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# **Strategic Options for Urban Infrastructure Management**

**William F. Fox**

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Division Chief  
Urban Development  
Division  
Sector Operations Policy  
The World Bank

Deputy Director  
Division for Global and  
Interregional Programmes  
United Nations  
Development Programme

Chief  
Technical  
Co-operation  
Division  
UNCHS (Habitat)

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## FOREWORD

This paper has been prepared for the urban infrastructure management component of the joint UNDP/UNCHS/World Bank-Urban Management Programme (UMP). The UMP represents a major approach by the United Nations family of organizations, together with external support agencies (ESAs), to strengthen the contribution that cities and towns in developing countries make towards economic growth, social development, and the alleviation of poverty. The program seeks to develop and promote appropriate policies and tools for five main components: municipal finance and administration, land management, infrastructure management, environmental management, and poverty alleviation. Through a capacity building component, the UMP plans to establish an effective partnership with national, regional, and global networks and ESAs in applied research, dissemination of information, and experiences of best practices and promising options. This paper is one in a series of discussion papers and management tools to be produced by the UMP urban infrastructure management component.

Phase 2 of the UMP (1992-96) is concerned with capacity building at both the country and regional levels and with facilitating national and municipal dialogues on policy and program options. It emphasizes a participatory structure that draws on the strengths of developing country experts and expedites the dissemination of that expertise at the local, national, regional, and global levels.

Through its regional offices in Africa, the Arab States, Asia and the Pacific, and Latin America and the Caribbean, the UMP seeks to strengthen urban management by harnessing the skills and strategies of regional experts, communities, and organizations in the private sector.

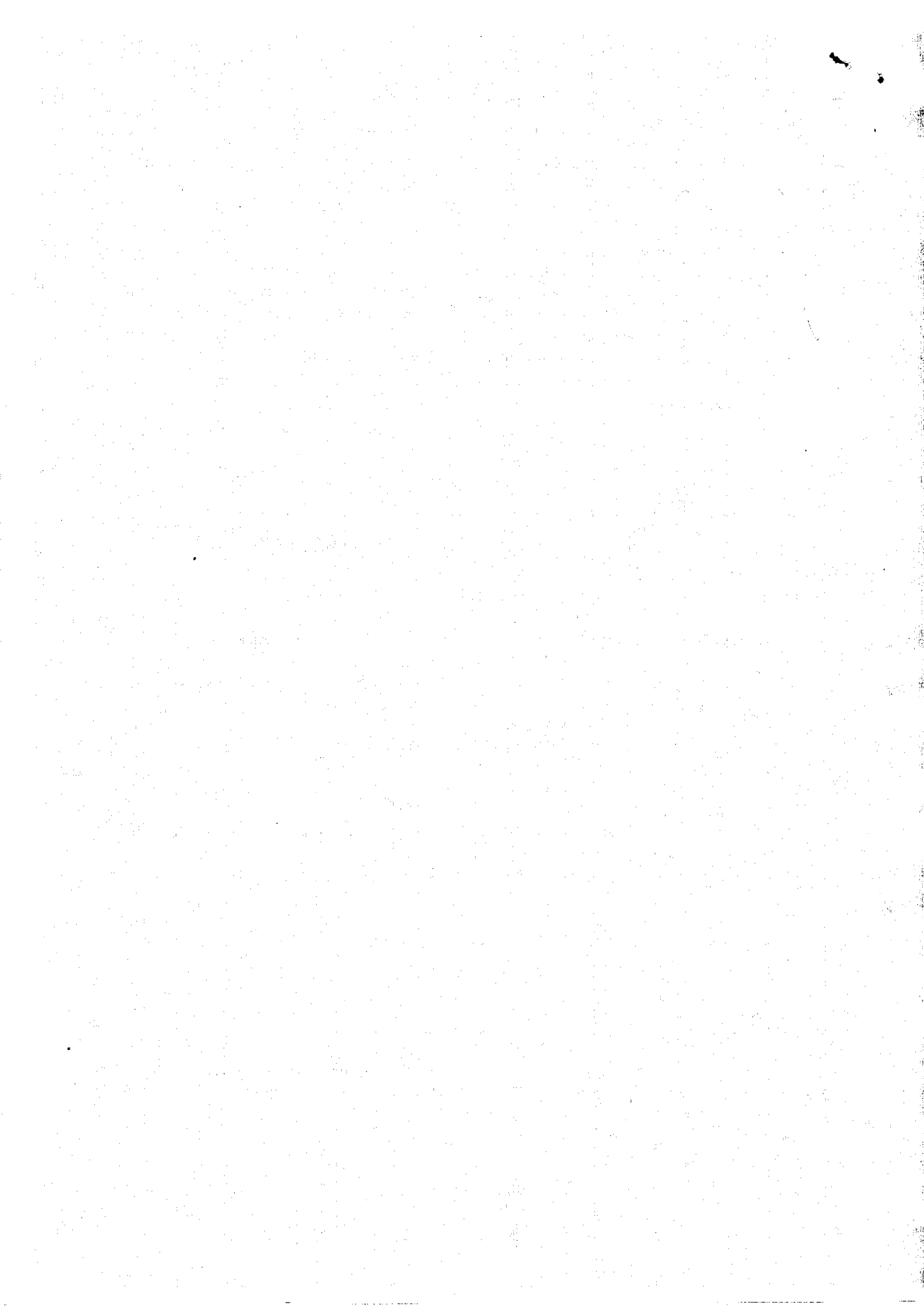
Regional coordinators use these networks to address the five program components in two ways:

- **City and country consultations.** The UMP brings together national and local authorities, private-sector networks, community representatives, and other actors to discuss specific problems within the UMP's subject areas and to propose reasoned solutions. Consultations are held at the request of a country or city, and often provide a forum for discussion of a cross-section of issues. These consultations generally result in a concrete action plan for policy and program change.
- **Technical cooperation.** To sustain follow-up to the consultations, the UMP uses its regional networks of expertise to provide technical advice and cooperation to implement action plans and to mobilize the resources needed for their implementation.

Through its nucleus team in Nairobi and Washington, D.C., the UMP supports its regional program and networks by synthesizing lessons learned, conducting state-of-the-art research, and supporting dissemination of program related materials.

Mark Hildebrand  
Chief  
Technical Cooperation Division  
United Nations Centre for  
Human Settlements (HABITAT)

Louis Y. Pouliquen  
Director  
Transportation, Water, and  
Urban Development Department



## ABSTRACT

Substantial investments in infrastructure have been made during the past decade by national, regional, and local governments, donors, private firms, and non-governmental organizations around the world. Differences exist across countries and services, but generally the universal delivery of infrastructure services continues to be plagued by problems that have existed for many years. The condition of infrastructure facilities is poor, the services provided are inferior, and the financing systems are inadequate.

The implications of poor service delivery can be felt throughout developing countries. Quality of life is diminished as consumers receive unreliable and poor services. Low income people often are most affected because they have the fewest acceptable options and are least likely to obtain alternative services. Business production costs rise substantially as firms contend with inadequate infrastructure services or install their own captive capacity. Small and newly starting firms, the source of many new jobs, will be the most disadvantaged, and their inability to succeed can substantially inhibit overall economic performance. Other consequences of poor service delivery include congestion, environmental degradation, and poor health conditions.

Experience of the past decade confirms that the solution to infrastructure problems is not merely to expand capacity by making new investments. Much more systematic changes must be undertaken if service delivery is to attain the standards necessary to improve quality of life and allow economic output to expand more rapidly. This paper identifies several broad areas for reform and recommends a series of actions to attain effective service delivery.

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## EXECUTIVE SUMMARY

Substantial investments in infrastructure have been made during the past decade by national, regional, and local governments, donors, private firms, and non-governmental organizations around the world. Differences exist across countries and services, but generally the universal delivery of infrastructure services continues to be plagued by problems that have existed for many years. The condition of infrastructure facilities is poor, the services provided are inferior, and the financing systems are inadequate.

The implications of poor service delivery can be felt throughout developing countries. Quality of life is diminished as consumers receive unreliable and poor services. Low income people often are most affected because they have the fewest acceptable options and are least likely to obtain alternative services. Business production costs rise substantially as firms contend with inadequate infrastructure services or install their own captive capacity. Small and newly starting firms, the source of many new jobs, will be the most disadvantaged, and their inability to succeed can substantially inhibit overall economic performance. Other consequences of poor service delivery include congestion, environmental degradation, and poor health conditions.

Experience of the past decade confirms that the solution to infrastructure problems is not merely to expand capacity by making new investments. Much more systematic changes must be undertaken if service delivery is to attain the standards necessary to improve quality of life and allow economic output to expand more rapidly. This paper identifies several broad areas for reform and recommends a series of actions to attain effective service delivery.

**The key to reformed infrastructure policy is delivering infrastructure services to meet users' demands.** Focusing on demand represents a radical departure from the traditional concentration on the supply of services with little attention paid to the user. Consumer dissatisfaction results from not having a demand orientation and leads to wasted investments, lost economic production, and low willingness to pay for services. A series of actions are integral to achieving a demand orientation, including:

- **Infrastructure must be provided by demand driven institutions.** Demand orientation means that all processes in organizations are responsive to consumers. The responsiveness must drive decisions such as what to deliver, what technologies to employ, and how prices should be set.
- **Service demands differ widely across cities, countries, and industries along the dimensions of accessibility, capacity, diversity, quality, time, condition, and price.** The traditional focus has been on capacity, but demands are increasingly shifting to other service dimensions. Delivery plans must be in place to meet demands that differ along each of these dimensions both within and across cities.
- **Infrastructure investments should be made in cases where a known demand for services exists.** Investments should seldom be made prospectively, in hopes that demand will develop.

- Demand should be managed through properly set prices.
- Services are best provided to low-income users by determining the specific services in demand and identifying cost effective means for meeting these demands.

**Better infrastructure is associated with better economic growth but infrastructure is best used to accommodate economic activity.** Infrastructure improvements are unlikely to stimulate more rapid growth, except for unusual circumstances where all elements of growth are in place except for adequate infrastructure. Still, appropriate infrastructure is imperative to a strong economy. Infrastructure investments will have the greatest effect on economic growth when a minimum complement of services is available, including transportation, water, electricity, telecommunications, and other services. Higher quality and more diverse services should be targeted to specific areas with more sophisticated users.

**Improved infrastructure must come from increased efficiency in the production of services.** The goal is to deliver services at the lowest possible life cycle costs for society. In the past, chosen technologies often have failed to offer the lowest cost and highest output, in part because the best long-run decisions have not always been made. Existing deficiencies may result either from some aspect of physical delivery (e.g., poor technology or inadequate operations and maintenance) or from the institutional structure (e.g., poor financing or inability to discern demand). In many cases overcoming these deficiencies offers the greatest potential for better services. For example, improved capacity can come from strengthened maintenance practices that reduce water and electricity losses. The life cycle costs of an under maintained system often are several times greater than those of a properly maintained system. Actions that can make delivery more efficient include:

- Service delivery technologies should be selected with the goal of meeting specific demands of users and facilitating maintenance. Other factors in the choice of technology include the existing technology and configuration of the urban network, costs, and service delivery conditions.
- A maintenance program that results in the maximum benefits from the infrastructure system, while delivering services at the least cost, must be developed. As noted, technologies and service delivery institutions must have the ability to undertake maintenance. Service delivery institutions must be given proper incentives to perform maintenance rather than rebuild systems. Resources must be set aside to finance adequate maintenance. Self help can be an important means of maintenance, particularly in low income areas, but will only occur if proper incentives are provided.
- An inventory of existing infrastructure services should be maintained for evaluating current service delivery and for planning purposes. The inventory also is important because the existing physical and organizational structure will heavily influence how expansions of urban services can be undertaken.
- Service delivery organizations must be held accountable. Examples include creating competitive pressures and making agencies responsive to users.

**Adequate service delivery cannot occur without a proper financing system and a satisfactory system will require that services are priced.** Properly set prices will generate sufficient resources to deliver services (in most cases), will ration consumption to the appropriate levels, and will serve as an indicator of demand. Elements of the financing system include:

- User fees should be set at marginal cost. In some cases, such as electricity, telephones, and water, connection fees should be imposed as well. Most services can be financed 100 percent with user fees, though some services such as urban mass transit and sewerage probably require some subsidy.
- Newly imposed user fees or significant increases in fees should be combined with service delivery improvements.
- User fees should be earmarked for service delivery.
- User fees must be enforced and all users required to pay.
- Equity should be integrated into the user fee system through special programs for those least able to pay. Lifeline rates and rising block pricing structures are examples of ways to assist the lowest income consumers.
- Private financing schemes such as concessions, and to a more limited extent BOTs, can be used to obtain private financing and benefits of privatization. However, in most cases, governments will be expected to continue to bear some of the risks of service delivery.

**Costs can be lowered and demands more effectively met by integrating competition into service delivery.** Private sector production and delivery through devolved governments appear to be the best means for interjecting competition. Some aspect of nearly every service can benefit from competition, though variation exists across services and cities. Increased use of competitive forces shifts the national government's role to an emphasis on regulation to ensure that producers deliver reliable services, quality output, and competitive prices. Some specific actions include:

- National governments must create an environment where competitive pressures can be brought to bear. Private sector production of services should be actively encouraged. Privatization can be most effective for telecommunications, electricity distribution, solid waste collection, and urban transportation. Free entry and exit of firms into other infrastructure markets also should be encouraged. In cases where complete privatization is inappropriate, creativity is necessary to stimulate private participation. Means for involving the private sector include allowing components of the infrastructure system to be privatized (such as road maintenance) and allowing firms to share infrastructure facilities (such as telephone lines).
- Devolution of services to local governments should also be pursued, though the benefits of decentralized government have sometimes been limited. Local governments must have the authority to make service delivery decisions,

including the ability to hire and fire workers, to invest, and to set prices. Local governments must be able to retain revenues to finance delivery. They also need access to loanable funds and to the necessary technical skills.

- Regulatory agencies must be enhanced in developing countries in order to maintain quality and reliability, prevent payoffs and collusion, and control prices. Skilled staffs with sufficient regulatory authority must be developed. Regulations that inhibit effective business practices should be discarded. Where possible, regulations that limit competitive pressures, such as those preventing competition with public service providers, should be eliminated.
- The choice of whether to use public or private sector producers should be made after consideration of the effects on quality and reliability of services, potential for corruption, and an analysis of costs that include contracting, regulating, and monitoring private firms.

**The consequences of infrastructure delivery must be fully considered, though care must be taken not to allow alternative goals to prevent efficient service delivery.** Environmental standards can be achieved as services are delivered more effectively. For example, better maintenance that lowers electricity losses and prices that reduce consumption will limit negative environmental impacts. Careful planning can mitigate some other costs of urbanization as well. For example, prices can also be set to lower the extent of congestion and other adverse effects in cities. To a limited extent, infrastructure policy can influence the geographic location of firms in cities because firms are likely to locate near infrastructure.

Infrastructure services can be a very effective means of increasing incomes for low income households. Better transportation services that reduce commuting costs and time, and more accessible water that reduces collection time, can allow households the opportunity to devote more time to income-earning activities. Improved drainage can allow households to engage in entrepreneurial activities. These same services, and others can be essential to maintaining an acceptable quality of life as well. Focusing service delivery on meeting these specific demands of low income residents and small businesses leads to greater user satisfaction. Lower delivery costs may also result because these services can be less expensive than extending the trunk lines of more traditional services to squatter and other low income neighborhoods.

## I. INTRODUCTION

Expenditures to expand, improve, and operate infrastructure are a significant use of the domestic, foreign, and donor resources available in most developing countries. Investment in infrastructure can absorb 10 percent of a country's gross domestic product (GDP) and the other infrastructure life cycle costs including operations, maintenance, and rehabilitation can substantially increase total expenditures. These infrastructure investments are intended to achieve many benefits. A frequent expectation is that better infrastructure will stimulate the economy. Local residents anticipate a better quality of life from infrastructure services. In addition, there may be hopes for civic benefits, such as pride in the community, or political gains, such as a politician's ability to cut a ribbon for a new facility.

### 1.1. Purpose of Paper

Substantial infrastructure spending occurs across the world, often with significant uncertainty about such basic issues as which investments to make, how to efficiently operate the systems, and what is the best approach for financing both the initial investment and the recurrent costs. The purpose of this paper is to provide a comprehensive review of the essential issues that policymakers must examine and the questions they must answer when deciding what infrastructure investments to make in urban areas, where to make them, how to finance them, and how to sustain the services.

Spending levels for infrastructure were often higher in the 1970s than in the 1980s. A review of 53 countries found that three-fifths of the countries raised their spending in real terms during the 1980s, with expenditures only tending to be lower for ports, railroads, and pipelines. Though there were substantial differences across countries, the review of infrastructure status concluded that conditions remain poor, performance standards low, and financing weak (Israel, 1992). An obvious inference is that additional funding for infrastructure is at best only part of the solution to achieving sustainable service delivery in the developing world. A much broader set of solutions that involve using resources more effectively must be identified if infrastructure improvements are to occur.

Nonetheless, differences between basic infrastructure categories, such as roads versus water systems, preclude a set of specific rules that apply to all services. Divergent demands for services and uneven infrastructure conditions across developing countries make it even more difficult to provide definitive answers for each country. Therefore, the specific concerns of each country cannot be addressed in a single paper. Instead the goals of this paper are to develop a framework within which the major infrastructure issues can be examined and to provide some general guidelines that can assist in decisionmaking. Fortunately, substantial similarities in the topics that must be considered exist across infrastructure categories, as well as regions and countries.

### 1.2. Audience

Infrastructure delivery involves numerous individuals, from policymakers to consumers to donors. The main audience for this report is policymakers in developing countries. These

individuals will work in a wide range of agencies, from finance to operations. Major users may be Ministers of Finance, Public Works, Local Government and Planning, and their senior staffs. Regional and local officials, including mayors, regional directors, and their senior staffs, is also an intended audience. The paper may also be useful to project officers for donor organizations and planners for nongovernmental organizations.

### 1.3. Approach

The approach followed in the paper is to begin most sections by stating an objective for the national- or local-level policymaker or system operator. The objective identifies the function that the policymaker or operator must carry out in undertaking infrastructure policy or the question he or she must answer in setting infrastructure policy. A series of actions follows each objective. The actions provide concrete conclusions about what is currently known about this topic or give guidance on how to proceed. All actions have implications for policymakers at some level of the process; many have implications for system operators as well. **Those actions that are most oriented to policy are highlighted with a P and those most oriented to the operational level begin with an O.** Several have both letters. The actions must be necessarily broad because they apply to a range of infrastructure types and countries. Each section discusses issues related to accomplishing the objective and explaining the action. The sections illustrate that decisions are often complex and that specific actions may not apply in all circumstances. The text also clarifies the points and gives examples.

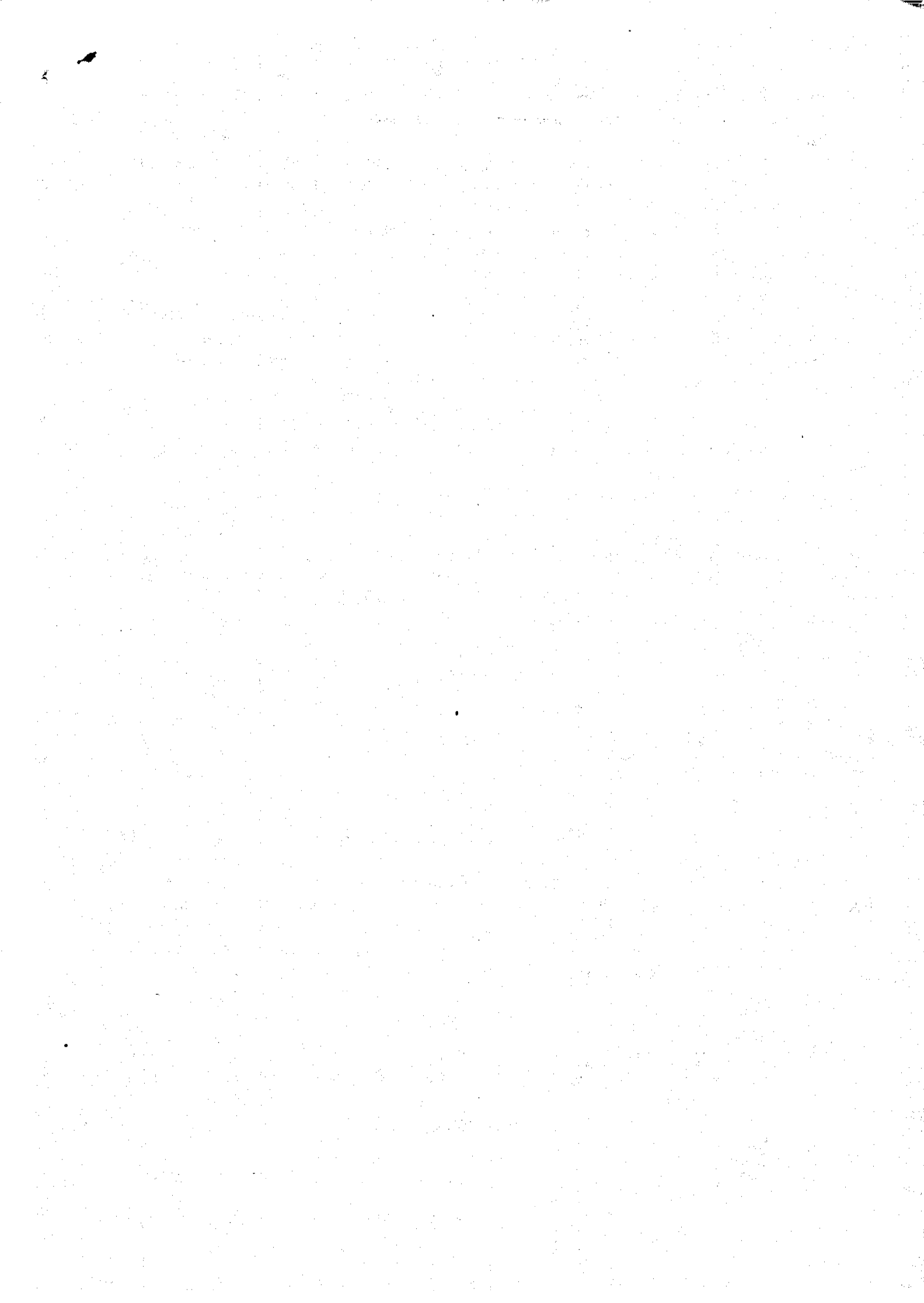
### 1.4. Paper Structure

Appropriate decisions must be made in three interrelated areas when designing sustainable systems. These major decision areas are:

- What infrastructure is demanded and how will it be produced?
- How will the infrastructure investments and life-cycle costs be financed?
- What institutions will be used to deliver services?

The paper is organized to help the policymaker address these three decision areas. The first section examines decisions on what infrastructure is demanded and where, to help determine the infrastructure services to provide. The goal is to select the right set of infrastructure services to produce. Policymakers must understand how infrastructure will be used, who will use it, and what infrastructure is currently in place if they are to make good decisions. The section also examines how the infrastructure will be produced. The goal is to deliver infrastructure services in the most cost-effective manner. Appropriate decisions must be made on service delivery technology and maintenance if the systems are to be sustainable.

The next section examines issues of how infrastructure investments and operations and maintenance costs will be financed. Choices for financing investments include domestic resources raised from taxes, user fees, other current government sources, domestic borrowing, private equity funding, and grants and loans from donors. Operations and maintenance must be financed from a subset of financing alternatives, which includes current government sources or user fees. Self help can be a very important means of finance as well.



The proper means of financing an infrastructure project is a separate issue from the project's economic merits. Although economic criteria may lead to the conclusion that a project should be chosen, the project could be difficult to finance if its benefits have many characteristics of a public good. Similarly, a project could be financially viable, as when the political power exists to obtain public sector financing, although economic criteria indicate it is undesirable. Despite this bifurcation in practice and in this report, we must recognize that a poor national or municipal finance system can lead to inadequate infrastructure investments from an economic perspective. Desirable services may remain unprovided because sufficient financial resources cannot be obtained, so a strong financing system is an essential element to making good infrastructure decisions.

Alternative institutional structures have received considerable attention recently because of their potential to offer the benefits of competition in the delivery of infrastructure. The third section examines the choices of the institutional framework within which infrastructure is provided. Privatization and decentralization of government are two options examined.

A final section of the report examines related issues, including the environmental and distributional consequences of infrastructure delivery. These topics are a vital concern for infrastructure policy and often explain why infrastructure is delivered.

### 1.5. Defining Infrastructure

Before proceeding, infrastructure must be defined. Public infrastructure is defined here as those services derived from the set of public works traditionally supported by the public sector to enhance private sector production and to allow for household consumption. Defined in this manner, infrastructure includes services such as roads, mass transportation, water systems, sewer systems, solid waste management, drainage and flood protection, electric installations, and telecommunications.

This definition deserves careful attention. First, the definition focuses both on infrastructure's role in production and in consumption. Delivering infrastructure services has been the motivation for many, and perhaps most, infrastructure projects. The role of infrastructure for residential consumption, particularly in low-income areas, is integral to the benefits. Infrastructure is also essential as the basis for production.

Second, infrastructure can be evaluated or defined in two dimensions. One is in terms of the services drawn from the physical facilities. The other is the physical facility itself. A tendency exists to focus on the facility because of the capital intensive production techniques of infrastructure.<sup>1</sup> Also, political leaders may emphasize the physical plant for political gain. Nonetheless, the definition employed here centers on the services, since infrastructure consumers are primarily interested in the services derived from the physical facility. Thus, decisionmaking about what to provide requires emphasis on the demand for services, not on the physical hardware and other inputs.

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1. Of course, the services may be produced with many different technologies, some of which are capital intensive and some of which are not.



Generally, consumers (including those using infrastructure services for production) are concerned with the facility only when they must access the facility to receive the service benefits.<sup>2</sup> Because most services derived from public infrastructure are brought to the user for consumption, the facility is usually not directly regarded as a component of the service. Water and sewerage are examples in which consumers receive the service with no necessary direct contact with the physical facility. In contrast, highways are an example in which the physical infrastructure is an important aspect of consumption. Road conditions influence both the comfort and cost of highway transportation.

There are two major advantages to focusing on services rather than capital. One is that policymakers are more likely to think flexibly about the best technology for producing the service. For example, policymakers may conclude that encouraging public group transportation, such as Jeepneys in the Philippines and matatu buses in Kenya, is a better solution to transportation needs than building more roads. Also, policymakers are more likely to focus on providing the specific services people demand instead of centering on engineering designs. However, operations and maintenance of facilities are the primary mechanisms for service delivery, so although concern about facilities should not be the primary force in determining what services are provided, the facility must be carefully considered.

The third characteristic is that this definition of public infrastructure excludes some items that could be regarded as part of the total infrastructure of a country, including investments in social or human capital and investments by business firms in their productive capital. These other important concerns are not addressed here.

#### **Box 1.1. Private provision of matatu buses in Nairobi**

Matatus are efficient, private-sector providers of bus service in Nairobi. Investors normally need to be of medium size to finance the capital costs, but many matatus are independently owned. The major consumers are wage earners in the formal sector; many informal sector workers continue to walk to work. Until 1984 matatus operated through an informal system, although with presidential permission. The system was self-regulating but dangerous. In an effort to improve safety, the system was formalized by the Traffic Act of 1984. The Act required matatus to have proper insurance, to be registered as public service vehicles, and to have annual inspections. Service quality has improved, and prices remain modest. Safety is still somewhat of a concern because drivers, who work 10 hours a day, seven days a week, are still regarded as reckless (Lee-Smith and Syagga, 1990).

Finally, not all public infrastructure is provided or produced by the public sector. The relative roles played by the public and private sectors vary widely by infrastructure type as well as across and within countries. Often the public and private sectors produce services jointly. Their roles can be clarified by separating the necessary functions into financing, construction, ownership, operation, and control over service delivery. At one extreme are major roads: the public sector often finances, owns, operates, and controls them, while the private sector constructs them (and in many countries the public sector may even undertake construction) and provides many of the vehicles. In

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2. An exception is when the facility fails, such as when a water line breaks. Failure often brings people in contact with a physical facility they otherwise take for granted.

selected cases the private sector plays a larger role, such as when it builds and finances roads in new housing developments.

Intracity transportation offers an example at the other extreme. The matatu system of buses in Nairobi operates almost entirely through the private sector (see Box 1.1). The private sector finances, builds, owns, and operates the buses, and the public sector only exercises limited control through minimal regulation of vehicle quality and by providing roads. Public control and partial financing combined with private ownership, operation, and construction are present (or can be present) in many cases of infrastructure privatization.

## II. SETTING INFRASTRUCTURE DELIVERY POLICY

Infrastructure policy decisions involve four sets of actors. The first are **policymakers**, who create the basic environment in which decisions are made and in many cases establish policies to determine overall spending, what types of agencies deliver services, and so forth. Second, **infrastructure managers** determine policy within service delivery organizations and make major decisions in areas such as technology. Third, **operational staff** are responsible for undertaking a daily provision of services. Finally, **users** are the major client for infrastructure services. Each set of actors is an integral component of good decisions and must be confronted with appropriate incentives in order to make the correct decisions. Although this paper is focused at the policy level, important roles for each set of actors are included in the recommended "Actions".

Large differences in infrastructure investments exist across countries. According to World Bank data, Nigeria invests about 7.9 percent of GDP in infrastructure, Malawi about 5.1 percent, Pakistan 3.8 percent, and Indonesia about 1.7 percent. A number of African countries are said to spend as much as 10 percent of GDP for water and sanitation alone. In most cases, investments occupy a greater share of economic activity at the municipal level than at the national level because infrastructure services are more important in cities.

A major concern for many government policymakers is determining the optimal share of infrastructure investments in the national economy or the government budget. However, infrastructure decisions are best approached from a bottom-up, micro level, rather than a top-down, macro perspective. There is no single share of the national budget that should be devoted to infrastructure investment. Instead there are individual projects, some of which yield an acceptable return and some of which do not. Deciding on the infrastructure budget actually involves choosing a set of individual projects from the range of options that cover all infrastructure types and projects in every area of the country. These multisectoral decisions are complex both because of information requirements and because responsibility may be spread across several ministries and several levels of government. Each project must be evaluated on its own merits and should be selected only if it provides an adequate return on investment. A detailed description of the techniques available for analyzing investment allocations is available in Habitat (1989).

Nonetheless, a project approach is inadequate by itself because of the interrelationships between infrastructure and the potential for uncoordinated development. Some type of general guideline or plan must be the basis for development of the overall infrastructure system. The plan should not be a detailed, rigid structure, but instead a framework that provides general guidance.

This section focuses on decisions related to individual projects. There are five issues in making delivery decisions on infrastructure projects. The first four address what types of services should be delivered and where they should be provided. The fifth analyzes how the services are to be produced and made available. Correct decisions using all this information are necessary for planning sustainable infrastructure projects. This part of the report is divided into sections on each of these issues:

- Goals for the Infrastructure—A Focus on Demand.
- Linkage Between Infrastructure and Economic Activity.

- Current Infrastructure Levels.
- Required Rate of Return on New Projects.
- Operational Characteristics of Infrastructure.

The issues discussed in this section are all part of the management process for urban infrastructure systems. That process is composed of monitoring and evaluation; options, policies, and development strategies; planning; programming; implementation; and operations and maintenance. This useful paradigm is not the focus here because the intent is to encourage policymakers to conceptualize the infrastructure delivery process with a new focus—a focus on demand.

## 2.1. Goals for the Infrastructure—A Focus on Demand

### *Objective 2.1: To design infrastructure delivery systems with a focus on the user.*

Perspectives differ on why infrastructure investments are important, and motivation can be an important determinant of where investments should be made. Nonetheless, the broad, nonpolitical goals of investments can generally be placed in two groups. One centers on infrastructure's role on the supply side and the other on the demand side. These goals are not completely separable because investments made to achieve one also are available for the other. First, investments may be intended to stimulate the economy. This objective is focused on how infrastructure influences the economy through the supply side. Better water, sewer, roads, and other services are expected to expand overall economic potential by allowing firms to be more productive. Infrastructure development in new Egyptian cities is an example of a supply-side orientation to developing infrastructure. The expectation was that productive activity would be located in the cities because a basic infrastructure was in place. In some cases the pump might be primed by moving public sector firms to the cities. Economic research shows evidence of the importance of infrastructure to the economy but suggests speculative investments made in hopes of stimulating growth in production are unlikely to be wise uses of a nation's scarce resources. The next section, on the linkage between economic activity and infrastructure, will consider the stimulative effect of infrastructure in more detail.

The second goal is to meet a demand for services. Demand arises from businesses in production, households, and government. Meeting a demand for services should be the primary objective of most infrastructure projects and the primary determinant of why projects are chosen. Willingness to pay for services will be much greater and resources will be used in ways that lead to increased satisfaction if infrastructure is built where there is sufficient demand for the services. Also, full use of infrastructure capacity is more likely if infrastructure is built where demand exists. Of course, demand must be measured so that sufficient capacity is installed to allow for reasonable growth in demand.

A demand oriented infrastructure investment requires a transformation of the institution. Demand orientation means that all processes in the organization respond to the consumer. The responsiveness must drive decisions on what services to deliver, what technology to employ, how the pricing system operates, and all other processes in the infrastructure delivery.

Producers in developing countries can only compete in a global economy if infrastructure services meet producers' requirements. Infrastructure planners and managers have traditionally focused on the supply of services because the delivery agencies have often operated as monopolists and because services were in such short supply that access was the primary consideration. In this environment, it is not surprising that infrastructure services have changed only slowly as demands have evolved. Thus, a demand focus is a reorientation of service delivery approaches.

**Action 1 [P]: Infrastructure should be provided by demand-driven institutions. A demand-oriented service provider will see that all processes in the organization are responsive to consumers. A complete reorientation of organizations is necessary to operate in this fashion. Infrastructure investments normally should be made only in those cases where a recognizable demand for the services exists. Speculative investments made with the hope of stimulating development only should be undertaken in rare circumstances.**

### 2.1.1. Articulating demand

**Objective 2.1.1: To measure the full demand for infrastructure services using the three ways that demand can be articulated.**

Several different groups demand infrastructure services, including businesses in their production processes, government in its everyday activities, and people for consumption. Services may be demanded to meet very basic life support needs, such as improved water, or they may be demanded to offset negative consequences of crowding, such as with solid waste disposal and subway systems. Furthermore, services may be needed to run machines or to improve quality of life, as with electricity.

Demand for services arises in at least three different ways, with the relative importance of each varying by service. The three ways are given in Table 2.1, along with a possible listing of the predominant source of demand for each service. First, demand can be voiced when users are both willing and able to purchase services—both willingness and ability must be present, or potential users are merely expressing a desire. Services that people are both willing and able to purchase represent a traditional, objective economic demand that parallels the demand for any private good or service. Unfortunately, the demand for infrastructure services is often present in developing countries when such needs are unable to find expression through an operating market.

The next two ways to articulate demand are essential elements in determining appropriate levels of service delivery. Demand can be for services that offer benefits to the community; but individuals acting independently are unlikely to choose adequate amounts of such services. The key characteristic of these services is that many of the benefits of consumption accrue to someone other than the direct user. The effects on others are termed externalities. Solid waste disposal and sewer treatment can have considerable value, but unless people are very altruistic, they will purchase an insufficient quantity of the services unless required to do so.<sup>1</sup> The community, normally operating through the government, must decide how much service—in addition to that demanded by people acting privately (the first method of demand articulation)—is necessary.<sup>2</sup> The additional willingness and ability to pay is articulated through the governmental decisionmaking process. This second form of demand has been the justification for much service delivery, but it only finds its expression through

1. Some personal sanitation services may be purchased or provided but demand is likely to be lower than what is consistent with economic efficiency. People pay for services they receive personally but may see little improvement in environmental conditions unless others also are provided with sanitation services.

2. As discussed in the financing section, consumers can be charged for the private portion of the benefits.

the government or a community association. The government's goal is to use the information available to it on consumer benefits from services such as sewerage to provide the economically efficient, or optimal, quantity of services. Efficiency occurs when service levels are expanded until the sum of all benefits or demands (both direct and indirect) from an additional unit of service just equals the cost of providing the additional services.

Third, demand may emanate from a decision to provide services to people regardless of their willingness or ability to pay. Policymakers may feel that access to services such as potable water is essential for maintaining a minimal standard of living and should be provided independent of ability to pay. Demand in this case is based on an intent by policymakers to achieve equity, and the demand must be articulated through the policymakers' views of the country's equity goals. The term "merit good" often is used by economists to describe services deemed so meritorious that all should receive them regardless of ability to pay. Question marks are placed after each service in Table 2.1 to show that policymakers may have different perspectives on what is a merit good, so no preconceptions can be made about which services fit this category. Demand for merit goods is expressed through the government, but in this case equity rather than the economic efficiency explains the government's role in articulating demand when externalities are present. Equity can only justify a limited portion of service delivery because cost recovery is an essential aspect of sustainable infrastructure service delivery. The need for cost recovery is discussed in detail in the financing section.

Table 2.1. Identifying demand for infrastructure services

	Articulated as private good	Articulated because of externalities	Articulated as merit good
Water	X		?
Wastewater		X	?
Roads		X	?
Solid waste	X		?
Drainage		X	?
Electricity	X		?
Telephone	X		?
Buses	X		?
Subways		X	?

See page 19 for further information.

**Action 2 [P]: The decisionmaker must measure demand by examining the three ways in which it is articulated: through a willingness and ability to pay, through the governmental process to ensure that an economically efficient quantity is produced, through the governmental process to ensure that people have a minimum standard of living, or some combination of these three. For most services, a primary source of demand must be a private willingness and ability to pay, because of the importance of private cost recovery.**

### 2.1.2 Defining demand

**Objective 2.1.2: To understand the specific services that consumers want.**

A tendency may exist to identify demand in the context of an existing infrastructure system or a traditional preconceived notion of infrastructure delivery systems. Policymakers with a demand orientation will discard prior notions of how services are delivered and begin with an understanding of what users want. This requires policymakers to consider entirely new service needs and means of service delivery.

Failure to meet demand results in discontented users. Consumer dissatisfaction leads to low willingness to pay, underused services, and other problems. The specific characteristics that are demanded will define both the service to be delivered and the way it is produced. For example, if residents on the urban fringe say they want improved water, the public response may be to install a series of public faucets. However, public faucets may offer little improvement over traditional water sources or vended water if both forms of water delivery are equally accessible. Research has shown that people place little value on improved accessibility when the difference in distance that water is carried is relatively short. As a result, public faucets may be underused and the investment substantially lost.

Alternatively, as has happened in many Filipino villages, people illegally tap in to public faucets for household connections because the service they are demanding is water in their house. Consumers with household connections use considerably more water than the amount they would gather from public faucets. The result is water systems that are unable to meet demand, causing users to become unhappy and unwilling to pay. Ultimately the improved water system can fail if demands are not met. A better understanding of demand would have revealed the service that users were actually seeking and increased system sustainability (see Box 2.2).

Another example is an expressed demand for better public transportation. Without a clear understanding of demand, the response may be to build more roads. However, the demand may be for public transport; therefore roads will be of little value to people without vehicles.

**Box 2.1. Water supply in Anambra State, Nigeria**

Hundreds of boreholes have been drilled in Anambra State during the past two decades to meet the water needs of rural residents during the dry season. Most of these boreholes are inoperative today. A significant problem is that the boreholes were drilled without careful consideration of local water demands. Residents are able to acquire sufficient water from traditional sources during the rainy season and only feel the need for improved water during the dry season. However, residents prefer to purchase water from private vendors over supporting a public water system with monthly payments, despite the greater costs of vendor water. Vendor-provided water has advantages because it can be bought only when needed and the purchases can be timed more carefully to when cash is available. Monthly payments to a water system must be made in the rainy season when cash is short and when water is available from traditional sources. Thus, the water system is inconsistent with local demands. Furthermore, residents do not trust the ability of the government to provide consistent water services. Evidence of past government failures to deliver water verifies these concerns. With care, effective institutions may be designed to deliver improved water services in ways that meet specific local needs (see Whittington, O'Korafor, Akore, and McPhail, 1990).

Inconsistency between the services demanded and those delivered may be most acute for low-income people. Although water connections, public buses, roads, and sewerage may be supplied, low-income residents may be most interested in services delivered through less structured systems. For example, they may want alternative sanitation services and kerosene for lighting. A service as basic as sidewalks for walking to work would significantly improve transportation in Nairobi. The potential for delivering the wrong service further emphasizes the need to focus on delivering infrastructure services rather than on constructing physical facilities.

Once policymakers understand the services actually in demand, they can choose the best way to deliver them. In some cases the specific service sought by users, as with the low-income residents in the previous paragraph, may be met without large capital investments. For example, a warning sign at each end of a narrow bridge may be an acceptable alternative in low-volume areas to the costly option of widening the bridge.

Demand exists for six different aspects of infrastructure services: accessibility, capacity, diversity, quality, condition, and time. Accessibility refers to the location of services relative to the population. For example, standpost water has less accessibility than household connections. Access depends on a number of factors besides geographic location, including behavior patterns and users' customs. Capacity refers to the maximum level of service that can be delivered. At the infrastructure system level, capacity may be the number of vehicles that a road can handle in an hour or the maximum electric load. These are important to the user to the extent that they constrain ability to obtain services. It may be most useful to compare service capacity at different locations using a scaled measure such as per capita or per household. Diversity indicates the range of services offered. For example, intracity subway and bus transportation are different forms of urban mass transit and may serve different groups. Quality includes reliability and other service attributes. Quality has two dimensions: the specific characteristics of infrastructure output (such as biological traits of water when it leaves the treatment plant) and reliability of the system (such as the frequency of distribution breakdown). Time is a dimension of each other demand attribute. For example, water flow capacity is given per unit of time and accessibility refers to the time required to collect a certain amount of water. Finally, condition is the only concept that deals directly with infrastructure's physical shape. Generally, condition is only important when it influences one of the other aspects of demand, such as quality. For example, a blackout caused by the poor condition of the electric facility only indirectly causes the user to want better conditions. On the other hand, consumers are often concerned with the condition of transportation modes because they directly access the physical facility.<sup>3</sup> The user is very concerned about potholes in the road and deficient bridges, for example.

The six dimensions of demand cannot be separated from price considerations. More of each dimension would be sought at the same price, but greater costs result from expanding any service while holding others constant.<sup>4</sup> The higher costs should be reflected in a higher price (or higher expenditures for more service consumed). Users will be more careful in demanding service expansions when they must pay a higher price for them. Thus, price adds a seventh dimension to the overall description of services.

***Action 3 [P]: Demand must be measured along seven dimensions including accessibility, capacity, diversity, quality, time, condition, and price. The importance of each dimension will vary dramatically across infrastructure types, cities, and users within a city.***

Access to infrastructure has grown dramatically in recent years. Eighty-two percent of urban populations in developing countries had access to water in 1990, 74 percent to electricity (up from 70 percent in 1980), and 72 percent to sanitation (Israel, 1992). Providing sufficient capacity or improving accessibility have been the focal points of infrastructure policy.

3. Alternatively, the physical characteristics of a road can be viewed as one aspect of quality.

4. This assumes that infrastructure was designed appropriately and is operating efficiently.



In measuring demand the questions have historically tended to be:

- Should people in a given community have access to services?
- Do people in that community have a minimally sufficient service capacity?

Improvement in accessibility continues to be demanded in some urban neighborhoods and in many rural places. In Africa and the Middle East, more than 25 percent of urban populations are estimated to have no access to safe drinking water, according to World Bank data. Less than 60 percent of urban populations have access to adequate sanitation, and less than half of solid waste materials are collected. Thus, better access will remain an important issue in urban demands. However, future demands in export-oriented economies and already-served areas are likely to focus beyond merely providing services to people and businesses (see Box 2.3). In many cases the largest unmet demand is for other dimensions of services, specifically diversity, capacity, and quality. Israel (1992) reports a 13-country study of telephone availability that finds 0.5 telephone lines per 100 residents in India and 18 per 100 in Portugal, versus 40–60 lines per 100 in developed countries. Yet he concludes that telecommunications is of growing importance. Future questions of infrastructure will shift because good service delivery requires attention to all dimensions of demand. Other important issues may be:

- How often do brownouts occur and how long do they last?
- How satisfied are users with the taste and appearance of water?
- What are the repair costs for private vehicles damaged by roughness of the road and how much time is lost because of poor driving conditions?

**Box 2.2. Infrastructure quality in Indonesia**

The quality of most infrastructure is below desired norms in Indonesia. Electric transmission and distribution are examples of poor quality. According to World Bank data, losses equal 18 percent of power production, well above the normal 14 to 15 percent. Furthermore, 44 percent of power is provided to captive users, indicating strong concerns about brownouts. Only 38 percent of local telephone calls and 20 percent of international direct-dial calls are successful because of network congestion caused by a shortage of equipment. Success rates for local telephone calls should be nearly twice what they are. Unaccounted-for water is 43 percent piped water, and irrigation efficiency is 25 percent, about half of desired efficiency.

Of course, identifying and meeting demands for these other service dimensions can be challenging. But measuring demand along each service dimension is essential, because consumers have many different ideas about improved service delivery. Meeting demands for improved capacity or accessibility can be difficult once a system is in place because the capacity (size of sewage pipes, for example) and accessibility (location, for example) may have been determined when the facility was constructed. Fortunately, certain aspects of quality, diversity, and condition can often be easily enhanced. Also, technological developments have often allowed new services to meet demands, such as with telecommunications.

**Action 4 (O): Future decisions on infrastructure delivery must integrate user demands for diversity, capacity, and quality into system design as early as possible. Demand will differ across cities and within cities so individual decisions on service characteristics must be made for very localized areas whenever possible. All decisions on the demand for infrastructure services must be evaluated in terms of delivery costs and prices.**

Israel emphasized the growing importance of reliable service delivery, where reliability is a major aspect of quality.<sup>5</sup> The costs to the economy from unreliable systems can be staggering. Unreliable systems mean lost time for businesses, as they are unable to operate during brownouts, and in lost equipment, as motors burn out because of power spikes. They mean inconvenience to households when water is unavailable and increased pollution as sewer systems fail to operate. They mean lost investments for the infrastructure provider as services cannot be sold. Israel emphasized that reliability is more important in export-oriented economies such as Chile, Korea, and Malaysia, than in subSaharan Africa. Reliability is also more important in service economies than in agriculture-based economies. He concluded that reliability should be built into service delivery now, so that infrastructure systems would not be a constraint on future growth. Israel also observed that building reliable systems does not mean that the entire operating organization must operate perfectly. The key is to focus on improving systems in which the greatest shortcomings exist, whether this be in the financial, managerial, or technical component of the system or in a subcomponent of one of these.

### 2.1.3. Measuring demand and project benefits

**Objective 2.1.3: To measure the extent of demand for each infrastructure type at each location.**

Measuring demand and determining benefits for the improvement of any specific service delivery are not identical. Project benefits arise in several ways, and analysis of demand is an important ingredient of measuring benefits. One potential benefit is cost savings on services already consumed. Lower expenditures because piped water is cheaper than vended water or time savings because public transportation is used in place of walking, are examples of cost savings. Benefits also result from the greater consumption that occurs as the price falls or as accessibility is enhanced. For example, water consumption may rise from as low as 10–20 liters per person using traditional water services to 150–200 liters per person with household connections. The consumption of additional water normally has benefits greater than what consumers pay for the water.<sup>6</sup> Benefits also accrue from improvements in other dimensions of service delivery. However, in some cases, infrastructure projects may not increase quality relative to services currently provided through the private sector.

No national consensus is likely to exist on the demand for infrastructure, so there is no single national solution to the problem of how much service to deliver. Many of the benefits from infrastructure services are localized and the value placed on benefits will depend on characteristics of the local population. Therefore, demand must be measured at each location to determine which services should be delivered.

5. Quality also includes aspects of the service output.

6. These benefits, termed consumer surplus, occur because demand curves are downsloping.

Considerable differences in the demand for each aspect of infrastructure service may also exist across regions and among individuals within an area. Demand is likely to depend on local tastes and culture, population demographics, climate and topography, and economic structure. For example, demand for improved water services in Philippine villages (as measured by willingness to pay) is higher where existing water sources are of poor quality or are distant from dwellings, as well as where incomes are high. Also, higher-income villagers appear to have much greater demand for household connections relative to standpost water than do lower-income residents.

To make proper decisions, the public decisionmaker needs to identify the source of demand, the level of services demanded, and the service characteristics in demand. Measurement of both present and future demand is necessary because demand rises with economic activity. Allowance must also be made for growth in demand after users have had sufficient time to see how they can use infrastructure services. In measuring demand, all beneficiaries of infrastructure services must be considered, regardless of where they live. The consumption or availability of some services in one region influences well-being in other regions. For example, national highway systems benefit residents across a country. Failure to treat sewage in one region reduces downstream water quality and requires greater treatment before water can be consumed. An acceptable airport in one area allows residents of all regions to travel more easily in and out of that area. The closer regions are, the greater are these cross regional effects.

The categorization in Table 2.1 can assist in measuring demand. The first group includes purely *private* goods, which are those for which the recipient is essentially the only beneficiary of its consumption—for example, electricity and water. Some services, articulated through a public process, fall between public (see Box 2.4) and private goods, having substantial benefits for the direct recipient but also for many others. These effects on others are often termed positive externalities if they provide benefits, and negative externalities if they impose costs. Subways and solid waste disposal are examples of services with positive externalities. The final category in Table 2.1 is demand articulated as a merit good. The actual service level for merit goods must be determined through a public process as well.

#### **Box 2.3. Public goods**

Public goods have two major characteristics. The first is that one person's consumption of the service does not diminish other people's ability to consume the same service. The second is that a person cannot be easily excluded from receiving the service benefits. Sewage treatment is an example of a service with many aspects of a public good. All residents receive benefits from treated sewage, not only the households whose sewage is treated.

Measuring demand for those infrastructure services that provide private benefits poses problems similar to those which any firm confronts in setting informed production and pricing policies by estimating the number of units it will sell at each price. Direct recipients must be identified and their benefits measured. Techniques could therefore be adapted from those used by private firms for estimating service demands.

Willingness-to-pay surveys are one tool that specifically measures benefits of infrastructure projects. Willingness-to-pay surveys are useful in cases where a market for the service (such as water) is viable, and in geographic locations where the market has not yet developed. These studies normally involve asking household residents how much water (or other service) they would consume and the amount they would be willing to pay for improved water services (see Box 2.5). Willingness to pay is an estimate of the benefits expected from improved water. This tool has generally been applied to household use rather than business use, so the results may understate total benefits. Willingness-to-pay surveys have focused on accessibility and capacity; however, carefully designed surveys of specific user groups could also identify demands for quality, condition, diversity and time.

#### **Box 2.4. Willingness-to-pay surveys**

A willingness-to-pay survey was conducted in 1986 in Laurent, a village of 1,500 people in southern Haiti. Laurent is located in a mountainous region and has two rainy seasons each year. Residents obtain water from six streams and one protected well, all of which are within two kilometers of the village. The streams often have little water and more than one hour can be necessary to draw the required water. Residents express a strong desire for clean drinking water and will go to more distant water sources if necessary. Bathing and clothes washing are normally performed in rivers, the nearest of which is 10 kilometers away.

Interviews were held with 170 households (out of about 225 households) during the dry season to determine the willingness to pay for public standposts and private water connections. The questionnaire and research structure were carefully designed to eliminate the effects of biased responses. One potential type of bias is strategic bias, which occurs when the respondent believes that the likelihood of obtaining improved water can be affected by giving certain answers. According to World Bank data, such people will say their willingness is very high if they believe someone else will pay for the improved water system. Alternatively, they will say their willingness to pay is very low if they believe the system is going to be built and their response will determine how much must be paid for the water (see Whittington et al, 1990).

Statistical research on demand in areas already served with water is another approach to measuring likely service demands. These studies are normally termed hedonic studies. Results of hedonic studies can be used to estimate demand in unserved communities, assuming unserved places would follow the same pattern as currently served areas.

Expenditures for services currently consumed in an area can be used to measure the benefits of improved water (see Box 2.6). Expenditures are often a lower boundary of the benefits that would result if comparable services were provided through an infrastructure project. However, benefits may be lower than actual expenditures for cases in which service quality falls with infrastructure projects. Whittington and Choe (1992) observe that quality may fall with water projects because vendors can be more reliable than water systems. Payments for vended water can also be timed to be more consistent with family income flows. Absence of private sector provision of infrastructure services that are private goods (water, intracity public transportation, etc.) indicates that either the cost of service is very high or that residents place a low value on the service.

### Box 2.5. Expenditures for vended water services

Important information on willingness to pay and benefits from improved water systems can be gathered by examining actual payments made to private water vendors. A survey of research in nine developing countries revealed a number of cities in which a majority of households purchase water that is either delivered by distributors or by walking to kiosks or neighbors. Use of vended water was more extensive in urban areas. Furthermore, residents in areas with poor alternative water sources and, secondarily, with higher income are likely to purchase more vended water. Sixty-five percent of households in Port-au-Prince, 80 percent of households in squatter settlements of Khartoum, and 32 percent of households in northern Jakarta purchase vended water. Monthly expenditures on water can be very large. For example, households spend US\$26 per month in Khartoum, US\$8 per month in Jakarta, and US\$6 per month in Port-au-Prince. These expenditures often represent more than 10 percent of income and can be as high as 55 percent of income in Khartoum. Actual expenditures represent a lower bound of willingness to pay, and the benefits of improved water if the quality of services is the same as for vended water. However, payment arrangements may be less desirable and water quality and system reliability may be lower for improved water systems. As a result, it may be better to see actual payments for vended water and an upper bound on willingness to pay for improved water. The analysis suggests that decisionmakers should question whether water projects would provide significant benefits in areas where no vending occurs, since the private sector should be able to see potential opportunities for profits (see Whittington and Choe, 1992).

**Action 5 [O]: Willingness-to-pay surveys, surveys of service requirements, and research on served areas should be the basis for determining the level of service delivery for private goods such as water and telephone service.**

The market may not provide the best valuations for merit goods or externalities. Thus, the techniques used to measure demand for private goods are often ineffective for measuring demand for other services. Proxies must be found for these others benefits. For example, the value of reduced health expenditures and the increased production resulting from reduced hours of sick-leave may be considered benefits of improved sanitation. Benefit/cost techniques and professional judgements are good sources of the data.

#### 2.1.4. Local information

Local input should be solicited to the extent possible when measuring demand and determining which services to deliver. Local input is important along two dimensions. First, national infrastructure planners and policymakers will benefit greatly from the input of urban policymakers and planners. Efficient local officials are generally most knowledgeable about local demand, willingness to pay, and other factors.

Second, the views of individual consumers and neighborhoods should be gathered by both local and national officials. Residents are the best source of data, since local customs and tastes can result in differing demands across regions of a country. Specific demands for water in Anambra State, Nigeria (see Box 2.2) are an excellent example.

Local input should be accurate when proposed services are to be financed with user fees, because consumers will pay for services only when their personal benefits exceed their personal costs. However, local information may be less accurate, leading to a difficult political dilemma when national revenues are used to fund local infrastructure projects. Every region will want the same infrastructure its neighbors have, regardless of expected benefits. Consumers and local political

officials can engage in strategic overstatement of infrastructure's benefits in an effort to justify projects. Local statements can be difficult to counter because demand estimates are uncertain and actual demand could fall anywhere within a wide range. For example, local officials are prone to claim that new or improved infrastructure will support broad economic growth. Decisionmakers must judge whether locally estimated benefits are reasonable reflections of true demand. Furthermore, there may be blatant political pressure to choose projects regardless of their overall benefits.

Users seem to value services more when they participate in decisions about them. Also, residents may offer considerable insights into the technical aspects of service delivery, despite not having the technical skills available in the Ministry of Public Works. Place-specific information on water conditions at different times of the year, for example, may be important in choosing whether to use ground water or surface water in an improved water system. Local residents should be much more knowledgeable about existing water conditions than central government employees located from the capital city, who have little access to place-specific information.

***Action 6 [O]: Locally generated measures of demand should be solicited to the extent possible to account for differences in tastes, customs, and practices across regions. Local information can also be important in more technical decisions.***

### 2.1.5. Managing demand

***Objective 2.1.5: To limit the need for infrastructure facilities by controlling demand.***

In most cases, demand can be managed to reduce the resources used for producing infrastructure. Setting user fees is one of the most effective ways to limit consumption. Fees for usage can be particularly appropriate in cases where demand was substantially underestimated during the construction phase, because fees can ration services in short supply. Unfortunately, user fees in developing countries often are much lower than marginal costs and therefore fail to moderate consumption as much as they need to. As a result, demand for infrastructure services often greatly exceeds available supply. Creative pricing is another effective way to manage demand. Time-of-day electric prices can be adopted to ration usage at peak times and to reduce the need to install additional capacity. Time-of-day pricing or interruptible service agreements may only be necessary for several large consumers. Singapore prices transportation access to limit downtown traffic congestion. Effluent fees are another way to limit demand. China has imposed a series of effluent fees that have the potential to reduce sewerage and water treatment costs.<sup>7</sup> Subsidies provide an alternative means of managing demand for certain services. Subsidies for recycling and for reducing effluents are means of cutting the demand for solid waste disposal and sewerage, respectively.

Service providers also can increase demand; in a limited number of cases it may be appropriate to do so. Helping users see the value of infrastructure services can be particularly important if the service was previously unavailable. Identifying and illustrating uses of infrastructure services for consumers is one means of stimulating demand.

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7. China has selected an interesting approach to the issue of spending the resources obtained from the fees. About 80 percent of the funds have been returned in grants to the fee paying firms for use in controlling discharges. A revolving loan program is now being considered to leverage greater reductions in environmental effects.

**Action 7 [P]: Efforts to manage demand are essential to limiting necessary infrastructure investments. Properly set user fees and charges are the most effective means of managing demand.**

### **2.1.6. Beyond benefit/cost analysis**

**Objective 2.1.6 To use properly designed benefit/cost analysis to assist in proper decisionmaking.**

Benefit/cost analysis is the major tool used for analyzing the desirability of new infrastructure investments. Techniques for benefit/cost analysis are well developed. Still, benefit/cost analysis has been criticized because it is possible for analysts to vary the shadow prices and other assumptions to support desired projects on other grounds.

Several guidelines can be given for the proper structuring of benefit/cost analysis. First, the work must be designed to properly account for all effects. Even when objective analysis is undertaken, making good infrastructure investment decisions involves more comprehensive thinking than is normally done in a traditional benefit/cost analysis. A significant shortcoming of most benefit/cost analysis is its restriction to the individual investment project being considered. For example, analysts often fail to consider the macroeconomic implications of infrastructure investment. One such example is when a weak financial sector requires the national government to finance many new infrastructure investments, potentially reducing government resources available for other uses, such as education. These other uses are the opportunity cost of infrastructure. Related to this are the macroeconomic consequences of the larger public sector budget deficit that can result from using general government revenues rather than user fees to finance infrastructure.

Second, benefit/cost analysis normally fails to address the important relationships between investments in various infrastructure types. Urban infrastructure sectors are highly interdependent. For example, the need to improve sewer lines followed the expansion of water systems into many Egyptian villages. Indeed, water supply, drainage, and sewage disposal networks are technologically part of a single integrated network, according to data from the World Bank. Another example is the rainwater runoff-collection system developed in the Maldives to maintain a supply of safe drinking water. More generally, a package of infrastructure services may be necessary to accommodate substantial economic growth. Thus, the benefits of several infrastructure expansions may be greater than the benefits of each one separately. Infrastructure investments must be properly sequenced and coordinated to yield the maximum benefits. Unfortunately, there has been too little analysis of the proper sequencing of infrastructure services.

Furthermore, the relationship between adjacent infrastructure projects is seldom considered. For example, benefits from a city-wide sewer system may be proportionately greater than those from independent projects in several neighborhoods. Ability to manage a group of projects more efficiently on a city or metropolitan-area basis, rather than a project basis, may be one benefit.

Third, standard benefit/cost analysis may not consider the multifaceted characteristics of services. Benefits from accessibility, capacity, diversity, quality, time, and condition must be fully considered. The demand for these (i.e., the importance of these characteristics) differs across users, and the variation in demand will be very wide within large urban areas. A casual consumer or local

artisan may easily accommodate blackouts, while a refrigeration firm may not. Also, some may seek only limited access to basic telephone service while others want facsimile and data-downloading capacity.

Fourth, gains from attaining each public policy goal must be considered, although the benefits may not be easily measurable in a traditional benefit/cost analysis. For example, a decision may be made to design infrastructure to achieve a desired urban growth pattern. Some have argued that Cairo water and sewer facilities should be built east/west into the desert, rather than north/south in the fertile land along the Nile, where the land has a much higher opportunity cost. The expectation is that housing will follow the infrastructure pattern. This example has benefits that, though difficult to measure, could be accounted for if the benefit/cost analysis were carefully prepared. The benefits from infrastructure built to achieve other goals, such as equity, are more difficult to quantify.

Finally, the analyst must factor changing demand for infrastructure services into the benefit/cost analysis. Some believe that increasing economic globalization necessitates a higher quality of infrastructure than has traditionally been required in many developing countries. The argument is that firms will be unable to meet the time-sensitive schedules required for many products (using just-in-time production techniques) unless consistent electricity, telecommunications, water, and other services are available. Therefore, it is important to consider the effects on international competitiveness of existing and new business. Effects of infrastructure on business practices in cities seeking to compete in international markets can go well beyond the small reductions in unit costs that result from improved infrastructure services, as firms may be unable to compete unless they can meet time requirements. For example, current policy in India seeks to improve export performance in terms of price and promptness. This improvement requires that the infrastructure operate as an interconnected network. The infrastructure must be of much higher quality than was necessary in the past, when policy was more inwardly focused. Nonetheless, although just-in-time production may be important in large urban areas in developing countries convenient to large international markets, the application of such timely production techniques may be limited for many developing countries in the near term.

**Action 8 [O]:** *Benefit/cost analysis should be used to combine information from demand estimates with data on costs. The analysis should be objective and go beyond standard applications.*

- *The analysis should consider consequences of the infrastructure and its financing on the macroeconomic environment.*
- *The analysis should consider the proper sequencing of each type of infrastructure investment and the appropriate timing of investments.*
- *Benefits from the full range of service characteristics must be quantified in the analysis.*
- *Effects on goals other than the specific outputs of the resources, such as equity, must be considered.*
- *Measurement must be flexible to anticipate alternative uses of infrastructure over time. Also, allowance must be made for changes in emphasis in the desired characteristics of the infrastructure.*

## 2.2. Linkage between Infrastructure and Economic Activity

**Objective 2.2:** *To determine the importance of infrastructure investments for supporting production and to determine whether infrastructure is an effective economic stimulant.*



This section examines the second aspect of choosing optimal infrastructure: the relationship between infrastructure services and economic activity. This section is a logical extension of the discussion about demand because one major source of demand for infrastructure services is the demand for services as an input in production. The topic is also important because infrastructure investments often have been justified as a way to raise income levels. The approach used in this section is to examine a series of specific issues related to the linkage between infrastructure and economic growth, including the mechanisms through which infrastructure influences the economy, the research evidence on which types of infrastructure are most important, the extent to which infrastructure crowds in or crowds out private investment, and the types of regions that benefit most from infrastructure.

### **2.2.1. Mechanisms for infrastructure stimulation**

The provision of infrastructure services can influence economic output through both the supply and the demand sides of the economy. A supply-side effect is normally anticipated when infrastructure stimulates the economy. Infrastructure can affect the supply or production of output in three ways. First, infrastructure services like the provision of electricity and water can be a direct input in production. Second, infrastructure can be a complement to private capital or labor. This happens when it makes other inputs more productive, such as roads that move labor to firms and outputs to market, and telecommunications that improve labor productivity. Good infrastructure can lessen the wasteful use of water, fuels, and land. Third, infrastructure can indirectly increase an area's overall ability to produce by attracting workers or private capital from other regions. Of course, this may simply shift a country's productive assets from one location to another. Private firms can be attracted because entrepreneurs value infrastructure services for their own consumption or because they believe the services will make their firms more productive. Also, workers can be attracted to an area because of the improved quality of life associated with having a good infrastructure in place or because the resulting productivity gains raise wage rates.

Three linkages can also be identified between infrastructure and the demand for output. First, infrastructure's construction creates income for workers who are directly employed as well as for other workers and entrepreneurs as materials, such as pipes and gravel, are purchased for use in construction or operations. In some cases, poverty-level workers benefit through employment in the least skilled activities, such as digging ditches or moving dirt. The spending and respending of these directly created incomes can create a multiplier effect on the economy, although the extent of these multiplier effects is often exaggerated.

Next, infrastructure investments can crowd in or crowd out private investment. Crowding-in occurs when development of infrastructure encourages more private investment. Crowding-out takes place when private investment is replaced by infrastructure. There are a number of reasons for crowding to occur in both directions, and they must be aggregated to determine the net effect. One reason for crowding-in is the complementary relationship between infrastructure and private capital. In this case, the expectation of greater productivity causes private firms to invest more as infrastructure is expanded. On the other hand, private investment can be crowded out because construction of infrastructure can require resources that otherwise would be used for private investment. The relative strength of these different forms of crowding depends on a number of factors, including how infrastructure is financed, whether there are unemployed resources available in the economy, and how savings and investment respond to interest rates.

Finally, greater demand for infrastructure services is expected as an economy develops because people (and businesses) purchase more water, electricity, and other services as their incomes rise. Thus, a positive correlation is expected between economic output and the level of infrastructure. But the causality described by this linkage is often that of higher incomes leading to demand for more infrastructure, rather than infrastructure causing economic growth.

### 2.2.2. Research evidence

Considerable research has been undertaken to determine whether infrastructure stimulates economic growth. The research is useful in providing general guidance, but fails to answer many of the specific questions that policymakers ask.

The evidence indicates that greater infrastructure is normally associated with higher economic production. There is the obvious conclusion that water, electricity, and access to markets through a road system are important to business production. However, expansions of infrastructure will not be the primary cause of economic growth. One reason is that demand for newly produced goods is essential, and infrastructure cannot cause growth without sufficient demand for outputs. Another reason is that resources invested in infrastructure may be diverted from better uses, such as education. Third, other inputs, such as appropriately skilled labor, entrepreneurs, and private capital, must be in place for growth to occur. One or more of these other inputs is often the constraining factor on growth.

The limited stimulative effects of infrastructure indicate that infrastructure is best used to accommodate economic activity rather than as a prospective tool. Thus, infrastructure expansions should be made selectively to meet known demands rather than diffused widely in hopes of causing economic growth. Some circumstances may exist in which infrastructure is the missing ingredient to growth, and investments would be stimulative. But a policy aimed at using infrastructure as a stimulant is likely to fail because the public sector will find it difficult to identify those communities in which infrastructure would make a difference. Even if these communities could be identified, the public sector probably will be politically unable to focus investments on those places where provision of infrastructure will truly stimulate growth.

Unfortunately, the problem is made somewhat more difficult because, while local leaders may recognize that infrastructure will not stimulate growth, they also realize that the city cannot grow effectively without infrastructure. Unless water and electricity are available, certain types of production cannot occur. Thus, local leaders seek infrastructure so their areas can have a chance for growth. But national decisionmakers have insufficient resources for making all services available at each location; the wisest course is generally to use scarce resources where a known demand exists.

***Action 9 [O]: Infrastructure investments should be located where a known demand for the services exists, and not as speculative investments in the hope that economic activity will follow.***

**Supply and Demand Effects.** Research supports each of the above six explanations on how infrastructure influences the economy. First, on the supply side, the evidence is that electricity, water, and other services have direct value as inputs in production. The findings also indicate that infrastructure makes other inputs—particularly investments by private firms—more productive than

they otherwise would be. Next, research indicates that infrastructure investments are of limited value in attracting labor and private investment to a region. Relocation of labor and private investment can make the attracting region more productive, but national output need not increase, because an offsetting loss in production can occur in the region of outmigration.

On the demand side, the construction of physical infrastructure increases local incomes as workers are hired and other inputs are purchased. However, the benefits are short-lived, being totally realized in the year that construction occurs. The longer-term benefits come through the supply-side use of infrastructure services to produce other goods. Also, there is substantial evidence that higher-income areas have greater demand for infrastructure.

**Action 10 [P]: Appropriately sized infrastructure services must be provided as the basis for private productive activity.**

**Site Attributes.** The above findings suggest how infrastructure affects the economy, but fail to provide guidance for individual projects. All infrastructure investments are site specific and the services normally can be neither exported nor imported. Some guidelines are available to help identify regions where infrastructure will be an important input in growth. Nonetheless, broad research fails to provide definitive guidance on whether specific investments at particular locations will play an effective role in growth. Specific analysis of investments at actual sites is necessary to ensure that appropriate investments are made.

Research has found that there are diminishing returns to infrastructure investment. In fact, in some cases production falls when infrastructure expands. Production is most likely to decrease in response to new infrastructure investments when the infrastructure is already significantly developed or where there is a large infrastructure relative to a low-density population, such as in some rural areas. Infrastructure expansions in some older U.S. cities have been associated with declining output.

Infrastructure investments in a currently unserved area may have different economic implications than those made to enhance one dimension of existing services.<sup>8</sup> Service expansions could be changes in condition, such as smoother roads; diversity increases, such as the option for a household water connection; or quality improvements, such as better treated water. Both new services and expanding services offer benefits. For example, introducing infrastructure in fringe parts of a metropolitan area can be productive for small businesses and the informal sector. Unfortunately, the only relevant finding related to whether new or expanded service is more productive is that infrastructure investments are subject to diminishing returns. The presence of diminishing returns suggests that service expansions are less productive than new services, at least once a minimum level of basic services is provided in a region.<sup>9</sup> On the other hand, quality and diversity increases will be important for certain industries that need consistent electricity, good data transfer, or high quality water.

Additional arguments can be made to support the value of both infrastructure expansions and new services. Physical infrastructure investments seem able to support economic expansion

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8. Incremental increases in service delivery to unserved parts of urban areas are considered as new investment here.

9. Diminishing returns need not set in for initial infrastructure investments.

beyond their design capacity, so the economic value of capacity expansions may be low until significant crowding occurs. Evidence for this is the rapid economic growth of some Asian countries without corresponding increases in physical infrastructure capacity. This suggests that new investments may be more productive than expansions, although quality of life may be improved substantially by infrastructure expansions that reduce congestion. However, a minimum complement of infrastructure may be necessary to support many types of economic activity. Therefore, provision of a single new infrastructure, such as water without electricity and sewerage, may allow little productive increase. To the extent that a minimum complement is necessary, little economic growth may be supported in the absence of broad infrastructure investments. Again, quality of life may be enhanced by providing even one service to a formerly unserved area.

***Action 11 [P]: The greatest benefits from infrastructure investments will result when a minimum complement of infrastructure services is made available in places with an appropriately trained labor force. Higher-quality and more diverse services should be targeted to specific areas where the demands of more sophisticated users have been identified.***

Other site characteristics can influence where infrastructure will have its greatest effects on productivity but there is scant research to support the conclusions. Infrastructure appears to be most productive when it is delivered in areas with many other assets important to growth, including an appropriately trained labor force and reasonable geographic access to markets. This is consistent with the notion that infrastructure is most effective as an accommodation to economic growth. Better education seems to be a more effective investment than increased infrastructure in the least developed areas. Infrastructure needs vary by industry and this means an area's industrial structure must be studied and its use of infrastructure well understood before infrastructure is designed for a specific place.

The basic character of the economy will be an important determinant of the type of infrastructure needed. Regions moving from an agrarian to a goods-producing economy may find traditional infrastructure, such as roads and railways, most important. Those areas moving from producing goods to services may find communications more important.

Further, infrastructure can only have value in production to the extent that demand exists for the outputs produced using infrastructure services. Most of this demand will be domestic. Thus, some have argued that broad industrial expansion may need to accompany significant infrastructure investment if there is to be sufficient demand for the goods produced using infrastructure as an input.

Development of infrastructure with the goal of relocating economic activity generally will be successful only within narrow geographic ranges. Infrastructure may be able to influence the location of development within a city, because there will be a tendency to locate where electricity and water services are available. The greatest effects will be on small firms or households, which are unable to deliver services for themselves. Providing infrastructure to growing, unserved areas of a city can be a successful strategy for meeting demands and increasing productivity. For example, benefits can be great if improved water is provided to an area formerly served by vended water, because of the potential for large cost savings. However, attempts to create growth poles through infrastructure developments are problematic. Attempts to locate growth centers 20–30 kilometers from cities in Korea, Thailand, and Ghana have failed to reach expectations. New cities in Egypt have experienced mixed success. Again, infrastructure is most successful when it supports areas which have other aspects necessary for growth.

**Action 12 [P]: Emphasize infrastructure development to support the most rapidly growing areas of cities. Only use infrastructure to alter development patterns when other important public policy goals are at stake and only after very careful planning and analysis. Infrastructure provision may be useful for improving development patterns along the urban fringe.**

**Crowding Out.** New public capital investments appear to initially crowd out private investment, but the net effect of new infrastructure can still be greater private investment. Research in the United States reveals that public investments crowd out, or replace, private investment by an approximately equal amount in the year they are made. Developing countries follow the same pattern, unless additional bank credit is made available to offset the resources absorbed in constructing infrastructure. However, the U.S. research shows the positive effect of infrastructure on the productivity of private capital, leading to greater private investment in subsequent years and indicating that private investment is crowded in. The dominant effect in the longer term is for infrastructure investments to increase private investment because of the productivity gains.

**Action 13 [P]: Macroeconomic policy should be structured to allow infrastructure investment without crowding out private investment. However, other macroeconomic policy goals, such as inflation, must be balanced against effects on crowding.**

**Effects on Poverty.** It seems reasonable to assume that certain infrastructure investments may be effective tools for helping reduce poverty, although research has tended to focus on other benefits of infrastructure decisions. Low-income households may be among the greatest beneficiaries of infrastructure enhancements at the urban fringe. Low-income residents are most likely to have long commuting times, for instance, or to spend considerable time collecting water. Income may be increased if better infrastructure services allow household members to devote more time to income earning activities. However, in practice the best services are often targeted to higher-income residents and communities.

When infrastructure meets the needs of industries that intensively use low-skill workers, wage increases may result. Delivering the needed infrastructure can be a way of attracting these industries and increasing the number of jobs for low-income workers. Furthermore, access to better equipment because of available electricity and other infrastructure services can make workers more productive and lead to higher wages. Construction of infrastructure facilities can provide employment for some poverty-level workers, although these jobs are seldom a sustained source of income. Finally, there may be some "trickle down" effects as better infrastructure raises wages and the standard of living across the spectrum of workers and indirectly benefits poverty-level workers.

Not all infrastructure investments lead to greater employment. In some cases, a group of workers could lose their jobs as infrastructure improvements are made. For example, a new source of electricity may allow implementation of labor-saving machinery. However, employment need not decline even with apparently labor-saving infrastructure. The total effect on employment also depends on how demand for locally produced goods is affected as greater production efficiency lowers the price of goods. The greater sales that accompany lower prices can result in the need for enough additional employees to offset job losses from the labor-saving investments.

Infrastructure also offers the opportunity to reduce poverty through health improvements. Unsafe or inadequate water and sanitation are estimated to account for 80 percent of illnesses

and 50 percent of hospitalizations in developing countries. Improving water and sanitation can allow workers to produce more during their work hours and to work longer hours. These changes can translate into higher incomes as wage rates rise and more paid hours are worked.

**Action 14 [O]: Each infrastructure investment has differential effects across the range of income levels. Those investments with the greatest implications for alleviating poverty should be identified and considered.**

### 2.3. Current Infrastructure Levels

**Objective 2.3: To develop an inventory of the infrastructure services available in each region and to identify those places where infrastructure services are unavailable.**

An inventory of current infrastructure is the third component of an informed infrastructure decision.<sup>10</sup> Monitoring the condition and performance of infrastructure should be an ongoing process. System supervisors can only make informed management decisions on the desirability of specific investments and optimal infrastructure policy based on information about the existing infrastructure stock and its operational features. Performance and usage data also help to measure demand, because usage relative to capacity can be important for estimating expansion needs. Nonetheless, demand cannot be evaluated only in terms of the existing systems, because a comparison with existing practice presumes that the right set of services is being produced, the technology is appropriate, and so forth. All of these assumptions are likely to be invalid.

A proper inventory allows identification of both served and unserved areas. An infrastructure inventory is most useful if it describes the detailed infrastructure characteristics available in each served region, including data on diversity, condition, quality, accessibility, capacity, time, and price. Services offered through both the public and private sectors must be measured, including those using traditional and nontraditional technologies. This information can be combined with analysis of infrastructure demand and likely economic effects of service expansions at prospective sites to determine where service shortfalls are greatest and where infrastructure expansion will have the most payoff. Determining where the greatest payoff will occur is essential because people will always want more services than can be delivered with available resources.

The inventory also plays a vital role in identifying the possible local solutions for system expansions. For example, expansion of sewer services within a city must occur within the context of the existing urban sewer network. The existing physical and organizational structure will heavily influence whether a new facility should be built or the existing facility expanded, what technology is selected, and other features of an expansion.

**Action 15 [O]: An inventory of existing infrastructure services should be maintained to provide a basis for evaluating current services and for future planning. The inventory should focus on collecting data on availability of services, although data on the physical attributes of infrastructure will also be useful.**

10. An argument can be made that monitoring should have been the first issue in this section, since it is an ongoing managerial function. However, the imperative to shift decisionmakers to a user/demand orientation led to demand being considered first.

Identifying service shortfalls requires a comparison of service availability with some measure of demand. Specific demand estimates for individual communities are one source of data for comparison with actual infrastructure levels. Unfortunately, in many cases, government officials are unlikely to have data on demand for all parts of the country or even all areas of a major city. Carefully constructed national guidelines can serve as a proxy for demand when local estimates are unavailable. Adoption of guidelines for service delivery can be thought of as national recommendations for minimum service levels. Guidelines should focus both on quality, such as characteristics of water when it leaves the sewage treatment facility, and quantity, such as per capita capacity of water facilities, and should consider the seven aspects of service delivery.

Guidelines are important for several reasons. Guidelines on capacity and service quality can help determine whether existing service flows are likely to be adequate for the city's demand. Furthermore, guidelines on when maintenance or rehabilitation should take place can be used to develop a plan for keeping existing infrastructure operational. Guidelines also permit planners to know when to budget for major rehabilitation projects at served sites.

However, guidelines must be used with care. Frequently the analyses developed to measure service shortfalls employ engineering or professional standards to determine the resources necessary to meet all of a country's or a city's infrastructure needs. The work may have been undertaken by an industry that would benefit from a substantial increase in expenditures. Highway and construction industries often have performed studies calling for massive increases in expenditures. Such studies can exaggerate the resources that should be devoted to meet service demands, in part because the price of services often is omitted from the studies. Also, guidelines generally fail to consider differences in local demand, and this may lead to a misstatement of true shortfalls.

Several rules should be followed when seeking to set objective guidelines. First, the focus should be on the output (service level) rather than the input (physical facility). Output-based guidelines center on the quality of water received by the user, not the amount of chemicals used in treatment; the safety and speed of movement on highways, not the number of miles of highways; and the number of brownouts per day, not the generating system. Attention to output increases the chance of identifying more efficient ways to meet specific service demand. Focus on inputs leads to similar production techniques at all sites without consideration of cost conditions and local demands.

Second, guidelines used to determine shortfalls should be consistent with reasonable levels of service quality. The level of quality in turn must be consistent with resource constraints and likely uses of services. For example, installing sophisticated telecommunications capabilities is a poor strategy in most areas of developing countries. Installing more moderately priced services in broader areas may be a more efficient use of resources.

Finally, micro-level guidelines applied to specific areas are essential to obtaining meaningful results. Cost estimates for meeting infrastructure shortfalls often are based on national or regional population and industry characteristics, but infrastructure needs are localized. The migration of people from an unserved to a served location could eliminate a shortfall, or migration in the other direction could create a shortfall. However, in both cases national or regional shortfall estimates would be unchanged because the data are too aggregated to allow observation of population shifts.

**Action 16 [O]: A set of reasonable guidelines on minimum infrastructure service levels should be developed for comparison with the inventory of service production. The guidelines should serve as rules of thumb for where service expansions should occur.**

#### **2.4. Required Rate of Return on New Projects**

**Objective 2A: To select an interest rate or minimum rate of return that can be used for comparing the benefits and service delivery costs of projects that have different useful lives.**

Information gathered in the three sections above must be combined to allow for comparison of projects producing different services and having different lifetimes. Alternative infrastructure projects are normally compared through their rate of return or present value, because the benefits accrue over a significant number of years and the costs often entail a large initial investment followed by a life cycle of other operations, maintenance, and rehabilitation expenditures. The techniques involved in calculating a present value or a rate of return are developed to combine both the timing and levels of benefits and costs.

Policymakers must choose a minimum acceptable rate of return to serve as a guideline for determining which specific projects yield a sufficient return for the invested resources. The rate is used for discounting in a present value calculation or comparing the anticipated rate of return for proposed projects. Choice of the specific rate is of considerable importance, because the rate provides a minimum cutoff for which projects are chosen. Furthermore, the rate influences the mix of projects selected. For example, a low rate tends to favor projects that yield benefits over a long period and a high rate favors short-term projects.

Unfortunately, there is no single, widely accepted conceptual basis on which to select the rate. Several rates have been proposed based on different assumptions about the alternative use of resources. One is the before-tax rate earned for marginal investments in the private sector. This follows from the assumption that the alternative use of resources is in private sector investments. Others have argued that the opportunity cost for at least some resources is consumption rather than investment, so an after-tax rate of return is more appropriate. Alternatively, a weighted average of the before- and after-tax rates of return could be adopted. In any event, measuring a rate of return in developing countries is often made difficult because capital markets are not permitted to operate freely and lending rates may not represent the opportunity cost of capital.

Third, it has been argued that there is a tendency for an economy to underinvest due to inadequate concern about the future. A market rate is inappropriate if this argument is accepted. A social rate of return lower than the market rate is suggested in this case. Little guidance is available on what the social rate should be.

The actual interest rate will vary by country and will depend on factors such as the tax structure and exchange rates. Gramlich (1990) has recommended that small countries use the interest rate adopted by the private sector in making decisions. He sees private investment as the alternative use of the funds. Following this logic, the best choice is the before-tax rate of return received in the private sector. Furthermore, Gramlich argues against using a social rate of return.



**Action 17 [P]:** *Developing country governments should make decisions on which infrastructure projects provide an acceptable return for the investment using the same interest rate that private firms operating in the country employ in selecting their investment opportunities.*

Only projects that *meet the minimum rate of return* should be funded. However, the rate of return should not be the sole criterion for projects selected. Nonquantifiable factors must be integrated into the decision. Other factors that should be considered in deciding on specific projects include:

- effects on income groups.
- degree to which project complements other infrastructure.
- environmental consequences.
- impacts on firms of different sizes.
- ability to finance the services.
- sustainability of the project.

Many decisions on smaller projects may need to be decentralized and undertaken without comprehensive analysis of rates of return. Establishing guidelines for funding of certain projects is an alternative to comparing each project on the basis of its rate of return. For example, any project that can be fully financed with user charges could be approved. Demand-based guidelines of the type discussed in the previous section are another way of selecting projects.

## 2.5. Operational Characteristics of Infrastructure

**Objective 2.5:** *To select the technology, operations and maintenance, and institutional structures for infrastructure projects.*

A specific means of providing infrastructure services must be identified once demand is fully understood. Production of infrastructure services is more than building a facility. A life cycle of activities is involved. The appropriate technology for service delivery, costs to deliver services, maintenance activities, and institutional capacity of the service delivery organizations are among the operational issues that must be addressed. The purpose of this section is to raise the primary issues and provide general guidance on how to confront these issues.

### 2.5.1. Technology

**Objective 2.5.1:** *To select a production technology appropriate for the service demands and service delivery conditions of the specific area where services will be provided.*

The actual technologies chosen to deliver services are likely to vary significantly within cities, across cities, and across countries (see Box 2.7). In each case, the goal should be to choose production techniques that provide the desired infrastructure services at the least life cycle cost possible. The delivery technology must be selected with intent to produce demanded services.

**Box 2.6. Selecting an appropriate technology for roads**

The specific technology and type of service that should be chosen depends on many factors, including demand, service delivery conditions, and life cycle costs. For example, gravel roads are less expensive when traffic volumes are low, weather is not extreme, construction materials are generally available, and adequate maintenance is expected. The specific traffic volume at which paving becomes appropriate ranges from less than 100 vehicles per day to more than 400 per day, depending on these factors. Knowledge of weight limits that will be observed and of road-use patterns also can affect technology decisions, according to World Bank data. For example, roads with more than 500 vehicles per day may need to be built to higher initial standards if the country is unable to enforce weight-limit standards because of the high costs of premature pavement usage. Limited patching may be appropriate for low-usage roads that should have been left unpaved, rather than trying to sustain the pavement quality.

Small-scale rather than broad technologies may better allow differentiated services to be delivered. Innovations increasingly allow service delivery with techniques that do not require large scale production to achieve reasonable costs. The distribution of services such as water or telecommunications may not benefit from smaller-scale technologies, but the production of telecommunications services and some other services often can. A private entrepreneurial urban transit system often is better than subways or large bus companies, for example. Neighborhood sanitation systems may be better in low-income neighborhoods than a large-scale sewer system. Inexpensive technologies often are available for delivering limited infrastructure services and they should be carefully examined, particularly for low-income areas. Low-cost sanitation systems have been estimated to cost 5 percent of a low-income household's budget for five years, while high-cost technology would absorb 50 percent of the budget for 20 years (see Box 2.8).

**Box 2.7. Service delivery costs for sanitation vary with technology**

Sanitation costs in developing countries were estimated for a variety of technologies. Estimates assumed six people per household. Average annual costs per household ranged from a low of \$28.50 for a pit privy (1978 U.S. dollars) to a high of \$400.30 per year for a sewerage system. Total costs depend partly on the collection and treatment activities necessary for each technology. Neither of these costs is incurred for the pit privy system. Also, almost all costs for the pit privy are for investment, while operations and maintenance costs are negligible. One third of costs for the sewerage system are for operations and maintenance. Decisions on appropriate technology must consider the benefits from each type of service, the life cycle costs, and other factors (see Kalbermatten et al., 1982).

Often, politicians fail to make the best long-term technology decisions. Small and Winston (1988) find that fewer resources could be used in the long run if U.S. highways were constructed with thicker surfaces, for example, though greater costs would be borne during the construction phase. Benefits would be an estimated four times greater than the additional investment costs if the U.S. chose the most efficient road investments.

The appropriate technology must be selected after evaluating several operational considerations, all of which are aspects of the service-delivery costs. The technology and urban system design already in place can have a significant influence on the technology used for system expansion. Any expansions or enhancements must be integrated into the existing spatially structured network. The institutional capacity of the organizations that select the technology and operate the

physical facility (these two organizations may not be the same) will be a key determinant. A general rule is to seek technology that offers simplicity in design and operation. Simple systems increase the probability that the service-delivery organization can provide proper operations and maintenance. Of course, appropriate trade-offs must be made between simplicity and productivity. Third, input prices for physical capital, labor, and land will be important in selecting the appropriate technology. There is a tendency to view capital as expensive in developing countries. However, in some cases, other resources may be relatively more expensive. For example, capital intensive sewerage technology is commonly used in Egypt because other technologies are land intensive, and, in some areas, land has a very high opportunity cost. On the other hand, donors can make capital look relatively inexpensive if subsidized borrowing rates are allowed or if the capital is provided in the form of a grant. Skilled labor is another input that can be relatively expensive in many places, suggesting the use of technologies requiring more mundane operations and maintenance. Fourth, service delivery conditions are very important. One example is the need to use ground water when no surface water is available. Next, the number and density of users can affect many aspects of the service and its distribution. Ability to reap the benefits of economies of scale, or likelihood of dis-economies of low density, are major concerns (see Box 2.9).

**Box 2.8. Appropriately sized maintenance contractors**

Careful planning can take advantage of economies of scale without the potential disadvantages of diseconomies of scale. Two types of contractors are used for national roads in Pakistan. Small, local contractors are used for routine maintenance, which includes repairing shoulders and bridges, vegetation control, and drain cleaning. Large, expensive machinery is unnecessary, so small, local firms can provide the maintenance. Other functions, such as repaving, regravelling, and major repairs, require more technical expertise and more expensive machinery. Some economies of scale exist for these services. Thus, large contractors are used for these services, allowing the lower costs from economies of scale (see Ostrom et al., 1990).

***Action 18 [O]: Technology selection must begin with an orientation to delivering specific services. An appropriate technology should be chosen separately for each location after consideration of existing service delivery technologies, the urban network already in place, input prices, life cycle costs, capabilities of the service delivery organization, and service delivery conditions. Emphasis should be placed on selecting a simple technology.***

The broad range of technologies available for producing infrastructure have changed infrequently. Furthermore, implementation of new technologies occurs slowly because existing infrastructure facilities have a long life. However, the pace of technology developments has quickened and the range of services demanded has broadened, so service providers will find it increasingly important to remain current. Innovations can add capacity, reduce service delivery costs, or help measure service usage at the margin. The latter can assist in evaluating demand or in pricing services. These innovations must be continually monitored to identify those that offer gains through increased productivity of existing physical infrastructure, lower costs, or greater revenue flows. Computerized control systems developed to monitor motors and other components of operating systems are one example of these innovations. Automatic meter reading, which allows for more efficient collection of consumption data, is another recent advance.

The private sector can be an effective source of technology improvements, although procurement solely on the basis of low cost is unlikely to yield technology improvements. Design

competitions and performance-based procurements offer opportunities to attract appropriate enhancements, but more information is required to make decisions on such bids, and much of the information may be unavailable. Indeed, measuring the costs and benefits of innovations is often very difficult.

***Action 19 [O]: Governments and service delivery authorities must stay abreast of changing technology and integrate new approaches that offer operational gains.***

### 2.5.2. Maintenance

***Objective 2.5.2: To design a maintenance program that ensures maximum benefits from the infrastructure system while services are delivered at the least cost.***

Adequate maintenance is essential to sustain infrastructure systems. Proper maintenance results in lower costs for service delivery agencies and greater benefits for users. A recent Urban Management Programme (1989) study observed that the present value of agency costs can be up to five times larger for rehabilitating roads than for providing adequate maintenance. An additional benefit is that future capacity expansions can be forestalled with good maintenance. For example, maintenance that reduces distribution losses for water or electricity could permit additional consumers to be served without capacity increases. Improved maintenance saved 250,000 cubic meters of water daily in Bombay. Unaccounted-for water in Latin America ranges from 40 to 60 percent of distributed water versus about 12 percent in the U.S., indicating the potential for improvement through good maintenance.

Israel (1992) concluded that good maintenance is the most cost effective way to increase service delivery and enhance infrastructure's contribution to the economy. However, the maintenance task varies widely by infrastructure. Telecommunications maintenance is the easiest to design because the needs are similar at all locations, as normal wear and tear is the main determinant. Highway maintenance plans vary more across sites because the needs depend on climatic conditions, type of vehicles used on the roads, and many other factors.

Users also benefit from good maintenance. Inadequate maintenance affects consumers through gradual degradation, as when a road is roughened by use, or through catastrophic failure, such as when a bridge collapses. Maintenance that offsets degradation or prevents the likelihood of catastrophic loss can both reduce user costs and raise service benefits. Vehicle maintenance and wear on tires can be reduced by up to 15 percent with good road surfaces. An estimated US\$25 million in vehicle costs could be saved every year in Ghana through good road maintenance.

Despite the potential benefits, a strong bias against proper maintenance appears to exist in most countries. The World Bank has estimated that the neglected maintenance in 85 countries has resulted in \$45 billion in lost road infrastructure during the past 20 years. Among the reasons maintenance tends to be underprovided are that officials prefer to concentrate on visible construction, force-account construction teams must be kept active, biases exist in government or donor aid programs, user demand is not always the main focus, and technology may be overly sophisticated. Furthermore, political leaders are often short sighted, focusing on agency costs during their tenure in office rather than on life cycle costs of the facility. Overall, these point to failure in the institutions charged with maintaining infrastructure.

**Action 20 [O]: Technologies and service delivery institutions must be chosen to maximize the ability to maintain infrastructure.**

Consumers, donors, and planners must all work to ensure properly maintained infrastructure. Practices and policies in each country must identify constraints on maintenance. Each new program must be evaluated to identify means to increase the likelihood of maintenance. U.S. grant and loan programs for state and local governments that finance construction or major rehabilitation of facilities but do not assist with maintenance often send the wrong signals. This incentive structure encourages governments to allow systems to deteriorate to the point that donor-financed major rehabilitation is necessary. At a minimum, these grant and loan programs should incorporate maintenance clauses in the financing agreements.

**Action 21 [P]: Incentives must be built into the infrastructure grant and loan programs of all donors and governments to encourage proper maintenance.**

Adequate resources must be allocated for appropriate maintenance. Qualified staff must be recruited, hired, and retained. Necessary equipment must be procured and maintained. Rolling stock upkeep is an essential ingredient of good infrastructure maintenance. Nonetheless, 70 percent of vehicles are consistently out of service in Harare, Zimbabwe. A plan must ensure appropriate maintenance and address basic issues such as frequency and type of maintenance, providers, financing the system replacement, and so forth. The plan must consider every step, including routine maintenance, periodic maintenance, emergency maintenance, and rehabilitation.

**Action 22 [O]: A good maintenance plan and the necessary resources to fulfill the plan must exist to make infrastructure services sustainable.**

Good information is an essential component of developing effective maintenance. Careful maintenance records must be kept to track the degree to which necessary functions are undertaken. An asset inventory must be developed and the condition of infrastructure monitored to ensure that appropriate maintenance is provided before user costs become prohibitive or before major rehabilitation becomes necessary. Using the data to alert users about the importance of infrastructure maintenance can help generate support for needed resources. A goal must be to generate the same enthusiasm for maintenance that exists for building new facilities.

**Action 23 [O]: Good maintenance and infrastructure condition records must be kept to serve as the information basis for an effective maintenance program. Delivery agencies must make service delivery decisions after explicitly considering the costs that users bear as they consume the services.**

Self-help can be an effective means for improved maintenance (see Box 2.10). Police and other officials can be expected to look out for maintenance problems such as potholes, for example. A training officer in each school zone in Tanzania organizes teachers and pupils to undertake basic maintenance tasks.

**Box 2.9. Self-help for operations and maintenance**

The Accra, Ghana, city council was unable to maintain and empty the two public pit toilets in Nima. Also, the Council was unable to provide refuse collection. Nima is a slum area with about 100,000 workers and self-employed people. Residents of Nima formed a local association in 1980 and successfully disposed of refuse and emptied the pit toilets. The local assistance continues to operate the pit toilets and charges fees to finance the operations (see Lee-Smith and Syagga, 1990).

### 2.5.3. Service delivery costs

**Objective 2.5.3: To select the services to be delivered and the technology, maintenance policy, and operations strategy for service delivery so that the total costs borne by society are minimized, while appropriate tradeoffs between costs and services are made.**

Costs are borne as the responsible agency produces services and as consumers use infrastructure services. Agency costs for a water system are the sum of construction, operations, and maintenance costs. Household costs include transportation and carrying costs. Society's costs are the sum of those imposed on both the agency and the consumer. The public policy goal should be to minimize society's costs. Both costs may be borne ultimately by the user, but there is a tendency on the part of service delivery agencies to focus on minimizing agency costs. One reason may be a desire to keep the public sector small. Other reasons may be to keep user fees low or to limit the degree to which the service costs are monetized.

A tradeoff normally exists between costs for the two groups. For example, agency costs can be reduced by offering standpost water rather than household connections, since consumers bear the carrying costs for retrieving water.<sup>11</sup> A system with household connections should be provided whenever savings in user opportunity costs and other benefits (properly discounted over time) exceed marginal costs of household connections. Still the public faucet system may be chosen because agency costs would be higher with connections. Road transportation is an extreme example because vehicle operation and congestion costs can exceed infrastructure costs. Road congestion is estimated to cost US\$9 billion per year in the United States and US\$1.7 billion per year in Korea (Stevens and Michalski, 1993). Road agencies can underprovide maintenance or choose a poor technology and push even more of the costs on to road users. Research in the U.S. indicates that user costs are five times greater for short-lived pavements than for long-lived pavements. Korean seaports are another example, in which delays caused by cargo congestion are estimated to cost US\$1 billion.

**Action 24 [P]: User costs must be explicitly considered in decisions on services and service delivery techniques. The goal should be to minimize society's costs.**

Agency costs for producing and distributing infrastructure services must be carefully evaluated because policymakers are directly responsible for these expenditures. The service delivery costs depend on a number of factors, including the chosen technology, the extent of economies of scale, population density, and service delivery conditions such as terrain and rainfall.

A tradeoff exists between service delivery costs and service production. As a result, service standards may need to be adjusted. Certain aspects of quality, capacity, diversity, accessibility, time, or condition of infrastructure can be reduced to fit limited resources. However, demand must be fully considered when tradeoffs are made because systems are much more likely to be successful when people and businesses are offered the services they want. Also, reductions in facility conditions to lower costs may be particularly detrimental to the reliability of some services. For example, water, sewerage, and electric power systems are much more likely to fail when they are not properly designed.

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11. Households also are charged the expense of connecting to major distribution lines in many cases. This can be a desirable financing technique but the major reason to impose the charge is so users pay for benefits they receive.

#### 2.5.4. Institutional capacity

***Objective 2.5.4: To deliver infrastructure services through institutions that have the capacity to provide services effectively.***

Inadequate institutional development has been at the center of most unsatisfactory service delivery results. Examples of investments lost because of the inability to sustain delivery are found in most countries; in many circumstances poor institutions are the underlying problem. Numerous Philippine community water systems have failed because electric stabilizers were not put in the design, sufficient financing was not available, inadequate maintenance took place, and so forth. A review of the problems led to the conclusion that much of the blame goes to poor decisionmaking and inadequate service delivery institutions.

Weak institutions might refer to both the service delivery agencies and to the overall institutional framework in which services are delivered. Problems in service delivery agencies include inadequate financial and managerial capabilities, failure to define goals of the government or agency, poor commitment to success, and poor personnel policies. The environment in which service deliverers operate may be poor because of deficient regulatory and legal systems or donor policies that conflict with the agency's.

It has been argued that building effective institutions to sustain service delivery is more important than making additional physical investments in most developing countries. Still, it must be recognized that some technical assistance projects focused on institutional development have not shown great success to date, although other projects have achieved improvements in institutional capacity.

Institutional development is promoted most effectively by creating the correct set of incentives. One positive step is to structure the service delivery system and to choose the technology after undertaking a careful evaluation of how service delivery agencies operate and relate to users in that country. This information can be used to design the entire institutional delivery system and a set of incentives for effective action.

Incentives must be established so that all participants, including policymakers, managers, operators, and consumers, work together to produce the desired services in cost-effective ways. Efforts must be made to adjust incentives that encourage behavior inconsistent with the desired outcomes.

***Action 25 [P]: Begin each infrastructure project with an evaluation of the incentives that confront each participant in the process. Support those incentives that enhance desired outcomes and alter those that are adverse.***

A second step is to hold service delivery agencies accountable. Privatization of service delivery and development of competitive markets in the private sector is the first of three ways to make organizations accountable. The degree to which competitive markets can be created depends on whether the good is closer to a public or private good. A better chance for competitive markets exists when the good is close to a private good. Competitive markets cannot be created for public goods, so some type of surrogate for a private market must be developed. Second, decentralization

of government may allow for better accountability. Some attempts to create competitive pressures between local governments have been tried by offering grants to the most efficient local governments. Further discussion of privatization and decentralization is provided below. Finally, allowing consumers to have a voice in service delivery decisions can improve accountability. Consumer complaints and endorsements can provide considerable direction for making correct service delivery decisions.

***Action 26: [P] Service delivery agencies must be structured with externally imposed incentives for efficient operations. Ways must be identified to hold agencies accountable by creating competitive pressures or by making them responsive to user attitudes.***

## 2.6. Will Infrastructure Investments be Optimal?

Despite careful attempts to measure demand, the level of infrastructure services may be inefficient for several reasons. The political structure may fail to accurately articulate demand for public goods and can lead to over- or under-provision relative to economic efficiency. Decisions made by politicians based on their time in office, which may be shorter than the life cycle of infrastructure, can result in poor long-term service delivery decisions. Alternatively, lack of trust in political leadership can cause insufficient support for appropriate infrastructure decisions.

Even in cases where demand is correctly articulated, poor public financing systems can lead to inadequate resources in the budget for financing infrastructure. The result will be insufficient infrastructure and user frustration. Foreign exchange shortfalls can cause similar problems.

Third, setting tariffs too low causes excess demand for infrastructure services and the reverse if tariffs are too high. One analyst recently observed that the majority of African countries set user charges below marginal cost. In fact, a likely case in many developing countries is very low or zero charges, which do not adequately ration services. The result may be infrastructure shortages, poor choices of production technologies by firms that use infrastructure services (e.g., firms choosing technologies that are too capital intense because the user price for infrastructure is too low), and overinvestment in infrastructure facilities. Electricity prices in Egypt are an example of low rates encouraging overinvestment in generation capacity. In another case, low water prices in Lagos have contributed to the city's chronic water shortages.

Distortions in other prices may also cause poor infrastructure decisions. Interest rates may be set too low, causing the apparent opportunity cost of resources to lie below the true cost, and leading to excessive public capital investments. Artificially high or low wage rates can distort capital/labor decisions, and so forth.

Next, incorrect infrastructure management decisions may cause inefficient uses of capital, excessive service provision costs, or other mistakes. For example, inappropriate technology may be chosen, causing over- (most likely) or underinvestment in capital relative to labor. Underprovision of maintenance is a related management problem that can require excessive rehabilitation or replacement. Overinvestment in production and underinvestment in distribution of services are other common factors that limit the effectiveness of service delivery. Deficient capacity in the initial design may have resulted from management problems.



Inadequate infrastructure (whether too much or too little) caused by any of the above problems will create a series of adverse economic consequences. These effects can be most disastrous for low-income residents, who are least able to purchase expensive alternatives when infrastructure services are not provided. First, production costs are increased and potential output is reduced. For example, very poor roads and frequent brownouts in Dar-es-Salaam, Tanzania, may have been keeping economic production below what it otherwise could be. Firms may substitute alternative, less-efficient production technologies to lessen the effects. Also, infrastructure is probably more available in some parts of the city than in others, even if the overall level is inadequate. Economic growth may be higher in better-served places as firms move or establish themselves in areas with better infrastructure. This can cause concentration of production. Land prices generally will be higher in areas served by infrastructure, indicating the value placed on infrastructure services. Land rents could be taxed away through user fees or infrastructure charges, but many countries fail to levy adequate tariffs even to fund service costs, and they certainly are insufficient to extract rents. A downside for better-served areas is that the pace of growth may be excessive. Cities or areas of cities that are better served may expand too rapidly, and rural areas may grow too slowly. Next, increased negative externalities, including greater congestion and lower environmental quality, will result from underprovided services. Lower quality of life is an expected consequence of the negative externalities; rationing of services and inadequate service quality can also be expected. Poor health and resulting low productivity are related effects of low service quality.

### III. FINANCING INFRASTRUCTURE SERVICES

**Objective 3.0: To determine the best source of financing for infrastructure investments and for operation and maintenance of facilities.**

Adequate financing is necessary for sustainable infrastructure systems. The role of finance is more than to ensure that sufficient funds are in place, because financing schemes can affect incentives and other goals, such as equity. This section examines topics in the financing of infrastructure. The discussion is separated into financing the initial physical capital investment and financing the operations and maintenance of services. This section only addresses financing where the resources are monetized. Often infrastructure can be fully or partially provided through self-help and in-kind contributions. These alternatives are recognized but not considered separately.

#### 3.1. Financing Initial Infrastructure Investments

**Objective 3.1: To determine the appropriate way to finance capital expenditures on infrastructure.**

Governments, donors, and the private sector are funding sources for infrastructure facilities (see Box 3.1). Government and internally generated private funding ultimately must be drawn from the same domestic resources. Donor resources or externally generated private-sector funding come from outside the country. These external resources will have the greatest economic effect when domestic resources are unavailable.

##### **Box 3.1. Financing transportation investment in Indonesia**

Indonesian investment in roads, airports, mass transit, and seaports has been financed from a combination of sources. User charges directly financed about 10 percent of investment. User fees can be levied in a number of areas, including mass transit, airports, and seaports. Toll roads can only be selectively implemented, but road usage can be priced in other ways, such as through gasoline taxes. External funds from donors plus other foreign borrowing have contributed about 40 percent of transport finance. Local funds, which can include general tax contributions and domestic borrowing, have provided the other half, according to World Bank data.

#### 3.1.1. Government funding

**Objective 3.1.1: To determine which infrastructure services should be financed through government sources and to identify the appropriate funding source for government finance.**

A strong capacity to finance certain services through government revenues is essential. Own-source revenues and borrowed funds are the financing sources for central governments. Subnational governments can add intergovernmental transfers from the national government to this list (Box 3.2). Intergovernmental revenues have been a primary financing source for local government infrastructure investment in many countries.

**Box 3.2. Intergovernmental transfers**

Intergovernmental transfers refer to financing assistance provided by one government to another. Normally the assistance goes from the national to a local or state (provincial) government or from the state to a local government. The assistance may be given to improve the efficiency of service delivery, to share the greater revenue-raising ability of higher governments, or to improve equity. The transfer may be in the form of a grant or a loan. Intergovernmental transfers do not increase the revenues available in government; they merely shift resources from one government to another. The granting government must finance the transfers through taxes, fees, or some other means.

The own-source current revenues of governments include taxes, charges for services, fees, net profits from government-owned companies, and miscellaneous revenues such as the sale of assets and interest earnings. Own-source capital revenues can include depreciation accounts and repayment of debt to the government. Both current and capital revenues may be deposited in the government's general fund or in an earmarked account. Infrastructure can be financed through either mechanism. An example of earmarked funds is the deposit of gasoline taxes in an account that can be expended only for highway maintenance and construction. Tax increment financing and urban service fees, though used only to a limited extent, are examples of innovative ways to generate revenues for an earmarked pool.

Borrowing is the other major funding source. However, borrowing is not a unique financing source if the resources must be repaid, as that simply shifts the timing of when own-source revenues must be raised to finance the infrastructure. Resources can be borrowed through a conventional bond market or from the banking sector, individual savers, or pension and other accounts, many of which may be controlled by the government. Note that these borrowed funds probably come from a private rather than a public source. The choice between using borrowed funds and own-source revenues is one of selecting the timing for payment of services. Borrowing is appropriate when it is acceptable to pay for the service over a considerable period, such as when benefits accrue over many years.

Borrowing could be from the Central Bank. In this case, infrastructure investment may be financed by creation of money, and greater inflation is the likely consequence.

***Action 27 [P]: Governments should use borrowed funds only to finance infrastructure investments in which the service benefits will be received over a period of years. The borrowed funds should be repaid at least as rapidly as the service flow from the facilities.***

Local governments frequently have limited ability to borrow, either because a fully operating credit market does not exist in the country or because local governments have inadequate own-source revenues for debt repayment. One possibility for providing local governments a borrowing option is the use of infrastructure development banks. The banks must initially be funded from some source, which could be the central government (Kenya), bond issues, or a group of local governments (Brazil). The World Bank has assisted in funding 26 infrastructure banks (Israel, 1992). Of course, initial finances from the central or local governments must be drawn from borrowings or own-source revenues. Few, if any, developing country infrastructure banks currently obtain funds by borrowing from the private sector.

Infrastructure bank resources are loaned as a source of funds for the initial costs of infrastructure projects. Loans must be repaid by the borrowing organization, usually from user fees. Amortization and interest payments from initial borrowers provide a revolving fund that can be used for lending to others. Infrastructure banks may lend resources to organizations other than local governments, such as to a local water authority.

Interest rates imposed on borrowers from infrastructure banks should be set at market levels for both financial and economic reasons. Financially, interest rates set below the market result in a subsidy to the borrower, and the subsidies eventually drain the bond bank's resources. Economically, market rates ensure that local borrowers make proper infrastructure decisions. Borrowers from a bond bank should choose projects only after analyzing benefits and costs using the interest rate to properly discount flows across time (as discussed above). The interest rate charged by a bond bank will be used for discounting. Projects will be selected that fail to return the opportunity cost of the invested funds if the rate is set lower than the market rate, because the market rate reflects the opportunity cost of infrastructure projects. Subsidized interest rates make long-term investments appear more attractive than they are to the economy.

Market rates will be necessary if infrastructure banks are to survive financially.<sup>1</sup> Despite the desirability of market rates, political expediency often leads to below-market rates. Infrastructure banks in developing countries generally have failed; a partial explanation is that they have set interest rates below market. Local governments in India and in some Brazilian states are exceptions, as they borrow at market.

***Action 28 [P]: In countries in which a functioning credit market does not exist or in which local governments have limited access to credit, infrastructure banks could be created to allow local governments to finance infrastructure investments. Local governments or other borrowers must be required to repay the borrowed funds. The interest rate charged on borrowed funds should be established at the rate that would be charged by an operating financial market.***

Also, infrastructure banks must have guidelines on the creditworthiness of the borrowing local government. Limits on debt relative to government revenues is one such guideline. Constraints on debt per capita or similar rules could be devised as well. These guidelines may be poor proxies for governments' ability or willingness to repay debt, so borrowing and repayment records must be closely followed. Attachment of intergovernmental revenues when local governments fail to make debt payments is one mechanism for encouraging repayment.

### 3.1.2. Donor financing

Donors are the next major group that finances infrastructure. Donors provide financial resources to an indigenous source, often the central or local governments. Donor funds provide access to resources from outside the domestic economy. These external funds have a greater stimulative

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1. Market rates will reflect a real rate of return, inflation, and lender risk.

effect than domestic funds because no initial crowding out is anticipated.<sup>2</sup> The funds can be granted or loaned; the stimulus is lower for borrowed funds because foreign exchange must be used to repay the donor. It has been estimated that less than US\$4 billion of housing and infrastructure is financed by donors in developing countries each year, so donors provide only about 3 or 4 percent of total investment financing. For example, the World Bank lent US\$1.66 billion for infrastructure in 1991, representing about 40 percent of total bank lending.

Donor-financed projects have the potential to distort the rational decisions of indigenous service providers. The wrong technology could be chosen or the physical facility might be "gold plated" with features that are unnecessary for the economic environment. Distortions can occur because donors offer subsidized interest rates, causing the same problems described for infrastructure banks. Also, distortions can be caused by donors establishing rigid standards, particularly related to physical inputs (such as type of water system technology that must be used), which fail to adequately consider local service delivery conditions.

***Action 29 [P]: Developing country governments and donors must work together to ensure that donor financing is provided in a way that causes selection of economically efficient projects and technologies.***

### 3.1.3. Private equity financing

Private-equity financing is the final source of funding.<sup>3</sup> Private-equity financing could come from the resources of parastatals or private-sector companies. Self-help is another form of private-equity finance. This discussion centers on private firms.

Private-equity financing occurs when the private sector has ownership or partnership interest in the infrastructure. This can involve some form of build-operate-transfer (BOT) arrangement, in which the private sector builds and then operates the facility for some period, after which the facility is transferred to the government. A carefully specified agreement between the private firm and the government must be negotiated (see UNDP). Very few entirely new infrastructure projects have been developed through the BOT mechanism, although the number of examples is growing. Turkey has BOT projects for airports and highways under way. Mexico, Thailand, and Malaysia also have road projects in process. China permits foreign corporations to undertake BOT projects for electricity and toll roads as a means of raising foreign equity capital. Hopewell Holdings Ltd. of Hong Kong currently operates an electric power plant in Guangdong Province and is starting a second. The firm arranged financing through banks and is permitted to sell power to repay the investment. An 18 percent annual return is expected. Hopewell is building another power plant in the Philippines and a toll road linking Canton and Hong Kong.

Despite the anecdotal evidence, the BOT arrangement will continue to be used infrequently. Major reasons for this include the lack of a proper regulatory framework and the unwillingness of private firms to share the risks of investments. (Israel, 1992). Authority to set the necessary rates and fees is another problem.

2. Crowding out still can occur if the construction sector or some other sector is unable to build both domestic and donor-financed projects.

3. Private lending is included above in borrowing.

An alternative to BOT arrangements is concessions, where a private firm contracts with the government to operate or expand an existing component of the infrastructure (see Box 3.3). Concessions have been more common than BOTs and probably offer much greater potential. For example, Venezuela is examining privatization of airport operations. In practice a normal difference in emphasis is that BOTs frequently focus on infrastructure construction, whereas concessions concentrate on infrastructure management and operation.

### **Box 3.3. Private operation of water services**

The government and a private firm work jointly to deliver water services in Côte d'Ivoire. The government undertakes investment, planning, and construction. The private firm, SODECI (SOCIÉTÉ des Eaux Côte d'Ivoire), operates and maintains the system for Abidjan and 240 other cities and towns. SODECI was originally founded by a French firm, but currently 53 percent of the firm is owned locally and 47 percent is French owned. The contractual arrangement specifies user fees and the portion of revenues going to SODECI and to the government. SODECI has control over personnel policy, but the government regulates service levels and water quality.

SODECI provides service to about the same number of households as the National Water Supply and Drainage Board (NWSDB) in Sri Lanka. O&M cost per cubic meter is about six times higher for SODECI, but service quality is better. SODECI provides 40 percent more water using fewer than one half the employees. SODECI delivers water 24 hours per day, versus 13 hours per day for NWSDB. The leakage rate for SODECI is about 10 percent, compared with 30–40 percent for NWSDB. Payment records are one measure of consumers' perception of service quality, with greater willingness to pay for better quality: SODECI has a 77 percent collection rate for its much higher fees, compared with 30 percent for NWSDB.

Private-equity financing offers another alternative with a number of advantages. First, private financing offers access to resources that otherwise would be unavailable. This appears to be the major impetus for China's decision to allow BOT projects for roads and electricity. Such private financing can have a stronger economic stimulus if it does not crowd out other investment, which it would in cases where private financing came from nondomestic sources, as it often does in China. Second, private capital from domestic sources may be helpful when the public sector has a weak financing system. Private financing can serve as a funding substitute when the public sector is unable to generate adequate resources. Third, private financing is also sought because it can lower the public sector's risks of making the wrong infrastructure investments. However, in most circumstances, the private sector demands some type of guarantee or public equity financing so public risks are not eliminated. Fourth, some reduction in construction costs and gains in infrastructure efficiency could result from practices and innovations of the private sector as the service delivery agency.<sup>4</sup> But very careful regulation of firms or strict bidding procedures must exist for firms to have incentives for transferring these potential benefits to consumers. Contracting and negotiation costs that arise when the government hires the private sector often offset efficiency benefits during the design and construction phases. Experience with BOT arrangements indicates that the negotiation process is often extended and difficult.

4. Of course, the private sector could potentially offer the same cost efficiency advantages by managing service delivery without providing private equity.

Disadvantages of private equity finance may result in some cases in which the private sector rather than the public sector selects projects. For example, a firm may approach the government with a proposed project that would require the government to engage in cost sharing or to build infrastructure (such as roads and electricity) to support the new facility. The ability to leverage private resources may encourage the government to comply. However, the government's resources may be diverted from more productive uses.

**Action 30 [P]: Private-equity financing should be solicited when private sector delivery of services will offer greater advantages than public sector delivery. The advantages can include operational cost savings and access to external finance.**

### 3.2. Financing Operations and Maintenance

**Objective 3.2: To determine the best financing source for operations and maintenance costs.**

Operations and maintenance (O&M) are normally financed through user fees, general fund contributions from the government, or intergovernmental transfers from the central to local governments. Intergovernmental transfers are often financed by the general fund of the central government. Intergovernmental aid has been the first victim of tight national budgets and has proved to be an unpredictable financing source for O&M expenditures in many countries (see Box 3.4). Transfers from the national government's general fund are almost always inadequate to meet needs. O&M, and particularly maintenance, may compete poorly for available general fund resources because the benefits often are not readily apparent. National governments may object to financing O&M because decisions to deliver services may have been made locally rather than nationally. Furthermore, general fund financing is likely to exacerbate government deficits, thereby increasing the negative macroeconomic consequences of deficits.

#### **Box 3.4. Intergovernmental revenues can be unpredictable**

Local governments are often promised revenue transfers from the central government but fail to receive the revenues when national tax revenues are tight. Local governments in Egypt receive financing for capital projects in four quarterly payments. A number of local governments have failed to receive the fourth quarter allotment in recent years. National authorities say projects are behind schedule, a point that local officials dispute. Local officials claim they must use local sources to replace these funds so they can finish the projects. Between 1978 and 1982, local governments in Ibadan, Nigeria, received only 12.8 percent of grants expected from the state government as a result of a statutory formula (see Peterson et al., 1990). The central government in Guatemala took over responsibility for collecting the property tax in 1988. Local governments were to receive a share of revenues. Despite rising property tax revenues, local governments are receiving the same funds as in 1987, and the funds are often very late in coming.

User fees are the preferred financing method whenever viable.<sup>5</sup> User fees can finance the full cost of infrastructure services that are private goods but probably cannot be the sole source for infrastructure services that have significant externalities. Water, roads, and telephones are private

5. User fees also can be the financing source for repayment of funds borrowed for initial infrastructure investments.

goods and can be fully financed with user fees. Sewerage, solid waste disposal, and urban mass transit can be partially financed with user fees but may need some contributions from the general fund.

User fees can be imposed in a variety of ways. The traditional means is a price levied per unit of purchased services. A specific charge per cubic meter of water is an example, but household metering is necessary to levy effective charges for water. The fee should be equal to the long-run marginal cost of delivery.

A second type of fee is a charge levied on a proxy for infrastructure consumption. Gasoline taxes are often levied with the expectation that gasoline consumption is a proxy for use of roads. A tax levied on the rental value of land or on the increase in rental value (that resulted from improved infrastructure services) can be intended as a surrogate for a charge on infrastructure services. Land served by infrastructure in Santa Cruz, Bolivia, sells for more than 10 times the price of unserved land, making the differential land value a good target for taxation.

A third form of fee is a lump sum charge for access to a service. A monthly charge to access all the water the user wants is an example.

Ability to impose user fees depends on user's willingness to pay, which is enhanced through good service delivery. Willingness to pay is greater when service delivery is reliable and consistent with users' demands. Allowing users a voice in initial project design is an important means of increasing their willingness to pay. Clear communication with users, from the initial stages of project design onward, as to how much they will be expected to pay, is another important means of encouraging willingness to pay.

**Action 31 [P]:** *User fees should be the source of finance for infrastructure investments and O&M to the extent possible. Services in which the benefits are private goods normally can be financed 100 percent with user fees equal to long-run marginal cost. Other services may require some financing in addition to user fees.*

User fee revenue appears to be the best source of O&M financing. Some revenues may be deposited into an earmarked fund in order to prevent user fees from being raided for other purposes.<sup>6</sup> However, the government must be committed to allocating earmarked funds as directed and not use them instead for expansion and upgrading. In addition, earmarking will succeed only if it is a manifestation of the government's commitment to maintenance, and not a substitute measure. Properly levied fees with the revenues deposited in a fund usually will allow sufficient revenues to adequately deliver services. Alternatively, fee revenues in many developing countries may go to the government's general fund rather than an earmarked pool for O&M. Fee revenues from a number of services go through the general government budget in Egypt rather than through separate pools for financing each service. On the other hand, in Paraguay, 10 percent of fuel tax revenues and revenue from a surcharge on imports are deposited in an earmarked fund for road maintenance.

**Action 32 [P]:** *A portion of user fee revenues should be available to finance the infrastructure's facilities and O&M.*

6. Delivering infrastructure services through a public sector company or authority can be an alternative means for preventing use of the funds for other purposes.



### 3.2.1. Advantages and disadvantages of user fees

Financial and economic gains result from financing services with user fees. First, financial sustainability requires sufficient resources to provide adequate O&M for the infrastructure. User fee revenue is the most reliable source of funds, but the fees must be high enough to provide the necessary revenues. User fees are imposed in most countries for at least some services, but the fees are set well below the marginal cost of services, so they often fail to generate required revenues. A survey of 37 countries reported by Israel (1992) found that user fees for telecommunications averaged 172 percent of service delivery costs. Road fees also tend to cover costs. Water services generally are the least able to be funded by user fees. For example, both China and Egypt impose water fees, but in each case the fees are low compared with service delivery costs. The effectiveness of user fees as a source of cost recovery for electric services lies between the extremes of water and telecommunications. The pattern suggests that user fees are employed more frequently and the fees are set closer to the cost of service provision when services are delivered by a private company or separate authority than when provided by a government department. As noted above, subsidies from the governments' general fund cannot be relied on to adequately finance operations and maintenance for those services that are not funded with user fees.

Second, economic efficiency is enhanced by setting prices (user fees) at the marginal cost of producing and distributing services. User fees ration service delivery to the economically efficient amount. This is because consumers will be unwilling to buy services unless they expect benefits at least equal to the user fee, so economic efficiency results from pricing the service. For example, failure to set water prices as high as the cost of delivery can encourage excessive use of water delivered through household connections. When the price of water is too low, household taps may be used to water gardens or water may not be shut off properly. The need for proper pricing of services grows as the service delivered becomes more sophisticated. Another advantage of pricing is that determination of user demand is directly revealed as consumers decide how much to purchase. Note that the economic efficiency benefits are obtained by properly pricing services, even if user fee revenues are not earmarked for financing service delivery.

***Action 33 [O]: Where possible, user fees should be directly linked to the level of consumption rather than being imposed as monthly charges. However, fees linked to consumption are only viable when the management capacity exists to meter consumption.***

Third, user fees follow the benefits-received principle: only recipients pay for services; nonconsumers are not charged. Low-income residents benefit from user fee financing if services are targeted to or normally demanded by high-income residents. Low-income people will neither pay for nor consume the services. Alternatively, tax financing of the same services may use revenues paid by low-income people for delivering services to high-income individuals.

User fees may fail to generate sufficient revenues or may need to be adjusted to meet several goals. First, user fees may not raise enough revenues to fully fund O&M if they are not properly enforced. Electricity, standpost water, and other services may be easily stolen, which makes it difficult to raise sufficient revenues. Also, political officials may be unwilling to impose fees or to cut off service delivery to nonpaying consumers. Payment of effluent fees to a number of companies in China has been delayed during the last two years because of financial difficulties.

Burma's Second Telecommunications Project only permits disconnection for failure to pay fees after one year (Israel, 1992). Excusing nonpayment makes imposition of user fees more difficult, because payers feel the system is inequitable. In sum, consistent enforcement of the established fee schedule is a key to financial sustainability.

***Action 34 [P,O]: User fees must be consistently enforced and all users must be required to pay. Services must be cut off and legal remedies exercised to ensure payment.***

Second, user fees can fail to fully finance service delivery even when they are set at marginal cost and enforced. Insufficient revenues can result when demand for services is lower than what is necessary to obtain all available economies of scale (that is, production is occurring in the down-sloping part of the average cost curve). Benefit-cost analysis is an economic rather than a financial analysis and could indicate that a project is appropriate even when it would lose money in operation. Service delivery remains economically efficient as long as total benefits exceed total production costs. Benefits exceed costs when consumer surplus (benefits above the user fees) exceeds the loss incurred from producing the service. The problem is to identify a means for financing the loss. A two-part pricing structure, such as one price for accessing telephone services and another price per call, is an example of how the service can be made financially sustainable and still achieve economic efficiency.

Third, user fees may raise insufficient revenues when the service has positive externalities. The price direct recipients pay should reflect their share of total benefits; normally this price is lower than marginal cost. Indirect recipients value others' consumption of sewage treatment, solid waste, and other services, but cannot be easily charged for their benefits. Thus, the government probably needs to subsidize the services. Greater urban transport use, for example, can benefit nonriders because of reduced congestion on the roads. Thus, a subsidy to encourage subway or bus ridership can be economically efficient. Furthermore, there may be hesitation about pricing some services, such as sewerage or solid waste disposal, because consumers could be discouraged from purchasing the service.<sup>7</sup> But the benefits of a low or zero price must be weighed against the lost revenue necessary to finance provision of the service. In most cases, some change will be appropriate.

***Action 35 [O]: User fees should be set at marginal cost. Separate connection charges may be necessary for services such as water, electricity, and telephones. A limited subsidy may be necessary for services with significant externalities.***

Next, user fees can raise at least a perceived equity problem because certain consumers or entire communities may be unable to purchase improved water, electricity, or other services. Minimal consumption of merit services may be regarded as part of subsistence living, and the government may seek means to allow each person access to these services regardless of their ability to pay. Unfortunately, the economic efficiency gains from imposing user fees and the equity goals are often in conflict. Reducing the price for all consumers is a very ineffective means of achieving equity because the benefits are not targeted to low-income consumers. Several means can be found for bringing equity into the pricing system without completely violating economic efficiency. One

7. Strictly enforced prohibitions against unauthorized disposal of sewage or solid waste can prevent consumers from choosing not to consume the service. These may be hard to enforce in many developing countries.

is to tie the user fee to income. Certain very-low-income consumers can be charged a minimal "lifeline" fee for the service while the vast majority of consumers pay the marginal cost fee. Of course, this requires an ability to measure income. Condition of the housing stock or some other externally visible proxy for income could be used to measure income. An alternative is a rising block pricing scheme. A rising block scheme is one in which the fee for additional units of consumption rises with usage. A rising block system probably will violate marginal cost pricing principles, but the problem will be minimal if the system is designed so that most consumers pay marginal cost. Also, rising block schemes may actually penalize low-income households. This occurs in cases where low-income households are not individually metered or where water is resold to other households. Many low-income families may be jointly priced, which results in their paying higher rates than separately metered high-income households (see Box 3.5). Another approach is to offer better services at a higher fee. Household taps could be made available to people at a high fee and standpost water at a much lower fee. Everyone could be offered access to some level of service in this way.

#### **Box 3.5. Rising block fees in Kumasi, Ghana**

A rising block pricing structure is used to sell potable water in Kumasi, Ghana. The first 3,000 imperial gallons of water on each meter are priced at 184 cedis (about US\$0.53) per 1,000 gallons. The price is 316 cedis per 1,000 gallons for consumption between 3,000 and 10,000 gallons. The rate is 460 cedis for consumption above 10,000 gallons. A survey of households found that 85 percent of residents lived in rental housing, 32 percent purchased water from neighbors, 10 percent obtained water from public taps or neighbors' wells, and 57 percent purchased water through a shared meter in a multifamily dwelling. None of the tenant households had individually metered water. Water rates are set per building (per meter), and relatively better-off households tend to live in less densely occupied buildings. Furthermore, low-income households are more likely to purchase water by the bucket from neighbors or to pay a flat rate for water purchased from neighbors. Analysis of monthly water bills leads to the conclusion that low-income people generally pay more for water. The major reason is that their densely populated buildings are more likely to confront the highest rates for water. Also, water purchased by the bucket from neighbors is more expensive. The average water bill for households purchasing water by the bucket is 53 percent above that charged to households purchasing through a shared meter. These results emphasize the need for sensitivity as to how pricing policies, which appear reasonable on the surface, affect low-income households in application (Whittington, 1990).

***Action 36 [P]: Equity should be integrated into a user fee-financed service by offering special programs for those least able to pay, not by lowering the price for all consumers. Lifeline rates, rising block pricing structures, and varied service levels are ways to introduce equity.***

#### **3.2.2. Establishing the price**

Setting the correct price requires knowledge of demand and marginal cost. Price should be set equal to the long-run marginal cost of service delivery, which includes the capital and O&M costs. Costs arising from externalities in the consumption or production of services should be included in the marginal cost, such as the additional congestion resulting from another vehicle on the road. Frequently, costs can be separated into those associated with connecting households to the system and those associated with production of the service. In these cases, a one-time connection fee can be charged in addition to a regular fee. Households in the Philippines are charged an initial connection fee for water services, in addition to the monthly user fee. Engineering studies and actual experience in areas where the service has been delivered can be good sources of information. Demand can be estimated, as discussed above, using research from willingness-to-pay studies and analyses of served regions.

Selecting an appropriate price when the service is initially offered can be important to designing a financially sustainable system. Initial user fees should be set at a sufficiently high level to cover costs. A price that is too low is particularly troublesome because it may be politically and practically difficult to dramatically raise rates soon after service delivery begins. Dissatisfaction or even riots can result from significant increases in prices for necessities. Therefore, users should be fully informed of the need to pay for services, of the fee structure, and of the likely need for fees to rise on a regular basis with increases in service delivery costs. Fees in many developing countries have gone unchanged, or declined in real terms for 15 years or more. This must be prevented, with prices increased regularly to avoid the difficulties of infrequent, large rate hikes.

***Action 37 [O]: As new services are planned, an information campaign should be undertaken to fully inform consumers of plans to set user fees to cover all costs, and the fees should be properly set with inception of service. Consumers should be made aware that future rate increases will be necessary as costs rise.***

A careful plan must be developed to introduce user fees for services that have been delivered in the past at nominal or no charge. Water services have been priced too low in many countries and policymakers have been hesitant to raise them substantially. Opposition to imposing user fees can be lessened by combining the price with a plan to improve services. In many cases service delivery has been inadequate, and consumers will pay for improvements. An alternative is to continue giving away (or pricing very cheaply) the inferior service and to provide a higher level of service to those who are willing to pay. With either approach, the resources generated from the fees should be used to finance service delivery improvements. However, using new revenues for better service delivery means that user fees should not be viewed as a quick means for reducing government budget deficits. Over time, revenues raised with user fees can replace subsidies and improve the budget position.

***Action 38 [O]: Imposition of user fees for previously unpriced services should be combined with service delivery improvements. Prices that are too low should be consistently raised with a target of reaching full marginal cost price.***

## IV. INSTITUTIONAL ISSUES

Privatization and decentralization can introduce greater competition into service delivery and cause service delivery to become more demand-oriented.

### 4.1. Governmental Responsibility

A clear delineation of responsibilities across levels of government is essential for efficient service delivery. In many countries the issue may be simply articulated as the degree of governmental decentralization appropriate for delivering each infrastructure service. This discussion evaluates the appropriate level of government to perform various functions in delivering infrastructure services. A role for the private sector may also exist.

***Objective 4.1: To determine which level of government should be responsible for service delivery.***

Substantial differences exist across countries and types of infrastructure in the sorting of responsibilities between levels of government. Nonetheless, the central government is responsible for infrastructure investment in most countries. Local governments provide 2 percent of investment funding in the Philippines and 5 percent in Tunisia. Still, the best strategy often allocates some responsibilities to each level of government (see Box 4.1). Local governments have had a much larger role in operations and maintenance activities in many countries. This section cannot provide rigid rules for how service responsibilities should be designated for every country, but a series of factors can be identified that will influence the degree to which local versus central governments should play a role in service delivery. Discussions of decentralization often focus more on political ramifications than economic benefits. Political factors are not considered here.

#### **Box 4.1. Water delivery responsibilities**

An example of shared responsibility is the allocation across governments for water services:

1. At the national level, an agency can be developed with responsibility for long-term planning, standard-setting, finance, procurement of imported parts and technical assistance, coordination of training, and provision of advice and support.
2. At the regional level (e.g., state/provincial governments), an agency can be created with responsibility for the development and finance of nationally approved standards and regulations, supervision and support to local systems, and planning and training for local management and technical staff.
3. At the local level, entities can be developed with responsibility for the management, collection of fees and monitoring of use, operation and maintenance of the local system, and, where size is appropriate, budgetary planning functions.

#### **4.1.1. Defining decentralization**

Decentralization is a value-laden term with widely different connotations. Care must be taken in determining which concept is being considered; it is generally preferable to use a more specific term. Some consider decentralization the devolution of authority to local governments. Devolution refers to the transfer of authority and responsibility for service delivery from the central

to local governments. Others may use the term to mean deconcentration of central government ministry staff. Deconcentration is movement of ministry offices to regional or local levels. This may occur with or without authority to make decisions outside the center. Deconcentration with authority means that regional or local officials are able to make many basic service delivery decisions. Of course, officials whose offices are deconcentrated often hesitate to make such decisions, even when granted the capacity to do so. Others may have privatization, public sector companies, or public authorities in mind when decentralization is mentioned.

#### 4.1.2. Advantages of devolution

***Objective 4.1.2: To identify benefits from devolving services to local governments.***

Devolution works well for delivering some services, but not for others. Devolution is most effective when economies of scale are limited, local choice is strongly desired, different tastes for services exist, benefits from service delivery mostly accrue to local residents, and strong local governments exist. Devolution is least effective when there are many beneficiaries across wide geographic areas, tastes for services are homogeneous, and economies of scale and economies of large geographic areas are significant. Trends in technology permit production in smaller and smaller units, meaning economies of scale are becoming less important and the potential for devolution is growing. Water, wastewater, city roads, solid waste collection, electric distribution, buses, and subways are often effectively administered through a devolved government structure. National roads, electricity production, and national telephone lines are examples for which devolution may be less effective. Even electricity production can be devolved in countries that have large populations or land areas.

In many cases, joint service provision by the national and local governments is a likely service delivery scenario, so the national government retains some role even with devolution. In these cases many essential functions for the central government remain. City roads may be provided at the local level and national roads at the central level. At a minimum, national oversight to ensure fair, noncorrupt, efficient service delivery remains a vital function. Some national financing may also be needed. Each government's responsibility must be clearly delineated to prevent duplication and conflicting conclusions (see Box 4.2). Understandable guidelines and allocation of responsibilities for maintenance can be particularly important.

#### **Box 4.2. Duplicated infrastructure planning**

Local government reforms were undertaken in Nigeria in 1971 and 1976 with the goals of developing more effective local councils and improving local revenues. Local council performance continues to be limited by duplication in planning functions. Four government agencies besides the local councils are responsible for urban planning, and both federal and state authorities frequently interfere with local council decisions. Councils have very weak planning capacities because the staffs receive training in general administration rather than in technical areas. Conflicts between national and local officials often arise because of differences in orientation during the planning process. Furthermore, the goals as perceived by federal and local officials frequently differ. Duplication of projects and excess capacity are results of poor development of local government skills and unclear lines of responsibility (see Peterson et al., 1990).

Devolved governments, and to a lesser extent deconcentrated governments, potentially offer several significant benefits including ability to deliver services that meet demand, efficiency, improved accountability, and greater ability to raise revenues. These benefits are expected to result from the existence of many relatively small local governments. The benefits may be less significant when local governments are the size of a metropolitan area. First, local governments can better tune services to demand. Local governments are often in a better position to know local tastes and to choose an appropriate set of services to meet demands of each local group (see Box 4.3). Devolution is particularly important for services in which feedback from users is essential to understanding the service characteristics being demanded. Furthermore, devolved services offer people and businesses a choice of services and taxes that is consistent with their respective tastes and needs. Central governments, on the other hand, tend to deliver similar services across regions without full consideration of local demands.

**Box 4.3. Meeting water demand in the Philippines**

Government policy in the Philippines has been to provide point source wells in villages least able to finance improved water, and to provide public faucets designed to serve six to eight households in more densely populated areas. Numerous improved water systems were built in villages during the 1970s and 1980s. Donors financed capital investment for many of the systems. Most of the systems went out of operation after several years, despite few payments being made to amortize the initial investment. One reason is that more affluent residents often connect household taps to the distribution pipes used for the public faucets. A general national government policy of designing the system for public faucets without regard to local information on demand has been an important factor in the failure of some systems. Water systems intended solely for public faucets are unable to deliver the quantity of water demanded with household connections. As a result, system operators adopt strategies to deal with water shortages, such as only operating during limited hours of the day. Users become dissatisfied and are less willing to pay as they perceive low service quality. The problem of sustainable water systems is exacerbated because surveys show that people are more willing to pay for household taps than for water taken from public faucets (Bohm, Essenburg, and Fox, 1993).

Second, efficiency can be enhanced in two ways. Some competitive forces can be fostered through "voting with the feet," which occurs when people and businesses move where services are consistent with their tastes. The risk that residents and businesses will vote with their feet can help make local governments more efficient. Local governments may seek to provide a better return for tax and fee revenues to attract or retard migration of residents and business. The importance of migration as a stimulus for competitiveness within a country depends on many factors, including local culture and geographic size of the country. The greatest effect of voting with the feet occurs between different local governments within a single urban area.

Also, lower-cost service delivery can occur if smaller, devolved governments are not subject to the diseconomies of scale associated with production by large cities or national governments. Diseconomies occur when minimum average cost is set at service delivery levels well below the size of the nation or large city. Diseconomies may arise as the management hierarchy becomes top heavy when services are provided across a wide geographic area or to many users. Service providers that are too small can incur diseconomies as well. Household water costs in Philippine

villages are 41 percent lower when 1,000 households are served than when 150 households are served.

Accountability is a third potential advantage of devolution. Competition between governments can cause local governments to be more accountable for services and taxes to attract desired households and businesses. Also, greater accountability is fostered by devolution because consumers are better able to identify those responsible for delivering services. Local governments can be more responsive as there are fewer conflicting interests to balance against each other.

Finally, some believe that users are more willing to pay for services provided by local governments due to their greater accountability. The presumption is that at the local level users are better able to link payments of a tax or fee to receipt of specific services delivered at the local level.

***Action 39 [P]: Service delivery should be devolved to local government to the extent possible, particularly for services such as water, sanitation, solid waste collection, and local transportation.***

#### 4.1.3. Requirements for effective devolution

***Objective 4.1.3: To ensure that the conditions are in place for effective devolution.***

Several factors must be in place for devolution to be a significant near-term option for a country. The existing government structure is an important determinant of the degree of decentralization possible in the near term. It is unlikely that a devolved system for infrastructure services could be practical unless substantial devolution already exists. Local governments need time to develop skills in decisionmaking, administration, revenue raising, and other areas before substantial responsibility can be passed to them. In addition, the existing level and success of decentralization may determine the political acceptability of further movements toward devolution. Deconcentration of the central government may be more practical in the short term if no devolution has occurred, yet even deconcentration may require some time for training and experience if little prior deconcentration exists.

Second, the structure of other institutions may be important to an effectively devolved system. For example, local governments cannot be expected to raise capital for major investments if no capital market exists. Local governments will be unable to purchase needed engineering services through the private market if no private market exists for the services. These problems can be overcome either through central government solutions (such as an infrastructure bank) or through interim support from the central government (such as short-term provision of engineering services). However, care must be exercised to avoid creating new public institutions that are likely to be perpetuated and undesirable in the long term. A clearly determined life span for institutions may help in eliminating them when their useful life is over, although the term must be sufficient to allow their goals to be achieved.

Next, the nationwide effectiveness of decentralization will be limited if necessary labor skills are unavailable. Insufficient skills are a problem in many developing countries, but the problem of limited skills is not as significant in the largest cities. Skilled labor is often unavailable in outlying areas, and workers with skills may not want to move to rural areas. Skilled workers



frequently prefer careers in the capital city, and may feel that the quality of life is inferior in a rural place or small city. One solution is to train people for work in outlying regions. Even so, once they have useable skills it may be difficult to keep them in outlying areas or even to keep them in government. Another option is to assign responsibilities so that more technical skills are undertaken by line ministries in the capital and more mundane tasks are performed by institutions in the field. Technologies must be carefully chosen to ensure that appropriate skills are available.

Third, the geographic scope of benefits can help determine the hierarchy of responsibilities. Defining service benefits by region is difficult because users may differ from service beneficiaries. Still, it is clear that direct users of the sewerage system are only a subset of the beneficiaries. Though major beneficiaries of a sewerage system may be local residents, downstream cities also benefit.<sup>1</sup> Devolution is more effective if governments are large enough that the benefits are received by all residents. Unless the government is large enough to incorporate service benefits, it will make service delivery decisions without fully considering nonresidents. For example, national roads may need to be designed and coordinated by the central government, although they could be constructed locally. On the other hand, intracity roads can be effectively designed, constructed, and operated at the local level because of the narrow range of benefits. The largest cities in many countries are of sufficient size to include most of the benefits from service delivery and may require little national oversight.

Perhaps most important, local governments need sufficient authority to meet their designated responsibilities or devolved service delivery is likely to fail. A tendency may exist to give local governments responsibility for delivering services, although they are not trusted enough to grant them the authority to do so. Failure to grant authority may illustrate the fear that local governments have insufficient capacity to deliver services. Alternatively, there may be a fear that the political risks of local revenue-raising are more damaging than poor service delivery.

Devolved governments must have the legal ability and institutional capacity to raise revenues and retain them at the local level for service delivery (see Box 4.4). Wide differences exist in the financial independence allowed local governments. Predictable grant structures must be combined with local revenue authority to form the basis for fiscal devolution. The grant structure is important because national governments can effectively eliminate local incentives to raise revenues by reducing grants when more revenue is raised locally. Local governments will respond to the fear of lost grants by limiting local revenue mobilization, particularly when national transfers are large relative to local revenues.

Permission from the national level is needed to raise other local government fees. Local governments are hesitant to use their very limited capacity to increase fees or tax revenues, fearing that national government transfers will be reduced if additional local revenues are raised. This ensures

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1. Revenue transfers from the central to local governments frequently are not intended to allow local governments to deliver services, but to cause them to consider benefits received by nonresidents. For example, the U.S. interstate highway system was built by state governments with 90 percent of the funding coming from large national grants.

that local governments remain dependent on national transfers because they have no incentive to raise revenues locally. Local revenue generation will become a reality only after proper incentives are instituted (see Fox, 1985).

**Box 4.4. Local government revenues in Egypt**

Local governments in Egypt have very limited ability to raise revenues. They therefore find it very difficult to generate resources for improving service delivery. More than 90 percent of local government revenues in Egypt have traditionally come from the national government. Seventy-seven percent of local revenues have come from an intergovernmental transfer from the national government, which is intended to cover local expenditures. Local governments receive revenues through a series of taxes that are legislated and administered by the Egyptian Ministry of Finance. The land, building, and vehicle taxes, which combined provide about 5 percent of revenues, are collected by the national government and shared with local governments on a formula basis (Fox, 1985).

Fortunately, the ability to provide local governments with sufficient authority to undertake their responsibilities is clearly under the central government's control. Local governments must have the ability to hire, fire, and set salaries if workers are to be properly motivated. They must be able to raise resources and make investment decisions to meet local demands. They must be able to set prices, cut off services, and prosecute for nonpayment if they are to adequately fund service delivery.

**Action 40 [P]: National governments must structure an environment in which local governments can effectively deliver devolved services.**

- **Access must be provided to lendable funds and necessary technical skills.**
- **Local governments must have the authority to make decisions related to service delivery, including the ability to hire and fire workers and to make investment decisions.**
- **Local governments must have authority to raise revenues and retain them at the local level for financing service delivery.**

Public sector companies and service delivery authorities deliver infrastructure in some cases. These autonomous institutional structures may offer advantages because of their clear separation from the central government. Normally they can set fees and collect revenues at least somewhat independently from government control. Independent water companies in Seoul, Bogota, and Bombay have had good collection experience. However, these institutions may be less accountable because their linkage to public officials or consumers may be tenuous. Incentives for efficiency may also be limited. On the other hand, in a number of cases, services are delivered by community associations, which should be very responsive to users. Rural Water and Sanitation authorities in the Philippines, some of which operate in suburban communities, provide an example of service delivery controlled by a community association.

**Action 41 [P]: Local service authorities should be considered as a means to deliver individual services. These authorities must have a board of directors or some other means of making them accountable to users. Competitive pressures should be designed to encourage efficiency.**

## 4.2. Privatization

***Objective 4.2: To create circumstances in which privatization of service delivery will result in lower cost production.***

Privatization is a second means of creating competitiveness and allowing for more effective articulation of demand. A series of political and historical developments may have determined a nation's blend of public versus private production, and in some countries this issue may be examined more as a philosophical than as an economic issue. Privatization is discussed in this paper as a pragmatic means of improving service delivery rather than as a philosophical approach. Private service delivery is preferable to government production if it increases well-being by reducing costs, meeting demands, or achieving other worthwhile benefits such as providing a greater choice of services.

Privatization, as with decentralization, is often touted as a means for lowering costs by encouraging competition. The presumption is that public sector producers have poor incentives for efficient operation because they lack pressure to operate at the lowest cost. The private sector, on the other hand, is presumed to be subject to competitive forces. However, the public sector does not always have poor incentives and the private sector does not always face competitive pressures, so benefits do not always result from privatization. For example, private firms may be set up as monopolies with little incentive to operate efficiently. Or, if they operate at low cost, they may not have incentives to pass the benefits on to consumers. U.S.-based research on whether the public sector or private firms are more efficient has shown mixed results.

Urban transit is an area in which private production can lower cost. Public bus systems often require large subsidies because of high operating costs. The system in Karachi receives a \$5 million annual subsidy, the system in Calcutta a \$10 million subsidy, and the system in Bangkok a \$30 million subsidy. On the other hand, the private sector Seoul system, which has 90 operating bus companies, receives no subsidy. Private minibus systems have proven very effective in many cities. Of course, some public bus systems, such as the one in Bombay, also operate without a subsidy. Some urban water supply activities in Chile, solid waste disposal and collection in Brazil, and intracity transportation in Nairobi are examples of effective private production of services.

Even if privatization appears beneficial, the public sector will maintain a role in providing most infrastructure. One reason is that the private sector does not adequately provide for externalities, such as sewerage, dams, and certain roads, unless government financing is involved. This is because of inability to charge user fees sufficient to finance the services. Next, some infrastructure services may be characterized by large economies of scale in production or distribution. These services are called natural monopolies and include the production of water, sewerage, and—to a lesser extent—electricity. Private firms may be able to deliver the services, but regulation is essential. Third, network externalities have often been espoused for telecommunications services, meaning the benefits to one user may depend on others being consumers as well. The government may need to be involved in establishing a pricing scheme or subsidizing the service to move toward universal service. Finally, the government will need to participate, at least in financing, if provision of infrastructure services is to be used as a way of redistributing income.

**Action 42 [P,O]: Private sector production of infrastructure services should be sought to lower user costs and to enhance service quality. Government participation may remain necessary for certain aspects of infrastructure delivery.**

#### **4.2.1. Types of privatization**

Privatization is defined here as a nongovernment role in the production or provision of services. Nongovernment organizations can be private firms or PVOs. In practice, privatization represents a continuum from purely private production through a range of public/private cooperation. At its broadest extreme, privatization is direct private sector production and delivery of services with little if any public involvement. Private electric and telephone companies are examples. In other cases the services may be for captive users, often as a back-up system for public services—for example, the production by manufacturers in Nigeria of electricity for their own use. At the other extreme is private production of a small intermediate step in delivery of a larger service, such as when private firms are hired to undertake some road maintenance. Purchase of architectural or engineering services from private firms for use by a public water authority is privatization. The Nigerian National Electric Power Authority contracts out maintenance for power station and transmission facilities. Also, maintenance is contracted out by the Nigerian Telephone Company. Private construction of roads that are operated and maintained by the public sector is another example. An intermediate form of privatization is contracting with private firms to operate public sector facilities. An Egyptian town, for example, has hired a private firm to operate a publicly owned sewerage system. The public and private sectors may be involved informally in service delivery. The public sector or a large private operator may offer bus transportation on major routes while other private firms use smaller vehicles to service lower-density areas. Private bus systems in Nairobi, Dar-es-Salaam, and Kinshasa have been successful and are supplanting other services.

Firms operating in a developing country often are unable to find all of the infrastructure they need at any single location. Their response may be to produce the services for themselves (see Box 4.5). A firm's treatment of its own water and sewage, production of its own electricity, and purchase of its own railroad cars are all examples. These infrastructure saving investments are a form of privatization and offer some advantages. The demands are clearly articulated, as the user determines how much to produce for itself. Furthermore, firms are able to select the exact services they want. For example, water can be treated to the specifications required. This precludes a city from needing to treat all water to a level necessary only for a small number of users. The major disadvantage is the firm's inability to benefit from economies of scale. Electricity is produced by private firms in Nigeria at nine times the average cost of developed and developing countries and at much higher prices than Nigeria's public sector electricity (Lee and Anas, 1989).

Self-help is a very important form of privatization. The Orangi Pilot Project in Karachi is a strong example. Between 1980 and 1990 the project developed a low-cost sanitary system for 47,000 households at one fourth the investment cost of municipally purchased systems. The project is self-managed and used self-financed construction.

#### Box 4.5. Infrastructure-saving investments

Frequent power interruptions, poor telecommunications, and other infrastructure quality problems significantly influence the ability to operate manufacturing firms. One response of firms is to produce their own infrastructure services. A survey of 179 firms in Nigeria revealed large investments to offset infrastructure deficiencies. Resources used for producing infrastructure place added pressure on the already limited capacity of firms to invest in productive capacity. All firms with more than 20 employees have standby electric power generators. Ten percent of total private investment by the firms is for generators. More than two thirds of large firms and 14 percent of firms with between 20 and 50 employees have dug private boreholes. Two percent of firm investment is for boreholes. Messenger motorcycles and private radio equipment is often used to transmit information, and the average manager is required to spend more than 10 hours per week traveling to meetings that could have been held over the telephone. Radio equipment and employee vehicles comprise more than three percent of firm investment (see Lee and Anas, 1989).

#### 4.2.2. Conditions for effective privatization

##### *Objective 4.2.2: To create conditions for effective privatization of service delivery.*

A key to obtaining the benefits of privatization is to aggressively encourage competitive market pressures. Neither government production nor close regulation may be necessary if the market is contestable and not colluding (see Box 4.6). In many cases the private market may not exist in developing countries, and needs to be encouraged to evolve. Also, competition can be generated by allowing foreign firms to compete. Belize and Guatemala permitted foreign firms to compete for road maintenance because no significant domestic market existed.

#### Box 4.6. Contestable markets

Contestable markets are necessary to achieve the benefits of competition. A market is contestable if potential entrants restrain the price-setting behavior of current producers. The most effective way to encourage contestable markets is to allow free entry and exit into markets to the maximum extent possible. Also, analysts have demonstrated that an industry must be characterized by low sunk costs if markets are to be contestable. Low sunk costs mean firms have limited losses if they enter an industry (or choose a location) and later decide to exit due to failure to achieve the expected profit. The firms can take investments from the low-profit industry or location and move them to higher profit opportunities.

Contestable markets often do not exist for broadly defined infrastructure because the investments are irreversible. For example, unprofitable roads cannot be rolled up and taken to a more profitable location, nor can major water plants or sewage distribution lines. Thus the entire capital investment, which often is large, may be lost in some cases.

*Action 43 [P]: Competitive pressures should be aggressively supported. Free entry and exit of firms into markets that deliver infrastructure services should be encouraged wherever possible. Local public transportation, solid waste, water, sanitation, and some telecommunications services are examples in which competitive private firms can provide good service delivery at low cost.*

Contestable markets require low sunk costs, a characteristic often not present in delivery of infrastructure services. The gains from competitive markets may still be possible in three ways,

despite high sunk costs for infrastructure. Whenever possible, government policy should create an environment for at least one of these three mechanisms to operate.

First, defining infrastructure less comprehensively may create contestable markets for some activities. High sunk costs may preclude a contestable market for roads, but lower sunk costs may allow a contestable market for highway construction. Franchising the operation of infrastructure facilities may also allow contestable markets to be created. Franchises must be rebid on a regular basis to maintain effective competition.<sup>2</sup>

Second, allowing all private firms equal access to sunk investments can be another way to create contestable markets. Competition to offer services using the fixed facility can create a contestable market. Considerable potential exists to create competition in service delivery over infrastructure networks. The U.S. has permitted several long-distance telephone carriers to deliver services across the same local telephone lines. Granting several railroad companies access to the same railroad tracks may be another example. Railway deregulation in the U.S. has been estimated to save users US\$15 billion annually, while trucking deregulation saves US\$14 billion (Stevens and Michalski, 1993). Limited use of the European electricity production grid is saving 3 percent of production costs, and greater savings potential exists.

Third, benefits can come from availability of substitutes even if the narrowly defined market is not contestable. Railroad services may not be contestable in many countries. But competition from highways and barges may allow the same benefits. Private transportation services, such as Jeepneys in the Philippines, can substitute for subways and public buses. Unfortunately, private substitutes for many infrastructure services may be weak alternatives. For example, private water vendors or private sewerage collection may be expensive at many locations relative to a piped system serving the same purpose. As a result, the government must be careful in assuming competition will effectively control costs for many broad infrastructure categories.

**Action 44 [P]: Government should seek to gain the benefits of competitive markets for service delivery by:**

- **Identifying aspects of infrastructure delivery that are contestable and allowing the private sector to compete for these portions of service delivery.**
- **Allowing all private firms equal access to shared infrastructure facilities such as telephone and railroad lines.**
- **Permitting private sector alternatives that compete with infrastructure services.**

2. Even so, the long term effects may not be lower costs. Franchise holders may benefit from first mover advantages or information asymmetries. These may allow the original holder to maintain the franchise without producing at low costs.

### 4.2.3. Regulating privatized services

Privatized firms require two types of overt regulation. For public firms, this regulation occurs implicitly inside the government bureaucracy rather than overtly as is necessary for privatized firms. (Stevens and Michalski, 1993). Implicit government regulations will be more sensitive to political pressure and more difficult to see.

The first form of regulation is to ensure the quality of privately produced services, both in terms of service reliability and output. For example, unless properly monitored, private producers may maintain their electricity access but cause more frequent brownouts to occur. Solid waste pickup may be less frequent. Private water vendors in South America are said to sell substandard water.

Judging quality is often difficult without significant monitoring. The degree of treatment for water and sewage and the frequency of brownouts can only be seen by careful tracking. The quality of materials used in road construction or repair is hard to evaluate without close supervision. Regulation of quality involves contract monitoring in cases where private services are purchased by a public infrastructure as a component of service delivery, and involves evaluation of service outputs and reliability when private firms operate the infrastructure.

Second, price regulation is necessary if a private firm is granted a monopoly franchise. Competitive forces can be emulated only with appropriate regulation. This form of regulation will be increasingly important because the existence of natural monopolies is declining as new technologies permit small scale production to develop. However, the lower service demands in developing country cities mean natural monopolies are more likely to occur than in developed country cities. Electricity, water, sewer, and telecommunications distribution, and in some cases the production of these services, will be natural monopolies for at least some geographic areas.<sup>3</sup>

Regulation of natural monopolies is intended to cause private firms to produce at low cost and pass the benefits on to consumers, but regulation around the world has been ineffective at fully achieving these objectives. The regulatory agency and the private monopoly will respond to the incentives before them and fail to deliver services at the lowest cost unless regulatory targets are properly identified. Normally, the regulatory goal has been either to control the rate of return or the price, but the former encourages firms to overinvest in capital and the latter encourages underinvestment. Both regulatory targets lead to distorted prices. Research is under way to design incentives for regulators to seek the lowest prices for consumers.

A decision must be made as to whether regulation or government production is preferred, based on issues such as whether the government is more efficient as a regulator or a service producer. Government in many developing countries can be an inefficient regulator of the private sector and this can push service delivery more towards a public than a private monopoly. But opportunities for cost savings through privatization are available in most countries and must be pursued. Further, improvements in regulatory capacities can allow developing country governments to achieve efficiency gains from privatization. The Public Utilities Commission in Barbados is an example of an organization providing regulatory oversight.

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3. The existence of vertical economies may mean that the combined production and distribution of services is a natural monopoly, even if one part (say, production) is not individually a natural monopoly.

Selling the rights for service delivery to the lowest bidder is an alternative to regulating a private provider of natural monopoly services. Bids can be taken for the right to deliver services for a specified interval. The least costly service delivery can result if the market among bidders is sufficiently competitive. Foreign bidders, in addition to domestic suppliers, may be necessary to ensure the degree of competitiveness. Several problems may prevent achieving the lowest costs, including: the first winner can gain information about actual costs of service delivery and market demand that allow it to gain advantages in subsequent bids (called first-mover advantages); the winning bidder may argue that the costs are higher than expected and insist on higher compensation; or the winning bidder may threaten to withhold vital services unless the compensation is raised. The public sector often maintains some service delivery capacity to prevent winners from achieving too much control through threats to suspend service. Furthermore, any form of contracting requires transparency in the contracting process if benefits from privatization are to be attained.

Regulations beyond what is necessary to maintain service quality and competitive prices will lower the benefits of competition. Examples of competition-inhibiting regulations abound—but may not be initially apparent. Manufacturing firms in Nigeria that produce their own electricity because of unreliable public supplies are prohibited from selling surplus electricity. Undoubtedly this is intended to prevent competition with the electric authority; however, it makes private electric production more inefficient because firms are unable to attain economies of scale. Rules that implicitly favor public sector service delivery, such as allowing governments greater access to foreign exchange or exempting government agencies from certain regulations, must be eliminated.

Overly rigid regulations may cause firms to operate outside the legal system. Transportation pricing regulations in Manila work effectively in heavily traveled areas but hinder provision of services in less-densely settled areas. Few if any carriers want to offer licensed transportation services in less-dense areas, a problem that could be overcome through more flexible regulations.

***Action 45 [P]: Regulations that limit private sector production of infrastructure services should be restricted to the minimum necessary to provide for safe use of services by consumers. Business regulations must be carefully evaluated to eliminate those that inhibit competition, or that bias service delivery towards the public sector.***

#### 4.2.3. When privatization can work

***Objective 4.2.3: To identify those service areas in which privatization will be most effective.***

Telecommunications, electricity generation, solid waste disposal, and urban transportation appear to have the greatest capacity for widescale privatization, but some aspect of every infrastructure service can be privatized. Characteristics of services that can be efficiently privatized include the following. First, privatization appears to offer the greatest potential cost savings for services that are already delivered in the private sector. The main reason is that the private sector is better able to identify profitable services than is the public sector. Also, the private sector obviously has experience and know-how in producing such services. Second, services that have easily observable output and can be readily monitored are likely to gain from privatization. The need for monitoring is important because private firms may sacrifice quality to earn greater profits. The public sector must recognize that the private sector is motivated by profits and regulate accordingly. Third,



services in which operational efficiencies are likely to be available are good candidates for privatization.

A number of specific examples for which privatization will work can be listed. One is private operation of publicly owned infrastructure facilities, including water and sewer systems. Purchase of services such as engineering and architectural services and many maintenance functions can be effectively privatized (see Box 4.7). Privately operated billing and fee-collection services, such as those in Cote d'Ivoire and Nigeria, are examples. Intracity buses in large cities, solid waste collection, road resurfacing, electricity production, and national and local telephone service frequently can be privatized. Services that are produced as natural monopolies can be privatized by taking bids or with regulated private monopolies.

**Box 4.7. Privatization of operations and maintenance**

Privatization offers the opportunity to reduce the costs of operating and maintaining services by bringing competitive pressures to bear. Operation and maintenance of a number of services is already performed by the private sector in some developing countries. Iquique, Curico, and Temuco in Chile have periodic and routine road maintenance performed by the private sector. Surakarta, Indonesia, has all periodic road maintenance performed by the private sector, but the public sector does routine maintenance. O&M for water supply and sanitation is less frequently contracted out, although many cities allow private involvement in some aspects.

Several issues must be considered when measuring the benefits of privatizing services. First, costs for private versus public service delivery must be measured fully so that accurate comparisons can be made. In measuring the full burden, contracting, monitoring contracts, and regulatory costs must be included with direct payments to the contractor. Similarly, the total costs of public service delivery often are greater than anticipated. These include administrative costs for personnel and other overhead costs. Decisions must be made on what to do with public sector employees in the event that privatization is adopted. The cost savings are much lower if the government maintains a policy of hirer-of-last-resort, as public employment may not be reduced by privatization.

***Action 46 [P]: Decisions on whether to offer services through the public sector or the private sector should be made after considering all costs of each delivery mechanism.***

Second, contracts must be developed to define each party's responsibilities. Contracts must be clearly specified and detailed to ensure that the private sector is delivering the expected services. But the private firm should also have room to innovate. A major contracting dilemma is whether the public or private sector bears the risk of unexpected events. For example, which entity bears the burden if the private firm underestimates service delivery costs? The private firm could earn lower profits, user fees could be increased, or the public sector could make larger payments. Which sector is responsible in the event that service delivery conditions change for some unexpected reason? Privatization may be more effective if private firms bear some of the risks so that incentives for cost-effective actions are in place.

Finally, the potential for corruption must be examined. This would include kickbacks or collusion in the bidding process, for example.

***Action 47 [P]: Country regulatory capacities must be enhanced through the acquisition of staffs able to adequately regulate private firms. Regulatory bodies must be created with incentives to operate in the interest of consumers. The government needs to regulate in order to:***

- ***Maintain service reliability and output quality.***
- ***Prevent payoffs and collusion.***
- ***Ensure that the private sector meets its contractual obligations.***
- ***Control prices for monopolist providers.***

## V. OTHER INFRASTRUCTURE GOALS

Two major goals of infrastructure are considered in this section. One is achieving a desired distribution of infrastructure services across groups, such as urban versus rural residents. The second is realizing environmental aspirations. Distributional objectives and environmental outcomes may not be essential to sustainable service delivery, but they are important related goals of public infrastructure. Of course, in several cases, environmental outcomes are the major goal of infrastructure.

### 5.1. Infrastructure and the Environment

*Objective 5.1: To understand the relationships between infrastructure services and the environment and to integrate these environmental effects into infrastructure policy decisions.*

A two-way relationship exists between infrastructure and the environment. Many infrastructure investments are intended to reduce the environmental degradation that results from production or consumption of certain goods. In this sense, environmental effects have been the focus of much of this document. Solid waste disposal and sewerage are examples in which infrastructure is expected to directly reduce effects of environmentally damaging emissions (see Box 5.1). Environmental degradation could be reduced indirectly as well. For example, availability of electricity could diminish deforestation from burning wood for fuel, although alternative energy sources such as kerosene are often better substitutes than electricity.

#### **Box 5.1. Recycling as a means to reduce solid waste management costs**

The volume of solid waste in developing countries is expanding rapidly and may double by the decade's end. A recent study concluded that solid waste management was the greatest environmental problem in metropolitan Manila. The city generates 4,000 tons of solid waste daily, at least 600 tons of which is uncollected. The negative consequences for Manila include deterioration in water, soil, and air quality and increased flooding.

The costs of handling solid waste normally comprise 30–50 percent of municipal budgets. Nonetheless, most developing country cities collect no more than 70 percent of solid waste and in some cases they only collect 30 percent. The preponderance of solid waste is disposed of in landfills, which operate as open dumps. Perhaps 3–5 percent of wastes in developing countries is currently being recycled by scavengers who sift through wastes and identify items that can be sold to used-material merchants. This informal system appears to offer the greatest benefits to intermediaries who often sell used materials at much higher prices than they pay. One area that has received little attention to date is composting of organic materials. Estimates suggest that up to one half of wastes could be handled this way. Government support for recycling through imposing user fees for waste disposal, encouraging composting, and formalizing the function of waste scavengers, can lead to considerable savings in the cost of processing solid wastes (see Sinnatamby and Dzikus, 1991).

Also, infrastructure can cause environmental degradation. Emissions from coal-fired electric plants create a negative externality that has had severe local consequences on cities in China, India, Poland, and Turkey. Availability of improved water services can change the water level in neighborhoods and dramatically increase the need for sewerage systems. Rain runoff problems can be exacerbated by a road system. Transportation emissions lead to water and soil pollution. Infrastructure allows manufacturing expansion, which creates environmental effects.

Several guidelines can be provided for integrating environmental consequences into infrastructure planning. First, minimization of environmental degradation should not be the goal. The value of an improved environment must be compared with the opportunity cost of cleanup and prevention. The proper public policy goal is to fully integrate environmental influences in a way that maximizes the well-being of residents. Second, negative externalities that result from the production of infrastructure services should be identified. The information can be used in several ways, for example, to seek alternative production technologies for infrastructure services that create less environmental effects, such as replacing coal fired electric plants with a different technology if the benefits of doing so exceed the cost of changing. Another use of the information is to plan for related infrastructure improvements that will be required by development of other infrastructure—for example, the need for sewage system enhancements to go with improved water services.

***Action 48 [O]: Negative environmental consequences from production or consumption of infrastructure services should be identified and alternative ways of delivering or using the services considered. Decisions to deliver infrastructure services must be made after considering the effects on the need for other infrastructure services.***

The next two guidelines offer means of lowering the environmental effects of infrastructure services that consumers want. Nonpolluting ways to enhance service delivery should be recognized and selected where they are economically efficient. Better maintenance may be an excellent way to provide more services with no environmental degradation. Reducing losses in electric or water distribution can allow more services to be delivered without additional environmental effects. Next, properly rationing those infrastructure services that cause environmental degradation can limit negative effects. Pricing infrastructure services at marginal cost lowers the amount of services that must be produced. The lower resulting demand for nonsubsidized electricity means fewer negative consequences from production of electricity. Less water will be pumped if higher prices are charged, and this will reduce the needed size of the sewage system. Traffic has been reduced by 40 percent in downtown Singapore as a result of charges placed on driving into the city. On the other hand, setting prices for environment-improving infrastructure, such as solid waste or sewerage, could reduce consumption of these services. Thus, marginal cost pricing is appropriate for these services only when consumers purchase the necessary quantities.

***Action 49 [O]: The production of infrastructure services should be limited, to control negative environmental consequences. Better maintenance will reduce the necessary infrastructure capacity and limit the need to produce services. Demand should be controlled with user fees set to cover marginal costs, including costs of environmental degradation.***

Fifth, environment improving infrastructure may be a lower priority than infrastructure that allows the economy to expand, including water, electricity, and telecommunications. Providing solid waste disposal and sewerage are much more attractive options once a basic complement of other infrastructure is in place. Finally, control of some infrastructure policy must remain with the national government. Regional governments are likely to underprovide environmental services because they fail to recognize negative externalities imposed on other regions. For example, one region may feel that dumping raw sewage downstream from residents is acceptable. However, the consequences for downstream communities may make this a very shortsighted and parochial decision. The national government is in a better position to ensure that regions consider issues that go beyond their own borders.

## 5.2. Distributional Consequences of Infrastructure

**Objective 5.2: To compare the groups that benefit from delivery of infrastructure services with those that pay for the services and to ensure that beneficiaries are the intended groups.**

Infrastructure policy should be designed after consideration of distributional effects. These effects can be important for several reasons. First, infrastructure availability can affect the location or technology decisions of firms. Any potential influence on economic activity and technology must be understood and considered in policy decisions. Second, knowledge of which group receives benefits is important, from an equity perspective, even if infrastructure does not influence any decisions. This section identifies some distributional outcomes that might be expected. The approach is to describe such effects by example rather than to provide a comprehensive listing of expected impacts.

**Action 50 [P]: The distributional availability of infrastructure services and the resulting consequences should be carefully analyzed and used to design infrastructure policy that achieves the major goals of economic efficiency and equity.**

### 5.2.1. Distribution by region

Regional differences in infrastructure services can be important for several reasons. First, inequities can be perceived when infrastructure appears to be provided more abundantly in one region than in another, but careful evaluation is necessary. Comparisons across regions frequently are made based on inputs, such as investments in facilities, although different service delivery conditions lead to very different outputs. For example, a water system relying on ground water can be more expensive to construct than one using surface water, but the investment differences do not result in differential services received by consumers. Also, no equity problem exists if infrastructure is financed by users. In this case, differential availability results because one region chooses to purchase more services than another.

Second, infrastructure delivery has cross regional effects. Good sewage treatment in one area benefits downstream residents. Good roads in one region assist another in moving its goods to market and so forth. Thus, every region wants as much of the nation's resources as possible, but should also be concerned that certain minimal services are available in other regions.

Third, availability of infrastructure may allow one region to grow more rapidly than others or change the rural versus urban distribution of population and production. Indeed, local officials often seek infrastructure because of a perception that their economic development will be enhanced. Still, the influence of differential availability of infrastructure on economic activity is expected to have a minimal impact on broad regional growth patterns. Lack of infrastructure can be a limiting factor, but its availability will generate little activity unless other determinants of growth are in place. This conclusion follows from the observation derived above that infrastructure is essential for accommodating economic growth but is a weak tool for promoting growth.

Infrastructure has a more important influence on the location of economic activity within a narrow geographic region. Planners have some ability to fashion development patterns within a narrow geographic area by the choice of where to deliver infrastructure services. For example, infrastructure can be an important ingredient in urban development and for promoting rural-to-urban

migration. Infrastructure decisions must be consistent with the goals of urban-rural development. Generally, more services are delivered in urban than rural places, and the desire to obtain certain services can be a factor in the urban migration decision. On the other hand, infrastructure often is intended to mitigate the costs of urbanization, so it is more important in urban than rural places. An efficient urban transport system reduces transportation costs but would be less necessary in rural places. An improved water system lowers costs of potable water and a sewer system offsets some sanitation problems. Thus, infrastructure can be a major factor in allowing urban growth. The infrastructure distribution system influences the structure of development within an urban area as well. Households and businesses can be expected to locate along infrastructure distribution networks.

Of course, rural areas also can be made more attractive through the delivery of infrastructure services, but services such as solid waste disposal and sewer treatment may have lower marginal benefits for rural residents because there is less need to offset effects of crowding. Infrastructure services may also be more expensive to deliver in rural places. Significant diseconomies of small populations or low population density can result in higher rural costs. However, economies of scale in the production of many infrastructure services are limited, at least after a minimal scale of operations has been reached, so per capita costs in larger rural places may not be higher than for urban areas. Costs often are higher in urban than in rural areas because greater demand for services offsets any advantages from scale economies.

***Action 51 [P]: Infrastructure policy should be developed in a manner consistent with the overall urban development strategy.***

### **5.2.2. Distribution by income class**

Infrastructure services generally are more available to higher income residents. The receipt of services may be progressive according to income because high-income residents are better able to influence the pattern of delivery to ensure that they are served. Also, many low-income urban residents live in informal housing arrangements and along the city fringe, where services are not yet provided. In some circumstances the services may be delivered only in areas that benefit a privileged, high-income minority. For example, urban poor are much more likely to take trips on foot. In Bombay, 80 percent of trips by low-income groups are on foot, but only 25 percent of trips by high-income groups are on foot. Many low-income workers in Nairobi often walk 12 kilometers each way to work. A survey of 32 Kenya cities found that 83 percent of high-income families have household connections for water while only 17 percent of low-income households have connections. In Pakistan, 77 percent of urban households have access to piped drinking water, although only 47 percent of households in Karachi's squatter settlements do. The squatter settlements often have water available only two hours per day, according to World Bank data. Many services may be totally unavailable through public means in slums and squatter settlements. Only 1 percent of households in Rio de Janeiro's *javelas* are attached to sewer facilities, and nearly half only have access to open ditches. On the other hand, lower-income residents may desire a different set of services from those sought by higher-income residents. For example, low-income people may only be willing to pay for water delivered by public faucets, while high-income people want household connections.

Market segmentation may exist in many cases. Formal infrastructure providers operate in higher-income neighborhoods and informal providers (vending water or hauling sewage) in low-income areas. Segmentation may occur because of political decisions not to offer services in low-income areas or because of institutional or technical problems with delivering services in some areas. Also, low ability to pay and rapid development of squatter housing may be explanations.

Low-income residents may be hurt in two ways by policies that deliver services to high-income residents. First, low-income people (particularly in urbanized areas) are forced to pay much higher prices to obtain essential services from vendors when the services are not available where they reside. Examples abound of low-income urban residents paying high prices to obtain fresh water from vendors or to have sewage removed, while high-income residents receive inexpensive public services (see Box 5.2). Second, low-income people may be taxed to pay for services received by higher-income residents, exacerbating the equity problem.

#### **Box 5.2. Water vendors versus public water providers**

Low-income residents, and particularly squatters, often live in areas without access to public services. Nonetheless, they need many basic services, including potable water. Private vendors' prices often are many times those charged by public utilities for similar volumes of water. Estimates are that vendors charge five times more than public utilities in Abidjan, 10 times more in Istanbul, up to 60 times more in Surabaya, and up to 100 times more in Port au Prince. Of course, vendors play an important distribution function in moving water to people. Also, water is purchased from vendors in small quantities. Nonetheless, better public distribution of water to low-income residents could result in improved service, as more water—and in many cases better water—is available at a lower cost (see UNCHS, 1990).

Better transportation and water services can be very effective in raising incomes of poverty-level residents. Other services are important to maintaining an acceptable quality of life. Specific service demands of low-income residents must be identified and low-cost means to meet these demands found. A focus on demand may be particularly important in low-income areas if service delivery is to be sustainable. The services must be consistent with what low-income people want, and in some cases, what they can afford. Simpler technology and labor-intensive approaches that rely on self help and community participation almost surely will be integral to meeting demands. Limited diversity, accessibility, and quality for each service may be necessary to keep service delivery affordable. Of course, standards for water, sanitation, and other services must meet minimum health criteria. Subsidies that are carefully targeted to low-income groups may be necessary in some circumstances, but the subsidies can be limited by requiring self-help. Charging some price, even if well below marginal cost, can be effective for discouraging waste. At the same time, a variety of services, such as sanitation, water, and others, must be offered.

***Action 52 [P]: Equity should be explicitly considered when infrastructure policy is set. Strategies should be identified to allow affordable, improved service delivery for low-income households. Selected services must be those demanded by low-income residents; normally this would require differentiation from the services available in higher-income areas. Both low- and high-income users should pay for services received, except for limited examples involving merit goods.***

### 5.2.3. Differences by industry and size of firm

Infrastructure investments can be of widely divergent value to different industries. Understanding which industries benefit from service expansion is a significant component of measuring infrastructure's overall benefits. Agriculture may benefit from irrigation and manufacturing from electricity. Firms in the service and financial industries may benefit most from telecommunications and so on. In the same vein, understanding the needs by industry is an essential aspect of anticipating the demand for services in an unserved region.

***Action 53 [P]: Infrastructure delivery should be structured to the needs of local industry.***

Lack of infrastructure may have differential consequences. Small firms and indigenous industry are likely to be harmed most by inadequate infrastructure. Large firms are better able to produce their own infrastructure services or to supplement inadequate services. Nigeria's electric production, where large firms are much more likely to have electricity generators than small firms, is an example. The small firms will either operate where electricity is available or go out of business. Small firms in Bogota and Seoul, for example, have been observed to locate in the city center or already served areas because of available infrastructure, while large firms have more flexibility in choosing locations, and frequently locate on the city's periphery. Negative effects on small firms damage the overall economy because the majority of jobs in developing countries are created in small firms. Small firms have been responsible for creating between 60 and 80 percent of new jobs in Seoul and Bogota. Roads, electricity, and telephones can be very important services for small businesses.

***Action 54 [O]: Specific consideration must be given to the infrastructure needs of small and informal businesses. Infrastructure that meets the demands of these firms should be provided in locations conducive to their development.***



## VI. PRIORITIES FOR FUTURE ACTION

A body of work evaluating developing country infrastructure policy has appeared during the past several years.<sup>1</sup> Israel (1992) and Christine Kessides' two World Bank Discussion Papers on infrastructure (1993) are excellent examples. The need for reform is apparent in Israel's conclusion that developing country infrastructure's condition remains poor, performance standards are low, and financing is weak. The major areas for reform identified in each of the reports are remarkably consistent and provide a basis for redesign of infrastructure policy around the world. Such policy reform is the next major step. This chapter identifies the cross cutting themes that arise in the three reports. A series of actions, or next steps, based on the themes is listed for national governments, cities, donors, non-governmental organizations, and users.

### 6.1. Cross Cutting Themes

Four separate themes for reform are specified, although their components are interdependent. Action on one but not other components will seriously impede the success of reform programs.

The first two themes dictate that national and, in some cases, local governments relinquish their control over service delivery, as users, private firms and non-governmental organizations are granted a much larger role in service delivery policies. Yielding authority requires a risk-taking, dynamic leadership that is willing to deliver services differently in order to improve service delivery. Substantive changes carry the potential for failure, and donors, national governments, and consumers must be willing to allow for some failures in exchange for the opportunity for more effective service delivery.

**The key to reformed infrastructure policy is delivering infrastructure services to meet users' demands.** Every process in delivery institutions must be responsive to the consumer. Movement to a demand orientation represents a shift from the traditional focus on expanding capacity through extending trunk lines and other means. Technology must be chosen, operations and maintenance must be performed, and other activities undertaken so as to meet demands. Responsive organizations will only exist if policymakers and system managers re-align processes from the internal/operational focus of the past to an external, demand-oriented future. Changing the direction of an ongoing institution is difficult, but has the potential to be vastly rewarding.

Consumers will be discontented unless service delivery decisions are based on demand. Dissatisfaction among consumers results in wasted investments, lost economic production, and low willingness to pay for services.

A demand orientation leads to service differentiation across cities and neighborhoods, both in terms of delivery technology and outputs. Policy must be sufficiently flexible to allow service delivery to reflect the differences. Policymakers must be willing to explicitly differentiate the services offered in higher income areas from those in lower income/lesser ability to pay areas as well

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1. Policy prescriptions also have been written for developed countries (see Stevens, Barrie, and Michalski, 1993).

as urban versus rural areas. Demand orientation also means that infrastructure investments seldom should be made prospectively in the hopes of stimulating development.

The tendency often exists to design infrastructure investments to accomplish a range of goals, from equity to environmental to job creation. Adoption of goals that are inconsistent with meeting demand or accomplishing other reforms listed here must be considered carefully, because policies designed to meet alternative goals can lead to unsustainable services.

**Competition must be introduced to lower service delivery costs and ensure that demands are met.** Delivery through devolved governments and private firms are two ways of introducing competition. Some aspect of every service will benefit from competitive pressures. Certain services, such as urban transit, solid waste management, electricity, and telecommunications, can be privatized. All other infrastructure services can profit either from delivery by devolved governments, regulated private delivery, or private production of a component of the delivery process.

Competitive delivery shifts the national government's role to an emphasis on the regulation necessary to assure that producers deliver reliable services, quality output, and competitive prices. The regulatory function occurs implicitly in a government operated system. Regulation must be overt and transparent in a privatized system. Incentives for regulators to operate in the best interest of consumers must be developed. Also, the national government will continue to have a limited role in subsidizing delivery of certain services because of externalities and equity goals.

**Pricing infrastructure services is necessary in order to finance service delivery, ration consumption to an economically efficient level, and provide an indicator of demand.** Prices should fully recover costs for all infrastructure services except those with significant positive externalities and for a very limited number of services, to ensure that low income residents have access. The cost of providing access can be minimized by targeting subsidies to the lowest income users and by differentiating services to meet the specific demands of low income users. Payment of fees must be clearly linked to receipt of services and significant fee increases should be combined with service enhancements.

Imposing prices, or user fees, to recover costs is politically difficult in the short run because many services have historically been underpriced, and user fees appear hard to integrate with equity goals. Nonetheless, pricing is central to enhanced service delivery and must be part of an improved delivery system. Failure to price services is also politically difficult because inadequate services lead to dissatisfied residents and businesses, and lower economic growth.

**Improved infrastructure must come more from increased efficiency than from large, new investments.** Service capacity often can be greatly increased by making existing investments more productive. Enhanced reliability and better quality service outputs must be achieved. Capacity is expanded by improved maintenance practices that extend investment and limit service losses. When new investments are necessary, the technology must be selected based on the ability to provide required maintenance, and on the ability to meet demands. Alternative delivery systems, specifically ones using smaller scale delivery systems, must be adopted where appropriate. Pricing and other means of managing demand must be implemented as well.

## 6.2. Next Steps for Key Actors

This section identifies some important next steps that national officials, urban officials, donors, non-governmental organizations (NGOs) and community based organizations (CBOs), and users must undertake to improve infrastructure delivery. The first three actors directly determine the policy agenda, while the last two influence the agenda. The relevance of points for national versus urban officials will vary across countries depending on the current allocation of service delivery functions. The list is developed based on the cross cutting themes, and is meant to identify first steps for reform, not to provide an exhaustive categorization of all that must be done.

### 6.2.1. National governments

**Plan delivery systems that provide the demanded services for each group of users.** Systems must be identified that meet the demands of all users across income strata and of businesses in urban areas that require more sophisticated services. Discerning the user's actual demands is a major task and must be conducted jointly with urban governments. The political will to differentiate services must be developed.

**Service delivery institutions must be given incentives to make all of their processes responsive to users.** Performance indicators must be developed and performance monitored. One incentive is to increase availability of grants and loans to those providers who meet certain output standards.

**Develop a framework for assigning service delivery responsibilities to national, regional, and urban governments and the private sector to achieve the most effective service delivery.** National governments normally will be involved in regulating, general planning, and limited financing of infrastructure. Wherever possible, private firms, devolved governments, or nongovernment organizations should provide the service delivery.

**Competition must be pro-actively developed.** Private delivery of services should be considered wherever possible, including telecommunications, solid waste management, and urban transit. Some countries may not have the capacity for the private sector or devolved governments to deliver and regulate services. In these cases, capacities must be developed pro-actively to support competitive delivery. Selected geographic areas and certain delivery components can be identified for contracting out with private firms. BOTs and concessions can be used to raise capital and promote competition. Private sector access to credit must be expanded and other constraints on private sector production eliminated. Similar strategies should be adopted for devolved governments.

**Development of a regulatory framework that supports institutional reform must be an integral component of change.** Operation of facilities and regulation of service quality and price must be separated. Regulatory commissions must be established in every country to fully regulate the reliability and output of infrastructure providers. Price regulation is necessary in cases where private firms are permitted to operate with monopoly power. Regulations that limit private competition with public infrastructure providers and limit efficient behavior must be carefully evaluated to ensure that they achieve the desired intention. Regulations should be confined to those necessary to support reliable service delivery, quality outputs, and competitive prices.

**Service providers must be allowed to set prices and retain revenues for financing investments, operations, and maintenance.** Limited subsidies from national or urban governments will be necessary in cases where large externalities are present or to achieve equity goals.

**Service providers must be given incentives to deliver maintenance services.** Grant and loan programs must be altered so they do not favor new investments. Programs to develop maintenance skills must be developed.

### 6.2.2. Urban governments

**Urban governments are in the best position to recognize service demands.** They must coordinate with national or regional governments to identify demands and to plan service delivery to meet these demands.

**Distinguish service demands for low income users and develop a financially sustainable plan to meet these demands.** Self help and CBOs should be seriously considered as service delivery mechanisms, with NGOs serving in catalytic and supportive roles. Limited national or local government financing may be necessary for the lowest income users.

**Where possible, contract with private firms to produce components of infrastructure services.** Operations and maintenance of infrastructure facilities, such as repair of roads or managing a water system, are examples.

**Urban governments must allow service deliverers, including departmental bureaucracies, to retain user fees to finance service delivery.**

**Service deliverers must actively seek users' participation and voice.** Users must be included on boards of directors and in other policy setting councils so they can articulate demand more effectively. Hearings and other sessions must be held to allow consumers to be heard.

### 6.2.3. Donors

**Donors must align their priorities with the effective service demands that exist in every country.** Donors have the potential to lead developing countries into becoming more demand oriented because incentives offered through donor programs will affect behavior, particularly if programs are sustained over a number of years. Donors must be flexible in providing financing for services that are widely differentiated across countries and cities. Flexibility places considerable pressure on project officers to allow for local solutions that may differ from experiences the officers have had with other projects.

**Research must be undertaken on the means by which infrastructure supports economic growth.** An understanding is needed of the appropriate sequencing of infrastructure services as urban areas develop. Analysis of how specific infrastructure services can make specific activities more productive needs to be undertaken. Research on the productivity of infrastructure must stay abreast of changes in international markets and production techniques. Also, research is necessary to measure effects of infrastructure on the environment, job creation, and poverty.

**Donors must be creative in identifying ways to cooperate with and finance private firms and devolved governments.** Competitive advantages will be impeded if financing and technical assistance only occur through existing or new national bureaucracies.

#### **6.2.4. Non-governmental and community-based organizations**

**NGOs need to be catalysts for more effective service delivery.** NGOs can raise awareness of service delivery problems, unserved areas, and other unmet needs. Pressure can be brought to bear if services purchased by consumers are not received or if service needs are not being met. NGOs can discern the specific, effective demands of users and articulate them to service providers that include national, regional and local governments, private firms, and other providers. Surveys and other means of collecting information on demand can be performed. Information can be conveyed in both directions, as NGOs help governments and other service providers communicate with users and potential users.

**NGOs must solicit only services that consumers demand, rather than unnecessary services that can be delivered by a donor or higher government.**

**NGOs should organize people to voice their demands and their attitudes about service delivery.**

**CBOs can implement actual delivery of infrastructure services, either in competition with public providers or because no public providers exist.** Squatter settlements may be major beneficiaries of CBO service delivery. Cooperatives, where people are owners or partial owners, have tended to be used for electricity, water, and telephones in rural places, but can be effective in specific urban neighborhoods. Self help projects are another means. Self help efforts can construct, operate and maintain, or manage service delivery. Alternatively, NGOs and CBOs can raise resources locally and contract with private service providers.

**NGOs and CBOs can raise the resources necessary to participate in self help, cooperative and other projects.**

**NGOs should train workers to operate and maintain infrastructure.** Self help projects would benefit most, but workers can be trained for formal projects as well.

**Neighborhood self help and cooperative projects need to be coordinated with the urban system.**

#### **6.2.5. Users**

**Users must have active input into the planning and decisionmaking processes.** They must clearly voice specific service demands and complaints about reliability, output, prices and other aspects of service delivery to providers. Users can serve on Boards of Directors, participate in hearings, and use other means to express attitudes and demands.

**Users need to be willing to participate in service delivery where formal public and private sector providers are unwilling or unable to produce required services.**

**Users must assist in resource mobilization.** They must pay reasonable prices to finance service provision. They can work with NGOs and CBOs to mobilize resources.

**Users must get involved through consultations or decisionmaking at the earliest stages of project development.** As appropriate, they must help determine which services to provide, communicate demands, help plan and implement projects, and assist in service delivery.

## ANNEX A: GLOSSARY

**Contestable Markets.** Markets in which the competitive pressure from potential entrants has a significant restraining influence on existing firms. An essential feature is that firms can freely enter to provide goods and services and can freely exit by moving productive inputs to other industries. Entry must involve small sunk costs. The economic efficiency benefits of competitive markets can be attained with contestable markets.

**Crowding in/out.** Crowding out refers to a reduction in other economic activity caused by expenditures on infrastructure. One example is when infrastructure investment uses resources that otherwise would have been employed in other forms of investment, including human capital or private businesses. Crowding in occurs when infrastructure investment increases the amount of other forms of investment. Many factors determine whether crowding out or crowding in occurs in a particular circumstance, including the extent of unemployment, the source of infrastructure finance, and the responsiveness of output to a rise in demand.

**Externalities.** The indirect effects imposed on others as production or consumption take place. The indirect effects may affect other's well-being or their ability to produce. Externalities are positive if indirect effects make others better off and are negative if they make others worse off.

**Gross Domestic Product (GDP).** The total value of goods and services produced in a country during one year. GDP measures production within a country and Gross National Product (GNP) measures production of a country's citizens regardless of where they live.

**Hedonic Studies.** Studies in which the value or price of infrastructure services is statistically explained using characteristics of the infrastructure service and the served population.

**Marginal Cost.** The additional cost of producing one more unit of infrastructure services. May refer in some cases to the additional cost of providing infrastructure services to one more person or household. All costs including operations, maintenance, and investment are included. Prices equal to marginal cost are economically efficient unless externalities are present.

**Merit Goods.** Goods or services deemed so valuable by society that they should be made available to people regardless of personal choices or ability to pay.

**Opportunity Cost.** The value placed on the best alternative that was rejected as an economic decision was made.

**Private Goods.** Any good or service for which consumption is rival. Rival consumption means two people cannot simultaneously consume the same good or service (or cannot both receive full value from the good). Normally consumption of a private good requires paying a price to receive the good.

**Public Goods.** Any good or service that is nonrival in consumption, meaning people can consume the same good or service simultaneously without reducing the value to each other. Attempts to

exclude people from consuming public goods are inefficient because the marginal cost of providing them to another person is zero.

**Shadow Prices.** Implicit measures of the total social cost of resources. Used in place of market prices when evaluating a project's value.



## **ANNEX B: SUMMARY OF OBJECTIVES AND ACTIONS**

### ***Objective 2.1: To design infrastructure delivery systems with a focus on the user.***

Action 1 [P]: Infrastructure should be provided by demand-driven institutions. A demand-oriented service provider will see that all processes in the organization are responsive to consumers. A complete reorientation of organizations is necessary to operate in this fashion. Infrastructure investments normally should be made only in those cases where a recognizable demand for the services exists. Speculative investments made with the hope of stimulating development only should be undertaken in rare circumstances.

### ***Objective 2.1.1: To measure the full demand for infrastructure services using the three ways that demand can be articulated.***

Action 2 [P]: The decisionmaker must measure demand by examining the three ways in which it is articulated: through a willingness and ability to pay, through the governmental process to ensure that an economically efficient quantity is produced, through the governmental process to ensure that people have a minimum standard of living, or some combination of these three. For most services, a primary source of demand must be private willingness and ability to pay, because of the importance of a private cost recovery.

### ***Objective 2.1.2: To understand the specific services that consumers want.***

Action 3 [P]: Demand must be measured along seven dimensions including accessibility, capacity, diversity, quality, time, condition, and price. The importance of each dimension will vary dramatically across infrastructure types, cities, and users within a city.

Action 4 [O]: Future decisions on infrastructure delivery must integrate user demands for diversity, capacity, and quality into system design as early as possible. Demand will differ across cities and within cities so individual decisions on service characteristics must be made for very localized areas whenever possible. All decisions on the demand for infrastructure services must be evaluated in terms of delivery costs and price.

### ***Objective 2.1.3: To measure the extent of demand for each infrastructure type at each location.***

Action 5 [O]: Willingness-to-pay surveys, surveys of service requirements, and research on served areas should be the basis for determining the level of service delivery for private goods such as water and telephone service.

Action 6 [O]: Locally generated measures of demand should be solicited to the extent possible to account for differences in tastes, customs, and practices across regions. Local information can also be important in more technical decisions.

### ***Objective 2.1.5: To limit the need for infrastructure facilities by controlling demand.***

Action 7 [P]: Efforts to manage demand are essential to limiting necessary infrastructure investments. Properly set user fees and charges are the most effective means of managing demand.

***Objective 2.1.6 To use properly designed benefit/cost analysis to assist in proper decisionmaking.***

Action 8 [O]: Benefit/cost analysis should be used to combine information from demand estimates with data on costs. The analysis should be objective and go beyond standard applications.

- The analysis should consider consequences of the infrastructure and its financing on the macroeconomic environment.
- The analysis should consider the proper sequencing of each type of infrastructure investment and the appropriate timing of investments.
- Benefits from the full range of service characteristics must be quantified in the analysis.
- Effects on goals other than the specific outputs of the resources, such as equity, must be considered.
- Measurement must be flexible to anticipate alternative uses of infrastructure over time. Also, allowance must be made for changes in emphasis in the desired characteristics of the infrastructure.

***Objective 2.2: To determine the importance of infrastructure investments for supporting production and to determine whether infrastructure is an effective economic stimulant.***

Action 9 [O]: Infrastructure investments should be located where a known demand for the services exists, and not as speculative investments in the hope that economic activity will follow.

Action 10 [P]: Appropriately sized infrastructure services must be provided as the basis for private productive activity.

Action 11 [P]: The greatest benefits from infrastructure investments will result when a minimum complement of infrastructure services is made available in places with an appropriately trained labor force. Higher-quality and more diverse services should be targeted to specific areas where the demands of more sophisticated users have been identified.

Action 12 [P]: Emphasize infrastructure development to support the most rapidly growing areas of cities. Only use infrastructure to alter development patterns when other important public policy goals are at stake and only after very careful planning and analysis. Infrastructure provision may be useful for improving development patterns along the urban fringe.

Action 13 [P]: Macroeconomic policy should be structured to allow infrastructure investment without crowding out private investment. However, other macroeconomic policy goals, such as inflation, must be balanced against effects on crowding.

Action 14 [O]: Each infrastructure investment has differential effects across the range of income levels. Those investments with the greatest implications for alleviating poverty should be identified and considered.

***Objective 2.3: To develop an inventory of the infrastructure services available in each region and to identify those places where infrastructure services are unavailable.***

Action 15 [O]: An inventory of existing infrastructure services should be maintained to provide a basis for evaluating current services and for future planning. The inventory should focus on collecting data on availability of services, although data on the physical attributes of infrastructure will also be useful.

Action 16 [O]: A set of reasonable guidelines on minimum infrastructure service levels should be developed for comparison with the inventory of service production. The guidelines should serve as rules of thumb for where service expansions should occur.

***Objective 2.4: To select an interest rate or minimum rate of return that can be used for comparing the benefits and service delivery costs of projects that have different useful lives.***

Action 17 [P]: Developing country governments should make decisions on which infrastructure projects provide an acceptable return for the investment using the same interest rate that private firms operating in the country employ in selecting their investment opportunities.

***Objective 2.5: To select the technology, operations and maintenance, and institutional structures for infrastructure projects.***

***Objective 2.5.1: To select a production technology appropriate for the service demands and service delivery conditions of the specific area where services will be provided.***

Action 18 [O]: Technology selection must begin with an orientation to delivering specific services. An appropriate technology should be chosen separately for each location after consideration of existing service delivery technologies, the urban network already in place, input prices, life cycle costs, capabilities of the service delivery organization, and service delivery conditions. Emphasis should be placed on selecting a simple technology.

Action 19 [O]: Governments and service delivery authorities must stay abreast of changing technology and integrate new approaches that offer operational gains.

***Objective 2.5.2: To design a maintenance program that ensures maximum benefits from the infrastructure system while services are delivered at the least cost.***

Action 20 [O]: Technologies and service delivery institutions must be chosen to maximize the ability to maintain infrastructure.

Action 21 [P]: Incentives must be built into the infrastructure grant and loan programs of all donors and governments to encourage proper maintenance.

Action 22 [O]: A good maintenance plan and the necessary resources to fulfill the plan must exist to make infrastructure services sustainable.

Action 23 [O]: Good maintenance and infrastructure condition records must be kept to serve as the information basis for an effective maintenance program. Delivery agencies must make service delivery decisions after explicitly considering the costs that users bear as they consume the services.

***Objective 2.5.3: To select the services to be delivered and the technology, maintenance policy, and operations strategy for service delivery so that the total costs borne by society are minimized, while appropriate tradeoffs between costs and services are made.***

Action 24 [P]: User costs must be explicitly considered in decisions on services and service delivery techniques. The goal should be to minimize society's costs.

***Objective 2.5.4: To deliver infrastructure services through institutions that have the capacity to provide services effectively.***

Action 25 [P]: Begin each infrastructure project with an evaluation of the incentives that confront each participant in the process. Support those incentives that enhance desired outcomes and alter those that are adverse.

Action 26 [P]: Service delivery agencies must be structured with externally imposed incentives for efficient operations. Ways must be identified to hold agencies accountable by creating competitive pressures or by making them responsive to user attitudes.

***Objective 3.0: To determine the best source of financing for infrastructure investments and for operation and maintenance of facilities.***

***Objective 3.1: To determine the appropriate way to finance capital expenditures on infrastructure.***

***Objective 3.1.1: To determine which infrastructure services should be financed through government sources and to identify the appropriate funding source for government finance.***

Action 27 [P]: Governments should use borrowed funds only to finance infrastructure investments in which the service benefits will be received over a period of years. The borrowed funds should be repaid at least as rapidly as the service flow from the facilities.

Action 28 [P]: In countries in which a functioning credit market does not exist or in which local governments have limited access to credit, infrastructure banks should be created to allow local governments to finance infrastructure investments. Local governments or other borrowers must be required to repay the borrowed funds. The interest rate charged on borrowed funds should be established at the rate that would be charged by an operating financial market.

Action 29 [P]: Developing country governments and donors must work together to ensure that donor financing is provided in a way that causes selection of economically efficient projects and technologies.

Action 30 [P]: Private-equity financing should be solicited when private sector delivery of services will offer greater advantages than public sector delivery. The advantages can include operational cost savings and access to external finance.

***Objective 3.2: To determine the best financing source for operations and maintenance costs.***

Action 31 [P]: User fees should be the source of finance for infrastructure investments and O&M to the extent possible. Services in which the benefits are private goods normally can be financed 100 percent with user fees equal to long-run marginal cost. Other services may require some financing in addition to user fees.

Action 32 [P]: A portion of user fee revenues should be available to finance the infrastructure's facilities and O&M.

Action 33 [O]: Where possible, user fees should be directly linked to the level of consumption rather than being imposed as monthly charges. However, fees linked to consumption are only viable when the management capacity exists to meter consumption.

Action 34 [P,O]: User fees must be consistently enforced and all users must be required to pay. Services must be cut off and legal remedies exercised to ensure payment.

Action 35 [O]: User fees should be set at marginal cost. Separate connection charges may be necessary for services such as water, electricity, and telephones. A limited subsidy may be necessary for services with significant externalities.

Action 36 [P]: Equity should be integrated into a user fee-financed service by offering special programs for those least able to pay, not by lowering the price for all consumers. Lifeline rates, rising block pricing structures, and varied service levels are ways to introduce equity.

Action 37 [O]: As new services are planned, an information campaign should be undertaken to fully inform consumers of plans to set user fees to cover all costs, and the fees should be properly set with inception of service. Consumers should be made aware that future rate increases will be necessary as costs rise.

Action 38 [O]: Imposition of user fees for previously unpriced services should be combined with service delivery improvements. Prices that are too low should be consistently raised with a target of reaching full marginal cost price.

***Objective 4.1: To determine which level of government should be responsible for service delivery.***

***Objective 4.1.2: To identify benefits from devolving services to local governments.***

Action 39 [P]: Service delivery should be devolved to local government to the extent possible, particularly for services such as water, sanitation, solid waste collection, and local transportation.

***Objective 4.1.3: To ensure that the conditions are in place for effective devolution.***

Action 40 [P]: National governments must structure an environment in which local governments can effectively deliver devolved services.

- Access must be provided to lendable funds and necessary technical skills.
- Local governments must have the authority to make decisions related to service delivery, including the ability to hire and fire workers and to make investment decisions.
- Local governments must have authority to raise revenues and retain them at the local level for financing service delivery.

Action 41 [P]: Local service authorities should be considered as a means to deliver individual services. These authorities must have a board of directors or some other means of making them accountable to users. Competitive pressures should be designed to encourage efficiency.

***Objective 4.2: To create circumstances in which privatization of service delivery will result in lower cost production.***

Action 42 [P,O]: Private sector production of infrastructure services should be sought to lower user costs and to enhance service quality. Government participation may remain necessary for certain aspects of infrastructure delivery.

***Objective 4.2.2: To create conditions for effective privatization of service delivery.***

Action 43 [P]: Competitive pressures should be aggressively supported. Free entry and exit of firms into markets that deliver infrastructure services should be encouraged wherever possible. Local public transportation, solid waste, water, sanitation, and some telecommunications services are examples in which competitive private firms can provide good service delivery at low cost.

Action 44 [P]: Government should seek to gain the benefits of competitive markets for service delivery by:

- Identifying aspects of infrastructure delivery that are contestable and allowing the private sector to compete for these portions of service delivery.
- Allowing all private firms equal access to shared infrastructure facilities such as telephone and railroad lines.
- Permitting private sector alternatives that compete with infrastructure services .

Action 45 [P]: Regulations that limit private sector production of infrastructure services should be restricted to the minimum necessary to provide for safe use of services by consumers. Business regulations must be carefully evaluated to eliminate those that inhibit competition, or that bias service delivery towards the public sector.

***Objective 4.2.3: To identify those service areas in which privatization will be most effective.***

Action 46 [P]: Decisions on whether to offer services through the public sector or the private sector should be made after considering all costs of each delivery mechanism.

Action 47 [P]: Country regulatory capacities must be enhanced through the acquisition of staffs able to adequately regulate private firms. Regulatory bodies must be created with incentives to operate in the interest of consumers. The government needs to regulate in order to:

- Maintain service reliability and output quality.
- Prevent payoffs and collusion.
- Ensure that the private sector meets its contractual obligations.
- Control prices for monopolist providers.

***Objective 5.1: To understand the relationships between infrastructure services and the environment and to integrate these environmental effects into infrastructure policy decisions.***

Action 48 [O]: Negative environmental consequences from production or consumption of infrastructure services should be identified and alternative ways of delivering or using the services

considered. Decisions to deliver infrastructure services must be made after considering the effects on the need for other infrastructure services.

Action 49 [O]: The production of infrastructure services should be limited, to control negative environmental consequences. Better maintenance will reduce the necessary infrastructure capacity and limit the need to produce services. Demand should be controlled with user fees set to cover marginal costs, including costs of environmental degradation.

***Objective 5.2: To compare the groups that benefit from delivery of infrastructure services with those that pay for the services and to ensure that beneficiaries are the intended groups.***

Action 50 [P]: The distributional availability of infrastructure services and the resulting consequences should be carefully analyzed and used to design infrastructure policy that achieves the major goals of economic efficiency and equity.

Action 51 [P]: Infrastructure policy should be developed in a manner consistent with the overall urban development strategy.

Action 52 [P]: Equity should be explicitly considered when infrastructure policy is set. Strategies should be identified to allow affordable, improved service delivery for low-income households. Selected services must be those demanded by low-income residents; normally this would require differentiation from the services available in higher-income areas. Both low- and high-income users should pay for services received, except for limited examples involving merit goods.

Action 53 [P]: Infrastructure delivery should be structured to the needs of local industry.

Action 54 [O]: Specific consideration must be given to the infrastructure needs of small and informal businesses. Infrastructure that meets the demands of these firms should be provided in locations conducive to their development.

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