INCORPORATING

INTERNATIONAL ENVIRONMENTAL LEGISLATION

INTO

POWER PROJECT DEVELOPMENT

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I ECONOMICS, ENERGY AND THE ENVIRONMENT

Tremendous disparities exist between the technologically and scientifically advanced countries of the world, the "Countries in Transition," and the truly underdeveloped countries. Most of the latter are not able to offer adequate modern services, such as dependable electric power, due to their inadequate infrastructures. This, in turn, restrains their economic growth.

As countries compete for markets, many of their governments find they do not have the monetary resources to finance major infrastructure improvements. They frequently then privatize government monopolies such as those for gas and electric utilities, and welcome independent power producers. This has catapulted the power development sector into playing a major role in the globalization process of narrowing the gap between the energy-rich and energy-poor countries. Privatization of electric power is occurring in many countries.

The challenge for every country is to promote economic growth that is "sustainable." Although vast amounts have been written about "sustainable growth," it is not precisely clear what is being sustained. The phrase generally means

> *"meeting the needs of the present generation without jeopardizing the ability of future generations to meet their needs."*

This means the economic growth that can occur without drawing down natural capital such as forests, animal and marine life, or excessively polluting the immediate region, the country or indeed the rest of the world. The key elements of sustainability are economic, environmental and social, including property rights (11). Environmental issues vary depending on the type of project. Financial institutions as well as national governments realize the importance of implementing policies that protect health and preserve natural resources such as forests, rivers and lakes. Donor agencies and international financial institutions are increasingly focusing on policies that will lead to sustainable development.

Quantifying the tradeoffs between energy policy and environmental objectives is important, but very difficult. Increased economic activity requires additional energy. Energy resources are important not only for economic prosperity, but also for a desirable quality of life. There is a synergy between economic growth and environmental quality. Some environmental problems decline as incomes rise; some problems initially worsen, but then improve as the economy improves (12). Without consideration for the environment, long-term development will be undermined. But, conversely, without accelerated economic growth in developing nations, funds for environmental protection and remediation will not be available; environmental policies will then fail.

A growing awareness of the potentially detrimental health and environmental effects of power plant emissions has lead to increased environmental regulation and enforcement throughout the world. Increasingly, electric system planners face the problem of meeting the growing demand for more power in both an economically viable and environmentally acceptable manner. Fortunately, properly planned electric system development need not cause extensive or irreversible environmental damage; environmental protection can be achieved without thwarting economic development.

A thermal power plant can be a significant source of harmful emissions, depending on its capacity, its mix of fuels and their characteristics. The amount and quality of coal, lignite and heavy oils to be used are of particular concern. The economic reality is, of course, that the availability of natural resources is the determining factor in choice of fuel for the power plant, rather than seeking to use the cleanest possible fuel at any cost.

Hydroelectric power plants may lead to major losses of forests and wildlife habitat, massive resettlements of populations, silting and flooding problems. The results of low-probability events such as earthquakes can be devastating to large numbers of people.

Successful implementation of environmental programs requires regional cooperation. Key industries in many countries are often state-owned and, as a practical matter, not forced to comply with recommended practices or even regulations. Economic dependence on exports further reduces the likelihood that facilities (especially if state-owned) would be shut down due to noncompliance. This situation is common.

The Ukrainian government, for example, depends on the Russian-built Chernobyl nuclear power plant. This twenty-one-year-old plant produces 3,760 megawatts, which represents forty percent of Ukraine's demand. Twenty-three countries have expressed their opposition to its continued operation. The Ukrainian government has taken the position that the plant is safe, and if other countries wish it shut, they should make compensation payments.

Similar situations exist in The Slovak Republic (Bohunice Plant), Bulgaria (Kozloduy Plant) and Lithuania (Ignalina Plant). In each of these, international pressure is being exerted to modify nuclear plants to conform to world standards, and in each of these the governments have demanded payments to comply.

II ENVIRONMENTAL OVERVIEW OF POWER PLANT PROJECTS

Two types of electric power generation will be discussed herein: thermal and hydroelectric. Nuclear, solar, fuel cells, geothermal, biomass and wind, though used to generate electricity, will not be included.

THERMAL POWER PLANTS

All thermal power plants generate electricity through a series of energy conversion stages that start with a fuel and produce electric energy. These include boiler plants, combustion turbines

and internal combustion engines. These may also be configured to operate as cogeneration plants.

Thermal power plant wastes are typical of those from the combustion process. Exhaust gases from burning coal and oil contain particulates (including any heavy metals present in the fuels), sulfur oxides, nitrogen oxides, carbon monoxide and volatile organic compounds. The concentrations of these exhaust gas pollutants are a complex function of the firing configuration, operating practices and fuel composition. Usually, gas-fired plants produce negligible quantities of particulates and sulfur oxides. Their exhaust gases do contain nitrogen oxides, but at much lower concentrations than from coal or oil-fired units.

Ash residues and the dust removed from exhaust gases may contain significant levels of sulfates, heavy metals and organic compounds as well as inert materials. Fly ash removed from exhaust gases make up 60-85 percent of the coal ash residue in pulverized coal boilers. Bottom ash includes slag and coarser, heavier particles than fly ash. They may substantially increase the volume of such solid wastes if certain pollution control methods are used such as flue gas desulfurization, or fluidized bed combustion. Conversely, good mining (or coal purchasing) practices may significantly reduce the volume of solid wastes.

Steam turbines, if used, require a way to condense and/or cool the exiting steam. Although using air cooling is not very unusual, it is far more common to use large quantities of water for this purpose. Water is also necessary for auxiliary station equipment, ash handling and flue-gas desulfurization systems. The characteristics of the waste water will depend on the way the water was used. Contamination by wastes from demineralizers, lubricating and auxiliary fuel oils and chlorine, biocides and other chemicals used to manage the quality of water in recirculating systems is common in different types of thermal power plants.

HYDROELECTRIC POWER PLANTS

Hydroelectric projects include dams, reservoirs, canals, penstocks, powerhouses and switch yards for the generation and transmission of electricity. Among the benefits of hydroelectric power are eliminations of air emissions and ash from burning fossil fuels and the problems of disposing of radioactive wastes from nuclear plants. Construction of hydroelectric power plants is labor intensive, creating many jobs during construction.

Hydroelectric projects, however, have a disruptive effect to both people and the ecological environment if they require permanent flooding for dam construction. These often require large numbers of people to be relocated, involving human rights issues besides the technological challenges. The controversial 1,800 megawatt Bakun dam project in Malaysia, for example will lead to the disappearance of homes and villages of 9,400 people. The Eltran II hydroelectric project on the Yalong River in China will displace 35,000 people, and the huge Three Gorges project on the Yangtse River will require resettlement of 1,000,000 people. Perceived inadequate payments to uprooted peoples for their land, farms and businesses, as well as slow disbursements thereof have been major factors leading to dissatisfaction by affected people. Additionally, they must consider education, health care, and the entire range of social factors that constitute fair and dignified treatment of all affected people.

Construction of a power plant can affect rural to urban migration or change the character of a community, enabling it to accommodate a more technical or manufacturing economy, and ultimately lead to a loss of cultural identity. Location of the facility could also increase the affluent/poor income gap.

III ENVIRONMENTAL IMPACT ISSUES

AIR ISSUES

Various pollutants, described below, can have adverse effects on the life and health of humans, animals, trees and flora, fish and other marine life. The severity of the effect depends on the specific pollutant, its concentration and the duration of exposure. Assessing the impacts of air pollution involves five considerations:

- Which pollutants will the plant emit?
- At what rates will they be emitted?
- What will the resulting ground-level concentrations be?
- What maximum allowable values should be imposed?
- How can the maximum allowable values be reached?

These will be considered in turn.

Emissions and Discharges - Health Related

The "Criteria Pollutants" normally considered for electric generating projects are those that, above threshold concentrations, lead to adverse health effects. They are:

- oxides of nitrogen NO_X
- sulfur oxides SO_X
- particulate matter (less than 10 micron diameter) PM_{10}
- volatile organic compounds VOCs
- carbon monoxide CO
- lead Pb

Emissions and Discharges - Greenhouse Gases

Certain compounds, including the following, absorb infrared radiation from the earth, thus acting as an insulating blanket, preventing heat from escaping from the atmosphere. These pollutants, termed *greenhouse gases*, have regional and global effects, causing elevated ambient temperature levels that may cause a rise in sea level as the glacial ice caps melt.

- carbon dioxide CO_2
- nitrous oxide N_2O
- methane CH_4
- ground-level ozone O_3

- chlorofluorocarbons CFCs

Emissions and Discharges - other

Besides gaseous emissions, issues related to power facilities may include the impacts of cooling tower plumes on visibility, salt deposition, fogging and icing. Mathematical models have been developed to predict the geographical extent and severity of these impacts.

Ground Level Concentrations

The exhaust gases leaving a power plant stack tend to behave in a very complex way. They are buoyant because of their high temperature and thus tend to rise. Simultaneously, they cool as they mix with the ambient air. The mixing also dilutes the stack gases, reducing pollutant concentrations. Additionally, the wind transports them, which frequently changes direction and interacts with buildings and hilly terrain.

The dispersion of exhaust gases can be analyzed, with varying degrees of accuracy, by many mathematical models developed during the last thirty years. The scientific establishment has vetted many models, and they are now accepted as "standards" to be used in environmental analysis.

The models require data about the emission rate, composition and temperature of the stack gases, the stack height and diameter, dimensions of nearby structures, and the elevation contours of the terrain. Additionally, they require much meteorological data, including hourly wind speed, direction and temperature. These requirements can cause serious delays since some models require a full year's site-specific weather data.

The models predict the increase in concentrations of pollutants from the stack as a function of distance from the stack, and time. These increases must then be added to the existing pollutant concentrations, to produce a total ground-level concentrations that those at various locations would breathe for various durations. The existing pollutant concentrations usually vary on a seasonal and weekly basis. This is the reason for studying a full year of actual air quality data. There is thus often a need for two different kinds of data: meteorological and existing air quality data.

Developing countries have recently begun to establish programs to collect accurate air quality data, determine current levels of pollutants, establish standards, project future emissions levels, and model projected emissions. Their data gathering, analysis and reporting system are, however, most often poorly funded. The data are frequently weak, not in a scientific format, and inadequate for drawing meaningful environmental conclusions. Many air pollution studies are therefore based on surrogate data from industrialized countries.

Opacity

By definition opacity means to cause to become opaque; impervious to light. Opacity problems can affect street and road traffic, shipping operations, or aircraft operations. They, moreover, can affect the aesthetics of the plant. Power plant opacity issues arise from two different sources.

The first relates to the emissions leaving the stack tip. Depending on the conditions of combustion, the types of post-combustion pollution controls used and the ambient weather

conditions, the opacity of the emissions can vary from clear to totally obscured. Problems are usually caused by particulate matter in the emission stream, or by water vapor in the exhaust condensing in the cooler ambient atmosphere causing a fogging effect. Usually, the particulate matter can be controlled by using either cleaner fuels such as natural gas, or pollution control devices such as a bag house or electrostatic precipitator.

The second item for opacity concern is the cooling tower. Part of the hot water entering the cooling tower evaporates into an air stream. As the air leaves and slowly drifts away from the cooling tower, the stream cools to the ambient air temperature and, under certain conditions of as cold weather and/or high humidity, the water vapor recondenses to fine liquid droplets. This situation can cause heavy, dense fog to form in the area of, or just downwind of, the cooling tower. To mitigate this impact either an alternative facility cooling system could be selected or a partial/full system shutdown might become necessary when visibility becomes poor.

WATER ISSUES

Three broad issues arise:

- the physical availability of water to the plant for cooling/condensing and steam generation purposes, and the legal right to use it
- the technically, economically and legally acceptable methods of discharging and disposing of waste-water
- the water quality will determine the type of water treatment necessary, and chemicals that must be used, stored and disposed of

Water Availability

The source of water is important since, besides legal and commercial considerations, it may be associated with disruption of hydrology or prolonged periods of reduced rainfall that could affect its availability. Water rights or impairment of other beneficial uses of the water, particularly for irrigation, may also be a major issue. It is possible to reduce the amount of water necessary for operation of cooling systems by installing air (fin/fan) coolers or evaporative recirculating cooling systems that use as little as five percent of the water volume required for once-through cooling systems. However, such systems will be more costly and require careful maintenance to reduce bio fouling and the resultant discharge of biocides in water vapors or droplet drifts. They also may reduce the thermodynamic efficiency of the plant.

Water Discharge

Water discharges include those from coal pile runoff, boiler blowdown, SO_2 and particulate scrubber water, cooling water and sanitary wastes. These can be lead to serious issues if they might affect the chemistry and temperature of surface or subsurface water, or a marine habitat. Details of oil spill control and countermeasures must be considered. Another impact of the discharge of water may be erosion or silt runoff, especially during construction, deposit of sludges or regional flooding. Where once-through cooling systems are used, careful siting of intakes and outfalls can reduce the impact of its discharge, reducing the use of biocides and anti-corrosion chemicals.

Controlling the discharge temperatures and extent of thermal plumes may be necessary to protect marine life.

SOLID WASTE ISSUES

Thermal plants can create solid waste residues including fly ash, flue gas desulfurization sludge and water treatment resins. Problems with air-borne dusts are minor; problems with sludge and wastes from scrubber systems used to control particulates, NO_X and SO_2 are often difficult and expensive to solve.

Fly ash handling systems are generally wet or dry, even though the dry handling involves wetting the ash to ten to twenty percent moisture to improve handling characteristics and mitigate dust created during disposal.

Using a wet system, the ash is mixed with water to produce a liquid effluent with five to ten percent solids by weight. This is discharged to settling ponds, often with bottom ash and flue gas desulfurization sludges included. These ponds may be used as the final disposal site, or the settled solids may be dredged and removed for final disposal in a landfill.

Problems may arise because the water will most often contain dissolved contaminants such as chlorides, sulfates and heavy metals such as lead, cadmium, vanadium and mercury.

INFRASTRUCTURE ISSUES

Roads are often inadequate and hard to improve in developing countries because of the way urban areas have evolved. Even if technically feasible, necessary improvements are often costly both in terms of capital requirements and implementation time. These issues, together with environmental protection, are magnified if forests need to be cleared. Road conditions are particularly important if frequent fuel deliveries are by truck or during construction when heavy equipment is moved to and from the site.

ECOLOGICALLY SENSITIVE AREAS

Loss of flora or fauna or endangered species is becoming a major issue when projects are on wetlands, destroy forests or cause acid rain that may damage nearby sensitive areas. There is much concern about the future of the rain forests of Latin and South America, Southeast Asia and parts of Africa. Loss of prime farmland can also be a negative impact of facility development, offsetting the potential for economic growth it creates. Negative impacts, such as silting and runoff or traffic through ecologically sensitive areas, are often more severe during plant construction than during normal plant operation.

ELECTROMAGNETIC FIELDS

Studies have been done to evaluate the health risks from proximity to the fields that surround

electric wiring and appliances. To date no conclusive evidence has been found to correlate adverse health effects and certain types of cancers with exposure to electric magnetic fields, but it is an issue often connected with power plant development and electric transmission.

IV THE "REGULATORS"

INTERNATIONAL TREATIES

Globally, the country in which the project is proposed might be a signatory to treaties or agreements such as the:

- **1985 Vienna Convention** provides for monitoring research and information exchange for international ozone protection
- **1987 Montreal Protocol on Substances that Deplete the Ozone Layer** phases out consumption and trade of ozone-depleting substances
- **1992 Rio Treaty** The United Nations Conference on Environment and Development (UNCED) to set principles for global sustainability
- **Berlin Mandate 1995** to control greenhouse gas emissions
- **Basel Convention** to reduce transboundary movement of wastes
- **Biodiversity Convention** to take action to preserve global species diversity
- **Climate Change Convention** encourages all parties to stabilize greenhouse gas emissions
- **London Convention** regulates at-sea dumping of hazardous wastes

The Intergovernmental Panel on Climate Change, sponsored by the United Nations, has now concluded that the first signs of global warming are appearing. Carbon dioxide emissions are likely to be taxed and/or regulated within the next few years, and an international carbon dioxide emissions trading program has been proposed to add incentives for reductions.

Any of these Conventions may play a role in project design and review by governmental

agencies and the financial community.

THE EUROPEAN UNION

Fifteen West European countries have joined into a European Union, binding themselves to accept *"Common Positions"* with respect to many activities, including environmental protection. Common Positions have now been adopted by the Council of The European Union setting forth a broad framework for *integrated pollution prevention and control* and *ambient air quality assessment and management* (7, 8).

Directives will apply to *"Combustion installations with a rated thermal input exceeding 50 MW."* Although the details are not yet available, it is clear that use of *"Best Available Techniques*," and *"Access to information and public participation in the permit procedure"* will be mandated.

Importantly,

> *"Member States shall take the necessary measures to ensure that competent authorities periodically reconsider and, where necessary, update permit conditions."* (8).

This will require project sponsors to devote additional efforts to insuring that costs associated with complying with changes in regulations be passed on to electric and thermal purchasers.

"Limit Values" and *"Alert Thresholds"* of ambient concentrations of criteria pollutants are to be established by 31 December 1996, and for other pollutants by 31 December 1999. It appears that European Union directives will require more post-construction operational monitoring than formerly encountered by individual countries.

NATIONAL GOVERNMENTAL AGENCIES

National environmental protection agencies of developing countries have a difficult task of balancing competing environmental and economic goals. They must:

- Establish standards officially through legislation and promulgation
- Monitor operating facilities to see that the standards are being complied with
- Take enforcement action if facilities are out of compliance

The first difficulty arises in establishing appropriate standards. This involves not just the basic principles of environmental protection, but balancing these with the national economic situation. Regulations must incorporate what is affordable and enforceable, considering the government's relationship to society and its socioeconomic priorities.

A common approach is to review the latest standards used by industrialized countries and international assistance agencies. The United States Environmental Protection Agency (USEPA) standards are the most frequently used because the USEPA has done extensive work on the subject and its studies and they widely disseminate conclusions. Unfortunately, this can result in a

government adopting stringent standards whose attainment is financially unaffordable within the prevailing economic situation.

The Asian Development Bank believes that a more appropriate method for setting standards is to review the history of the evolution of standards in the industrialized countries. Then consider these in the context of the country's economic situation (except some critical health-related standards such as those addressing the very low human tolerance for mercury.)

> ***Importantly, the strictest standards imposed on any specific project may or may not be those of the government of the project's host country; they may be those of the financial community.***

THE FINANCIAL COMMUNITY

The financial community consists of equity investors, guarantors and lending institutions. Financing new electric generating capacity requires cooperation among these entities.

Multilateral lending institutions have realized that to increase the effectiveness of monetary assistance, they must include strategic objectives such as economic growth, poverty reduction, women in development, population planning and environmental protection. There is now a strong emphasis on the latter factor; nearly all loan applications now require environmental review procedures related to the size of the project and the severity of its environmental impacts.

Most banks now give their staffs environmental guidelines, technical papers, tools and techniques and staff training programs to increase the level of their institutional awareness and understanding of environmental issues.

Multilateral lending institutions today strive to be sure that they have considered all relevant environmental impacts before they will finance a project. Their procedures are intended to avoid environmental liabilities that could affect the implementation of projects, and ensure that capital and operating cost estimates include items related to environmental protection. This is often done in stages beginning with an environmental screening or categorization, which determines if an environmental assessment, impact statement or audit are necessary depending on the size and scope of the project.

While increasing environmental awareness, banks are creating stronger local institutions by promoting development of skilled personnel, forcing consideration of policy and market reforms, using uniform standards and enabling technology transfer from developed countries. They are also promoting regional and international cooperation.

V ENVIRONMENTAL STANDARDS

AIR STANDARDS

The harmful effects of air pollutants are determined by their concentration in the atmosphere and the duration of exposure. Concentrations are usually expressed as Parts Per Million by Volume (ppmv) or by weight per unit volume (micrograms per cubic meter - $\mu g/m^3$). The effects of common pollutants on human health have been thoroughly studied and documented. Results of many studies have delineated the maximum allowable concentrations of various pollutants that will not adversely affect health. *Standards* are concentration levels of air pollutants below which significant harmful effects are not encountered. These are incorporated into *Primary Air Quality Standards* that protect human life, and *Secondary Air Quality Standards* that protect wildlife, streams, rivers and forests.

Countries may develop new guidelines for their ambient air quality standards or may use levels previously established by others, such as those of the USEPA, the World Health Organization, or the European Union. Large differences do exist between the numerical standards adopted by various countries and organizations (17).

The World Bank

The World Bank is the entity that has by far the largest influence on the environmental programs of the countries in transition and the newly emerging economies. These include the countries where demand for new electric generating capacity is greatest. The World Bank's approach to environmental protection is widely used as the model by other multilateral agencies and by the financial community. Its impact cannot be overstated.

The World Bank is a multilateral development institution whose goal is to help its developing members' countries grow economically and socially to improve their quality of life. The World Bank includes several legally and financially different entities:

- The International Bank for Reconstruction and Development (IBRD)
- The International Development Association (IDA).
- International Finance Corporation (IFC)

These first two institutions have three related functions: lending funds, providing economic and technical advice, and serving as a catalyst to encourage other investors. The IBRD borrows from world capital markets to finance its loans. IDA helps the poorest countries with resources contributed by its wealthier members. The IFC, solicits foreign and domestic capital to invest, in tandem with its own funds, in the private sector of developing countries.

The Multilateral Investment Guarantee Agency (MIGA), also associated with the World Bank, stimulates direct foreign investment in developing countries by protecting investors from noncommercial risk such as war or repatriation.

The World Bank has a strong Environment Department that proactively considers the environmental component in its assessment of potential projects (17, 18, 19, 20, 21, 22, 23).

"The Bank requires that new projects [50 megawatts$_e$ and larger] meet the emission

numbers contained in the sector specific guidelines unless the site-specific environmental analysis, which the Bank requires . . . provides a justification for a variance . . . Normal Bank procedures for analysis of industrial projects includes (a) an appropriate environmental assessment . . . Depending on the circumstances, these site specific requirements will be as strict as or stricter than those set out in the handbook." (24).

An environmental specialist categorizes projects by a process designated "environmental screening," to determine the extent of environmental analysis required to support project development. The categories are as follows.

Category A — Diverse and significant potential environmental impact requiring an environmental assessment

Category B — Significant potential environmental impact that can be readily identified and quantified and for which remedial measures can be prescribed without much difficulty

Category C — Insignificant potential environmental impact not requiring an environmental assessment.

An ***environmental assessment*** is an extensive examination of a project's environmental impacts to determine their significance. *Environmental assessments* are completed for projects in Category A and partial analyses are completed for projects in category B of the screening process. Before an *environmental assessment* begins, a scoping session is usually held to identify specific environmental issues that may affect the project. Scoping frequently initiates the public participation process.

If a proposed location has existing structures or ongoing operations an ***environmental audit*** of the site should be conducted to determine environmental concerns and liabilities associated with past and present activities, and their implications for property transfer. This audit would be part of the *environmental assessment* for the project and might show a need to study the site in greater detail. This ***environmental audit*** normally occurs after the project has passed an initial review.

Environmental investigations determine which factors should be incorporated into the project design. A common example might be that certain emissions are too high, so pollution control equipment with higher than normal efficiencies must be installed to reduce emissions to an acceptable level.

It is virtually certain that thermal and hydroelectric power projects will fall under Category A if they are large or category B if they are moderate. For these, the World Bank's new Industrial Pollution Prevention and Abatement Handbook (23) is quite specific; requirements are stringent. For example,

"A comprehensive monitoring and reporting system is required."

The composition and thermal discharge requirements for water effluent discharges are equal to or even more stringent than those currently imposed in many regions of the United States. With respect to air quality, the World Bank requirements for air emissions are also equal to or even more stringent than many of those currently imposed in the United States. For example, an extensive amount of base line air quality data is required.

The World Bank is currently updating its Industry Sector Guidelines (24). It has specific emissions *recommendations* which must be *considered* in all projects they review. Theoretically, and in practice, the *recommendations* need not be strictly met. However if they are in fact met, no further analysis or extensive documentation is necessary, and the review will be quicker and simpler. If they are not met, a rather detailed justification must be provided.

A full *environmental assessment* must be completed before a design basis covering emissions of air pollutants for a new power plant is set. The assessment should establish baseline concentrations of PM_{10}, SO_X, NO_X, CO and ozone without emissions from the proposed project, and identify the main sources contributing to the total emissions of these pollutants within a defined airshed encompassing the project.

An appropriate dispersion model must then be used to investigate the impact of the proposed project on the ambient concentrations of pollutants under alternative assumptions about environmental controls. If there is any likelihood that the plant will be expanded in the medium or longer term, modeling must also be done for the impacts both immediately and after any probable expansion. Finally, the costs of installing alternative emission controls should be compared with the costs of other measures designed to reduce pollution exposures. If there are significant concerns about the long range transport of acid rain pollutants, this analysis should be extended to identify least-cost options for reducing total emissions from a region or country as appropriate.

The specified *recommendations* listed below represent basic minimum guidelines that apply to all projects. More stringent requirements would be imposed if the environmental assessment shows that the adverse environmental impacts outweigh the additional costs involved, although no quantitative criteria are presented. As an example, if the *environmental assessment* establishes for one or more pollutants that a) the baseline exposure of the population in the airshed exceeds the trigger value for ambient exposure specified in the relevant pollutant guidelines and b) the project will worsen citizen exposure levels, then the government and the World Bank may agree either that the project must comply with stricter emission requirements or that alternative measures should be started to reduce emissions from other sources to mitigate exposure and risk to the health of those within the airshed, or perhaps the project should not proceed.

The *environmental assessment* should also address additional project-specific environmental concerns, such as emissions of cadmium, mercury and other heavy metals resulting from burning certain types of coal or heavy fuel oil. In such cases, the government and the World Bank will agree on specific measures to mitigate the impact of such emissions and on the associated emission requirements.

The following World Bank guidelines apply to new fossil-fueled thermal power plants or units of 50 megawatts$_e$ or larger and have been set at levels that can be achieved by adopting a

variety of low-cost options or technologies, including the use of clean fuels. The following are World Bank *recommendations*:

> **Particulates:** For a coal-fired plant or unit, the recommended removal efficiencies from exhaust gases are 99 percent for all particulates (PM) and 98 percent for PM_{10}. These removal efficiencies are to be achieved at least 95 percent of the time that the facility is operating. For all facilities, emissions should not exceed 50 mg/Nm^3 for particulates under full load conditions (24).
> **Nitrogen oxides:** For a coal-fired plant or unit a reduction in NO_X emissions of 40 percent (relative to the case in which no NO_X controls are installed) is recommended, to be achieved for 95 percent of the time that the plant or unit is operating. This should correspond to an emissions level of 650 mg/Nm^3 (230 ng/J). For an oil- and gas-fired plant or unit, the recommended reduction rates are 25 percent and 5 percent respectively, corresponding to emissions levels of 360 (100 ng/J) and 240 mg/Nm^3 (65 ng/J) (24).
>
> **Sulfur dioxide**: It is recommended that total SO_X emissions from the power plant or unit should be less than 0.20 tonnes per day per $megawatts_e$ of capacity for the first 1000 megawatts plus 0.10 tons per day for the incremental over 1000 $megawatts_e$. The concentration of SO_X in the flue gases should not exceed 2000 mg/Nm^3 (24).

WATER STANDARDS

Water Quality

Water quality *standards* do not differ to any significant extent throughout the world. USEPA standards and World Bank recommendations are presented in references 16 and 24, respectively. The reality is, unfortunately, that local facilities in many parts of the world ignore standards. It cannot, however, be assumed that those developing new projects will be allowed much latitude in meeting water standards.

Thermal Plumes

Controlling the discharge temperatures and thermal plumes may be necessary to protect the aquatic environment from the effects of thermal pollution. The World Bank has set a limit (24) to the size of the thermal plume. The requirement states:

> *"The effluent should result in a temperature increase of no more than 3 degrees Celsius at the edge of the zone where initial mixing and dilution take place. Where the zone is not defined, use 100 meters from the point of discharge."*

Water Monitoring

> Requirements will be site-specific. The World Bank requires that:
> *"The pH and temperature of the wastewater discharges should be monitored on a continuous basis. Levels of suspended solids, residual chlorine, heavy metals, and other pollutants in wastewater discharges should be measured monthly if treatment is provided."* (24).

SOLIDS STANDARDS

The World Bank has not published quantitative criteria for disposal of solids. Potential dangers are associated with dust and liquid runoff, rather than the mere existence of solids. Criteria for these are well established.

EVOLVING VIEWPOINT

The World Bank is focusing more strongly on operational monitoring and pollution prevention. Thus, future standards will be related to emissions per unit of production (e.g., grams per kilowatt-hour) and concentrations in streams that can be monitored.

Additionally, they will adopt a larger viewpoint of a project. An "offset" approach will be encouraged by which reductions from other facilities will be encouraged where appropriate.

PROBLEMS WITH STANDARDS

Several troublesome issues arise with surprising frequency in international projects.

+ Numerical values may be presented with no indication of what the units are (i.e., volumetric concentration, mass concentration, mass per unit of energy input, etc.)

+ Laboratory methods are not presented or referenced. The technical requirements are occasionally lower than can be practically measured.

+ Confusion often results from the use of different revisions of guidelines and standards.

OTHER MULTILATERAL LENDING INSTITUTIONS

Project sponsors may become involved with any of several regional multilateral lending agencies. These include:

- **Asian Development Bank (ADB)**
- **European Bank for Reconstruction and Development (EBRD)**
- **InterAmerican Development Bank (IADB)**
- **African Development Bank (AfDB)**

All these have a mission to improve the quality of life of the population of their region, and focus on sustainable development. They each have an Environmental Division that has issued environmental guidelines for selected industrial development projects, including thermal power projects and power transmission lines, and have adopted systematic environmental procedures to review projects. They, moreover, help their members' countries to formulate and implement environmental policies, and play an active role in developing regional programs for transnational and cross-media environmental issues.

The environmental guidelines each have adopted are very similar to those of The World Bank. See, for example, references 1, 2, 3, 4, 5, 9, 10.

VI MEETING ENVIRONMENTAL REQUIREMENTS

AIR ISSUES

Although the creation and emission of air pollutants are unavoidable when electric power is generated from combustion of fuels, their total mass emitted and the resulting ambient ground-level concentrations in the air we breathe are controllable. If the air quality standards will be violated from an uncontrolled facility, pollution control devices or processes must be used. The costs involved to meet the standards must, of course, be borne by the project.

The height of the discharge stack affects the ground level concentrations of pollutants; a taller stack reduces ground-level concentrations. Stack height, however, has no effect on the total mass of pollutants emitted. Using tall stacks occasionally, and correctly, leads to charges they are merely shifting that pollution from one location to another. Stack height can also be both an aesthetic consideration or safety issue if the plant is located near an airport or in flight paths. Zoning regulations frequently regulate the maximum height of a "structure," and must be carefully considered.

Air Pollution Prevention and Control

The simplest and, often, the most cost-effective form of pollution control is to use cleaner fuels. Combined cycle plants burning natural gas has high thermal efficiencies, good environmental performance and low capital costs. If unavailability and high price of natural gas eliminate this option, then the use of low sulfur fuel oil or low sulfur / low ash coal should be considered. Although cleaner fuels are more expensive, reductions in operating or environmental costs may make them more cost-effective. Other technologies include the following.

PM_{10}

Controls capable of 98-99 percent removal efficiency should always be installed. The options for removing particulates from exhaust gases include use of settling chambers, cyclones, jet scrubbers, spray towers, electrostatic precipitators (ESPs), baghouses (fabric filters), and venturi scrubbers. Cyclones may be adequate for small boilers, but their overall removal efficiency is less than 90 percent for total suspended particulate matter and much lower for PM_{10}. Baghouses can have removal efficiencies of 99.8 percent or better and have the potential to enhance the removal of SO_X when sorbent injection or dry scrubbing systems are used. ESPs are available in a broad range of sizes for power plants and can have removal efficiencies of 99.8 percent or better.

Choosing between a baghouse or an ESP depends on fuel and ash characteristics as well as operating and environmental factors. ESPs can be less sensitive to plant interruptions than fabric filters, because their operating effectiveness is not as sensitive to maximum temperatures and they have low pressure drops. On the other hand, fuel and boiler characteristics can adversely affect ESP performance as well as by poor operating or maintenance procedures, so that actual removal efficiency falls below its

design specification. Modern baghouses can also be designed to achieve very high removal efficiencies of PM_{10} at capital costs comparable to those for ESPs when low sulfur fuels are used. It is necessary to ensure the availability of filters and provide appropriate training of operations and maintenance staff; factors that should be included in cost comparisons.

SO_X

Limiting the sulfur content of their liquid fuel can decrease these emissions both for combustion turbines and internal combustion engines.

The range of options for the control of SO_X from boilers is greater because of large differences in the sulfur content of different fuels and in control costs. Usually for low sulfur (<1 percent sulfur), high calorific fuels, specific controls may not be required. Coal cleaning (when applicable) and sorbent injection into ducts (leading to a 30 to 60 percent reductions) or into fluidized bed combustors (leading to a 95 percent reduction) may be adequate for medium sulfur fuels (1 to 3 percent sulfur). For high sulfur fuels (>3 percent sulfur), wet flue gas desulfurization (scrubbers) which can achieve a 95 percent reduction should be considered. Flue gas desulfurization costs are substantial, however, due to high capital costs, high energy usage, use of chemicals, and disposal of residues. Integrated Coal Gasification - Gas Turbine plants may be economical in specific circumstances (13).

NO_X

Using Low-NOx combustors can decrease these emissions for combustion turbines, and further by chemical reduction with ammonia in a Selective Catalytic Reduction (SCR) system. SCR may also be applied to internal combustion engines, oil and gas-fired boilers. Reduction of 80 to 90 percent of the initial NO_X is technically and economically practical. Boilers should employ Low-NOx burners, reducing NO_X emissions by 40 percent. There is increasing experience with SCR systems for coal-fired boilers.

Provision for Future Needs

The possibilities that there may be changes in fuel composition and/or regulations will always exist. It may be economically prudent to provide space for future pollution control systems such as wet flue gas desulfurization, baghouses and SCR.

Air Monitoring and Reporting

Systems for continuous emissions monitoring (CEM) of particulates, SO_X, NO_X and other pollutants including heavy metals in the stack exhaust can be installed at reasonable costs for coal and oil-fired power facilities. Direct measurement of PM_{10}, NO_X and SO_X in flue gas samples should be performed every 12 months along with the calibration of the CEM. Ash and sulfur content of the fuel should also be monitored (24).

Air quality monitoring systems may also be required to measure ambient levels of PM_{10}, NO_X and SO_X outside the plant boundary in several locations including those where:

- there is the least influence of the power plant (the background)
- the maximum pollution concentration is expected

- there are sensitive receptors such as protected areas and population centers. The number of air quality monitors should be greater if the facility is located in areas prone to temperature inversions or other meteorological conditions which lead to high levels of air pollution affecting nearby populations or sensitive ecosystems.

WATER ISSUES

Chemistry

Chemical treatment technologies to maintain acceptable limits of wastewater composition are well known, and present no unusual problems. In extremely sensitive situations, it is possible, though very costly, to use "zero liquid discharge" systems. These are essentially complex evaporator systems requiring much chemical control and sophisticated plant operators.

Thermal Plumes

Designers may predict the thermal plume dimensions and temperature contours by using mathematical models that consider the discharge characteristics (flowrate, temperature, discharge geometry) along with the ambient receiving body conditions (depth, water current direction and speed, topography, temperature, etc.). Proper selection of various outfall dimensions and discharge location can normally lead to an acceptable situation.

Water Monitoring

Meeting monitoring requirements for pH, temperature and composition of wastewater discharges is neither difficult nor expensive. Although monitoring may be required for environmental protection, it is also justifiable for detecting changes in plant operation and ensuring that the facility is being properly maintained.

SOLIDS ISSUES

Dewatered ash and chemically stabilized sludges can be disposed of in landfills that have low permeability and/or are lined. Where there are heavy metals present in ash residues and flue gas desulfurization sludges, leachates and overflows from settling ponds must be monitored and treated. The composition of the waste, together with local conditions and regulations, will dictate proper disposal methods.

VII OBTAINING ENVIRONMENTAL PERMITS

The number of countries that have simple or nonexistent environmental regulations are dwindling. Environmental permits that show that the extent and impacts of pollution have been properly considered, are now required for virtually any meaningful project in almost every country.

The definition of a "meaningful project" is somewhat subjective. The United States Environmental Protection Agency considers a project to be worthy of detailed analysis if its air pollutant

discharge rates exceed tabulated "Significant Emission Rates" (15), or if the increase in ground-level concentrations exceeds tabulated "Significant Air Quality Impacts." (14). Naturally, many other factors may lead to a requirement for an intensive environmental review. Generally, projects between twenty and fifty megawatts$_e$ may be environmentally meaningful, and projects above fifty megawatts$_e$ will usually be subject to careful scrutiny.

The approval process for constructing and operating electric generation plants in many countries is long and complicated. Over the last several years most countries have developed some type of environmental government agency, but the power and effectiveness of these agencies vary widely. In countries with strict regulations, a surprisingly large number of ministries, in addition to the primary one, have a strong interest in power projects. Each has its own layer of bureaucracy which must be satisfied before they can reach any binding resolutions.

Permits necessary to construct and operate thermal power projects normally involve air, water, solid waste disposal, fuel storage and land use issues. National, state or provincial and local municipalities may issue these or agencies. They usually handle air emissions permits on a national or provincial level. Some countries have their own environmental standards; others use international standards. In rare cases where a country itself has not adopted standards, World Bank, USEPA or other lending institution standards may be proposed by the developer.

Water acquisition or discharge permits can be national, provincial or local. These depend on the location and amount of water necessary to operate the plant and its source. Discharge permits depend on the destination of the discharge. For instance, discharge to the ocean or a large lake would be a national concern, while discharge to a sanitary sewer system would be a local concern.

Solid waste disposal could also be a national or local issue depending on the size of the country. Fuel storage is probably local since any emergency (except nuclear disasters) will affect only the immediate area. Land use is also defined locally, except large hydroelectric projects.

Although noise standards may be national, they are usually administered locally. While noise is not usually an "emission" that needs a specific permit, considering its magnitude is important since it is one of the most frequent causes of community complaints, and can be readily abated during the project design phase.

BASIC REQUIREMENTS FOR OBTAINING PERMITS

Before environmental issues can be tackled the most basic requirement is obtaining clear answers to three simple questions:

"What do you want to build?"
"Where do you want to build it?"
"How do you want to operate it?"

Changes in any of these cannot only affect the types of permits required, but also make an impossible project possible or vice versa. Lack of a clear basis for operating scenarios, plant engineering, and equipment selection adds to the cost and timetable of the environmental analysis of the

project. Each time major components change so do calculations and evaluations. Once the project is defined, a list of the agencies that will be involved with the permitting and licensing of the project, and all applicable regulations, can be prepared.

PRE-APPLICATION ACTIVITIES

Initial informal contacts can be made with appropriate agencies, and the proposed project described to officials and their staffs. They will normally voice their concerns, allowing project sponsors to assess the likelihood of success and develop a realistic timetable for securing permits. Very often, they will express strong enthusiastic support for the project; occasionally it is real.

A more formal scoping meeting will help identify obstacles which must be overcome such as uncertain operating scenarios, lack of site-specific data, lack of standardized analytical methodologies, and lack of trained technical staff. Effects on the local and regional infrastructure, must be assessed and the public must be allowed to comment. Alternatives or mitigation measures should be discussed if appropriate. Local concerns should be identified as early as possible in the project development.

Summarize the meeting results in an internal memo with your understanding of the local position and concerns. Send a copy of the memo to the agencies it applies to for their informal review and comment. This will avoid any misunderstandings or misinterpretations.

After receiving an informal response, prepare and send each involved agency a formal summary of points agreed upon, asking for written confirmation of its points. Carefully prepare all applications, discussing your approach and assumptions with each concerned agency as you work. Once you submit the applications follow their progress with telephone calls or visits. Respond to comments in a timely, candid and professional manner.

PERMIT RECONNAISSANCE

Since permits and approvals and licenses are on the critical path for project development, it is extremely prudent to complete a "Permit Reconnaissance" as early as possible. Properly done by those with broad and current experience, it will identify appropriate government agencies, areas of particular concern, the most time consuming activities, public notification requirements and potentially fatal flaws. Upon completion, a permitting timetable can be developed showing the sequence of approvals.

As noted previously:

> ***Often, the nation in which the facility is to be located is not the entity that sets the most stringent criteria to which a project must conform.***

Extensive research and care must be taken to identify qualifying standards, permitting procedures, appropriate governmental and financial agencies that will be involved, documentation requirements and other site-specific issues.

Dynalytics typically prepares a project-specific report that indicates the situation with respect to obtaining licenses, permits and approvals to construct and operate an independent power plant in any location throughout the world. All major licenses, permits and approvals will be addressed, including requirements of environmental, zoning and land use regulations. Depending on the developer's needs,

Dynalytics typically addresses the following:

- Regulatory basis for requirement (legal citation)
- Office that issues the permit, with Contact Person's name, title, address, telephone number and FAX number
- Method of application (application form, letter, etc.)
- Significant Issues
- Approval process - Internal ("one-stop," multi-agency reviews, etc.)
- Approval process - External (advertisements, public hearings, etc.)
- Anticipated Approval Time
- Fees
- Likelihood of obtaining the permit in an acceptable time period
- Other issues as appropriate for a specific project and location

It is important that this Permit Reconnaissance be based on information obtained from competent, responsible and experienced parties. Sources of information include knowledgeable consulting firms, local (and United States) government staff, information brokers and others with formal training as information professionals. Technical and procedural information is becoming increasingly available electronically through the Internet.

It is exceedingly important to insure that all permit requirements and their significance are clearly understood. An overall licensing, permitting and approvals schedule can then be developed showing the interrelationship between each permit and the various procedural and engineering tasks involved to gain approval.

DEFINE ENVIRONMENTAL DESIGN BASIS

Establishing emission and discharge limits is critical that are, simultaneously, technically and economically attainable, can be adhered to by plant operating personnel with reasonable training and efforts, and that are acceptable to the regulatory community. Unless all three conditions are met, the project is unlikely to succeed.

DOCUMENTATION, APPLICATIONS, AND THE ENVIRONMENTAL REVIEW PROCESS

This paper is focused on environmental issues which must be addressed to obtain the approvals and licenses necessary for realizing electric sector projects. Certain documents will be necessary for government regulatory agencies and the same or additional documents will be required by the financial

institutions. A list of documents needed for financial closing will include the power purchase agreement, fuel supply and transportation agreements, the engineering-procurement-construction contract and the operating and maintenance agreement. Other necessary documents include engineers' reports and various approvals and licenses as well as any environmental land use approvals or licenses or environmental reports.

OBSTACLES TO OBTAINING ENVIRONMENTAL PERMITS

Environmental permits may be difficult to secure for a variety of reasons. Dynalytics places the difficulties in four categories: serious environmental problems exist; there is local or governmental opposition; applications have not been carefully prepared; the Regulatory Staff is insecure. These will be discussed in turn.

Serious Environmental Problems Exist

Dynalytics' direct experience with many regulatory agencies and many Western companies indicate that virtually all Western developers accept their responsibility to protect the environment and, when presented with a situation that is objectively untenable, will modify the proposed plant design, operation or location. In addition to the philosophic and moral issues, the Project Development process is simply too lengthy and expensive for problematic projects. They will drop these and another selected from the many more attractive opportunities existing throughout the world.

Local or Governmental Opposition

Local or governmental opposition presents the developer with an extremely difficult dilemma since objections are often couched in environmental terms. The nature of the objections must be analyzed and a decision made about whether or not they might be overcome in a reasonable time. Objections are usually site-specific, including perceived damage to the environment, aesthetics or existing business interests. A sophisticated Public Relations company can help with gathering and interpreting public opinion data, and establishing a sensible course of action. Applications will, as a practical matter, not be submitted for truly objectionable projects.

Incompleteness

Most reviewing agencies have experienced competent staff. They, moreover, are willing to commission independent experts to assess controversial situations, or to provide specialized expertise. Environmental documents will *always* be reviewed with respect to the following.

PROJECT DESCRIPTION: Major equipment selected and operating scenarios, such as part-load profiles, plans for handling gas curtailments, types and compositions of fuels, delivery methods and storage scenario with amounts of fuels to be stored and emergency precautions related to containment and treatment of oil spills, method of cooling/condensing and noise mitigation measures

SITE: Description of the site including its location, proximity to wetlands/forest or other conservation areas and flood-plains (if appropriate), land use/zoning requirements, base-line air, water and soil pollutant levels, and noise data

AIR: Quantities and emission rates for air pollutants for various realistic operating scenarios, types of control equipment, guaranteed emission rates, predicted ground-level concentrations and comparisons

with established criteria

WATER: Quantity and source of water, method of treatment, waste-water discharge quantities, compositions, temperatures and disposal methods, and effects on the environment

SOLID WASTE: Characterization of solid and hazardous wastes, disposal methods, and effects on the environment.

NOISE: Ambient noise levels resulting from operation, during daytime/nighttime hours at the site boundary and at any sensitive receptors

POSSIBLE ALTERNATIVES: A brief discussion of alternative fuels, sites and technologies to establish the reason for the proposed selection

COST / BENEFIT ANALYSIS: A brief discussion of alternate pollution control technologies, with reasons presented for the options being proposed.

Inconsistencies in Environmental Analysis

Many documents are required in the development of a project including environmental permits, fuel supply/transportation agreements, power purchase agreements and the Engineering-Procurement-Construction (EPC) contract (6). It is important that the project descriptions and quantitative information presented be consistent. This is a difficult feat as each document may be prepared during a different phase and the operating scenarios or equipment, selection and size may change from one time period to another. Following are some specific examples of items which need attention to consistency.

a. Between the Power Purchase Agreement, the Fuel Supply/Transportation Agreement and the EPC Contract

- Fuel analysis
- Handling of gas curtailments
- Consistency with design capacity and load factors

b. Between the Power Purchase Agreement and the Thermal Sales Agreement

- Consistency of fuel usage with design capacity/load factor
- Consistency of water usage, discharge rates and characterization with design capacity and load factor

c. Within the EPC Contract

- Stack height & diameter, building dimensions
- Emission levels and equipment specifications
- Water usage and discharge details
- Noise levels

Insecure Regulatory Staff

The Regulatory Staff, in many countries, has an excellent technical education and often been exposed to a wide variety of operating plants. They, however, very often see no advantage to

recommending acceptance of a developer's position and approving an application for a permit. They, in fact, worry about being associated with any controversy that may arise, particularly with high-profile projects. They view any positive decision as a severely career-threatening step.

An insecure staff member takes two defensive positions.

+ ***Makes unending requests***
  "We need additional information; We need additional information; We need additional information; We need additional information . . . "

+ ***Focuses on procedural matters***
  "We have a new form; The form was not filled out properly; The form was not filled out completely; The form was not properly certified; The form was not properly delivered; The form does not have all the required attachments; The form . . . "

Dynalytics' experience throughout the world indicates that staff insecurity is the most common problem, and by far the largest cause of delays in securing permits. It may be alleviated by devoting a great deal of time to educating regulatory staff, and being careful to include senior-level agency members in the process.

PROJECT MODIFICATIONS

An experienced environmental consulting firm should be involved early in the siting and design process to maximize the chance of successfully receiving all required permits, licenses and approvals. They can offer viewpoints concerning the choice of locations which would pose the least environmental impact, pollution limits that will be acceptable, and many intangible and subjective factors that affect project viability. If severely they can avoid negative impacts in the planning stage, they will avoid costly changes or future community opposition.

A major issue which leads to delays and drives up the environmental costs of the project is the number of changes in operating or siting scenarios that must be evaluated. Early inclusion of environmental permitting experts can help avoid repeated modeling scenarios and report rewrites.

POST-CONSTRUCTION REQUIREMENTS

The host country may or may not have follow-up requirements to keep facilities in compliance with the requirements of their permits. These would include:

Permit Restrictions

Permits may be issued with conditions such as restrictions on the number of hours a plant may operate using a certain type of fuel, or the quantity of a particular fuel used per year, or times when they do not allow truck deliveries.

Monitoring and Record-keeping

Monitoring requirements for air and water vary widely from country to country. Record-keeping and proper operations of equipment may be a problem if local personnel operate the plant without proper training or experience.

Enforcement

Unfortunately, even if countries have established standards, appropriate environmental regulations are often not in place. Enforcement is generally weak and poorly funded. Existing facilities, particularly if government-owned, are very often not held to strict criteria that appear in written regulations. In many countries there are no mechanisms, monetary resources, technical skills or political will-power to enforce regulations, eliminate duplication of responsibility, and establish clear lines of authority. Environmental protection is often a low priority factor, as they concentrate concern on more immediately pressing social problems. **Those developing new projects must not, however, assume they will be treated in the same lax manner.**

VIII TRENDS

Governmental

Governments are increasingly having to respond to concerns about the environmental consequences of existing energy development strategies. As nations see the negative effects of unregulated pollution on their populations and their resources, they are beginning to adopt strict regulations to abate pollution. The problem is often not the fact that regulations are not in place, but that enforcement is not practiced because of manpower and economic constraints. In areas where local governments have not taken the initiative to create regulations, other entities, such as multilateral lending institutions, impose their standards. It is, moreover, now unusual for a country's energy officials to act autonomously, even within the energy sector. Structural reforms have been brought about in many countries by deregulation, financing needs and consumer pressure. There is also a sharp increase in global and transnational agreements to decrease the dangers associated with the greenhouse effect and acid rain, issues which go beyond the jurisdiction of a single country.

Overseas Private Investment Corporation (OPIC) is now claiming that the Foreign Assistance Act of 1991 imposes a duty to see that projects it insures do not "pose unreasonable or major environmental hazards to, or cause degradation of the tropical forests." They are now insisting on broad environmental covenants, including that project activities will comply in all material aspects with World Bank thermal power plant guidelines. This will be difficult to interpret since the guidelines are, inevitably, not absolutely specific in all details.

Financial Community

Banks have progressed from the reactive approach of solving environmental problems as they arose to a proactive approach. The latter identify and anticipate problems by examining proposed projects from both economic and social points of view, and are evaluating plans in an ever increasingly comprehensive manner. They are focusing on economic and environmental sustainability and citizen input. Orientation has shifted toward stronger policies and sharper focus on project quality. Also, impacts far beyond the immediate project site are considered. No longer are just local impacts assessed, but they also include global issues such as global warming and greenhouse effects.

In practice, consumers, utilities and public interest groups and governments participate to greater or lesser extent while deciding the acceptability of new energy projects. Each group frequently has its own technical and legal experts to deal with multiple criteria involving economic efficiency and social issues, including environmental concerns. This leads to a variety of environmental targets, data formats, application and review procedures for each project depending on the country, the regional location and the financial institutions involved. Local groups, throughout the world, are becoming more knowledgeable, more vocal, and exerting increasing influence on project development.

Litigation

Extensive and intensive litigation of almost any issue had been a practice unique to the United States. Importantly, the World Bank now has instituted an appeals process by which intervenors can "litigate" projects on environmental grounds thus delaying or even stopping them. They have established an independent Inspection Panel that will review controversial issues and make recommendations. Dynalytics expects all other multilateral lenders to follow suit.

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