appropriate price signals. The use of regulatory alternatives to price caps that reflect true costs and reduce the retail supplier's incentive to maximize electricity sales should be explored. Regulators should also craft retail rate formulas that are at least neutral with respect to generation technology. For example, rules that allow utilities to pass through fuel costs to customers and other practices that differentially treat the risks associated with different generating options should be avoided. Also, performance-based ratemaking can be designed to explicitly encourage the acquisition of target levels of renewable resources and to create incentives for retail service providers to invest in DSM by decoupling profits from sales.

Last, time-of-use and area rates would give appropriate price signals for end users to consider energy- and demand-reducing measures. Rates differentiated by time and location could be used first in bringing service to unelectrified regions and phased in for grid-connected regions.

Privatization

Use environmental performance as a criterion when weighing bids for transferring power sector assets to private ownership. If competing bids to privatize generation or other assets are roughly equal under financial criteria, environmental criteria (e.g., investment in pollution control) could be used to tip the balance toward the more environmentally-friendly bid. Including such criteria will increase the likelihood that the price paid for assets reflects the future investment needed to address environmental problems.

As a prerequisite, governments should require a third-party environmental audit of power sector assets to determine the investment required to bring the sector to national or international standards. In addition, the privatization entity could establish provisions that examine past environmental performance. A bidder with a poor environmental record in any country (as evidenced by fines, prosecutions, or other data) would be disqualified. Last, full public disclosure of environmental information will help ensure that environmental criteria are included in decisions.

Use the privatization process to leverage improved environmental performance. Investors in any private enterprise have an incentive to minimize risk and prefer to know the rules of the game before entering into an arrangement. From their perspective, even stringent regulations may be preferable to an uncertain regulatory environment. Thus, a precondition for privatization is the presence of stable, predictable and transparent policies.

Investors' risk aversion can be used to advantage, for example, in legislation that allows environmental ministries or other stakeholders to become involved in negotiating the terms of asset transfers with investors (e.g., how the responsibility for environmental problems will be allocated between the buyer and the government selling the asset, the extent to which these problems will affect the asset's price or transferability). In addition, more stringent regulations on new private generation can be exploited for their "spillover" effects on other power plants. Last, environmental requirements and incentives for compliance should be made consistent among all owners (e.g., public and private utilities, IPPs).

Allocate part of the privatization proceeds to finance sustainable energy investments. While the power sector's new private owners may improve its environmental performance as a side effect of overall managerial improvements, they are less likely to invest in environmentally-superior technologies with long-term paybacks (governments may also be reluctant to impose so many conditions on buyers that the sector's sale might be jeopardized). One option is allocate part of a public distribution system's sale proceeds to an account that new owners or others could tap to electrify rural areas using renewable resources.

Draft and adopt model power purchase agreements that avoid a bias against environmentally-superior technologies. PPAs that provide incentives for the selection and operation of environmentally-superior technologies might include provisions that offer: 1) premium rates for projects whose environmental performance exceeds national standards and/or penalties for poor performance, 2) payment terms (such as front-end loading) that do not discriminate against environmentally-superior, capital-intensive generating options with comparable life cycle costs to environmentally-inferior options, and 3) explicit assignment of the risks and liabilities associated with future environmental controls between power suppliers and purchasers (e.g., which party will bear the risk of possible climate policy changes, such as a carbon tax that would raise a project's future operating costs and potentially affect the choice of generation fuel).

Enact laws and regulations that clarify and strengthen the responsibilities of private distributors for rural electrification. The sequence of decisions in privatizing distribution services (terms of the utility's sale, criteria for awarding bids, distribution concession contract, and subsequent regulation of the concessionaire) affect the new owner's technology choices for electrifying rural areas. If the government specifies at least some fundamental rural electrification requirements in the privatization bidding documents it issues, all bidders could assess the associated costs and risk, and factor them into their bids. Beyond this, the bid evaluation criteria could include business plans for serving off-grid areas in a least-cost manner. Once the contract is awarded, the state could allow a higher return if the concession meets specified performance objectives.

Restructuring

Ensure equal access to transmission capacity for all types of generation where transmission services become common carriers. Transmission rate structures should not be biased against intermittent or low-capacity-factor renewables. If the demand component of transmission charges is based on the generation facility's capacity equivalence (e.g., an average level of coincident peak capacity output per month) rather than maximum rated capacity, then intermittent resources would pay their fair share of transmission costs. The energy component of transmission costs should be based on some fraction of total investment in the transmission grid.

Create incentives to the distribution and retail components of unbundled power sectors to fully consider distributed resource options. Regulators should require electricity distributors to use least-cost procedures in analyzing distributed resource options in their resource planning and acquisition. Here, distribution companies must collect information on area- and time-differentiated marginal costs of service, including generation, transmission, and distribution costs. Because most utilities do not have the ability to collect this information, regulators may need to develop model least-cost analytic procedures and train utilities in them. This would provide a more accurate analysis of the cost-effectiveness of renewables, dispatchable DSM measures, and other distributed resource options.

Consider adopting a renewable energy portfolio standard for retail providers. Here, retail or wholesale electricity suppliers might be required to purchase a minimum amount of their generation needs through long-term contracts with renewable developers based on competitive bidding (the UK's non-fossil-fuel obligation approach) or to use renewables for any generating capacity they develop themselves (the Bolivian approach). A version of this being debated in the United States would create a "renewable energy credit" each time a kWh of electricity is generated from a renewable energy source. All retail suppliers would be required to obtain these credits equal to some percentage of the power they sell.

Wholesale Competition

Require wholesale power markets to consider the environmental characteristics of competing generators. Generators' environmental and related operating characteristics can be explicitly included in the criteria for evaluating bids for long- and short-term power purchases. In the wholesale market, purchasers could require that competing bidders specify how they would meet a set of performance standards. For example, sellers would be required to meet specified heat rates (e.g., 10,000 Btu/kWh or below) at thermal plants. If thermal efficiency falls below this standard, generators would be required to offset the shortfall with units that are more efficient than the standard.

An option for incorporating the environmental characteristics of merchant plants into the operations of spot or short-term markets focuses on prices rather than standards. Here, the power system operator would determine generation dispatch priority based on social marginal costs. Such calculations would include fuel, variable O&M, and external environmental costs (as determined by government regulators). Social cost dispatch would strengthen merchant plant developers' incentives to choose technologies and fuels with low emission factors.

Retail Competition

Create incentives for retail electricity suppliers to promote demand reduction measures. New market rules should allow competition for energy services rather than simply for kilowatt hours. Under these rules, competing retail service providers could offer electricity supply combined with efficient end-use equipment and energy management services.

Ensure that investments in commercializing environmentally-superior technologies continue to be made. Regulators should create mechanisms that assure funding to bring environmentally-superior technologies to commercial maturity. The UK and California, for example, assess a systems benefit charge on retail electricity suppliers to recover "stranded benefits" — investments that provide benefits to customers but might not have been made by the separate firms in a reformed power sector, especially under retail competition.

The objective of this charge is to recover certain costs from all retail electricity customers, regardless of the service provider. The charge may be used to fund low-income programs, energy efficiency, renewable energy technology development, or other environmental initiatives. Explicit government bodies may need to be created to carry out these initiatives.

Policy Options Outside of the Reform Process

Policy makers can take several actions to promote environmental performance outside the reform process itself. These actions can be taken to lay the groundwork for reform or initiated while reforms are being made.

Strengthen environmental policies and institutions before undertaking major reforms, especially privatization. Before new plants are approved or assets are sold, developing countries should evaluate their environmental policies, compare them with international standards, and consider strengthening them. Even where the laws on the books are adequate, a country may need to upgrade its regulations, standards, and enforcement capacity.

Allowing environmental stakeholders (e.g., energy, environment and finance ministries, elected officials, NGOs, private power developers, ESCOs) to participate in the reform process will help ensure that environmental issues are considered at key decision points. For example, the national environmental agency should be given authority to participate in developing reform policies.

Evaluate the environmental implications of reforms being contemplated. A programmatic environmental assessment of reform options is a useful way to understand their environmental effects. While many developing countries have laws requiring project-specific environmental impact assessments, they generally do not have experience with or regulations requiring programmatic impact assessment.

Developing the in-country technical expertise to model the reforms' environmental impacts is key. Creating the institutional authority, including new enabling legislation, may also be required. The costs for establishing baseline conditions and monitoring impacts should be borne by the power sector.

As part of this assessment, policy makers could establish a benchmark for the environmental performance of the reformed power sector. The environmental outcomes that would be obtained through the adoption of least social cost-resource planning and acquisition is one benchmark. If a given reform fails to meet benchmark environmental outcomes, policy makers would identify appropriate adjustments to the reform.

Implement reforms in upstream sectors that eliminate barriers to the use of clean energy technologies. Policy reforms may be needed to reduce both subsidies to relatively dirty fuels and barriers to using clean fuels. Examples of the former are to reduce or eliminate subsidies in the extraction, processing, and transport of domestically-produced coal. An example of the latter is to ensure that trade tariffs are not biased against importing clean fuels or technologies.

Determine how power sector reforms affect greenhouse gas emissions. Although power sector reforms tend to reduce local pollutants more than CO_2, they can reduce CO_2 relative to the base case of continued public ownership and control. By implementing power sector reforms that reduce both CO_2 and local pollutant emissions, a developing country should be able meet its responsibilities under the Framework Convention on Climate Change without jeopardizing its aim of increasing overall generating capacity.

Development Assistance and Cooperation

Bilateral and multilateral development assistance organizations have a variety of tools at their disposal (concessional lending, institutional strengthening, technical assistance, analytic studies, etc.) that can help developing countries implement policy interventions such as those described above. Given their limited resources, donors should identify countries whose planned reforms offer the greatest opportunities to shift the power sector in sustainable directions.

Make environmental performance improvement an explicit component of technical and financial assistance to the power sector. Rather than assume that environmental performance improvement will be a side benefit of sectoral reform; donors should make it an explicit component of technical assistance and loan packages. Growing local and global environmental threats demand

that international agencies take a more pro-active stance. Fulfilling this recommendation could take several different directions:

- Help countries review their environmental policies in the reform context.
- Co-sponsor an international workshop on the environmental implications of power sector reforms and on how to design and implement reforms that improve the sector's environmental performance.
- Develop explicit environmental guidelines in training programs and on-site technical assistance for power sector privatization. Incorporate these guidelines in the terms of reference for hiring advisors to client country power ministries.
- Multilateral development banks should be more active in integrating environmental sustainability into their loan packages for energy sector reform and in helping countries understand the environmental implications of alternative reforms.

Ensure that institutional capacity for environmental protection is in place before providing assistance. Donors should provide technical assistance to ensure that a country's institutional capacity for developing, implementing, and enforcing environmental policy is in place prior to reforms. Indicators of this capacity include the presence of an environmental impact assessment of policy reform options, establishment of environmental performance benchmarks in privatization bidding documents and concession contracts, and market incentives compatible with improved environmental performance (such as the elimination of subsidies or adoption of full social cost power dispatch rules).

Help developing country governments design indigenous solutions to power sector problems that promote environmental sustainability. Developing countries tend to adopt electricity technologies and policy frameworks from industrialized countries rather than solutions that are tailored to their individual needs. Donors should help developing country governments design indigenous models and institutional mechanisms for power sector structure, operation, and regulation that are environmentally sustainable.

Provide leadership to the independent power industry to adopt standards of environmental performance. Assistance agencies should develop a collaborative project with the international power industry and private lending institutions whose goal is to develop a voluntary code of conduct for power sector projects and privatizations. This initiative would generate a set of sustainability principles for international power development and a plan for promoting their adoption in the larger power development community.

Help country environmental stakeholders become more involved in the reform process. Donors could develop country-specific strategies to engage host country stakeholders in the reform process at critical points. Activities could include sponsoring multi-stakeholder dialogs over a

long enough period to craft recommendations for incorporating environmental considerations in power sector reform, and pairing environmental officials who have addressed electricity industry restructuring issues with their developing country counterparts.

Conduct analyses of the implications of power sector reforms on environmental performance. Donors might develop and pilot test a simple analytic tool that would enable in-country decision makers to compare the relative environmental implications of alternative power sector reforms. They might also sponsor studies that estimate the greenhouse gas implications of alternative power sector reforms, particularly in countries with large fossil fuel resources (i.e., China, India, Indonesia, and Russia), and develop alternative approaches for guiding the reforms in more climate-friendly directions.

U.S. Agency for International Development
Bureau for Global Programs, Field Support, and Research
Center for Environment
Office of Energy, Environment, and Technology

The Center for Environment of the Bureau for Global Programs, Field Support, and Research houses the environmental programs of the U.S. Agency for International Development (USAID). One of five *Centers of Excellence* within the Agency, the Center for Environment, provides field support to U.S. bilateral assistance efforts, manages global environmental program activities, oversees USAID's environmental research efforts, and is USAID's principal liaison on technical environmental issues to the rest of the U.S. Government, non-governmental organizations and universities, and other bilateral and multilateral donors.

The Office of Energy, Environment, and Technology is a part of the Center for Environment and helps developing countries and emerging economies find market-oriented solutions to their energy and environment problems. The Office helps set the energy policy direction for the Agency and responds to the short-term needs of USAID's field offices in assisted countries.

A lack of energy is seriously curtailing economic growth in developing countries and countries in transition. Expansion of energy supplies imposes a huge financial burden while increasing environmental threats in these countries. In addition, many countries lack the institutional capability and appropriate technology to operate and manage energy systems efficiently. These factors contribute to the role energy development plays as a leading contributor to global climate change and regional and local environmental problems.

To address these problems, the Office of Energy, Environment, and Technology leverages the financial resources of multilateral development banks, such as The World Bank and the InterAmerican Development Bank, the private sector, and other bilateral donors to increase energy efficiency and expand energy supplies, enhance the role of private power, and implement novel approaches through research and adaptation. These approaches include improving power sector investment planning ("integrated resources planning") and encouraging the application of cleaner technologies that use both conventional fossil fuels and renewable energy sources. The Office's promotion of greater private sector participation in the power sector and a wide-ranging training program also help to build the institutional infrastructure necessary to sustain cost-effective growth.

Further information regarding Center for Environment and Office of Energy, Environment, and Technology activities can be requested by contacting the Office of Energy, Environment, and Technology at the following address.

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