Sector Guidelines

for Pre-Feasibility Studies on

ENERGY EFFICIENCY

A. Introduction

1. Context

Cities Development Initiative of Asia (CDIA) Sector Guidelines describes the approach to pre-feasibility studies in the sectors most commonly encountered in CDIA support to cities. These guidelines are a sector-specific appendix to the overarching *CDIA Pre-Feasibility Study Guidelines* (CDIA 2011) that sets out the format, process, and output requirements in general.

The Sector Guidelines are not meant to replace terms of reference or to provide detailed technical input for consultants, who are assumed to be qualified and experienced professionals in their field and thus technically capable. These apply to the conduct of a pre-feasibility study (PFS) for a project or group of projects (hereinafter referred to as "the project") identified and prioritized in the plan and by the relevant authority for implementation.

These guidelines apply in the context of existing policies, visions, plans, and studies pertaining to energy conservation and other related issues. These address the approach expected of consultants engaged at the PFS stage as regards energy conservation and efficiency.

Energy conservation activities primarily fall under two categories, energy efficiency and renewable energy. These guidelines will focus mainly on demand energy efficiency, which includes reductions in energy consumption through the provision of urban services as well as in public, residential, and commercial buildings and building users. Urban services such as street lighting, water pumping, and public buildings account for a significant amount of total energy consumption and make up a large portion of a municipality's expenses. While energy consumption of most urban services comes under the direct control of the city authority, consumption by residential and commercial users is an important component that could be influenced by city governments. Although not discussed in detail, cities may also influence supply side energy efficiency and renewable energy. With the use of regulatory powers and fiscal incentives, cities may encourage activities such as the introduction of

technological improvements in power plants, conversion to combined heat and power (CHP) generation, retrofitting buildings with solar or photovoltaic panels and mandating their use in new buildings, and developing electricity generation capacity from "green" sources such as wind, hydro, or solar. Henceforth, energy efficiency in these guidelines will relate to demand side energy efficiency unless otherwise stated.

2. Objective

CDIA support to the formulation of any energy efficiency project aims to enhance the impact, sustainability, and inclusiveness of the project. This means that the project should

1. Comprise a viable component of an *integrated energy conservation program,* including consideration of energy efficient urban development, low carbon transport, resource efficient industrial production,[1] environmental sustainability, and a conducive policy framework (see section B);
2. Be *inclusive* in the sense that affordable and accessible options are available for the stakeholders in the target areas *and* that persons negatively affected by the project should be minimized and adequately compensated for any adverse impacts (see section C);
3. Be *economically viable* and *financially sustainable* in that the economic rate of return on a project must be acceptable *and* that revenues, subsidies, taxes or levies, concession, lease revenue, microfinancing, grants/loans, community service obligation payments, carbon credits, or any combination of these must be capable of funding capital and operational costs of various components of the project, including long-term maintenance and capacity building (see section D);
4. Be *environmentally sustainable* in that the proposed project must aim at improving the existing environmental and health conditions and that adequate measures will be taken to mitigate any potential adverse environmental impacts of the project (see section E); and
5. Have *sound, transparent governance* arrangements enabling efficient financing, design and construction, commissioning, and operation of the project (see section F).

B. Developing an Integrated Energy Efficiency Project

The vision for any city in Asia must include an environment-friendly, low carbon, integrated, and inclusive development. To achieve this vision, energy efficiency programs are central. These programs are needed to transform the existing environment and local economy. Such programs should be broadly based, ideally integrated[2] across residential and commercial activities, and based on a sound policy and planning framework. The consultant should review this framework and the role of the energy efficiency project within it. If it is not adequate in terms of providing strategic guidance to the project as regards social, economic, and environmental contribution to the city's development, the consultant should, within the limits of resources provided under the contract, propose enhancements to this framework based on available data and consultations. Based on an assessment of energy use by residential and commercial sectors, and on an analysis of resource use

[1] Resource efficiency encompasses both energy and material flows.
[2] Programs involving a single sector or subsector, e.g., energy efficient street lighting, are of course perfectly acceptable as the subject of a CDIA PFS but the guideline is written to encompass a more comprehensive approach to energy efficiency.

by industry, priority investments for increasing the efficiency of energy and resource use[3] can be identified.

Energy efficiency opportunities can be grouped into three broad fields of activities, urban development, transport, and industrial production systems. Key considerations for each group are set out below.

1. Urban Development

There are two main potential areas of application for energy efficiency:

a. Greenfield projects would involve new and planned future urban development projects of a commercial and residential nature, involving subdivision of nonurban land. These would normally involve projects for new housing, regional shopping, and employment centers. The focus of energy efficiency activities would be on achieving an urban development pattern that would substantially reduce embedded energy costs in construction, and higher density development to support local public transport systems, energy efficient buildings, and a pedestrian environment.

b. Retrofitting projects would involve reengineering and retrofitting existing residential, commercial, and public buildings to improve their energy efficiency by improving insulation, circulation, and introducing more energy efficient services.

Planning for more green space, urban agriculture, and orienting buildings to prevailing winds also reduce "heat island" effects, and consequently, energy use for cooling.

2. Energy Efficiency Transportation Projects

It is estimated that the transport sector contributes to 14% of greenhouse gas emissions. [4]In cities, the figure is much higher. Given that Asian cities remain relatively dense, the following approaches to energy efficiency could significantly reduce the demand for energy in the transport sector:

a. Mass Transit Systems

Most Asian cities lack good public transport systems with buses, trains, and ferries being overcrowded, and the network does not efficiently service employment areas. Investments to rectify this situation will have a large impact on energy efficiency with commuters switching to more energy efficient modes of transport.

b. Engine Conversion

Several Asian cities have supported projects to remove, or replace two-stroke engines with four-stroke engines, to reduce particle emission levels and improve fuel efficiency. The conversion of motor vehicles to cleaner fuels and combustion, e.g., buses from diesel to gas usage, offers an important opportunity for energy efficiency.

[3] Resource efficiency for industry will always result in energy savings but needs to be based on an analysis of resource flows, production processes, and the 3R—reduce, reuse, recycle—potential. Such analysis can never be made for all industry but the main industrial clusters in a city should be analyzed.

[4] Economics of Climate Change. Sir Nicholas Stern Report (2006)

c. Smart Transport Systems

The major part of the transport network in Asian cities is inefficient, with many competitors operating with excess carrying capacity on the arterial transport network. Development of smart transport systems that improve the efficiency of vehicle carrying levels and limit the number of operators permitted to engage in intra-urban transport services frees up capacity on the road network and improves energy efficiency. Other measures to improve traffic management, including the co-location of bus terminals with major retail, commercial, and industrial employment areas; the development of inter-modal transfer stations and facilities; and the introduction of congestion pricing are measures that boost the use of public transport and reduce per capita GHG emissions from the sector.

3. Energy Efficient Industrial Area Design and Production Systems

Industries are major contributors to energy demand and anthropogenic GHG emissions. The International Energy Agency (IEA) (2006) estimates that implementing energy efficiency policies could reduce industrial energy consumption by 10% in developing countries by 2030. There are two key measures that could be quickly applied:

a. Energy Efficient Industrial Area Design and Development

There is a tendency to segregate heavy industrial activities from other lighter scale industrial and/or commercial developments, which significantly reduces opportunities to create industrial synergies or clusters.[5] Clusters help reduce transaction costs through sharing common infrastructure, facilities and services, and facilitate material recycling and reuse.

b. Cleaner Production Systems

Cleaner production involves firms utilizing fewer materials and adopting cleaner production technology to reduce material inputs and wastes from industrial processes. There are significant energy efficiency opportunities to support the conversion of production systems, such as boilers to more efficient and GHG reducing fuels and technologies.[6]

The project design should describe the key areas of integration across subcomponents relating to the aforementioned five broad fields of activities, infrastructure investments, and how these will achieve the energy efficiency potentials discussed above. Documentation of the project design should also demonstrate in broad terms how it will contribute to the GHG and/or energy efficiency outcomes as against "business as usual" scenarios. For specific infrastructure investments, for example, sector guidelines on urban transport and solid waste management are available. Mechanisms to finance the project should be described in section D, and to manage the project, in section F.

[5] Enright. 2000.
[6] The *Journal of Cleaner Production* includes many articles on ways to make industrial systems cleaner.

Summary

- Review planning framework to identify important gaps and recommend approaches for policy to bridge these gaps.
- Identify priority investment components in each of the key intervention areas.
- Demonstrate, and quantify where possible, how the proposed project improves on the "business as usual" scenario.

C. Developing an Inclusive Energy Efficiency Project

The base for developing an inclusive energy efficiency project is understanding the capacity of local communities, particularly the poor, to participate in and benefit from program components. This includes an analysis of the following:

1. Employment impacts and constraints to participation, including a holistic view of the community, taking into account informal economic activity such as cleaners, shopkeepers, street vendors, food stalls, informal transport systems, etc., which may be affected positively or negatively by the project.

2. The need for support to engage poverty groups in these programs (by different income and other groups such as single -parent households), with special focus on women who are the main energy consumers and buyers in household-related consumption (such as cooking gas, firewood and/or coal, and electricity).

The first major task for the consultant is to undertake a rapid screening of the proposed program components to determine the following:

- The potential benefits to income and other groups and their employment opportunities; ("potential" should be gauged not just by likely cost of conventional delivery but also include potential for cost-reduced delivery—local, rather than imported, materials for insulation, for example—and cross-subsidy possibilities); and
- Likely disruption to communities in terms of a relocation, division, noise, disruption of the visual context of important historic or scenic sites. The scale and cost of relocation should be estimated along with options for near-site resettlement[7] (to minimize disruption to employment).

Changes to the design should be considered where (i) significant employment opportunities could be created or made more accessible, particularly for low-income groups, or (ii) significant disruption could be reduced. Costs associated with the social impact mitigation measures should be included in the financial assessment (section D) and the associated management systems should be incorporated into the governance arrangements (section F).

[7] Off-site resettlement is to be avoided wherever possible. Potentials for energy efficiency in parallel to transit development should be assessed, to provide additional units for resettlement.

Summary

- Document the design by subcomponent and assess outcomes for each group (define market segments by identifying key potential users and/or beneficiary groups by income and other characteristics, e.g., gender).
- For the proposed design, estimate benefits by group.
- Consider alternative design options to maximize employment and other benefits, particularly for the poor, and to minimize disruption.

D. Ensuring Financial and Economic Viability

1. Financial Assessment

Crucial to the viability of the project will be a realistic assessment of revenue streams for each investment with a direct cost recovery component, such as energy production, water supply, insulation savings, and others. Often, assumptions are "over optimistic." The assessment of affordability and willingness to pay on the part of each market segment in each investment should be rigorous and well documented. If the assessment of existing preliminary estimates suggests they are unrealistic, cheaper, more appropriate alternatives, or increase in the density of development should not just be considered but also strongly suggested. Costs should be benchmarked against average construction costs in country (preferably), or in like country. The latter is available on the web. Costs should explicitly include social (e.g., relocation) and environmental mitigation measures.

Subsidies, cross-subsidies from leasing of property, community service obligation payments, and others should be assessed for their sustainability and legal enforceability. Clean Development Mechanism (CDM) for energy efficiency investments, and other credit/subsidies from international agencies should be assessed based on prior experience with similar projects and, if necessary, on engagement of specialist expertise[8] to provide advice where such funding is crucial to the viability of the project.

The financial assessment should include cash flow, income statement, and balance sheet projections of any corporate or special purpose vehicle (SPV) entities involved in the financing as well as a standard financial cost benefit analysis (CBA). The hurdle rate adopted for this latter should be the relevant weighted average cost of capital (WACC) for the sector and country, but where private investors are involved, market rates for return in equity and debt should be the benchmark for viability.

In particular, the assessment must include an analysis of the cash flow of the participating (mostly local) government(s) with project capital expenses and subsidies included to determine the sustainability of the project in relation to the likely revenue streams for the local government(s). Such an analysis should be the basis for discussions about alternate organizational structures for implementation (see section F). For example, public–private partnership (PPP) models can be used on unbundled, commercially viable components of projects. Thus, such analysis should be done in a preliminary form early in the consultant engagement period.

[8] ADB Clean Energy Facility can provide resources for assessments of Clean Development Mechanism.

Summary

- Rigorously assess revenue assumptions and costing and strongly advocate alternatives where such assessments make viability suspect.
- Adopt realistic return hurdle rates.
- Assess impact of project on local governments' budget and use as basis for developing implementation options.
- Provide financial analysis for all relevant organization participants and adopt realistic return hurdle rates.

2. Economic Assessment

Economic assessment techniques for energy efficiency projects are understood by professionals. These normally include estimates of cost savings, health improvement, and employment (income increase or decrease). Benefits from avoided carbon emissions are less commonly taken into account. The economist/ financial analyst should make all efforts to estimate them, adopting proxy values such as where necessary as set out in ADB's Guidelines for the Economic Analysis of Projects.[9] Care should be taken to avoid double counting, such as health and employment productivity increases. Shadow pricing of costs is standard and follows an established process in each country. Hurdle rates for economic assessment are routinely set by ADB and other agencies in each country. Adopt ADB standards where available.

Summary

- Estimate all benefits of the proposed project.
- Undertake economic assessment using established processes and hurdle rates in the country concerned using ADB standards where possible.

E. Ensuring Environmental Sustainability

Environmental sustainability for cities calls for energy savings, energy efficient codes, and standards and measures to mitigate ecological degradation and maximize environmental benefits.

1. Energy savings are crucial for sustainability

Cities are major users of power and can achieve savings by introducing technical innovations such as automatic switching of street lighting and the use of energy-saving lights, and improving management and operation arrangements, including contracting out of maintenance services. Measures to optimize pumping operations in water and sewerage systems of frequent and large power users can also result in significant power savings. So can system improvements that reduce leakage. As energy savings become increasingly important, the incentives for more energy efficient housing and behavior will need to come mainly from national government policies, with legislative and financial instruments introduced in the city and/or regional government.

In addition to the transport and/or land use initiatives previously discussed, cities can reduce individual energy use by planning to cut energy consumption, encourage alternative energy generation such as wind and solar power, support the development and use of efficient transport

[9] ADB. 1997. *Guidelines for the Economic Analysis of Projects.*

technologies, and encourage the adoption of energy efficient development, housing, and construction materials. Much of the agenda can be accomplished or at least encouraged by formulating and enforcing appropriate planning and building regulations, utility pricing, and land tax.

2. Match building codes to sustainability requirements

Most cities can adopt bylaws to regulate the construction of buildings through design and construction requirements and administrative provisions for approvals, inspection, and enforcement. The practice of developing, approving, and enforcing building codes varies widely from country to country. Some codes include structural safety, fire safety, and health requirements, while others include noise mitigation and accessibility requirements. Traditionally, building codes have been long, complex sets of rules requiring a great deal of specialized knowledge to interpret. These codes have often been inappropriate for Asian cities and, in enforcing minimum standards, governments have increased development costs and often made it difficult for low-income families to afford housing built to legal standards. Asia's building codes—often based on those of the developed and industrialized countries that have different physical, climate, and social environments—should change to become more appropriate to the needs of dense, mixed-use, rapidly growing, and largely tropical or subtropical cities.

Lately, many Asian countries have begun relaxing building standards by reducing lot sizes and allowing mixed use. This flexibility can be expanded. For example, several countries, beginning with Australia, have moved to much shorter, objective-based buildings codes in recent years. Rather than prescribing specific details, these codes list a series of objectives that all buildings must meet but leave the question of methods open. When they apply for a building permit, the designers must demonstrate how they meet each objective. From the environmental perspective, building codes should aim at maintaining densities, encouraging the use of natural light and the harvesting of water, utilizing alternative energy, and dealing adequately with wastewater.

3. Maximizing benefits and minimizing impacts

Energy efficiency projects will have environmental benefits, but may also have environmental impacts. The objective of the PFS is to maximize the former while minimizing the latter. In terms of reducing environmental impacts, the process is similar to that adopted for social assessment. The proposed investments and facilities should be screened to determine (i) potential environmental impacts in terms of noise and pollution to communities, and (ii) potential impacts on water resources, forest resources, biodiversity, etc. as set out in ADB's environmental checklist.[10] Mitigation measures should be formulated and estimated. The implications of these measures should be included in the financial assessment (see section E) and governance arrangements (section F) of the project.

Most infrastructure projects would eventually require the preparation of an environmental impact assessment (EIA) as a basis for an environmental or similar permit. At the PFS stage, a rapid environmental assessment (REA) or a rapid environmental impact assessment (REIA) may be required.[11] It is also vital that the requirements and the time frame for a full-blown EIA are identified already during the PFS stage to avoid delays in downstream work as well as unexpected investments costs for environmental protection measures.

[10] ADB. 2003. *ADB Environmental Assessment Guidelines.*
[11] ADB *Rapid Environmental Assessment checklists for categorization of projects.*

Summary

- Environmental sustainability can be accomplished or at least encouraged through the formulation and enforcement of appropriate planning and building regulations, utility pricing, and land tax.
- Building codes and standards should become more appropriate to the needs of dense, mixed-use, rapidly growing, largely tropical or subtropical cities.
- Document and cost proposed environmental mitigation measures.

F. Ensuring Good Governance

The institutional arrangements for implementing the project must be clearly described and agreed with the client government.[12] The ability to successfully implement energy efficiency investments—achieving social and environmental benefits, avoiding and/or mitigating adverse impacts, and achieving financial sustainability, depends on a sound governance structure.

The PFS must include the following:

(a) Discussion of organizational options for design, construction/commissioning, and operation, including the possibility of PPP options. Where such options are pursued, the organization structure for transparent oversight and/or regulation of private operations needs to be considered. In terms of services integration, the arrangements for coordination across sectors and facility providers need to be described. Finally, arrangements for stakeholder participation (in particular, any affected persons as described in sections C and E) must be proposed.
(b) Consideration of how, and with what incentives, will the existing institutions and stakeholders change to the proposed arrangements. For example, will existing landowners be shareholders in a redevelopment company? Will informal vendors be included in revamped retail facilities?
(c) Consideration of the legal basis of each involved organization, its sources of revenue and responsibilities for expenditures (these two must match), and the hierarchy of authority across organizations (the legal basis of coordination).

Governance elements for energy efficiency projects should reflect funding arrangements. Components of such developments can be "unbundled" and will have their own SPV. Consultants must consider such requirements and design the governance structure accordingly. For example, what authority regulates the SPV, and on what legal basis? The organization design under construction may vary from that under operation. These should be described together with arrangements for the required transition.

Summary

- Design of institutional arrangements must be thoroughly documented, encompassing the legal and financial bases of sustainable operation.
- A clear description of how we get from where we are now to the proposed arrangements is required.

[12] CDIA 2011 *Guidelines for Urban Governance and Institutional Development*

G. Institutional Strengthening

Since most Asian cities have various agencies working on different parts of the energy efficiency problem, initial priorities for a PFS team should focus on ensuring all concerned agencies participate in the PFS process. The team should design a structure of participation to engage these agencies throughout the duration of the PFS period and develop a communication strategy to ensure participation. Such a process will improve institutional capacity by fostering dialogue, setting joint priorities, and coordinating approaches to investment.

H. Capacity Development

It is clear that capacity development is an essential foundation for sustainable energy efficiency in any given city. The PFS must identify all stakeholders, define their respective responsibilities, and suggest a capacity development program that will match proposed projects and measures. The overarching goal is to create a safe and sustainable system and ensure that investments in the sector are properly handled.

In many Asian cities, several international or national nongovernment organizations (NGOs) are active in public awareness programs or other capacity development. Although this is generally commendable and useful from an educational point of view, these activities are often isolated events and seldom coordinated with the local government programs, on a long-term basis. The PFS team should strive to identify these actors and stimulate dialogue between NGOs, government, and private sector to ensure a common understanding and basis for action.

The PFS team should explicitly plan activities for capacity development and training, designed and conducted to address the local situation and needs, during the PFS as well as part of a future capacity development program.

I. Conclusion

Although a PFS financed by CDIA will not support urban planning studies, it may help a city concretize its city development vision, examine alternatives to solve its energy efficiency problems, and recommend investments for further feasibility study and/or implementation.

The criteria for a successful CDIA PFS, derived from the above, can be summarized as follows:

- *Technical effectiveness*—the extent to which proposed investments solve the needed energy efficiency goals of a city;
- *Impact*—the extent to which the investments impact, positively or negatively, the livability of the area, efficiency of land use, the local economy, nearby natural resources, air quality, energy, the urban transport network and access to services, etc.;
- *Cost effectiveness*—the extent to which the costs of the investments are commensurate with their benefits;
- *Financial sustainability*—the extent that funds required to build and operate the preferred options are likely to be available and affordable; and
- *Equity*—the costs and benefits of the alternatives are distributed fairly across different population groups.