Promoting Environmental Improvements Through Projects

Chapter 5

This chapter presents several examples of projects with potential for enhancing environmental improvement aside from the traditional growth-oriented objectives. For instance, if an integrated pest management (IPM) component can be included in an irrigation project, it can bring environmental benefits other than increased agricultural production. Irrigation projects are traditionally considered as economic growth-oriented projects with increased agricultural output as the objective. With the introduction of IPM systems to an irrigation project, it can (i) increase inland fish production, (ii) bring benefits of reduced cost for agro-chemicals, (iii) improve water quality in the area, and (iv) improve nutritional status of the rural poor. These additional benefits can be complementary to the traditional benefits (i.e., increased agricultural production) of the project. This chapter focuses on the improvement of project design through the incorporation of environmental enhancement components to traditional or growth-oriented projects. For additional consideration see Box 8.

I. Three Possible Scenarios

Not every project/intervention, however, is always capable of bringing these kinds of positive environmental impacts. In principle there can be three types of project interventions: (i) win-win situations, (ii) trade-off situations, and (iii) worse-off situations. In win-win situations, not only can the intervention increase the benefits of traditional objectives but it can also contribute positively to the improvement of environmental quality or natural resource conservation. Project proponents need to make every attempt to incorporate such components to the maximum extent to project design as early as possible. This kind of intervention can often bring

Box 8. Financial Analysis, Private Sector Projects, and Environmental Impacts

There is a diverse array of project funding sources. In general, they could be private, public or a combination of both. Private sector investments are in general profit-oriented. Public sector projects are either revenue-generating or nonrevenue-generating. A project's environmental impacts are independent of its investment source (private or public). Biophysical relationships are unbound, hence, there will be no difference in EA due to the ownership of the project. For example, EA requirements of the ADB indicate that its environmental requirements and guidelines are the same regardless of the investment source. However, due to socioeconomic structures, legal requirements and various economic incentives, the behavior of a public sector investor may be different from that of a private sector investor.

The private sector could also be less attentive to (or disregard) the economic analysis of a project. The exception is where the private sector project is funded by the public sector. In contrast, financial analysis and viability usually plays a larger role in private sector projects. In some instances, the public sector can undertake projects that are not financially viable yet may have substantial social or economic benefits. The private sector will probably avoid such projects unless there is a direct subsidy (transfer) to cover additional costs. For the public sector, financial analysis, apart from economic analysis, becomes important if the project is revenue-generating. Therefore, financial analysis becomes an important indicator of the nature of the project.

environmental benefits at no added cost, or added costs which are much smaller than incremental benefits.

Although win-win situations are very attractive, it should be noted that such situations might not always be found. In other cases, a detailed examination of benefits of incoming and cost of outgoing project activities is essential for a proper judgment. For example, a school or a health center in a plantation crop project may reduce crop production by one percent or less (due to less area available for planting). If workers can obtain better education for their children or better health services in the plantation project itself, it can assure social stability. In this case, the benefits (hopefully

The financial viability of a project has a broad definition. It implies that at the optimum, the project should have the ability to replicate itself, finance its day-to-day operation and maintenance, and service its debt (ADB, 1997). Under financial analysis, the preparation of cost tables and financing plans are given major emphasis. In expressing environmental goods and services in financial terms, environmental investments can be identified as a project asset or liability. If the project positively contributes to environmental improvement, investors will be able to capitalize on this to earn more cash resources.

In the national level economic analysis, environmental investments can be shown to bring more benefits than costs. However, in the individual investor's viewpoint such investments become attractive if they make profits. In many cases, further financial analysis of environmental implications of a project clearly demonstrates that investment in environment-friendly activities is self-liquidating, and in some cases is even profitable. Financial analysis can help determine whether individual investors should make such investments.

Financial analysis of environmental impacts can also help in determining the profitability of cleaner technology adoption, industrial restructuring, efficiency improvements and many other environment-friendly activities that may be part of the project. Therefore, financial analysis of environmental impacts could help in: (i) deciding whether to add or delete environmental components, (ii) understanding financial gains vs. investments on environmental control, and (iii) designing environmental projects.

Corporate environmental accounting is now an emerging field. It can aide management in better accounting for environmental charges, fees, tradable permits, cost of meeting standards, and meeting internal and external environmental requirements (Schaltegger, 1996).

economists can value them properly) due to improved education and health facilities could be higher than the one percent reduced crop production—the one percent represents the added cost to the plantation project from the cost of facilities provision and related civil work. Therefore, such alternatives need to be encouraged, specifically when the component's added cost is lower than incremental benefit, as much as possible. Such activities fall into the second category of trade-off methods to promote environmental enhancement.

When project intervention can be a trade-off situation, as a result of adding one environmentally beneficial component to the project, it may

require sacrificing a part of the traditional objective(s) that would be a cost to the project. In such cases, project proponents may want to perform economic (and financial) analysis for the intervention alone to decide whether the intervention is worth it or not. This is an important task where the economic evaluation of environmental impacts can help analysts make informed decisions.

Again, take an irrigation project for an example. If upland soil conservation or watershed management can be included as a component of the project design, benefits to the project (win-win situation) should not only bring an increase in agricultural production in the upper watershed, but also reduce dredging cost of canals or reservoirs. Due to some reasons upper catchment development activities reduce water yield (this can happen if fast growing tree species are planted) and thereby reduce water available for irrigation, then there will be a situation of trade-off. Watershed protection may be environment-friendly or beneficial but due to reduced water yield, agricultural production (traditional benefits) may be reduced. Economic and financial analyses (comparing economic benefit against cost of what comes in versus what goes out) may be needed in this case to justify the additional intervention to the project.

The third situation is that the added intervention brings only negative impacts to the traditional project—being bad for the economy as well as the environment. Therefore, it cannot be considered as an economically viable alternative to be added into the project. In the previous example, if the project was designed to clear the upper watershed then there will be a situation where everything will be worse. Damages to the watershed not only reduce the environmental quality but also reduce the water available for irrigation especially during the dry season. As a result, not only will the project be environmentally harmful but also it will not be able to achieve the specified traditional objectives such as increase in food production, or increase electricity generation. Therefore, such components must always be avoided in project design. Several sector-specific examples for win-win or trade-off options are given in the following sections.

II. Sectoral Examples

A. Agriculture Sector

Table 2 presents cases of how agriculture sector projects can be modified to enhance their contribution to environmental improvement. It provides four cases using (i) livestock projects, (ii) irrigation projects, (iii) plantation crop projects, and (iv) agriculture credit projects on how to make such transition. For example, livestock projects usually include components such as imported breeds, fodder development, disease control, artificial insemination, etc. with the project objective of traditional economic growth via increased production of animal husbandry products. The traditional growth-oriented objective can be supplemented or changed into the line of poverty reduction, women in development, and social development with environmental enhancement as objectives.

In order to make these changes it is necessary to focus on different project components such as the (i) integration of livestock to enhance the shifting cultivation in project areas, (ii) improvement of nutrition of the poor people by introducing multipurpose livestock, and (iii) introduction of livestock-based cottage industries where rural women can benefit. Further, components like wildlife farming; solar, wind, mini hydroelectric or renewable energy for processing activities; fish, duck and livestock systems; watershed management and fodder production; and proper utilization of cow dung, animal waste and other residues can bring substantial amount of additional benefits to the project.

Plantation crop establishment and development, has been a traditional mode of development assistance extended by many donor agencies to developing countries. These activities were justified based on economic growth, employment generation, and provision of foreign exchange earnings. However, there is a large potential to make these projects environment-friendly, yet it has not been extensively explored in the past. From the land-use planning viewpoint, such projects can provide a substantial catalytic role. Developing countries can easily make a strategy which ensures that macro level environmental issues related to land-use planning is given due consideration, specially since most plantation crops use large portions of

Table 2: Sustainable Agricultural Projects

Type of Project	Traditional Objective	Component Usually Included	Environment Enhancing Objective
Livestock Projects	*Increase food production and increase employment thereby increasing income*	• *Imported breeds* • *Fodder development* • *Disease control* • *Market development* • *Processing* • *Artificial insemination*	*Reduce poverty, increase food production and employment, better nutritional levels, increase income;* *Soil conservation, natural resource management, improve health standards, women employment, cottage industries, better marketing*
Irrigation Projects	*Increase agriculture (often rice) production and increase employment, thereby increasing income*	• *Infrastructure development* • *Infrastructure rehabilitation* • *Fee for service/cost recovery* • *Technology packages* • *Fertilizer, plant varieties, pesticides* • *Farm mechanization*	*Reduce poverty, increase agricultural production, not only rice but other vegetables, cash value crops;* *Social development, health improvement, water user groups;* *Watershed management, natural resource conservation, water conservation, electricity generation (hydropower), proper drainage systems, women's involvement*
Plantation Crops • *Oil Palm* • *Rubber* • *Tea, etc.*	*Increase employment, earn foreign exchange*	• *Plantation crop establishment and development* • *Infrastructure such as roads* • *Processing plants* • *Marketing*	*Increase income and employment, earn foreign exchange;* *Women's employment;* *Better sanitation, housing;* *Natural resource management, soil and water conservation, organic crops, nature-friendly processing, green labeling*
Agricultural Credit	*Increase employment and economic growth*	• *Credit provision* • *Institutional development* • *Small farmer credit* • *Agro-industy credit* • *Agricultural banks and financial sector developments*	*Reduce poverty;* *Increase employment for women, cottage industries;* *Environmental improvements*

Suggested Project Scope and Design Element	Remarks
• *Integrate livestock component to improve shifting cultivation* • *Multipurpose livestock systems (e.g., rabbits for meat, manure and weed reduction)* • *Integrated pig-fish-duck-water weed system* • *Farming wildlife and processing with solar dryers* • *Nutritional studies to determine all forms of protein sources* • *Stall feeding over compost mounds* • *Improved disease control* • *Nature-friendly livestock farming*	*Considerable improvement can be obtained by integrating livestock production as part of a complex social environment, increased dietary improvement may be gained from including nature-friendly livestock management systems, with mixed and tree-based agriculture.*
• *Integrated pest management and multicropping systems* • *Closed cycle water recycling systems using solar pumps* • *Irrigation/aquaculture combined systems* • *Duck herding for snail and pest control, and other biological controls* • *Grain handling, drying and storage* • *Integrated watershed management to reduce source of sedimentation* • *Hydropower generation* • *Fish production* • *Water user groups, community management of irrigation and other natural resources* • *Tree farming*	*The main concern regarding irrigation projects is their narrow monoculture focus. Irrigation needs to be viewed within a total system approach preferably as a whole watershed. Issues such as upland protection and instream uses should be seen as integral components of irrigation projects. Farmer-managed irrigation systems, O&M fee collection, community-managed natural resources should be considered.*
• *Agro-ecological plan for layout of different land uses* • *Vegetation and natural landscape retention* • *Wildlife management plan* • *Waste minimization and recycling plan* • *Farming system research and design for home gardens* • *Social forestry and nontimber forest uses, community-based resource management* • *Total marketing plan including surplus from home gardens* • *Value-added operations (processing packaging, etc.)* • *Land tenure plan* • *Optimum siting of processing plants and infrastructure* • *Health and education facilities development*	*Many plantation sector projects are based on the concept of nucleus estates. Village-estate interaction should be looked into. Household needs, environmental and natural resource management, home garden development, social activities should be considered as part and parcel of plantation development projects.*
• *Integrated credit and land tenure/land titling systems* • *Provision of low-cost funds to traditional moneylenders with agreement to reduce borrowing costs for lenders* • *Women's agricultural improvements with agreement to cancel the loan if output does not meet agreed levels* • *Credit for environmentally sound business and cottage industries* • *Organize credit users associations* • *Provision for credits targeted to the poor, NGO and women* • *Institutional strengthening (i.e., Environmental Cell)* • *Environmental awareness* • *Credit, business, environmental technologies screening, training and microfinancing*	*Provision of credit should stem from a clear understanding of how farmers currently deal with risk, and their fallback strategies (such as moneylenders). Attempts should be made to introduce risk-reducing strategies. Microfinancing should not be misinterpreted as small credit or small credit schemes.*

land for monoculture. There is a need to mitigate macro level ecosystems deterioration in developing countries. The existence of a traditional dual economy, and the ecologically unsound large-scale land utilization, can be addressed through plantation development projects. At the micro level, estates can be made environment-friendly, often resulting in win-win situations. The introduction of a timber plantation in the plantation crop area, specially if adjacent to streams, elevated areas, uncultivatable areas throughout wind corridors—can bring not only fuelwood requirements for processing (e.g., tea or rubber), but also the much-needed ecological balance. Consistent with current trends, these products can be made into green, or environment-friendly products through the reduction of the application of inorganic chemicals, or the introduction of IPM or biological pest control measures. Mixed cropping should also be encouraged, bringing added profits in most plantations. These components contribute towards making plantation projects environment-friendly.

In general, agricultural credit projects are considered to be economic growth-oriented. They include components such as institutional development, and credits for small farmers and agro-industries. Such projects can still accommodate new components such as women in development, poverty reduction and environmental improvements. In order to make this transition, the following components can be considered as potential candidates for a project: (i) integrate credit facilities with improved land tenure rights; (ii) agricultural banking for women; (iii) earmarked funding for poverty reduction; (iv) introduce environmental units/cells in financial institutions; (v) earmarked funds for environmental improvement (i.e., soil conservation, fodder development, and tree planting); and (vi) improve environmental awareness.

B. Energy Sector

Linkages between energy and environment are quite clear in all aspects of energy production, distribution and consumption. These environmental impacts vary from micro to macro as well as from household (indoor pollution) to global level (greenhouse gas emissions). These environment-energy linkages can be addressed through (i) an appropriate

mix of market-based and regulatory environmental policies, and (ii) well-designed projects that have internalized all environmental externalities. Such approach can, in the long-run, help ensure sustainability in the energy sector. However, it requires a conscious effort on the part of a wide-array of stakeholders, to focus on structural reforms, energy pricing, energy efficiency, demand-side management, supply-side management, development of alternative energy sources, and regional cooperation for energy emissions trading.

The conversion of traditional growth-oriented power projects into projects with environmental enhancement components is dealt with in this section. Table 3 shows three cases where (i) hydropower projects, (ii) power sector development projects, and (iii) coal-fired thermal power projects are considered as examples. Hydropower projects generally include components like dam or reservoir construction, power plant or generating house with turbines and distribution lines. The outcome is increased electricity production and generally these projects fall into the category of economic growth. However, if the project designers could include components like a dam or reservoir cum watershed protection program; biodiversity conservation, national parks, recreation, and forestry development in the upstream; or ecotourism, downstream irrigation, wetland and aquatic biodiversity protection and bird sanctuaries, they can bring substantial amounts of environmental benefits. Environmental benefits from avoided CO_2 generation from fossil fuels and increased carbon sequestration from forestry-related activities would allow the project to be more environment-friendly.

Power sector projects generally include components like introduction of power plants, development of coal or other fossil fuel resources and distribution lines. Some of the new project components such as energy conservation, community forestry projects which also act as carbon offsets, wood-stove programs, polluter-pays approach to control air emissions, change in appliances, bulbs, introduction of renewable energy (solar, wind, geo-thermal), clean coal technologies, reduction of transmission losses, rehabilitation or closure of old and inefficient power plants, fuel switching programs, district heating, co-generation, private sector involvement in energy production and increase in energy production efficiency can enhance environmental benefits substantially.

Table 3: Sustainable Energy Projects

Type of Project	Traditional Objective	Component Usually Included	Environment Enhancing Objective
Hydropower Project	*Increase electricity supply, thereby accelerating economic growth*	• *Dam construction* • *Generating house* • *Distribution lines*	*Increase electricity supply, rural electrification, forestry and biodiversity conservation, establishment and development of national parks, forest sector development, watershed management, irrigated agriculture, fish production, soil conservation, natural resource management*
Energy Development Project	*Increase electricity production, thereby improving economic growth*	• *Introduction of thermal power plants* • *Development of coal/ natural gas resources* • *Introduction of transmission lines* • *Renovation of power utilities* • *Energy efficiency and energy conservation improvements*	*Introduce clean coal and other clean fuel technologies for power production; Efficiency improvements, rural electrification, tariff reforms, institutional strengthening, closure of old and inefficient power plants specially coal-fired power plants, demand-side management and energy conservation; Introduce renewable energy wind, solar and biomass; Reduce energy losses; Increase wood-saving cookstoves usage; Restructuring and deregulation of power production and distribution; Competitiveness in the industry and private sector participation; Increase forest cover; Change in appliances, bulbs, etc. Energy conservation, increase efficiency*

Suggested Project Scope and Design Element	Remarks
• *Rural electrification* • *Closure of old and inefficient coal-fired power plants* • *Reservoir cum watershed protection* • *Biodiversity conservation, national park establishment and development* • *Promotion of ecotourism* • *Forestry development, aquatic resources (e.g., lake, river) development* • *National park/green area establishment and development* • *Irrigation development* • *Community participation* • *Environmental benefits from CO_2 and other air emission reduction* • *Energy sector reform and restructuring* • *Enhancement of competition in energy markets*	*Consider hydropower production as watershed management or biodiversity conservation. Integrate community development and community participation as project components.*
• *Energy conservation and demand-side management* • *Energy efficiency improvement* • *Market development and tariff reforms* • *Private sector involvement in energy production and distribution* • *Reforestation or afforestation to offset environmental emissions* • *Pollution control measures, desulfurization, TSP reduction and ash utilization* • *Polluter-pays approach* • *Withdrawal or reduction of energy subsidies* • *Environmental enhancement, energy conservation, awareness and education program* • *Institutional strengthening, transparency in tariff-setting* • *Closure of old and inefficient coal-fired power plants* • *Fuel switching and use of cleaner fuel* • *Least-cost planning including environmental costs of various power production options* • *Public participation, rural electrification and good governance in the sector* • *Energy sector reform and restructuring* • *Enhancement of competition in energy markets BOO/BOT and other forms of IPPs and private sector participation.*	*Consider energy as a part of the community. Sustainability in the power sector is an important issue to be addressed. Promotes energy efficiency with environmental improvement.*

Type of Project	Traditional Objective	Component Usually Included	Environment Enhancing Objective
Coal-Fired Thermal Power Plant	*Increase electricity supply, thereby economic growth*	• *Coal-fired power plant* • *Transmission lines* • *Turbines, dynamotors* • *Boilers* • *Coal mines, coal transportation* • *Ash disposal*	*Increase energy efficiency, energy conservation, better utilization of coal resources, clean coal technologies, rural electrification; Environment improvement and/or management and monitoring; phase-out of old and inefficient plants (offset); Pollution control equipment, methods and resources (water) conservation*

Today a wide array of clean coal technologies (CCTs) is available for reducing SO_2, NO_X, and TSP emissions in coal utilization in the world. These CCTs can help reduce acid rain, and some technologies lower CO_2 production per unit of energy produced. Therefore, CCTs not only help achieve obvious reductions in on-site emissions, they reduce transboundary externalities such as acid rain and global warming due to greenhouse gas emissions. A large number of such methods are economically attractive enough and even poor countries can adopt them. Table 4 gives the characteristics of CCTs.

The most widely available CCTs can be divided into four main categories: (i) pre-combustion technologies (e.g., coal washing and crushing); (ii) in-situ technologies (e.g., alter the design of coal furnaces); (iii) post-combustion technologies (e.g., use of catalysts and other methods to reduce SO_2 and NO_X); and (iv) advanced coal utilization technologies (these methods supersede the standard stages of pulverized coal burning using integrated energy conversion processes, e.g., atmospheric fluidized-bed combustion and integrated gasification combined cycles).

These CCTs can effectively reduce the adverse environmental impacts of coal utilization in a country and the region. It is estimated that TSP, SO_2 and NO_X reduction from CCTs range from 50-99 percent. Although CCTs do not directly reduce CO_2 generation, it helps reduce the amount of CO_2 generated per

Suggested Project Scope and Design Element	Remarks
• *Use of clean coal technologies such as coal washing, sorbent injection, dry scrubbers, atmospheric fluidization (bed combustion can be considered)* • *Desulfurization, use of low-sulfur coal, electrostatic precipitator with high efficiency, baghouse installation, fuel transport management, tall stacks* • *Greenbelt establishment, afforestation, reforestation* • *Adequate waste disposal/management plan* • *Sound ash disposal/utilization program* • *Environment (esp. air) monitoring system* • · *Improved and efficient water cooling system*	*Attempts should be made to reduce emissions (i.e., SO_2, NO_x TSP, etc.). Look for cleaner fuel and efficiency improvements.*

unit of energy produced through coal burning. There are other activities which can act as CO_2 offsets such as the closure of old and inefficient power plants, and the establishment of carbon sinks through afforestation/reforestation.

Technologies related to environment-friendly renewable energy resources are also becoming economically viable options. This includes wind power, solar photovoltaics, minihydro plants, and biomass-based energy systems. Another advantage of these energy systems is that most are oriented toward private sector involvement in energy production, coupled with decentralized locations. Heavily subsidized energy production encourages concentrated and centrally controlled energy production, making renewable energy sources, non-economical. However, if proper economic analysis of these energy production systems is undertaken (including the economic evaluation of environmental impacts), project modification with renewable energy options become economically convincing.

The ADB's energy policy paper clearly states that there are problems in promoting sustainable energy systems in the region. It says that "some of the major constraints to the development of decentralized and sustainable renewable energy systems in rural areas include: (i) overemphasis of national energy policy on the expansion of bulk commercial energy supply capacity through centralized systems largely to meet urban and industrial needs; (ii) low priority of renewable energy systems; (iii) weak

Table 4. Characteristics of Clean Coal Technologies

Technology	% of SO2 Removed	% of NOX Removed	Particulate Removal	Capital Costs ($/kW) New Plants	Retrofits
Physical coal cleaning	*10-40*	*None*	*30-60% lower fly ash*	*$1-5/ ton of coal*	*$1-5/ ton of coal*
Advanced coal cleaning	*30-70*	*None*	*Up to 70% lower fly ash*	*$5-20/ ton of coal*	*$5-20/ ton of coal*
Low-NO_x combustion	*None*	*30-60*	*None*	*2-10*	*5-25*
Sorbent injection	*30-60*	*None*	*None*	*50-80*	*70-100*
Duct injection					
Pre-ESP	*30-70*	*None*	*None*	*50-100*	*60-120*
Post-ESP	*70-90*	*None*	*None*	*80-170*	*100-200*
Wet FGD	*90-99*	*None*	*% depends on ESP-FGD configuration*	*120-210*	*150-270*
Dry FGD	*70-90*	*None*	*None*	*110-165*	*140-210*
SNCR	*None*	*35-60*	*None*	*5-10*	*10-30*
SCR	*None*	*70-90*	*None*	*50-100*	*50-150*
Combined SO_x/NO_x	*80-95*	*80-90*	*Possible by some technologies*	*300-400*	*300-400*
Advanced ESP	*None*	*None*	*Up to 99.9%*	*40-100*	*40-100*
Bagfilters	*None*	*None*	*Up to 99.9%*	*50-70*	*50-70*
Hot-gas cleanup	*None*	*None*	*Up to 99.9%*	*Not available*	*Not available*
AFBC	*70-95*	*50-80*	*None*	*1,300-1,600*	*500-1,000*
PFBC	*80-95*	*50-80*	*None*	*1,200-1,500*	*Not available*
IGCC	*90-99.9*	*60-90*	*None*	*1,500-1,800*	*Not available*

AFBC = atmospheric fluidized bed combustion; ESP = electrostatic precipitator; FDG = flue gas desulfurization; IGCC = integrated gasification combined cycle; NO_x = nitrogen oxides; PFBC = pressurized fluidized-bed combustion; SCR = selective catalytic reduction; SNCR = selective noncatalytic reduction; SO_x = sulfur oxide

Source: World Bank, 1995.

technology research, transfer and development policies; (iv) lack of emphasis on establishing close links between research and development outputs and local manufacturing and fabrication capabilities; (v) weak institutional structures for implementation of rural energy projects; and (vi) unavailability of reliable information on rural energy needs, supplies and environmental status." This section of the ADB energy policy highlights the current nature of energy problems in the region. Most of these problems are related to economics, policies and institutions. In terms of environmental aspects, it is clearly seen that the lack of information and awareness of the environmental deterioration has evolved with energy production—serving as one of the main bottlenecks for sector development. Once the costs of SO_2, TSP, NO_X, CO_2 and other emissions are factored in fossil fuel based energy production, energy produced through renewable resources becomes more economically attractive. This type of comparison can be made only through undertaking well informed economic evaluation of environmental impacts of energy production. To paraphrase ADB's energy policy paper (para 80)—economic evaluation of environmental impacts can (i) help minimize the adverse environmental effects of energy production, and (ii) assure sustainability in the sector.

C. Urban Infrastructure Sector

Although it is difficult to convert some of the infrastructure projects into environment-friendly ones, still there are many ways in which a project proponent can make an attempt to do that. Table 5 provides a series of examples on how urban infrastructure development projects can be converted into environment-friendly projects. A traditionally economic growth-oriented urban development project with introduction of urban roads and highways can be converted into an environment-friendly one incorporating the following components, inter alia: (i) increase public transport, (ii) introduce vehicle emission taxes, (iii) cost recovery of parking places, (iv) encourage private sector mass transportation, (v) include electric or alternative fuel use for transport, and (vi) increase efficiency of transport system. As a result of the inclusion of some of these measures, urban transport development projects in badly polluted cities can provide significant environmental improvement benefits.

Table 5: Sustainable Urban Infrastructure Projects

Type of Project	Traditional Objective	Component Usually Included	Environment Enhancing Objective
Urban Development Project	*Increase economic growth*	• *Subways, buses and trains, railways, highways and urban road introduction and improvements* • *Water supply and drainage, sewerage, sewage treatment and solid waste management*	*Increase economic growth, environmental improvements in the city; Reduce air or water pollution, industrial relocation, improved solid waste management; Reduce congestion for time and energy savings, urban park development; Improve aesthetics and conserve historical areas; Reduce noise; Conserve electricity, water and natural resources; Increase mass transport; Urban poverty reduction; Improve utilization of energy and natural resources in urban areas*
Urban Infrastructure • *Ports Development Project*	*Improved capacity and efficiency Economic growth*	• *Expansion/addition of berths* • *Port operation management capacity building* • *Other related infrastructure (e.g., highway, etc.)*	*Environment improvement of the port area; Integrated economic-cum-environmental planning for development (E-C-E); Increase energy efficiency, energy conservation and demand side management.*
• *Road Improvement Project*	*Economic growth*	• *Upgrading road (highways), enlargement* • *Upgrade of operational and management system of the road*	*Cost recovery; Institutional building, toll roads; Landscape enhancement and management, tree planting along roads*
• *Telecommunications Project*	*Increased economic activity and growth*	• *Communication systems, wire networks and exchange towers, distribution systems*	*Lower travel time and associated energy and material consumption; Travel and movement of goods and services; Low energy consumption, energy conservation; Information networking and institution building*

Suggested Project Scope and Design Element	Remarks
• *Include methanol or electric mode of transport for low pollution* • *Increase public transport* • *Introduce vehicle emission fees, charges or taxes on sulfur and carbon* • *Vehicle inspection and maintenance systems* • *Cost recovery of parking space and maintenance of roads, BOO/BOT scheme for road and other infrastructure facilities* • *Increase efficiency of transport system* • *Better drainage, sewerage and sanitation, solid waste management* • *Guided land development* • *Private involvement of these activities as enterprises* • *Environmental awareness* • *Urban parks and recreation* • *Institution building, health improvement, urban poverty reduction* • *Education improvement* • *Low-cost housing* • *Household and public utility and energy conservation* • *Introduction of alternative fuel systems (CUG & LPG)* • *Control stationary source emissions* • *Road safety measures, cost of road accidents are high, valued at $500 billion a year globally with 10-15 million injured annually. Although only 4% of vehicles are in the Asia Pacific, 42% of road accidents and related deaths occur in the region (World Bank, 1999)*	*In badly polluted urban areas improvements in environment could be the main goal of a project. Social development objectives can also be included, through helping urban poor, better health and sanitation.* *The whole urban community should be considered as one system.*
• *Creation/expansion of pollution control and monitoring capabilities of the management authorities* • *Installation of waste-disposal facilities (wastewater and solid waste)* • *Acquisition/operation of oil/water separation ships* • *Energy conservation* • *Increase efficiency* • *Reduction in accidents* • *Improvement of occupational health* • *Establishment of monitoring functions* • *Capacity building for environmental management of relevant government agencies, NGOs and the private sector* • *Plantation management* • *Integrated area management* • *Soil conservation, coastal zone management* • *Rural road development* • *Institution building* • *Ensuring equitable access to information* • *Introduction of alternative fuel systems (CUG & LPG)* • *Control stationary source emissions*	*Project causes minimum damages to natural ecosystem and environment (establishment of tows, cables, buildings, etc.). Institution building and equitable access to information required.*

If properly designed, for example, a port development project can be converted to a very much environment-friendly project through energy savings, reduction in air pollution, reduction in marine pollution, increase in energy efficiency, and reduction of work place accidents. Another possible example are road projects. In general, road projects are considered as environment-unfriendly. It is often argued that rural roads are the leading factor for deforestation. Yet this does not have to be the case. Road projects can be designed in such a way that it could enhance coastal protection, or combined with tree planting programs. For instance, one of the ADB-funded road projects in Lao, PDR (with Japanese Government grant financing) introduced roadside tree planting and road beautification for a 500-kilometer road stretch. Roads can also increase safety and energy savings and bring several other environmental benefits. The road sector can also be used to promote environment-friendly transport systems such as railways and other public transport systems. Railway transport can lead to substantial savings in energy, reduction in pollution and reduced accidents. As a final example, improvements in telecommunications can save substantial amounts of resources which would have otherwise been allocated on road and transport systems. Current technologies allow the minimization of required telecommunications infrastructure.

D. Industry Sector

Integrating environment and natural resource components into industrial projects is a difficult task. The main avenue towards this step is to make industrial projects more environment-friendly. There is much pressure given the trend of massive industrial growth and improper treatment of environmental considerations. However, certain activities such as industrial restructuring, price reforms, structural reforms, adoption of ISO 14000 and other international standards, waste minimization and pollution prevention—are steps that result in cleaner, hence more environment-friendly industries.

In general, industries are the domain of the private sector. As such, market forces should be allowed to function, and no distortions by mechanisms such as subsidies should be allowed. This assures efficiency in the allocation of resources. Many other avenues can be taken to reduce the

adverse environmental impacts of industries. These may include the application of polluter-pays-principle, international standards, and price reforms.

There are many industrial projects such as cement plants, chemical factories and industrial parks in the Asian and Pacific region. Table 6 summarizes some of the ways in which such traditional economic growth-oriented projects can be converted into environment-friendly ones. One of the most important underlying principles in this regard is the technology transfer. Often, better technologies can help improve the environment more than anything else, although it is not sufficient. They automatically bring environmental benefits such as reduction in emissions, energy savings, reduction in wastewater and solid wastes, and better quality products. Often, replacement of old, inefficient and outdated machinery, equipment and procedures can be part of industrial projects. They can also be part of energy and power sector projects and infrastructure projects. Technology transfer can be a clear case of win-win situation if the project proponent is keen on tapping such benefits. Cleaner production results not only in environmental benefits but economic benefits as well. It has been proven by experience that cleaner production results in improved profitability of industries. Thus, pollution prevention rather than pollution control and other end-of-pipe prescriptions should be applied. This points to a preventive rather than curative approach to tackling industrial pollution problems.

Construction of a cement plant is traditionally considered as an economic growth-oriented project. However, if the project is designed to replace such old technologies with more efficient methods, for example, reduction in TSP using an electrostatic precipitator or better waste minimization techniques, recovery (reuse) of wastes, reduction of occupational health hazards, and introduction of landscape and greening of public areas around the factory could bring substantial environmental benefits to a project. If such changes can be brought into a project located in an environmentally polluted area, then it can be considered as an environmental improvement.

Cleaner production (CP) is a business improvement method which also creates significant environmental and energy benefits. CP requires that changes be made on several aspects of the business. These changes, when applied to industries, more often than not, are cost-free. Most of these

Table 6: Sustainable Industrial Projects

Type of Project	Traditional Objective	Component Usually Included	Environment Enhancing Objective
Fertilizer Industry	*Increase fertilizer production, foreign exchange savings*	• *Factory buildings* • *Machines* • *Raw and finished materials storage*	*Reorganization of fertilizer industry;* *Technology transfer and emission taxes;* *Replacement of old, polluting machinery with less polluting, energy-saving equipment;* *Road improvement, health, community settlement, housing and workers welfare;* *Adequate mitigative measures;* *Proper marketing;* *Elimination of subsidies*
Industrial Estate (Park) Development	*Economic growth*	• *Factory building* • *Land/site preparation, and reclamation of area* • *Machinery/equipment*	*Industrial sector re-organization;* *Overall pollution control and energy efficiency;* *Waste minimization and resource conservation;* *Comprehensive environment management in industrial estates;* *Enhanced health and occupational safety of workers;* *Industrial emergency response and preparedness;* *Poverty reduction in rural areas;* *Policy, monitoring, and institutional capacity building*

changes are behavioral and management redirections. With the changes in the knowledge-base, products and processes will change, leading to cleaner and more profitable products. Business-minded managers will adopt these changes when they are profitable in the real cash sense. The profitability analysis must therefore capture all aspects of the business process including environmental impacts in both the short and long-run. Evidence all over the world show that for the last 20 years, most industries have not applied CP because they did not conduct the profitability analysis properly.

Suggested Project Scope and Design Element	Remarks
• *Modification of production process, cleaner production technologies* • *Improvement of environmental protection in areas inside and outside the workplace* • *Recovery and reuse of waste* • *Minimization or avoidance of hazardous waste production* • *Improved safety for workers and the surrounding environment* • *Provision of green areas and tree planting* • *Development of compatible land uses of the surrounding areas*	*Restructuring of the fertilizer industry should go hand-in-hand with other economic reforms including market reforms. Polluter-pays principle must be adopted. Workers' welfare, housing, roads, health, child care facilities should be included.*
• *Centralized waste treatment and disposal facilities* • *Monitoring and mitigation center* • *Formulate emergency response and health and safety plan* • *Industrial-environmental audits* • *Establishment of industrial parks in poor areas* • *Community and social development facilities including education* • *Control of hazardous waste production (e.g., heavy metals, corrosive acids, carcinogenic agents and other chemicals) and their disposal*	*Pollution control, waste minimization and industrial growth can be integrated in an area for both economic growth and environment purposes; recycling waste and central waste management can be considered.*

The result of this is that industries have lost money and pollute unecessarily. Waste is matter out of place, but it is not a non-resource. If an industry is paying a high water or electricity bill, it may mean that there are leakages or that equipment, including the lowly light-bulb, is not switched-off when not used. Although this seems all too obvious, large businesses have been able to save millions just by paying attention to these "trivial" matters—replacing water taps or introducing automatic switching electrical systems. In the same context, a textile factory's wastewater does not only result in

pollution, it oftentimes also shows a wastage of textile dyes, hence a reduction in profits. In this example, the most sensible action is not to generate colored waste or minimize such wastewater through appropriate changes in the products or processes. Unpriced resources or subsidized energy often encourage these types of wastes. If environmental impacts are properly evaluated and demonstrated, it can be realized that someone is paying for all the wastages—this would lead to a more profitable, cleaner, and more environment- and consumer-friendly outputs.

III. Environmental Improvement Projects

Table 7 provides a set of ADB-funded case-specific examples where environmental improvement has been considered as a project component. The Beijing Environment Improvement Project in PRC was categorized as a project with the primary objective of environmental enhancement due to its commitment to invest on better quality drinking water, improved air quality and replacement of high polluting machinery/equipment. The total investment of the Project is estimated at $157 million and about 80 percent of this amount is allocated for the improvement of the Beijing environment.

Rapid growth and industrialization coupled with heavy reliance on coal as primary energy source resulted in serious damages to the Beijing environment. For example, the PRC used three times the energy per unit output compared to the US and 15 times higher compared to Japan (1993), creating serious environmental degradation. The major environmental problems in PRC cities such as Beijing are (i) air pollution, (ii) water pollution, and (iii) industrial solid and hazardous waste. Among urban residents, chronic pulmonary diseases, which is linked to TSP, is the leading cause of death (26 percent of all deaths).

In most urban areas, industrial wastewater is the dominant source of water pollution. It contributes to as much as 80 percent of total pollution. Approximately 27 billion tons of wastewater is produced in PRC annually, of which only 30 percent is treated. Only half of this wastewater meets the national standard. Several billion tons of untreated solid waste, including hazardous waste and toxic chemicals, find its way to the system. About 80 percent of this comes

from industry or energy production sources. Beijing alone generates 270,000 mt of hazardous waste annually, which is not properly disposed.

In 1993, approximately 75 percent of energy was from coal sources. The present level of coal use is 1.1 billion t/yr and the figure is expected to increase to 1.4 billion t/yr by 2000. This will lead to major environmental pollution problems which will have direct impacts on the local people. The present SO_2 concentration is 322 $\mu g/m^3$ (1991) which is four to five times higher than the WHO guidelines of 60-90 $\mu g/m^3$. During winter, this amount increases 10-15 times WHO standards due to winter heating. There will also be transboundary effects in terms of acid rain and global warming impacts via greenhouse gas production.

The total project cost is $459 million, of which ADB financed $157 million. The Project includes a strong policy package and supports seven previous loans for PRC's urban environmental improvement. This includes water supply, cleaner energy sources, wastewater treatment, industrial relocation, and pollution abatement in six major cities: Beijing, Chengdu, Dalian, Hefei, Qingdao and Tangshan. There are also three loans totaling $535 million under ADB's assisted industrial sector loans. These projects aim to improve energy efficiency and promote industrial restructuring.

There are other examples which will be used here to highlight the incorporation of environmental enhancement components in project design, specifically: (i) Mumbai and Chennai Ports Project in India, (ii) Segara Anakan Conservation and Development Project in Indonesia, (iii) Plantation Reform Project in Sri Lanka, and (iv) Second Tourism Development Project in Nepal. The Ports Project in India is aimed at reducing gas and oil leaks, reducing accidents, and improving efficiency with better port facilities. Total cost is about $180 million and it is estimated that about $122.2 million will invest on environmental improvements. It should be noted however, that ADB conservatively classified the project's environmental objectives as secondary. This is an example of a win-win situation for an infrastructure improvement project. Replacement of aged submarine pipelines and rehabilitation of three marine oil terminals can be considered as technology transfer.

The Segara Anakan Project in Indonesia ensures the conservation and protection of a large extent of wetlands. The Project's components are:

Table 7: Examples of ADB Projects with Environmental Improvement Components

Project	Objective
1. PRC: Beijing Environmental Improvement Project	*Reduction of air, water and hazardous waste pollution*
2. IND: Mumbai and Chennai Ports	*Improve capacity at three selected major ports through rehabilitation, modernization and augmentation of existing infrastructure*
3. INO: Segara Anakan Conservation and Development Project	*Assess the technical feasibility and economic viability of various engineering measures to conserve the Segara Anakan lagoon as an ecological entity and valuable economic resource while preserving existing upstream development*
4. PRC: Henan Power Project	*Use of coal resource to save oil; construction of a large and more efficient power plant, energy efficiency and conservation to support economic growth. This project does not have environmental objectives. However, it was able to compensate for almost all environmental emissions through innovative mitigation measures*
5. NEP: Second Tourism Development Project	*Environmental improvement and waste management. Road and other infrastructure improvement*
6. SRI: Plantation Reform Project	*Economic growth is primary objective with environment as secondary objective*

Component	Remarks
1. *Air quality improvement* 2. *Drinking water quality improvement* 3. *Toxic and hazardous waste management* 4. *Capacity building of environment agencies*	*Categorized as a project with primary objective of environment. Total investment is $157 million on loan.*
1. *Replacement of aged submarine pipelines and rehabilitation of the three marine oil terminals* 2. *Extension of the container terminal* 3. *Reconstruction of damaged and partly collapsed multipurpose quay*	*Project has environment as secondary objective and total of $122.2 million will be for an environment-friendly component. Total project cost is $180 million.*
1. *Initial dredging in selected locations of the lagoon to remove a portion of the mudflats* 2. *Conventional dredging to remove approximately 1 million m^3 of sediment annually from the lagoon for five years* 3. *Diversion of the Citanduy and Cikonde rivers* 4. *Development of aquaculture in the lagoon; and conservation management of mangrove areas* 5. *Provision of erosion control measures in the Segara Anakan upper watersheds*	*Primary objective of this project is environment with secondary objective of poverty reduction. Total cost is $45.6 million.*
1. *Construction of 2x (300-350) new power plant* 2. *Conversion of two small 6MW units in Yuzhou City to cogeneration and close ten industrial boilers* 3. *Replacement of power supplied by 16 inefficient generating units from three power stations (182 MW equivalent)* 4. *Development of afforestation program and greening public areas*	*Better technology will be used. Closures and the green area offset emissions due to the new plants. Environment is not an objective but damages to environment will be reduced. Cofinancing by the Bank through Bank loan is $200 million, while total loan is $900 million.*
1. *Development of Lake Phewa solid waste management urban sanitation, promotion of tourism* 2. *Road improvement (existing) of road drainage, planting trees, improvement of landscape* 3. *Capacity building in local communities, training ecotourism, etc.* 4. *Domestic airport improvement* 5. *Institutional strengthening*	*More than 50 percent of project cost will be investment on environmental improvement and primary objective will be environmental. Total cost is $23.9 million and environmental component is $11.29.*
1. *Credit facilities* 2. *Policy and institutional reform* 3. *Environmental improvement* • *Watershed reforestation* • *Soil conservation* • *Mini hydropower units* • *Pollution control*	*Project does not qualify for 20 percent of investments on environmental aspects. However, environment as a secondary objective was confirmed due to substantial environmental benefits.*

(i) initial dredging of certain parts of the lagoon to remove mudflats, (ii) conventional dredging of annual sediments for a five-year period, (iii) diversion of Citanduy and Cikonde rivers, (iv) development of aquaculture of the lagoon, (v) conservation management of mangrove area, and (vi) provision of erosion control of upper catchment area. Instead of traditional engineering, i.e., dredging of lagoon, the project includes a broad concept for lagoon management. It helps in the conservation of mangrove, management of aquaculture and conservation of soil in upstream areas.

Nepal's Tourism Project is another example of environmental enhancement as a primary objective. This project assists in the disposal of solid wastes, improvement of Lake Phewa environment, planting trees, and institutional strengthening and capacity building for ecotourism development in the country. More than 50 percent of the total project costs are invested on environmental improvement activities.

The Sri Lanka Plantation Reform Project also has environment improvement as a secondary objective. The total project cost was estimated at $80 million and ADB's contribution was $60 million. The Project's environmental improvement components are watershed rehabilitation and reforestation, implementation of improved soil conservation measures, establishment of mini hydroelectric plants to reduce the pressure on fuelwood, upgrading of pollution control measures, and environmental sanitation facilities for the workers including better housing facilities. Due to these investments, ADB classified the project's environmental objective as secondary.

Aside from the projects described in this section and those presented as case studies in this book, several recent Bank-funded projects have successfully integrated environmental components into project design. These include (i) the Command Area Development Project in Bangladesh which integrates an IPM component; (ii) the Second Industrial Energy Efficiency and Environmental Improvement in the People's Republic of China (PRC) which includes industrial restructuring for reduced pollution and energy conservation; and (iii) the Henan Power Project in the PRC which has afforestation and the closure of old and inefficient power plant components, details of which are found in the Box 9.

Box 9. PRC: Henan Power Project

The Project will:

- *Support economic growth;*
- *Construct a 600-700 MW power plant with a total cost of $936 million, $200 million of which is Bank-financed;*
- *Allow market forces to function;*
- *Improve energy efficiency; and*
- *Reduce adverse environmental impacts*

With- and without-Project scenarios were compared and the Project will result in the following:

- *Reduction in net SO_2*
- *Reduction in net NO_X*
- *Reduction in TSP*
- *Increase in CO_2, however, a 43,000 ha reforestation/afforestation component was introduced to offset part of the additional CO_2 emission*
- *Closure of 12 inefficient small boilers*
- *Conversion of 10 boiler units into cogeneration (182 MW total)*

In this Project, environmental valuation assisted in convincing the Government to include a 43,000-ha forest to offset environmental damages in addition to the closure and conversion of old and inefficient boiler units.

It is also evidenced by the experience in these projects as well as those discussed in the cases that the inclusion of the economic evaluation of environmental impacts served to improve the economic viability of the project as well as enhance sustainability. If adjustments are made to improve environmental quality and such adjustments are treated as an integral part of project design, environmental benefits can serve to improve the economic indicators such as EIRR and NPV. However, it is misguided to think that adding a few environment-friendly components on an *ad hoc* basis will make a "dirty" project look good. This underscores the value of carefully conducting environmental economic analysis in project work. In this regard, appropriate sector policies, carefully crafted project design, and creative conduct of project analysis have no substitutes.

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