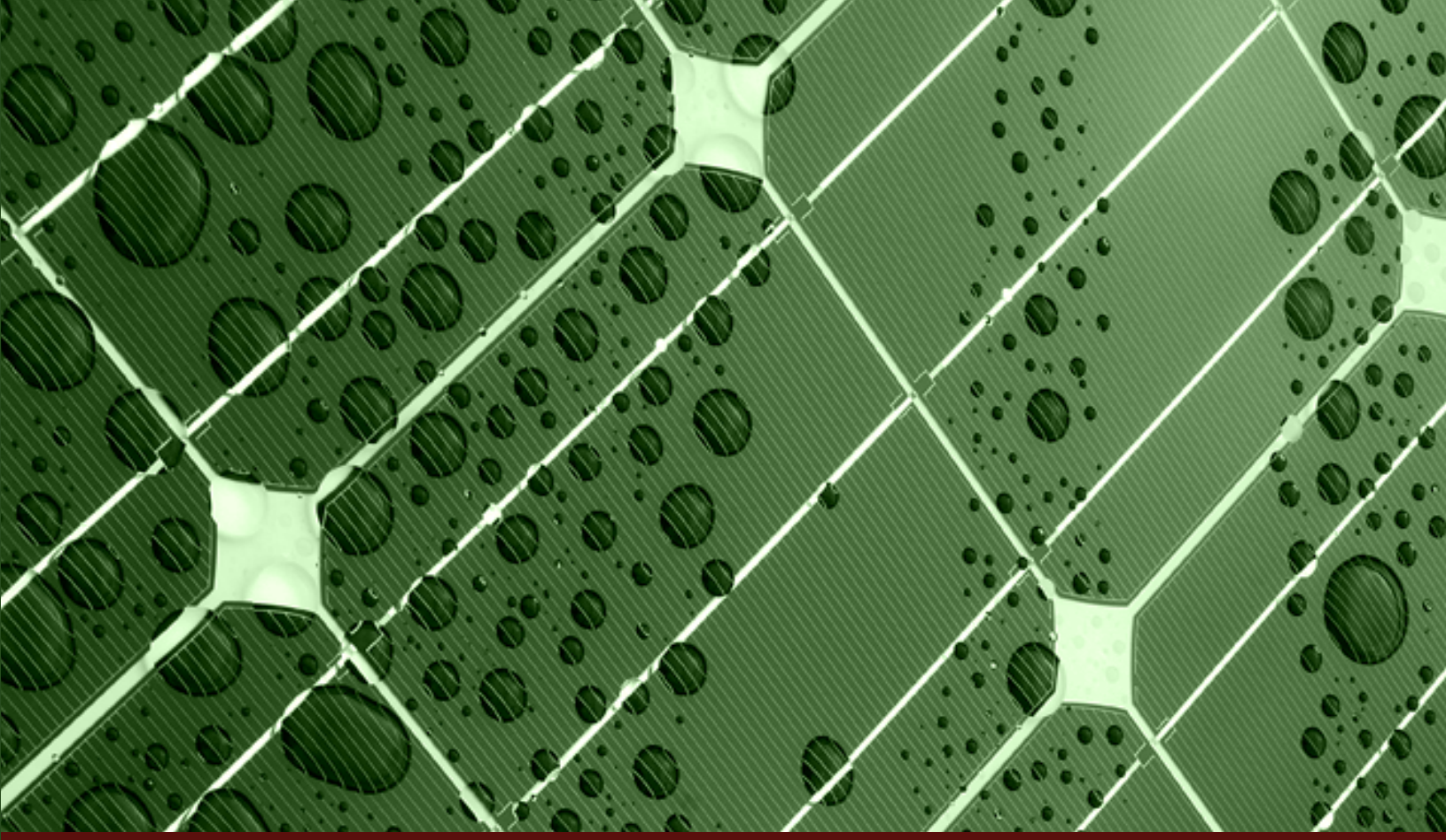

Evaluation Knowledge Study

Review of Energy Efficiency Interventions

Independent Evaluation ADB

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Printed in the Philippines

ISBN 978-92-9092-931-4 (Print), 978-92-9092-932-1 (PDF)
Publication Stock No. BKK125173-2

Cataloging-In-Publication Data

Asian Development Bank.
Review of energy efficiency interventions.
Mandaluyong City, Philippines: Asian Development Bank, 2012.

1. Energy efficiency. 2. Energy security. I. Asian Development Bank.

Note:
In this report, "$" refers to US dollars.

Asian Development Bank
6 ADB Avenue, Mandaluyong City
1550 Metro Manila, Philippines
Tel +63 2 632 4444
Fax +63 2 636 2444
www.adb.org

For orders, please contact:
Department of External Relations
Fax +63 2 636 2648
adbpub@adb.org

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ABBREVIATIONS

ADB	–	Asian Development Bank
CFL	–	compact fluorescent lamp
CHEEF	–	China Energy Efficiency Financing
CHUEE	–	China Utility-based Energy Efficiency
CMI	–	Carbon Market Initiative
CMP	–	Carbon Market Program
CNIGC	–	China National Investment and Guarantee Company
CO_2	–	carbon dioxide
DMC	–	developing member country
EEI	–	Energy Efficiency Initiative
GDP	–	gross domestic product
GEF	–	Global Environment Facility
IBRD	–	International Bank for Reconstruction and Development
IED	–	Independent Evaluation Department
IFC	–	International Finance Corporation
PRC	–	People's Republic of China
WBG	–	World Bank Group

WEIGHTS AND MEASURES

cct-km	–	circuit-kilometer
gce	–	gram of coal equivalent
GWh	–	gigawatt-hour
Kgoe	–	kilogram of oil equivalent
kV	–	kilovolt
kWh	–	kilowatt-hour
m^2	–	square meter
MVA	–	megavolt-ampere
MW	–	megawatt
mtoe	–	million tons of oil equivalent
tpa	–	ton per annum

ACKNOWLEDGMENTS

A team of staff and consultants from the Independent Evaluation Department (IED) contributed to this study, including analyses, desk reviews, interviews, research and data collection. The core team included Kapil Thukral (Team Leader) and Renato Lumain and Roslyn Perez (team members). Robert Taylor, Hong Miao, Parimal M. Sadaphal, Elizabeth Lat, and Minerva Dacanay were the consultants. Alan D. Poole was the external peer reviewer. Yovan Rizaldi, the project assistant, provided strong analytical support.

The earlier version of this report were reviewed by relevant departments and offices of the Asian Development Bank. Alastair McIndoe and Eric Van Zant edited the report. Alex Pascual worked on the book design and typesetting, and Caren Joy Mongcopa proofread the report. Njoman George Bestari and Mike Diza provided the overall production support.

The evaluation was prepared under the overall guidance and supervision of H. Satish Rao (formerly Director General, IED) and Hemamala Hettige (Officer-in-Charge, IED). It was approved by Vinod Thomas (Director General, IED).

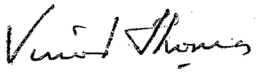
We further acknowledge the comments on an earlier version of this report, as provided by relevant departments and offices of the Asian Development Bank. IED retains full responsibility for this report.

FOREWORD

Improving energy efficiency is now recognized worldwide as a highly cost-effective means to increase energy availability. This will be vital for the Asia and Pacific region which is expected to become the world's largest energy-consuming region by 2050—and be most exposed to risks related to energy security and climate change. Governments across the region must encourage measures to contain energy consumption and increase the use of all types of clean energy—a process in which the Asian Development Bank can assist its developing member countries.

The study focuses on energy efficiency improvements in industry and buildings. The two sectors are large electricity consumers and provide ADB with a good opportunity to promote demand-side energy efficiency. So far, ADB's support for improving energy efficiency has had a supply-side orientation—accounting for about 40% of total clean energy interventions during 2003–2010. Going forward, ADB is expected to move toward a more balanced and integrated portfolio of supply and demand-side side energy efficiency improvement interventions, as envisaged under ADB's long-term Strategy 2020. ADB has already begun some standalone demand-side energy efficiency projects, and support may gradually increase over the next several years in response to client demand and ADB's rising expertise in preparing such interventions.

The study notes the pricing and other barriers in promoting demand-side energy efficiency. It also notes a range of approaches that can be adopted for promoting demand-side energy efficiency. The report also recognizes that a major challenge is to analyze and identify the type of efficiency measures that would work best in a given country. The study highlights measures that call for commercial banks to work closely with energy service companies, mechanisms that work through market forces such as trading of energy efficiency certificates, sectors and segments where regulation is the preferred mode, such as the setting of minimum energy performance standards for certain type of energy using equipment, and other settings where administrative measures have proved useful.



Vinod Thomas
Director General
Independent Evaluation

EXECUTIVE SUMMARY

Introduction

Rapid economic growth in Asia and the Pacific, which is expected to continue outpacing the rest of the world in coming years, will make the region the largest energy consumer in the foreseeable future. Unless the Asian Development Bank (ADB) and its developing member countries encourage measures to contain energy consumption, the region will be increasingly exposed to risks related to energy security and climate change.

Among the options available to contain energy consumption are the improvement of energy supply-side efficiencies by reducing energy losses in the supply chain, and energy demand-side efficiencies achieved through consuming less energy for the same level of service. Improving energy efficiency is recognized as a highly cost-effective alternative to increasing energy availability. A megawatt of power capacity saved (e.g., by retrofitting energy-efficient industrial equipment) costs about half that of adding the equivalent coal-fired power-generating capacity.

Industry and buildings accounted for more than 70% of all energy use and more than 85% of electricity use in the region in 2008, the most recent year for which complete data are available. It is often difficult to estimate the technical and market potential for energy efficiency improvements in industry and buildings. Therefore, scaling up energy efficiency investments in industry and buildings, though highly desirable, is challenging. This evaluation focuses on these investments, reviews ADB's efforts in this area as well as on the supply side, and provides information on how they can further support energy efficiency improvements on the demand side.

Based on the study, two key lessons are identified to enhance ADB's participation in demand-side energy efficiency initiatives, which could contribute to the improved design of these interventions. The executive summary introduces the motivation for the study, its key findings, and some future considerations.

Key Lessons

Promoting commercial financing of energy efficiency investments in industry and buildings. Commercial financing could be encouraged by bringing together two very different communities: commercial banks, which normally have strong financial expertise but inadequate technical skills, and energy service companies. While these are normally technically well qualified to implement at least one type of energy efficiency project, they often lack the financial strength to finance more than a handful of them. The risks perceived by commercial banks for financing energy efficiency initiatives could be mitigated with interventions that comprise (i) lines of credit dedicated to financing projects that qualify as energy efficiency investments, and/or (ii) partial credit guarantees through which a commercial bank shares part of the credit risk with ADB or

another credible guarantor. Such interventions could include a capacity development component to help banks enhance their understanding of energy savings from costs associated with energy efficiency projects. And they could also help energy service companies gain a better understanding of the requirements for bankable projects.

Facilitating energy efficiency improvements in specific energy-user categories. ADB could support the governments of developing member countries design and implement a large variety of energy efficiency projects targeted to improve energy performance in specific sectors or segments. For instance, to help facilitate the market penetration of energy efficient appliances, ADB interventions could focus on (i) setting or upgrading minimum energy performance standards and labeling programs for appliances used in households, public services, businesses, and for industrial equipment; (ii) setting up or equipping private and public sector laboratories for appliance and equipment testing; and (iii) creating institutional capacity for a credible verification and enforcement mechanism. Similarly, to encourage the construction of energy-efficient buildings, ADB interventions could focus on capacity development in concerned government bodies to enhance the skills base and institutional procedures to have a credible mechanism for the verification and enforcement of energy efficient building codes.

Objective and Scope

Recognizing that ADB's support for improving energy efficiency has had a supply-side orientation, the primary objective of this study was to gather information on types and designs of possible future demand-side interventions.

The study focuses on energy efficiency improvements in the industry and buildings sectors, but excludes transport, agriculture, and other sectors. This allows a more thorough investigation of the design of interventions in the reviewed sectors. The study also does not compare the resources and effort required to prepare demand-side and supply-side energy efficiency project interventions, or their relative costs. The study also does not attempt to analyze policy alternatives to promote energy efficiency investment, although it is recognized that these are stimulated by supportive policies and regulatory environments.

The ADB interventions that were examined are:

(i) Approvals for demand-side energy efficiency investments in industry and buildings during 2003–2010 that totaled about $260 million, and accounted for 4% of ADB's clean energy portfolio. These comprised a multitranche financing facility that offered a line of credit for industrial energy efficiency projects coupled to a capacity development grant, and a partial credit guarantee facility to backstop building energy efficiency projects. In addition, there were five other interventions for efficient lighting; these comprised loans with accompanying or standalone grants.

(ii) ADB's loans and investments for industrial development prior to 2003 (mostly during the late-1980s and 1990s) were through direct interventions and lines of credit to financial institutions in developing member countries. Energy efficiency aspects were studied for loan and investment approvals

of about $1.0 billion for direct interventions, along with $1.4 billion for setting up various lines of credit. Some of these interventions stated energy efficiency objectives upfront.

(iii) Supply-side interventions accounted for about 40% of total clean energy interventions during 2003–2010. These were studied from the energy efficiency perspective for the specific purpose of determining whether insights could be gained for advancing such investments in industry and buildings. In particular, system-loss reduction aspects of more than 30 loans and investments for power transmission and distribution system expansion and strengthening projects were examined, along with a few ongoing loans and investments to improve the efficiency of central district heating services in cold climates.

Key Findings from ADB Experience

Energy pricing and other market imperfections need to be addressed to promote energy efficiency investments. Energy policies seeking to align energy prices with the cost of energy supply are insufficient for generating these investments. It is not easy to assess the extent to which ADB's policy dialogue on reexamining tariff policies and the rationalization of electricity prices promote end-use efficiency improvements. Among the reasons that electricity tariff adjustments alone do not result in improved energy efficiency are insufficient metering of some customer categories and utility inefficiencies that allow unbilled use to be classified as a nontechnical loss. To boost energy efficiency investments, ADB and the governments of developing member countries should support the removal of various barriers, such as the

(i) poor awareness of readily available energy efficiency options;
(ii) high-risk perception of these investments among commercial banks;
(iii) relatively poor credibility of many energy service providers; and
(iv) insufficient capacity to audit, monitor, and verify energy use and energy savings in various end-user categories.

ADB's rich experience in supporting energy supply-side projects provides few insights into the design of demand-side energy efficiency interventions. These are mostly transmission and distribution projects, which have increasingly incorporated features to improve energy efficiency as part of their project design. For such projects, estimates of changes in transmission and distribution losses can be made, and the effects of design changes during implementation can also be assessed. However, given the basic difference between network-based transmission and distribution systems and industry and buildings, which are point consumers, such interventions provide little insight into the design of demand-side energy efficiency interventions. Likewise, ADB's extensive experience in supporting district heating projects does not provide further guidance on the design of demand-side interventions.

Appropriate energy use measurement and verification systems must be incorporated into project design. Such systems were put in place in the Guangdong Energy Efficiency and Environment Improvement Program. However, available documents on several ADB interventions made in the 1980s and 1990s provide little

evidence of any attempt to systematically compile "before-and-after" energy-use data for ADB-supported projects and subprojects. In particular:

(i) Through over 15 lines of credit extended to development financial institutions, ADB's main objective was to make foreign exchange available to enable industry to modernize and expand. Energy efficiency objectives were not articulated upfront for most of these interventions. Available documentation provides no evidence that any party—either the sub-borrower, the concerned financial institution, or ADB—had made any attempt to estimate energy savings.

(ii) For about 10 of ADB's direct loans and investments to industry, where energy efficiency was stated upfront as a primary or secondary objective, the overall energy-use data at the plant level are available for many projects. However, the data do not appear to be internally consistent for many industrial units. So, little can be said about the veracity of the measurement and verification system.

Concerted effort is required to ascertain that lines of credit extended for industrial energy efficiency actually support energy efficiency subprojects. For a line of credit that ADB approved in 1994, the energy efficiency improvement objective was explicitly stated at appraisal. Yet, it supported several diesel-fired captive power plants, which do not qualify as energy efficiency measures. The reason was that the concerned financial institution encountered problems regarding subproject origination.

Key Findings from the Experiences of Other Development Partners

The findings from ADB's energy efficiency efforts are supplemented by the experiences of other development partners to provide ideas for further energy efficiency initiatives, including ones for private sector operations.

A diagnostic review of the local institutional environment is required for the design and development of energy efficiency delivery programs. A diagnostic review conducted upfront would provide useful information for the design of a suitably adapted and customized delivery program. Such an exercise could cover relevant financial sector issues, local technical assessment and project development capabilities, the energy efficiency market, the role of government and development partners in the energy efficiency arena, and local contractual frameworks and customs.

The efficacy of lines of credit and partial credit guarantees for energy efficiency investments can be enhanced with technical assistance support for energy efficiency project origination. A commercial bank that is beginning to engage in commercial energy efficiency financing must be able to originate energy efficiency projects (i.e., build a pipeline of projects that qualify as energy efficiency investments). Depending on the resident expertise in the bank, and its technical partners, if any, support can be provided to enhance the technical and financial appraisal skills of staff. At a practical level, this may also mean developing a ready-to-use spreadsheet to help staff quickly assess whether or not a given project opportunity meets the criteria to qualify as an energy efficiency project. Technical

assistance support can also help staff to gather the information and data for the spreadsheet.

Partial credit guarantees can encourage commercial energy efficiency lending. A partial credit guarantee from a credible source can reduce the risk perceived by commercial banks for energy efficiency lending, and help improve the credibility of newly established energy service companies, or ones with small balance sheets. To the extent that partial credit guarantees backstop energy performance contracting-based projects, these instruments can also provide a good opportunity for banks to interface with energy service companies; helping both entities to better understand and appreciate each other's role in broad basing energy efficiency investment and financing.

Energy efficiency programs are best implemented by aligning their objectives with the business approaches and market development strategies of financial intermediaries. It is best to begin program development with the identification of local financial intermediaries interested in energy efficiency lending, followed by the design of energy efficiency interventions that conform to the specific business interests of financial intermediaries. For instance, a commercial bank whose strategic objectives overlap with the objectives of a partial credit guarantee is more likely to finance energy efficiency projects. If the program is designed to include another partner organization, such as a utility company, its strategic objectives should also be aligned with that of the energy efficiency program.

An exit strategy for the development partner is critical. Efforts to promote commercial energy efficiency financing should aim to leave behind sustainable schemes that can function without further development partner support. For instance, a line of credit or partial credit guarantee can be designed to allow a participating commercial bank to identify, appraise, and approve a subloan itself without further approvals from government or development partners. This will help the bank to start making sound business decisions on energy efficiency lending. In the event of energy efficiency lending from a participating bank ceasing or slowing markedly after the end of a partial credit guarantee, it may be necessary to have a follow-on partial credit guarantee. Perhaps a good indication that the first instrument contributed, if only partly, to enhancing commercial energy efficiency financing would be if the terms of the follow-up guarantee called for a lower first-loss threshold and lower risk-sharing percentages below and above this threshold.

For promoting energy efficiency measures targeting specific end-user segments, the capacity development effort needs to be strategic and long term. Most sector-specific energy efficiency programs in ADB developing member countries begin with a narrow focus. But as experience is gained and expertise developed, programs have become more broad based and ambitious. Yet such programs call for capacity development efforts that cover a broad range of stakeholders over the medium term, including some in the private sector. For instance, standards and labeling programs have normally begun with a few types of appliances, a small number of models, which are rather easily achievable energy efficiency performance-rating standards, and monitoring and verification systems largely in areas with high appliance sales. As a result, capacity development efforts in the initial stages are likely to be limited to just a few manufacturers and testing laboratories, and a few officials from

regulatory or government bodies. But, as the program broadens and expands, it is very likely that more diversified capacity development efforts will be required for a wider set of stakeholders.

For promoting energy efficiency measures targeting specific end-user segments, certain design principles must be observed. For the successful introduction or broad-basing of a utility led demand-side energy efficiency intervention or some other energy efficiency intervention that targets specific measures in specific end-user segments, the following are considered important aspects of project design: (i) aligning the interests of all stakeholders to achieve program objectives, (ii) instituting information systems so that a verifiable data trail is created and energy savings can be reasonably verified, and (iii) minimizing the probability that stakeholders cannot recover the costs of participating in the program.

Future Considerations

According to Strategy 2020, to meet growing energy demand in a sustainable manner, ADB will help expand the supply of energy, as well as "promote energy efficiency through supply-side and demand-side measures." ADB is therefore expected to move towards a balanced portfolio of supply- and demand-side energy efficiency improvement interventions. ADB has begun supporting standalone demand-side projects in recent years. Support for such projects may gradually increase over the next several years in response to client demand and rising expertise in preparing them. ADB can offer policy advice and technical assistance to help the governments of developing member countries establish a regulatory and institutional environment that encourages energy efficiency investment in end-use sectors. Technical assistance may also be targeted at public and private sector players for subregional cooperation for specific energy efficiency measures. For instance, it may be used for formulating building energy codes and minimum performance standards for specific appliances, and for meeting targeted specific energy consumption in selected manufacturing segments.

MANAGEMENT RESPONSE

On 21 November 2011, the Director General, Independent Evaluation Department, received the following response from the Managing Director General on behalf of Management.

I. General Comments

1. We welcome IED's Evaluation Knowledge Study (EKS) on reviewing and evaluating ADB's energy efficiency (EE) interventions. It provides a balanced assessment of ADB's EE related activities and offers useful recommendations to pursue a balanced supply-side and demand-side interventions.

2. We agree that ADB's energy efficiency interventions have been dominated by supply side projects. Apart from modernization investments in industry and buildings to spur energy efficiency, ADB's demand-side approach will focus on various reforms in price incentives, regulation, technical standards, technology progress, etc. As such, "a balanced portfolio" mentioned in the study should not necessarily be interpreted as meaning significant increase in the demand-side lending volumes.

3. We value the key findings on the experiences of other development partners. The lessons learnt from other MDBs would be useful for improving ADB's design and implementation of EE projects in the future.

II. Comments on Key Findings from ADB Experience

4. Key Finding 1: Energy pricing and other market imperfections need to be addressed to promote EE investments. We agree. With regards to the barriers to EE investment, ADB is making efforts to address some of these barriers:

(i) ADB recognizes that more needs to be done to help DMC governments establish the right enabling regulatory frameworks to promote clean energy. Since 2010, ADB has organized Dialogue on Clean Energy Governance, Policy and Regulation in the annual event of Asia Clean Energy Forum to promote regulatory transformation in the region. Key themes that were included in the Dialogues are implementation of strong regulatory frameworks, better monitoring and verification processes, institutional capacity building and mobilizing proper financing mechanisms.

(ii) ADB also notes the existing energy market failure caused by various fossil fuel subsidies in reflecting the real cost of fossil fuel consumption. Fossil fuel subsidies increase fiscal expenditures, spur greenhouse gas emissions, and benefit mainly the non-poor. In 2011, ADB approved a regional technical assistance (RETA) to examine the issues and hurdles related to phasing out of the fossil-fuel subsidies in DMCs. This RETA will also seek to find out ways to address the needs of DMCs for affordable modern energy services while tackling climate change and other environmental concerns.

5. **Key Finding 2: ADB's rich experience in supporting energy supply-side projects provides few insights into the design of demand-side EE interventions.** We agree but some efforts are currently underway. We recognize that standalone demand-side EE investments need more resources, time, and effort in order to achieve considerable progress compared with traditional energy sector investments. Given these constraints and to strengthen synergies between supply side and demand side interventions, ADB will explore the establishment of an integrated supply- and demand-side management and finance program.

6. **Key Finding 3: Appropriate energy use measurement and verification systems must be incorporated in the project design.** We agree. We will keep promoting establishment of appropriate measurement and verification systems in DMCs in close collaboration with the governments and by incorporating this component into the project design. We are also facilitating knowledge sharing of best practices on this and setting up of regional database and benchmarks for energy efficiency in major energy subsectors through various regional cooperation mechanisms.

7. **Key Finding 4: Concerted effort is required to ascertain that lines of credit extended for industrial EE actually support EE subprojects.** We agree. To ensure that the lines of credit are utilized by financial institutions for EE subprojects as originally intended, we will focus on capacity development of borrowing institutions for the identification of viable subprojects while supporting market research and projects development in the downstream area. To engage in vital commercial EE financing opportunities, ADB will keep promoting demand side EE interventions through public-private partnership, with ADB taking a lead role in policy advisory work, enhancing regulatory framework, pricing, technical standards, etc., while energy service companies and commercial banks provide necessary technical support and funding.

CHAIR'S SUMMARY: DEVELOPMENT EFFECTIVENESS COMMITTEE

Discussion Highlights

1. Independent Evaluation Department (IED) produced the subject report drawing from evaluative evidence from ADB, developing countries and development partners. The context was that ADB support for renewable energy technologies had increased 50-fold since 2006 compared to the previous five years but support for energy efficiency in industry and buildings sectors accounted for only 4 per cent of ADB's clean energy approvals from 2003 to 2010. IED stressed that reducing energy consumption through energy efficiency not only creates dollar savings but also reduces carbon emissions. IED found that that it was difficult to promote energy efficiency because of poor awareness and perceptions issues among commercial banks, among other related factors.

2. Management thanked IED for the well structured report stating that the conclusion exhorting to do more in energy efficiency in buildings and industry was somewhat general. Management laid out the constraints in doing more about energy efficiency recognizing that there is a sector cap of about 20 to 25 per cent. Staff explained that while energy efficiency is one of the desired outcomes of ADB's energy program, the same could be said about clean energy and energy access, which may lead to trade-offs in some areas. Responding to DEC's inquiry whether it is Management's preference to focus on clean energy, staff clarified that ADB's existing expertise on the supply side enable it to focus on that sector but did not preclude them from partnering with private companies holding expertise on energy efficiency in a given sector.

3. DEC noted that ADB should strengthen its function as a knowledge bank in regard to energy efficient investment in DMCs. The report mentioned that commercial banks normally have strong financial expertise but inadequate technical skills while energy service companies are technically well qualified but they lack financial strength. ADB is expected to connect both sides by tapping into past lessons on various sectors as well as providing credit modalities suitable for the project, such as partial risk guarantees.

Definition of energy efficiency

4. DEC members clarified how IED defined energy efficiency and remarked that linking the definition to energy source (renewable or not) and the gross domestic product further muddles the definition. IED clarified that energy efficiency is defined as energy input per unit of output and that the type of energy source or GDP structure in terms of energy supply sources is a separate issue. Some DEC members also remarked that energy efficiency is a broad term which may also cover fuel efficiency, land use planning, transport in urban centers, and waste recycling.

Evaluation modality

5. IED was asked why the report produced was a knowledge study rather than a special evaluation study (SES). DEC members were informed that any evaluation has an objective to evaluate against, and SES is conducted if there is a huge portfolio to look at. Because there are not many energy efficiency projects to evaluate, a knowledge study was produced where the key objective of the report is learning.

Compact fluorescent lamps (CFL)

6. DEC members emphasized that CFL projects in Philippines, Sri Lanka and Pakistan were met with constraints raising question on their effectiveness. Regional and Sustainable Development Department (RSDD) claimed that switching to CFL has been proven to reduce electricity consumption. However, the lessons drawn from such projects showed that the expectations towards the Clean Development Mechanism credit (CDM) were too high. Moreover, it was found that: 1) there was no viable recourse for companies to recover the cost incurred in distributing CFLs; 2) consumers were provided free CFLs who then resell it in the grey market; and 3) implementation arrangements should have taken into account implementation delays, particularly in procurement and distribution because of CDM expectations. To avoid future implementation delays, Management introduced rigorous project readiness criteria.

Energy Service Companies (ESCOs)

7. While the report observed that more work could be done to encourage ESCOs to engage in energy efficiency efforts, Management acknowledged their inherent limitations in penetrating major industries such as steel and cement. It was pointed out that ESCO type operations encounter difficulties finding expertise. Staff also observed that ADB needs the legal basis for engaging ESCOs.

Demand versus supply side interventions

8. DEC members remarked that there was no comparison made between the resources and effort required to prepare demand and supply side project interventions. IED indicated that the information available is not sufficient to make a comparison. Some DEC members noted that there is a window for involvement in selected industries such as textiles, and pulp and paper where energy conservation potential is considerably high compared to other sectors. Discussions also centered on pricing and subsidies to clean energy but it was mentioned that greater effort is required to undertake such interventions, which partly explain why multilateral development banks are not expanding their involvement in the said area.

Conclusion

9. DEC welcomed the Evaluation Knowledge Study on Review of Energy Efficiency Interventions. Members noted that energy efficiency covers not only electricity but also

fuel use in transportation and other sectors. However, electricity is a very important subsector which needs special attention. Members emphasized the importance of clean energy as well as energy efficiency and encouraged staff to relate the two in terms of costs and benefits and strive for more analytical clarity when discussing the two issues.

10. Members noted that time overruns need to be controlled in energy efficiency projects. More attention needs to be paid on how to accelerate success in switching to CFL. Appropriate pricing and regulatory regimes can play an important role in achieving energy efficiency. While commendable effort is being made on the supply side for achieving energy efficiency, there was scope for selective intervention on the demand side, particularly in textiles and pulp and paper subsectors. Members appreciated that ESCOs had a bright prospect in cutting down costs and encouraged ADB in its effort in demand-side interventions. However, the legal aspects of encouraging ESCOs also need to be looked into. Achieving energy efficiency requires an integrated approach and the members also encouraged staff to look at land use planning, the transportation sector and how one could recycle waste into energy.

CHAPTER 1

EVALUATION FOCUS

A. Rationale

1. The Asian Development Bank's (ADB's) developing member countries have achieved remarkable economic growth during the past half century, and are expected to continue growing faster than the rest of the world for the foreseeable future.[1] The projected GDP growth of 3.5% a year for Asia and the Pacific[2] from 2005 to 2030 is expected to be achieved with annual energy demand growth of 2.4% per year, faster than the world average of 1.5% per annum.[3] Current trends also indicate that Asia will become the largest energy-consuming region by 2050, and will be most exposed to risks related to energy security and climate change.[4]

Current trends indicate that Asia will become the largest energy-consuming region by 2050

2. The oil price shocks of 1973, 1979, and 1990, and high international oil prices since the early 2000s compelled developing member countries to enhance their energy security by increasing energy supplies. ADB's response has largely supported the augmentation of indigenous energy supplies. Energy efficiency, which reduces the need for supply-side capacity additions, has not been the primary objective of ADB support.

3. Given the very high probability that global climate change is a consequence of increased anthropogenic greenhouse gas emissions,[5] the efforts of ADB's developing member countries at managing their emissions will be watched closely by the global community. It is in this context that ADB needs to provide direction and leadership to increase penetration of all types of clean energy in Asia and the Pacific. Since the early 2000s, ADB's support has centered on increasing supplies of cleaner fuels, such as natural gas and cleaner coal-based power generation technologies, as well as promoting renewable energy technologies and supply-side energy efficiency improvements in power and district heating systems. ADB's support for demand-side energy efficiency has been mostly through nonenergy sector interventions. These aimed to increase urban water supply, improve sewerage services, replace dilapidated water distribution systems, rehabilitate irrigation infrastructure, and induce a shift in freight and passenger traffic from road to rail. ADB's energy efficiency interventions in industry—the sector consuming the most energy—has been minimal since the early 2000s.

ADB needs to provide direction and leadership to increase penetration of all types of clean energy in Asia and the Pacific

[1] ADB and the Asia-Pacific Economic Cooperation (APEC). 2009. *Energy Outlook for Asia and the Pacific*. Manila. (October).

[2] In addition to ADB's developing member countries, the Asia and Pacific region also includes Australia, Japan, and New Zealand.

[3] Energy Information Administration (EIA). 2009. *International Energy Outlook*. Washington, D.C.

[4] ADB. 2011. *Asia 2050: Realizing the Asian Century*. Manila.

[5] Intergovernmental Panel on Climate Change (IPCC). 2007. *Climate Change 2007: Synthesis Report (Contribution of Working Groups I, II and III to the Fourth Assessment Report of the IPCC)*. Geneva.

B. Objectives

The study focuses on energy efficiency improvements in the industry and buildings sectors

4. Recognizing that ADB's support so far for energy efficiency improvement has had a supply-side orientation, the primary objective of this study was to gather information on type and design of future demand-side interventions. The study focuses on energy efficiency improvements in the industry and buildings sectors (and excludes transport, agriculture, and other sectors). This allows for a more thorough investigation of the design of interventions in these two sectors by ADB, as well as other development partners and the governments of developing member countries. The study does not compare the resources and effort required to prepare demand-side and supply-side energy efficiency project interventions, or compare their relative costs. It also does not analyze policy alternatives to promote energy efficiency investments, although it is recognized that this is stimulated by supportive policies and regulatory environments.

5. The industrial and building sectors, characterized by large energy consumers, provide ADB a good opportunity to advance demand-side energy efficiency. Table 1 shows that, in Asia, industrial energy consumption accounts for about 40% of total energy consumption, with energy consumption in buildings[6] accounting for about 32%. The respective shares of the industrial sector and buildings in electricity consumption are 58% and 30%.

Table 1: Energy Demand Profile in Asia and the Pacific in 2008[a]
(million tons of oil equivalent, on net calorific value basis)

Item	Electricity	Coal	Oil Products	Gas	Other Energy[b]	Total
Total fuel consumption	421.6	623.2	741.2	198.6	615.1	2,599.8
Industry	246.4	491.5	105.5	66.8	95.4	1,005.5
Transport	4.4	3.3	332.7	7.9	2.4	350.8
Residential	78.3	53.4	65.4	50.0	488.5	735.4
Commercial and public services	48.3	13.1	29.5	16.2	9.0	116.0
Agriculture/forestry	21.3	8.1	30.9	0.4	0.1	60.7
Fishing	0.3	0	1.4	0	0	1.7
Nonspecified	22.8	22.3	6.7	26.1	14.5	92.3
Nonenergy use	0	31.6	169.2	31.3	5.1	237.2

[a] To match ADB's developing member countries, Asia and the Pacific should include the excluded Marshall Islands, Federated States of Micronesia, Nauru, and Tuvalu. Likewise, Asia and the Pacific should exclude French Polynesia, Macau, and New Caledonia, which are included.
[b] Other Energy includes nuclear, hydropower, geothermal, solar, wind, combustible renewables, and waste.
Source: International Energy Agency (based on database at http://www.iea.org/stats/index.asp).

6. This evaluation knowledge study reviews ADB's efforts in demand-side energy efficiency and provides information to enable ADB to increase this effort. Since the early 2000s, ADB's approvals for demand-side investments in industry and buildings have aggregated to about $260 million. This is less than 4% of all approvals for clean energy, and less than 25% of approvals for supply-side energy efficiency improvements in power transmission and distribution systems, and centralized district heating services.

7. Against this background, this evaluation knowledge study focuses on understanding the type of interventions ADB should support to promote demand-side

[6] Includes energy consumption in residential and other buildings, such as commercial, public, and government buildings, as well as public services, such as water supply, sewerage services, garbage disposal, street lighting, and traffic lighting systems.

energy efficiency investments, particularly in industry and buildings. The study focuses on the need to

(i) evaluate the experience of supply-side energy efficiency projects for lessons that can be useful for further promoting supply-side and demand-side efficiency.
(ii) learn from ADB's experience in industrial sector support, mostly during the 1990s and earlier, when industrial modernization was the primary objective.
(iii) draw on external experience to understand a range of approaches and business models for advancing energy efficiency in industry and buildings.

C. Study Period

8. During the 1980s and 1990s, ADB interventions included loans and other support interventions to industrial enterprises and lines of credit to development financial institutions to modernize the industrial sector. These efforts may have been associated with energy efficiency benefits and are therefore reviewed.

9. In addition, the study focused on 2003–2010 when ADB also supported energy efficiency projects as part of its clean energy portfolio. Before 2003, ADB's role was largely confined to technical assistance and capacity development for clean energy.[7] Although ADB began helping developing member countries source funds for emission reduction projects in 2003,[8] overall, ADB's support for energy efficiency improvements in industry and buildings was minimal during 2003–2010. It is noteworthy, however, that two of the seven ADB interventions approved during this period were for improving energy efficiency in industry and buildings in the People's Republic of China (PRC).

D. Evaluation Methodology

1. Components of the Evaluation Knowledge Study

10. Contextual and strategic review. Links between energy efficiency improvements and reduced vulnerabilities in developing member countries were explored through a literature review. In particular, the implications of increasing investment in energy efficiency for better energy security, improved local environments, and climate change mitigation were examined. Publicly available information on energy efficiency was compiled to gauge improvements in supply-side efficiency in recent years, and

[7] The Asia Least-Cost Greenhouse Gas Abatement Strategy was designed to assist 12 developing member countries meet their commitments under the United Nations Framework Convention on Climate Change. The strategy was an awareness creation and capacity development exercise that provided inputs to the developing countries in the formulation of national least-cost greenhouse gas abatement strategies and action plans, as well as to identify a portfolio of greenhouse gas abatement projects. ADB executed the strategy study during 1995–1998. This was followed by the "Promotion of Renewable Energy, Energy Efficiency and Greenhouse Gas Abatement" from 2000 to 2007. Its aim was the capacity development of domestic stakeholders in 18 developing member countries to promote investments in renewable energy, energy efficiency, and greenhouse gas abatement technologies. It also provided a forum for ADB staff to share information about problems in promoting clean energy technologies in different developing member countries, and created the initial impetus within ADB to mainstream clean energy technologies in energy sector operations.

[8] ADB. 2003. *Clean Development Mechanism Facility*. Manila. This paper informed the ADB Board about the establishment of the Clean Development Mechanism Facility at ADB, as well as its functions and operational modalities.

qualitative and quantitative assessments for energy efficiency across end-use sectors with a focus on industry and buildings.

11. **Study of demand-side energy efficiency projects.** All seven ADB interventions targeted at industry and buildings were studied. They comprise support to industry for retrofits of energy efficient equipment, and support to buildings for energy efficient lighting and other measures.[9] For one ADB-supported project, desk studies were supplemented by site visits and discussions with stakeholders to understand the priority accorded to energy efficiency in industry and buildings by owners, management, and government, as well as to understand stakeholders' perceptions on the barriers they face for improving energy efficiency, and the level of difficulty in addressing those barriers. All these projects are ongoing, and the focus is on their design and implementation efficiency. Where projects have made significant progress and sufficient information is available, the energy efficiency-related results orientation was also examined.

12. **Study of industrial support projects.** Particularly before the turn of the century, the two major types of ADB interventions intended to support industrial establishments were lines of credit extended to development financial institutions to support industrial modernization, expansion and new or greenfield units, and direct support to industry for the same purposes. Through a review of project documents available within ADB and public information, the energy efficiency implications of these types of interventions were assessed to gain insights into the design and regulatory/financial aspects of such projects.

13. **Study of energy supply-side projects.** Using project documents and discussions with ADB staff, the evaluation team analyzed information on energy sector projects to understand the outlook for energy efficiency improvement. The focus was on transmission and distribution projects that help reduce system losses. But for completeness selected power generation and centralized district heating projects were also studied.

14. **Review of experiences of other development partners.** In recognition of the extensive experience of some development partners in the propagation of energy efficiency measures in buildings and industry, key findings and lessons from relevant experiences were documented.

2. Approach Used

15. **Type of analysis**. All demand-side energy efficiency projects in industry and buildings were approved after December 2007. Consequently, all demand-side projects are ongoing, although some have made more progress than others.[10]

16. For industrial support projects approved in the 1980s and 1990s, the only available information on project outputs and outcomes is contained in project completion

[9] For the purposes of this evaluation, buildings include residential and other buildings (including commercial, public, and government buildings), as well as lighting-related public services, such as street lighting and traffic management.

[10] Regarding data on energy efficiency improvements or energy savings, the singular exception is one demand-side project that had made significant progress by mid-2011, although its disbursement closing date has been extended to December 2013 from December 2012.

reports, and project performance evaluation reports for the few postevaluated projects. Energy efficiency benefits had not been recognized upfront for many of these industrial support projects; and in most cases the extent of energy savings had not been measured or verified.

17. Most of supply-side energy efficiency projects approved since the early 2000's have yet to be completed, and so performance-related information is not available. For supply-side efficiency projects, some measurements are normally an integral part of the project design, which can provide some basis for estimating energy savings.

18. Due to limited information, and because the design and approval criteria for many industrial support projects did not consider energy efficiency objectives, the study does not focus on a postevaluation type of analysis. The ADB interventions are therefore reviewed from the perspective of understanding (i) design aspects in terms of explicit incorporation of energy efficiency objectives, as well as other aspects related to the institutional framework, financing mechanism, technology choices, beneficiary identification and selection, and approaches to the measurement and verification of energy savings; and (ii) implications for results in effectively addressing institutional and financial barriers to energy efficiency and the likelihood of efficiency-related outcomes from the interventions.

19. Data sources. A mix of desk studies and site visits provided the information for the review. The desk study included (i) literature reviews and data/information compilation from publicly available sources, and (ii) reviews of ADB project documents and archives, accompanied by discussions with concerned ADB staff. For a small sample of projects, the evaluation team also conducted site visits. Although all demand-side energy efficiency projects approved since December 2007 were investigated, most of the effort centered on projects in the PRC and India. This is because together they accounted for about 56% of ADB's clean energy investment approvals from 2003 to 2010, and the demand-side energy efficiency policy and institutional framework has progressed more in these two countries than in other developing member countries.

20. Limitations. The energy efficiency implications of policy reforms supported through program loans, technical assistance, and other policy dialogue was not assessed. The study focused on industry and buildings, where ADB began making interventions since late 2007. It does not include ADB investments in transport, agriculture, and other sectors, which account for a significant share of energy use and potential for energy efficiency improvement.

Chapter 2

CONTEXTUAL AND STRATEGIC ASPECTS

21. Access to energy is critical to economic development and poverty reduction. Although increasing energy access is one of the prime concerns in many developing member countries, and per capita energy consumption in developing countries is far below that of developed countries (Appendix 1), there are substantial opportunities to improve energy efficiency in the entire energy supply chain, including end-use efficiency improvements across all major sectors.

A. Energy Efficiency and Energy Security

Energy security refers to the continuous availability of energy in different forms, in sufficient amounts, and at affordable prices

22. Energy security refers to the continuous availability of energy in different forms, in sufficient amounts, and at affordable prices to facilitate undisrupted economic activity.[11] The objective of energy security is to assure adequate, reliable supplies of energy at reasonable prices and in ways that do not jeopardize major national values and objectives.[12] The environmental sustainability aspects of energy sourcing and utilization thus appear to be embedded in the concept of energy security. Countries become vulnerable to energy insecurity in several ways, the most important being insufficient domestic energy supply, which forces them to become net energy importers. Inadequate financial resources increase vulnerability by limiting energy production, supply, transportation, transmission, and reliability. The technical characteristics of some resources also add to the vulnerability. Electric power facilities, fossil fuel refineries, pipelines, and transportation systems are vulnerable to breakdown and sabotage. Fossil fuels exacerbate air pollution, and nuclear power plants pose safety and proliferation risks.

23. Governments seek to analyze a vast array of policy choices, institutional and financial mechanisms, as well as technologies to address energy security concerns. From the perspective of net energy- and oil-importing ADB developing member countries, whose economies are poised to grow in the coming years, energy security concerns normally encompass (i) supply-side policies to reduce vulnerability to oil price volatility by augmenting indigenous energy supplies, as well as diversifying the energy import basket and sources of energy imports;[13] and (ii) demand-side policies that focus on managing energy demand. This includes energy efficiency improvements to reduce the amount of energy required to provide the same level of energy services—for

[11] World Energy Council. 2009. *Promoting Energy Security through Energy Efficiency*. Workshop on Energy Efficiency, Addis Ababa. 29–30 June.

[12] D. Yergin. 1988. Energy Security in the 1990s. *Foreign Affairs*. 67(1. Fall. USA.

[13] In general, supply-side policies encourage the exploration, extraction, conversion, transmission, and distribution of commercial energy. Specific tax policies and regulations may also be designed to encourage, among other things, foreign and domestic investment in research and development for new energy technologies, and investment in oil and gas exploration and development in difficult geographies.

instance, through replacing incandescent bulbs with compact fluorescent lamps (CFL) and improved insulation for refrigerators. Demand-side policies can also incorporate broader conservation efforts, from changes in individual behavior or structural economic changes.

B. Energy Efficiency and Environmental Linkages

24. By the 1980s, it was recognized that the unmitigated local environmental consequences of infrastructure development, notably fossil-fueled power generation and transportation, imposed significant costs on the economies of developing member countries. Among them are health costs, damage costs to agriculture and forests, and displaced project-affected families. The Asia region had some of the world's most polluted cities. Such consequences threatened to undo gains in poverty reduction made through economic growth and development.[14] Throughout Asia, as elsewhere in the world, governments enacted environmental quality regulations and emission standards, recognizing that environmental benefits outweighed compliance costs. Although environmental regulations and emission standards have become more stringent during the past few decades, environmental mitigation costs still represent a relatively small percentage of most infrastructure project costs.[15] There is little evidence that compliance with local environmental standards and the requirement for pollution control reduced gross domestic product (GDP) growth rates in Asia and the Pacific. Installing electrostatic precipitators in coal-fired power plants resulted in direct benefits to local populations through avoidance of health damage costs. Policymakers in the developing member countries are therefore normally not opposed to passing the incremental costs of electrostatic precipitators to local consumers.

Unmitigated local environmental consequences of infrastructure development impose significant costs on the economies of developing member countries

25. Avoiding greenhouse gas emissions is a different matter. This is because benefits from emission reductions by foregoing coal use for power generation for more expensive imported liquefied natural gas, or from adopting expensive carbon capture and storage technology,[16] do not accrue to consumers in developing member countries. Indeed, it becomes difficult for policymakers in these countries, especially the small ones, to justify such investment options. The extent to which these measures mitigate greenhouse gas emissions has no measurable effect on damage costs resulting from rising sea levels or reduced rainfall, which are largely a function of the extent to which large emitters abate their emissions.

26. Using less coal for power generation through improved efficiency, or switching to natural gas, results in lower greenhouse gas and other pollutants.[17] Improved natural

[14] A. Ramirez et al. 1997. *Economic Growth and Human Development*. Discussion Paper No. 787. Economic Growth Center. New Haven, Connecticut: Yale University.

[15] For instance, a flue-gas-desulfurizer for sulfur dioxide removal from a coal-fired power plant increases the cost of power generation by about 5%. The increase in the cost of power from installing electrostatic precipitators for fly-ash removal is even less. Similarly, cost increases due to the installation of ash disposal systems, a wastewater treatment facilities, high stacks, and dust suppression systems are also less than 5%.

[16] Carbon capture and storage is still at a relatively early stage of development, and the incremental cost of power from a coal-fired power plant with this system is not known with any degree of certainty. But according to one estimate, the adoption of carbon capture and storage would increase the cost of power by about 70%. Refer to E. Rubin. 2009. *Global Outlook for Coal-Based Power Generation: Implications for Developing Countries*. Presented at the 2009 World Bank Energy Week, Washington, D.C.

[17] This is most likely, even when natural gas composition includes a significant portion of carbon dioxide, which is separated prior to gas supply to power plants or other consumers.

gas to electricity conversion efficiency further reduces greenhouse gas and other pollutants. The same also holds true for energy-consuming sectors. Although per capita energy consumption and per capita greenhouse gas emissions in developing member countries are far below those in the developed ones (Appendix 1), the opportunities to improve efficiencies in the energy chain are substantial.

C. Energy Efficiency Improvements

1. Energy Efficiency Trends

Energy requirements in most developing member countries have outpaced GDP growth

27. Over the past few decades, energy requirements in most developing member countries have outpaced GDP growth. But the energy intensity of GDP (energy use per unit of GDP) has not been the same across all developing member countries. The differences reflect a wide variety of factors, such as climate and weather conditions, geographic size, levels of urbanization, population density, industrial mix, and natural resource endowments. Time trends of energy-GDP intensity have also varied, reflecting the growth profile of a particular country. A declining trend signifies increasing energy efficiency at the country level. For instance, during the 11th Five-Year Plan 2006–2010, the PRC's energy intensity declined by 19.1% (against a government target of 20%), thus improving the energy efficiency of the overall economy.[18] Similar declining trends of energy intensity are also evident in other developing member countries,[19] and reflect more than just technology improvements and productivity increases.

28. A gross indicator for energy efficiency incorporates several factors:

(i) energy intensity reduction owing to changes in the economic structure, and particularly the decline of industry's overall share of GDP coupled with a rise in the share of the services sector, as well as a relative decline in the share of energy intensive industry in favor of high-technology and inherently less energy-consuming modern industrial segments;
(ii) a declining share of coal use (even if coal use increases in absolute quantities) in favor of natural gas, a fuel inherently amenable to higher efficiency of use, be it for power generation or other applications;[20]
(iii) changes in consumer behavior triggered by demand-side policies that are intended to reduce energy use without adversely affecting the quality of life;[21]
(iv) efforts in recent years to improve energy supply-side efficiencies, particularly in electricity transmission and distribution;
(v) penetration of higher efficiency appliances for residential and commercial use that provide the same level and quality of product or service while consuming less energy;

[18] Eleventh National People's Congress. 2011. Report on the Work of the Government delivered at the 4th Session, Beijing, 5 March.

[19] The Indian economy's energy intensity (in kilograms of oil equivalent [kgoe] per constant US dollar in the year 2000) showed a general declining trend from a little over 1 kgoe/$ in 2000 to about 0.88 kgoe/$ in 2008; it was lowest in 2007 at 0.76 kgoe/$ (derived from World Bank Indicators Database; see http://data.worldbank.org/indicator).

[20] C.J. Cleveland. 2005. *Energy Quality, Net Energy, and the Coming Energy Transition*. In K. S. Deffeyes. 2005. *Beyond Oil: The View from Hubbert's Peak*. Hill and Wang: New York.

[21] Such as setting indoor air temperature at a slightly higher level during summer months to reduce air-conditioning load.

(vi) penetration of higher-efficiency industrial equipment requiring less resource inputs, including energy, to attain the same level of output; and

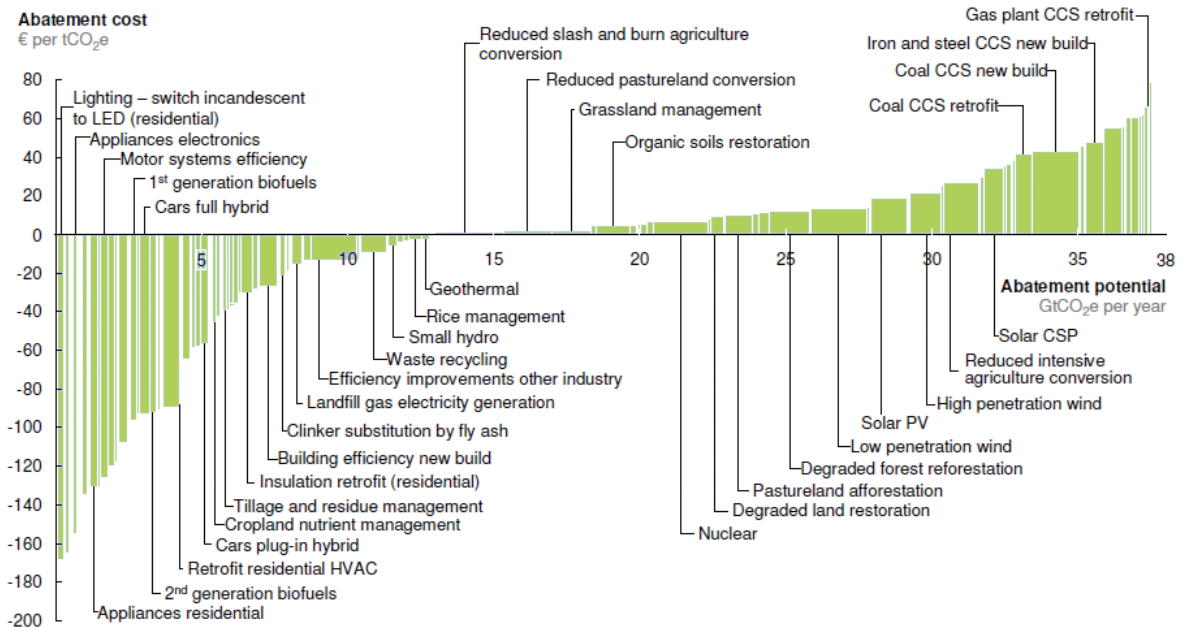
(vii) increased emphasis on recycling and the reuse of production resources, including energy. Appendix 1 provides further information on energy efficiency.

29. Energy efficiency as the least expensive option to increase energy supplies was first articulated in the late 1980s.[22] The idea has gained acceptance over the years among various governments, researchers, manufacturing and trading enterprises, as well as not-for-profit environmental and human rights organizations.[23] It is now recognized that a megawatt saved by using energy-efficient industrial equipment costs about half or less than the cost of adding a megawatt of coal-fired generating capacity.

Energy efficiency is also among the most inexpensive and profitable options for greenhouse gas abatement in various global growth scenarios

30. Energy efficiency is also among the most inexpensive and profitable options for greenhouse gas abatement in various global growth scenarios.[24] Figure 1 shows the carbon dioxide (CO_2) price at which an array of greenhouse gas abatement measures becomes economically viable. The large, negative CO_2 price at which various energy efficiency measures, such as lighting retrofits and appliance replacements, becomes economically viable shows that these are more attractive than other greenhouse gas abatement options.

Figure 1: Global Greenhouse Gas Abatement Cost Curve to 2030



CCS = carbon capture and storage, CSP = concentrated solar power, $GtCO_2e$ = gigaton of carbon dioxide equivalent, HVAC = heating, ventilation, and air-conditioning, LED = light-emitting diode; PV = photovoltaic, tCO_2e = ton of carbon dioxide equivalent

Note: This curve presents an estimate of the maximum potential of all technical greenhouse gas abatement measures below €80 per tCO_2e if each option is pursued aggressively. It does not predict the role that different measures and technologies will actually play.

Source: McKinsey & Company. 2010. *Impact of the Financial Crisis on Carbon Economics: Version 2.1 of the Global Greenhouse Gas Abatement Cost Curve.* USA.

[22] A. Lovins. 1989. *The Negawatt Revolution—Solving the CO_2 Problem, Keynote Address at the Green Energy Conference*. Montreal.

[23] International Rivers. 2009. The Power of Negawatts. *Efficiency: The Greenest Electricity Source*. Berkeley.

[24] Mckinsey & Company. 2010. *Impact of the Financial Crisis on Carbon Economics, Version 2.1 of the Global Greenhouse Gas Cost Abatement Curve*. USA.

2. Barriers to Energy Efficiency Improvement

31. Owners and managers of industrial units and buildings can quickly implement energy efficiency measures, and typically within a few months of deciding to do so. However, in many developing member countries, investments other than energy efficiency improvements are being preferred. This is due largely to business and regulatory environments which make it possible to realize huge financial returns from expanding production capacity or constructing more buildings.[25]

32. The importance of energy efficiency and the difficulties of implementing these projects are noted.[26] Correcting inefficiencies offers the potential for three positive outcomes: lower capital cost requirements,[27]reduced greenhouse gas emissions and other sources of air pollution, and enhanced energy security.

Although the energy efficiency potential is known to be high, actual implementation remains limited

33. Although the energy efficiency potential is known to be high, actual implementation remains limited. Key barriers normally include (i) insufficient end-user awareness of the potential benefits or a low priority accorded to energy efficiency; (ii) constraints related to the ready availability of energy efficient equipment, which may reflect either the manufacturers' priorities or abilities, supply chain inadequacies, price differentials between standard and energy efficient versions of the same equipment, and poor power supply quality affecting the performance of energy efficient equipment; (iii) poor service and delivery systems, given the high risks perceived by many commercial banks to finance energy efficiency over other types of investment that improve only the bottom line,[28] and insufficient financial strength and credibility of many energy service companies; and (iv) inadequate policy and regulatory frameworks to deliver energy efficiency across a range of users, as well as encourage energy efficiency improvements in specific end-user segments.

3. Policies to Address Energy Efficiency Barriers

34. Key requirements for developing and accelerating energy efficiency investments include formulating national policies and strategies with enabling laws and regulations, as well as other legislation, for pricing and nonpricing signals to enhance energy efficiency. Among nonpricing signals are measures encouraging competition in industry by reducing entry barriers, tax and fiscal incentives, and promoting technology upgrades. Monitoring, verification, and enforcement mechanisms are needed for achieving targeted efficiency performance levels in industry and buildings. A further key requirement is putting in place suitable institutional mechanisms to finance, deliver, and facilitate compliance through a judicious mix of incentives/disincentives, verification, and enforcement.

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[25] This evaluation knowledge study does not present a comparative analysis because its basic purpose is to understand how energy efficiency interventions can be designed to promote energy efficiency investments where they are attractive, and because of the large database requirement for a comparative analysis of financial rates of return from energy efficiency versus capacity enhancement investments.

[26] ADB. 2007. *Energy Policy 2000 Review: Energy Efficiency for a Better Future*. Manila.

[27] As the capital cost of new capacity ($ per unit of energy generated or delivered) is normally higher than the capital cost of an energy efficiency measure ($ per unit of energy saved).

[28] This is due in good measure to inadequate expertise in most commercial banks to appropriately appraise energy efficiency projects that result in energy savings and reduce energy bills.

35. The standard set of remedies to address such barriers includes a mix of policy and investment support measures designed to (i) enhance energy efficiency investment across a range of sectors, which normally involves the commercialization of energy efficiency financing; or (ii) be directed at a specific subsector—for instance, through utility-led, demand-side management programs,[29] appliance standards and labeling programs, and building energy codes.

36. That the long-run energy price elasticity of demand is negative means that higher energy prices reduce demand.[30] But despite the long-term benefits of improved energy security, cleaner environments, and reduced atmospheric greenhouse gas concentrations, policy makers find it difficult to justify energy price increases and removing energy price subsidies. Subsidies are ostensibly instituted by governments to serve social objectives. Even if they are poorly targeted, as is normally the case, and the middle class receives a larger share of the subsidy pie, removing them would perhaps put a far bigger burden on the poor. Pricing reforms therefore call for a good understanding of poverty and distributional impacts.

Pricing reforms call for a good understanding of poverty and distributional impacts

D. ADB Strategies and Policies

37. Under ADB's first Long-Term Strategic Framework,[31] ADB programs must (i) promote environmentally sound development without compromise; and (ii) support overall economic efficiency to deliver sustainable economic growth and social development through good governance, increased sector-wide approaches to assistance, efficient use of capital, and competitive capital markets. The Long-Term Strategic Framework says, "In addition to advocating the integration of environmental policies and objectives into national development policies and objectives, ADB must ensure, in conjunction with developing member countries, that environmental policies adopt an integrated resource management approach. The recent water policy adopted by ADB takes such an integrated approach; the forestry and energy policies, which are under review, will do the same." Although there is no specific mention of "energy efficiency" in the Long-Term Strategic Framework, the concept is embodied within the "integrated resource management approach."

38. Strategy 2020 is more direct. It identifies infrastructure, which includes energy, as one of the five core areas for ADB investment. It explicitly mentions that to meet growing energy demands in a sustainable manner, ADB will help expand the supply of energy, as well as "promote energy efficiency through supply-side and demand-side measures." Although support to industrial and commercial sectors is not recognized as a core area for ADB investment, Strategy 2020 does recognize that the infrastructure deficit, which includes energy shortages, constrains market-led growth and access to social

[29] Demand-side management program designs can vary. Some programs are marketing efforts to encourage customers to adopt new technologies (such as efficient lighting), rebates for certain types of energy efficiency equipment, and free energy audits. Typically, demand-side management programs either reduce total energy consumption or shift consumption to reduce demand during peak times.

[30] According to one estimate, the overall long-run price elasticity of demand is -0.72, and ranges from -1.35 for natural gas use in industry to -0.32 for electricity use in industry. As quoted in Independent Evaluation Group, World Bank. 2009. *Climate Change and the World Bank Group: Phase 1: An Evaluation of World Bank Win-Win Energy Policy Reforms*. Washington D.C. (page 44, Table 4.2).

[31] ADB. 2001. *Moving the Poverty Reduction Agenda Forward in Asia and the Pacific: The Long-Term Strategic Framework of the Asian Development Bank (2001–2015)*. Manila.

services in many countries; and is one of the key developmental challenges facing the region. Strategy 2020 also advocates that, to spur market-led growth, ADB must advise governments on the basics of a business-friendly environment, including reliable rules, regulations, and policies that do not disadvantage private sector enterprise.

39. In line with ADB's first energy policy paper,[32] which focused on overcoming oil price shocks and emphasized the need to develop indigenous energy sources to augment energy supply, ADB responded by helping developing member countries create energy infrastructure and address the environmental and social implications of new energy projects. The Energy Policy 1995[33] focused on demand-side management. It recommended an emphasis on both supply-side and demand-side energy efficiency improvements before providing support for capacity addition in the power subsector (electricity), fossil fuel subsectors (coal, oil, and gas), and rural energy systems, including renewable energy sources. A review of the Energy Policy in 2000[34] confirmed the soundness of the existing energy policy framework, and recommended a realignment of ADB's energy sector interventions along four operational priorities. One of them was "addressing regional and global environmental impacts by supporting measures to address acid rain problems, use of clean energy."

40. The Energy Policy 2009 reiterates this stance and states that improving energy efficiency by examining both demand-side and supply-side alternatives is a priority for ADB. Toward this objective, and along with the emphasis on implementing the policy as guided by the three pillars of the policy,[35] ADB will (i) expand its operations in the industrial sector by collaborating with industry associations, domestic banks, and specialized energy efficiency agencies and energy supply companies; and (ii) assist in identifying energy efficiency options and preparing financial assistance guarantees.

[32] ADB. 1981. *Role of the Bank in the Energy Sector in the Region.* Working Paper No. 2-81.Manila.

[33] ADB. 1995. *Energy Policy 1995*. Manila.

[34] ADB. 2000. *Energy 2000: Review of the Energy Policy*. Manila.

[35] The three pillars are (i) promoting renewable energy and energy efficiency; (ii) maximizing access to energy for all; and (iii) promoting energy sector reform, capacity building, and governance.

Chapter 3

ADB'S ENERGY SECTOR STRATEGIES AND OPERATIONS

A. Clean Energy Program

41. During the study period (2003–2010), ADB's clean energy investment approvals increased significantly, from about $300 million or less during 2003 and 2004 to between $1.25 billion and $1.75 billion a year during 2008–2010. The annual target of $1 billion for clean energy investment approvals to be achieved by 2008 through the Energy Efficiency Initiative (EEI) launched in 2005 has been exceeded. This increase in clean energy investment approvals was made possible by (i) the catalytic support provided to EEI through the clean energy financing partnership facility; and (ii) increased activity through the Carbon Market Initiative (CMI) (renamed Carbon Market Program [CMP] in 2010) to identify, screen, prepare, and support clean energy projects. The clean energy financing partnership facility focuses on ADB-supported interventions; the CMP, in addition, assists non-ADB clean energy projects.

The annual target of $1 billion for clean energy investment approvals to be achieved by 2008 through the Energy Efficiency Initiative launched in 2005 has been exceeded

42. Available information on projects already supported or in the pipeline shows that the CMP has emphasized renewable energy, supply-side energy efficiency, and waste management projects. Energy efficiency projects for industry and buildings have so far received significantly less support through CMP. Several venture capital funds that have a stated focus on clean energy technology through the CMP companies and clean energy projects and have received contributions through ADB's venture capital initiative also have a similar emphasis. However, a significant portion of total clean energy financing partnership facility allocations from 2008 to 2010 was to promote energy efficiency measures. Appendix 2 provides further information on on EEI, CMI/CMP, the clean energy financing partnership facility, and the venture capital initiative.

43. The extent to which demand-side energy efficiency technologies or projects will be supported through newer ADB initiatives—such as the Climate Technology Center and Low Carbon Technology Market Place—is uncertain. Attempts are being made to support energy efficiency through the Clean Technology Fund with cofinancing from ADB and other sources.[36] Some private sector initiatives also include support for energy efficiency[37] and ADB has also supported a few public sector energy efficiency programs.

[36] For instance, industrial energy efficiency and other programs being discussed for support in Viet Nam and Indonesia. The Clean Technology Fund is to provide grants for public sector projects, and soft loans for private sector projects.

[37] Such as (i) a $100 million line of credit is being negotiated with a commercial bank in India to support renewable energy and energy efficiency subprojects—the amount to earmark for supporting only energy efficiency subprojects—is also to be decided upfront; and (ii) a $30 million line of credit exclusively for supporting energy efficiency investments in Bangladesh.

B. Clean Energy Lending Portfolio

44. ADB's total clean energy investment portfolio during the 8-year study period was $7.3 billion. Figure 2 shows that it included renewable energy and large hydro projects (48% of the total portfolio) and supply-side energy efficiency interventions. These comprised the supply and use of cleaner fuels and deployment of cleaner power generation technologies (26%), improving power transmission and distribution, and centralized district heating (more than 14%). The supply-side energy efficiency interventions included a large number of transmission and distribution system expansion and strengthening projects, and a relatively small number of interventions in high-efficiency clean coal technologies, gas-based combined cycle plants, and centralized district heating systems. Demand-side energy efficiency interventions accounted for less than 12% of the clean energy portfolio by amounts approved (Figure 2), but 30% by number of loans and investments approved during the study period (Figure 3). For demand-side energy efficiency interventions in the industry and buildings sectors, the corresponding shares were 4% and 5%, respectively. Appendix 3 lists the approvals by type of clean energy during the study period.

Figure 2: Share of ADB Loan/Investment Approval Amounts by Type of Clean Energy during Study Period

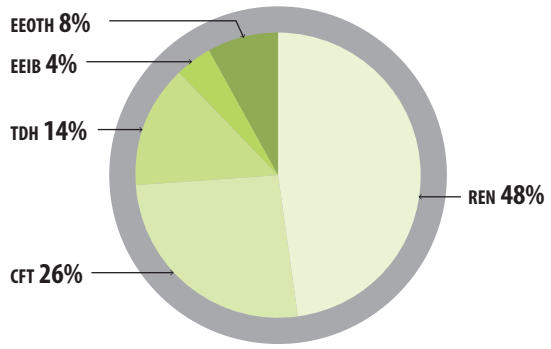
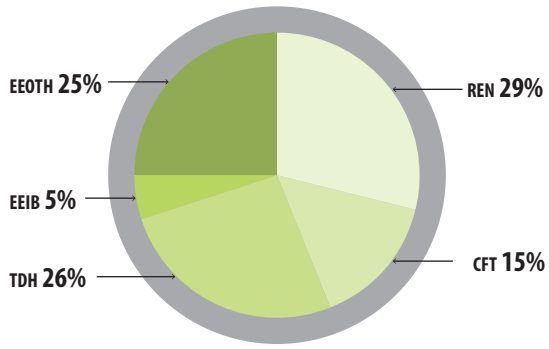


Figure 3: Share of Number of ADB Loans/ Investments Approved by Type of Clean Energy during Study Period

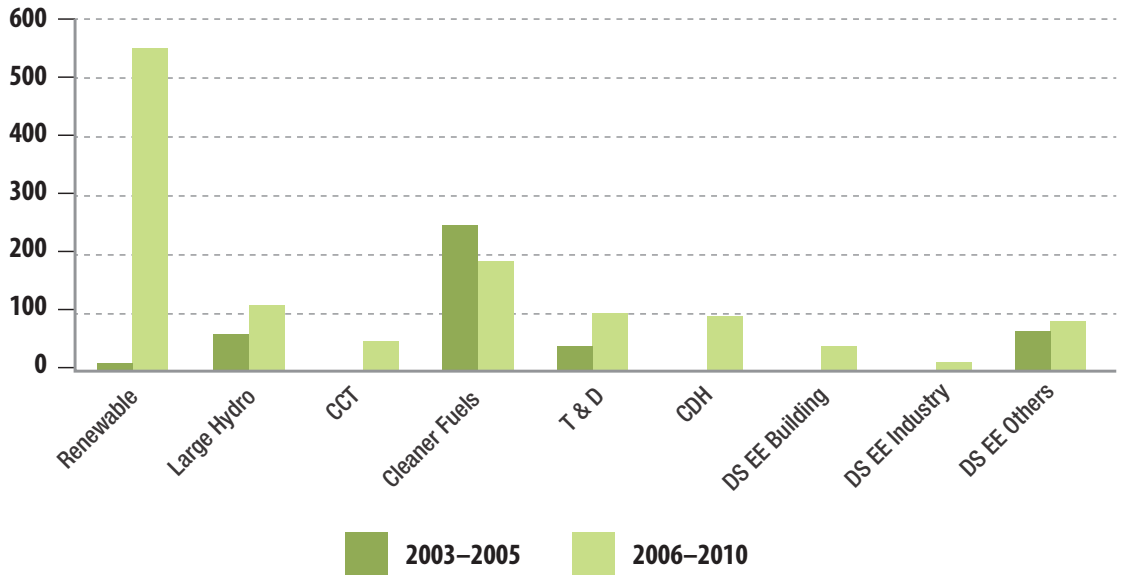


CFT includes cleaner fuels (e.g., natural gas) and clean technologies (e.g., coal-fired power generation with supercritical steam boilers); REN includes all renewable energy (wind, small hydro, solar, biomass, etc.) and large hydro; TDH includes efficiency improvements in power transmission and distribution systems as well as in centralized district heating; EEIB includes demand-side energy efficiency measures in industry and buildings (note that "buildings" includes commercial, public sector, and government buildings, as well as public services such as street lighting and traffic signals); EEOTH includes improved urban water supply and/ or sewerage services, replacement of dilapidated water distribution systems, rehabilitation of irrigation infrastructure, and intermodal passenger and freight transport shift arising from new or expanded rail projects.
Source: Compiled by Evaluation Team (from data in reports on http://www.adb.org/Clean-Energy/projects.asp).

45. Figure 4 shows the annual average investment approvals in various categories of clean energy projects during the two subperiods: (i) subperiod I (2003–2005), when ADB was only managing the Clean Development Mechanism facility as a 3-year pilot initiative; and (ii) subperiod II (2006–2010), during which ADB began building on the experience gained through the Clean Development Mechanism facility, and launched the EEI in 2005 and the CMI in 2006. Annual average clean energy approvals jumped

nearly threefold in subperiod II.[38] Other salient observations from Figure 4 are (i) the annual renewable energy portfolio multiplied nearly 50-fold during 2006–2010, compared with 2003–2005; (ii) approvals for transmission and distribution system improvements, a supply-side energy efficiency intervention, more than doubled during 2006–2010; (iii) the portfolio for district heating efficiency improvements, also a supply-side energy efficiency intervention, nearly equaled that of transmission and distribution system improvements, although no such measures had been supported in the first subperiod;[39] (iv) annual average investment approvals for improving urban water supply services, wastewater treatment facilities, rehabilitation of agricultural infrastructure, and rail transport projects increased marginally during the second subperiod; and (v) demand-side energy efficiency interventions for industry and buildings began to be approved only after 2006.

Figure 4: Clean Energy Approvals during Study Period
(Annual averages; $ million)



CCT = clean coal technology; CDH = centralized district heating; DS EE = demand-side energy efficiency; T&D = transmission and distribution.
Source: Compiled by Evaluation Team (from data in reports on http://www.adb.org/Clean-Energy/projects.asp).

46. ADB extended significant support to industry before the study period. This included direct lending to industrial enterprises in selected developing member countries with the objective of reducing local environmental impacts and achieving energy efficiency co-benefits. The support also included extending lines of credit to development finance institutions aimed in most cases at strengthening and expanding these institutions, as well as enabling industrial enterprises to upgrade technology and modernize by providing access to foreign currency. In some cases, energy efficiency improvement was also a stated objective. Some of these cases are listed in Appendix 4.

[38] During the 3 years 2003–2005, total approvals for clean energy averaged $429.6 million annually compared with $1,204 million for clean energy approvals during the 5 years 2006–2010).

[39] However, centralized district heating systems improvement projects had received ADB support during the 1990s.

Chapter 4

REVIEW OF ADB'S DEMAND-SIDE ENERGY EFFICIENCY PROJECTS

47. All demand-side energy efficiency projects and programs of particular interest to this evaluation knowledge study were approved during or after 2007. They are all under implementation and are reviewed separately, in recognition of intercountry differences in policy, regulations, institutional mechanisms, skills base, technology sophistication and other relevant factors that influence energy efficiency project designs and outcomes for a range of end-user segments. Appendix 5 gives a brief overview.

A. Guangdong Energy Efficiency and Environment Improvement Program

48. Design aspects. This $100 million multitranche financing facility program (Loan 2426-PRC, 2611-PRC), approved in June 2008, is consistent with the priorities of the Government of PRC for energy efficiency and efforts made by the Guangdong provincial government in view of the province's fast-growing economy and relatively low natural resource endowments.[40]

49. A high level of commitment from the Government of PRC and the Guangdong provincial government is also evident from the institutional structure and management framework established to implement the multitranche financing facility program.[41] The steering committee provided overall policy direction and operational guidance. The project management office and Guangdong Finance Trust Company Limited are respectively responsible for day-to-day project and financial management.

50. The multitranche financing facility program was proposed using the financial intermediation loan modality, with Guangdong Finance Trust Company as the financial intermediary. However, the project management office conducts technical appraisals of candidate subprojects. Because only proven technologies are supported, the project management office does not take on any technology risk. Guangdong Finance Trust Company conducts financial appraisals of subprojects and appraises the sub-borrowers; it does not take on any risk of loan repayment. The appraisal findings are presented to the steering committee and ADB, and subloans are finally approved by ADB. In the event of repayment default from any sub-borrower, the Guangdong Finance Department remains responsible for repayments of the ADB loan to the Government of PRC. For this reason, the ADB line of credit is not administered as a traditional financial

[40] Guangdong imports 100% of its coal requirements, 80% of its oil needs, and approximately 20% of electricity from other provinces.

[41] Tranche 1 of $35 million equivalent became effective in January 2009, and Tranche 2 of $22.06 million equivalent, in May 2010. Negotiations for Tranche 3 were concluded in June 2011, and it is expected that Tranche 3 will become effective by late 2011 or early 2012.

intermediation arrangement. Guangdong Finance Trust Company also does not provide any service for cofinancing of subprojects from commercial sources.

51. The need for capacity development within the Guangdong provincial government and greater awareness through better outreach to the industrial and commercial energy-user community in Guangdong was recognized upfront. A capacity development grant thus became an integral part of the project design. This also incorporated measurement and verification of energy efficiency gains through approaches that comply with existing standards in the PRC. Further details are in Appendix 6.

52. Implications for results. The periodic financing request for each tranche is accompanied by a list of efficiency power plant subprojects identified for financing. However, the time taken from filing applications for new subprojects to the tranche release means that potential sub-borrowers have to wait 6–8 months or even longer after completing their feasibility studies. As a result, some sub-borrowers have preferred to invest in efficiency power plant subprojects with their own funds or from other sources.[42] To the extent that sub-borrowers on the periodic financing request list invest in efficiency power plant subprojects without availing of an ADB subloan, the project management office identifies other sub-borrowers with viable and credible efficiency power plant subprojects—and further time elapses for ADB to approve the financing of those projects.[43] Four of the nine sub-borrowers in the original list for Tranche 1 dropped out; none did from the Tranche 2 list. However, there is no certainty that all sub-borrowers identified in the periodic financing request for Tranche 3 will wait to avail of an ADB subloan. In recognition of this fact, ADB extended the disbursal closing date by 12 months from December 2012 to December 2013.

53. By end-June 2011, Tranche 1 and Tranche 2 disbursals exceeded 95% and 90% of the respective tranche amounts, and the subproject pipeline for Tranche 3 had also been identified. The following factors indicate that the efficiency power plant program has made significant progress: (i) sub-borrowers generally acknowledge that they have benefited from ADB lines of credit; (ii) some sub-borrowers identified at the periodic financing request stage for Tranches 1 and 2 began the withdrawal process soon after the respective tranche became effective; (iii) two sub-borrowers through Tranche 1 expressed interest in receiving further assistance, and their proposed second efficiency power plant subprojects are included in the list submitted along with the period financing request for Tranche 3;[44] and (iv) propelled by energy efficiency targets set by the Government of PRC, many subprojects supported through Tranches 1 and 2 have been implemented and are beginning to show energy savings.

[42] Even though ADB had accepted the government's request for approving retroactive financing of up to 20% of Tranche 1 and Tranche 2 loan, proceeds for eligible expenses incurred not more than 12 months before signing of the tranche loan agreement.

[43] Following technical and financial appraisals by the project management office and Guangdong Finance Trust Company, respectively, the candidate subprojects are approved for support by the Guangdong Development and Reform Commission and the National Development and Reform Commission before they are sent to ADB for final approval.

[44] The two Tranche 1 sub-borrowers are Guangdong SGIS Songshan Company, which received a subloan of CNY78 million ($11.5 million); and Guangzhou Zhiguang Electric Company, which received a subloan of CNY67 million ($9.9 million).

54. To estimate post-implementation energy savings, measurement and verification protocols complying with national standards have been followed.[45] Table 2 provides an overview of the energy savings and emission reduction performance of the multitranche financing facility program. Post-implementation energy savings estimated for Tranche 1 and Tranche 2 subprojects, plus the initial energy savings estimates for the Tranche 3 subproject pipeline, indicate that it is very likely the multitranche financing facility program will exceed the targeted efficiency power plant capacity of 107 megawatts.[46] This is reinforced when efficiency power plant capacity estimates are revised to take into account transmission and distribution losses in Guangdong province.[47] As greenhouse gas and some local pollutants are also reduced with energy savings, some emission reduction parameters are also indicated in Table 2. Further details by subproject are given in Appendix 6.

55. With tranche loans to be repaid in 15 years, and subloans in 3–5 years, the line of credit can revolve about three times, and estimated efficiency power plant capacity thus increases threefold or more.

Table 2: Performance Indicators for Guangdong Energy Efficiency and Environment Improvement Program (as of end-June 2011)

Item	Unit	Tranche 1	Tranche 2	Tranches 1+2	Tranche 3	All Tranches
Total Investment	$'000	74,877	61,147	136,024	74,044	210,068
ADB Loan	$'000	32,059	22,059	54,118	42,941	97,059
Energy Savings	MWh/year	635,332	146,749	782,081	329,427	1,111,508
EPP Capacity	MW	127.4	29.4	156.8	66.0	222.8
EPP Capacity (revised)	MW	135.0	31.1	166.2	70.0	236.1
Equivalent Coal Savings	tSCE	222,366	51,362	273,728	108,711	382,439
GHG Savings	tCO_2e	495,559	114,463	610,022	256,953	866,975
Other Emission Savings	tSO_2	5,718	1,321	7,039	2,965	10,004
Energy Savings per Unit Investment	MWh/$'000	8.5	2.4	5.7	4.4	5.3
Energy Savings per Unit Investment	tSCE/$'000	3.0	0.8	2.0	1.5	1.8
Avoided Capacity per Unit Investment	kW/$'000	1.8	0.5	1.2	0.9	1.1
GHG Emission Savings per Unit Investment	tCO_2e/$'000	6.6	1.9	4.5	3.5	4.1
SO_2 Emission Savings per Unit Investment	tSO_2/$'000	0.08	0.02	0.05	0.04	0.05
Energy Savings per Unit of ADB Loan	MWh/$'000	19.8	6.7	14.5	7.7	11.5
Energy Savings per Unit of ADB Loan	tSCE/$'000	6.9	2.3	5.1	2.5	3.9
Avoided Capacity per Unit of ADB Loan	kW/$'000	4.2	1.4	3.1	1.6	2.4
GHG Emission Savings per unit of ADB Loan	tCO_2e/$'000	15.5	5.2	11.3	6.0	8.9
SO_2 Emission Savings per Unit of ADB Loan	tSO_2/$'000	0.18	0.06	0.13	0.07	0.10

ADB = Asian Development Bank, EPP = efficiency power plant, GHG = greenhouse gas, kW = kilowatt, MW = megawatt, MWh = megawatt hours, SO_2 = sulfur dioxide, tCO_2e = ton of carbon dioxide equivalent, tSCE = ton of standard coal equivalent, tSO_2 = ton of sulfur dioxide.
Note: Energy, capacity, and emission savings estimates for two subprojects in Tranche 1 are not available and are excluded from the above data.
Source: Based on data given by Project Management Office in the Guangdong Provincial Government.

[45] IED relied essentially on data compiled by the project management office.

[46] Although, on average, a coal-fired power plant in Guangdong province operates about 6,000 hours per year, the province imports about 20% of its power requirement from other provinces (where power plants operate an average of about 5,000 hours per year). Therefore, at the margin, the efficiency power plant capacity is computed on the assumption that incremental capacity operates about 5,000 hours per year.

[47] The average transmission and distribution losses in Guangdong province (of about 6%) are considered, because the energy savings are estimated at the consumer and not the dispatch end.

56. Beyond government-set targets, the following aspects have emerged since ADB approved the program that are ensuring continued interest in enhancing industrial energy efficiency: (i) some energy efficiency equipment manufacturers have either already set up energy service companies or are considering setting up service units after they received support from the ADB line of credit; (ii) the concept of a physical measurement-based measurement-and-verification protocol to estimate energy savings has become increasingly accepted within the Guangdong provincial government and industrial, commercial and business communities in Guangdong; and (iii) the Guangdong provincial government has set up a mechanism to reward well-performing efficiency power plant subprojects. Besides, the capacity development effort, which is intended to increase awareness and raise skills to plan and implement energy efficiency measures, will also ensure the continued interest of enterprises in Guangdong province to avail of the ADB line of credit.[48] However, the provincial government bears all the credit risk,[49] and the Guangdong Finance Trust Company does not arrange cofinancing from commercial banks or other sources. This means that the partial financial intermediation mechanism for energy efficiency lending does not engage with the commercially oriented financial services sector.

The partial financial intermediation mechanism for energy efficiency lending in Guangdong does not engage with the commercially oriented financial services sector

B. Energy Efficiency Multi-Project Financing Program

57. Design aspects. A partial credit guarantee facility (PCG 7271-PRC) to encourage selected participating banks to expand financing for energy efficiency projects was approved in December 2007. It limits ADB's aggregate liability to CNY800 million and is in line with the Government of PRC's objective of reducing the energy intensity of GDP in the 11th plan period (2006–2010) and 12th plan period (2011–2015). The partial credit guarantee facility also supports the government's initiative to encourage the private sector to contribute to economic growth, and the ADB priority to pioneer innovative contractual and financial structuring to encourage private participation and enhance management expertise.

58. As designed, the partial credit guarantee facility covers up to 48.5% of a participating bank's loan portfolio to a prespecified maximum value.[50] It enables commercial banks to expand their energy efficiency–related products and services, and so enables building developers and administrators borrow for investing in energy efficiency measures.[51] Johnson Controls, an energy service company, would guarantee savings from such measures.

[48] In particular, through the following components of the capacity development program: (i) workshops for opinion makers and research institutes, among others, on low carbon development strategies for Guangdong province; (ii) seminars and workshops for potential sub-borrowers to promote the efficiency power plant program and clarify subloan application processes; (iii) a multipurpose website intended to create awareness of energy efficiency and the efficiency power plant program for the public; and (iv) seminars and workshops for project management office staff on economic and financial analysis, procurement processes, and related issues.

[49] 100% of the loan amount is covered through collateral and guarantees. Any residual risk is taken by the Guangdong provincial government, as it is responsible for repaying the ADB loan to the PRC government.

[50] This includes (i) a first loss coverage of up to 10% of the loan principal of a bank's energy efficiency portfolio, of which the partial credit guarantee fund covers up to 80%; and (ii) for the remaining 90% of the loan principal, the fund covers up to 45%.

[51] Building developers and construction companies for design and construction of new energy efficient buildings, and building administrations for energy efficiency retrofits in existing buildings.

ADB recognizes the need to be flexible in credit criteria to address the highly divergent and technical nature of energy efficiency projects

59. Implications for results. Since the program was approved, ADB has extended guarantee cover of CNY700 million to two banks.[52] As of July 2011, no energy efficiency project had been covered by the partial credit guarantee, although more than 30 building projects had been evaluated by Johnson Controls and proposed to one of the participating banks. Even so, given the large and fast-growing market for energy efficiency improvement in buildings,[53] and as the partial credit guarantee program is available for 9 years (until 2016), ADB is discussing possible technical assistance support to the participating banks to enhance their capacity to offer energy efficiency-related products and services. ADB recognizes the need to be flexible in credit criteria to address the highly divergent and technical nature of such projects. It is also noted that with the hike in interest rates and reduction in credit growth target since late 2010, the risk premium for energy efficiency related loans is expected to increase. Because energy efficiency projects normally lack collateral value, this will increase the market attractiveness of the partial credit guarantee.

C. Philippine Energy Efficiency Project

60. Design aspects. The project (Loan 2507-PHI) was approved in January 2009 with a loan of $31.1 million and a grant of $1.5 million. It is in line with the commitment of the government of the Philippines to improve energy efficiency in the economy, as is evident from the enactment of the Climate Change Act of 2009[54] and the Philippine Energy Plan (2009–2030), whereby energy efficiency and conservation are explicitly recognized as an integral part of the energy security framework. The project design, however, appears to have been overly ambitious. In particular, some stakeholders have little incentive to participate in some energy efficiency program components.

61. Other components are proceeding slower than originally anticipated, and/or have been scaled down. There are no clear incentives for electric utilities and cooperatives to implement the national residential lighting program and distribute free compact flourescent lamps (CFLs) to households. The plan, as of July 2011, is to seek the assistance of other government bodies to implement the national lighting program.

62. Implications for results. Although the scheduled closing date is 31 October 2011, progress as of July 2011 indicates significant delays. The creation of a super-energy service company as a subsidiary of the Philippine National Oil Company has been stalled,[55] possibly because there were no clear incentives for the oil company to incur expenses for such a unit. The national residential lighting program was behind schedule, and less than half of the scaled-down volume of CFLs had been distributed.[56]

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[52] The agreement with Standard Chartered Bank is for partial credit guarantees of up to CNY400 million, and one with Shanghai Pudong Development Bank of CNY300 million. The agreement with Shanghai Pudong was concluded in May 2011.

[53] Estimated at about CNY80 billion in 2007, and estimated to reach CNY190 billion by 2017. ADB. 2007. *Report and Recommendation of the President to the Board of Directors: Proposed Credit Guarantee for the Energy Efficiency Multi-project Financing Program in the People's Republic of China.* Manila (approved on 14 December 2007).

[54] Republic of the Philippines. 2009. *Climate Change Act of 2009*. Manila (27 July).

[55] The super-energy service company was intended to develop projects for implementation in the public sector, and encourage—by providing financial and technical advisory support, as well as assisting with bringing in necessary financing—other energy service companies to implement energy efficiency projects in private sector enterprises.

[56] The original target of distributing 13 million CFLs had been scaled down to 8.6 million. Of this, about 3.7 million CFLs had been distributed by end-June 2011.

The process to engage contractors has just been completed for two lighting retrofit programs for government office buildings and street lights. For the retrofit of traffic signals and pedestrian crossings, the contractor bid evaluation process was nearing completion. But as of July 2011, no lighting retrofits had actually been implemented under any of the three retrofit programs. Given the difficulties encountered in adhering to procedures required for claiming carbon credits under the Clean Development Mechanism, accreditation for the mechanism is not being pursued beyond the first lot of 5 million CFLs.

63. Under the plan, the residential lighting program and all retrofit programs are expected to be completed by end-December 2011 or early 2012. Successful completion appears unlikely. Meeting these time goals depends on several factors: (i) that without the incandescent bulb exchange, the government agencies now engaged in CFL distribution would be more inclined, and more effective at, distributing CFLs than the electric cooperatives; (ii) that the contractor installing efficient traffic and pedestrian crossing lights begins work by mid-September (as per the revised timelines set in July 2011); (iii) that there are no significant delays in procuring various types of lights for government buildings, streets, traffic signals, and pedestrian crossings; and (iv) that the Department of Energy's project management office and its consultant are able to monitor the progress of all components, and give timely advice to the project steering committee to resolve issues before they become critical.

64. While project implementation may suffer further delays, it is highly likely that the national residential lighting program and the three lighting retrofit programs will eventually be implemented, and that energy savings will occur. No information on actual CFL usage and performance is available from the residential lighting program, the only component that has so far been partly implemented. This means there is no information on the actual failure rate of the distributed CFLs, how CFLs are being disposed of, and whether any households have gone back to using incandescent lamps.[57] This also illustrates the challenges associated with formulating verifiable carbon credit schemes from the demand side. At this time, only pre-implementation estimates of energy savings are available. These indicate an annual savings of about 195 gigawatt-hours (GWh) from all components, with over 96% of savings coming from the scaled-down residential lighting program alone.

65. In a narrow sense—efficient lights, once installed, will continue to be used—the project outcomes will be sustained. But in the broader sense of whether free CFLs and retrofitted lights will be replaced by new efficient lights at the end of their life will depend considerably on the success in creating public awareness of the benefits of efficient energy use, as well as establishing clear links with the government's climate change initiatives and capacity building in various concerned institutions. [58]

Whether free CFLs and retrofitted lights will be replaced by new efficient lights at the end of their life will depend considerably on the success in creating public awareness of the benefits of efficient energy use

[57] Anecdotal data suggests that actual failure rates are much higher than originally anticipated. With the prevailing procurement system, which requires the procurement of qualified equipment on the basis of lowest first cost, CFLs were not procured from the most credible manufacturers, but from the ones that offered CFLs at the lowest price.

[58] To the extent that the sale of incandescent bulbs is banned in certain areas (for instance, in Metro Manila), residential customers will continue to use CFLs or other efficient lighting technologies.

D. Energy Efficiency Investment Program (Loan 2552/2553-PAK)

66. Design aspects. The multitranche financing facility investment program for Pakistan (Loans 2552/2553-PAK), approved in August 2009, is consistent with the government's policy to improve energy efficiency, as well as with ADB's country partnership strategy for Pakistan (2009–2013).[59] ADB approved Tranche 1 of the financing facility in September 2009. It comprises a $20 million loan from ADB's Special Funds resources for supporting the multitranche financing facility program management over a 5–6 year period, and a $40 million loan for the National CFL Project, envisaged to be completed by 31 July 2012. The National CFL Project has a cofinancing agreement with the Agence Française de Développement for an amount of $25 million equivalent under a loan administered by ADB.

67. The project management office was to have been set up in the Planning Commission to help overcome institutional weaknesses by supporting the Office of the Member (Energy), Planning Commission. The purpose was to coordinate with concerned agencies[60] for implementing the energy sector road map, which specifically includes energy efficiency improvements in all sectors of the economy;[61] and the multitranche financing facility investment program, through monitoring, reporting, selection, and preparing investment projects, as well as managing consultant support.

68. Under the original design of the National CFL Project, the government was to buy CFLs and provide them to distribution utilities, which were to deliver them to customers for free, and bear the distribution cost. The government was also to be responsible for conducting surveys and record keeping according to the measurement-and-verification protocols necessary to estimate energy savings and emission reductions. In addition, an independent transparently selected entity was to verify the savings and certify emission reductions.

69. Implications for results. The relocation of the project management office from the Planning Commission to the Ministry of Water and Power caused a 7-month delay in loan signing. Another 4-month delay followed in complying with loan conditions to achieve loan effectiveness. With the relocation of the project management office to the power sector line ministry, it became difficult to implement an integrated energy strategy and road map, although the government has agreed to establish an interministerial steering committee to coordinate with the concerned agencies for this purpose.

70. As of mid-June 2011, supply contracts to procure 30 million CFLs in two lots were scheduled to be finalized. In terms of planning for free distribution to households, most

[59] Pakistan has experienced shortfalls in electricity supply since fiscal year (FY) 2007. Power capacity additions have been less than required. Households, which accounted for 50% of power use in FY2008, continued to use inefficient lighting and appliances. Industrial enterprises, which accounted for more than 40% of total national energy consumption in FY2008, also continue to use inefficient technology and equipment. Although the National Energy Conservation Policy adopted in 2006 provides a framework for energy efficiency, there is no integrated platform for energy sector strategy and policy making.

[60] Including Ministry of Water and Power, and Ministry of Petroleum and Natural Resources, responsible for their respective energy subsectors; and Ministry of Environment, responsible for climate change management-related issues.

[61] By providing policy guidance and planning support, support for interagency and development partner cooperation, and capacity development support.

distribution companies have made plans to allocate resources. However, given that the first lot of 10 million will take up some utilities six months to distribute, it is very likely that the National CFL Project will not be completed by the targeted date of January 2012. But cost overruns are not expected. The project cost is estimated at $85 million,[62] while the CFL procurement costs are less than $50 million.[63]

71. As conceived, inflows from the sale of carbon credits would be sufficient to recover CFL distribution costs, as well as costs incurred for measurement and verification. However, owing to various factors—including the inadequate commitment and awareness of distribution utility and government personnel—progress has been slow. To the extent that utilities can remain motivated to incur upfront costs on CFL distribution and other activities necessary for claiming carbon credits, the expected output of reduced peak electricity demand will be achieved.

72. The start of the $30 million financial intermediary loan and the financing of a risk sharing demonstration project for industrial energy efficiency is being delayed, while steps to begin a supply-side efficiency improvement project (rehabilitation and replacement of thermal power plants) have been discussed.

E. Clean Energy and Access Improvement Project (Loan 2518-SRI)

73. Strategic aspects. The project (Loan 2518-SRI) for Sri Lanka, approved in April 2009, includes a demand-side management component. Given that the Ceylon Electricity Board and Lanka Electricity Company found it difficult to recover payments for street lighting from urban local bodies[64] in their service areas, the emphasis on demand-side management for street lighting is well placed. Necessary institutional enablers are also in place. The Sustainable Energy Authority, established in October 2007, is mandated to develop and implement policy for energy efficiency and conservation measures. The Public Utilities Commission of Sri Lanka was empowered in April 2009 to regulate the electricity supply industry.

74. Under the project, the Ceylon Electricity Board and Lanka Electricity Company are to establish specialized units to function as energy service companies. These are expected to work towards improving street lighting in selected urban local-body areas in their jurisdictions.[65] This is to demonstrate the viability of the energy service company business model, and replicate pilot energy efficiency lighting projects through this model.

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[62] In addition to an ADB loan of $40 million, there is a cofinancing agreement with Agence Française de Développement for the equivalent of $25 million. The government will also contribute the equivalent of $20 million.

[63] The contract price of the first lot of 10 million CFLs was originally about $9.5 million, and for the second lot of 20 million, about $37 million. It is expected that the contract for the first lot will be changed and the price increased. Although this will increase the total costs of the National CFL Project, these will likely not exceed committed resources.

[64] Municipalities, town councils, and 'pradeshiyasabhas' (local government authorities).

[65] Street lighting operations' improvement is expected to include the following: (i) separation of street lighting feeders and installation of feeder meters; (ii) replacement of old conductors and feeder controls; (iii) replacement of incandescent and mercury evaporation lamps with CFLs or sodium lamps to save energy and ensure longer performance; and (iv) installation of time-of-day switches and electronic timers to cut electricity consumption during the daytime, eliminate overcharging, remove delays caused by manual switching of lamps, and ensure reliable operating schedules.

75. Implications for results. As of October 2011, the establishment of energy service company units in the Ceylon Electricity Board and Lanka Electricity Company was in progress. Because of the lack of skills at both entities to manage and operate an energy service company, selected personnel have been trained to design municipal lighting projects. Pilot energy efficiency lighting projects have also been initiated. Since the Ceylon Electricity Board and Lanka Electricity Company have at this stage only technical skills, consultants have been engaged, and are in the process of developing a workable shared-savings mechanism.[66] The difficulties in developing such a mechanism, which is the heart of the energy service company business model, can be gauged by the fact that Ceylon Electricity Board's estimated energy consumption for street lighting is about 150 GWh, which includes about 52 GWh of unaccounted for energy.

F. Energy Access and Efficiency Improvement Project (Grant and Loan 2587-NEP)

76. Strategic aspects. The Energy Access and Efficiency Improvement Project (Grant and Loan 2587-NEP), approved in September 2009, is to assist the Nepal Electricity Authority to address its primary concerns of increasing access to electricity and improving the reliability of supply. Given the inherent benefits of reducing the energy requirement at the point of consumption in a power system that suffers high transmission and distribution losses, a grant of $2 million through the Climate Change Fund and the Clean Energy Fund is being provided. The grant aims to expand the geographical coverage of the Nepal Electricity Authority's CFL distribution program. For quality assurance, the grant provides consulting support for creating awareness, conducting surveys, advising on CFL procurement, and devising a fluorescent lamp disposal strategy.

77. Implications for results. As of October 2011, a consultant has begun work.

G. Java-Bali Distribution Performance Improvement Project (Grant and Loan 2619-INO)

78. Relevance. The Java-Bali Distribution Performance Improvement Project (Grant and Loan 2619-INO), approved in March 2010, is to assist the Perusahaan Listrik Negara to reduce peak demand and system losses on the islands of Java and Bali through efficient lighting and network rehabilitation. The $1 million grant is to be used as follows: (i) $700,000 for promotion and distribution of efficient lighting, which includes financing of CFLs and light-emitting diodes for free distribution; and (ii) $200,000 for consulting support for implementation assistance and monitoring.

79. Implications for results. ADB and Perusahaan Listrik Negara signed the grant agreement in June 2010. A baseline survey was to begin by September 2011, but little preparatory work had been done by August 2011.

[66] The consultants are also developing standards for street lighting in Sri Lanka. Some designated energy service company staff are also receiving training on running street lighting design software.

Chapter 5

REVIEW OF ADB'S INDUSTRIAL SUPPORT PROJECTS

A. Financial Intermediation Loans

1. Industrial Energy Efficiency Project (Loan 1343-IND)

80. **Design aspects.** ADB approved a unique $150 million line of credit (Loan 1343-IND) in December 1994 to focus on industrial energy efficiency projects in India.[67] The borrower and executing agency, the Industrial Development Bank of India, a premier development finance institution, had some prior experience in providing assistance for energy conservation and pollution control projects.[68] Key aspects of the project design are given in Table 3. The design called for baseline measurements before subproject implementation, and post-implementation measurements of "energy consumption across the specific equipment or manufacturing process replaced or modified" to determine energy savings.

Table 3: Key Project Design Aspects of the Industrial Energy Efficiency Project

Item	Description
Target Subsectors	(i) Energy intensive industry subsectors in which market-oriented reforms had been implemented, such as aluminum, cement, chemical, copper, pulp and paper, sugar, and textiles (ii) Other energy-intensive subsectors may also be considered for support, in consultation with ADB, as market-based reforms in these subsectors (e.g., fertilizer, iron and steel)
Scope of Subprojects	(i) Modification of existing production processes through installation of equipment required for energy efficiency and optimization of overall plant operations (ii) Technological restructuring of existing production facilities (iii) Energy efficiency-related licensing or other technology-acquisition subprojects
Subproject Selection Criteria	(i) No greenfield or expansion subprojects should be supported (ii) Increase in energy efficiency should be "at least 18% in all subprojects, as measured by before-project and after-project energy consumption across the specific equipment or manufacturing process replaced or modified" (iii) After subproject implementation, the plant should meet all local and national environmental standards plus internationally accepted safety standards (iv) The economic internal rate of return should be at least 12% in real terms, and the financial internal rate of return should exceed the respective weighted average cost of capital after tax in real terms (v) Sub-borrowers should contribute at least 25% of the subproject costs from their own resources, maintain a debt-service ratio of at least 1.5, and have a debt-equity ratio not higher than 60:40

Source: ADB. 1994. Report and Recommendation of the President to the Board of Directors: Proposed Loan to India for the Industrial Energy Efficiency Project. Manila (21 November, approved on 13 December).

81. **Implications for results.** Of the 26 subprojects approved and supported, 8 were for modification of production processes, 7 for capacity expansion of production

[67] ADB. 1994. *Report and Recommendation of the President to the Board of Directors: Proposed Loan to India for the Industrial Energy Efficiency Project.* Manila (21 November, approved on 13 December).

[68] Through its equipment finance scheme, and the energy audit subsidy scheme.

facilities, 10 for power generation plants, and 1 for a greenfield cement production facility. The following deviations from the project design merit mention:

(i) No subproject involved technology licensing or technology acquisition, implying that only proven energy efficiency technologies were deployed in the subprojects;
(ii) 10 power generation plants were supported, comprising 3 cogeneration plants and 7 captive power plants. Cogeneration and captive power plants were not considered in the original project design. For one thing, many captive power plants have low capacity utilization levels and poor thermal efficiencies; and
(iii) Conceptually, it is not clear how the energy efficiency increase—which was to have been at least 18%, as agreed in the subproject selection criteria—could have been ascertained for the 7 expansion subprojects and 1 greenfield subproject. No such efficiency increase was reported in the project completion report or verified in the project evaluation report.[69]

82. In general, it is not clear whether any baseline energy use and savings estimates were firmly established in the energy audit reports of the subproject enterprises. The covenant that required monitoring the actual realization of energy efficiency targets a 5-year period, and submission of data to ADB, could be only partly met.[70]

While a sector loan provides the required flexibility for financing multiple subprojects, it is also expected to improve sector policies; in this case, for energy efficiency and strengthening institutional capacity

83. The "Industrial Energy Efficiency Project," which was originally formulated as an energy efficiency sector loan, was later reclassified as a financial intermediation loan, albeit for the purposes of administration system registration. While a sector loan provides the required flexibility for financing multiple subprojects, it is also expected to improve sector policies; in this case, for energy efficiency and strengthening institutional capacity. However, the energy efficiency action plan agreed upon during appraisal, and included in the report and recommendation of the President, was not covenanted and hence not pursued.[71] No technical assistance for institutional strengthening was included in the project design, despite a request from the Industrial Development Bank of India for one. Effectively, the Industrial Energy Efficiency Project was formulated largely as a special line of credit to the bank.

2. Other Lines of Credit for Industrial Lending

84. Design aspects. ADB also extended several other lines of credit to development finance institutions in developing member countries (Appendix 4). The primary aim was to extend subloans in foreign exchange for modernization and equipment rehabilitation, as well as capacity expansion for industrial enterprises. Subloans for greenfield industrial units were also considered for support in some cases provided they showed special economic merit, such as introducing new technology or having a strong export orientation. Energy efficiency improvements of the sub-borrowing

[69] IED. 2005. *Performance Audit Report: Industrial Energy Efficiency Project in India*. Manila (Loan 1343-IND, 17 May).

[70] ADB. 2002. *Completion Report: Industrial Energy Efficiency Project in India.* Manila (23 April).

[71] Through policy dialogue during the project formulation stages, the Government of India and ADB agreed on an energy efficiency action plan that set timelines for achieving implementation of certain strategies and achieving certain objectives relating to pricing matters (e.g., market-based pricing for petroleum products, remunerative power tariffs), as well as nonprice aspects (e.g., legal and regulatory framework for energy efficiency).

industrial enterprises were not explicitly considered, and the reporting of any energy efficiency-related indicators was not covenanted.

85. Implications for results. Available documentation within ADB provides no evidence that any party—be it the sub-borrower, financial institution or ADB—tried to establish any system to estimate energy efficiency improvement from the lines of credit.[72]

86. A brief investigation of one development finance institution in India showed that it is difficult to find information on closed loans or projects completed more than 10 years ago. Annual reports and other publicly available information on the sub-borrowers were also scanned.[73] However, annual reports contain yearly data on energy consumption and energy expenditures, whereas several subprojects were implemented over a 12–36 month period; and neither the beginning nor the end of the implementation period coincided with calendar or fiscal years. Besides, annual reports contain consolidated data on energy consumption and expenditure across all manufacturing units of the sub-borrower; the data are not specific to the particular manufacturing facility that benefited from the subloan from a line of credit.[74]

B. Direct Lending to Industry

87. Program design. During most of the 1990s, ADB extended direct support to state-owned as well as private sector industrial manufacturing enterprises. ADB-supported projects were a mix of new installations (greenfield manufacturing units) and plant modernizations, including some with significant capacity expansions. The need for ADB to support developing member countries close the demand-supply gaps of specific commodities and products (e.g., nitrogenous fertilizers, synthetic fibers, plasticizers, and steel) was acknowledged upfront in several reports and recommendations of the President. For loans meant for industrial enterprises in the PRC in particular, energy efficiency improvements and energy savings were also stated upfront as either a primary or a secondary objective.[75]

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[72] Establishing an appropriate baseline entails considerable work, but there is no indication from available project documents that any such effort was made by the sub-borrowers and/or the development finance institutions and/or ADB. The generally accepted practice for assessing the energy efficiency benefits of a modernization/rehabilitation type of subproject is to compare the performance (including but not limited to energy intake) of a production facility after a subproject is implemented against a baseline established before the project was implemented. A similar approach is also adopted for expansion subprojects, in which the objective is to compare energy intensity after expansion with a baseline intensity estimated before expansion.

[73] Although energy audit reports are not usually available in the public domain, it is also unlikely that a significant number of the sub-borrowers would have conducted any energy audits at the time the ADB loan supported subprojects were being implemented (i.e., during late 1980s through mid-1990s). Energy audits became mandatory for selected industrial segments only during the early 2000s after the passage of the Energy Conservation Act (2001).

[74] The study team recognizes that this limitation may be unique to India. However, time and resource constraints made it difficult to conduct similar investigations in other countries.

[75] The stated objectives normally comprised some of the following: (i) to introduce modern technology in the country to enhance productivity and attain scale economies in the production process; (ii) to introduce modern technology to promote efficient resource utilization, energy conservation, and environmental protection to manage or reverse deteriorating air and water quality, and to promote sustainable improvements in industry; (iii) to introduce managerial expertise that emphasizes efficiency, commercialization, and accountability; (iv) to strengthen institutional capacity for environmental management and monitoring; and (v) to enhance government ability to undertake necessary policy reforms in energy conservation as well as to ensure continued progress in market-based energy pricing.

88. Implications for results. Additional land was acquired for some industrial ADB-supported subprojects in the PRC. Consulting services for detailed design and training were also part of the assistance provided for some subprojects. In many cases, however, the subprojects entailed capital costs that exceeded or nearly equaled the annual gross revenue of beneficiary enterprises (Table 4). What is more, the approved ADB loan amount also exceeded the gross revenue of these enterprises. The financial and economic internal rates of return estimated at appraisal for the subprojects also appeared optimistic by the time they had been implemented and the loans closed.

Table 4: Overview of Selected ADB-Supported Industrial Subprojects in the People's Republic of China

Item	L1162	L1178	L1248	L1270	L1436
Enterprise	LISC	QCP	ACFP	TCF	HCCL
Main Product	Steel	Cement	Fertilizer	Ceramic	Cement
Loan Approval Date	Mar 1992	Sep 1992	Aug 1993	Nov 1993	May 1996
Subproject Start Date	Q1 1992	Q3 1992	Q3 1994	Q4 1993	Q3 1996
Ratio of ADB-Supported Subproject Capital Cost to					
- Gross revenue	5.3	3.7	5.0	0.8	2.2
- Total assets	3.9	2.2	4.2	0.4	0.8
Ratio of ADB Share of Subproject Capital Cost to					
- Gross revenue	1.3	1.3	1.6	0.4	1.2
- Total assets	1.0	0.8	1.3	0.2	0.4
Weighted Average Cost of Capital					
- At appraisal	9.0%	4.7%	9.5%	5.3%	6.3%
- Actual	4.9%	8.4%	5.4%	4.4%	4.3%
Financial Internal Rate of Return					
- Projected at appraisal	15.2%	11.7%	14.8%	15.3%	11.6%
- Actual at completion	6.9%	7.9%	8.6%	3.0%	10.0%
- At evaluation	…	…	…	2.4%	…
Economic Internal Rate of Return					
- Projected at appraisal	22.9%	22.1%	14.3%	14.8%	13.2%
- Actual at completion	15.8%	4.4%	13.6%	5.0%	12.7%
- At evaluation	…	…	…	4.2%	…

… = not available, ACFP = Anyang Chemical and Fertilizer Plant, ADB = Asian Development Bank, HCCL = Huaxin Cement Company Limited, L = Loan, LISC = Laiwu Iron and Steel Company, Q1 = first quarter (1 Jan to 31 Mar), QCP = Qujiang Cement Plant, Q3 = third quarter (1 Jul to 30 Sep), Q4 = fourth quarter (1 Oct to 31 Dec), QCP = Qujiang Cement Plant, TCF = Tangshan No. 6 Cement Factory.

Notes:

ADB share of subproject capital cost is prorated on the basis of ADB's total actual loan assistance and the sum total of capital costs of all subprojects supported through the loan.

Data on gross revenue and total assets of the subproject enterprises, used for computing the ratios, pertains to the most recent calendar year prior to the year in which the subproject implementation commenced; Total assets include current assets, net fixed assets, construction works-in-progress, and other assets.

Source: Compiled by the study team from project documents.

89. From available project documentation, it appears ADB gave due consideration to the following issues during the appraisal process for industrial loan projects in the PRC: (i) consistency of the project/subproject in implementing the government's strategy for a particular industry subsector (e.g., steel or cement); (ii) technical risks associated with the proposed project/subproject; (iii) enterprise-specific issues, including the enterprise history of financial and operational performance, arrangements for financial audits, capacity enhancements, and technology infusions; and (iv) consistency of the enterprise's environmental performance and the proposed project/subproject performance with government policies and guidelines, as well as mitigations proposed, if any, as part of the proposed project/subproject. Implementation risks of time and cost overruns were also recognized upfront.

90. However, risks associated with a decrease in output prices and/or an increase in input prices are merely mentioned. For computing internal rates of return at appraisal, it is assumed that relatively stable ex-factory prices will prevail in the PRC, despite government policies to make ex-factory commodity prices increasingly reflect market conditions in the coming years.[76] The fact that the Asian financial crisis in the late-1990s depressed commodity prices in the international market meant essentially that the assumptions made at appraisal (i.e., stable or gradually rising market prices) did not hold at project completion. With large loan amounts, the enterprises found it difficult to service their debt.

91. Similarly, the commodity price-risk issue did not receive due attention upfront for industrial projects supported in India. ADB approved support for large-scale industrial enterprises in the late 1980s on the premise that import tariff protection would continue even though the government had begun adopting policies to increase the competitiveness of some industry segments.

92. Energy savings and efficiency improvements should have been achieved through the loans in the PRC, which were meant to modernize industry and expand plant sizes to approach economies of scale. Moreover, energy efficiency objectives had been acknowledged upfront.[77] However, data on efficiency improvements or energy intensity before and after subproject implementation are not always presented in the available project documentation. And in many cases where presented, they appear inconsistent. The manner in which the data are presented also varies across projects. This makes it difficult to compare the energy intensity of a manufacturing enterprise in one segment—say cement or steel—in one loan project with a similar enterprise supported through another loan project.[78] For further details, refer to Appendix 7.

[76] For at least four of the five loans/projects referred to in Table 4, one of the covenants was for the government to decontrol raw material and/or output product prices.

[77] In some cases (Loans 1162-PRC, 1270-PRC, and 1436-PRC), benefit monitoring and reporting are also covenanted. However, whether or not this includes monitoring of energy savings related benefits is clear only for Loan 1436-PRC.

[78] For instance, in some cases the total energy consumption per ton of product is presented in coal-equivalent terms or in kilocalories. In some cases, the fuel and electricity consumption levels per ton of product are presented separately. In neither case is complete background information available on intrinsic energy content of different types of fuels and quantum of fuel use.

Chapter 6

REVIEW OF ADB'S ENERGY SUPPLY-SIDE PROJECTS

A. Power

93. Power supply-side projects approved comprise of 44 loans and investments during the study period. They include (i) 14 loans approved from five multitranche financing facilities, mostly for transmission and distribution system expansion and strengthening; (ii) five private sector investments, three of which support coal-fired power plant construction or refurbishment, one long-distance transmission line, and one a mix of power generation and transmission and distribution network improvement; (iii) two loans for gas-based power; and (iv) more than 20 other loans for transmission and distribution system expansion and/or strengthening. Few of these projects have been completed.

ADB has supported several projects to increase electricity access and improve the quality and reliability of affordable electricity supplies

94. Design aspects. Because reducing the infrastructure deficit, which includes energy shortages, is a key development challenge facing Asia and the Pacific, ADB has supported several projects to increase electricity access and improve the quality and reliability of affordable electricity supplies. Increasingly, such projects have features for improving energy efficiency as part of the project design.

95. ADB-supported transmission and distribution projects have helped reduce these losses. Transmission projects include high-voltage direct current lines, which enable bulk power transmission over long distances (over 1,000 kilometers) with minimal energy loss, and high-voltage alternating current lines. ADB has also supported technical and managerial approaches to reduce distribution losses. These include high-voltage distribution systems[79] and the distribution franchisee system, wherein a profit motive propels franchisees to invest in reducing distribution losses.[80]

96. ADB-supported generation projects are also designed to increase generation efficiency. Projects include power plants using clean coal technology, gas-fired combined cycle plants, and the renovation and modernization of power plants. Appendix 8 gives an overview of the status of several loan projects approved during 2003–2010.

[79] In a high-voltage distribution system, conventional distribution transformers are no longer required. High-voltage lines are extended to run close to low-voltage consumers, and low-voltage lines are consequently short. This reduces the opportunity to pilfer electricity from overhead distribution lines.

[80] Various business models may be adopted. For instance, in a single point power supply program, ADB supports the executing agency to create the enabling infrastructure (33/11 kilovolt [kV] substations, adequate metering on outgoing 11 kV feeders, customer metering) before handing over a specific 11 kV feeder and all customers to a franchisee/cooperative. The franchisee is responsible for power purchase from the power utility and for supply, operation, and maintenance of the distribution system downstream, as well as metering, billing, and collection. The profits so realized are to remain with the franchisee, and this profit motive is expected to improve the financial viability of distribution operations, as well as compel the franchisees to reduce distribution losses.

97. Implications for results. Most of these projects are still being implemented. Their success, in terms of improved system efficiency, will be influenced by regulatory, institutional, financial, and other enablers in the concerned developing member country.[81]

98. The extent to which the ongoing transmission and distribution projects will reduce transmission and distribution losses will become apparent at completion. The precise estimation of energy efficiency improvements resulting from ADB-supported investments in transmission and distribution systems, which are normally only part of a utility's overall investment program, is difficult, and entails massive database requirements. Such data are not available for any ongoing project, and are not normally compiled by ADB at project completion.[82] However, reasonable estimates of changes in transmission and distribution losses can be made, and the effects of design changes during implementation can be assessed.

The extent to which the ongoing transmission and distribution projects will reduce transmission and distribution losses will become apparent at completion

99. Measures to gauge the efficiency or the heat rates of power generation projects are normally an integral part of power plant design. For this reason, the plant or unit efficiency improvement from plant renovation and modernization is easily known, as is the unit efficiency of ADB-supported capacity additions.

100. Policy dialogue that helps enhance overall system efficiency has accompanied power supply side projects, and comprises a mix of one or more of the following: (i) Tariffs: re-examining tariff policies, rationalizing electricity retail tariffs, recovering operational costs, reassessing the role of tariff subsidies, and tariff structures encouraging economic load dispatch; (ii) Regulation: establishing an appropriate regulatory framework and encouraging private sector participation; (iii) Institutional development: improving the corporate governance and capacity of sector institutions; and (iv) Other issues: long-term sector planning in terms of system expansion, enhanced service coverage and sector restructuring, as well as a utility's financial restructuring.

101. Although most supply-side power generation and transmission and distribution projects approved during the study period are still ongoing, issues that facilitate or undermine their timely implementation are noticeable in projects approved 2 or more years ago. Such issues are not specific to supply-side energy efficiency projects and are known to have affected implementation delays in completed energy projects of all types.[83] They include (i) inadequacies of the project management function; (ii) bidding

[81] For transmission and distribution system efficiency improvements, the enablers would be a comprehensive restructuring or corporatization of utilities that increases their commercial orientation, or transition over a period of time to higher voltage levels for transmission, shorter low voltage distribution lines, properly sized transformers and other equipment and computerized load dispatch. For efficiency improvement in the generation system, such enablers would be regulations and systems that encourage competition in generation, gas availability that makes it possible to set up high-efficiency combined-cycle power plants, and technical capabilities and technological prowess, along with a large system size that allows high-efficiency clean coal-technologies for generation.

[82] Refer to ADB. 2011. *Project Completion Report: Northern Area Rural Power Distribution Project in Lao People's Democratic Republic.* Loan 2005-LAO. Manila. 30 June; and (ii) ADB. 2008. *Project Completion Report: Rural Electrification and Network Expansion in Bhutan.* Loan 2009-BHU. Manila. 12 August. In the recently released project completion report in June 2011, only the declining trends of total transmission and distribution losses in the country are shown. No attempt is made to assess system losses in parts of the transmission and distribution network set up or improved with ADB support. The other project completion report for an assistance project, in Bhutan, points out that it is "difficult to make a meaningful assessment of (Bhutan Power Corporation's) system losses due to the need to allocate transmission losses."

[83] Given that, for the 64 project completion reports for energy sector projects released from January 2003 to July 2011, 59 project loans were delayed, the average delay being more than 24 months.

and procurement-related issues; (iii) difficulties in fully complying with environmental and social safeguards; and (iv) scope change, financial, and other concerns. Further details are in Appendix 8. It is noteworthy that inadequacies in the project management function contributed to implementation delays in over 25% of the interventions—even though the project management office was in most cases set up in an organization that was implementing a project in its area of core competence, as per project design,

B. District Heating

1. Municipal District Energy Infrastructure Development Project (Loan 7279-PRC)

102. Design aspects. The loan (Loan 7279-PRC) to support joint ventures between Dalkia Asia and local partners for managing and improving the efficiency of district heating and cooling systems in their concession areas was approved in June 2008.[84] This was in line with the Government of PRC's objectives of reducing the energy intensity of GDP in the 11th and 12th Five-Year Plan periods, as well as government initiatives to encourage the private sector to contribute to economic growth. At appraisal, Dalkia Asia and its local partners had obtained concessions for managing and improving the efficiency of district heating and cooling systems in four cities in northeastern provinces. They also had plans to obtain more concessions to cover about 100 million square meters (m^2) of floor space by 2013. Efficiency improvements were planned to be achieved through the use of combined heat and power systems in an integrated network.[85]

103. Implications for results. The Government of the PRC introduced new regulations in 2010 restricting foreign ownership to less than 50% in the northeast, as it did for other parts of the country. Unable to obtain concessions in more cities, Dalkia Asia chose to intensify efforts to set up integrated and high-efficiency heating and cooling networks in its concession areas in four cities in northeastern provinces. ADB funds are being used in two cities, with a combined floor heating area coverage of 11.3 million m2 in 2009/10. By mid-2011, ADB had disbursed CNY450 million, less than one-third of the A loan limit. Although precise information is not available, energy efficiency improvement measures have been implemented in the two cities. In Jiamusi, the pipeline network has been improved to enable combined heat and power units to supply 90% of the heat in 2010, compared with 83% in 2007. In Harbin, more than 50 small and old boilers have been removed, and the network expanded considerably to supply heat from efficient combined heat and power plants.

[84] ADB approved an "A loan" of up to CNY1.4 billion and a "B loan" of up to CNY1.4 billion.

[85] Replacing small, old, and inefficient coal-fired heaters traditionally deployed in households by combined heat and power units. Also, rehabilitating and expanding network capacity by laying large heat lines and setting up substations (thereby allowing high pressure and high temperature heat supplies), as well as introducing supervisory control and enterprise-wide resource planning software systems for real-time management and purchasing, budgeting and planning purposes. Efficiency increases of 15%–40% are possible with the introduction of combined heat and power units, and 5%–20% for network rehabilitation and integration.

2. Other District Heating Projects

104. Design aspects. Five other loans to the PRC that were approved during the study period included improved centralized district heating components. All these loans are still active. In the three multisector loans, the district heating components accounted for less than 15% of the approved loan amounts; their primary aims being to improve the urban air and water quality and to foster urban development in line with government policies. In the two energy sector loans, urban environment improvement is their primary objective, and an energy efficiency improvement objective is explicitly mentioned in one of them.

105. Implications for results. Policy dialogue that has accompanied the design and processing of these project components has implications for improved end-use efficiency by moving toward implementing actual heat-consumption-based tariffs, and improving collection efficiency.

Chapter 7

APPROACHES TO ENHANCING ENERGY EFFICIENCY IN INDUSTRY AND BUILDINGS

106. Two broad categories of approaches have been used for promoting energy efficiency investments in end-user segments (para. 35). To be successful in a country context, a relevant approach needs to be adapted in keeping with the state of governance (including normal interpretations of legal and regulatory frameworks), and accepted business and social practices, as well as the general backdrop of economic growth, GDP composition, sophistication of financial systems, growth outlooks in the industrial and commercial sectors, and the dispersed nature of the target audience.

A program or intervention propagating energy efficiency through a certain approach need not be big or broad to start with

107. A program or intervention promoting energy efficiency through a certain approach need not be big or broad to start with. Indeed, it may be best to begin with something small and narrowly focused. Over time the program scope can be increased by incorporating more types of energy efficiency measures for a wider cross-section of industrial and building users. The program can also become increasingly sophisticated and help end-users to meet more ambitious and stringent standards for equipment and system efficiency.

108. With this in mind, the limited number of ADB interventions approved in support of energy efficiency in recent years,[86] as well as those in progress,[87] is considered as just a start. It is very likely that ADB will have a better understanding of the critical success factors for energy efficiency interventions, with more interventions across more developing member countries happening over time.

109. An overview of experience gained from energy efficiency programs supported by the World Bank Group (WBG) and some developing member country governments was compiled with the objective of learning from experience elsewhere. This compilation is limited, however, and may not provide a well-rounded evaluative perspective of such energy efficiency programs.

[86] In addition to the demand-side energy efficiency interventions listed in Appendix 3 and assessed in Section IV, ADB approved a few projects with demand-side energy efficiency components during 2011. These include (i) ADB. 2011. *Technical Assistance to the People's Republic of China for Development of Energy Manager Program for Energy Conservation in Shandong*. Manila. 20 June (approved on 31 May); and (ii) ADB. 2011. *Proposed Loan: Shandong Energy Efficiency and Emission Reduction Project (People's Republic of China)*, Manila, 28 July (approved 18 August).

[87] Among other loans and investments planned, a loan to support industrial energy efficiency projects in the PRC's Hebei Province is being processed.

A. Commercial Financing of Energy Efficiency Investments

110. The financial community continues to associate energy efficiency lending with high risks and the dispersed and diverse nature of energy users contributes to this perception. Enhancing and sustaining investment in energy efficiency requires merging two very different communities of practice: (i) financing institutions and financial intermediation; and (ii) energy efficiency equipment and service providers. These may also be project developers and implementers.

111. The experience of the WBG over the past decade suggests that the following principles should be considered in the design and development of new energy efficiency delivery programs: (i) conducting upfront a diagnostic review of the local institutional environment (i.e., the financial sector, local capacities for technical assessment work, the energy efficiency market, and the role of government and development partners in energy efficiency);[88] and (ii) incorporating some flexibility to respond to feedback from clients and beneficiaries, as well as new developments in the market or changes in regulations.

112. With the objective of encouraging commercial energy efficiency financing, the WBG has extended lines of credit to selected commercial banks with grants from the Global Environment Facility (GEF) to be used to create capacity for energy efficiency project origination and building the energy efficiency project pipeline. The International Finance Corporation (IFC) has been developing and implementing commercial energy efficiency financing programs through local financial institutions since 1997. Where a risk-sharing facility, a bilateral loss-sharing agreement between IFC and a commercial bank (or an enterprise that originates assets) is to be structured, IFC normally accesses GEF grants to backstop a portion of the principal losses below a certain threshold.

1. Financial Intermediation for Energy Efficiency Subprojects

113. A traditional financial intermediation arrangement can help build the energy efficiency lending portfolios of commercial banks. ADB's relevant experience includes a line of credit extended to a provincial government in the PRC. This is actually being administered as a partial financial intermediation arrangement, but it has been successful in supporting energy efficiency subprojects, achieving energy savings, and verifying the claimed energy savings. Lines of credit have also been extended to development finance institutions in various developing member countries and administered as a traditional financial intermediation arrangement. The relevant aspects of these two types of line-of-credit programs can be combined to enable a commercial bank to make commercially sound decisions on the financing of subprojects that meet basic qualifying criteria for conservation subprojects.

A traditional financial intermediation arrangement can help build the energy efficiency lending portfolios of commercial banks

114. This has been successfully demonstrated by the WBG-supported China Energy Efficiency Financing (CHEEF) project approved in 2008.[89] To enable participating banks to originate energy efficiency projects and start up energy efficiency lending businesses, a technical assistance grant of $13.5 million from the GEF accompanied a

[88] World Bank. 2008. *Financing Energy Efficiency: Lessons from Brazil, [People's Republic of] China, India and Beyond*. Washington, D.C.

[89] World Bank. 2008. *Project Appraisal Document. Proposed Loan in the amount of US$200 million and a Proposed Grant from the Global Environment Facility Trust Fund in the amount of US$13.5 million to the People's Republic of China in Support of the Energy Efficiency Financing Project*. Washington, D.C. (21 April).

$200 million loan. Given the stated objective—to assist the development of energy efficiency loan windows in participating commercial banks—a key design feature of the CHEEF project was that the participating banks should appraise the subprojects themselves and not require any specific approvals from the government or the WBG.[90]

115. The loan closing date for the CHEEF project is December 2013, but given the rapid progress in disbursals from the two commercial banks, which administered $100 million lines of credit each, a follow-up project was approved in 2010. This was to set up an energy efficiency loan window at a third bank, and a further follow-up line of credit was expected to be approved before the end of 2011. The participating banks have so far supported mostly large and energy-intensive enterprises, where energy costs have been high enough to focus the attention of the Government of the PRC and the enterprise management on energy savings. They have given subloans for energy efficiency investments in the $5 million–$10 million range, mostly for more waste-heat recovery and power generation subprojects.

116. Certain changes, however, are possible in the foreseeable future, and the preparedness of the CHEEF-supported commercial banks to continue with energy efficiency lending will need to be re-examined from the viewpoints of (i) whether or not large enterprises that have been borrowing through the energy efficiency loan window so far will continue to borrow further for such investments;[91] and (ii) even if they continue to borrow, will the energy efficiency investments be of the same type and size, or be specific to an industry segment and entail less capital cost. It is likely that over time commercial banks will need to expand their knowledge and their understanding of other types of energy efficiency measures, and broaden and deepen their project origination skills.

2. Risk Sharing with Commercial Banks

117. The limited experience of commercial banks in energy efficiency lending implies that historical information—which is required to estimate potential losses from energy efficiency financing—is not available. To the extent that it is possible to attenuate the high risk (or perceived high risk) associated with energy efficiency lending, such as through a risk-sharing arrangement with a credible entity like a government or multilateral bank, commercial banks should be more amenable to extending energy efficiency financing.

Risk-sharing percentages and thresholds are the key design parameters of partical credit guarantees

118. Risk-sharing percentages and thresholds are the key design parameters.[92] The WBG has successfully used appropriately designed risk-sharing arrangements to accelerate energy efficiency financing from commercial banks in the PRC. It is possible to structure a partial credit guarantee facility depending on, among other factors, the needs of a commercial bank, whether or not a third-party guarantor is to participate, the risk or perceived risk associated with the type of energy efficiency subprojects, and

[90] The participating banks are required to ensure that the line of credit is made available only for energy conservation projects that meet predefined criteria. During annual monitoring/supervision missions, the WBG performs a sample check on the subloans extended by the participating banks.

[91] With an increased deposit reserve ratio requirement for commercial banks and high interest rates (in the 8%–10% range) since late 2010, some large enterprises are in a position to access relatively cheap financing by issuance of corporate bonds.

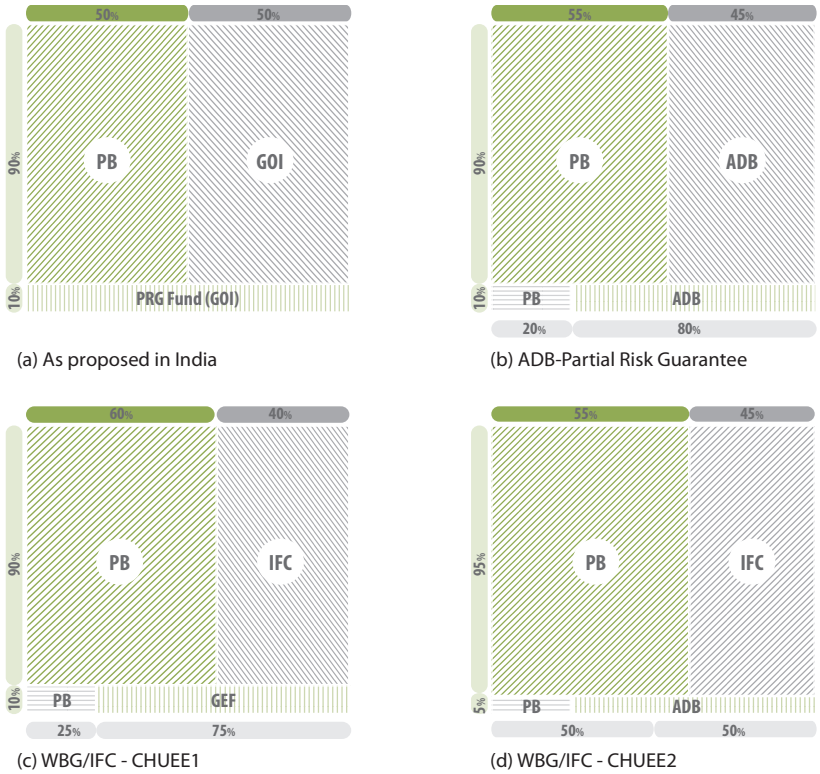
[92] There is normally one first-loss threshold, and risk-sharing percentages may vary above and below this threshold—as do entities that backstop the losses. The second-loss threshold is often 100% of the loan principal in the participating bank's loan portfolio.

the type of clientele expected to be covered by the partial credit guarantee facility, as well as the risk appetites of the various participants.

119. Figure 5 shows some possible variants of the partial credit guarantee facility—a structure proposed by the Bureau of Energy Efficiency to the Government of India for creating a partial credit guarantee fund—and the structures of three partial credit guarantee facilities supported by two multilateral development banks in the PRC. One indicator of success for a partial credit guarantee facility is that a successor facility (should one be required) is structured with a lower first-loss threshold and/or lower risk-sharing support to the commercial bank both below and above the first-loss threshold. Structures of two successive partial credit guarantees negotiated by the WBG under the China Utility-Based Energy Efficiency (CHUEE) program illustrate this trend (Figures 5c and 5d). IFC did not provide the riskiest type of guarantee: the first-loss coverage, where GEF provided the necessary backstop in PRC.

120. The CHUEE program was utilized rapidly. As of June 2009, its two participating banks had provided loans totaling CNY3.5 billion ($512 million), which financed 98 energy efficiency projects. Although a base-case default rate of 4% was assumed in the program design, there have been zero defaults in the portfolio. No loan losses required payouts from any of the reserves. Nearly half of the investments were for industrial power generation, usually associated with waste heat or gas recovery. The largest beneficiaries were the steel, chemical, and cement industries.

Figure 5: Alternative Structures of Partial Credit Guarantees



ADB = Asian Development Bank, CHUEE = China Utility-Based Energy Efficiency Finance Program, GEF = Global Environment Facility, GOI = Government of India, IFC = International Finance Corporation, PB = participating bank, PRG = performance risk guarantee, WBG = World Bank Group.
Source: Compiled by study team.

121. Even so, a program such as the CHUEE is not likely to be an adequate incentive for a commercial bank to increase or focus on energy efficiency lending. It is important to find the right balance between a commercial bank's strategic objectives and the energy efficiency intervention program. The CHUEE program experienced different outcomes from the two participating banks. One of the participating banks benefited from the program's support for establishing a dedicated department for energy efficiency lending, preparation of guidelines and procedures for loans, and developing capacity for applying project finance tools to energy efficiency finance.

122. As with the CHEEF program, most CHUEE beneficiaries have been large enterprises. Smaller enterprises are less likely to implement energy efficiency measures, and use bank loans to finance such measures significantly less because of difficulties in meeting collateral requirements. It is estimated that 9% of the enterprises would not have implemented energy efficiency measures without the loans that the CHUEE guaranteed. Even so, moving down to smaller companies is a key challenge for energy efficiency financing. The size of the transaction gets smaller, as well as the greenhouse gas mitigation impact per transaction.

123. Past WBG experience also shows that (i) a partial credit guarantee is seldom sufficient to increase energy efficiency lending by commercial banks, which often require complementary advisory services to strengthen the assessment of risks associated with underlying loan products, as well as capacity development for marketing teams and energy service companies; (ii) commercial banks' energy efficiency lending operations improve if technical assistance targets certain market failures (technical skills, regulatory) and financial incentives match their requirements; (iii) government actions, energy pricing and subsidy policy, and other regulatory reforms actively shape energy efficiency markets and influence the behavior of commercial banks; and (iv) sustainability—considered in terms of the continuity of a commercial bank's energy efficiency lending operations after reduced or no partial credit guarantee cover—depends on the ability of these banks to change their culture and strategic orientation.[93]

3. Promoting Energy Service Companies

124. Utility companies, equipment suppliers, and/or energy service companies are required for marketing energy efficiency financing, and act as technical consultants, facilitators, and aggregators. Energy service companies specialize in performing these functions, and provide a broad range of comprehensive energy solutions. These include the design and implementation of energy savings projects in government and commercial buildings, and industry. Energy service companies enter into energy performance contracts with client organizations. Some of the more popular variants of such contracting are (i) a shared savings contract, in which the energy service company provides the bulk of financing for a project and is compensated by the client from a portion of the energy cost savings resulting from the project; and (ii) a guaranteed savings contract, in which the client provides the bulk of the financing for a project that the energy service company designs, implements, operates, and guarantees energy

[93] Independent Evaluation Group (World Bank, IFC, MIGA). 2010. *Assessing the Impact of IFC's [People's Republic of] China Utility-Based Energy Efficiency Finance Program.* (IEG Study Series; Energy Efficiency Finance). Washington, D.C.

savings; in exchange, it receives savings-linked compensation. Appendix 9 provides further information on the types of performance contracts.

125. The financial community does not understand the principles of energy performance contracting and sharing cost savings well. Because one of the CHUEE's objectives was to remove constraints to energy efficiency investments, the promotion of sustainable energy service company business became a strategic priority. The CHUEE provided technical assistance for capacity development of energy service companies and brokered relationships with commercial banks.

The financial community does not understand the principles of energy performance contracting and sharing cost savings well

126. Attention to the following is required to propel the energy service industry forward: (i) increasing the interface between the financial community and energy service companies; (ii) successfully demonstrating energy performance contracting-based projects for achieving energy efficiency improvements; (iii) accumulating learning from these projects to identify workable performance contracting arrangements and begin standardizing them; and (iv) establishing standard approaches to verify energy savings, which form the basis for the measurement-and-verification protocols embedded in performance contacts. Partial credit guarantees that support the financial community may also support the energy service industry. For instance, of the 58 energy efficiency project loans backstopped by the first project of the CHUEE program in the PRC (Figure 5c), 14 involved energy service company projects.[94]

127. However, in most developing member countries the energy service industry is nascent and would likely benefit from a guarantee facility dedicated to covering energy performance contracting-based projects. A WBG project approved in 2002 supporting the energy service company loan guarantee program operated by the China National Investment and Guarantee Company (CNIGC) issued loan guarantees covering $69 million of the $123 million invested in 148 performance-contracted projects during 2004–2009.[95] The project's most notable achievements were: (i) many of the 42 energy service companies granted CNIGC guaranteed loans went on to receive their first-ever bank loan because of the guarantee cover, and were able to build a credit history with the financial community; (ii) CNIGC introduced 12 different banks to energy performance contracting and the energy service company business; and (iii) CNIGC developed specialized technical and credit appraisal methods for the energy contracting business that catered to local Chinese banking customs and laws. Appendix 9 provides further information. The partial credit guarantee facility proposed by the Bureau of Energy Efficiency in India (Figure 5a) is also intended to backstop only energy service company projects.

In most developing member countries the energy service industry is nascent and would likely benefit from a guarantee facility dedicated to covering energy performance contracting-based projects

128. As the energy service industry grows, a partial credit guarantee facility would best serve only a slice of it. In addition to new entrants, energy service companies with some experience and financial standing may still have sufficient need for the guarantee instrument to justify the additional cost.

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[94] This was possible in the PRC, where the World Bank and GEF began to support the energy service industry in the mid-1990s, and where $870 million of energy performance contracting-based investment had taken place by 2007, when the CHUEE was launched. By 2010, more than $4 billion of energy service company projects had been implemented in the PRC.

[95] World Bank. 2002. *Project Appraisal Document, Proposed GEF Grant of SDR 19.7 million (US$26 million equivalent) to the People's Republic of China for the Second Energy Conservation Project*. Washington, D.C. 25 September.

4. Supporting Financial Leasing Companies

129. There are some advantages for the energy efficiency business in cases in which a lessee enterprise is allowed to enter a leased asset on its balance sheet, even if ownership is retained by the leasing company (unless or until the assets are eventually purchased by the lessee enterprise). In such arrangements, practically all risks incidental to asset ownership—and the benefits arising from them—are transferred to the lessee, who bears the cost of maintenance, insurance, and repairs. Such a financial lease may be structured so that projected energy savings fully cover the lessee enterprise's lease payments. There can be greater flexibility and room for innovation if leasing companies raise loans from commercial banks to fund energy efficiency equipment. The World Bank approved a loan to help two leasing companies to cofinance large energy efficiency investments in May 2011.[96] For further details, refer to Appendix 9.

B. Energy Efficiency Improvements in Specific End-User Categories

Measures that ADB has supported for improving energy efficiency in buildings have essentially been efficient lighting retrofit programs

130. Measures that ADB has supported for improving energy efficiency in buildings have essentially been efficient lighting retrofit programs. The WBG, however, has also supported several countries in designing and/or implementing building energy codes and standards and labeling programs, albeit mostly as small components of larger projects. For further information, refer to Appendix 1. In addition, several developing member country governments have embarked on such energy efficiency enhancement mechanisms.

1. Buildings

131. In helping governments to address barriers to enhancing energy efficiency in buildings, multilateral support may comprise (i) facilitation of energy efficient retrofits in existing buildings through energy efficiency delivery mechanisms discussed above (paras. 110–129), and (ii) codes for new buildings that cover energy efficiency aspects. The latter calls for the modification of existing building codes in many developing member countries, which have traditionally emphasized safety, earthquake proofing, and fire protection. Where a suitable code exists, support may focus on aspects of implementation.

132. Scope. A comprehensive building code needs to cover five major components: (i) building envelope (walls, roof, and windows), (ii) lighting (indoor and outdoor), (iii) heating-ventilation-air-conditioning systems, (iv) service water heating and pumping, and (v) electrical systems (transformers, power factor). To begin with, governments may prefer to focus on the most important components. For instance, the Government of the PRC has preferred to codify standards for heating-ventilation-air-conditioning systems only. Design and performance standards may also be set for buildings with different time-of-day occupancy and energy requirement patterns, as well as for buildings in various climate zones.

[96] World Bank. 2011. *Project Appraisal Document: Proposed Loan in the amount of $150 million to the People's Republic of China for a Shandong Energy Efficiency Project*. Washington, D.C. (13 May).

133. Compliance. To check for compliance with standards set in building codes, support for adopting the following approaches may be offered: (i) a prescriptive approach, whereby the performance of each component and subsystem in a building should meet required energy efficiency norms; (ii) a "whole building" compliance approach, in which the energy performance of a building is compared with a baseline building; and (iii) a subsystem-based, trade-off approach that allows for flexibility through balancing some high-efficiency components or subsystems with lower efficiency components or subsystems.

134. Implementation. With the engagement of local governments, architects and engineers, academic institutions, technical consultants, and the equipment manufacturing industry, it becomes possible to develop capacity. This can be done through certification of building energy auditors, making auditing equipment and software toolkits available, measurement and verification systems, and legal enforcement mechanisms. Perhaps one way is to begin the compliance checking process with the simulation of building designs for energy performance before a system of onsite inspections during construction, and annual inspections post-construction can be instituted. For further details of implementation aspects in the Indian context, refer to Appendix 10.

2. Efficient Lighting Programs

135. As clock time for lighting on a day-to-day basis normally coincides with the occurrence of, and contributes to, peak power loads, an emphasis on electricity pricing reforms should, in theory, stimulate demand for efficient lighting in residential, commercial, and other buildings. Nevertheless, many WBG-supported CFL programs packaged with tariff reforms in recent years were justified from the viewpoint of peak load reduction and whereby tariff reforms which were not directly linked. CFL programs have also helped address other concerns, such as increased electricity access and improved supply reliability. In general, efficient lighting retrofit programs are also seen contributing to national climate change mitigation objectives.

Efficient lighting retrofit programs are also seen contributing to national climate change mitigation objectives

136. An overview of energy efficiency lighting programs supported by the Government of India is provided in Appendix 10, and by the WBG in Appendix 1. The sustainability of CFL use is enhanced when (i) efforts are made to create awareness in the target population; (ii) findings from a small pilot or demonstration project are incorporated in larger roll-outs; (iii) the organization responsible for CFL distribution is incentivized to distribute, and households have good reason to use CFLs;[97] and (iv) there is a system keeping track of CFL usage, failure, disposal and replacement rates. Although CFL programs supported by the WBG and some developing member country governments are designed to distribute CFLs for a certain fee (unlike ADB's CFL programs which aim to distribute CFLs for free), an important similarity is that projected revenue from the sale of most likely certified carbon credits is expected to meet the cost of administering the CFL distribution program.

[97] For instance, if households are required to make a small payment (that need not cover the full cost of the CFL), they would actually use the CFL if they are aware that they would incur savings.

3. Standards and Labeling Programs

Comprehensive standards and labeling programs to improve the energy efficiency of locally available appliances and equipment are expected to result in energy savings

137. With economic activity and income levels in Asia and the Pacific set to rise in the foreseeable future, the stock of appliances and equipment used in residential, commercial, and public buildings is likely to increase significantly. Comprehensive standards and labeling programs to improve the energy efficiency of locally available appliances and equipment (whether manufactured or assembled locally or imported) are expected to result in energy savings. The key components of a standards and labeling program are: (i) setting energy efficiency performance standards for equipment and technical requirements, (ii) creating awareness of the target user community on the benefits of using energy-efficient equipment and a labeling program that identifies such equipment, and (iii) monitoring and enforcement of the labeling program. If properly implemented, a standards and labeling program can provide important information on how the stock of equipment is evolving.

138. Standards and labeling programs in the PRC and India provide some guidance for other developing member countries (Appendixes 9 and 10 give an overview of the programs in these two countries). In addition to household appliances, standards and labeling programs cover a range of equipment used in the PRC's industrial and commercial sectors. The key design features of such programs are: (i) to begin with, energy efficiency performance standards are set for just a few types of equipment and appliances, then more are gradually added; (ii) standards, once set, are made increasingly stringent over time; (iii) the appliances and equipment produced and available locally are tested according to established protocols, and the labeling program classifies tested appliances and equipment in one of the five energy efficiency levels, and the label is designed to make it easy to distinguish between the five classes; (iv) manufacturers initially participate in the labeling program voluntarily and participation is made mandatory over time; (v) the awareness campaign focuses on areas where potential demand for efficient equipment is high; (vi) energy savings attributable to the standards and labeling program are estimated on the basis of each model's sales; and (vii) the monitoring and enforcement program relies on a mix of self-reported performance and labeling by participating enterprises, check-testing by government in accredited laboratories, and, possibly, challenge-testing in accredited laboratories at the request of the user community. Suitable testing facilities continue to be set up and accredited to facilitate monitoring and enforcement.

139. Similar standards and labeling programs have also been designed and implemented in some developing countries for selected industrial equipment, such as three-phase induction motors and centrifugal pumps.

C. Other Programs

140. ADB could also consider supporting developing member countries advance energy efficiency improvements through the design and implementation of (i) an energy efficiency performance-based rating system for existing buildings, so that those with high scores can provide insights for improving the performance of other buildings; and (ii) a scheme to issue energy savings certificates to large, energy-intensive industrial enterprises, and trading these certificates to help these companies meet their energy

efficiency improvement obligations in a cost-efficient way.[98] Further information on the initial designs of such schemes, in the context of India, is provided in Appendix 10. ADB could play a role in promoting regional industrial energy efficiency standards for energy-intensive industries and technology dissemination, as well as sharing lessons from administrative measures adopted for energy efficiency improvement by some countries, such as the PRC and the Republic of Korea. However, since some programs for improving energy efficiency are run on a commercial basis, ADB could have at most a limited role.[99]

ADB could play a role in promoting regional industrial energy efficiency standards for energy-intensive industries and technology dissemination

[98] Suitable schemes for carbon emissions trading could also lead to similar energy savings outcomes.

[99] For instance, realizing the importance of energy management, the International Organization for Standardization (ISO) in 2011, released the ISO 50001 standard for Energy Management System. This standard enables a compliant enterprise to adopt a systematic approach and achieve continual improvement of energy performance (including energy efficiency). Agencies accredited by ISO offer certification services to enterprises on a commercial basis across the globe. Selected agencies in Asia have been accredited to offer such certifications (such as DNV Business Assurance India), and they have already begun offering certification services for a fee (for instance, Brandix Casualwear Limited, Seeduwa, Sri Lanka obtained certification in July 2011).

Chapter 8

KEY FINDINGS

141. The key findings of this evaluation exercise are based on:

(i) a quick assessment of the performance of seven ADB interventions approved during the study period (2003–2010) to promote demand-side energy efficiency improvement measures in industry and buildings;
(ii) a review of in-house information on 11 lines of credit that ADB extended to financial institutions to promote industrial development in various developing member countries during the 1990s and before;
(iii) a review of nine loan and investment projects approved by ADB for supporting industrial growth from the late 1980s to early 2000s;
(iv) a review of about 30 ADB-supported interventions in the power sectors of developing member countries during the 2003–2010 study period, mostly for transmission and distribution system expansion and strengthening, and, in some cases, for system efficiency improvement objectives; and
(v) learning from the experience of selected demand-side energy efficiency interventions by the WBG and GEF to promote energy efficiency in industry and buildings, as well as from selected programs designed and encouraged by some developing member country governments.[100]

142. A broad range of interventions and approaches was assessed with the objective of providing insights into the design of successful energy efficiency interventions for the coming years. These approaches can be classified in to two broad categories: (i) delivery mechanisms which increase the commercial financing of energy efficiency across a range of energy-consuming sectors; and (ii) mechanisms that are directed at specific end-user categories to improve their energy efficiency performance. It is recognized that a conducive government policy environment, as well as the political economy of any particular developing member country and market readiness for energy efficiency will influence the design and success of an intervention.

A. Key Findings from ADB Experience

143. Objectives for improving energy efficiency are likely to be consistent with other objectives of many developing member country governments. Energy efficiency improvements contribute to addressing energy security concerns by reducing vulnerability to supply disruptions; and solving local environmental problems by reducing the need for energy supply with the accompanying benefits of reducing emissions. Both these concerns have been traditionally recognized by developing member country governments. In recent years, there has also been heightened recognition of the need to mitigate greenhouse gas emissions, and energy efficiency contributes towards this broad goal.

[100] Most learning is directly or indirectly linked to information contained in paras. 106–139, and in Appendixes 1 and 11.

144. There is significant market potential for demand-side energy efficiency improvements. It is usually difficult to estimate the technical and market potential for improvements in industry and buildings. However, where suitable energy efficiency delivery mechanisms operate in a supportive policy and regulatory environment, the potential demand for energy efficiency investments is very significant. In the absence of such a supportive environment, the potential demand for these investments may be significantly lower, and industrial and building owners and entrepreneurs often prefer to invest in ventures with higher returns.

145. Rational electricity tariffs alone do not provide enough impetus to investment demand for energy efficiency. The extent to which ADB's policy dialogue on the reexamination of tariff policies and rationalization of electricity prices promotes end-use efficiency improvements is not clear. Among the reasons that electricity tariff adjustments alone do not result in improved energy efficiency is insufficient metering of at least some customer categories, coupled with unrecorded and unbilled power use. These get classified as nontechnical losses by utilities in many developing member countries. Besides, rising prosperity and increasing access to electricty in many of these countries contribute to higher electricity demand. While continued policy dialogue on tariff adjustments can improve the financial viability of a power utility, and improved metering can identify priority areas for system upgrades, a substantial effort beyond tariff adjustments is needed to address barriers to energy efficiency, as well as encourage industry and building owners and managers to invest in energy efficiency measures.

While continued policy dialogue on tariff adjustments can improve the financial viability of a power utility, and improved metering can identify priority areas for system upgrades, a substantial effort beyond tariff adjustments is needed to address barriers to energy efficiency

146. Addressing specific market imperfections will help promote energy efficiency. A large number of end-users needs to implement a range of measures before energy efficiency investments have a noticeable aggregate effect. It would be useful for governments and development partners to support the removal of the following barriers to such investments:

(i) poor awareness of readily available energy efficiency options;
(ii) the high-risk perception of most commercial banks;
(iii) the relatively poor credibility of many energy service providers; and
(iv) insufficient capacity to audit, monitor, and verify energy use and energy savings in various end-user categories.

147. ADB is just beginning to focus on providing support for energy efficiency improvements in industry and buildings. Indeed, ADB's support for investment in these areas and building energy efficiency improvements has lagged its support for renewable energy technologies, even though demand-side energy efficiency is explicitly included as a core area of operations in Strategy 2020. That industry and buildings account for a major share of energy consumption, and that demand-side measures are often economically more attractive than supply increases, is well understood in ADB. However, ADB could build on its still-limited experience in energy efficiency intervention design, which normally calls for addressing barriers to energy efficiency as well. It is noteworthy that in all seven demand-side energy efficiency projects/components supported since 2003, ADB's interventions have included grant support to address these barriers. ADB's Clean Energy Program, which has successfully steered a sharp rise in support for renewable energy technologies since 2006, could also play a similar role in stimulating ADB's operations departments to prepare and seek approval for demand-side energy efficiency interventions.

148. The progress of ADB-supported projects/components in improving energy efficiency in industry and buildings has been slower than envisaged. Of the seven ADB interventions, only the Guangdong Energy Efficiency and Environment Improvement Program has progressed smoothly. Strong government commitment and good project management contributed to its progress, although the project's closing date had to be extended by 12 months. In other projects, progress was slow owing to (i) insufficient commitment by the implementing agencies to fully implement the CFL residential lighting program; and (ii) inadequacies of project management, which led to delays in engaging contractors for other light retrofitting components. Most other projects, approved by or before September 2009, have yet to show significant progress. Although there have generally been no environmental and social-safeguard-compliance issues associated with such interventions, project management has been more difficult than for energy supply-side projects. This is because promoting energy efficiency is not the core business of organizations setting up project management offices.

The need to remove the infrastructure deficit in developing member countries, which includes energy shortages, is a key development challenge for ADB

149. ADB's rich experience in supporting energy supply-side projects provides few insights into the design of demand-side energy efficiency interventions. The need to remove the infrastructure deficit in developing member countries, which includes energy shortages, is a key development challenge for ADB. Since well before the beginning of the study period in 2003, ADB had been supporting transmission and distribution system expansion and strengthening projects in many developing member countries. Increasingly, such projects have energy-efficiency-improvement-related features as part of their project design. For such projects, reasonable estimates for system loss reduction can be made and the effects of project design or scope changes on transmission and distribution losses can be broadly assessed. However, given the basic difference between a transmission and distribution system, which is a network, and industry and buildings (the point consumers), such interventions provide little insight into the design of demand-side energy efficiency interventions.

150. Appropriate energy use measurement and verification systems must be incorporated into project design. Suitable systems to estimate energy savings have been put in place in the Guangdong Energy Efficiency and Environment Improvement Program. However, available documents on several ADB interventions in the 1980s and 1990s provide little evidence of any attempt to systematically compile data on energy use "before" and "after" a project or subproject was implemented. Through various lines of credit extended to development finance institutions, ADB's main objective was to make foreign exchange available to enable industry to modernize and expand. Energy efficiency objectives were not articulated upfront for most interventions, and available documentation provides no evidence that any party—be it the sub-borrower, the concerned financial institution, or ADB—had made any attempt to estimate energy savings. For many industrial projects supported through ADB's direct loans and investments, where energy efficiency was stated upfront as a primary or secondary objective, the overall energy use data at the plant level are available. However, in several cases, the data do not appear to be internally consistent, and little can be said about the veracity of the measurement and verification system.

151. A concerted effort is required to ascertain whether lines of credit extended for industrial energy efficiency actually supported such subprojects. For a line of credit that ADB approved in 1994, the energy efficiency improvement objective was

explicitly stated at appraisal. Yet, it supported several captive power plants, which do not qualify as energy efficiency measures. The reason is that the financial institution encountered problems in the energy efficiency subproject origination.

152. ADB's experience in supporting industrial process conversion projects is mixed. Where the intended beneficiaries of ADB support are manufacturing enterprises, it is important to consider all relevant risk factors at appraisal, including price risk (i.e., the financial implications of a decrease in output prices and/or a rise in input prices). This is particularly important where the level of ADB support to an enterprise exceeds its annual sales receipts and/or asset base.

B. Key Findings from the Experiences of Other Development Partners

153. A diagnostic review of the local institutional environment is required for the design and development of energy efficiency delivery programs. To obtain useful information for designing a suitably adapted and customized energy efficiency delivery program, a country- and sector-specific diagnostic review conducted upfront may cover (i) the financial sector; (ii) local capacities for technical assessment work, including project development, and their organization; (iii) the energy efficiency market; (iv) the role of government and development partners in the energy efficiency arena; and (v) local contractual frameworks and customs.

154. It is important to incorporate flexibility in the design of energy efficiency delivery programs. Most delivery programs supported by the WBG have required adjustments during implementation. The means to do so efficiently should be considered upfront. Programs should include provisions for serious periodic review, including feedback from clients. Legal documents should allow midcourse adjustments to be made relatively easily.

155. The efficacy of lines of credit and partial credit guarantees for energy efficiency investments can be enhanced with technical assistance support for project origination. This entails the creation of a pipeline of projects that qualify as energy efficiency investments according to given criteria. The effectiveness of a line of credit and a partial credit guarantee to help a commercial bank build a new product line for energy efficiency project lending improves if accompanied by technical assistance for project origination. Depending on the expertise of the bank and its technical partners, if any, technical assistance support can be provided to enhance the technical and financial appraisal skills of staff. At a practical level, this can also mean developing a spreadsheet enabling the quick assessment of whether a project opportunity meets the criteria to qualify as an energy efficiency project, and training staff to gather the necessary information and data to use the spreadsheet.

The effectiveness of a line of credit and a partial credit guarantee to help a commercial bank build a new product line for energy efficiency project lending improves if accompanied by technical assistance for project origination

156. The energy efficiency lending portfolios of commercial banks may initially cover only a few types of projects. Banks may wish to begin focusing on just a few types of energy efficiency projects to develop the expertise to handle projects in this area. Over time, and in response to changing policy environments and business

opportunities, they could increase their skills base to cover other types of energy efficiency measures.

157. Financial leasing companies can also provide impetus to the deployment of energy efficiency equipment. Where local laws allow a lessee enterprise to enter a leased asset on its balance sheet even when ownership is retained by the leasing company, and lease rental payments are fully covered by projected energy savings, financial leasing of energy efficiency equipment can be a good business opportunity. In such situations, an energy efficiency intervention can be designed to support leasing companies.

158. Partial credit guarantees can encourage commercial energy efficiency lending. A partial credit guarantee offered from a credible source, such as a multilateral development partner or a government, can reduce the risk perceived by commercial banks for energy efficiency lending and help improve the credibility of newly established or small energy service companies. To the extent that a partial credit guarantee backstops energy performance contracting-based projects, it can also provide a good opportunity for banks to interface with energy service companies. This helps both entities better understand and appreciate each other's role in broad-basing energy efficiency investment and financing.

159. Energy efficiency programs are best implemented when aligned to the business approach and market development strategies of financial intermediaries and other partners. It is best to begin energy efficiency program development with the identification of local financial intermediaries interested in energy efficiency lending. The intervention can then be designed to conform to the specific business interests of the selected intermediary. For example, by facilitating entry into new markets, such as lending to residential housing cooperatives or small and medium enterprises. The intervention can also strengthen existing lending relationships while improving the quality of the assets of intermediaries. A commercial bank whose strategic objectives overlap with the objectives of a line of credit and/or partial credit guarantee is more likely to originate, screen, appraise, and finance energy efficiency projects. If the energy efficiency program is designed to include another partner organization, such as a utility company, its strategic objectives should also be aligned with the energy efficiency program.

Several types and variants of energy performance contracts, adapted to local conditions, are used in energy service company projects across the globe

160. Concerted action is required to propel the energy service industry forward. Several types and variants of energy performance contracts, adapted to local conditions, are used in energy service company projects across the globe. Support for the energy service industry in a given social-political-economic context may begin with efforts to demonstrate the success of projects based on energy performance contracts. Lessons from a number of such projects can be accumulated to identify workable performance contracting approaches, which will contribute to reducing transaction costs.

161. An exit strategy for the development partner is critical. All efforts to promote commercial energy efficiency financing should aim to leave behind sustainable schemes that can function without further development partner support. For instance:

(i) A line of credit or partial credit guarantee can be designed to allow a participating commercial bank to identify, appraise, and approve a subloan

itself, without further approvals from government bodies or development partners; this will enable the participating bank to begin making sound business decisions on energy efficiency lending; and

(ii) Should at the end of a partial credit guarantee term, energy efficiency lending from a participating bank cease or slow considerably, which makes it necessary for a follow-on partial credit guarantee, perhaps a good indication that the first partial guarantee contributed, albeit partly, to enhancing commercial energy efficiency financing would be if the follow-on partial guarantee calls for a lower first-loss threshold and lower risk-sharing percentages below and above this threshold.

162. For promoting energy efficiency measures targeting specific end-user segments, the capacity development effort needs to be strategic and long term. Most sector-specific energy efficiency programs in developing member countries begin with a narrow focus. As experience has been gained and expertise developed, programs have become more broad-based and ambitious. For instance:

(i) Appliance and equipment standards and labeling programs normally begin with a few types of appliances, a small number of models, easily achievable energy efficiency performance rating standards, and a system to monitor and verify the labeling. The latter is confined largely to urban areas where appliances are in maximum demand. Capacity development efforts at the initial stages are therefore likely to be limited to staff of a few manufacturers and testing laboratories, and a few officials from regulatory or government bodies. Over time, as the program expands, it is very likely that more diversified capacity development efforts will be required for a wider set of stakeholders.

(ii) Building energy codes may at first only be implemented in areas where substantial construction is anticipated, perhaps only with compliance checks limited to computer simulations of building energy performance. Periodic building inspections begin only when trained building energy auditors become available. This calls for a continuous effort at capacity development in the medium term, including the creation of expertise in relevant government entities and regulatory bodies, as well as private and public sector construction companies and educational institutions.

163. For promoting energy efficiency measures that target specific end-user segments, certain design principles must be observed. For the successful introduction or broad-basing of a utility-led demand-side energy efficiency intervention, or other intervention that targets specific measures in specific end-user segments, the following are considered important aspects of project design: (i) aligning the interests of all stakeholders to achieve the energy efficiency program objectives; (ii) instituting information systems so that a verifiable data trail is created, and that energy savings can be reasonably verified; and (iii) minimizing the probability that stakeholders cannot recover the costs of participating in programs. For a residential CFL lighting program, this means that (i) households and buildings must be incentivized in some way to affect the necessary replacements, and that utilities or other agencies responsible for distribution must be incentivized to distribute; (ii) a system is instituted to gather data on CFL usage, CFL failure and disposal, CFL repurchase, and CFL leakage into the black-

market; and (iii) the CFL distribution or dissemination models should maximize the probability of full-cost recovery for all program participants.

C. Future Considerations

It is expected that ADB would consider striving towards a better balanced portfolio of supply-side and demand-side energy efficiency interventions

164. ADB's Strategy 2020 states explicitly that to meet growing energy demand in a sustainable manner, ADB will help expand the supply of energy, as well as "promote energy efficiency through supply-side and demand-side measures". It is therefore expected that ADB would consider striving towards a better balanced portfolio of supply-side and demand-side energy efficiency improvement interventions. ADB has begun supporting some standalone demand-side projects in recent years, although, in most developing member countries, ADB still supports supply-side projects that include relatively minor components for demand-side improvement. Support for demand-side projects could gradually increase over the next several years in response to client demand and rising ADB expertise in preparing such interventions.

165. ADB can also offer policy advice and technical assistance to help developing member country governments establish regulatory and institutional environments that encourage energy efficiency investment in end-use sectors. Technical assistance may also be targeted at public and private sector players for sub-regional cooperation in specific energy efficiency measures. For instance, building energy codes, minimum performance standards for appliances, and specific energy consumption in selected manufacturing segments.

APPENDIXES

Appendix 1

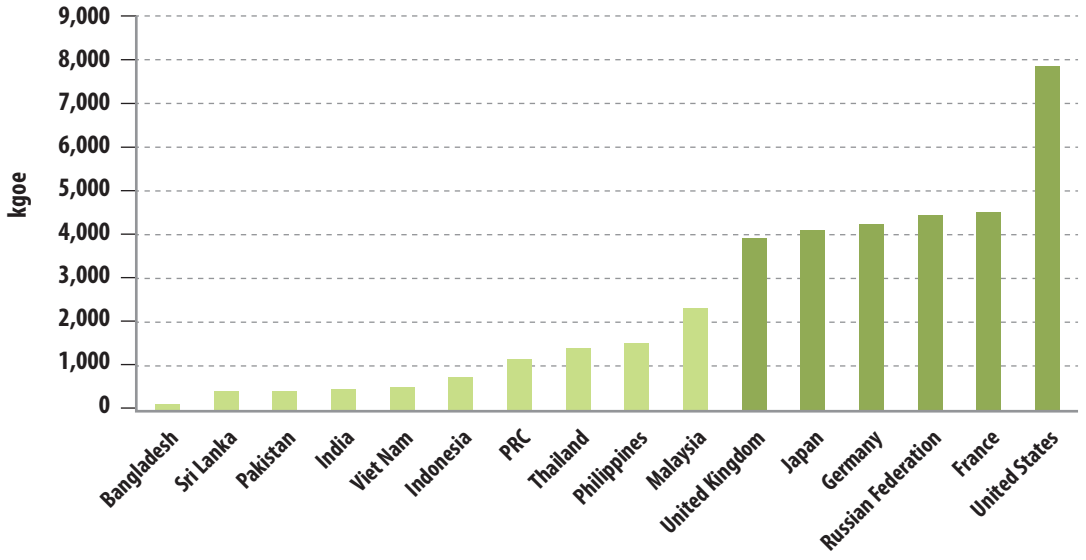
ENERGY EFFICIENCY

A. Introduction

1. Although per capita energy consumption and greenhouse gas emissions per capita in ADB developing member countries are far below those of developed countries (Figures A1.1 and A1.2), there are substantial opportunities to improve efficiencies in the entire energy chain. The potential comes from higher efficiencies in power generation, reduced losses in transmission and distribution, and a range of improvements in end-use efficiency across all major sectors.

2. Despite the considerable potential, efforts to improve end-use energy efficiency have consistently fallen short of expectations. Energy efficiency is simply not as visible as energy generation, and a lack of rigorous monitoring and evaluation—and the perception of electricity utilities that end-use efficiency improvements are not in their self-interest—hinder progress. Subsidized energy prices constitute a further barrier to consumer-driven improvements.

Figure A1.1: Per Capita Energy Consumption in 2003

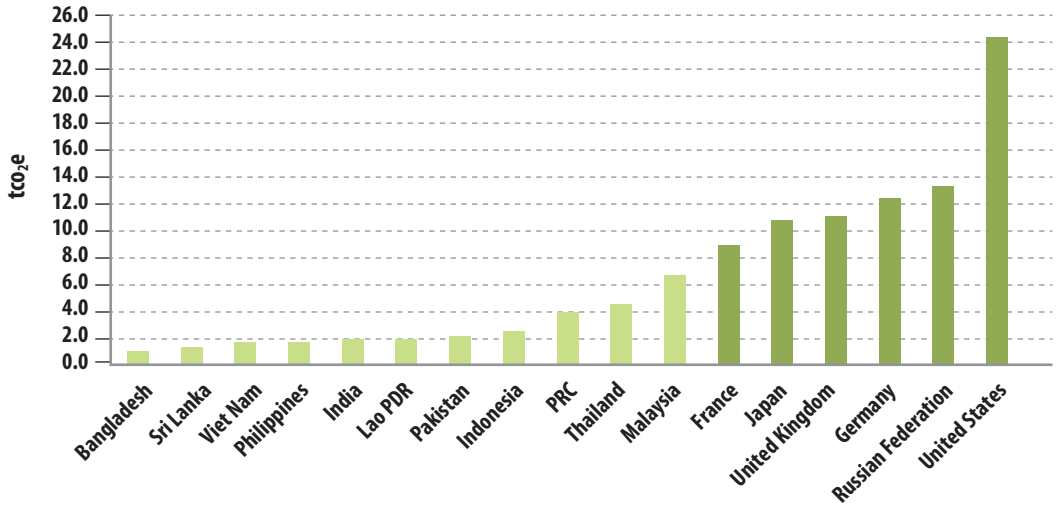


kgoe = kilograms of oil equivalent, PRC = People's Republic of China.
Source: World Resources Institute. http://en.wikipedia.org/wiki/List_of_countries_by_energy_consumption_per_capita

3. Energy efficiency projects supported by international financial institutions are much more staff intensive than large supply-side projects, and disbursing large sums is difficult when compared with loans for large generation projects. Several developing member countries have enacted energy efficiency laws, such as the People's Republic

of China (PRC) in 1998 and India in 2001. The follow-on activities for end-use energy efficiency improvements in both countries are detailed in Appendixes 9 and 10.

Figure A1.2: Per Capita Greenhouse Gas Emissions



tCO_2e=tons of carbon dioxide equivalent, Lao PDR = Lao People's Democratic Republic, PRC = People's Republic of China.
[a] Data for the year 2000; without land use change.
Note: If land use change is also considered, then per-capita greenhouse gas emission levels in Indonesia and Malaysia reach or even exceed developed country levels.
Source: World Resources Institute. http://en.wikipedia.org/wiki/List_of_countries_by_greenhouse_gas_emissions_ per_capita

B. Measures and Priorities for Energy Efficiency Investment

4. Priorities for improving energy efficiency can differ vastly from one country or subregion to another. For instance, in some South Asian countries, despite progress in reducing electricity transmission and distribution losses in recent years, these losses remain high, and many cost-effective opportunities for further reductions still exist (Table A1.1). Transmission and distribution loss reduction has therefore been the focus of a series of ADB-supported projects in these countries over the past several years.[1] Such assistance has helped (i) reduce power shortages; as with reduced technical losses, more usable energy is available to consumers through the transmission and distribution system; (ii) reduce captive power generation, which often relies on inefficiently run diesel generators, and this in turn cuts overall greenhouse gas emissions; (iii) reduce nontechnical losses from electricity pilferage and metering related problems, which in turn reduce electricity use because newly metered, former pilferers have to pay for their consumption.[2]

[1] For instance, along with the policy loan approved in December 2003 to restructure the Assam power sector in India, a project loan for improving the transmission and distribution system in Assam was also approved. This was followed by the approval of a $200 million multitranche financing arrangement in November 2009 for improving the power transmission and distribution systems in Assam. Likewise, the transmission and distribution rehabilitation projects in Madhya Pradesh in India through Loan 1869 was approved in 2001, along with a policy loan to reform and restructure the Madhya Pradesh power sector, followed by a multitranche financing arrangement beginning 2007 (through which six tranches have been approved thus far: loans 2323 and 2324 in April 2007, loans 2346 and 2347 in August 2007, loan 2520 in April 2009, and loan in December 2010).

[2] However, many of the systems in South Asia that have high commercial transmission and distribution losses also suffered from high levels of unserved demand. Therefore, the kilowatt hour freed up by lower technical losses and reduced consumption of former pilferers is taken up by customers who were previously subject to power cuts. But even though the net result of such a response is no change in total grid-based generation, there is still a net reduction in greenhouse gas emissions, because generation by diesel standby and captive generation is reduced.

Table A1.1: Transmission and Distribution Losses in Selected States in India
(% of energy dispatched)

State	2002–2003	2003–2004	2004–2005	2005–2006	2006–2007	2007–2008	2008–2009[a]	2009–2010[a]
Assam	39	36	38	33	33	38	34	32
Gujarat	31	29	34	30	24	25	23	24
Himachal Pradesh	21	22	26	21	17	16	16	15
Madhya Pradesh	44	44	43	41	39	42	40	39
Uttaranchal	48	45	34	32	33	32	33	30

[a]Estimated.
Notes:
1. The figures in respect of Orissa and Delhi have not been included.
2. The improvement shown in 2008–20009 and 2009–2010 may only be because the data is provisional/estimated.
In addition, state governments often change the previous year's numbers marginally in new submissions each year.
Source: Compiled by Planning Commission, Government of India, from various state power utilities, cited in http://planningcommission.nic.in/data/datatable/1705/final_84.pdf

5. Continued improvements in power generation efficiency have been best demonstrated in the PRC through its much-publicized program to construct new coal-fired power plants to feed rising demand, as well as replace small, old, and inefficient coal-fired plants built during the past half century.[3] Over 31,000 megawatts (MW) of small capacity was decommissioned in 2007 and 2008, and over 108,000 MW of efficient large capacity installed during the same period. As a result, the average coal consumption for power generation declined from 367 grams of coal equivalent per kilowatt-hour (gce/kWh) in 2006 to 349 gce/kWh in 2008 (Table A1.2).

Table A1.2: Efficiency of Coal-Fired Power in the People's Republic of China

Technology	Unit Capacity (MW)	Net Specific Coal Consumption (gce/kWh)	Net Efficiency (%)
Ultra supercritical	1,000	286.5	43.03
Ultra supercritical	600	292	42.09
Supercritical	600	299	41.10
Subcritical	600	331	37.12
	300	340	36.15
	100[a]	410	29.98
	50[a]	440	27.93
	25[a]	500	24.53
	12[a]	550	22.35
	6[a]	600+	20.48
Average 2006		367	33.49
Average 2007		357	34.43
Average 2008		349	35.21

gce/kWh = grams of coal equivalent per kilowatt hour, MW = megawatt, PRC = People's Republic of China.
[a] By 2007, the combined capacity of small units (100 MW or less) accounted for about 40% of total thermal capacity in the PRC.
Source: Mao, Xianxiong. 2009. *How does* [People's Republic of] *China Reduce CO_2 Emissions from Coal-Fired Power Generation: Activities and Deployment of Clean Coal Power Generation and Carbon Capture in* [People's Republic of] *China*. World Bank Energy Week.

[3] As per the policy of "large substitutes for small," the decommissioning of inefficient small units is the key criteria for including new large power plants in the national power development plan (for instance, to construct 2,600 MW large units, at least 840 MW of small capacity must be decommissioned). The program to decommission 114,000 MW of small capacity is to take place in small steps. Unit capacity in new power plants is to be at least 600 MW (except for combined heat and power plants) with supercritical or ultrasupercritical parameters.

6. Coal consumption clearly declined further in 2008 and beyond because (i) 2008's order book comprised more than 80 units each of 1,000 MW capacity; (ii) the use of ultrasupercritical boilers; and (iii) smaller, inefficient units continued to be shut down. In addition to the local and global environmental benefits of such improvements in coal conversion efficiency, coal transportation costs in the electricity price build-up would also have decreased.

7. Even so, it is difficult to gauge the potential for reducing specific energy consumption for power generation in the existing stock of coal-fired power plants. Power plant loading and capacity utilization, as well as quality of maintenance, make such an assessment difficult, as does the fact that different generating units are designed to use different qualities of coal. What is more, design efficiency levels vary according to unit capacity as well as manufacturing design. For these reasons, it is difficult to assign one level of target efficiency across all power generating units.

8. For analogous reasons, it is not correct to assign a fixed energy consumption norm for all manufacturing units within any industrial segment. It is widely acknowledged in India that the broad range of specific energy consumption is a reflection of the differences in vintage, production capacity, raw material quality, and the product-mix of various industrial establishments in a given industrial segment. The typical range of specific energy consumption in some industrial segments is shown in Table A1.3. While it varies by a factor of up to 2 for most industrial segments, the variance is particularly large for the pulp and paper and textile sectors, which reflects their wide range of activities. For instance: (i) in the pulp and paper sector, there are only-pulping units which use a range of raw materials such as wood, fiber crops or wastepaper, and there are only-paper making units with which use pulp as raw material, which are integrated pulping and papermaking units; and (ii) in the textile sector, there are some spinning mills that produce fabric from various natural or synthetic yarns, and the fabric texture and thickness can vary significantly; some processing units engaged in singeing, coloring, and printing a fabric; and composite units that do both spinning and processing. A cross-country comparison also shows a wide range of average specific energy consumption levels for various industrial segments (see Table A1.4).

Table A1.3: Specific Energy Consumption in Selected Industrial Segments in India

Industrial Segment	Range of Specific Energy Consumption
Aluminum (Refinery)	28–4.12 million kCal/ton of Alumina
Aluminum (Smelter)	875–17,083 kWh/ton
Cement	900 kCal/kg of clinker (thermal), plus 66–127 kWh/ton (electrical)
Chlor-Alkali	300–2,600 kWh/ton of Caustic Soda
Fertilizer	86–9.11 GCal/ton of Urea
Integrated Steel plant	15–8.18 GCal/ton of steel
Sponge Iron	4–7.6 GCal/ton (thermal), plus 135 kWh/ton (electrical)
Pulp and Paper	3–121 GJ/ton
Textile	000–16,100 kCal/kg (thermal) plus 0.25–10 kWh/kg (electrical)

GCal = gigacalorie (million kilocalories), GJ = gigajoule, kCal = kilocalorie, kg = kilogram, kWh = kilowatt hour.
Source: Bureau of Energy Efficiency (Ministry of Power, Government of India). 2011. Perform, Achieve and Trade (PAT) Consultation Document. New Delhi (January).

Table A1.4: Specific Energy Consumption of Select Industries (kWh/ton)

Country	Steel	Cement	Pulp and Paper	Fertilizer
India	9.5	2.0	11.1	12.2
United Kingdom	6.1	1.3	7.6	11.2
United States	6.1	0.9	9.7	11.3
Japan	4.2	1.2	…	…
Sweden	5.0	1.4	7.6	…

… = not available, kWh = kilowatt-hour.
Source: The Climate Group. 2011. *India's Clean Revolution*. London.

9. To assess the energy efficiency potential within the manufacturing industry, it is useful to find a suitable benchmark for specific energy consumption or decide on a target for a fairly homogenous group of manufacturing units. The benchmark or target specific energy consumption should be achieved within a set time period (say, up to 5 years). The extent to which the actual specific energy consumption of all units in a homogenous group are higher than the benchmark or target for that group would be an indicator of the technical energy efficiency potential within the specified period. To achieve the technical potential, however, it may be necessary to create supporting regulatory, institutional, and financial mechanisms.

10. Estimating a country's industrial energy savings potential is difficult. Where estimates are available, it is hard to ascertain how precise they are. For instance, even though it is known that the estimates in Table A1.5 are based on a comparison of the stock of industrial units in India, which has some of the world's most efficient industrial plants, the underlying data may not always be reliable.

Table A1.5: Specific Energy Consumption of Selected Industries (kWh/ton)

Industry	% Share of Energy Cost	Energy Conservation Potential (%)
Iron and Steel	8	10
Fertilizers and Pesticides	3	15
Textiles	9	25
Cement	9	15
Pulp and Paper	8	25
Aluminum	2	10
Sugar	4	30

kWh = kilowatt-hour.
Source: The Climate Group. 2011. *India's Clean Revolution*. London.

C. Policy and Regulatory Measures

1. Energy Pricing and Subsidies

11. Energy pricing policies influence the impetus towards energy efficiency. Below cost and subsidized energy prices encourage consumption and are a drain on government budgets. They reduce economic efficiency and generally impose costs on the local and global environment. For instance, in the PRC and India, where more than the optimal level of coal-fired thermal generation results in unnecessary local and greenhouse gas emissions. However, to the extent that subsidies increase welfare, they need to be encouraged. Well-targeted subsidies aimed at increasing electricity access to the rural poor often have significant social and equity benefits. And besides, given

the low level of consumption in newly electrified households, the incremental burden of greenhouse gas emissions is miniscule compared with that of the growth of the urban and industrial economy.[4]

12. Despite political rhetoric and the best of intentions, the targeting performance of many energy subsidy programs is often weak. Little of the subsidy actually reaches the poor, with most accruing to the lower- and middle-income classes that consume the bulk of commercial energy.[5] The experience in India shows that subsidies can create financial pressures on electricity distribution companies and result in poor quality service to all, as well as impose large costs on the presumed beneficiaries. Traditionally, certain Indian power utilities have also found the poor financial situation—ostensibly arising from subsidies—has masked their own operational inefficiencies. In short, energy subsidies can be "large, burdensome, regressive, and climate damaging."[6]

2. Demand-Side Management

13. Demand-side management programs, as traditionally run by utilities, encourage customers to reduce and/or shift their energy use. Some examples of demand-side management programs include marketing efforts to encourage customers to adopt new technologies, such as efficient lighting, rebates for certain types of energy-efficient equipment, and free energy audits. Typically, these programs aim to either reduce total consumption or shift consumption to off-peak times.[7] Demand-side management programs cover a range of technologies, especially for efficient lighting. While they can be in a utility's financial interest, particularly for load shifting, sustaining demand-side management in the long term requires supportive regulations. In many developing member countries, utilities also have an indirect motivation to promote demand-side management, because it enables them to serve more customers, and reduce financial loss as peak-time demand decreases.

3. Building Codes and Appliance Standards

14. Appliance standards and building energy codes have proven to be some of the most effective and cost-effective policies for improving energy efficiency. Building energy codes are important because of the long-term and significant impact they can have on reducing energy demand. Because buildings typically last for 30–40 years, their initial design is the single most important factor in determining their energy consumption pattern. Energy savings measures are less expensive during initial construction than through later retrofits. But builders rarely have an incentive to maximize efficiency, because they do not pay the energy bills, and buyers have little way of knowing what future energy performance may be.

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[4] As per World Bank estimates, providing 2 billion people with electricity access consuming 30 kWh/household/month would boost global greenhouse gas emissions by less than 0.4% even if power were provided entirely by the most carbon-intensive means: the rest of the world increases its carbon emissions by this amount about every 2 months. See World Bank Independent Evaluation Group. 2008. *Climate Change and the World Bank Group: Phase I—An Evaluation of World Bank Win-Win Energy Policy Reforms*. Washington, D.C.

[5] K. Komives, V. Foster, J. Halpern, and Q. Wodon. 2005. *Water, Electricity and the Poor: Who Benefits from Utility Subsidies*. World Bank. Washington, D.C.

[6] World Bank Independent Evaluation Group. 2008. *Climate Change and the World Bank Group: Phase I—An Evaluation of World Bank Win-Win Energy Policy Reforms*. Washington, D.C.

[7] Load shifting reduces investment costs substantially, but its impact on greenhouse gas emissions depends on how peak versus base-load power is generated.

15. The "appliance standards" includes two types of policies. The first policy sets minimum efficiency levels for appliances used in residential, commercial, government, and public buildings, such as refrigerators, lighting ballast, hot water heaters, and air conditioners. The second policy involves voluntary or mandatory appliance labels that describe energy performance and consumption, or endorse a product as energy efficient. Efficiency standards have also been set and labeling programs implemented for some industrial equipment, such as three-phase induction motors and centrifugal pumps, in some countries. Box A1.1 shows some key findings from WBG and GEF supported interventions.

Box A1.1: Building Codes and Appliance Standards—Overview of World Bank and Global Environment Facility Experience

Overall, the World Bank and the GEF work on appliance standards and building codes has been very successful in adopting new codes and standards, and somewhat less successful in establishing the necessary infrastructure to implement the codes. Funding is the key limiting factor, both with assistance on code adoptions and with capacity development for enforcement.

In almost every case, countries have adopted new regulations or strengthened existing codes and standards. This is an extremely high success rate for engagement on any policy, and it is particularly noteworthy given the World Bank's low level of funding for code and standard development. By 2004, 74 countries had adopted codes or standards of some kind. The challenge for these countries and for the World Bank is to create institutions that will oversee the effective implementation of these standards.

Codes and standards components of World Bank projects are often envisioned as a tool that can enhance the ability of utilities to implement demand-side management programs. This can be useful and effective, in that the demand-side management organization can help ensure there is a wide market for compliant appliances. However, this approach can also be limiting if the codes and standards are written by or for the demand-side management program instead of the country as whole. Aside from supporting voluntary efforts to use standards and labeling as demand-side management tools, the World Bank's main engagement on code and standard implementation has been in partly funding testing laboratories. But these efforts have done relatively little to create capacity for enforcement of mandatory codes and standards.

There is very little World Bank documentary evidence on the success or failure of the codes and standards components of its projects. Monitoring and evaluation of this kind of effort cannot end with project closure, but requires tracking standard adoption and implementation. The lack of documentary evidence is most likely linked to financing: the codes and standards work received only a fraction of the financing in any given project, and was therefore not a priority for assessments at project close.

Source: Independent Evaluation Group. 2009. *Climate Change and World Bank Group: Phase 1: An Evaluation of World Bank Win-Win Energy Policy Reforms*. Washington D.C.

4. Efficient Light Bulbs

16. In many developing countries, lighting is the largest use of power in the residential sector. Lighting demand is concentrated in the early evening hours and utilities are forced to build additional generation capacity to supply electricity during these hours.

17. Switching from standard incandescent lamps to CFLs reduces energy consumption by saving fuel and capacity costs while mitigating carbon dioxide emissions. CFLs draw only 20%–30% as much power as equally bright incandescent lights and last much

longer. Households benefit from lower energy consumption, and CFL adoption can pay for itself in 2–14 months.[8] Utilities benefit from lower power sales, especially when supply costs exceed tariffs, and from reduced capacity costs.

18. Despite the significant benefits, households have been slow to adopt CFL technology. Adoption barriers include the higher upfront price of CFL bulbs, distaste for the color or quality of the illumination, skepticism about the lifespan of these bulbs, and poor consumer knowledge. Since the early 1990s, public entities, utilities, and development agencies have implemented several programs to encourage CFL adoption through subsidizing bulbs, procurement in bulk to reduce costs, imposing quality standards, offering certification, and mounting advertising campaigns. Box A1.2 provides an overview of the experience of the WBG in supporting CFL programs.

Box A1.2: Compact Fluorescent Lamp Programs—Overview of World Bank and Global Environment Facility Experience

Since 1994, the WBG has supported residential CFL programs in more than 20 countries and covered some 50 million CFLs, primarily through bulk distribution or market-based projects. Many projects have received GEF or carbon fund support, although many recent projects aimed at rapid crisis mitigation have been implemented without GEF assistance.

Bulk-purchase projects have become favored because of their ability to reduce unit costs of bulbs through bulk discounts, as well as their substantial and immediate reductions in peak electricity demand, and the ability to access carbon financing.

A variety of tools have been adopted to encourage the commercialized use of CFLs, such as combining limited-term subsidies, standards and labeling, public education, and targeted credit schemes. Although credit schemes were generally unsuccessful, the claimed benefits include electricity savings, reductions in greenhouse gas emissions, and catalyzed reductions in CFL prices. However, these claims could not be validated owing to insufficient data on CFL price reduction and diffusion rates compared to other countries.

Failure rates of CFLs were relatively low, and CFL projects have also been a cost-effective response to energy emergencies by saving both costs of providing additional capacity and the fuel cost of running diesel generators.

The potential to combine electricity pricing reform with the promotion of CFLs and other efficiency devices as a way of cushioning the transition to environmentally and financially sustainable pricing remains unexplored. CFLs have been sold as a peak-load reduction tool, rather than as a tool to mitigate tariff increases.

Source: Independent Evaluation Group. 2010. *Climate Change and World Bank Group; Phase II: The Challenge of Low-Carbon Development*. Washington, D.C.

[8] For further details, refer to Independent Evaluation Group. 2010. *Climate Change and World Bank Group: Phase II: The Challenge of Low-Carbon Development*. Washington, D.C.

Appendix 2

THE DEMAND-SIDE ENERGY EFFICIENCY FOCUS OF ADB'S CLEAN ENERGY PROGRAM

A. Overview of ADB's Clean Energy Program

1. ADB's Clean Energy Program seeks to facilitate the transition of its developing member countries to a low-carbon growth path, meet their energy security concerns, provide universal access to energy, and achieve ADB's vision of a region free of poverty. ADB promotes the wide-scale development of clean energy projects through a range of programs, financing facilities, and other initiatives. Figure A2.1 provides an overview of the completed and ongoing clean energy propagation measures; the more prominent ones are discussed below.

B. Energy Efficiency Initiative

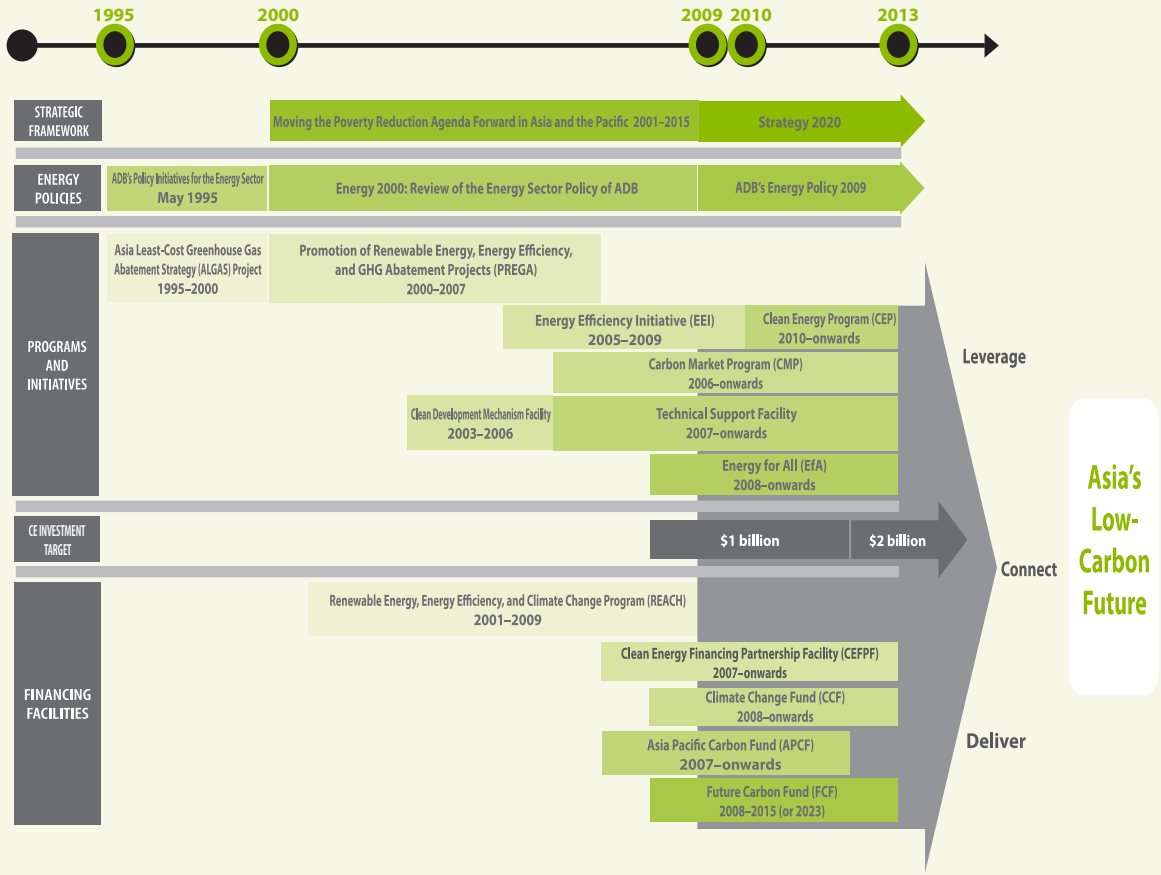
2. The Energy Efficiency Initiative (EEI) was launched in July 2005 with the aim of investing $1 billion a year in clean energy development programs from 2008 to 2010 to catalyze capital flows to energy efficiency and renewable energy projects in the PRC, India, Indonesia, Pakistan, the Philippines, and Viet Nam as initial priority countries. This target has been consistently exceeded each year since 2008. An additional $3 million grant to expand the EEI to include Afghanistan, Bangladesh, Cambodia, Lao People's Democratic Republic, Mongolia, and Uzbekistan was approved in November 2008.

3. In light of its success in helping ADB meet its investment goals in clean energy and in mainstreaming clean energy into ADB's operations, the EEI was evolved into the CEP in 2010. The program has an expanded mandate to support clean energy through both energy efficiency and renewable sources—and not only in energy sector projects but also in water supply and sanitation, the urban sector, transport, and agriculture.

C. Carbon Market Program (Carbon Market Initiative until 2010)

4. ADB's Carbon Market Program (CMP) helps developing member countries tap into the growing global carbon market so they can more systematically address the transition to a low-carbon economy. Most public and private carbon procurement programs in the market provide payment only upon project completion and delivery of carbon credits. For certain developing member countries, this has proved to be a critical upfront financing gap, which stands in the way of implementing these projects. The CMP helps fill this financing gap by providing upfront support for project preparation and implementation. It does this through two facilities and two funds.

Figure A2.1: Evolution of ADB's Clean Energy Program



Source: ADB. 2011. Promoting Clean Energy in Asia and the Pacific. *Energy Security, Access and Low-Carbon Development*. Manila.

5. **Technical Support Facility.** ADB approved the Technical Support Facility in December 2007.[1] The regional technical assistance was approved for more than $4 million. It was financed by the governments of Austria, Finland, and Luxembourg; the Spanish Cooperation Fund for technical assistance; and the Swiss Cooperation Fund for consulting services; and administered by ADB. The regional technical assistance has (i) helped to assess the capacities of developing member country governments and other stakeholders to identify and implement Clean Development Mechanism projects; (ii) helped ADB to undertake a preliminary assessment of projects, and identify projects with greenhouse gas abatement potential; (iii) helped to conduct Clean Development Mechanism-related due diligence, supported project proponents in preparing necessary documentation, including project design documents; introduced projects to ADB-managed carbon funds; obtained host-country approval from designated national authorities; conducted successful validations by designated operational entities; and registered projects with the Clean Development Mechanism's Executive Board. As of April 2011, the Technical Support Facility was engaged in monitoring or developing 57 projects in developing member countries at various stages in the Clean

[1] ADB. 2007. *Proposed Technical Assistance for Implementation of the Technical Support Facility under the Carbon Market Initiative*. Manila (27 November; RETA 6438, approved on 18 December 2007).

Development Mechanism cycle.[2] More than 20 of these 57 projects are not supported by an ADB loan or grant.

6. Of these projects, 16 are classified as energy efficiency projects, of which 8 are demand-side energy efficiency projects. They include (i) 3 municipal solid waste management and/or wastewater treatment projects, (ii) 3 buildings and municipal lighting retrofit projects, and (iii) 2 industrial energy efficiency projects. However, recent information on ADB-supported loan projects indicate that the inclusion of some of the demand-side energy efficiency projects in the list is optimistic. For instance, at least two projects shown as candidates for project design document validation in 2011 turned out not to be strong candidates for validation. The project management office of the ADB-supported Guangdong Energy Efficiency and Environment Improvement Investment Program is aware that because most energy efficiency subprojects comprise installation and the use of energy efficiency equipment in a large number of end-users, it is very likely that new methodologies will need to be framed for claiming credits under Clean Development Mechanism, or a new regime that succeeds the mechanism after 2012. Given that this will be a lengthy process, the project management office is inclined to seek a reallocation of grant funds for other capacity development requirements. A delay in distributing a large number of CFLs in Pakistan also means that little progress has been made so far.

7. Asia and Pacific Carbon Fund. The Asia and Pacific Carbon Fund is a trust fund established and managed by ADB on behalf of sovereign fund participants.[3] It began operations in May 2007 after receiving commitments totaling $151.8 million. Along with the Future Carbon Fund, it helps increase the viability of greenhouse gas mitigation projects by providing finance for project preparation and implementation. The Asia and Pacific Carbon Fund also provides upfront payments against the purchase of between 25% and 50% of certified emissions reductions expected to be generated by a project up to 2012. The remaining 50%–75% of certified emissions reductions may also be purchased by the fund on a pay-on-delivery basis or sold by the project sponsors in the market, including through the Credit Marketing Facility. Although most of the projects that the Asia and Pacific Carbon Fund was monitoring as of April 2011 were not supported through ADB funding, the list of these projects clearly shows the absence of demand-side energy efficiency projects.

8. Future Carbon Fund. The Future Carbon Fund is a trust fund established and managed by ADB on behalf of public and private sector fund participants.[4] It became operational in January 2009 and received funding commitments of $115 million by its closing on 31 March 2010. The Future Carbon Fund is being used to stimulate investments in greenhouse gas mitigating projects in ADB's developing member countries by enabling project developers to gain immediate benefits for greenhouse gas reductions beyond 2012. Only projects supported by ADB with debt/equity guarantees or technical assistance are eligible. As of 2010, the Future Carbon Fund was one of the seven publicly

[2] These included 4 projects registered with the Clean Development Mechanism's Executive Board, 1 in request for registration, 8 in the validation stage, 11 ready for validation, and 32 projects in earlier stages, such as project design documentation and host country approval. The Executive Board had rejected one project.

[3] Asia and Pacific Carbon Fund participants are Finland, Luxembourg, Pro Mundi Vita (Flemish Region of Belgium), Portugal, Spain, Sweden, and Switzerland.

[4] Future Carbon Fund participants are Finland, PMV (Flemish Region of Belgium), Republic of Korea, Sweden, Pohang Iron and Steel Company (Republic of Korea), Eneco Energy Trade (the Netherlands).

announced carbon funds that purchased credits beyond 2012, and the only one that makes the bulk of funds available up front to assist in project financing needs. It provides for up to 75% of the expected volume of certified emissions reductions to be generated after 2012. Together, the Asia and Pacific Carbon Fund and the Future Carbon Fund provide seamless cofinancing opportunities to stimulate greenhouse gas mitigation projects in the region. The remaining certified emissions reductions may be sold by project proponents in the market, including through the Credit Marketing Facility. As of April 2011, four projects with a combined expected certified emissions reduction volume of 15% of the total in the Future Carbon Fund portfolio were classified as energy efficiency projects. However, of these, only two—CFL Distribution in Pakistan and Improved Water Mills in Nepal—are actually demand-side energy efficiency projects. The Talimarjan Power Generation and Transmission Project in Uzbekistan is a supply-side project, while the Solar Cook Stove Project in PRC is a renewable energy project.

9. **Credit Marketing Facility.** This helps sponsors to market additional credits generated beyond those sold upfront to the Asia and Pacific Carbon Fund and the Future Carbon Fund. The Credit Market Facility engages qualified firms as "sellers' representatives." Their performance is monitored by ADB, and they are compensated through a fee upon the successful transaction of certified emissions reductions. Since the market facility projects in the Asia and Pacific Carbon Fund and the Future Carbon Fund pipelines, it is evident that there is little support for demand-side energy efficiency.

10. **Clean Energy Financing Partnership Facility**. To help finance the EEI, the Clean Energy Financing Partnership Facility was established in April 2007. It was designed to fund small investments that require quick transactions, finance some technology transfer costs of clean technologies, and provide grant assistance for activities such as developing the knowledge base on clean energy technologies. The Clean Energy Financing Partnership Facility comprises three funds: (i) the multi-donor Clean Energy Trust Fund; its current financing partners are Australia, Norway, Spain, and Sweden; (ii) the single-donor Asian Clean Energy Fund sourced from Japan; and (iii) the Carbon Capture and Storage Fund established through the Government of Australia's Global Carbon Capture and Storage Institute. ADB works closely with its financing partners to move towards achieving the Clean Energy Financing Partnership Facility's initial target of $250 million.

11. The ADB Energy Policy 2009 refers to renewable energy, energy efficiency, cleaner fuels, and cleaner technologies jointly as clean energy. The Clean Energy Financing Partnership Facility's resources help support all types of clean energy options, and have helped finance the deployment of new, more efficient and less polluting supply and end-use technologies, as well as financing policy, regulatory, and institutional reforms that encourage clean energy development. Eligible activities under the Clean Energy Financing Partnership Facility include (i) biomass, biofuel, and biogas; (ii) rural electrification and energy access; (iii) distributed energy production; (iv) waste-to-energy projects; (v) demand-side management projects; (vi) energy-efficient district heating; (vii) energy-efficient buildings and end-use facilities; (viii) energy-efficient transport; (ix) energy-efficient street lighting; (x) clean energy power generation, transmission, and distribution; (xi) manufacturing facilities of clean energy system components, high-efficiency appliances, and industrial equipment; (xii) energy service companies development; (xiii) carbon capture and storage; and (xiv) integrated gasification combined cycle, supercritical, and ultrasupercritical steam technologies.

12. The Clean Energy Financing Partnership Facility can extend support for (i) deployment of new clean energy technology, (ii) projects that lower barriers to adopting clean energy technologies, (iii) projects that increase access to modern forms of clean and efficient energy for the poor, and (iv) technical capacity programs for clean energy. Many demand-side energy efficiency-related activities are also eligible for support, notably (i) demand-side management projects; (ii) energy-efficient transport, buildings, street lighting, and end-use facilities; (iii) manufacture of high-efficiency appliances and industrial equipment; and (iv) development of energy service companies.

13. By 2010, the Clean Energy Financing Partnership Facility had allocated $28.5 million to clean energy projects, which included some energy efficiency ones. These comprised: (i) $2 million to the PRC related to capacity development for implementing energy efficiency subprojects in Guangdong province, (ii) $2 million to Nepal to facilitate the power utility's CFL program (for advisory, survey, and awareness creation), (iii) $1.5 million to the Philippines for communication and the social mobilization necessary for the efficient lighting program, and (iv) $1 million to Indonesia to help distribute half a million CFLs. In addition, the Climate Change Fund is also being used primarily to finance the implementation of pilot energy efficiency projects in Sri Lanka (paras. 73–75 of the main text).

D. Venture Capital Initiative

14. ADB encourages the growth of risk capital in the Asian clean energy sector by investing equity in several private equity funds. These in turn invest equity in clean energy projects and companies. Although some of the funds specifically include energy efficiency as one of their focus areas, investment lags behind other clean energy sectors. As of March 2011, three ADB-promoted funds had the following investments in energy efficiency: (i) the China Environment Fund III, which invested in three investee companies in the sector, representing 24% of its total investments as of 31 March 2011; (ii) the China Environment Fund 2002, which made one investment representing 11% of its total investments; and (iii) the FEGACE Asia Sub-Fund, which has one small investment in the energy efficiency sector in India, representing 0.21% of total investments. [5]

15. ADB has promoted several clean energy funds in the past few years. For instance, following a call for proposals in July 2007, ADB approved a total investment of $100 million in five funds in 2008. ADB contributed less than 25% of the target size in each of the five funds. The five funds are (i) the Republic of Korea-based Asia Clean Energy Fund, with a target size of $200 million to invest in clean technology, renewable energy, and energy efficiency across Asia; (ii) the China Clean Energy Capital, with a target size of $100–150 million to invest in renewable energy projects/technologies, energy efficiency, and other clean energy technologies in the PRC; (iii) China Environment Fund III, with a target size of $200–250 million to invest in a portfolio of companies working in the PRC to improve the environment by reducing, reusing, and recycling natural resources; (iv) the Global Environment Facility South Asia Clean Energy Fund, with a target size of $200 million to invest in companies and projects promoting the use

[5] It is unlikely that the funds are investing in energy efficiency projects because of their relatively small size, or energy service companies, as their operations are most likely not scalable. The funds are more likely to invest in energy efficiency technology companies or energy efficiency equipment manufacturing companies.

of efficient, reliable, and cleaner forms of energy in South Asia; and (v) the MAP Clean Energy Fund, with a target size of $400 million to invest in a portfolio of clean energy projects focusing on Southeast Asian countries.

16. In 2009, ADB also approved an equity investment of up to $15 million[6] in the Mekong Brahmaputra Clean Development Fund. The target fund size was $100 million, with a first closing of a minimum of $40 million. The target investment subsectors were renewable energy, energy efficiency, and conservation (including natural resource conservation), industrial wastewater and solid waste treatment, and recycling. ADB also contributed to two funds in 2010: the Renewable Energy Asia Fund and the Clean Resources Asia Growth Fund, each totaling $20 million. The former focuses on renewable energy technologies and projects; the latter on (i) pollution and waste management technologies, (ii) water and wastewater solutions, (iii) sustainable agriculture technologies, (iv) energy efficiency technologies, and (v) supply chain investments for alternative energy. In 2010, ADB also called for proposals from clean technology fund managers to identify more clean energy funds to contribute to.

[6] Or 25% of the fund's total share capital, whichever is less.

Appendix 3

ENERGY EFFICIENCY PROJECT APPROVALS (2003–2010)

Category		Sector	Country	Loan No.	Project Name	Total Loan Amount ($ million)	% Clean Energy	Clean Energy Investment ($ million)	Approval Date
1.	RE	Finance	REG	7187	FEGACE Asian Sub Fund LP	20.00	100	20.00	02-Dec-03
2.	DS EE-Other	Water and Other Municipal Infrastructure Service	IND	2046	Urban Water Supply and Environmental Improvement in Madhya Pradesh	200.00	2	4.00	12-Dec-03
3.	DS EE-Other	Agriculture and Natural Resources	UZB	2069	Amu Zang Irrigation Rehabilitation Project (formerly Amu Zang Water Resources Management Project)	73.20	8	6.00	14-Dec-03
4.	DS EE-Other	Transport and ICT	PRC	2051	Yichang-Wanzhou Railway Project	500.00	10	50.00	15-Dec-03
5.	DS EE-Other	Water and Other Municipal Infrastructure and Services	FIJ	2055	Suva Nausori Water Supply and Sewerage Project	47.00	12	5.80	18-Dec-03
6.	T&D	Energy	LAO	2005	Northern Area Rural Power Distribution	30.00	5	1.50	18-Sep-03
7.	T&D	Energy	BHU	2009	Rural Electrification Network Expansion	9.40	100	9.40	30-Sep-03
8.	T&D	Energy	IND	2036	Assam Power Sector Development Program (Project Loan) – Tranche 1	150.00	0	0.00	10-Dec-03
9.	R&R	Energy	IND	2037	Assam Power Sector Development Program (Program Loan)- Tranche 2	100.00	9	9.00	10-Dec-03
10.	R&R	Energy	BAN	2038	Power Sector Development Program (Project Loan)	100.00	0	0.00	10-Dec-03
11.	T&D	Energy	IND	7185 / 2016	Tala-Delhi Transmission	62.00	5	3.00	16-Jan-03
12.	LH	Energy	PRC	2032	Gansu Clean Energy Development Project	35.00	86	30.22	05-Dec-03
13.	T&D, CF	Energy	BAN	2039	Power Sector Development Program (Project Loan)	186.00	47	87.00	10-Dec-03
14.	RE	Agriculture and Natural Resources	PRC	2082	Fujian Soil Conservation and Rural Development II	80.00	19	15.26	24-Apr-04
15.	DS EE-Other	Transport and ICT	PRC	2116	Dali-Lijiang Railway Project	180.00	10	18.00	02-Dec-04
16.	DS EE-Other	Water and Other Municipal Infrastructure and Services	AZE	2120 / 2119	Urban Water Supply and Sanitation	30.00	27	8.00	07-Dec-04

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Category		Sector	Country	Loan No.	Project Name	Total Loan Amount ($ million)	% Clean Energy	Clean Energy Investment ($ million)	Approval Date
17.	DS EE-Other	Agriculture and Natural Resources	TAJ	2124	Irrigation Rehabilitation Project	22.72	5	1.14	10-Dec-04
18.	DS EE-Other	Multisector	IND	2151	Multi-sector Project for Infrastructure Rehabilitation in Jammu and Kashmir	250.00	16	39.40	21-Dec-04
19.	DS EE-Other	Multisector	PAK	2153	Multisector Rehabilitation Project for Azad Jammu and Kashmir	57.00	35	19.80	21-Dec-04
20.	T&D	Energy	VIE	2128	Northern Power Transmission (Sector) Project	120.00	5	6.00	13-Dec-04
21.	T&D	Energy	IND	2152	Power Grid Transmission (Sector) Project	400.00	5	20.00	21-Dec-04
22.	CF	Multisector	FSM	2100 /2099	Omnibus Infrastructure Development	19.00	28	5.40	05-Nov-04
23.	CF	Energy	PRC	2112	Liaoning Environment Improvement Project	70.00	66	46.10	25-Nov-04
24.	CF	Energy	PRC	2146	Coalmine Methane Demonstration Project	117.40	100	117.40	20-Dec-04
25.	CF	Energy	IND	7192	Petronet LNG Ltd (Dahej LNG Terminal Project)	9.70	100	9.70	13-Jan-04
26.	DS EE-Other	Transport and ICT	PRC	2182	Zhengzhou-Xi'an Railway Project	400.00	10	40.00	22-Sep-05
27.	DS EE-Other	Water and Other Municipal Infrastructure and Services	PAK	2211 /2212	Rawalpindi Environmental Improvement	60.00	10	5.70	13-Dec-05
28.	DS EE-Other	Water and Other Municipal Infrastructure and Services	IND	2226	Kerala Sustainable Urban Development (formerly Urban Infrastructure Development and Environment II)	221.20	1	2.84	20-Dec-05
29.	T&D	Energy	AFG	2165	Power Transmission and Distribution Project	26.50	5	1.30	14-Apr-05
30.	T&D	Energy	VIE	2225	Northern Power Transmission Expansion (Sector) Project	360.00	5	18.00	21-Dec-05
31.	LH	Energy	LAO	2162	Greater Mekong Subregion Nam Theun 2 Hydroelectric Project	20.00	100	20.00	04-Apr-05
32.	LH	Energy	LAO	7210	Nam Theun 2 Power Company Limited	100.00	100	100.00	04-Apr-05
33.	LH	Energy	PAK	7222	Laraib Energy Ltd./New Bong Escape Hydropower Project	37.30	100	37.30	21-Nov-05
34.	CF	Energy	BAN	2188 /2189	Gas Transmission and Development Project	230.00	79	181.60	27-Oct-05
35.	CF	Energy	INO	7224	Tangguh LNG Project	350.00	100	350.00	14-Dec-05
36.	RE	Energy	PAK	2286 /2287	Renewable Energy Development Sector Investment Program – Project I	115.00	100	115.00	13-Dec-06

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	Category	Sector	Country	Loan No.	Project Name	Total Loan Amount ($ million)	% Clean Energy	Clean Energy Investment ($ million)	Approval Date
37.	DS EE-Other	Water and Other Municipal Infrastructure and Services	PRC	2237	Shandong Hai River Basin Pollution Control	80.00	0.4	0.30	21-Jun-06
38.	DS EE-Other	Agriculture and Natural Resources	UZB	2245 /2246	Land Improvement	60.20	3	1.81	24-Jul-06
39.	DS EE-Other	Transport and ICT	PRC	2274	Taiyuan-Zhongwei Railway Project	300.00	10	30.00	23-Nov-06
40.	T&D	Energy	PAK	2289 /2290	Power Transmission Enhancement- Project I	236.00	5	11.80	13-Dec-06
41.	T&D	Energy	CAM	2261	Second Power Transmission and Distribution Project	20.00	5	1.00	04-Oct-06
42.	T&D	Energy	TAJ	2303	Regional Power Interconnection Project	21.50	5	1.080	19-Dec-06
43.	T&D	Energy	AFG	2304	Regional Power Interconnection Project	35.00	5	1.75	19-Dec-06
44.	LH	Energy	PRC	2296	MFF-Gansu Heihe Rural Hydropower Development Investment Program-Project 1	22.00	100	22.00	18-Dec-06
45.	CCT	Energy	IND	7242 /2249	NTPC Capacity Expansion Financing Facility	300.00	30	89.00	27-Jul-06
46.	CDH	Energy	PRC	2260	Inner Mongolia Autonomous Region Environmental Improvement	120.00	81	97.10	29-Sep-06
47.	CF	Energy	IND	7227	Central Uttar Pradesh Gas Limited (CUGL)	2.60	100	2.60	17-Jan-06
48.	CF	Energy	IND	7245 /2256	Petronet LNG Limited for the Dahej LNG Terminal Expansion Project	150.00	89	134.00	30-Aug-06
49.	CF	Energy	PRC	7244 /2255	China Gas Holdings Limited/Central Asia Natural Gas ShenZhen Company Limited/ Zhongran Investment Limited for the municipal gas infrastructure development	150.00	100	150.00	30-Aug-06
50.	RE	Energy	IND	2309	MFF-Uttaranchal Power Sector Investment Program (Tranche 1)	41.92	100	41.92	02-Jan-07
51.	RE	Energy	IND	7253	Tata Power Wind Energy Financing Facility	79.30	100	79.30	17-Apr-07
52.	DS EE-Other	Water and Other Municipal Infrastructure and Services	IND	2331	MFF-Jammu and Kashmir Urban Sector Development Program (Subproject 1)	42.20	11	4.80	04-Jan-07
53.	DS EE-Other	Multisector	IND	2312	MFF-North Karnataka Urban Sector Investment Program (Subproject 1)	33.00	25	8.25	26-Jan-07

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Category		Sector	Country	Loan No.	Project Name	Total Loan Amount ($ million)	% Clean Energy	Clean Energy Investment ($ million)	Approval Date
54.	DS EE-Other	Water and Other Municipal Infrastructure and Services	ARM	2363	Water Supply and Sanitation Sector Project	36.00	41	14.80	31-Oct-07
55.	DS EE-Other	Multisector	IND	2366	MFF-Rajasthan Urban Sector Development Investment Program (Subproject 1)	60.00	24	14.48	08-Nov-07
56.	DS EE-Other	Water and Other Municipal Infrastructure and Services	BAN	2382 /2383	Dhaka Water Supply Sector Development Program (Program and Project Loan)	200.00	23	46.05	10-Dec-07
57.	DS EE-Other	Water and Other Municipal Infrastructure and Services	INO	7262	PT PAM LYONNAISE JAYA (PALYJA) (West Jakarta Water Supply Development Project)	50.00	20	10.00	31-Aug-07
58.	DS EE-Building	Energy	PRC	7271	Energy Efficiency Multi-Project Financing Program	107.00	100	107.00	14-Dec-07
59.	T&D	Energy	IND	2323	MFF - Madhya Pradesh Power Sector Investment Program (Tranche 1)	106.00	7	7.42	04-Apr-07
60.	T&D	Energy	IND	2324	MFF - Madhya Pradesh Power Sector Investment Program (Tranche 2)	45.00	100	45.00	04-Apr-07
61.	T&D	Energy	IND	2346	MFF - Madhya Pradesh Power Sector Investment Program (Tranche 3)	144.00	7	10.08	21-Aug-07
62.	T&D	Energy	IND	2347	MFF - Madhya Pradesh Power Sector Investment Program (Tranche 4)	90.00	31	28.00	21-Aug-07
63.	T&D RE	Energy	SAM	2368	Power Sector Expansion Project	26.20	41	10.90	27-Nov-07
64.	T&D	Energy	PAK	2396	MFF-Power Transmission Enhancement -Project II	220.00	5	11.00	17-Dec-07
65.	T&D, CF	Energy	PAK	7254	PAK: Karachi Electric Supply Company Ltd. (KESC) Post privatization rehabilitation, upgrade and expansion	150.00	20	29.40	29-May-07
66.	T&D	Energy	CAM	7256	CTPL Power Transmission Project	8.00	5	0.40	27-Jun-07
67.	CDH	Multisector	PRC	2360	Jilin Urban Environmental Improvement Project	100.00	13	12.70	29-Oct.07
68.	CF	Energy	PAK	7265	Equity Investment and Guarantee: Daharki Power Project	46.75	60	28.05	30-Oct-07
69.	CF, T&D	Energy	BAN	2332 /2333	Sustainable Power Sector Development Program	465.00	34	157.73	26-Jun-07
70.	T&D	Energy	IND	2415	MFF-National Power Grid Development Investment Program (Tranche 1)	400.00	100	400.00	28-Mar-08
71.	RE	Multisector	PRC	2428	Integrated Ecosystem and Water Resources Management in the Bayangdian Basin Project	100.00	7	6.60	24-Jun-08

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Category		Sector	Country	Loan No.	Project Name	Total Loan Amount ($ million)	% Clean Energy	Clean Energy Investment ($ million)	Approval Date
72.	T&D, RE	Energy	IND	2498	Uttaranchal Power Sector Investment Program (Tranche 2)	62.40	53	33.38	23-Dec-08
73.	RE	Energy	PRC	7285	Inner Mongolia Wind Power Project (Datang Sino-Japan Renewable Power Corp)	23.85	92	21.97	04-Sep-08
74.	RE	Energy	IND	7277 /2417	Gujarat Paguthan Wind Energy Financing Facility (a.k.a., Samana Wind Power Project)	45.00	100	45.00	17-April-08
75.	RE	Energy	IND	7277 /2434	CLP Wind Farms Private Limited (Samana Phase 2 Project and Saudatti Project)	60.00	100	60.00	17-Apr-08
76 .	RE	Energy	REG	7275	Asian Clean Energy Private Equity Funds	100.00	100	100.00	17-Apr-08
77.	DS EE-Other	Multisector	IND	2410	MFF-Uttaranchal Urban Sector Development Investment Program (Tranche 1)	60.00	35	21.10	01-Feb-08
78.	DS EE-Other	Multisector	PRC	2420	Xinjiang Municipal Infrastructure and Environment Improvement	105.00	9	9.80	23-Apr-08
79.	DS EE-Other	Transport and ICT	PAK	2424	Preparing Lahore Rapid Mass Transit System	6.00	20	1.20	04-Jun-08
80.	DS EE-Other	Water and other Municipal Infrastructure and Services	UZB	2466	Surkhandarya Water Supply and Sanitation	30.00	25	7.50	03-Nov-08
81.	DS EE-Other	Multisector	PRC	2407	Gansu Baiyin Urban Development Project	80.00	15	12.20	23-Jan-08
82.	DS EE-Industry	Energy	PRC	2426	MFF-Guangdong Energy Efficiency and Environment Improvement (Tranche 1)	35.00	100	35.00	09-Jun-08
83.	T&D	Energy	AZE	2437	Power Transmission Enhancement Project	160.00	7	11.20	10-Sep-08
84.	T&D	Energy	PAK	2438 /9	Power Distribution Enhancement Investment Program	252.00	17	42.80	12-Sep-08
85.	CCT	Energy	PHI	7273	Masinloc Coal-Fired Power Project (Masinloc Power Partners Co, Ltd.)	200.00	5	10.00	17-Jan-08
86.	CCT	Energy	IND	7276	Mundra Ultra Mega Power Project (Coastal Gujarat Power Ltd.)	450.00	20	90.00	17-Apr-08
87.	CDH	Energy	PRC	7279	Municipal District Energy Infrastructure Development Project (Dalkia Asia Pte Ltd.)	400.00	75	300.00	02-Jun-08
88.	LH	Energy	PRC	2408	MFF-Gansu Heihe Rural Hydropower Development Investment Project-Project 2	28.00	100	28.00	29-Jan-08
89.	LH	Energy	VIE	2429	Song Bung 4 Hydropower Project	196.00	100	196.00	26-Jun-08

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Category		Sector	Country	Loan No.	Project Name	Total Loan Amount ($ million)	% Clean Energy	Clean Energy Investment ($ million)	Approval Date
90.	LH	Energy	IND	2461	Himachal Pradesh Clean Energy Development Investment Program-Tranche 1	150.00	100	150.00	27-Oct-08
91.	LH	Energy	BHU	2463 /4	Green Power Development	80.00	100	80.00	29-Oct-08
92.	RE, T&D	Energy	IND	2502	Uttaranchal Power Sector Investment Program (Tranche 3)	30.60	100	30.60	08-Jan-09
93.	RE	Energy	VIE	2513	Quality and Safety Enhancement of Agricultural Products and Biogas Development Project	95.00	20	19.10	18-Mar-09
94.	RE	Energy	VIE	2517	Renewable Energy Development Network Expansion and Rehabilitation for Remote Communes Sector	151.00	52	78.59	30-Mar-09
95.	RE	Energy	SRI	2518 /9	Clean Energy and Access Improvement	160.00	18	28.66	14-Apr-09
96.	RE	Energy	THA	7290 /2504	Biomass Co. (Biomass Power Project)	76.80	100	76.80	13-Jan-09
97.	RE	Energy	PRC	7291 /2505	Sanchuan Clean Energy Development Co Ltd. (Small Hydropower Development Project)	203.57	100	203.57	13-Jan-09
98.	RE	Energy	PRC	7297 /2512	CecicHke Wind Power Co Ltd. (Zhangbie Wind Power Project)	34.30	100	34.30	10-Mar-09
99.	RE	Energy	IND	7300	Public-Private Partnership for Renewable Energy Development	40.00	100	40.00	28-May-09
100.	RE	Water and other Municipal Infrastructure and Services	PRC	7296	China Everbright Environmental Energy Limited-CEEEL (Municipal Waste to Energy Project)	200.00	100	200.00	04-Jun-09
101.	RE	Energy	REG	7304	Mekong Brahmaputra Clean Development Fund	15.00	100	15.00	16-Dec-09
102.	DS EE-Other	Water and other Municipal Infrastructure and Services	IND	2506	Rajasthan Urban Sector Development Investment Program-Tranche 2	150.00	2	3.45	19-Jan-09
103.	DS EE-Other	Water and other Municipal Infrastructure and Services	KGZ	2556	Issyk-Kul Sustainable Development Project	16.50	21	3.50	30-Sep-09
104.	DS EE-Other	Water and other Municipal Infrastructure and Services	SRI	2557 /8	Greater Colombo Wastewater Management Project	100.00	14	13.72	28-Sep-09
105.	DS EE-Other	Water and other Municipal Infrastructure and Services	UZB	2564	MFF-Water Supply and Sanitation Services Investment Program-Tranche 1	60.00	35	21.20	08-Oct-09

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Category		Sector	Country	Loan No.	Project Name	Total Loan Amount ($ million)	% Clean Energy	Clean Energy Investment ($ million)	Approval Date
106.	DS EE-Other	Transport	PRC	2601	Lanzhou Sustainable Urban Transport	150.00	18	27.40	11-Dec-09
107.	DS EE-Other	Transport	CAM	2602	GMS Rehabilitation of the Railway in Cambodia (Supplementary)	42.00	20	8.40	11-Dec-09
108.	DS EE-Other	Transport	PRC	2605	Railway Energy Efficiency and Safety Enhancement Investment Program-Tranche 1	300.00	40	120.80	15-Dec-09
109.	DS EE-Building	Energy	PHI	2507	Philippine Energy Efficiency	31.10	100	31.10	29-Jan-09
110.	DS EE-Building	Energy	PAK	2552 /3	Energy Efficiency Investment Program-Tranche 1	60.00	100	60.00	22-Sep-09
111.	DS EE-Industry	Energy	PRC	2611	Guangdong Energy Efficiency and Environment Improvement Investment Program-Tranche 2	22.10	100	22.10	16-Dec-09
112.	T&D	Energy	IND	2510	National Power Grid Development Investment Program-Tranche 2	200.00	60	120.00	03-Mar-09
113.	T&D	Energy	IND	2520	MFF-Madhya Pradesh Power Sector Investment Program-Tranche 5	166.00	7	11.62	13-Apr-09
114.	T&D	Energy	IND	2592	Assam Power Sector Enhancement Investment Program-Tranche 1	60.30	8	4.90	12-Nov-09
115.	T&D, RE, Hydro, DSEE-Building	Energy	NEP	2587	Energy Access and Efficiency Improvement	69.50	41	26.70	30-Sep-09
116.	CDH	Multisector	PRC	2606	Shanxi Small Cities and Towns Development Demonstration Sector	100.00	9	8.70	13-Oct-09
117.	CDH	Multisector	PRC	2574	Hebei Small Cities and Towns Development Demonstration Sector	100.00	3	3.10	06-Nov-09
118.	LH	Energy	IND	2596	Himachal Pradesh Clean Energy Development Investment Program-Tranche 2	59.10	100	59.10	08-Dec-09
119.	RE	Multisector	PRC	2632	Integrated Renewable Biomass Energy Development Sector	66.10	100	66.10	16-Apr-10
120.	RE	Energy	IND	2687	Himachal Pradesh Clean Energy Development Investment Program-Tranche 3	208.00	100	208.00	22-Oct-10
121.	RE	Energy	PAK	2726	MFF-Renewable Energy Development Sector Investment Program PFR2	200.00	100	200.00	13-Dec-10
122.	RE	Energy	PNG	2713 /14	Town Electrification Investment Program-Tranche 1	57.30	100	57.30	6-Dec-10
123.	RE	Energy	THA	7311	Natural Energy Development Company (Solar Power Project)	70.00	100	70.00	16-Apr-10
124.	RE	Energy	THA	7314 /2676	Bangchak Petroleum Public Company (BCP)-Bangchak Solar Power Project	134.30	100	134.30	5-Oct-10

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Category		Sector	Country	Loan No.	Project Name	Total Loan Amount ($ million)	% Clean Energy	Clean Energy Investment ($ million)	Approval Date
125.	RE	Energy	PRC	7317	Jilin Wind Power Project	240.00	100	240.00	16-Nov-10
126.	RE	Energy	PAK	7319	ZoeluEnerji Power Project	36.80	100	36.80	24-Nov-10
127.	RE	Energy	REG	7320 /21	Proposed Equity Investments Clean Resources Asia Growth Fund and Renewable Energy Asia Fund	40.00	100	40.00	25-Nov-10
128.	DS EE-Other	Water and other Municipal Infrastructure and Services	UZB	2633	Water Supply and Sanitation Services Investment Program	140.00	1	1.60	16-Apr-10
129.	DS EE-Other	Water and other Municipal Infrastructure and Services	PAL	2691 /2	Water Sector Improvement Program	16.00	6	0.90	9-Nov-10
130.	DS EE-Other	Transport	NEP	2656	Kathmandu Sustainable Urban Transport	10.00	18	1.80	22-Jul-10
131.	DS EE-Other	Multisector	BAN	2695	City Region Development Project	120.00	17	20.00	10-Nov-10
132.	DS EE-Industry	Energy	AZE	7313	Garadaqh Cement Open Joint Stock Company (Garadaqh Cement Expansion and Energy Efficiency Improvement Project)	27.00	1	0.30	1-Jun-10
133.	T&D	Energy	INO	2619	Java-Bali Electricity Distribution Performance Improvement Project	50.00	80	40.00	22-Mar-10
134.	T&D	Energy	KGZ	2671	Power Sector Improvement Project	16.70	9	1.50	27-Sep-10
135.	T&D	Energy	IND	2677	Assam Power Sector Enhancement Investment Program-Tranche 2	89.70	25	22.00	05-Oct-10
136.	T&D	Energy	IND	2681	Bihar Power System Improvement Project	132.20	5	6.60	19-Oct-10
137.	T&D	Energy	PAK	2727	Power Distribution Enhancement Investment Program (Tranche 2)	242.00	13	31.00	14-Dec-10
138.	T&D	Energy	IND	2732	MFF-Madhya Pradesh Power Sector Investment Program-Tranche 6	69.00	39	26.80	21-Dec-10
139.	CCT	Energy	PRC	2616	Tianjin Integrated Gasification Combined Cycle Power Plant Project	135.00	27	36.50	08-Feb-10
140.	CDH	Energy	PRC	2658	Inner Mongolia Autonomous Region Environmental Improvement Project (Phase II)	150.00	23	34.50	06-Aug-10
141.	CF	Energy	BAN	2622 /23	Natural Gas Access Improvement	266.00	58	154.20	26-Mar-10
142.	CF	Energy	UZB	2629 /30	Talimarjan Power Project	350.00	34	120.00	20-Apr-10
143.	CF	Energy	AZE	2646	Janub Gas-Fired Power Plant Project	232.30	33	76.70	2-Jun-10
144.	CF	Energy	AFG	7307	Sungas LLC (Sungas Liquefied Petroleum Gas Project)	8.00	35	2.80	25-May-10

Table continues on next page

Category		Sector	Country	Loan No.	Project Name	Total Loan Amount ($ million)	% Clean Energy	Clean Energy Investment ($ million)	Approval Date
145.	CF	Energy	PRC	7316	Zhongran Investment Limited (ZIL)-Municipal Gas Infrastructure Development Project (Phase 2)	200.00	42	83.20	9-Nov-10
146.	RE	Energy	BHU	0228	Rural Renewable Energy Development	21.60	100	21.60	29-Oct-10
147.	RE	Energy	THA	0201	Natural Energy Development Company (Solar Power Project)	2.00	100	2.00	16-Apr-10
148.	RE	Energy	PRC	0202	Integrated Renewable Biomass Energy Development Sector	3.00	100	3.00	16-Apr-10
149.	RE	Energy	PRC	0203	Integrated Renewable Biomass Energy Development Sector	9.20	100	9.20	16-Apr-10
150.	DS EE-Other	Transport	NEP	0212	Kathmandu Sustainable Urban Transport	10.00	20	2.00	22-Jul-10
151.	T&D	Energy	INO	0198	Java-Bali Electricity Distribution Performance Improvement Project	1.00	70	0.70	22-Mar-10
152.	T&D	Energy	KGZ	0218	Power Sector Improvement Project	28.10	9	2.50	27-Sep-10
153.	CCT	Energy	PRC	0196	Tianjin Integrated Gasification Combined Cycle Power Plant Project	5.00	27	1.40	8-Feb-10
154.	CF	Energy	RMI	9148	Improved Energy Supply for Poor Households	1.80	60	1.10	6-Aug-10

AFG = Afghanistan, ARM = Armenia, AZE = Azerbaijan, BAN = Bangladesh, BHU = Bhutan, CAM = Cambodia, CCT = clean coal technology; CDH = centralized district heating, CF = cleaner fuels, DS EE = demand-side energy efficiency, FIJ = Fiji, FSM = Federated States of Micronesia, IND = India, INO = Indonesia, KGZ = Kyrgyz Republic, LAO = Lao People's Democratic Republic, NEP = Nepal, PAL = Palau, PAK = Pakistan, PHI = Philippines, PNG = Papua New Guinea, PRC = People's Republic of China, R&R = reform and restructuring, RE = renewable energy, REG = Regional, RMI = Republic of the Marshall Islands, SAM = Samoa, SRI = Sri Lanka, T&D = transmission and distribution, TAJ = Tajikistan, THA = Thailand, UZB = Uzbekistan, VIE = Viet Nam.
Source: ADB database; http://www.adb.org/Documents/Clean-Energy/investments-2010.pdf

Appendix 4

ADB SUPPORT TO INDUSTRY DURING THE 1980s AND 1990s

Table A4.1: ADB Support to Development Finance Institutions for Industrial Lending

	Country	Loan No.	Project Name	Loan Amount ($ million)	Approval Date
1.	BAN	773	Rural and Agro-Based Industries Credit	20.00	19-Dec-85
2.	IND	778	Industrial Credit and Investment Corp. of India	100.00	03-Apr-86
3.	PAK	878/879	Third Development Financing	200.00	17-Dec-87
4.	SRI	896	Second Development Financing	40.00	04-Aug-88
5.	IND	975	Industrial Finance Corporation of India	150.00	24-Oct-89
6.	PAK	996	Fourth Development Financing	250.00	12-Dec-89
7.	IND	1072	Second Industrial Credit and Investment Corp. of India	120.00	18-Dec-90
8.	BAN	1071	Agricultural and Rural Credit	60.00	18-Dec-90
9.	PHI	1088	Third Development Bank of the Philippines	100.00	16-Jul-91
10.	SRI	1090	Third Development Financing	50.00	23-Jul-91
11.	PRC	1206	Industrial Technology Finance	120.00	10-Dec-92
12.	IND	1208	Financial Sector Program	300.00	15-Dec-92
13.	INO	1223	Second Development Finance	200.00	30-Mar-93
14.	SRI	1302	Fourth Development Finance Loan	75.00	28-Jun-94
15.	IND	1343	Industrial Energy Efficiency Project	150.00	13-Dec-94
16.	PAL	1371	Financial Sector Intermediation Loan	100.00	07-Sep-95
17.	PRC	1477	Everbright Bank of China	60.00	05-Nov-96

BAN = Bangladesh, IND = India, INO = Indonesia, PAK = Pakistan, PAL = Palau, PHI = Philippines, PRC = People's Republic of China, SRI = Sri Lanka.
Source: Asian Development Bank database; compiled by study team.

Table A4.2: ADB's Direct Support to Industry

	Sector	Country	Loan No.	Project Name	Loan Amount ($ million)	Approval Date
1.	Industry and Trade	IND	7014/0833	DCL Polyesters	0.749	15-Jul-87
2.	Industry and Trade	IND	7024/0893	Andhra Petrochemicals	7.000	30-Jun-88
3.	Industry and Trade	IND	7032/0950	Indian Acrylics	8.140	31-Jan-89
4.	Industry and Trade	PRC	1162	Lai-Wu Iron and Steel Mill Modernization and Expansion	133.000	31-Mar-92
5.	Energy	PRC	1178	Industrial Energy Conservation and Environment Improvement	107.000	24-Sep-92
6.	Industry and Trade	PRC	1248	Fertilizer Industry Restructuring (Sector)	250.000	24-Aug-93
7.	Energy	IND	1212	Energy Conservation and Environment Improvement	147.000	17-Dec-93
8.	Water & Other Municipal Infrastructure Services	PRC	1270	Tangshan and Chengde Environmental Improvement	140.000	25-Nov-93
9.	Water & Other Municipal Infrastructure Services	PRC	1336	Beijing Environment Improvement	157.000	29-Nov-94
10.	Energy	PRC	1436	Second Industrial Energy Efficiency and Environment Improvement	178.000	09-May-96
11.	Agriculture & Natural Resources	PRC	1491	Anhui Environmental Improvement Project for Industrial Pollution Abatement	112.000	26-Nov-96
12.	Multisector	PRC	1890	Acid Rain Control and Environmental Improvement	147.000	19-Dec-01

ADB = Asian Development Bank, IND = India, PRC = People's Republic of China.
Source: Asian Development Bank database; compiled by study team.

Appendix 5

SELECTED DEMAND-SIDE ENERGY EFFICIENCY INTERVENTIONS (2003–2010)

Item	MFF: Guangdong Energy Efficiency and Environment Improvement Investment Program	Energy Efficiency Multi-Project Financing Program	Philippine Energy Efficiency Project	MFF: Energy Efficiency Investment Program	Clean Energy and Access Improvement Project	Energy Access and Efficiency Improvement Project	Java-Bali Electricity Distribution Performance Improvement Project
Loan Number	2426, 2611	7271	2507	2552/3	2518	2587	2619
Country	PRC	PRC	PHI	PAK	SRI	NEP	INO
Approval Date	9 June 2008 (2426) 16 Dec 2009 (2611)	14 Dec 2007	29 Jan 2007	22 Sep 2009	14 Apr 2009	27 Nov 2009	22 Mar 2010
Effectiveness Date	9 Jan 2009 (2426) 28 May 2010 (2611)		28 May 2009	30 Aug 2010	9 Feb 2010	4 Jun 2010	25 Apr 2010
Expected Disbursement Closing Date	31 Dec 2011 (2426) 31 Dec 2012 (2611)						
Expected Completion Date			30 Apr 2011		31 May 2013	30 Sept 2014	31 May 2012
Expected Loan Closing Date			31 Oct 2011	31 Jul 2012 (2552) 31 Mar 2017 (2553)	30 Nov 2013	31 Mar 2015	30 Nov 2012
ADB assistance ($ million) Total Tranche 1 Tranche 2	 100.00 35.00 22.06	CNY800 million	31.10	 780.0 60.0 30.0	164.2 ($4.4 million for demand side EE)	65.0 ($2.0 million for demand side EE)	51.0 ($1 million for demand side EE)
Demand-side EE related Project Components	• Development of 107 MW energy power plant (EPP) with annual 532 GWh of energy savings; • Development of energy service company (ESCO) sector in Guangdong;	To set up system and framework agreement in order to provide energy end user with increased access to finance for energy efficiency projects	• Component 1: Efficient Lighting Initiative - Retrofit of government office building - National Residential Lighting Program - Public Lighting Retrofit Program - Energy efficiency testing and lamp waste management	• Tranche 1: Replacement of incandescent bulbs in 30 million residential light points with compact fluorescent lamps, and investment program management support project	• Component 1: Energy efficiency improvement - Demand-side management for municipal street lighting	• Component 5: Energy efficiency in lighting	• Output 4: Reduced peak demand and increased awareness of efficient lighting options in isolated grids and selected islands

Table continues on next page

Item	MFF: Guangdong Energy Efficiency and Environment Improvement Investment Program	Energy Efficiency Multi-Project Financing Program	Philippine Energy Efficiency Project	MFF: Energy Efficiency Investment Program	Clean Energy and Access Improvement Project	Energy Access and Efficiency Improvement Project	Java-Bali Electricity Distribution Performance Improvement Project
	• Development of capacity for promoting and assessing energy efficiency projects; and • Replication of the EPP model in other provinces		• Component 2: Efficiency Initiatives in Building and Industries - Super Energy Service Company (ESCO) - Efficient-Building initiative • Component 3: Communication and Social Mobilization • Component 4: Project Implementation Support				
Executing Agency(ies)	Guangdong Provincial Government	Selected financial institutions	Department of Energy	Ministry of Water and Power (for the Investment Program) Pakistan Electric Power Company (Pvt) Ltd. (for Tranche 1& 2)	Ministry of Power and Energy	Nepal Electricity Authority	State Electricity Corporation
Implementing Agency(ies)	14 Sub-borrowers from Tranches 1 and 2; more sub-borrowers expected in Tranche 3		Mostly public utilities	Karachi Electric Supply Company , and eight distribution companies	Ceylon Electricity Board and Lanka Electricity Company (Private) Ltd.	Nepal Electricity Authority	State Electricity Corporation

ADB = Asian Development Bank, EE = energy efficiency, GWh = gigawatt-hour, MW = megawatt.
Source: Compiled by study team.

Appendix 6

GUANGDONG ENERGY EFFICIENCY AND ENVIRONMENT IMPROVEMENT PROGRAM

A. Background on Guangdong Province

1. Guangdong has a long-standing history of economic development, and is now the largest and fastest growing economy among the provinces of the People's Republic of China (PRC). Its gross domestic product (GDP) has grown 15.6% per annum since 2000, from CNY 1,074 billion in 2000 to CNY 3,948 billion in 2009. The share of industry in Guangdong's GDP was 41.5% in 2000 and 45.8% in 2009, with a peak share of 47% in 2006. The industry sector, which is dominated by manufacturing, accounts for about 66% of total electricity use.

2. Guangdong province has relatively low natural resource endowments, and imports 100% of its coal requirements, 80% of its oil needs, and around 20% of its electricity from other provinces. Power demand has outpaced supply growth, and power shortages have been experienced during the peak summer periods. The energy intensity of Guangdong province has declined since 2000, given that its total primary energy consumption grew at about 13% per year from 2000 to 2009, from about 80 million tons of coal equivalent (Mtce) in 2000 to 197 Mtce in 2009.

3. Guangdong province is among the top ten emitters of sulfur dioxide (SO_2) in the PRC, accounting for about 5% of total SO_2 emissions in the country in 2009. Over 90% of the province experienced acid rain in 2010 with a 45.9% frequency,[1] primarily as a result of SO_2 and nitrogen oxides pollution. Emission reduction, therefore, remains a huge challenge for the province, which cannot be met without substantial improvement of energy efficiency.

B. Energy Efficiency-Related Targets and Priorities

4. The Government of the PRC prioritizes energy efficiency and environmental protection, and it set obligatory targets for reducing energy intensity and pollutant emissions in the 11th Five-Year Plan, 2006–2010. From 2005 baseline levels, the national targets were a 20% reduction in energy intensity by 2010; and a 10% reduction in emissions of major pollutants, including SO_2, emitted mostly from coal-fired power plants. After the targets were set, the State Council issued a number of guidelines and plans to strengthen the nation's efforts towards energy efficiency improvement and pollutant reduction. The Energy Conservation Law, which became effective on

[1] Acid rain frequency is defined as the percent number of days that rainwater has a pH value of less than 5.65.

1 April 2008,[2] contributed to achieving a 19.1% reduction in energy intensity and a 14.3% reduction in SO_2 emissions by 2010.[3]

5. The targets of the 11th Five-Year plan were distributed to the provinces. As Guangdong province had the least energy intensity in 2005, its target for energy intensity reduction was set at 16% (less than the nationwide target);[4] and as Guangdong is among the top ten SO_2 emitting provinces, its SO_2 emission reduction target was set at 15% (more than the nationwide target). The Guangdong provincial government established a policy framework for improvement and pollutant reduction in key sectors—energy, energy-intensive manufacturing industries, commercial and government facilities, building construction, electric equipment manufacturing, and transportation. The policy framework facilitates improved compliance and encourages local financial institutions to support energy efficiency improvement and pollutant reduction projects.

6. The Guangdong provincial government also formulated several plans and strategies to help achieve the energy intensity and pollution reduction targets. These include the (i) Guangdong Electricity Demand-Side Management Implementation Plan, 20 November 2006; (ii) Plan on Strengthening Energy Conservation Effort in Guangdong, 22 November 2006; (iii) Guangdong Provincial Mid- and Long-Term Energy Conservation Plan, 5 June 2007; and (iv) Guangdong Comprehensive Energy Conservation and Pollutants Reduction Plan, 19 July 2007. The latter plan specifically requires the Guangdong provincial government to expedite the pilot testing of efficiency power plant subprojects, promote the implementation of efficiency power plant subprojects, and develop a strong energy service company industry.

7. From 2010 baseline levels, the Government of the PRC has set targets for further reducing energy intensity by 16%, and major pollutant emissions (e.g., by 8% of SO_2) in the 12th plan (2011–2015). These targets are also to be set for various provinces.

C. ADB Assistance

8. In response to a request from the Government of the PRC, ADB approved financing of a $100 million equivalent multitranche financing facility program from ordinary capital resources, with interest rates determined in accordance with ADB's London interbank offered rate-based lending facility and a 15-year term. Tranche 1 of $35 million equivalent became effective in January 2009 and Tranche 2 of $22.06 million equivalent in May 2010. The negotiations for Tranche 3 were concluded in June 2011, and expected to become effective at the end of 2012.

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[2] The Energy Conservation Law defines key energy-consuming enterprises as ones that consume more than 10,000 tons of coal equivalent (tce) per year. There are more than 15,000 such enterprises operating in the PRC; most are industrial enterprises. The law also allows relevant provincial agencies to designate enterprises consuming between 5,000 and 10,000 tce per year as key energy-consuming enterprises.

[3] Department of Environment Protection, National Development and Reform Commission, Government of the PRC, 2011, [People's Republic of] *China's 12th Five-Year Plan Energy Conservation and Emission Reduction Targets and Priorities*, Beijing, 9 May.

[4] The energy intensity of Guangdong province in 2005 was 79 tce per million CNY of GDP, compared with the national average of 123 tce/million CNY of GDP.

D. Program Design

9. Institutional structure and management framework. The Guangdong provincial government is the executing agency with overall responsibility for implementing the multitranche financing facility investment program. The provincial government has established a project management office to implement the program under the leadership of the program steering committee. It is responsible for policy direction, operational guidance, and subloan approvals. It coordinates, guides, and supervises program implementation. It also issues program implementation rules, reviews the investment budget, reviews and approves subprojects, and adjusts and modifies eligibility criteria according to the energy efficiency and emission reduction requirements of the Guangdong provincial government. The program steering committee comprises (i) the Guangdong Economic and Information Commission, which leads the day-to-day coordination of the steering committee; (ii) the Guangdong Finance Department, which is responsible for the supervision of loan flow, loan withdrawal requests from ADB, and overall management of the trust account under the trust agreement with the Guangdong Finance Trust Company Limited, the financial intermediary; (iii) the Guangdong Development and Reform Commission, responsible for reviewing and approving feasibility studies of new candidate subprojects, their foreign capital utilization plan, and submissions of pipeline subprojects to the National Development and Reform Commission for approval; and (iv) the Guangdong State Asset Supervision and Administration Commission, responsible for promoting the investment program to provincial state-owned enterprises.

10. The project management office and Guangdong Finance Trust Company are respectively responsible for day-to-day project and financial management. The office is responsible for (i) marketing and promoting the multitranche financing facility investment program; (ii) reviewing and assessing subproject applications based on the selection criteria and the approval process for subprojects; (iii) overseeing implementation of subprojects; (iv) measuring and verifying energy savings of completed subprojects with the assistance of independent measurement and verification consultants; and (v) overall monitoring, management, and reporting for the investment program. The Guangdong Finance Trust Company, as the financial intermediary, is responsible for (i) financial viability assessment and financial due diligence of subprojects and sub-borrowers, (ii) subloan collateral and guarantee management, (iii) subloan lending and recovery, (iv) management of the trust account, and (v) portfolio management monitoring and periodic financial reporting.

11. Financial mechanism. The multitranche financing facility program was proposed using the financial intermediation loan modality. ADB's operations manual[5] defines and establishes the following criteria for eligible financial intermediaries that onlend funds under the modalities of (i) financial soundness; (ii) adequate credit and risk financial management practices; (iii) compliance with prudential regulations; (iv) acceptable corporate and financial management practices; (v) sound business objectives and strategy; (vi) autonomy in lending and pricing decisions; and (vii) adequate policies, systems, and procedures to assess and monitor the economic, social, and environmental impacts of subprojects. In addition, financial intermediaries should have or develop capacity to mobilize domestic resources. It is evident therefore, that the multitranche

[5] ADB. 2003. *Operations Manual, Section D6/BP: Financial Intermediation Loans*. Manila.

financing facility program is not designed as a traditional financial intermediation, but as a partial financial intermediation modality. This is because the Guangdong Finance Trust Company, selected and entrusted by Guangdong Provincial Finance Bureau, conducts trust management according to a trust agreement signed between Guangdong Provincial Finance Bureau and Guangdong Finance Trust Company on 5 November 2008. Criteria (vi) and (vii) are not applicable to Guangdong Finance Trust Company, and are carried out by other participating entities. Lending and pricing decisions are made by the Guangdong provincial government, because it bears the risk of the project. The project management office monitors the economic, social, and environmental impacts of subprojects. The Guangdong Finance Trust Company neither takes on credit risk nor is it required to mobilize domestic resources for subprojects.

12. As the financial intermediary responsible for subloan collateral and guarantee management, the Guangdong Finance Trust Company has set up and updated collateral and guarantee rules for subprojects in three tranches. There has been a progressive easing of guarantee and collateral requirements with each subsequent tranche. For the first tranche of the subloans, which were guarantees covered by land mortgage, the borrower enterprise and a guarantee company were required to add up to 100% of the subloan amount. In the second tranche, future cash-flow receivables were accepted to provide some form of guarantee cover. And in the third tranche, even personal guarantees from shareholders were considered acceptable. Clearly, energy service companies and energy efficiency equipment manufacturers prefer the guarantee and collateral requirements for subloans from the second and third tranches.[6]

13. The Guangdong Finance Trust Company has set up a management system in keeping with the requirements of the trust agreement. The company set up a special trust account, which is distinct from other accounts it manages. It conducts the entire process of monitoring and supervision from subproject screening, selection and approving, agreement signing, subloan withdrawal application, disbursing, and tracking subloan utilization. The Guangdong Finance Trust Company's internal control systems are as required by regulations for trust companies. In cooperation with the project management office, the company also manages three handbooks: Financial Management Handbook, Energy Savings Measurement and Verification Handbook, and Procurement Management Handbook.

14. Subproject selection criteria. The subproject selection criteria take into account four main aspects: technical eligibility of the subproject, social and environmental implications of the subproject, subproject economic and financial aspects, and the financial soundness of the subborrower.

15. In terms of the technical criteria: (i) the efficiency power plant subproject must use proven high-efficiency technologies with reliable, measurable, and verifiable energy savings that will contribute to achieving the energy conservation goals set in Guangdong's Mid- and Long-Term Energy Conservation Plan, and the 11th Five-Year Plan of the PRC; (ii) the estimated efficiency power plant subproject cost and energy

[6] In particular, (i) for the first-tranche subloans: a land mortgage, a holding company and top-management-team joint and several liability guarantee, and guarantee cover by a company were considered acceptable; (ii) for the second-tranche subloans: guarantee and collateral from pledged receivables, IPO guarantee, real estate guarantee, and guarantee company covers; and (iii) for third-tranche subloans: land mortgage, solicitation companies guarantee, top-management individuals and shareholders' guarantee.

savings must be reasonable and consistent with the energy savings claimed by the equipment manufacturers and/or general engineering principles; and (iii) the simple payback period (the total investment cost by annual savings in electricity bills) is less than 5 years in the case of end-users. Subprojects proposing the use of proven energy efficiency technologies are considered eligible. Such technologies include motors and motor-drive systems; transformers and reactive power compensators; green lighting; heating, ventilation, and air conditioning; air compressors and pumping systems; recovery of waste energy from industry; industrial boilers and industrial cogeneration; public facilities' energy-saving projects; renewable energy projects; and other related energy efficiency improvement projects.[7]

16. The subproject social and environmental criteria are that (i) they should not involve land acquisition or involuntary resettlement or have adverse impacts on indigenous people, and (ii) no subprojects entailing building new facilities should be located in designated environmental protection zones. The latter does not refer to existing facility retrofits but to new constructions.

17. Selected subprojects must also meet the following economic and financial criteria: (i) the total economic benefits must exceed the total economic costs of the subproject; (ii) the economic internal rate of return must be greater than 12%, and remain viable even under adverse sensitivity scenarios; (iii) for end-user subprojects, savings in electricity bills must be sufficient to cover the loan repayments; and (iv) the financial internal rate of return must be greater than the weighted average cost of capital, and must show viability even under adverse sensitivity scenarios.

18. The sub-borrower should be financially sound and must (i) not have a bad credit record, based on the People's Bank of China credit history database; and (ii) meet the following financial performance indicators: (a) total debt–equity ratio of less than 75%, (b) the debt–service ratio is greater than 1.2, and (c) the current ratio is at least 1.2. In the event that a sub-borrower does not meet these indicators, but the projected energy savings are considerably higher than average, the sub-borrower must provide acceptable collateral and/or a loan guarantee for the amount of the subloan or as agreed upon with the Guangdong Finance Trust Company; and (iii) the sub-borrower must contribute a minimum of 20% of the total subproject investment cost as counterpart financing. In the event a subproject has good energy savings potential, but the sub-borrower does not meet some of these criteria, then the subproject application is submitted to the project steering committee for consideration.[8]

19. Measurement and verification. Different energy efficiency improvement measures require different energy saving measurement and verification procedures and protocols. The project management office has prepared the Energy Savings Measurement and Verification Handbook, which it regularly updates with the assistance of a measurement and verification consultant.[9] By June 2011, the handbook covered 13 types of subproject measurement and verification protocols. These draw upon (i)

[7] Although the program is to support the energy power plant concept and implementation, one subproject supported through Tranche 2 (which promotes high-efficiency furnaces in the aluminum industry) results in only natural gas savings.

[8] Although there has been no such subproject so far, the Guangdong provincial government has kept this provision to cater to exceptional subprojects.

[9] Through a grant of $2 million from the Clean Energy Fund and the Climate Change Fund.

measurement and verification guidelines and standards framed by the Government of the PRC and the Efficiency Valuation Organization, which are applicable to all types of subprojects;[10] (ii) government standards applicable to energy management systems' subprojects and production line energy conservation subprojects;[11] and (iii) government guidelines for new facility construction subprojects.[12] The handbook presents PRC standards for measurement and verification in general, as well as specific standards that refer to sectors and industries, issuing authorities and agencies, and applicable subprojects.

20. The measurement and verification of energy savings is performed by independent consultants. Three agencies were selected as third party consultants for the first tranche subprojects, which were increased to five given the scope of the second tranche subprojects. The cost of measurement and verification is borne by the Guangdong provincial government.

21. In keeping with the standards and guidelines, and in view of the cost of conducting measurement and verification, direct measurements are conducted over short periods, and extrapolations are made to estimate annual energy savings. The normal procedure for the measurement and verification of energy savings from subprojects is as follows:

(i) Pre-Energy Efficiency Retrofit: Before removing existing equipment or systems, the method for determining the baseline annual energy consumption is established, necessary measurements made, and data collected.

(ii) Verification of Equipment/System Installation: After the energy efficiency retrofit is completed, the newly installed equipment/system is inspected and verified for performance as per contract specifications.

(iii) Measurement and Verification of Post-Retrofit Energy Savings: Once the new equipment/system is functioning, a direct measurement or estimation method is used to determine the annual energy consumption of the new equipment/system. The annual energy savings are the difference between the baseline annual energy consumption and the post-retrofit annual energy consumption. Factors affecting the measured energy consumption data, such as annual operating hours, equipment loading level, and outdoor temperature, are used to normalize the savings, as estimated through the actual measurements.

(iv) Annual Energy Savings Tracking and Monitoring in Subsequent Years: Annual energy savings of the subprojects are expected to be tracked and analyzed during the respective subloan periods. However, this depends on cost considerations and availability of budget.

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[10] Refer to (i) Government of the PRC, 2008, Guidelines for Energy Audit of Energy Conservation Projects (jointly issued by National Development and Reform Commission and Ministry of Finance), Beijing; and (ii) Efficiency Valuation Organization, 2007, *International Performance Measurement and Verification Protocol*, Washington D.C.

[11] Refer to (i) Government of PRC, 2008, *General Principles for Calculation of the Comprehensive Energy Consumption (GB/T 2589-2008)*, Beijing; (ii) Government of PRC, 2009, *General Principles for Monitoring and Testing (GB/T 15316-2009)*, Beijing; and (iii) Government of PRC, 2009, *Calculating Methods of Energy Saved for Enterprises (GB/T 13234-2009)*, Beijing. These standards have been jointly issued by the General Administration of Quality Supervision, Inspection and Quarantine of PRC, and Standardization Administration of PRC.

[12] Government of PRC, 2007, *Guidelines for Energy Saving Evaluation and Audit of Fixed Assets Investment Projects* (issued by NDRC), Beijing.

22. The consultant normally delivers a baseline energy consumption measurement report, and also a post-implementation measurement report. The latter report also contains the energy savings verified after the implementation of the subproject. By June, 2011, for the first tranche of subprojects, baseline measurement and verification for all eight subprojects, and post-implementation measurement and verification for six of eight subprojects, had been completed. The remaining two post-implementation exercises were planned to be conducted within a few months. For the second tranche of subprojects, baseline measurement and verification for five of six subprojects had been completed, and the post-implementation exercise was being planned.

23. Procurement and disbursement. Sub-borrowers are required to follow procedures set out in the Procurement Management Handbook developed by the project management office with the assistance of a qualified tendering company certified by the Ministry of Commerce.[13] Where necessary, the project management office also guides sub-borrowers to enable them to follow the procurement handbook. This is based on relevant procurement rules in ADB's Procurement Guidelines (2007, as amended from time to time) for financial intermediaries. It adopts appropriate procedures for payment of reasonable prices and fair canvassing when selecting suppliers. Procurement must be from ADB member countries. Sub-borrowers are encouraged to procure goods through competitive bidding or shopping around in the interests of economy and efficiency. In cases of noncompliance, the Guangdong Finance Trust Company exercises the right to recall that portion of subloan.

24. Loan proceeds under each tranche are disbursed in accordance with ADB's Loan Disbursement Handbook (2007, as amended from time to time). The loan proceeds from ADB are first paid through the Guangdong Finance Department to a special trust account. The transfer takes place promptly within 5 working days from approval by the State Administration of Foreign Exchange's Guangdong branch. The trust account is managed by the Guangdong Finance Trust Company and used to finance eligible subprojects. The withdrawal request for any subloan is required to be supported by a withdrawal application, and a certification from Guangdong Finance Department showing that the (i) subloan and subproject agreements for the subproject have been executed by the Guangdong Finance Trust Company, project management office and the sub-borrower; and (ii) agreements include terms and conditions specified in the related legal agreements with ADB, and are legally binding for the parties. This certification is a condition for subloan disbursement. Additionally, each withdrawal request needs to be supported by the simultaneous application for subloan approval and withdrawal for subloans not exceeding the free limit of $10 million. For subloans in excess of the free limit, copies of the subloan and subproject agreements are required to be submitted with the subloan approval and withdrawal statement to ADB via the project management office. The disbursements under each subloan are usually in several installments based on the readiness of the subproject.

25. By June 2011, over 95% of the first-tranche ADB line of credit of $35 million had been disbursed, as well as over 90% of the second-tranche credit line of $22.06 million.

[13] As per relevant procurement laws and rules in the PRC, the project steering committee approved, and the project management office contracted, the tendering company.

26. Capacity development. The project management office was assessed to have reasonable technical expertise for related activities. A grant of $2 million from the Clean Energy Fund and Climate Change Fund under the Clean Energy Financing Partnership Facility was extended to enhance the project management office's capacity for (i) technical assessment for certain energy efficiency technologies, (ii) economic analysis of subprojects in accordance with ADB guidelines, (iii) measurement and verification of energy savings from subprojects, and (iv) development of clean development mechanism projects.

27. The categories of the grant included (i) consultant services; (ii) equipment, such as computers and printers; (iii) study tours, training, and workshops; and (iv) contingency. Given the project management office's capacity development needs, as well as the need for strengthening capacity for policy and decision making, as well as enforcing Guangdong provincial government regulations and policies, the office prepared terms of reference for three consulting assignments: the "technical", "mechanism," and "financial" packages. Through a competitive bidding process, the office selected consulting firms for the "technical" and "mechanism" packages, and the process to engage a consultant for the "financial" package was under way as of June 2011. The project management office has committed $974,000 for the "technical" and "mechanism" packages and $279,000 was budgeted for the "financial" package.

28. The "technical" package is designed to facilitate smooth implementation of the energy power plant program. In particular, the package assists the project management office work out preliminary technical assessment methods and procedures for subproject screening and evaluation. This includes the modification of the relevant templates, drafting and updating the Measurement and Verification Handbook, offering training, developing and maintaining the program's multipurpose website, promoting the energy power plant program, and finding solutions to impediments in implementing the program.

29. The scope of the "mechanism" package is intended to ensure that the energy power plant program progresses in the right direction. In particular, it reviews and evaluates the existing management mechanism and regulations and policies applicable to energy efficiency and emission reduction in Guangdong. It identifies problems faced in promoting energy efficiency and emission reduction efforts, and it documents the experiences and lessons learned from other provinces and countries. The package recommends workable management mechanisms and policy initiatives relevant to Guangdong's economic and development situation. The package also aims to improve policy implementation and project management capacities through various capacity development activities. These include training, study tours, and seminars to streamline the implementation and enforcement of energy efficiency and emission reduction policies during the 12th plan period. In so doing, the consultant is also required to evaluate the ongoing energy power plant program, which is recognized as having had a demonstration effort, and identify lessons from the program design and implementation thus far.

30. The proposed "financial" package seeks approaches to attract more financial institutions and commercial banks to finance energy efficiency and emission reduction projects in Guangdong province.

31. Capacity development activities conducted so far include:

(i) seminars and workshops for project management office staff on economic analysis, financial analysis, and procurement processes;
(ii) seminars and workshops for potential sub-borrowers to promote the efficiency power plant program, and applying for subloans;
(iii) workshops for opinion makers and research institutes on low carbon development strategies for Guangdong province;
(iv) training for borrowers on how to apply for withdrawals, and separate accounting systems for subprojects;
(v) English language training for Guangdong Finance Department staff;
(vi) design of brochures in Chinese and English on all aspects of the efficiency power plant program for dissemination within and outside the PRC; and
(vii) ongoing development of a website to create awareness of energy efficiency for the public at large; filing applications for subloans by potential sub-borrowers; filing applications for withdrawals and disbursals by sub-borrowers; making loan and interest repayments through the internet; tracking by the project management office, Guangdong Finance Trust Company, and other project steering committee members of the subloan withdrawal and repayment situation, and overall financial management of the energy power plant program.

32. The project management office set up an account of $200,000 to meet expenditures for organizing training programs and workshops, awareness creation, and developing a website. Until June 2011, $118,738 had been disbursed to cover the first payments of consultant contracts for "technical" and "mechanism" packages; and expenses for four training and workshops, as well as outreach and awareness creation of the investment program.

E. Program Implementation Status (as of June 2011)

33. With more than 95% disbursal from Tranche 1, 90% disbursal from Tranche 2, and the subproject pipeline identified for Tranche 3 by end-June 2011, it is evident that the efficiency power plant program is generally moving in the right direction. In addition, the following also indicates that the program has made significant progress: (i) some of the sub-borrowers identified at the periodic financing request stage for Tranches 1 and 2 began the withdrawal process soon after the respective tranche became effective; (ii) two of the sub-borrowers, Guangdong SGIS Songshan Company and Guangzhou Zhiguang Electric Company, that were supported by CNY 78 million ($11.47 million) and CNY 67 million ($9.9 million), respectively, through Tranche 1 have expressed interest in receiving further assistance; and their proposed second efficiency power plant subprojects are included in the list submitted with the periodic financing request for Tranche 3; (iii) propelled by energy efficiency targets set by the Government of the PRC, many of the subprojects supported through Tranches 1 and 2 have been implemented and are beginning to show energy savings; (iv) some energy efficiency manufacturers have already set up energy service companies after receiving support from the ADB line of credit; (v) the concept of measurement and verification of energy savings has become increasingly accepted; and (vi) a suitable reward mechanism has been set up for efficiency power plant subprojects.

34. Immediate and short-term benefits. All seven sub-borrowers that the study team met (of 14 supported so far) indicated that they benefited from the ADB line of credit administered by the Guangdong Finance Trust Company. Similar reasons were expressed by most sub-borrowers and include: (i) support from the ADB line of credit helped improve their profile in the market, which in turn improved the marketability of their products and services; (ii) easier access to credit from other sources, even during times of tight liquidity in financial markets, coupled with the lower cost of funds from the ADB line of credit compared to commercial borrowing, meant energy efficiency equipment manufacturers were able to increase raw material purchases, maintain high capacity utilization, and outperform their competitors; and (iii) the facility of partial advance withdrawal payments also improved their cash-flow positions.

35. Timelines. The periodic financing request for each tranche is accompanied by a list of efficiency power plant subprojects identified for financing. This reaffirms the continued interest from enterprises in Guangdong province to avail of the ADB line of credit. However, the time taken from the receipt of a periodic financing request from the Government of the PRC to the tranche release means that potential sub-borrowers have to wait 6–8 months or even longer after completing the feasibility studies. As a result, some sub-borrowers have preferred to invest in their specific efficiency power plant subprojects with their own funds or other sources. This was even though ADB had accepted the government's request for approving retroactive financing of up to 20% of Tranche 1 and Tranche 2 loan proceeds for eligible expenses incurred not more than 12 months before the signing of the tranche loan agreement. To the extent that sub-borrowers on the periodic financing request list invest in their efficiency power plant subprojects without availing of the ADB subloan, the project management office needs to identify other sub-borrowers with viable and credible subprojects. The Guangdong Development and Reform Commission, National Development and Reform Commission, and ADB need time to approve the financing of those subprojects. Although four of the nine sub-borrowers in the original periodic financing request list for Tranche 1 dropped out (none did from the Tranche 2 list), there is no certainty that all sub-borrowers identified in the list for Tranche 3 will wait long enough to avail of an ADB subloan. In recognition of this fact, ADB agreed to extend the disbursal closing date by 12 months from December 2012 to December 2013.

36. Sub-borrower categories. Most sub-borrowers supported through Tranches 1 and 2 are energy efficiency equipment manufacturers or energy efficiency equipment manufacturers-cum-energy service companies (and in one case a stand-alone energy service company). Only one energy-user has so far been supported. Part of the reason may be that at the project preparation stage few end-user subprojects were identified. However, the principal reason is essentially that once end-users have conducted feasibility studies for their efficiency power plant subprojects and are convinced of the benefits, they normally find it better to invest in their subprojects at the earliest and not wait for several months before a tranche becomes effective. In other words, they prefer to rely on their own resources or more expensive commercial borrowing rather than wait—unless, of course, the energy efficiency subprojects entail high costs. It is anticipated that as subloan repayments begin, and the second batch of subprojects are supported, the time lag between submitting an application for a subloan and the release of funds should be significantly reduced for most subprojects. This is because ADB would need to be informed only for subloans exceeding $10 million equivalent, and that more end-users' subprojects would be supported through the revolving line

of credit. However, the precise modalities of approval and withdrawals for the second and subsequent batch of projects need to be worked out.

37. Energy service companies. The only stand-alone energy service company supported so far—Zhuhai Charlie Technology Energy Saving Company—was set up in 1999 and is backed by a privately wealthy owner. Profitable energy efficiency equipment manufacturers with strong balance sheets have also recently set up energy service companies. For instance, Guangdong Real Faith Lighting Company spun off its project services division into an energy service company in March 2010, and Foshan Younger set one up recently. Instead of being energy service companies with expertise in a single energy efficiency product, which is normally the case in the PRC, some of these companies are beginning to offer energy service company services for a range of energy efficiency equipment. For instance, Zhuhai Charlie has already moved to multiproduct energy performance contracting, which includes lighting, air-conditioning, and low voltage variable frequency controllers. This is in addition to its longstanding work on waste heat recovery and boiler retrofits. Likewise, the Guangdong Zhongyu Technology Company, which set up an energy service company in January 2011, plans to offer such services centered on its own products. These include digital equipment for monitoring and optimizing power flows in transmission and distribution networks, and energy efficient lighting and air-conditioning. Such developments indicate a maturing energy service industry in Guangdong province. Even so, no equipment manufacturer intends to "market" through its energy service company or through the services or similar products from a competitor. Even so, all such energy service companies have been registered with the National Development and Reform Commission, and the products that these companies will market conform or exceed national standards.

38. Measurement and verification. The measurement and verification of energy savings is performed by different independent agencies using standards set by the Government of the PRC. This normally calls for establishing baseline energy consumption, and then verifying the energy savings once a year. Although this meets the government's measurement and verification standards, the resulting energy savings estimates may only be indicative. For instance, the annual energy savings from a furnace with a 20-ton combustion chamber for aluminum scrap are based on one set of measurements over a 4-hour period. The concerned furnace manufacturer, Foshan Younger Furnace Industry Company, which recently set up an energy services company, has made it clear that to have a better estimate of annual energy savings, it would require energy service company clients to agree to measurement-and-verification protocols that include several measurements spread over different months and seasons each year. Given that the energy savings of subprojects are currently estimated using national standards (that is, once a year after subproject implementation), it is best to consider them as "first cut" estimates that need to be refined. However, doing this will entail higher costs. It is therefore worthwhile considering a balance between efficacy of energy savings estimates and the increased costs of measurement and verification.

39. Efficiency power plant capacity estimates. These are calculated from rough energy savings estimates based on the assumption that a power plant operates about 5,000 hours per year (Tables A6.1 and A6.2 give estimated potentials and measured energy savings, and efficiency power plant capacity for Tranche 1 and Tranche 2 subprojects). In reality, however, coal-fired power plants which comprise the bulk of

power plant capacity in Guangdong Province operate for about 6,000 hours annually,[14] but Guangdong imports 20% of its power requirements from other provinces. For the purposes of computing efficiency power plant capacity, it is correct to assume that at the margin, a power plant operates about 5,000 hours per year. Given the average energy loss in Guangdong's power transmission and distribution system is at 6%, the efficiency power plant capacities can be recomputed. As a result, the estimated capacity on the basis of baseline and post-retrofit measurement and verification increases from 127.4 MW to 135.0 MW for Tranche 1 subprojects; and from 29.4 MW to 31.1 MW for Tranche 2 subprojects. On the same basis, the estimated efficiency power plant capacity from Tranche 3 subprojects, which have yet to be implemented, increases from 66.0 MW to 70.0 MW. Nevertheless, it is important to note the massive increase in the capacity estimates that were made at the feasibility study stage for Tranche 1 subprojects, which increased from 52.6 MW to 127.4 MW, according to project management office estimates. The difference is difficult to explain on the basis of available information. However, even without the jump in Tranche 1, it is very likely that the multitranche financing facility program would exceed the targeted efficiency power plant capacity of 107 MW.

40. During the design period, the efficiency power plant, concept for this program was extended, and it was different from the traditional efficiency power plant concept. This may be applicable for heat recovery-cum-power generation subprojects, such as in Guangdong SGIS Songshan Company. But it appears to be a stretch for subprojects that simply result in thermal energy savings without incremental power generation, such as through Foshan Younger's furnace retrofits and Zhuhai Charlie's boiler retrofits.

41. Reward mechanism for efficiency power plant subprojects. In addition to reward mechanisms that the Guangdong provincial government set up for energy efficiency projects in general, mechanisms were established to reward efficiency power plant subprojects meeting the following criteria: (i) the sub-borrowers repay principal, interest, and commitment fees on schedule; (ii) the subprojects achieve the expected energy efficiency outcomes; and (iii) there is no default on any terms and conditions of the loan agreement between sub-borrower and the Guangdong Finance Trust Company or project agreement between sub-borrower and the project management office. This source of funds for rewards is the surplus arising from the difference in interest payments to ADB and the interest collections on subloans, as well as the difference, if any, in other charges paid to ADB against those collected from sub-borrowers. The interest rate differential is currently high. However, there is no guarantee that a sufficient surplus will continue to be generated over the 15-year term of the ADB program. This is because inflation in the PRC is significantly high, which puts pressure on devaluing the renminbi. As a result, the Guangdong provincial government is open to the idea of augmenting the source of funds at an appropriate time to ensure that eligible sub-borrowers receive noticeable incentives.

[14] Information provided by the project management office shows the average number of hours of operation of coal-fired power plants in Guangdong Province in 2010 was (i) 6,015 hours for units of 600 MW or more capacity; (ii) 5,981 hours for units of 300–600 MW capacity; and (iii) 6,344 hours for units of 200–300 MW. The overall average for all coal-fired power plants in Guangdong Province was 6,026 hours.

Table A6.1: Guangdong Program Tranche 1 Subprojects: Estimated Potential and Realized Energy Savings and Emission Reductions

EE Benefit / Sub-borrower	Estimated Potential							Realized						
	EE Benefit		Energy Savings	Emission Reductions				EE Benefit		Energy Savings	Emission Reductions			
	MWh/ year	MW	CE (t)	CO_2 (t)	SO_2 (t)	NOx (t)	TSP (t)	MWh/ year	MW	CE (t)	CO_2 (t)	SO_2 (t)	NOx (t)	TSP (t)
1. Guangzhou Zhiguang Electric Co.	69,795.0	14.0	23,032.4	54,440.1	628.2	139.6	233.8	374,422.0	74.9	131,047.6	292,049.0	3,369.8	748.8	1,254.3
2. Guangzhou G.K. Energy Saving S&T Co.	12,595.0	2.5	4,156.4	9,824.1	113.4	25.2	42.2	39,292.0	8.0	13,752.1	30,647.6	353.6	78.6	131.6
3. Zhuhai Secpower Transformer Co.	2,397.0	0.5	791.0	1,869.7	21.6	4.8	8.0	376.0	0.1	131.6	293.2	3.4	0.8	1.3
4. Zhuhai Charlie Technology Energy Saving Co.	6,706.0	1.3	2,213.0	5,230.7	60.4	13.4	22.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5. Guangdong Zhongyu Technology Co.	22,058.0	4.4	7,279.1	17,205.2	198.5	44.1	73.9	77,113.0	15.4	26,989.4	60,147.8	694.0	154.2	258.3
6. Guangdong SGIS Songshan Co.	126,770.0	25.4	41,834.1	98,880.6	1,140.9	253.5	424.7	136,714.0	27.0	47,850.0	106,637.1	1,230.4	273.4	458.0
7. Kaiping Fulai Electric Co.	18,867.1	3.8	6,226.2	14,716.4	169.8	37.7	63.2	500.0	0.1	175.1	390.1	4.5	1.0	1.7
8. Guangdong Haihong Co.	12,739.0	2.5	4,203.9	9,936.4	114.7	25.5	42.7	7,291.0	2.0	2,551.8	5,687.0	65.6	14.6	24.4
Total	**262,824.1**	**52.6**	**86,732.1**	**205,002.8**	**2,365.5**	**525.6**	**880.5**	**635,332.0**	**127.4**	**222,366.0**	**495,558.6**	**5,717.9**	**1,270.6**	**2,128.3**

CE = coal equivalent, CO_2 = carbon dioxide, EE = energy efficiency, M&V = measurement and verfication, MW = megawatt, MWh = megawatt hour, NOx = nitrogen oxides, SO_2 = sulphur dioxide, t = ton, TSP = total suspended particulates.

Note: Totals exclude energy savings and emission reduction benefits for Zhuhai Secpower Transformer Co. (where postretrofit M&V was not completed by end-June 2011) and for Zhuhai Charlie Technology Energy Savings Co. (for which postretrofit M&V had not been started by end-June 2011).

Source: Project Management Office.

Table A6.2: Guangdong Program Tranche 2 Subprojects: Estimated Potential and Realized Energy Savings and Emission Reductions

EE Benefit / Sub-borrower	Estimated Potential							Realized						
	EE Benefit		Energy Savings	Emission Reductions				EE Benefit		Energy Savings	Emission Reductions			
	MWh/ year	MW	CE (t)	CO_2 (t)	SO_2 (t)	NOx (t)	TSP (t)	MWh/ year	MW	CE (t)	CO_2 (t)	SO_2 (t)	NOx (t)	TSP (t)
Zhuhai Singyes Green Building Tech. Co.	3,098.0	0.6	1,022.0	2,416.0	28.0	6.0	10.0	2,893.0	0.6	1,012.5	2,256.3	26.0	5.8	9.7
Jiangmen Daguangming Transformer Co.	6,235.0	1.2	2,058.0	4,863.0	56.0	12.0	21.0	4,067.0	0.8	1,423.5	3,172.4	36.6	8.1	13.6
Foshan Younger Furnace Industry Co.	14,509.0	2.9	4,788.0	11,317.0	131.0	29.0	49.0	43,803.0	8.8	15,330.9	34,166.0	394.2	87.6	146.7
Guangdong Zhongyu Technology Co.	39,907.0	8.0	13,169.0	31,127.0	359.0	80.0	134.0	83,443.0	16.7	29,205.0	65,085.0	751.0	167.0	280.0
Guangdong Real Faith Lighting Co.	6,775.0	1.4	2,236.0	5,285.0	61.0	14.0	23.0	12,543.0	2.5	4,390.0	9,783.4	112.9	251.0	42.0
Guangzhou Tachimoto Electronic Co.	67,534.0	13.5	22,286.0	52,677.0	608.0	135.0	226.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	**138,058.0**	**27.6**	**45,559.0**	**107,685.0**	**1,243.0**	**276.0**	**463.0**	**146,749.0**	**29.4**	**51,361.9**	**114,463.1**	**1,320.7**	**519.5**	**492.0**

CE = coal equivalent, CO_2 = carbon dioxide, MW = megawatt, MWh = megawatt hour, NOx = nitrogen oxides, SO_2 = sulphur dioxide, t = ton, TSP = total suspended particulates.

Source: Project Management Office.

Table A6.3: Guangdong Program Tranche 3 Subprojects: Financing and Estimated Potential Energy Savings and Emission Reductions

Sub-borrower	Sub-project	Total Investment CNY'000	ADB Loan		EE Benefit		Energy Savings	Emission Reductions			
			CNY'000	$'000	MWh/year	MW	CE (t)	CO_2 (t)	SO_2 (t)	NOx (t)	TSP (t)
Guangdong SGIS Songshan Co., Ltd.	Establish an energy management center for the steel & iron co.	111,500.0	75,000.0	11,029.4	120,454.5	24.1	39,750.0	93,954.5	1,084.1	240.9	403.5
Guangong Rizhao New Tech Application Co. Ltd.	Promote insulating copper bus-bar	45,000.0	30,000.0	4,411.8	16,321.0	3.3	5,385.9	12,730.4	146.9	32.6	54.7
Guangdong Chengya Energy Service Co.	Energy efficiency retrofit at power plants and mobile phone base stations	170,000.0	100,000.0	14,705.9	133,251.3	26.7	43,972.8	103,936.0	1,199.3	266.5	446.4
Guangzhou Zhiguang Electric Co., Ltd.	Promote variable speed controllers of large power on HV motors	75,000.0	50,000.0	7,352.9	25,312.5	5.1	8,353.1	19,743.8	227.8	50.6	84.8
Guangzhou Borch Machinery Co., Ltd.	Promote energy efficient BS series injection molding machines	102,000.0	37,000.0	5,441.2	34,087.5	6.8	11,248.9	26,588.3	306.8	68.2	114.2
	Total	**503,500.0**	**292,000.0**	**42,941.2**	**329,426.8**	**66.0**	**108,710.7**	**256,953.0**	**2,964.9**	**658.8**	**1,103.6**

ADB = Asian Development Bank, CE = coal equivalent, CO_2 = carbon dioxide, EE = energy efficiency, HV = high voltage, MW = megawatt, MWh = megawatt hour, NOx = nitrogen oxides, SO_2 = sulphur dioxide, t = ton, TSP = total suspended particulates.
Source: Project Management Office.

Appendix 7

DIRECT SUPPORT TO MANUFACTURING

A. Background

1. Mostly during the 1990s, ADB extended direct support to the manufacturing industry in developing member countries , with the stated rationale made in the various reports and recommendations of the President. The rationale pertained to a combination of: (i) introducing modern technology to enhance productivity and attain economies of scale in the production process; (ii) introducing modern technology to promote efficient resource utilization, energy conservation, and environmental protection to manage or reverse deteriorating air and water quality, and promote sustainable improvements in industry; (iii) introducing managerial expertise emphasizing efficiency, commercialization, and accountability; (iv) strengthening institutional capacity for environmental management and monitoring; and (v) enhancing government ability to undertake needed policy reforms in energy conservation, as well as ensuring continued progress in market-based energy pricing. In addition, the rationale also pertained to helping close the demand-supply gaps of specific commodities and products (e.g., nitrogenous fertilizers, synthetic fibers, plasticizers, and steel) through a mix of expansion and greenfield projects. Although targeted mainly at specific industrial and manufacturing enterprises,[1] the wide range of ADB sector classifications at approval is noteworthy (Appendix 4).

2. Three nonsovereign loans and equity investments in India were made in addition to the support to the manufacturing sector through ADB lines of credit extended to development financial institutions. The ADB investment of equity plus loan was at least twice as high as the free-limit of investments allowed through the first line of credit extended to the Industrial Credit and Investment Corporation of India (Loan 0778-IND).[2] A loan for the modernization of selected public sector refineries in India was approved in December 1992. But a substantial portion of the loan was cancelled following a request from the government in February 1994, although most of the subprojects were already implemented.[3]

[1] Some loans (e.g., Loans 1270-PRC, 1336-PRC, and 1491-PRC) also supported gas or district heating or water utilities, and other measures for environmental clean-up.

[2] The three investments in India were approved in July 1987, June 1988, and January 1989. At these points of time, ADB had extended only one line of credit to Industrial Credit and Investment Corporation of India (Loan 0778-IND), whose free-limit was set at $3 million. Compared with the free-limit level, the financing to the three projects was as follows: (i) $19 million equivalent for Investment 7014, comprising $3 million as equity and $16 million as loan; (ii) $7 million equivalent for Investment 7024, comprising $3 million as equity and $4 million as loan; and (iii) $8.1 million equivalent for Investment 7032, comprising $2.2 million as equity and $5.9 million as loan.

[3] Of the approved amount of $147 million, $107.7 million was cancelled. The refining companies (the executing agencies), which had strong balance sheets and could borrow from commercial sources at 13%-14% per annum, were not willing to borrow at the government relending rate of 17% per annum at the time.

B. Project Scope and Viability

3. The ADB-supported projects were a mix of new installations (greenfield manufacturing units) and plant modernizations, including some with significant capacity expansions. Additional land was acquired in some projects, and consulting services for detailed design and training were included in some projects. More specifically, the loan projects in the PRC included:

(i) The Laiwu Iron and Steel Company modernization and expansion project (Loan 1162-PRC) included a modern blast furnace, a sintering plant, a converter, a ladle furnace, a thermal power station, an oxygen plant, a continuous casting mill, water supply and a wastewater treatment plant, pollution monitoring and control equipment, quality and production control equipment, power generation equipment, and additional mining and quarrying equipment.

(ii) The Quijiang Cement Plant modernization subproject (Loan 1178-PRC) included the conversion of two production lines from wet process to semi-dry process, installation of a two-stage preheater, precalciner, replacement of an obsolete electrostatic dust precipitator, and modification of rotary kilns. Similarly, process equipment was replaced with modern equipment in two other cement plants in Guangdong and Hunan provinces, one fertilizer plant in Guizhou province, and one iron and steel plant in Jilin province.

(iii) The Anyang Chemical Fertilizer Plant modernization and expansion subproject (Loan 1248-PRC) included improvements in coal gasification, desulphurization, synthesis ammonia compression, and carbon dioxide removal systems along with installation of ammonia and hydrogen recovery systems and a low energy consuming urea production process. Similarly, process improvements and capacity expansions were made in a chemical plant in Heilongjiang province, and a fertilizer plant in Henan province.

(iv) Coal gasification plants were constructed in the Tangshan No.2 Porcelain Factory and Tanhshan Ceramic No. 6 Factory to replace heavy oil-fired and coal-fired kilns, with support extended through Loan 1270-PRC.

(v) The Huaxin Cement Company Limited modernization and expansion subproject (Loan 1436-PRC) aimed to replace its wet process and shaft kilns with a suspension preheater dry process kiln. The scope included quarry equipment, a limestone crushing and preblending plant, a raw meal homogenizing and feeding plant, a kiln preheater and calciner system, a coal mill, instrumentation, a process and control system, conveying equipment, a weighing system, and a waste gas treatment facility. Similarly, process upgradation and technology modernization were affected in two chemical plants and one steel plant.

(vi) The Anhui Tongdu Copper Limited Company modernization subproject (Loan 1890-PRC) upgraded the smelter and blast furnace system for producing blister copper, electrolytic copper, and associated products, as well as installing a double conversion and double absorption process to replace the existing single conversion and single absorption process in the sulfuric acid recovery systems. Loan 1890-PRC also contributed to process improvements in another nonferrous metals enterprise, a caustic soda production unit, and a coke oven gas production facility.

4. All industrial subprojects supported in the PRC were for modernization and/or expansion. With the exception of subprojects implemented through Loan 1890-PRC, all subprojects entailed capital costs that exceeded or nearly equaled the annual gross revenue of the respective enterprise. In subprojects supported through three of the earliest loans, the subproject capital cost far exceeded the annual gross revenue in the full year prior to the start of the subproject by a factor of 3.7 times or more. They also exceeded the total assets of the enterprise by a factor of 2.2 of more. In such cases, ADB's share of the capital cost of the subproject nearly equaled the total assets of the enterprise, and exceeded its annual gross revenue.

5. Table A7.1 also shows that other than for subprojects through Loan 1890-PRC, the financial internal rates of return and economic internal rates of return estimated at appraisal for subprojects implemented through other loans appeared overly optimistic by the time the subprojects had been implemented and the loans closed. For some subprojects, the financial internal rates of return at completion fell below the weighted average cost of capital, and the economic internal rates of return at completion fell below the 12% threshold. In subprojects supported through five loans, the stated reason for declines in both rates of return related to softer product prices caused by increased competition and/or weak demand. An increase in feedstock and energy prices, and higher than anticipated investment costs also contributed to lower financial internal rates of return and the economic internal rates of return in some cases.

Table A7.1: Overview of Selected ADB-Supported Industrial Subprojects in People's Republic of China

Item	L1162	L1178	L1248	L1270	L1436	L1890
Enterprise	LISC	QCP	ACFP	TCF	HCCL	ATC
Main Product	Steel	Cement	Fertilizer	Ceramic	Cement	Non-ferrous metals
Loan Approval Date	Mar 1992	Sep 1992	Aug 1993	Nov 1993	May 1996	Dec 2001
Subproject Start Date	Q1, 1992	Q3, 1992	Q3, 1994	Q4, 1993	Q3 1996	Q4, 2002
Ratio of ADB Supported Subproject Capital Cost to: - Gross Revenue - Total Assets	 3 9	 7 2	 0 2	 8 4	 2 8	 17 08
Ratio of ADB Share of Subproject Capital Cost to: - Gross Revenue - Total Assets	 3 0	 3 8	 6 3	 4 2	 2 4	 07 03
Weighted Average Cost of Capital: - At appraisal - Actual	 0% 9%	 7% 4%	 5% 4%	 3% 4%	 3% 3%	 4% 3%
Financial Internal Rate of Return: Projected at appraisal - Actual at completion - At evaluation	 2% 9% NA	 7% 9% NA	 8% 6% NA	 3% 0% 4%	 6% 0% NA	 3% 8% NA
Economic Internal Rate of Return: Projected at appraisal - Actual at completion - At evaluation	 9% 8% NA	 1% 4% NA	 3% 6% NA	 8% 0% 2%	 2% 7% NA	 3% 9% NA

ACFP = Anyang Chemical Fertilizer Plant, ADB = Asian Development Bank, ATC = Anhui Tongdu Copper Company, HCCL = Huaxin Cement Company Limited, LISC = Laiwu Iron and Steel Company, L = Loan, QCP = Quijiang Cement Plant, Tangshan No. 6 Cement Factory.

Note: (i) Q1: first quarter (1 Jan to 31 Mar); Q2: second quarter (1 Apr to 30 Jun); Q3: third quarter (1 Jul to 30 Sep); Q4: fourth quarter (1 Oct to 31 Dec); (ii) Total assets include current assets, net fixed assets, construction works-in-progress and other assets; (iii) Data on gross revenue and total assets of the subproject enterprises used for computing the ratios, pertains to the most recent calendar year prior to the year in which the subproject implementation commenced; (iv) ADB's share of subproject capital cost is prorated on the basis of ADB's total actual loan assistance and the sum total of capital costs of all subprojects supported through the loan.

Source: Compiled by study team from reports and recommendations of the President and project completion reports for the six loan projects, and appraisal reports for Loans 1162-PRC and 1178-PRC.

6. Three industrial projects supported in India were to establish new manufacturing facilities: (i) a 15,000 ton per annum (tpa) polyester filament yarn facility for DCL Polyesters Limited, (ii) a 30,000 tpa oxo-alcohol facility for Andhra Petrochemicals Limited, and (iii) a 12,000 tpa acrylic staple fiber facility for Indian Acrylics Limited. Data available from the reports and recommendations of the President are summarized in Table A7.2.[4] All projects were completed with some delays,[5] and coincided with a period of fast depreciation for the rupee. As a result, the projects suffered cost overruns in local currency terms, although not necessarily in dollar terms.[6] It is quite likely that if assumptions on product pricing and other factors that create competitive pressures, such as a reduction in import duties, are kept unchanged for the three projects, the financial internal rates of return and economic internal rates of return at completion will remain at acceptable levels.

Table A7.2: Overview of Selected ADB Supported Industrial Projects in India

ADB Investment Number	7014-IND	7024-IND	7032-IND
ADB Loan Number	0833-IND	0893-IND	0950-IND
Enterprise	DCL Polyesters Limited	Andhra Petrochemicals Limited	Indian Acrylics Limited
Main Product	Polyester Filament Yarn	Oxo-alcohols	Acrylic Staple Fiber
Investment and Loan Approval date	Jul 1987	Jun 1988	Jan 1989
Total Project Cost at Approval ($ million equiv)	113.2	91.9	86.9
ADB Contribution ($ million equivalent): - Equity - Debt	 3.0 16.0 + 5.0[a]	 3.0 4.0	 2.2 5.9
Financial Internal Rate of Return at Approval	23.5%	21.3%	21.5%
Return on Equity at Approval	...	16.2% (year 8 book value)	29.0% (3rd year)
Economic Internal Rate of Return at Approval	14.2%	21.2%	8%

... = not available, ADB = Asian Development Bank, IND = India.
a Through ADB Complementary Financing Scheme; debt arranged by SBI Capital Markets Limited.
Source: Compiled by study team from report and recommendation of the President.

C. Energy Efficiency Improvements

7. Energy savings and energy efficiency improvements should have been achieved through the loans in the PRC, which were basically meant to modernize industrial plants and expand plant size to approach economies of scale. However, data on energy efficiency improvements or energy intensity before and after subproject implementation are not always presented in the available project documentation. This includes project files, reports and recommendations of the President, project completion reports, and, if prepared, evaluation reports. In many cases where data

[4] The study team could not obtain the project completion reports for the three projects. The reports were not available in the project files, which suggests that they were not prepared,

[5] For instance, the DCL Polyesters Limited facility, which was planned to have been completed by July 1989, was delayed by about 16 months owing to time lost in obtaining government approvals. It began partial operations by November 1989, when the spinning line began to be run on purchased polyester chips, and was completed in November 1990, when the esterification and polymerization plants were commissioned. The Andhra Petrochemicals Limited facility was planned to be completed by September 1990, but suffered delays of about 3 years owing to poor and incompetent project execution (i.e., poor site selection, and an unreliable civil works contractor). Commercial operations of the Indian Acrylics Limited plant began in April 1993 with a delay of about 2 years, caused in part by failure of the local contractor to perform, as well as peace and order problems at the plant site, including a terrorist attack.

[6] DCL Polyesters Limited, Andhra Petrochemicals Limited, and Indian Acrylics Limited incurred cost overruns of about 30%, 85%, and 70%, respectively, in rupee terms. Yet ADB did not disburse all its foreign currency equivalent equity and loan contributions to Andhra Petrochemicals Limited and Indian Acrylics Limited. To Andhra Petrochemicals Limited, ADB contributed $2.06 million in equity and $3.99 million in debt. To Indian Acrylics Limited, ADB contributed $1.62 million in equity and $4.77 million in debt.

are presented, they appear to be internally inconsistent. The manner in which data are presented also varies considerably across projects. This makes it difficult to compare the energy intensity of a manufacturing enterprise in one segment—say cement or steel—in one loan project with a similar enterprise supported through another loan project.[7] Table A7.3 illustrates the wide variations in the compilation of data relevant to energy efficiency. In general, where the energy efficiency-related data are available, they are likely to be a poor representation of reality. This is most glaring in the case of electricity consumption before subproject implementation in Laiwu Iron and Steel Company (Loan 1162-PRC). But it is also true for other subproject enterprises from other loans, as there is no evidence from available project documentation that suitable methods to estimate energy efficiency improvements were adopted.

Table A7.3: Energy Efficiency Improvements in Subprojects in PRC

Loan No.	Enterprise	Parameter Description	Parameter Value
PRC	LISC	Capacity (tpa): - before subproject - after subproject Coal gas consumption intensity (m3/t): - before project - after project Electricity consumption intensity (kWh/t) - before project - after project	 - 240,000 - 628,000 - 47.98 - 16.76 - 182.14 - 16.09 (a)
PRC	QCP	Production (tpa): - before subproject - after subproject (expected at appraisal) - after subproject (actual) Energy consumption intensity (million kCal/t) - before subproject - after subproject (as per appraisal) - after subproject (actual)	 - 394,000 - 598,600 - 800,000 - 1.58 - 0.90 - 0.92
PRC	XCP	Production (tpa): - before subproject - after subproject (expected at appraisal) - after subproject (actual) Energy consumption intensity (million kCal/t) - before subproject - after subproject (as per appraisal) - after subproject (actual)	 - 828,000 - 948,000 - 800,000 - 1.40 - 0.86 - 0.83
PRC	YCP	Production (tpa): - before subproject - after subproject (expected at appraisal) • after subproject (actual) Energy consumption intensity (million kCal/t) - before subproject - after subproject (as per appraisal) - after subproject (actual)	 - 540,000 - 780,000 - 700,000 - 1.50 - 0.90 - 0.84
PRC	CCFP	Production (tpa): - before subproject - after subproject (expected at appraisal) - after subproject (actual) Energy consumption intensity (million kCal/t) - before subproject - after subproject (as per appraisal) - after subproject (actual)	 - 310,000 - 378,000 - 321,670 - 9.35 - 8.02 - 8.02

[7] For instance, in some cases the total energy consumption per ton of product is presented in coal-equivalent terms or in kilocalories. In some cases, the fuel and electricity consumption levels per ton of product are presented separately. In neither case, is complete background information available on intrinsic energy content of different types of fuels and quantum of fuel use.

Table continues on next page

Loan No.	Enterprise	Parameter Description	Parameter Value
PRC	ACFP	Capacity (tpa ammonia)	
		- before subproject	- 80,000
		- after subproject	- 160,000
		Energy consumption intensity (GJ/t of ammonia)	
		- before subproject	- 65.15
		- after subproject (expected at appraisal)	- 51.92
		Energy savings from subproject (%)	
		- after subproject (expected at appraisal)	- 20.3%
		- after subproject (actual)	- 1.5%
	HLCP	Capacity (tpa ammonia)	
		- before subproject	- 55,000
		- after subproject	- 180,000
		Energy consumption intensity (GJ/t of ammonia)	
		- before subproject	- 68.0
		- after subproject (expected at appraisal)	- 52.2
		Energy savings from subproject (%)	
		- after subproject (expected at appraisal)	- 23.2%
		- after subproject (actual)	- 5.0%
	PCFP	Capacity (tpa ammonia)	
		- before subproject	- 80,000
		- after subproject	- 150,000
		Energy consumption intensity (GJ/t of ammonia)	
		- before subproject	- 66.8
		- after subproject (expected at appraisal)	- 51.1
		Energy savings from subproject (%)	
		- after subproject (expected at appraisal)	- 23.5%
		- after subproject (actual)	- 16.7%
PRC	TCF	Energy intensity (GJ/t of ceramic)	
		- before subproject	- 51
		- after subproject	- 11
PRC	HCCL	Coal consumption intensity (kgce/t cement)	
		- before subproject	- 196.5
		- after subproject (expected at appraisal)	- 146.6
		- after subproject (actual)	- 146.8
		Electricity consumption intensity (kWh/t cement)	
		- before subproject	- 109.5
		- after subproject (expected at appraisal)	- 105.0
		- after subproject (actual)	- 107.7
		Energy intensity reduction at evaluation (vis-à-vis before subproject)	
		- heat	- 49%
		- electricity	- 22%
PRC	ATC	Energy consumption intensity (kgce/t copper)	
		- before subproject	- 993.00
		- after subproject (actual at completion)	- 400.22

ACFP = Anyang Chemical Fertilizer Plant, ATC = Anhui Tongdu Copper Company, CCFP = Chishui Chemical Fertilizer Plant, kgce = kilogram of coal equivalent, kCal = kilo calories, kWh = kilowatt hour, GJ = gigajoules, HCCL = Huaxin Cement Company Limited, HLCP = Heilongjiang Chemical Plant, LISC = Laiwu Iron and Steel Company, PCFP = Pindingshan Chemical Fertilizer Plant, QCP = Quijiang Cement Plant, t = metric ton, tpa = ton per annum, XCP = Xiangxiang Cement Plant, YCP = Yingde Cement Plant.

Note: As per the evaluation report: (i) the comparison of electricity consumption before and after the project shows a substantial decline, which could not be independently verified; and (ii) the before-project figure appears to be massively overestimated but the trend showing a significant reduction is to be expected; and (iii) the after-project figure appears to be a reasonable estimate of electricity consumption intensity.

Sources: (i) IED. 2003. *Performance Audit Report: Laiwu Iron and Steel Company Modernization and Expansion Project.* Manila (Loan 1162-PRC, 25 February); (ii) ADB. 1999. *Completion Report: Industrial Energy Conservation and Environment Improvement Project.* Manila (Loan 1178-PRC, 17 September); (iii) ADB. 1993. *Proposed Loan: Fertilizer Industry Restructuring (Sector) Project*. Manila (Loan 1248-PRC August); (iv) ADB. 2002. *Completion Report: Fertilizer Industry Restructuring Project*. Manila (Loan 1248-PRC, 18 December); (v) ADB. 1993. *Summary Environment Impact Assessment for the Proposed Fertilizer Industry Restructuring Project,* Manila (PRC, 31 March); (vi) ADB. 2003. *Completion Report: Second Industrial Energy Efficiency and Environment Improvement Project.* Manila (Loan 1436-PRC, 17 October); (vii) IED. 2005. *Performance Audit Report: Second Industrial Energy Efficiency and Environment Improvement Project.* Manila (Loan 1436-PRC, 19 September); (viii) ADB. 2009. *Completion Report: Acid Rain Control and Environmental Improvement Project.* Manila (Loan 1890-PRC, 24 December).

8. Such a situation exists despite a stated primary or secondary objective in the reports and recommendations of the President for all six loan projects was to support the national and provincial government's energy conservation program. The loan

or project covenants for four of the six loan projects (Loan 1162-PRC, Loan 1270-PRC, Loan 1248-PRC, and Loan 1436-PRC) also included a specific clause that required the subproject implementing enterprises to submit benefit monitoring and evaluation reports for 5 years after the subproject facilities had reached full production.[8] Where this loan/project covenant existed, it is reported to have been only partly complied with, normally through the submission of one or two annual benefit monitoring and evaluation reports. The Independent Evaluation Department understands that, as a result of difficulty in complying with this covenant, it has been dropped. This perhaps explains why it does not appear in the loan/project agreement for loan 1890-PRC, the last project in this list to have been approved for ADB support. The tendency to overestimate energy efficiency benefits at appraisal is also noted, as borne out by a comparison of estimates of energy savings at appraisal vis-à-vis estimates after subproject implementation (see Table A7.3).

9. As all three equity investment-cum-loan projects to Indian industry were for new installations, their energy efficiency aspects can at best be gauged only by comparing their energy consumption intensity with existing installations. Installations existing at the time when these projects were being appraised in the late 1980s were old (e.g., other acrylic staple fiber plants operating in India during appraisal of Inv 7032-IND had been built in the 1970s or earlier). Or they had deployed technologies that could not produce high quality products (e.g., only low-quality oxo-alcohols were being produced in India, and high-quality oxo-alcohols had to be imported during appraisal of Inv 7024-IND). The energy intensity of the three new installations cannot be estimated from publicly available information. For such reasons, it is difficult to gauge the energy efficiency benefits of the three investment-cum-loan industrial projects.

D. Project Risk Assessment

10. The substantially reduced financial internal rates of return and economic internal rates of return for subprojects supported through five of the six loans in the PRC indicates that, in approving these loans, ADB had inadvertently assumed certain risks.

11. From available project documentation, it appears that ADB had given due consideration to the following issues during the appraisal process for industrial loan projects in the PRC: (i) consistency of the project/subproject in implementing the government's strategy for the particular industry subsector (e.g., steel, fertilizer, etc.); (ii) technical risks associated with the proposed project/subproject; (iii) enterprise-specific issues including the enterprise history of financial performance (return on net fixed assets, sales revenue, operating profit), operational performance (labor productivity, product quality and consistency, capacity utilization), supply chain issues (raw material supply), arrangements for financial audits, capacity enhancements and technology infusions, and emphasis on training; (iv) consistency of the enterprise's environmental performance and the proposed project/subproject performance with government policies and guidelines, and mitigations proposed, if any, as part of the proposed

[8] The loan and project covenants for the two other loan projects (loan 1178-PRC and loan 1890-PRC) are required to submit to ADB: (i) quarterly progress reports during implementation; (ii) execution and initial operation report after implementation is completed; and (iii) audited financial statements not later than six months after the end of each fiscal year.

project/subproject. Implementation risks of time and cost overruns are also recognized, even if the adequacy of contingency arrangements is not assessed.

12. Risks associated with a decrease in output prices and/or increase in input prices are simply mentioned in the project documentation. It is normally assumed that relatively stable prices in the PRC will prevail even when ADB was seeking to dismantle the prevailing price regulations there, and encouraging ex-factory commodity prices to begin reflecting market conditions. References to the likelihood of depressed world market commodity prices are mentioned, but it is normally assumed that commodity prices will remain stable or rise slightly in the coming years. Such assumptions go into the financial internal rates of return and economic internal rates of return computations at appraisal.

13. In the particular case of the five loan projects (1162, 1178, 1248, 1270, 1436), the enterprise subprojects came on stream in the late 1990s, when the Asian financial crisis had occurred. Although no ex-factory commodity price data of the subproject enterprises are available, it is known that the financial crisis did impact global commodity markets (Box A7.1). It is also known that, following 2 consecutive years of decline in 1998 and 1999, the consumer price index in the PRC increased in 2000.[9] Both the global market and local consumer market pricing situations strongly point to the fact that ex-factory commodity prices in the PRC were low at the time the subprojects came on stream.

Box A7.1: Contribution of Asia to World Output and Commodity Demand

Movements in real commodity prices since the mid-1970s have generally followed the cyclical swings in aggregate demand in the major industrial economies. In particular, an estimate of the output gap among G-7 countries broadly explains movements in commodity prices until the mid-1990s. During the late 1990s however, there was a sharp decline in real commodity prices at a time when changes in the excess supply among G-7 countries were relatively small.

The recent break in the historical relationship between commodity prices and the G-7 output gap appears to be explained largely by the effects of the Asian crisis. In the earlier part of the 1990s, the rapid real growth in Asia, with the associated strong increases in investment expenditure, particularly on large infrastructure projects, meant that the Asian region accounted for a disproportionate share of the growth in world demand for commodities. Over the 1992–1996 period, the Asia region's contribution to the growth of global demand for some key commodities has been estimated to be about 70 per cent. In 1998, following the economic turbulence that began in Asia after mid-1997, there was virtually no growth in real GDP in the region.

So whereas strong growth in Asian demand was supporting commodity prices throughout the early and mid-1990s, the economic downturn in the region has had a strong negative effect on the global demand for commodities and has placed downward pressure on their prices.

Source: Bank of Canada Review. 1999. *Recent Developments in Global Commodity Prices: Implications for Canada*. Canada, Summer.

14. Comprehensive commodity price risk management was important, because ADB-supported subprojects in the PRC had been sizeable compared with the asset base and/or sales revenues of the concerned enterprises. This is why it became difficult for these enterprises to service their debt.

[9] ADB. 2000. *Country Assistance Plan 2001–2003: People's Republic of China.* Manila.

15. In India, too, the commodity price risk issue did not receive due attention. For instance, ADB supported Andhra Petrochemicals Limited and Indian Acrylics Limited facilities on the premise that import tariff protection would continue. With economic reforms initiated in 1991/92, when the government began its trade and tariff policy reforms, neither project company was able to sustain financial viability and service ADB debt. Box A7.2 and Box A7.3 gives further information on these projects.

Box A7.2: Andhra Petrochemicals Limited's Debt Servicing Problems and Asian Development Bank Response

- Appraised again in the late-1980s.
- Andhra Petrochemicals Limited built a sub-economic plant on assumed tariff protection.
- But the Government of India implemented tariff reforms forcing Andhra Petrochemicals Limited to price oxo-alcohol products at international market prices.
- International market oxo-alcohol prices were depressed in 1993 and 1994 owing to recessionary conditions in many industrialized countries.
- A reduction in the tariff rate for oxo-alcohols was not matched by a reduction in the tariff of liquefied petroleum gas, the feedstock for propylene. Local liquefied petroleum gas prices remained much higher than international market prices. Besides, the Hindustan Petroleum Corporation Limited's propylene plant also entailed high conversion costs. The delivered price of the company's propylene was 40% higher than the delivered cost of imports, as per the pricing formula in the offtake agreement.
- Options to import propylene directly at world market prices were not really worthwhile because:
  - Andhra Petrochemicals Limited has a 10-year propylene off-take agreement with Hindustan Petroleum Corporation Limited and it is the only Hindustan customer.
  - Andhra Petrochemicals Limited would need a significant additional capital outlay to set up handling facilities at an east coast port and lay a pipeline to the plant.
  - Difficulties in servicing debt to ADB. So ADB deferred principal payments by 2 years, with the final maturity remaining unchanged.

Source: Andhra Petrochemicals Limited project files; compiled by study team.

Box A7.3: Indian Acrylics Limited's Debt Servicing Problems and ADB Response

- World-wide glut of acrylic staple fiber in the mid-1990s, when the Indian Acrylics Limited facility came on stream in April 1993.
- In India too, the total installed capacity in July 1994 was 112,000 ton per annum, compared to an estimated/projected demand of 76,000 tons for 1994/95.
- Cost of insurance and freight prices of imported acrylic staple fiber:
  - at appraisal in late 1980s ($2.43/kg),
  - after completion in 1994 ($1.50/kg).
- Retail prices in 1994 $3.35/kg, inclusive of 65% import duty and 23% counter-veiling duty.
- Ex-factory price of Indian Acrylics Limited's acrylic staple fiber of $2.50/kg, inclusive of 23% excise duty.
- Indian Acrylics Limited's acrylic staple fiber is dry-spun, which is not preferred in the local market and therefore sells at a small discount compared to wet-spun fiber.
- Signs of poor due diligence at appraisal:
  - Main raw material acrylonitrile is imported,
  - Production of acrylic staple fiber is not labor intensive,
  - Indian Acrylics Limited's project viability was based largely on tariff protection,
  - With the government's trade and tariff reforms initiated in 1991/92, the differential between product and feedstock import duties had been squeezed.
- However, some positive sign seen in 1995:
  - New uses of acrylic staple fiber have been introduced in addition to traditional uses in making sweaters, blankets and knitwear,
  - Implies some strengthening of demand and rise in prices.
- Therefore, Indian Acrylics Limited's experienced difficulties in servicing debt. So ADB:
  - Extended loan grace period from 3.5 to 5.5 years,
  - Changed amortization schedule,
  - Cancelled $1.13 million of original loan approval.

Source: Indian Acrylics Limited's project files, compiled by study team.

Appendix 8

SUPPLY-SIDE POWER SECTOR ENERGY EFFICIENCY INTERVENTIONS

A. Introduction

1. During the study period (2003–2010), ADB implemented nearly 30 interventions to provide financial assistance for the growth of the power supply sector in various developing member countries. These interventions included six multitranche financing arrangements and five nonsovereign investments. Together, these interventions have helped expand and modernize the entire power supply chain and have assisted in improving policy and regulatory frameworks, institutional mechanisms, project management capabilities, electricity access, and quality and reliability of power supply, as well as rationalizing power tariffs.

B. Energy Efficiency Aspects of ADB-Supported Power Supply-Side Projects

2. Energy efficiency improvement considerations—mostly in the form of transmission and distribution loss reduction, and better heat rates—are explicitly included upfront at the project design stage for most ADB-supported projects. Table A8.1 provides an overview of the energy efficiency improvement targets set for several ADB-supported projects. There are well-established procedures to measure and estimate the energy efficiency of supply-side projects. For power generation, it is on the basis of heat rate;[1] and for transmission and distribution systems on the basis of their losses.[2] Systems necessary to estimate and track improvements in the energy efficiency of generation and transmission and distribution systems are well recognized by most policymakers, regulators, and utilities.[3]

[1] Defined as the ratio of energy content of input fuel (e.g., in kilocalories) to the net energy generation (gross energy generation less auxiliary consumption). Although the heat rate is normally estimated for a specific generating unit, an overall power station heat rate may also be derived for an entire power station that comprises many units of different capacities and vintages.

[2] Most often, transmission and distribution loss levels are measured for the entire transmission and distribution network, which comprises lines and transformers/substations at various voltage levels. Transmission losses and distribution losses may also be estimated separately.

[3] Such systems comprise a mix of (i) energy metering at generation end, at various voltage levels in the transmission and distribution network, and at consumer end; and (ii) other measurements, such as quantity and quality of fuel feed for power generation. Metering forms a basis for energy accounting that tracks technical losses in the transmission system, and technical plus nontechnical losses in the distribution system. Metering is normally an integral part of project design. Specific subproject components for energy accounting systems may also be included to facilitate better energy accounting in specific portions of a transmission and distribution system.

Table A8.1: Energy Efficiency Aspects of ADB-Supported Power Supply-Side Projects (2003–2010)

Loan No.	Project	Approval Date	Energy Efficiency Consideration at Appraisal	Comments
2005-LAO	Northern Area Rural Power Distribution Project	18-Sep-03	Targeted to reduce T&D loss to 15% by 2005 and kept at 15% thereafter	Covenanted in Project Agreement; Actually reduced T&D losses to about 12% by 2009
2009-BHU	Rural Electrification Network Expansion	30-Sep-03	Targeted that T&D loss should not exceed 13% even when network expands to increase electrification rate	Covenanted in loan agreement; Actual T&D losses about 10.3% in 2007 (year of loan closing)
2036/2037-IND	Assam Power Sector Development Program/Project	10-Dec-03	Targeted to reduce T&D losses to 25% by FY2008	Actually reduced to 29.61% by FY2008
2038/2039-BAN	Power Sector Development Program/Project Loan	10-Dec-03	Targeted to reduce Distribution losses in Dhaka Electricity Supply Company (DESCO) area from 26% in 2001 to 18% by 2008.	The stated objectives of Part C of the Project Loan (which is about renovation, upgrading and extension of distribution in 10 towns in northwest Bangladesh) include distribution loss reduction.
2128-VIE	Northern Power Transmission (Sector) Project	13-Dec-04		No transmission loss reduction targets set, although it is likely that some of the works will lead to improved transmission efficiencies
2152-IND	Power Grid Transmission (Sector) Project	21-Dec-04	Targeted to reduce T&D losses from about 30% (or 45-55%) to 20% (or something like that)	Why a loan to PGCIL be fixing targets for SEBs or discoms is not clear
2165-AFG	Power Transmission and Distribution Project	14-Apr-05	Targeted to reduce T&D losses in project areas from 35-40% in 2004 to about 30% by 2010.	
2225-VIE	Northern Power Transmission Expansion Sector Project	21-Dec-05	Targeted to reduce transmission losses from 14.7% in 2005 to 13.8% in 2010 and 11% in 2015.	The targets most likely refer to % system losses as seen by EVN
2261-CAM	Second Power Transmission and Distribution Project	04-Oct-06	As covenanted in the loan agreement, the utility should maintain T&D losses at 16% or less.	In Dec 2009, reported distribution losses were 9.7%
2289/2290/2396-PAK	MFF - Power Transmission Enhancement Investment Program	13-Dec-06		Acknowledged in the RRP that KESC's and WAPDA's inability to comply with some financial covenants in previous loans is linked to their inability to meet system loss reduction targets. No targets set, but acknowledged that some subprojects will improve system reliability and reduce system losses.
2309-IND	MFF - Uttaranchal Power Sector Investment Program	02-Jan-07	Improved efficiency of generation system (by renovating, modernizing and upgrading) existing hydropower plants	
2323/2324-IND	MFF - Madhya Pradesh Power Sector Investment Program	04-Apr-07	Targeted to reduce: (i) Transmission losses from 5.2% in FY2006 to 4.9% in FY2009; and (ii) Distribution losses from 40-45% in FY2006 to 19% in 2012	HVDS Schemes and Distribution franchising schemes

Table continues on next page

Loan No.	Project	Approval Date	Energy Efficiency Consideration at Appraisal	Comments
7254-PAK	KESC Post-privatization Rehabilitation, Upgrade and Expansion	29-May-07	Targeted to reduce transmission losses from 5% (in 2006) to below 3% by 2010; Also targeted to reduce overall T&D losses from about 34% in 2006 to about 17% by 2012	
2332/2333-BAN	Sustainable Power Sector Development Program	26-Jun-07	Targeted to reduce: (i) Transmission losses from 3.4% in 2005 to 3.2% in 2009; (ii) Distribution losses in Dhaka Electricity Supply Authority (DESA) area from 30% in 2005 to 20% in 2009; and (iii) Distribution losses in Dhaka Electricity Supply Company Limited (DESCO) area from 16.7% in 2005 to 12% in 2009	
7256/2337-CAM	Cambodia Power Transmission Lines Company Limited (CPTL): Power Transmission Project	27-Jun-07		Acknowledge that high (but improving) distribution losses, along with other factors, contribute to the need for high power tariffs. Also acknowledge that distribution losses are gradually improving.
2368-SAM	Power Sector Expansion Project	27-Nov-07	Targeted to reduce technical system losses by 10% by Q4-2010 and by 20% by Q4-2012; Also targeted to reduce non-technical system losses by 10% by 2010	
7273-PHI	Acquisition and Rehabilitation of Masinloc Coal-fired Thermal Power Plant Project (Masinloc Power Partners Co. Ltd.)	17-Jan-08	The acquiring company planned to rehabilitate the plant, which was anticipated to improve heat rate from 10,250 BTU/kWh to 9,822 BTU/kWh	The rehabilitation was also expected to increase the net generation and capacity utilization
2415/2510-IND	MFF - National Power Grid Development Investment Program	28-Mar-08	Power Grid to maintain transmission losses in the 3-4% range, at par with international standards,	
2437-AZE	Power Transmission Enhancement Project	10-Sep-08	Targeted to reduce transmission losses from 6% in 2006 to 3% in 2012	
2438/2439-PAK	MFF - Power Distribution Enhancement Program	12-Sep-08	Targeted to reduce each year, the System technical loss and Commercial loss by 10% of the previous year's loss figure.	
2592/2677-IND	MFF - Assam Power Sector Enhancement Investment Program	27-Nov-09	Targeted to reduce T&D losses from 35% in 2009 to 19% by 2014; Correspondingly, also targeted to reduce distribution losses from 29% in 2009 to 15% by 2014	In addition to normal investments, includes investments: (i) to enable distribution franchisee arrangements through a single point power supply (SPPS) system; (ii) to convert 60 distribution transformers to high-voltage distribution system (HVDS); and (iii) to install aerial bunched conductor (ABC) cables.
2587-NEP	Energy Access and Efficiency Improvement Project	27-Nov-09	Targeted to reduce system losses in pilot areas for distribution loss reduction and private sector participation, from 25% in 2008 to 22% by 2013	

Table continues on next page

Loan No.	Project	Approval Date	Energy Efficiency Consideration at Appraisal	Comments
2619-INO	Java-Bali Electricity Distribution Performance	22-Mar-10	Targeted to reduce overall distribution loss from 8.4% in 2008 to 7% by 2013	On the basis of assistance in selected areas
2629/2630-UZB	Talimarjan Power Project	20-Apr-10	Targeted to retire 570 MW of inefficient power plant capacity by 2016; Overall, generation efficiency to increase from 31% to about 50% by 2015	System T&D losses of 20% of net energy generation are acknowledged as being high
2671-KGZ	Power Sector Improvement Project	27-Sep-10	Targeted to reduce transmission losses from 5.7% (in 2009) to 4.7% by 2014; and reduce distribution losses from 26% in 2009 to 20% in 2014	
2681-IND	Bihar Power System Improvement Project	19-Oct-10	Targeted to reduce system losses by 3% by 2016 in the four distribution circles covered by the Project	

AFG = Afghanistan, AZE = Azerbaijan, BAN = Bangladesh, BHU = Bhutan, BTU = British Thermal Unit, CAM = Cambodia, EVN = Electricity of Viet Nam, FY = fiscal year, HVDS = high-voltage distribution system, IND = India, INO = Indonesia, KESC = Karachi Electric Supply Company, KGZ = Kyrgyz Republic, LAO = Lao People's Democratic Republic, MFF = multitranche financing facility, NEP = Nepal, PAK = Pakistan, PGCIL = Power Grid Corporation of India Ltd., PHI = Philippines, RRP = report and recommendation of the President,SEB = state electricity board, T&D = transmission and distribution, UZB = Uzbekistan, VIE = Viet Nam, WAPDA = Water and Power Development Authority.
Source: Compiled by the study team.

The executing and implementing agencies for most projects are power utilities or power companies that have implemented several projects of a similar scope as ADB-supported projects. Although most approved in or after 2003 are still being implemented, the progress so far strongly suggests that many have not been implemented entirely as envisaged at appraisal. In particular, the following broad issues have arisen between the approval and completion stages: (i) inadequacies of the project management function; (ii) bidding and procurement-related issues; (iii) difficulties in fully complying with environmental and social safeguards; and (iv) other factors, which include changes in project scope, and financial and security concerns.

3. The fact that the projects are not being implemented entirely as planned implies that either the benefits were not fully delivered or, if delivered, then with delays. Tables A8.2 to A8.5 provide examples of the range of factors likely to result in delays or not fully delivering energy efficiency benefits. These are summarized below.

Table A8.2: Project Management Related Aspects that Affect Project Implementation

Loan No.	Description
2438/2439-PAK	Delays in implementation of the project were caused by weak contract management and weakness in decision making.
2396-PAK	External monitoring consultants have not yet been hired for preparing the monitoring reports.
7254-PAK	Due to the delays in the implementation of the turnaround plan for generation, transmission, distribution and business operation, IFC concluded that there was a real risk that the Karachi Electric Supply Company would not be able to service ADB and IFC loans when due, and suggested that loan repayment be rescheduled to align with projected cash flows without changing the final payment date. There was also a concern that the equity capital injected by Abraaj Capital would not be used to service debt.
7256-CAM	None of the shareholders of the Cambodia Power Transmission Company Limited had sufficient technical expertise. The company and plant should be run by a professional management team and a reliable operation and maintenance contractor.
2437-AZE	Project management needs to be strengthened to improve efficiency and accelerate field survey and engineering design work.
2368-SAM	The PMU is reprioritizing the remaining subprojects due to insufficient funder the loan for covering all proposed subprojects.
2165-AFG	The Ministry of Energy and Water requested for continued advisory services of the project implementation specialist and an additional technical adviser following the restructuring of the project implementation support unit.
2323/2324-IND	There was a need for providing distribution companies with a more comprehensive program for capacity building, and introducing them to new technologies from other countries.
7273-PHI	Masinloc Power Partners Company Limited faced recurring technical and mechanical issues, which resulted in increased downtime and decreased generation capacity. Coupled with demand slowdown, these problems impacted the company's performance and profitability.
2225-VIE	The National Power Transmission Corporation wasted much time in determining the utilization of loan savings. It should focus on urgent acquisition of equipment and spares to utilize loan savings.

ADB = Asian Development Bank, AFG = Afghanistan, AZE = Azerbaijan, CAM = Cambodia, IFC = International Finance Corporation, KESC = Karachi Electric Supply Company, MPPCL = Masinloc Power Partners Co. Ltd., PAK = Pakistan, PHI = Philippines, SAM = Samoa, VIE = Viet Nam.
Source: Compiled by the study team.

Table A8.3: Bidding and Procurement Related Aspects that Affect Project Implementation

Loan No.	Description
2128-VIE	Defective relay equipment was not replaced by the contractor, as a result the implementation of two substations was delayed.
2289/2290-PAK	Systematic leaks of confidential information regarding evaluation process and recommendations.
7254-PAK	Advance payment to the contractor was delayed; delayed customs clearance.
2415/2510-IND	Overly long evaluation of bids for five contract packages. Delays in awards of the last 2 packages.
2152-IND	Bid evaluation takes more than 3 months after bid closing; this should have been evaluated faster and submitted to ADB sooner. Frequent extensions of bid closing dates and bid validity. Not awarded contracts (17 packages) even after ADB approval received; this should not take more than a month, but took 5 months on average.
2165-AFG	Technical specifications changed by executing agency/implementing agency, which required an extension of the bid submission date.
2332/2333-BAN	4–5 months for technical bid evaluation. Overly long preparation time for the request for proposal and bidding documents.
2587-NEP	Delay in technical bid evaluation (if executing agency staff has to learn the ADB guidelines). Revise evaluation criteria if no suitable candidates can be found (e.g., PPP consultants).
2225-VIE	Need to rebid owing to misprocurement (bid opening records of 3 lots under packages 1.1, 1.2, and 2 were compromised, so ADB recommended the re-bidding of all 3 lots).

ADB = Asian Development Bank, AFG = Afghanistan, BAN = Bangladesh, IND = India, NEP = Nepal, PPP = public-private partnership, VIE = Viet Nam.
Source: Compiled by the study team.

Table A8.4: Environmental and Social Safeguards Compliance Related Aspects that Affect Project Implementation

Loan No.	Description
2438/2439-PAK	A 132 kV transmission line subproject under Peshawar Electric Supply Company did not comply with ADB Resettlement Policy, and works were started before the affected persons had been fully compensated. ADB and Peshawar Electric Supply Company mutually agreed to drop the subproject from the ADB project scope.
2128-VIE	• Compensation of some affected households located along Van Tri-Soc Son transmission line and reallocation of seven households affected by Hai-Phong-Vat Cach transmission line took time to resolve. • Delay in the submission of reports on implementation of ethnic minority and gender issues, and on the environmental management plan implemented by contractors.
2289/2290-PAK	Compliance with ADB's safeguard policy is generally poor. Land acquisition and resettlement plans are required to be updated according to the revised route of the transmission line. Some of the affected persons complained they were not paid compensation and interest for land acquired.
7254-PAK	A large number of subgrids could not be energized in a timely fashion following delays in obtaining right-of-way and city government permits.
2152-IND	• Pursuant to ADB's Involuntary Resettlement Policy, as long as project-affected persons need to be compensated, the implementing agency is required to disclose the draft resettlement plan and submit to ADB for approval. There was a delay in acquiring a portion of the required land. • Along one of the transmission line routes, the affected persons on the right- of-way demanded an enhanced compensation package. The Government of Kerala formed a high-level committee to investigate the matter. Its decision-making took a long time, and resulted in a delay in closing the project.
2165-AFG	Alternative sites for a substation under consideration posed different social and environmental problems. For instance, in the event the substation was constructed on one candidate site, then the transmission line would need to pass over a large cemetery located between the site and the Taluqan town. The substation site selection process was time-consuming.
2332/2333-BAN	Land was acquired before formal approval obtained for the acquisition. Construction could begin only after the approval had been received.
2225-VIE	The Northern Power Project Management Board started the construction works before land acquisition, and resettlement activities were not yet completed.
2261-CAM	As per the loan agreement, no civil works can commence without the completion of the land acquisition, resettlement activities, and compensation. Delays in this process can delay commencement of subproject civil works and construction. For the extension of a 230 kV transmission line from Kampot to Sihanoukville, the resettlement plan needed to be updated before submission to ADB for approval. In general, ADB recommended that there should be a separate mission to assist the executing agency on how to comply with the social safeguards and achieve results.

ADB = Asian Development Bank, AFG = Afghanistan, BAN = Bangladesh, CAM = Cambodia, IND = India, kV = kilovolt, PAK = Pakistan, VIE = Viet Nam.
Source: Compiled by the evaluation team.

Table A8.5: Other Aspects that Affect Project Implementation

Loan No.	Description
2289/2290-PAK	Security The completion of four subprojects was delayed due to security reasons. Civil works and construction could not commence even after materials had been delivered to the site. Completion was rescheduled from December 2010 to March 2011
7254-PAK	Financial Concerns Abraaj Capital's formal entry into the equity transaction was delayed as this required that Karachi Electric Supply Company pay for power purchases to the Water and Power Development Authority on the basis of average costs (overall blended grid tariff), while the authority demanded payment on the basis of marginal costs (tariff for oil based power generation).
2437-AZE	Change in Scope As there were loan savings of $60.0 million, Azenergy requested ADB to utilize these savings for financing a 100-km long 220 kV transmission line for replacing existing 110 kV lines.
2368-SAM	Financial Concerns One of the contractors threatened to withdraw unless the currency of payment was changed partially from US dollars to Japanese yen, which was not acceptable to ADB. Owing to unfavorable yen currency fluctuations, there may be insufficient funds under the loan to cover all subprojects. This necessitated a reprioritization of the remaining subprojects under the sector loan.
7273-PHI	Market Risk While Masinloc Power Partners has contracted 95% of its dependable capacity, this arrangement is only during peak hours and represents about 70% of total energy generation. Until the company is able to increase its contracted capacity to mitigate merchant risk, the project will be dependent on the spot market for 30% of its energy generation and will continue to be subject to supply-demand volatility and price risk. Masinloc Power Partners wants to reduce its exposure to the spot market.
2587-NEP	Financial Concerns A review committee recommended the financial restructuring of the Nepal Electricity Authority through a reduction in interest rates, an active loss reduction program, payment of large outstanding dues for municipal street lighting, and other measures. These measures can be recommended after the review committee report is accepted by the Council of Ministers. ADB may not continue support if this acceptance does not come through.
2225-VIE	Change in Scope National Power Transmission Corporation proposed to drop QuangNinh-Mong Duong 500 kV T/L due the delay in the implementation of the Mong Duong Power Plant and request the financing of (i) NhoQuan 500 kV substation, (ii) TuyenQuang 220 kV substation, and (iii) the Bim Son 220 kV substations
2261-CAM	Change in Scope The Electricité du Cambodge proposed changing the scope to a 115 kV substation and an associated 15 km transmission line in Sihanoukville town.

ADB = Asian Development Bank, AZE = Azerbaijan, CAM = Cambodia, KESC = Karachi Electric Supply Company, kV = kilovolt, MPPCL = Masinloc Power Partners Co. Ltd., NEA = Nepal Electricity Authority, NEP = Nepal, NPT = National Power Transmission Corporation, PAK = Pakistan, PHI = Philippines, SAM = Samoa, VIE = Viet Nam.
Source: Compiled by the evaluation team.

4. **Project management.** Several weaknesses in the project management of ADB-supported power supply-side projects are evident. Weak contract management, weaknesses in decision making, and insufficient technical skills, coupled with inadequate capacity development measures, are the normal manifestations. In certain projects these led to situations where necessary surveys to select sites for new substations or transmission line routes were not conducted efficiently. Engineering design work is not sufficiently well monitored and/or subproject reprioritization work suffered in the event funding constraints arose. The fact that investment management experts and/or technical advisers cannot be mobilized sufficiently early causes further delays. The inability to recruit monitoring consultants makes it difficult to monitor implementation progress, recommend timely corrective action, and ascertain that remedial actions are being taken.

5. The cumulative effects of poor management of previous projects or initiatives may also become an overriding concern that constrains the progress of the ADB-supported project. For instance, owing to the delayed implementation of the turnaround plan of a borrowing power utility, it became necessary to first reschedule loan repayments to align them with projected cash flows before work on the project—which is also to contribute to the turnaround plan—could begin.

Bidding/procurement. Most bidding and procurement-related factors that have caused completion delays can be attributed to the long lead times taken by the program or project management office or the decision makers (such as project steering or tender evaluation committees) to formulate requests for proposals and bidding documents, evaluate bids, and award bids even after ADB approval. This is normally symptomatic of a slow or cumbersome decision-making processes and/or poor skill levels. In a few instances, temporary bottlenecks may arise that impede quick decision making, or technical specifications are changed, which necessitates an extension of bid submission dates. The need to improve governance has also become evident in some cases, when the resultant rebidding process has contributed to delays.

6. In a few cases, completion delays are also attributed to the contractor or equipment supplier when they fail to replace defective equipment, or government bodies not directly linked to the project or tendering process. For instance, delayed customs clearances for equipment imports.

7. **Environmental and social safeguards.** Compliance-related issues of environmental and social safeguards arise in most power generation, transmission, or distribution system projects. Where necessary, environmental impact assessments, environmental management plans, and other documents are prepared. The implementation of all impact mitigation plans and compliance with ADB safeguards is not always straightforward. Experience from power supply-side projects since 2003 suggests the most difficult issue appears to be related to land acquisition, especially when project-affected persons need to be resettled and compensated for loss of land, livelihood, property, and other assets.

8. **Other factors influencing viability and timely completion.** The array of power supply projects in this study shows that changing the scope of projects during implementation is not unusual.[4] Project scopes may be changed for various reasons, but most notably when the implementation of a power evacuation transmission line needs to be postponed because of delays in setting up the power station. Or when cost savings occur during project implementation and the inclusion of another subproject is justifiable.

9. Financial concerns that impede progress are likely to be associated with some type of social or noneconomic priorities of the government. For instance, a power utility can sell its equity only when issues related to its power purchase tariffs are settled. Market risk concerns are particularly important for merchant power plants with

[4] Although it is entirely possible that a delay causes a change in project scope (for instance, if a previously included subproject gets implemented by the borrower's own funds or some other source of funds), it is more likely that a change in project scope causes delay.

significant exposure to the spot power market. Security concerns have also affected the progress of at least one loan project.

C. Assessment of Selected Power Supply-Side Interventions

1. Generation and Cross-country Transmission Line Projects

a. Backdrop of Power Scenario, Policies, and Strategies

10. Power scenario. For several decades, India has experienced a severe power supply deficit. At the beginning of the study period, the peak power deficit was an estimated 6,700 MW, or about 7.7% of peak demand (Table A8.6).[5] Despite rapid expansion in power generation capacity from 112,000 MW in 2003/04 to more than 176,000 MW in March 2011, power shortages remain. In 2010/11, the peak power shortage was estimated at 9.8%, and energy shortage at 8.5%; the estimated shortages are anticipated to increase in 2011/12 to 12.9% and 10.3%, respectively (Table A8.7).[6] Although India's eastern and northeastern subregions have been exporting surplus power to other subregions for several years, as of 2011, all five subregions in the country are suffering from peak power shortages. These range from an estimated 5.9% in the northeast to 14.5% in the southern subregion. Increasing power shortages are due to a variety of reasons; the most salient being (i) real GDP growth rates of over 8% per year since 2005/06 ; (ii) renewed emphasis on rural electrification to increase the share of electrified rural households (from 44% in 2004/05 to nearly 100% within 5 years) by providing access to an additional 78 million rural households;[7] (iii) continued high technical and commercial losses—30% or higher in several states—in the transmission and distribution system; (iv) the poor financial performance of many power utilities and their consequent inability to raise sufficient funds for the expansion of their power systems; and (v) generally limited scope for private participation in generation, owing to difficulties in negotiating bankable project agreements.

Table A8.6: Overview of Power Sector Scenario in 2003–2004
(megawatts)

Region	Installed Capacity	Peak Demand	Peak Availability	Surplus/ (Deficit)
Northern	30,500	25,000	22,800	(2,200)
Western	32,700	29,800	24,000	(5,800)
Southern	30,500	22,500	21,000	(1,500)
Eastern	16,000	8,500	11,000	2,500
Northeastern	2,300	1,100	1,400	300
Total	**112,000**	**86,900**	**80,200**	**(6,700)**

Source: ADB. 2004. *Report and Recommendation of the President: Proposed Loan to India for the Power Grid Transmission (Sector) Project.* Manila (November).

[5] The power deficit estimate is most likely underestimated, the major reasons being (i) it is based not on the true peak power requirements, but on the basis of suppressed demand from customers connected to the grid, coupled with (ii) the long lead times (often 6 months or more) normally taken by power utilities to provide service connections to new customers that apply for new connections.

[6] Central Electricity Authority (Ministry of Power, Government of India), *Load Generation Balance Report, 2011-12*, New Delhi, May.

[7] Through the *Rajiv Gandhi Grameen Vidyutikaran Yojana* launched in April 2005, the Government of India provides 90% of the capital cost of the program. As originally envisaged, the program was to be implemented over a 5-year period at an estimated cost Rs 160 billion (about $3.5 billion), electrify all villages and habitations (with populations of above 100 persons), provide access to all rural households, and provide free service connections to households below the poverty line.

Table A8.7: Overview of Power Sector Scenario in 2011/12
(megawatts)

Subregion	Energy			Peak		
	Requirement	Availability	Surplus / (Deficit)	Demand	Met	Surplus / (Deficit)
	(GWh)	(GWh)	(GWh)	(MW)	(MW)	(MW)
Northern	279,581	249,145	(30,436)	41,000	36,140	(4,860)
Western	287,757	256,237	(31,520)	42,422	37,781	(4,641)
Southern	250,024	223,814	(26,210)	37,247	31,859	(5,388)
Eastern	105,461	97,294	(8,167)	17,171	15,185	(1,986)
North-Eastern	10,918	10,884	(34)	2,198	2,068	(130)
All India	**933,741**	**837,374**	**(96,367)**	**136,193**	**118,676**	**(17,517)**

GWh = gigawatt-hour, MW = megawatt.
Source: Central Electricity Authority (Ministry of Power, Government of India). *Load Generation Balance Report, 2011–2012*. New Delhi (May).

11. Power sector policies and strategies. In compliance with the Electricity Act 2003, the Government of India notified the National Electricity Policy in February 2005.[8] Recognizing that electricity is one of the key drivers of economic growth and poverty reduction, the policy set a target of providing electricity access to all within 5 years. The rural household electrification program, which is being implemented through a targeted program (footnote 3), supports this policy. This program to connect 78 million rural households, including free service connection to those living below the poverty line, is still to be fully implemented. It calls for extensive capital investment in which power utilities and state governments are required to invest up to 10% of the capital cost. Power utilities are required to maintain the rural electricity distribution backbone. This comprises 33/11 kilovolt [kV] or 66/11 kV transformers and 11 kV subtransmission lines, and village electrification infrastructure of at least one distribution transformer per village and low-voltage lines.

12. In keeping with the target of providing electricity to all, the Government of India envisaged generating capacity additions of 100,000 MW during the 10-year period spanning the 10th Five Year Plan period (2002/03–2006/07) and 11th plan period (2007/08–2011/12). The government recognized that this capacity addition target was not feasible from the list of projects under implementation and in the pipeline. Large capacity power generation projects, such as ultra mega power projects each with a capacity of about 4,000 MW, are needed to reduce power shortages in the coming years.[9] The ultra mega power projects are to deploy supercritical technology to achieve fuel conversion efficiencies. They are to be awarded to private or public sector developers through tariff-based competitive bidding. Nine project sites have so far been identified, of which six have been awarded to developers that quoted the lowest levelized tariffs in their bids. The National Thermal Power Corporation has won the bids to implement two

[8] Ministry of Power, Government of India. 2005. National Electricity Policy, Resolution No. 23/40/2004-R&R (Vol. II). New Delhi (12 February).

[9] The ultra mega power projects are seen as an extension of the mega power projects, which had been encouraged. See Ministry of Power, Government of India, 2006, *Mega Power Project Policy, Letter No.A-118/2003-IPC*, New Delhi, 2 August; and Ministry of Power, Government of India, 2009, *Revised Mega Power Project Policy*, New Delhi, 14 December.

of the six ultra mega power projects. It is also in the process of setting up other large and supercritical coal-fired power plants.

13. The Electricity Act 2003 provides an enabling framework for the accelerated and efficient development of the power sector. The act aims to encourage competition to yield efficiency gains to improve the quality and reliability of affordable electricity supply. Open access in transmission was introduced to promote competition in power generation from state-level and central power-generating companies, as well as the private sector. Generators are able to sell power to different distribution licensees across the country. Strengthening the transmission system for bulk power transfers from one subregion to another, or one state to another, is therefore an essential prerequisite for open access in transmission. Towards this objective, the Power Grid Corporation of India Limited, the central transmission company, prepared a national transmission development plan. This entails an investment of about $12.6 billion during the 10th and 11th plan periods to 2011/12. The transmission company is in the process of strengthening and expanding its grid by adding more high-voltage alternating current lines at 400 kV, high-voltage direct current lines at 765 kV or 800 kV, and large substations.

b. ADB Support

14. National Thermal Power Corporation Capacity Expansion Financing Facility (Loan 7242). To finance the corporation's capacity expansion program, and in keeping with the Government of India's power capacity addition target, ADB approved in July 2006 a loan of up to $300 million to National Thermal Power Corporation on a corporate basis (i.e., without a sovereign guarantee). The loan was to be provided in two tranches. Tranche A from ADB's ordinary capital resources of up to $75 million with a maturity of up to 11 years, including an availability period of up to 4 years, and semiannual repayments starting at the end of year 7. And Tranche B of up to $225 million with a maturity of up to 7 years, including an availability period of up to 18 months, and semiannual repayments starting at the end of year 4. Tranche B, loaned by ADB as lender of record under its Complementary Financing Scheme program, will be syndicated to commercial banks by the lead financing program arranger. Two coal-fired thermal projects were supported through the loan, including a portion of the foreign exchange requirements:

(i) the Sipat Super Thermal Power Project (Stages I and II) located in Bilaspur, Chhattisgarh state, comprising 1,980 MW (3x660 MW) capacity utilizing high efficiency supercritical steam technology (Stage I), and 1,000 (2x500 MW) of conventional subcritical capacity (Stage II); and
(ii) the Kahalgaon Stage II Super Thermal Power Project located in Bhagalpur, Bihar state, comprising two phases (Phase I of 2x500 MW, and Phase II of 500 MW) being constructed concurrently, all with conventional subcritical capacity.

15. Mundra Ultra Mega Power Project (Loan 7276). In April 2008, ADB approved a senior secured nonsovereign loan of up to $450 million for the construction of the 4,000 MW coal-fired power plant with supercritical technology, comprising five units, each of 800 MW. This was awarded to the Tata Power Company, India's largest private utility company. It holds 100% of the shares in Coastal Gujarat Power Limited, which is the borrower. The ADB loan was to be utilized in two tranches: (i) a tranche of up to $250 million to be funded by ADB through its ordinary capital resources, and (ii) a tranche of

up to $200 million funded by ADB and syndicated to the Export-Import Bank of Korea through a risk participation agreement.

16. **Power Grid Transmission (Sector) Project (Loan 2152):** Towards facilitating open access in the transmission system in the medium term, the Power Grid Corporation of India Limited planned significant investments each year to 2011/12 as part of its national transmission development plan. ADB approved a loan of $400 million to the company in December 2004 to help meet a part of the cost of its grid strengthening program. A sector loan modality was adopted to provide flexibility in choosing subprojects that met the technical, financial, economic, environmental, and social criteria agreed upon by the company and ADB. During appraisal, three core subprojects were identified for support that covered the states of Tamil Nadu and Andhra Pradesh and the union territory of Pondicherry. Additional subprojects were to be approved for support if they met the eligibility and selection criteria. Overall, the ADB sector loan was to support about 70% of the total cost of the core and additional subprojects, and meet about 86% of their total cost. The three core subprojects selected upfront comprised:

(i) Grid strengthening for Tamil Nadu. The subproject comprises construction of 600 circuit-kilometers (cct-km) of new 400 kV transmission lines from Tirunelveli to Udumalpet, and 220 cct-km of new loop-in-loop-out 400 kV transmission lines from Madurai to Trivandrum; construction of a new 400/220 kV substation with 2x315 megavolt-ampere (MVA) transformation capacity at Tirunelveli; and augmentation of existing 400/220 kV substations at Udumalpet and Trivandrum, each with a 315 MVA transformer.

(ii) Grid strengthening for Tamil Nadu II. The subproject comprises construction of 280 cct-km of new 400 kV transmission lines from Pugalur to Madurai, and 156 cct-km of new 400 kV transmission lines from Udumalpet to Arasur; construction of new 400/220 kV substations with 2x315 MVA transformation capacity each at Pugalur and Arasur; and augmentation of 400/220 kV substation bays at Madurai and Udumalpet.

(iii) Grid strengthening for Tamil Nadu, Andhra Pradesh, and Union Territory of Pondicherry. This includes the establishment of a new 2x315 MVA substation at Pondicherry and Warangal by 60 cct-km line-in-line-out of one of the circuits of Neyveli-Sriperumbudur 400 kV double-circuit transmission line and 38 cct-km line-in-line-out of Ramagundam-Khammam 400 kV single-circuit transmission line, respectively.

17. **Multitranche Financing Facility—National Power Grid Development Investment Program (Loans 2415 and 2510):** In view of the Power Grid Corporation of India Limited's long-term expansion plans, which extend far beyond the national transmission development plan's terminal date of 2011/12, ADB and the company agreed to a multitranche financing modality for $600 million, which ADB approved in March 2008. The facility provided long-term and predictable financing, and helped Power Grid Corporation of India prepare for external commercial borrowings to broaden and deepen its access to financial markets. The first tranche of $400 million was provided for the financing of two projects: upgradation of transmission capacity from Uttarakhand and an 800 kV high-voltage direct-current line from northeastern to northern-western India. The second tranche of $200 million, which was approved in March 2009, was also used to finance more high-voltage direct-current line packages for the same line from northeastern India.

c. Implications for Results

18. National Thermal Power Corporation Capacity Expansion Financing Facility (Loan 7242). At appraisal, it was expected that Sipat Stage I would be fully commissioned during the 11th plan period (i.e., by March 2012), while Sipat Stage II would be fully commissioned during the 10th plan period (i.e., by March 2007). Stage II was included as an afterthought, as it was believed that National Thermal Power Corporation would manage to implement power projects with conventional subcritical technology more easily, and therefore contribute to alleviating power shortages in the near term. In reality, however, both Stage I and Stage II have suffered delays, which appear to be more significant for Stage II. Disputes related to water use between National Thermal Power Corporation and the Government of Chattisgarh State being the principal cause for this delay. The two 500 MW Stage II units could be commissioned and begin commercial operations only after the water-related dispute had been resolved. The first Stage I unit of 660 MW was commissioned in June 2011, and became the first operating unit with supercritical technology in India. The other two 660 MW units are expected to be commissioned during 2012. The Kahalgaon Stage II project also suffered delays. Although expected to be completed by March 2007, the last unit of Kahalgaon Stage II began commercial operations in March 2010.

19. Mundra Ultra Mega Power Project (Loan 7276). At appraisal, the first unit of the Mundra project was expected to be commissioned by March 2011, and the remaining four units at regular 4-month intervals. The project was expected to be completed by July 2012. However, progress appears to have been slow. The 800-MW Unit-1 is expected to be synchronized in July 2011 and its commercial operations are expected to begin by September 2011. The other four units of 800 MW each are expected to begin commercial operations by 2013.

20. Power Grid Transmission (Sector) Project (Loan 2152). The original scope of the project included three subprojects: (i) Grid Strengthening for Tamil Nadu I, (ii) Grid Strengthening for Tamil Nadu II, and (iii) Grid Strengthening for Tamil Nadu, Andhra Pradesh, and Pondicherry. An additional six subprojects were approved during 2005–2007: (i) Grid Strengthening for Kerala I, (ii) Grid Strengthening for Kerala II, (iii) Northern Region System Strengthening Scheme V, (iv) Enhancement of Transmission Capacity in East-West Corridor of Northern Region, (v) Western Region Strengthening Scheme VI, and (vi) Procurement of Bulk Conductors and Insulators.

21. On 21 December 2004, ADB approved a $400 million loan to Power Grid Corporation of India Limited with the Government of India as guarantor. The loan was signed on 3 November 2005 and declared effective on 10 January 2006. The original loan closing date was 31 December 2009. At the request of the Power Grid Corporation of India on September 2009, ADB approved an extension of the loan closing date by 12 months from December 2009 to 31 December 2010. This was because of delays in the implementation of two subprojects: Grid Strengthening for Kerala I and Grid Strengthening for Kerala II. Power Grid Corporation of India is the borrower and executing agency of the project. The loan was delegated to the India Resident Mission for administration effective 1 January 2010.

22. As of December 2010, Power Grid Corporation of India Limited had awarded all 46 contracts amounting $399.20 million—100% of the loan amount. Of nine subprojects,

seven had been completed. The implementation of the Grid Strengthening for Kerala I and II subprojects has been delayed by more than 3 years due to (i) rebidding of tower packages A1, A2, and A3; (ii) a stay order by the High Court of Kerala on the opening of bids; and (iii) severe right-of-way problems on the Edamon–Muvattupuzha–North Trichur 400 kV line. The contracts for the tower packages were finally awarded in March 2008 (against the targeted date of March 2006) after the High Court of Kerlala vacated the stay order. Construction of the line started in March 2010, far later than the scheduled date of October 2006 after the Government of Kerala issued an order on 4 February 2010 increasing the compensation package for (i) tower footings; (ii) loss of standing crops and plantation, and damage to trees during the construction of the transmission line; and (iii) use of the right-of-way along the transmission line corridor.

23. Both the Power Grid Corporation of India Limited and contractors were fully mobilized by the end of 2010 to implement the project. But due to continued resistance in some areas, and particularly in the Kottayam and Pathanamtitta districts by project-affected people, overall implementation has been slow. The affected people are demanding enhanced compensation for the right-of-way and upfront payment of the additional compensation money. This is instead of the current practice of making payments—as per the Government of Kerala's order—after the construction of the line and an assessment is carried out by revenue officials. A decision to enhance the compensation package was expected by August or September 2011 from a committee appointed by the Government of Kerala. A revised implementation schedule will be prepared. It is clear, however, that the delay will be more than 1 year beyond the revised closing date of December 2010.

24. As of 11 December 2010, Power Grid Corporation of India Limited had achieved $399.20 million (about 100% of the loan amount) of the contract award, and $373.47 million (93.4% of loan amount) of cumulative disbursements.

25. Multitranche Financing Facility—National Power Grid Development Investment Program (Loans 2415 and 2510). ADB support for the upgradation of transmission capacity in Uttarakhand was dropped on account of delays in the construction and commissioning of hydropower capacity in the state. Tranche 1 and Tranche 2 are now being used to finance a long +800 kV high-voltage direct current line from northeast to northern India. This is intended to evacuate power from about 10,000 MW of hydropower capacity in northeastern India. Although the construction of the transmission line and converter/inverter stations at either end is progressing on schedule, it is likely that it will not be commissioned on time because of delays in the completion of all hydropower capacity planned in the northeast. It is likely that to begin with, only one line on the high-voltage direct current system will be commissioned. As and when necessary, the system's second line will get commissioned. It is noteworthy that the high-voltage direct current option was preferred over a conventional alternating current line because it allows exporting and importing subregional grids to operate at different frequencies. This provides higher system stability, entails lower costs, and results in lower transmission losses over long distances.

26. It is estimated that there will be a total savings of about $76 million from Tranche 1 and Tranche 2 approvals. These are due to good project management by Power Grid Corporation of India Limited, as well as the timing of the floating of tenders and the award of contract packages. The tenders were floated during 2006–2008 when metal

prices were rising, and when contracts were negotiated and awarded on the basis of prices indexed to world copper and other commodity prices. During the procurement stage, however, when prices began to fall and competition among suppliers increased, considerable cost savings were realized. Tranche 2 funds allocated for the Uttarakhand transmission lines were reallocated to the northeastern + 800 kV high-voltage direct current line.

27. The $76 million savings are expected to be reallocated for other transmission subprojects through a third tranche. An ADB fact-finding mission in July 2011 identified two suitable subprojects that comprised two substations and a short 400 kV line in Daman, Diu, and the Dadra-Nagar-Haveli areas, which are part of Power Grid Corporation of India Limited's long-term expansion plan. Environmental and social safeguard documents have also been submitted by the company. A sign-off was expected by September 2011.

2. Assam

28. Backdrop. Assam reformed its power sector in the early 2000s by unbundling the Assam State Electricity Board into five companies: one generation company, one transmission company, and three distribution companies. The Government of Assam also initiated a financial restructuring plan to take over part of the board's past liabilities, and provide transitional financial support for cash deficits of new power sector companies. Following the financial restructuring, tariffs and costs gradually converged from 2003 to 2007, resulting in cost coverage of 85% in 2007.

29. Since 2002, Assam has experienced increasing peak power shortages, as demand rose from 688 MW in fiscal year (FY) 2002 to 848 MW in FY2008. Generation from the Assam Power Generation Corporation Limited accounted for 45% of Assam's total power availability of 1,960 GWh in the first half of 2008. Only 766 MW was available to respond to the peak power demand of 848 MW in 2008.

30. In FY2008, Assam's transmission network was able to meet a maximum demand of 766 MW (90% of the maximum demand of 848 MW) and transmitted 4,079 GWh (92% of the energy requirement). Substantial investment in transmission capacity is required if the projected peak demand in 2014 of 1,883 MW is to be met. Although Assam's aggregate technical and commercial losses declined from 42.5% in 2003 to 35.0% in 2008, they are still high. During the same time period, transmission losses declined from 9.0% to 6.0%, and distribution technical losses from 18.0% to 12.5%, thus reducing annual greenhouse gas emissions by an estimated 0.48 million tons of carbon dioxide equivalent. However, there is further scope to reduce technical distribution losses by taking steps to reduce transformer overloading and long low-voltage feeder lengths.

a. Assam Power Sector Development Program (Policy and Project Loans) (Loans 2036/2037)

31. ADB support. ADB approved $150 million in December 2003 to support reforming and restructuring Assam's power sector. This helped set the stage for the growth and performance improvement of the sector. Before loan effectiveness, several policy measures had been achieved to fulfill conditions to release the first tranche of $90 million. Further conditions were subsequently met for the release of the second

tranche of $60 million in 2005. ADB also approved a $100 million project loan for improving transmission and distribution systems, as well as billing and collection systems. The project loan also included socioeconomic and environmental monitoring of transmission, distribution, and rural electrification works to ensure compliance with ADB social safeguards for affected communities, and provided training to the Assam State Electricity Board in these matters.

32. Implications for results. The following achievements are noteworthy: (i) the constitution by the Government of Assam of a statutory independent power sector regulatory authority, the Assam Electricity Regulatory Commission, with budgetary provisions for adequate staffing and for the performance of its duties; (ii) unbundling of Assam State Electricity Board in October 2003 into one generation company, one transmission company, and three distribution companies;[10] (iii) the Government of Assam's approval of the financial restructuring plan and signing of a memorandum of understanding with the Assam State Electricity Board to restructure debt and provide transitional financial support to enable the newly formed companies to start with a clean slate, ADB provided funding for part of the debt restructuring adjustment, and the distribution companies achieved cash breakeven by 2007; and (iv) the issuance of a rural electrification policy by the Government of Assam for greater efficiency in managing system losses and improving revenue collection in rural areas, and easier access to rural electricity services. By FY2006, all power companies' liabilities had been liquidated, cost recovery increased to 99% by 2007, and system losses declined to 29.6% by FY2008.

33. The transmission component of the project loan helped enhance transformation capacity for it to meet peak demand without grid disturbances, and it helped maintain grid frequency within 49.5–50.5 hertz in 2010. At project completion, total expenditure was $319.63 million, comprising $100.0 million in foreign currency from the ADB loan and $219.63 million in local currency from Assam State Electricity Board and the Government of India. ADB's share of financing decreased from 41.1% to 31.3%, due to the increase in government funding from $143.5 million to $219.63 million. At loan closing in June 2009, there was an undisbursed amount of $40.3 million from the government-funded portion of the project that was expected to be completed by November 2010.

34. Along with the funds from the Government of India's Accelerated Power Development and Reforms Program, the ADB project loan helped achieve the following by March 2009: (i) 100% computerization of billing and collection systems; (ii) significant improvements in voltage, the reliability index, and load distribution; and (iii) an increased consumer base of about 1.7 million users by the loan's closure in 2009, compared with 1.1 million at appraisal in 2004.

35. The rural electrification component was completed by June 2009 and contributed to (i) augmenting 15 substations (33/11 kV); and (ii) renovating 1,201 defective distribution transformers (11/0.4 kV), and associated 11 kV lines and low-tension lines for 4,030 kilometers covering 1,201 villages. Item (i) was financed from the Government of Assam's resources and item (ii) by ADB. At appraisal, it was proposed to upgrade the capacity of 23 substations (33/11 kV). This was reduced to 15, since 8 of the proposed augmentation works were funded from other sources.

[10] Later amalgamated in to one distribution company.

36. A revenue management system involving the installation of consumer meters and establishing meter testing and maintenance facilities was also implemented. These covered three distribution circles—Dibrugarh, Jorhat, and Guwahati-II—through a mix of support from ADB and the Government of India's Accelerated Power Development and Reforms Program in the three distribution circles. A communications package was cancelled due to cost overruns. The number of consumer meters connected was reduced from 600,000 to less than 375,000, as this was deemed sufficient.

b. Assam Power Sector Enhancement Investment Program (Loans 2592 and 2677)

37. ADB support. ADB approved a $200 million multitranche financing facility loan in November 2009 to support the Government of Assam's transmission and distribution road map for meeting unserved demand at projected growth rates, and to assist Assam power companies consolidate improvements made since the comprehensive reform and restructuring programs were implemented. The multitranche financing facility loan was to (i) provide financial assistance and certainty for continued support; (ii) offer flexibility required for investments by Assam power companies at different stages of readiness; and (iii) guide the provision of subsequent loans for the ongoing transmission, distribution, and rural electrification expansion, improvement programs, and capacity development. Through the $60.3 million Tranche 1 approved in November 2009 and $89.7 million Tranche 2 approved in October 2010, the focus was to be on (i) increasing access to power by adding more 220 kV and 132 kV transmission lines, augmenting grid substation capacity and upgrading optical fiber cables for communication; (ii) transmission loss reduction through the replacement of inefficient grid transformers, circuit breakers, relays and isolators, as well as the augmentation of existing grid substations and installation of capacitor banks; and (iii) providing consulting services to improve the institutional capacities of unbundled power companies for project planning and management.

38. Tranche 3, which has yet to be approved for $50 million, will focus on (i) increasing access to power through grid electricity, as well as off-grid renewable energy sources; access to grid electricity was to be enhanced by the construction of new distribution lines and distribution substations, as well as augmenting existing distribution substations (pilot projects for renewable energy, such as biomass, solar, and mini-hydropower, were also to be developed); (ii) distribution loss reduction by expanding the high-voltage distribution network and the installation of aerial bunched conductors; and (iii) improving governance in distribution and supply with increased participation, competition, and transparency, as well as improving the financial viability of distribution system operations through the single-point power supply program for distribution franchising. The distribution franchising component was to expand the franchisee program to double consumer coverage with support for physical investments, such as last-mile distribution lines and bulk metering, and capacity development, such as training programs for franchisees and the Lower Assam Electricity Distribution Company Limited through technical assistance.

39. Implications for results. As of May 2011, for Tranche 1 (Loan 2592) transmission system works, the necessary site surveys, soil testing, and design approval processes were in progress. Of the six turnkey procurement packages in Tranche 1, contracts for five for $43.85 million equivalent had been awarded through international competitive

bidding processes, and technical bids for the remaining package were being evaluated. As of May 2011, total project progress for Tranche 1 was reported to be 40%.[11] Regarding Tranche 2 (Loan 2677), of the five turnkey procurement packages, technical bids for two were being evaluated as of May 2011. Bid documents for the other three packages had also been floated. Progress was reported to be 18% by May 2011, and the Assam Electricity Board was confident that contracts for all five packages can be awarded within 2011.

40. All major covenants have generally been met. The government and Assam Electricity Board are undertaking activities to ensure that achieving the project's objectives conform to sound administrative, financial, engineering, environmental, and power sector development practices. Staffing and funding for the project monitoring and implementation units are already in place. The Assam Electricity Grid Corporation Limited is managing the day-to-day coordination and project implementation, including the capacity development activities of Tranches 1 and 2. The Assam Electricity Board arranged the funding for land acquisition, which is currently in process.

41. As of May 2011, it appeared that the Government of Assam had allocated sufficient counterpart funding required for work under Tranches 1 and 2, and no major risk to project implementation from lack of counterpart funding was foreseen. The Assam Electricity Board had obtained the required experience for the ADB procedures from previous project implementation; and this contributed to the successful preparation of bidding documents under Tranche 2.

42. Tranche 3 is proposed to finance a set of projects for (i) access to power in distribution, (ii) energy efficiency enhancement, distribution loss reduction, and (iii) distribution franchising. New distribution substations and lines will be constructed to enable the rollout of relevant franchising models. The Assam Power Distribution Company Limited has submitted the detailed project reports to the Government of India's Ministry of Power. ADB's consultation mission in March 2011 reviewed project readiness and agreed to the approval of Tranche 3 ($50 million) by September 2011. ADB's fact-finding mission fielded in May 2011 also endorsed the approval of Tranche 3. In addition to the construction and upgradation of 33/11 kV substations and the construction of new 33 kV and 11 kV lines, Tranche 3 proposals also include proposals for distribution loss reduction through pilots for a high-voltage distribution system and aerial bunch conductors. Assam Power Distribution Company Limited also proposes distribution franchising through a single-point power supply program. In the program, ADB will provide funds to the company to create the enabling infrastructure—a 33/11 kV substation, adequate metering on outgoing 11 kV feeders, customer metering—before handing over an 11 kV feeder and all customers downstream to a franchisee. The franchisee will be responsible for power purchases from the Assam Power Distribution Company at 11 kV. The franchisee will also be responsible for the supply, operation, and maintenance of the distribution system downstream, as well as metering, billing, and collection. Realized profits will remain with the franchisee. The profit motive of the franchisee is expected to improve the financial viability of distribution operations, as well as compel the franchisees to reduce distribution losses. Whether or not this

[11] Back-to-office report dated 7 June 2011.

approach achieves the intended outcomes will only become apparent after a few years.[12]

43. The investment program in accordance with the report and recommendation of the President included increasing access to power through grid electricity, as well as off-grid renewable energy sources, and the development of pilot projects for renewable energy. There is, however, no renewable energy component in either of the ongoing Tranches 1 and 2, or in the proposals for Tranche 3.

3. Uttarakhand Power System Investment Program (Loans 2309, 2498, and 2502)

44. Backdrop. Uttarakhand's[13] estimated hydropower potential is about 20,000 MW. Only 1,160 MW had been developed by end-2005, and the state has been a net electricity importer for several years. With several hydropower projects under implementation, including 14 with a combined capacity of 5,525 MW that were expected to be commissioned between 2006 and 2010, Uttaranchal was expected to become a net exporter of electricity by 2010. An additional 4,791 MW of capacity was under development at the end of 2005, and a further 9,090 MW was being planned. Uttaranchal needs to expand its transmission network to keep pace with increasing generating capacity. The sector roadmap targeted 100% village electrification by 2008 and 100% household electrification by 2012. This calls for the rapid expansion of the 33 kV, 11 kV, and low voltage distribution network.

45. ADB support. ADB approved a $300 million multitranche financing facility loan in March 2006 to encourage the reform of Uttarakhand's power sector, promote clean energy, and energy efficiency improvements, as well develop capacity to manage the ongoing multibillion dollar expansion program. The multitranche financing facility was to be converted into individual loans in line with individual project readiness, which also included policy, safeguards, financial management, fiduciary oversight, and capacity development action plans. ADB approved Tranche 1 in January 2007 of $41.92 million to support (i) the construction of four small hydro power plants,[14] (ii) a hydrological information system for Uttarakh and Jal Vidyut Nigam, (iii) hardware and software for transmission planning and operations for the Power Transmission Corporation of Uttarakhand Limited, and (iv) consulting services in design and construction management for Uttarakh and Jal Vidyut Nigam and Power Transmission Corporation of Uttarakhand. Tranches 2 and 3 were to focus on setting up time-critical transmission lines, substations, and auxiliary equipment; and for capacity development and strengthening the institutional framework within the Government of Uttarakhand, the Uttarakhand Electricity Department, and various implementing agencies.

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[12] ADB had previously extended technical assistance to Assam Power Distribution Company Limited and franchisees to enhance management practices, conduct feasibility studies, and develop a second-generation single-point power supply model with more responsibilities for downstream distribution-related activities (e.g., capital investment and expanded operation and maintenance activities to be handed over to the franchisee depending upon expansion of services in urban and large areas, and development of risk-sharing models.

[13] Uttaranchal was carved out of the former northern state of Uttar Pradesh in November 2000. In 2007, it was renamed Uttarakhand.

[14] Kaldigad hydropower plant, Kaliganga-I hydropower plant, Kaliganga-II hydropower plant, and Madhyamaheshwar hydropower plant

46. Implications for results. Although ADB approved the $300 million investment program in March 2006, less than $135 million has so far been approved through the three tranches: Tranche 1 of $41.92 million approved in January 2007 became effective in March 2007, Tranche 2 of $62.40 million approved in December 2008 became effective in April 2009, and Tranche 3 of $30.60 million approved in January 2009 became effective in April 2009. All three tranches were scheduled to be completed by June 2012. The following observations are noteworthy: (i) although the investment was originally envisaged to be fully utilized by January 2013, ADB approved the release of only $134.92 million—less than 45%—through three tranches by July 2011; and (ii) actual disbursals have been significantly lower than the tranche approvals following the cancellation of certain tranche investment projects and other outputs. For instance, the hydrological information system was dropped after it was discovered that hydrological data collection are in the purview of the Central Water Commission and not the Uttarakhand state water commission. One proposed transmission line in Tranche 2 was cancelled because of a hydropower development suspension order by the Government of India. Contracts for three transmission lines and one substation augmentation, whose bidding has been conducted as advance action for Tranche 4, are proposed to be included in Tranche 2 instead. In addition to the original four small hydropower projects in Tranche 1, the rehabilitation of one small hydropower plant was added to Tranche 1.

47. The capacity development effort has been conducted through Tranche 1. This focused on the preparation of tender documents and the bid management process, maintenance of ADB financing accounts, documentation of environmental and social impact related issues, and project implementation support. The human resource development and corporate management components under Tranche 3 are expected to be implemented for the capacity development of the project management office of the Uttarakhand Electricity Department, the executing agency, as well as the two implementing agencies, Power Transmission Corporation of Uttarakhand Limited and Uttarakh and Jal Vidyut Nigam.

Appendix 9

ENERGY EFFICIENCY PROGRAMS IN THE PEOPLE'S REPUBLIC OF CHINA

A. Government Policies and Programs

1. The current set of government-sponsored energy efficiency programs in the PRC is among the most comprehensive, far-reaching, and sophisticated energy conservation programs in the world. The programs are well organized, and enjoy strong political and financial support. The programs are comprehensive in coverage and include all sectors and a series of complementary approaches using both regulation and the market. The programs also utilize an implementation system that runs through each of the various levels of government to consumers. Even so, achieving sustainably large improvements in energy efficiency is a daunting task. The barriers and difficulties in promoting energy efficiency that persist in all countries are also evident in the PRC. These include an insufficient understanding of the potential for energy efficiency among energy users, biases in favor of investments to expand production over investments to reduce operating costs, the small size of many projects, and potentially high transaction costs. Adding to this is the PRC's desire for continued rapid growth with the industry sector playing a leading role, the size and the dispersed nature of its economy, and considerable internal variations in economic and human capital development.

2. When the PRC's economy began to transition to a market economy in the early 1990s, policies to promote energy conservation did not accompany the transition program. The years 1996–2005 marked a period with relatively slow progress in the promotion of energy efficiency. With very fast growth in energy-intensive industrial commodity production during the 10th Five-Year Plan period (2001–2005), the energy intensity of the PRC economy (e.g., energy use per unit of GDP) rose for the first time in two decades. Knowing that strong economic growth could not be sustained with such growth rates in the PRC's already huge energy demand, the country's leadership set out a new, aggressive energy conservation program for the 11th plan period (2006–2010). Its target was to reverse the increase in energy intensity and reduce energy use per unit GDP by 20%.

3. The 11th plan period brought about the introduction and institutionalization of a sweeping range of major new policies and programs. While some were built upon the experience of previous programs, many were new, and some had never been tried in any other country before. Particular emphasis was placed on regulating energy use, and the use of regulatory and administrative policy. The rationale behind the new energy conservation policies in many ways parallel approaches used in environmental regulation. In essence, energy use is considered a matter of public concern, and needs to be optimized for the public good. Regulation is used to interject such public-good interests into the market. The strong regulatory approach was also accompanied by efforts to spur market-based mechanisms to deliver savings, and some attention was

also given to the increased use of energy pricing tools. However, the balance between regulatory policies and use of tax policy or pricing to spur incentives has strongly favored regulation.

4. Energy use per unit of GDP fell by 19.1% during 2006–2010, coming very close to the targeted 20%. This achievement required a great effort, as many of the basic macroeconomic development trends of 2001–2005 continued through the decade, and especially with the government's stimulus package in 2009 and early 2010 in response to the financial crisis. But compared with 1980–2000, changes in economic structure contributed far less to the energy intensity reduction in 2006–2010. Physical reductions in energy use per ton of commodity or unit service had to provide the bulk of the gains.

5. The targeted energy intensity reduction for the 12th plan (2011–2015) is 16%. A new target to reduce carbon emissions per unit GDP by 17% over the period has been added. This target reflects the continuing effort of the PRC to meet its commitment to reduce the carbon intensity of its economy by 40%–45% during 2005–2020.

6. While many details and local government plans had not been completed and published as of the end of May 2011, the theme of the energy conservation effort during the 12th plan is to strengthen the quality of implementation of the policies and programs launched during the 11th plan. Most of the main policies and basic program designs required for the coming 5 years have already been put in place. What is now required is (i) drafting and issuing the many detailed types of accompanying regulations, standards, and implementation guidance, which will be a painstaking process; (ii) large-scale and sustained investments to strengthen the currently thin institutional systems needed for effective, high quality implementation; and (iii) incorporation of new and creative ideas on program implementation to further increase results.

7. The 12th plan includes "five big construction efforts" for energy conservation:

(i) **Energy conservation renovation work.** This includes continuing and deepening a broad range of policies and programs designed to provide incentives and technical and financial support for the renovation of existing assets in all economic sectors.

(ii) **Efforts to promote energy conservation practices and more energy efficient appliances and equipment in society.** This includes appliance and equipment standards and labeling, and many types of information dissemination programs.

(iii) **Development and promotion of new energy-efficient technologies.** This includes identifying key areas for government support, introduction into manufacturing, and adoption.

(iv) **Expanded development of energy performance contracting.** One preliminary goal is to increase energy performance contracting investment to about $50 billion over the 5-year period.

(v) **Capacity development.** This includes capacity development for government systems (e.g., in monitoring and supervision, statistical systems, enforcement of regulations, and assistance in implementing standards), as well as broader training and information dissemination.

8. The PRC has an energy consumption reporting system which in principle can augment data gathered from project-related measurement and verification, and thus help improve estimates of energy savings. During the 11th plan period (2006–2010), this reporting system required that large energy consuming enterprises reported energy consumption and related data to the government. For reporting energy consumption and energy savings, the enterprises set up energy consumption data gathering systems, which included metering energy use in sub-assemblies and key equipment. In theory, the government can also have access to project related measurement and verification data. This can be double-checked or reconfirmed with enterprise level data, or modified to make it more consistent with enterprise level data.

9. In the 12th plan period (2011–2015), this type of energy consumption reporting system is being extended to enterprises with annual energy consumption levels of more than 5,000 tons of standard coal equivalent. This most likely included more than 20,000 enterprises. For these enterprises, the provincial governments will begin receiving the energy consumption data during the 12th plan period and be in a position to double-check measurement and verification-based project-level energy savings estimates. The government is also expected to come up with an "Energy Conservation Savings Calculation Standard" during the 12thplan period, so that the procedures used in verifying and cross-checking reported energy savings can be reconfirmed and verified using consistent protocols.

B. Developing Energy Efficiency Loan Windows in Banks

10. World Bank–CHEEF. Approved in May 2008, the World Bank's China Energy Efficiency Financing Project (CHEEF) includes an International Bank for Reconstruction and Development (IBRD) loan of $200 million and a Global Environment Facility (GEF) grant of $13.5 million. The loan closing date is December 13, 2013. The IBRD loan is onlent in US dollars at a London interbank offered rate-based fixed rate from the Ministry of Finance to the Export-Import Bank of China and Huaxia Bank. Each received $100 million. Huaxia Bank has also received loan funds from the Agence Française de Développement for onlending in a companion project. Export-Import Bank of China is a policy bank wholly owned by the government, while Huaxia Bank is a national, joint-stock commercial bank. The banks onlend IBRD loan proceeds to medium and large-sized industrial enterprises for energy conservation projects. These must meet basic defined energy conservation project definitions to qualify for loan proceeds. The two banks must repay the IBRD funds to the Ministry of Finance, which repays IBRD, according to terms laid out in their onlending agreements. The banks appraise the projects themselves, and no specific project approvals are required from the Government of the PRC or World Bank as long as project guidelines are followed. The banks onlend on market terms determined by them. They are also required to match IBRD funds by 1:1 in their new energy conservation lending programs

11. The IBRD component's main aim was to foster the development of energy conservation lending operations within the beneficiary banks that could be sustained as commercial undertakings using the many sources of funds available to them. The CHEEF program therefore aimed to make participating banks become more familiar with energy efficiency projects and cash-flow savings, and be able to originate energy efficiency projects. Participating banks were to do technical and financial appraisals

themselves or engage consultants for this work. The banks were also to decide themselves whether or not to lend to a particular energy efficiency project, and build up an energy efficiency project pipeline. In other words, the participating banks assumed the credit risk. The World Bank was involved in the decision-making process to approve a few subloans for candidate subprojects. Once the banks became familiar with the process, the World Bank did only post-approval sample checks to confirm whether or not the subloans were given for qualifying energy efficiency subprojects. It is noteworthy that the government-appointed auditors also reviewed subloans and subprojects, which compelled the banks to ascertain that only qualifying energy efficiency subprojects got financed.

12. The GEF component provides technical assistance to the banks to start up their new energy conservation lending business, support for other banks to initiate similar programs, and a range of dissemination activities. Technical assistance support was also given to the PRC's National Energy Conservation Center, an agency under the National Development and Reform Commission, on various energy efficiency policy topics.

13. As of end-2010, Export-Import Bank of China had allocated virtually all its loan proceeds and, after a slow start, Huaxia Bank has now moved rapidly to commit its loan proceeds to eligible projects.[1] A follow-up IBRD loan to Export-Import Bank of China (CHEEF 3 Project) has been prepared; it follows a similar format to the first loan but with some additional target markets. This loan is expected to become operational soon.

14. A follow-up CHEEF 2 Project was approved in 2010. It provides a $100 million IBRD loan, which is onlent to Minsheng Bank. Minsheng is the largest nonpublicly owned bank in the PRC. The IBRD loan is to develop an energy efficiency lending program for medium and large-scale industry similar to the programs supported under the CHEEF project.

15. A CHEEF 3 Project has been prepared and was expected to have been approved in 2011. This project will provide additional IBRD financing to Export-Import Bank of China to be used to further expand its energy efficiency lending business.

16. IFC–CHUEE. The International Finance Corporation (IFC, part of the WBG) operates a series of Risk Sharing Facility arrangements with PRC banks in support of energy efficiency project lending. This is under the umbrella of the China Utility-based Energy Efficiency (CHUEE) finance program. As with other IFC Risk Sharing Facility operations, the CHUEE agreements with various PRC banks are bilateral loss-sharing agreements, whereby the banks, IFC, (and, in the case of CHUEE to date, a third party) share losses incurred from any defaults on loans covered under the program. Loss-sharing coverage exists in two reserves, each with a threshold. The first-loss reserve covers losses up to a specified threshold, after which the second-loss reserve covers any further losses, also up to a specific threshold. Pledges of IFC's own funds are combined with pledges of participating bank's funds in the second-loss reserve. However, IFC cannot pledge its own funds for the first-loss reserve. These must be covered by the participating bank, together with a third, additional party if needed.

[1] Huaxia Bank introduced an incentive system for its loan officers, as a result disbursals of this line of credit for energy efficiency projects began to increase.

17. The first project of the CHUEE program (now called CHUEE 1) was launched in 2007, with $16.5 million of GEF funds. These were used to cover a third-party position in the first-loss reserves to be set up with participating banks, and to support technical assistance and incremental project management costs. The funds were also used to cover IFC's commitment to provide suitable loss coverage sharing for the second-loss reserve from its own funds, based on negotiations for each agreement. Agreements were signed with Industrial Bank (Xinye Bank) in December 2006 and the Bank of Beijing in November 2007. The size of the first-loss reserves was set at 10% of loan principal amounts, shared with 75% provided by GEF through the IFC, and 25% by the banks. The second-loss reserve covered the balance of loan principal amounts, with IFC's coverage at 40% and that of the banks at 60%. The share of the banks' risk coverage was covered through various loan security measures negotiated between the banks and the borrowers.

18. Industrial Bank quickly built up its energy efficiency loan portfolio, which was a great success for the project at the outset. In less than a year, Industrial Bank had fully committed the coverage of its initial risk-sharing facility of RMB460 million (about $60 million), financing 50 loans to 35 companies. Because the natural gas utility demand-side management aspects of the project were proceeding less smoothly,[2] those aspects were largely abandoned in favor of the risk-sharing facility efforts focusing on large enterprises. In late 2007, the IFC negotiated additional risk-sharing coverage arrangements with Industrial Bank (CHUEE 2). This provided $100 million of IFC funds for second-loss coverage, and a reallocation of GEF funds to use some allocated for technical assistance for additional first-loss coverage. Industrial Bank targeted a portfolio of RMB1.5 billion (about $210 million) in energy efficiency loans. The CHUEE 2 arrangement lowered the first-loss coverage to just 5% of the loan principal, and the GEF's risk coverage share of that (again through IFC) to 50%. Approvals from the State Foreign Exchange Administration for the new agreement were not obtained until October 2009. However, Industrial Bank moved ahead with its lending programs. In addition, in June 2008, a Risk Sharing Facility agreement was also signed with Shanghai Pudong Development Bank, although that appears to have moved slower.

19. As of June 2009, Industrial Bank and Bank of Beijing had provided energy efficiency loans totaling RMB3.5 billion ($512 million) under the CHUEE program. These financed 99 projects. No loan losses have required payouts from any of the reserves. Although a base-case default rate of 4% was assumed in the program design, there have been no defaults in the portfolio. Nearly half of the investments were for industrial power generation, usually associated with waste heat or gas recovery. Among the 58 loans backstopped under CHUEE 1 at that time, 14 involved energy service companies, including 7 of the Bank of Beijing's total of 8 loans. Loan amounts involving energy service companies were smaller than others, averaging $1.8 million each.

20. The program experienced different outcomes between Industrial Bank and Bank of Beijing in terms of portfolio growth and the ability to use the guarantee. Earlier,

[2] The partner gas-based utility had mostly small and medium-sized enterprise clients, such as hotels, shopping malls, restaurants, while the bank did not have a small and medium-sized enterprise focus. With little geographic overlap between the client bases of the utility and the bank, the bank focused on building its energy efficiency lending portfolio in the market segment it was most familiar with–large enterprises. In fact, a large number of loan applications from small and medium-sized enterprises were rejected on the grounds that they could not provide acceptable collateral.

IFC energy efficiency programs in other countries also experienced varied usage of financial facilities. Obviously, a guarantee by itself is not an adequate incentive to increase energy efficiency lending; and the program needs to find the right balance between the strategic objectives of banks and the program's objectives. Industrial Bank, for example, combined the marketing of energy efficiency loans with a strategy of retaining customers. Thus, it made energy efficiency loans largely to existing clients, whereas Bank of Beijing targeted new clients and faced difficulties in growing its energy efficiency loan portfolio.

21. It is noteworthy that since 2006, certain PRC banks have begun to strengthen lending to small and medium-sized enterprises (SMEs), albeit gradually. As a result, in 2010 IFC launched work on a series of new "CHUEE 3" projects. One effort is a new "CHUEE SME" initiative, designed to support energy efficiency lending to SMEs by participating banks through new risk-sharing facilities. Funds for the third-party share in the first-loss reserve are planned to be provided by the PRC's Ministry of Finance, using a portion of funds remaining from the Energy Management Company Guarantee Fund financed by the GEF under the now completed World Bank Second Energy Conservation Project (see below). In addition to Industrial Bank and Shanghai Pudong Development Bank, Binhai Rural Commercial Bank of Beijing and perhaps some others may participate. Another project under discussion is a more local risk-sharing facility operation in Hangzhou municipality, for which the local government may support the third-party first-loss reserve position.

C. Financing Energy Service Companies

22. **World Bank Second Energy Conservation Project.** While the various projects to develop energy efficiency lending in PRC banks resulted in support for some projects involving energy service companies, their focus has been on developing energy efficiency loans more generally. One program that focused exclusively on developing credit financing for energy service companies was the World Bank-GEF Second Energy Conservation Project, approved in October 2002 and rendered effective in June 2003. Aside from technical assistance support to the PRC's new energy service company association, the Energy Management Association, the project supported an energy service company loan guarantee program operated by China National Investment and Guaranty Company. Some $22 million was placed in a reserve account to help cover the risks of default on guarantees for commercial loans from PRC banks for energy performance-contracted energy efficiency projects. China National Investment and Guaranty Company issued loan guarantees for 148 energy service company projects during 2004–2009. Guarantees totaled CNY517 million ($69 million), supporting CNY918 million ($123 million) in energy performance-contracted project investment. Because nonrecoverable default losses were exceptionally small, and operating costs defrayed by reserve interest and guaranteed fee income, the $22 million in the reserve account remained in place at the end of the World Bank project, and is available to the government for continued support of energy efficiency investments.

23. While the lending support to the PRC's new energy service companies was important, perhaps the greatest value of China National Investment and Guaranty Company's program was to operationally introduce the new companies to the financing world—and the new energy performance contracting business to the

banking industry. China National Investment and Guaranty Company's developed a dedicated team focused for 6 years on making financing arrangements for energy service companies work. The company guaranteed loans to 42 mostly privately owned energy service companies. Two-thirds of them received their first bank loan ever under the program, and were subsequently able to build experience and credit records with financial institutions. China National Investment and Guaranty Company developed specialized technical and credit appraisal methods for the energy performance contracting business adhering to PRC banking customs. The guarantee company partnered with 12 banks and six provincial guarantee companies, introducing them to the business and executing transactions. The most active partner bank in the program was Bank of Beijing, which also pursued loan guarantees for relatively large projects involving energy service companies under the IFC CHUEE program.

24. China National Investment and Guaranty Company developed new financing approaches as the program evolved. CNIGC issued guarantees for multiproject lines of credit to 12 energy service companies with project experience, backed in part with the accounts receivable of the energy service companies from previously executed projects. China National Investment and Guaranty Company continues to be active in energy efficiency financing following the closure of the World Bank project in 2010. But perhaps the most important sustainable contribution was the links created between energy service companies and banks that had been nonexistent before.

D. Supporting Financial Leasing Companies

25. Unlike operating leasing, financial or capital leasing as licensed in the PRC includes leases that meet one or more of the following criteria: (i) ownership of the asset is transferred at the expiry of the lease, (ii) the finance lessee has the option to purchase the asset at the expiry of the lease, (iii) the lease term covers most of the useful life of the asset, and (iv) the total rents are approximately equal to the value of the leased asset. Enterprises are allowed to enter the leased asset on their balance sheets and depreciate the leased asset as if it were their own, even though ownership is retained by the leasing company unless or until the assets are eventually purchased by the lessee enterprise. The financial leasing model provides many advantages in the energy efficiency business. Leases can be structured to be similar to energy performance contracts, so that project energy cost savings fully cover host enterprise lease payments. This provides for greater flexibility and room for innovation than if bank loans are used by energy service companies and/or enterprises to pay for the investments.

26. World Bank Shandong Energy Efficiency Project. Approved in June 2011, the largest component of this project includes onlending of $134 million of IBRD loan proceeds to co-finance energy efficiency investment projects being financed by two financial leasing companies in Shandong Province—Rongshihua Leasing Company ($64 million) and Guotai Leasing Company ($50 million)—and one new large energy service company Luxin Energy Investment and Management Company ($20 million). The three financing companies will at least match the IBRD financing amounts from their own sources. They will assume all the repayment risks of the IBRD loan to the government, and will select and appraise projects by themselves as long as they meet the criteria agreed upon in the project's operational manuals. Rongshihua Leasing is

a corporate outgrowth from the Shandong Energy Management Company, formed as one of the PRC's first three pilot energy service companies in 1996, and supported under the World Bank's first Energy Conservation Project. The company received one of the first corporate financial leasing licenses offered in the PRC under a pilot program operated by the Ministry of Commerce and State Taxation Administration. It has piloted the use of the financial leasing model for energy efficiency projects, drawing on its 15 years of experience in energy performance contracting. Guotai Leasing is also seeking to develop an energy efficiency financial leasing business, while Luxin Energy is a large investment company trying to develop energy performance contracting on a large scale.

Box A9.1: Basic Types of Chinese Energy Performance Contracting Models

Energy performance contracts in the People's Republic of China are generally classified into three types, or "modes." Although the characteristics of each mode are similar in many respects to those bearing the same English language name, there are differences, and therefore the Chinese categorization cannot truly be used interchangeably with categorizations in other countries. In all cases, energy service companies undertake detailed project design, manage most project implementation aspects, and guarantee energy savings performance. However, financing, contract, and asset ownership arrangements vary.

Shared savings contracts. In this mode, energy service companies provide the bulk of project financing and are compensated for their investment and services by their client from a portion of the energy cost savings resulting from the project. The assets created by the project are owned by the energy service company until contract completion, when they are transferred to the client, usually at no charge. The minimum energy cost savings stream from the project is estimated by the energy service company in the contract, usually conservatively, and acknowledged by the client. In most cases contracts provide for payment streams to the energy service companies based on an agreed percentage share of the agreed estimated minimum cost savings scenario, as long as the monitoring arrangements for project savings verify that at least the agreed level of energy savings has materialized with normal asset operation. Any additional savings are usually "given" to the clients. As long as the project is implemented with the basic results originally expected, these contracts typically result in a predictable payment stream. There are cases where payment streams vary every payment period, based on ongoing measurements of actual savings during the contract period. But these are in the minority. Hence, most Chinese shared savings contracts are actually not the same as the traditional "shared savings" contracts as defined in North America. They are probably closer in principle to the "energy service company-financed guaranteed energy savings contracts" typically used for federal government energy performance contracting in the US.

As described later, shared savings contracts currently are the only energy performance contracting mode recognized for the government's new energy performance contracting financial incentives. Hence, this mode is likely to further expand, and will probably become more standardized.

Guaranteed energy savings contracts. In these contracts, clients provide the bulk of project financing themselves. Assets generated belong to the client. In addition to design and implementation services, energy service companies guarantee the energy savings levels from the project. To be considered proper energy performance contracting, failure to achieve the guaranteed energy savings amounts must have direct financing consequences to the energy service company.

Outsourcing contracts. In this mode, energy service companies finance and develop energy savings assets within the client's facilities, and operate these assets over an extended period for agreed compensation. This is linked in one way or another to the energy savings achieved. The energy service company owns the assets, and transfers them to the client at the end of the contract, which may be 8–10 years. One common

example is the development of on-site build-operate-transfer power generating facilities using waste heat or byproduct gas from a plant. The energy service company builds and operates the plant, purchasing the energy resource for a small fee or no charge, and sells the electricity to the plant at a rate well below the plant's purchase price from the grid. Another example is where energy service companies develop or purchase local district heating assets, undertake energy efficiency renovations and operate the system, and receive remuneration from the larger difference between heat sales revenue and fuel costs. In a final example, an energy service companies develops, purchases or leases the lighting and/or space conditioning assets of a building, undertakes energy efficiency renovations, operates the system, pays the building's electricity bills, and charges the building owner or occupant fees for predefined lighting and/or space conditioning services, at costs lower than before the energy service company's involvement.

Energy service companies and their clients have developed many variations on these modes as well as different types of financing arrangements and risk-sharing regimes. Companies with leasing licenses are beginning to offer financial leasing contracts developed around energy efficiency projects. Some companies are beginning to look at the development of special purpose companies for large projects involving several energy service companies working together.

Contract provisions and monitoring and verifications schemes are typically far simpler than in North America. For the many projects which involve relatively simple equipment replacement or renovation, minimum energy savings estimates are relatively easily agreed between energy service companies and clients. If the equipment operates at commissioning as expected, energy savings may then be stipulated and payment schedules agreed in the contract then confirmed . Many contracts specify a "normal" operating regime, which is used to calculate stipulated savings and payments to the energy service companies accordingly. Risks of operating regime changes usually fall to the client. Energy prices for calculating energy cost savings streams also are typically set out in the contract, so that the benefits or risks of energy price changes also fall to clients. Where clients have specific needs or concerns, energy service companies often will vary contractual arrangements. However, if energy service companies are looking to banks or other financial institutions for project loan financing, it is important for project payment regimes to be as fixed and predictable as possible. Generally speaking, the greater the contingencies on the payment stream, the more difficult it is to secure outside financing.

Source: S. Xiaoliang, Z. Lin, and B. Taylor. 2011. [People's Republic of] *China's ESCO Industry: Saving More Energy Everyday Through the Market*. Beijing: Energy Pathways. ESCO=energy service company.

E. Standards and Labeling

27. The PRC first adopted minimum energy performance standards in 1989. Today, there are standards for a wide range of domestic, commercial, and selected industrial equipment. In 1999, the PRC launched a voluntary endorsement label, which has grown to cover more than 40 products.[3] In 2005, the PRC started a mandatory energy information label, also referred to as the "Energy Label".

28. Minimum energy performance standards and the voluntary endorsement labeling specifications have been updated and revised in order to reflect technology improvements to products in the market. Indeed, the PRC has built up strong infrastructure to develop and implement product standards. Until at least 2008, the government's primary focus was on the technical requirements for efficiency performance. Less attention was paid to monitoring and enforcement, with a minimal commitment of resources and little expansion of administrative capacity in this area.

[3] This includes some water saving products.

Thus, market compliance with both mandatory standards and labeling programs has been questionable, and actual energy savings may have been undermined as a result.[4]

29. Mandatory minimum efficiency standards. Developed by the China National Institute of Standards, mandatory energy efficiency standards now cover most residential and commercial appliances, lighting, heating, and cooling equipment, and total 22 or more. Beginning in 1999, the institute developed a series of new single-period standards based on international practice. In 2003 it began development of the so-called reach standards, or two-period, two-tiered standards. The proposed 2007 reach standard, which formally was a part of the 2003 standard, will be superseded by the 2008 standard. This has its own, more stringent 2011 reach standard.

30. Voluntary energy efficiency labeling. The voluntary energy efficiency endorsement labeling program is analogous to the US Energy Star program with which it cooperates closely. It has been administered by the China Standards Certification Center since 1998. The program currently labels 50 products from more than 300 participating manufacturers. The products include home appliances, consumer electronics, office equipment, lighting, and selected industrial equipment. The program requires that manufacturers agree to an on-site audit of production facilities, undertake third-party testing in certified laboratories, and comply with ISO 9000 standards. Audits are repeated annually.

31. Mandatory energy information labeling. In 2005, the PRC launched a categorical mandatory energy information label, adapted from the European Union categorical energy label. It includes five categories of efficiency classes. The label initially covered two products. It was extended in 2007 to cover four products, and the China National Institute of Standards is responsible for managing this program. Unlike both the mandatory standard and the voluntary energy efficiency label, manufacturers are able to self-report the energy consumption of each model.

32. Enforcement and monitoring mechanism for minimum energy performance standards. Implementation of the PRC's appliance standards and labels is governed by a variety of laws and regulations, and overseen by several related agencies and departments. Agencies involved in the implementation and enforcement of appliance standards and labels include the state-run Administration of Quality, Supervision, Inspection and Quarantine and its provincial branches, as well as the China National Institute of Standards and China Standards Certification Center.

33. Although the quality testing of products takes place every quarter, the emphasis is more on safety. For products covered under the minimum energy performance standards program as of 2008, the energy efficiency aspect was not regularly monitored once the product was introduced. National product quality supervision testing was the main mechanism to verify the compliance status of products with standards. The Administration of Quality, Supervision, Inspection and Quarantine is in charge of organizing national product quality testing, publicizing test results and enforcing actions against offenders.

[4] Nan Zou, Lawrence Berkeley National Laboratory (Environmental Energy Technologies Division). 2008. *Status of* [People's Republic of] *China's Energy Efficiency Standards and Labels for Appliances and International Collaboration, Berkeley*, March.

34. Enforcement and monitoring mechanism for labeling program. The China Energy Label Center, an agency within the China National Institute of Standards, supervises the registration and monitors the use of energy information labels. Since 2008, steps taken to close the gaps between the PRC and international best practices include (i) introducing product registration and reporting requirements for minimum energy performance standards (i.e., for products not covered by the "Energy Label"); (ii) increasing attention to energy efficiency monitoring and verification as part of the regular testing program, as well as doing so for a larger sample to qualify as vigorous monitoring; and (iii) improving the testing infrastructure as well as increasing budgetary allocations.

F. Key Energy Using Enterprise Energy Use Annual Reporting System

35. The PRC's Energy Conservation Law, as amended in 2007, requires all key energy-using enterprises to report their energy-use situation to government authorities. Key energy-using enterprises are defined as enterprises consuming 10,000 or more tons of coal equivalent (tce) per year and, if so required by provincial or local authorities, enterprises consuming 5,000 tce per year. Most provincial governments appear to be including enterprises in the 5,000-10,000 tce consumption range, as well as enterprises consuming 10,000 tce or more, in their definitions of key energy-using enterprises.

36. The National Development and Reform Commission issued templates for energy use reporting and guidance on completing the templates, and began collecting data annually for the 1,000 top enterprises in the country as part of the "1,000 Enterprise" program, during the last several years of the 11th plan (2006–2010). With the experience gained, templates are being revised and the program expanded to include all of the 10,000 enterprises in the new "10,000 Enterprise" program of the 12th plan (2011–2015). The 10,000 enterprises account for over 80% of the PRC's total industrial energy consumption. Annual energy use reports will be required to be collected by local and provincial government authorities and submitted to the National Development and Reform Commission for all of the 10,000 enterprises. Strong efforts are being made to keep the reporting system confidential and secure. Provincial and prefectural governments are also likely to use these templates, perhaps with further adjustments of their own for the reporting of the remaining key enterprises. These total up to 27,000 enterprises if all those consuming over 5,000 tce are included. Many provincial and prefecture governments are also planning additional, simpler monthly or quarterly reporting.

37. The basic format and content of the annual reporting template used by one leading prefecture government is summarized below. As the basic templates all follow the National Development and Reform Commission guidance, templates used by other provincial and local governments are likely to be quite similar.

38. One table in the annual report includes basic summary information for the reporting year. This includes (i) the name and address of the enterprise; (ii) its legal representative; (iii) the energy manager assigned with responsibility for enterprise energy management and coordination with the government, and this person's contact

information; (iv) gross industrial output of the enterprise expressed in constant prices; (v) sales income; (vi) total comprehensive energy consumption (tce); (vii) total energy operating cost expressed in renminbi; (viii) the share of energy costs in total operating cost expressed as a percentage; (ix) the unit energy consumption (tce/RMB10,000 of gross industrial output value); and (x) the main products, annual production capacity for these products, actual production amount, and unit energy consumption (tce/physical unit).

39. Another table in the annual report shows the structure of energy use. Consumption quantities in original units are provided, together with coefficients used to convert to tce (guidance coefficients are provided but can be changed), and tce consumption amounts for the following: electricity (kilowatt-hour), coal, gasoline, diesel oil, heavy oil, liquefied petroleum gas, and heat purchased from outside. Electricity is to be converted to tce according to thermal power generation energy use values for that year.

40. A third table in the annual report includes a list of products, their units of measurement (tons/pieces, etc.), annual production capacity, actual production and the total energy use for the production of products. The table includes the specific energy consumption for the current and previous period, and a comparison of the previous and current specific energy consumption calculation. This is expressed as a percentage of energy savings in the production of a commodity based on the specific energy consumption comparison (be it positive or negative) for the year. The table also lists the standard specific energy consumption quota for that commodity (national or local) if applicable.

41. The next table in the annual report includes two templates—one on physical products and their specific energy consumptions, and the other on changes in unit energy consumption per unit of gross output value, where enterprises can provide explanations of factors influencing changes.

42. The last table in the annual report includes reporting on the enterprise's performance in meeting energy conservation targets during the last 5 years. A summary table includes (i) the total energy savings target for each year, (ii) the actual energy savings achieved, based on calculation of changes in commodity physical specific energy consumptions, and (iii) the actual energy savings achieved based on calculation of changes in output value specific energy consumptions. A section explains the calculation methods and other circumstances, by year.

G. Energy Conservation Special Fund

43. Several provincial governments in the PRC have established special energy conservation funds to provide resources for their various energy conservation-related activities. In the case of Guangdong, the provincial government's proposed annual allocation from its budget is RMB200 million; it is managed by the Guangdong Finance Department and the Guangdong Economic and Information Commission.[5]

[5] Guangdong Finance Department and Guangdong Economic and Information Commission. 2008. *Announcement on Guangdong Energy Conservation Fund Management Method; Temporary (Yuecaigong No. 126 2008)*. Guangzhou (9 July).

44. Projects and activities eligible for support from the conservation fund include: (i) key energy conservation projects, identified by Guangdong's long- and mid-term energy conservation planning; these include motor system energy savings, energy system optimization, residual heat and pressure utilization, petroleum saving and inter-fuel substitution, combined heat and power cogeneration, and green lighting; (ii) the creation of a platform for energy conservation services through capacity building of energy service companies, measurement and verification companies and other energy service providers; (iii) the promotion and application of advanced energy savings products and equipment, and high-efficiency lighting products in accordance with relevant national programs; (iv) comprehensive resource utilization projects, such as for integrated planning and utilization of coal and other mineral resources, and timber saving through substitution and recycling projects; (v) clean production projects that lead to energy saving and pollution reduction projects in manufacturing enterprises; and (vi) awareness and capacity development activities, such as promotion and awareness activities related to energy saving, integrated resources utilization, and clean production, as well as capacity development for policy studies, information exchanges, energy supervision and monitoring.

Appendix 10

ENERGY EFFICIENCY PROGRAMS IN INDIA

A. Introduction

1. In 2001, the Government of India enacted the Energy Conservation Act, which came into force in 2002. As provided by the act, the government established the Bureau of Energy Efficiency under the Ministry of Power. The bureau implements the provisions of the act and spearheads energy efficiency improvements through regulatory and promotional measures. The act also empowers state governments to put in place a legal framework to create an institutional setup promoting energy conservation in their states, and to help monitor these efforts.

2. The government also formulated the National Climate Change Action Plan in 2008. The plan includes the National Mission on Enhanced Energy Efficiency as one of the eight focus areas in the strategy for climate change mitigation and adaptation. The plan also acknowledges that the ongoing (as of 2007/08) energy efficiency initiatives of the Bureau of Energy Efficiency will lead to the avoidance of about 10,000 megawatts (MW) of power capacity additions during the 11th Five Year Plan period (2007/08–2011/12). To accelerate energy efficiency improvements, the Bureau of Energy Efficiency was to launch four new initiatives as part of the National Mission on Enhanced Energy Efficiency. These initiatives are market-based mechanisms for enhancing the cost effectiveness of energy efficiency improvements of energy-intensive large industries and facilities through the certification of tradeable energy savings. They aim to (i) accelerate the shift to energy-efficient appliances in designated sectors, and make these appliances more affordable through innovative measures; (ii) create mechanisms that help finance demand-side energy efficiency measures in all sectors by capturing future energy savings; and (iii) develop fiscal instruments to promote energy efficiency.

3. Since 2008, the Bureau of Energy Efficiency has been engaged (through consultations with government ministries, external experts, research and development institutions, and private industry) in launching a partial risk guarantee fund to encourage energy service companies to promote energy efficiency projects, and a venture capital fund to provide last-mile equity investments in emerging energy-efficient technology areas. The Bureau of Energy Efficiency has also been instrumental in the design and, where possible so far, launch of initiatives with and through other institutions with specific energy efficiency-related mandates, as well as in consultation with a broad range of stakeholders.[1] Progress in implementing these initiatives and the

[1] These include (i) the Perform, Achieve and Trade scheme for large and energy-intensive enterprises; (ii) the Energy Conservation Building Code for commercial buildings: (iii) the Standards and Labeling program for household appliances; (iv) demand-side management program for agriculture pumpset efficiency improvement; (v) a demand-side management program for municipal street lighting and municipal water supply and water treatment; and (vi) a household lighting efficiency improvement program.

implementation modalities vary widely. The intended objective is to achieve energy savings of 23 million tons of oil equivalent (mtoe) by 2014/15, and a cumulative avoided electricity capacity addition of 19,000 MW. For the 12th plan period (2012/13–2016/17), the target for avoided capacity is likely to be enhanced to about 30,000 MW.

4. In broad terms, the Government of India and the Bureau of Energy Efficiency have preferred to follow a two-pronged approach in which the institution of necessary regulations is accompanied by capacity development efforts at the central, state, and local levels. Recognizing the need for engaging state and local governments to implement energy efficiency initiatives, the government and bureau have preferred an approach whereby a large number of states can be engaged at the earliest opportunity through the design of energy efficiency schemes that are easy to understand and implement, and thus attract the maximum number of state governments. Over time, as state governments see the benefits of energy efficiency, which would increase political commitment for energy efficiency, more ambitious targets and increasingly stringent regulations can be set. This approach should foster a sustained capacity development effort to enable oversight, monitoring, and the enforcement of increasingly stiff targets and stringent regulations. Initiatives that have begun to yield results or show promise by mid-2011 are elaborated below.

B. Energy Conservation Code for New Buildings

5. The Government of India launched the Energy Conservation Building Code in May 2007 for implementation in new buildings on a voluntary basis. Following the amendment to the Energy Conservation Act in 2010, the code set minimum energy standards for new commercial buildings having a connected load of 100 kilowatt or contract demand of 120 kilovolt ampere.[2] The emphasis on new buildings reflects the economic growth profile in which service industries with offices in urban centers and satellite townships will account for an increasing share of India's GDP. From about 660 million square meters of floor space in commercial buildings in 2010, the floor space is projected to grow to 1.75 billion m2 by 2030.[3] Indeed, more than 60% of commercial floor space by 2030 is expected to be in buildings that have yet to be built.

6. The Energy Conservation Building Code is intended to be a first-generation building code in which ease of implementation is a key consideration. The code was finalized following (i) an extensive consultative process; (ii) an extensive data collection process on building designs, construction materials, insulation materials, glass types, lighting, and heating-ventilation-air-conditioning; and (iii) building design simulations, including detailed energy and life-cycle cost analysis.

7. **Scope.** The Energy Conservation Building Code covers India's five climatic zones.[4] It covers five major building components: (i) building envelope (walls, roofs, windows), (ii) indoor and outdoor lighting, (iii) heating-ventilation-air-conditioning systems, (iv)

[2] Originally, as per the Energy Conservation Act 2001, the Energy Conservation Building Code was to set minimum energy standards for commercial buildings that have an electrical connected load of at least 500 kilowatts or a contract demand of at least 600 kilovolt ampere.

[3] USAID ECO III Project. 2010. *Total Commercial Floor Space Estimates for India*. New Delhi.

[4] Hot and dry, hot and humid, temperate, cold, composite (mixed).

service water heating and pumping, and (v) electrical systems (transformers, power factor). The three major categories of buildings covered are day-time use office buildings, buildings occupied by information technology service providers, where work may go on 24 hours a day, and shopping malls and commercial buildings. Here, energy consumption is at a maximum during evening hours, weekends, and other holidays.

8. **Compliance.** The Energy Conservation Building Code allows for compliance checks in three ways: (i) a prescriptive approach, whereby the performance of each component and subsystem in a building should meet required energy efficiency norms; (ii) a "whole building" compliance approach in which component or subsystem-level measurements are not made; this allows for flexibility in meeting or exceeding energy efficiency requirements compared with a baseline building; and (iii) a subsystem-based trade-off approach that allows for flexibility through balancing some high-efficiency components or subsystems with other lower efficiency components or subsystems.

9. The use of energy simulation software is necessary to ascertain the compliance of the building design via the "whole building" approach. The simulation software estimates the year-round energy consumption of a new building through its proposed design, and compares it with a baseline building of standard design. The new building design is considered to be in compliance with the Energy Conservation Building Code if its simulated annual energy consumption is estimated as being less than or equal to a building of standard design.

10. **Implementation.** The National Building Code (2005) is being modified to include the key aspects of the Energy Conservation Building Code, and particularly by including a section on "Approach to Sustainability." The aim is to implement the code with the engagement of state governments and urban local bodies. The move from voluntary to mandatory compliance of the code has begun in a small way. At the behest of Bureau of Energy Efficiency and Ministry of Power, the Ministry of Urban Development initiated the process of implementing the code in the states through a government notification. The Ministry of Urban Development directed the urban development departments of state governments to adopt the Energy Conservation Building Code. In some states, such as Haryana in northwestern India, the state laws have been modified. But it is clear that before compliance with the code becomes mandatory, it will be necessary to develop capacity at the central, state, and local levels. This will need to be done in terms of certified building energy auditors, making available auditing equipment and software toolkits, designing a suitable measurement and verification system, and a legal mechanism for enforcement, as well as encouraging and attracting energy service companies and energy efficiency equipment suppliers. The active engagement of state governments, architects and engineers, academic institutions, technical consultants, and the equipment manufacturing industry is vital. It is intended to have the necessary capacity development in place by the end of the 12th plan period (i.e., by March 2017).

11. In view of the realities on the ground, it is expected that compliance checks and audits will be introduced only gradually. To begin with, building plan drawings will be reviewed to assess compliance. This will most likely not be done by technical experts from or affiliated to each urban local body, but by a group of technical experts working with state-level urban development departments. On-site checks and measurement and verification would begin to be implemented as and when a critical mass of certified building energy auditors is created.

C. Energy Performance Rating of Existing Buildings

12. Rising energy costs have prompted many commercial buildings to be retrofitted with better air-conditioning systems, more efficient lighting, and double-pane glass windows to reduce energy consumption. Also as a result of rising energy costs, attempts are being made to rate buildings by their energy performance.

13. Scope of building benchmarking exercise. A commercial building energy benchmarking exercise was launched in 2007, which began with the collection of whole building energy data.[5] Substantive information was collected for 760 buildings of various types (offices, hotels, hospitals, and malls) in all five climatic zones. Public and private sector buildings in metropolitan cities as well as a few small cities and towns were included. For a specific building type in each climatic zone, the performance of a hypothetical benchmark building was estimated using regression techniques, and the surveyed buildings were indexed against this benchmark to compute a performance score for each building.

14. Limitations. Although the benchmark building and high-performance score buildings can provide clues to improving the performance of other existing buildings, this is still difficult to glean from the available information. The limitations of the performance scoring exercise carried out so far include the following: (i) information was not compiled on the operation schedule of the air-conditioning or heating-ventilation-air-conditioning, thermal comfort levels, and indoor air quality; therefore, it is difficult to assess whether a fully air-conditioned building consumes less energy and attains a high performance score because it is truly efficient or because it does not maintain the required comfort level all year round; (ii) standard climate metrics, such as heating and cooling degree days, were not found to be significant determinants of energy consumption in any of the building types, which may reflect the fact that the ratio of floor area to building surface area is high, or that the indoor environment varies widely; (iii) most buildings are from predominantly urban settings, so it is difficult to extrapolate the survey findings to buildings in areas where building density is relatively low;[6] and (iv) few buildings in the cold climatic condition were covered in the survey.

15. Towards refining the building benchmarking exercise. The survey needs to be improved by including more information, enhancing data reliability, ensuring balanced coverage, and increasing sample size. The survey data need to be expanded to include information on the year of construction, building envelope characteristics, building orientation, occupancy schedules by shifts, and system and equipment load. Data reliability can be improved by using electronic means to administer the survey. Regulations for adhering to thermal comfort standards and indoor air quality standards should ideally be in place, as well as a building energy audit program. As variations in weather conditions can affect energy consumption levels by up to 15%, efforts should be made to conduct the survey every 2-3 years. This calls for a comprehensive capacity development program that would include a large number of professionals across the country to design and conduct the surveys, as well as analyze the findings.

[5] This included information such as connected load, electricity generated on site, electricity purchased from utilities, built-up area, air-conditioned area, number of floors, type of air-conditioning, climatic condition, occupancy levels, and operating hours.

[6] The urban heat island effect is very different in areas with high building density vs. areas with low building density.

Once sufficient information is available, it will be possible to effectively rate commercial buildings on the basis of their energy performance,[7] and a more focused effort to improve the energy efficiency of poorly performing buildings can then be launched.

D. Trading of Certified Energy Savings

16. The Energy Conservation Act 2001 allows the Bureau of Energy Efficiency to set mandatory energy efficiency improvement targets for large energy-consuming industrial facilities that are notified as designated consumers. Under the 2010 amendment of the act (i) the Government of India can issue energy savings certificates to designated consumers whose specific energy consumption is less than the prescribed norms and standards; (ii) designated consumers whose specific energy consumption is more than the prescribed norms and standards should purchase energy savings certificates to comply with them; and (iii) the government, in consultation with the Bureau of Energy Efficiency, sets the value of the energy savings certificates. In response, the bureau has designed the perform, achieve, and trade scheme.

17. Scope and design. The key design features of the perform, achieve, and trade scheme include the following: (i) it covers to begin with 477 designated customers across eight energy-intensive industries, each with energy consumption higher than a specified threshold value; these customers had a combined consumption of 165 mtoe in 2010/11, about 35% of total primary energy consumption;[8] (ii) the baseline specific energy consumption for each designated customer is taken as the average specific energy consumption over the 3-year period 2007/08–2009/10 , as observed from records maintained by the designated customers, electricity and fuel purchases, changes in fuel stocks, self-generation of electricity, capacity utilization levels, and the production of various products or product grades; (iii) an overall specific energy consumption reduction target of 4.16% over a 3-year period beginning with the date of the Government of India's notification (likely by August 2011), which amounts to about 6.6 mtoe; (iv) a specific energy consumption reduction target is set for each designated customer in view of its vintage, size, type of production process, and baseline specific energy consumption SEC vis-à-vis other designated customers in the same sector—a customer with a relatively high baseline specific energy consumption is required to achieve a greater specific energy consumption reduction and vice versa; (iv) towards the end of the 3-year period, determining specific energy reductions on the basis of an independent review of records kept by the designated customers, as well as independent verification of energy purchases from suppliers, product sales from off-takers, and relevant tax filings; (vi) issuing energy savings certificates[9] to designated customers who exceed their mandated specific energy consumption reductions for trading on the national power exchanges; and (vii) mandating designated customers

[7] For instance, if a star-rating system is to be followed along the lines of United States Environmental Protection Agency's Commercial Building Energy Consumption Survey, it may be possible to rate the buildings. The following system has been proposed: 5 stars for the top 3 percentile, 4 stars for the next 6 percentile, 3 stars for the next 12 percentile, 2 stars for the next 24 percentile, and 1 star for the bottom 55 percentile. It is expected, however, that to begin with, the top 10 percentile may be awarded a 5-star status in India.

[8] Aluminum, cement, chlor-alkali, fertilizer, iron and steel, pulp and paper, textiles and thermal power stations. The threshold annual energy consumption values are (i) 30,000 million tons of oil equivalent (mtoe) for cement, fertilizer, iron and steel, pulp and paper, and thermal power stations; (ii) 12,000 mtoe for chlor-alkali; (iii) 7,500 mtoe for aluminum; and (iv) 3,000 mtoe for textile units.

[9] One energy savings certificate is equivalent to 1 mtoe of energy savings.

who do not achieve the required specific energy consumption to pay a penalty of Rs1 million (about $22,200), plus complying with the reductions through a mix of purchasing energy savings certificates and paying the market value of the shortfall in the purchase of these certificates.

18. Limitations. It is widely recognized that the first 3-year cycle of the perform, achieve, and trade scheme is a learning phase. The following governance-related and allied issues remain to be addressed: (i) although specific energy consumption reduction targets for each designated customer have been set through a consultative process with industry and technology experts, as well as the concerned customers,[10] more than 10% of customers raised objections to their reduction targets; (ii) this is particularly important because it is generally known that the specific energy consumption for any industrial enterprise varies significantly due to various factors, such as the quality of raw materials, capacity utilization, and the mix of product grades; however, as of now, the perform, achieve, and trade scheme allows for specific energy consumption normalization only on the basis of capacity utilization and factors beyond the control of the designated customer;[11] (iii) in the entire process, there is no actual measurement of the energy use of any major industrial equipment used by a designated customer; all data are based on the existing system of compilation of energy consumption and other relevant information, energy consumption and the production reporting system, and the independent verification of the records maintained by designated customers; and (iv) the penalty imposed on defaulting designated customers appears to be rather high, which deters defaults on the one hand, but also strengthens the resolve of defaulting customers to dispute the specific energy consumption reduction findings by designated energy auditors. The key issue that emerges is the need for an effective but not too onerous system of energy savings measurement and verification.

19. Extended timelines. The first 3-year cycle is considered a pilot phase, which gives time to firm up other institutional and regulatory aspects, such as (i) the appointment of a perform, achieve, and trade scheme administrator, who will be responsible for issuing energy savings certificates, monitoring transactions, and compliance;[12] (ii) a price discovery mechanism is required for energy savings certificates and whether a price cap needs to be considered; and (iii) developing regulations for the banking of energy savings certificates.

E. Small and Medium Enterprises

20. The Small Industries Development Bank of India has supported micro, small, and medium-sized enterprises to upgrade technology, reduce raw material wastage, reduce costs, and increase their competitiveness. In so doing, the bank has adopted a cluster approach, whereby it is able to assist multiple micro, small, and medium-sized enterprise units manufacturing the same product, and where each unit requires similar measures to improve competitiveness. Energy efficiency gains have often accompanied such measures.

[10] More than 50 consultative meetings were held during the preparatory phase from mid-2008 to March 2011.

[11] Such as requirements to comply with new regulations.

[12] An internet portal is planned to be set up and become fully operational by the end of the first 3-year cycle.

21. More recently, the Small Industries Development Bank of India appears to have reversed its approach for at least a part of its operations. With lines of credit from the Japan International Cooperation Agency and Agence Française de Développement , the emphasis in the past 2–3 years has been to focus on implementing energy efficiency measures. These have often come with other co-benefits, such as improved capacity utilization, reduced production cost, and improved competitiveness. The Bureau of Energy Efficiency has compiled a list of electrical and thermal energy efficiency equipment, their specifications, manufacturers, and expected energy savings.[13] The Small Industries Development Bank of India has been promoting the installation of energy efficiency equipment mainly from this list. Although no energy measurements have been made for installations made through the Japan International Cooperation Agency and Agence Française de Développement Alliance for Development, lines of credit, it is very likely that energy savings per unit of production are indeed achieved. In 2009, Kreditanstalt für Wiederaufbau extended a line of credit of €50 million, and specified a carbon emission reduction target of about 80,000 tons of CO_2-equivalent.[14] With the Bureau of Energy Efficiency as lead executing agency, the Small Industries Development Bank of India is also executing a GEF and a World Bank line of credit with the aim of developing capacity for conducting energy audits for micro, small, and medium-sized enterprise units, and preparing feasibility studies and bankable detailed project reports. The Small Industries Development Bank of India has continued with the cluster approach while managing these lines of credit. And in some cases, it has begun to draw lessons from interventions made in one cluster for application in another producing the same product.

F. Compact Fluorescent Lamp Dissemination

22. The Government of India launched the Bachat Lamp Yojana program to increase the penetration of energy-efficient and high-quality compact flourescent lamps (CFLs) in households and replace the traditional incandescent bulbs. The CFLs, which normally cost about Rs80–100 each, are distributed to households at a cost of Rs15 a lamp, with the investor making up the price difference through the sale of carbon credits. A key design aspect is that neither the power utilities nor any government body is engaged in the procurement or distribution of the lamps; this is the responsibility of an investor.

23. To encourage investors to participate in the Bachat Lamp Yojana program, the Bureau of Energy Efficiency has developed an umbrella framework for the program of activities, which was registered with the Clean Development Mechanism's executive board in April 2010.[15] Such an arrangement has reduced Clean Development Mechanism transaction costs for investors, as key requirements of the mechanism do not have to be addressed provided the program of activities is followed. These also allow the investor to assume a minimum CFL usage of 3.5 hours a day, although investors have the option to conduct a survey in their project areas and claim credits on the basis of higher usage. Investors, however, may not conduct expensive field surveys to assess actual CFL

[13] Bureau of Energy Efficiency. 2009. *Energy Saving Equipment List (Revision 3.0)*. New Delhi (20 July).

[14] The original target of 400,000 tons of CO_2 equivalent was revised downward when it was realized that it was too ambitious.

[15] The Bachat Lamp Yojana perform, achieve, and trade scheme defines key Clean Development Mechanism requirements, which include the determination of project baseline, additionality, methodology, and monitoring protocols to assess CO_2 emission reduction.

usage.[16] The Bachat Lamp Yojana program has targeted the replacement of 400 million incandescent bulbs across the country, and is being implemented in various states.[17]

24. On the other hand, this system does not require investors not to keep track of CFLs that have been distributed (e.g., how used CFLs are disposed of, whether they are actually being used by the buyer, or whether the buyer sells them on the black market). In addition, some investors may inadvertently sell CFLs to middle-income users who also buy CFLs at market prices, but such information is not publicly available.

G. Standards and Labeling

25. The Bureau of Energy Efficiency launched a large awareness campaign in the mid-2000 to encourage the purchase of energy efficient selected household and commercial appliances, such as televisions, air-conditioners, refrigerators, and tubular fluorescent lamps. Given the relatively high purchasing power in urban areas, the target audience for the awareness campaign was in cities and townships.

26. The Bureau of Energy Efficiency also designed an appliance labeling program in consultation with appliance manufacturers, and introduced a labeling scheme in 2006.[18] Manufacturers and importers participating in the labeling program are required to file an application with the bureau. On getting clearance, applicants are allowed to affix the star-rating label as per the bureau-approved design on their appliances and equipment. The applicant is held responsible for the accuracy of the label displayed. The star-label rates appliances in one of five categories according to efficiency ranges. The scheme was introduced on a voluntary basis for a few appliances, with the intention that eventually more appliances will be covered, and the scheme made increasingly mandatory. Over time, and in consultation with manufacturers, economists, regulators, and opinion leaders, the intention is to make the 5-star rating scale more stringent. For instance, by raising the bar all or many of the 5-star rated television sets would be re-rated as 4-star, the currently 4-star rated televisions re-rated as 3-star, and so on.

27. Verification and challenge. The Bureau of Energy Efficiency verifies label contents, and how labels should be displayed for each equipment/model on a regular basis. For this, the label user (labeling enterprise) provides a sufficient sample of products for free, is responsible for transporting the sample to an accredited laboratory, and bears all costs associated with "verification-testing." In the event of a written complaint alleging inaccurate labeling, the Bureau of Energy Efficiency's committee of experts first ascertains whether a "challenge testing" is to be conducted. Should it decide that one is required, the complainant bears upfront the cost of sealing the required samples and transporting them to an accredited laboratory. The complainant and the label user may witness the testing. If the equipment meets the required efficiency levels and passes the challenge test, the complainant forfeits the expenses already incurred. If

[16] For instance, C-Quest, an investor that distributed 1.5 million CFLs to railway employee households, has chosen not to conduct a field survey of actual lamp usage.

[17] These comprise Andhra Pradesh, Chattisgarh, Delhi, Goa, Haryana, Madhya Pradesh, Orissa, Punjab, Rajasthan, Tamil Nadu, Uttar Pradesh, Uttarakhand, and West Bengal.

[18] Bureau of Energy Efficiency. 2006. *Energy Efficiency Labels: Details of Scheme for Energy Efficiency Labels*. New Delhi.

the equipment does not pass the test, the label user reimburses the expenses to the complainant, and an enforcement process is followed.

28. Enforcement. In case of failure in the verification or the challenge-test, the label user may opt for a second test. This is carried out with twice the initial test sample size, and all samples are required to pass the test. If the equipment passes the second test, no further action is taken, and the same label may continue to be affixed to the product. If the equipment fails the second test, the label user, within a period of time set by the Bureau of Energy Efficiency, must correct the label level or remove the deficiencies for units that have not yet been put on the market. If the latter, the label user is also required to change any faulty labeling information on advertising material. In the event the label user fails to comply, the use of the label for that particular model or equipment is prohibited. The bureau gives wide publicity to these labeling failures, and may also advise the government to bar the model or equipment and/or the label user from participating in public tenders.

29. Testing facilities. The Bureau of Energy Efficiency registers independent laboratories accredited by the National Accreditation Board for Laboratories. The bureau also registers independent laboratories that are equipped to conduct specific test procedures—for particular equipment or appliance—as per other internationally recognized standards.

H. State Energy Conservation Funds

30. In addition, the Government of India and Bureau of Energy Efficiency are encouraging each state to set up an energy conservation fund. A Rs20 million allocation from the government's budgetary resources is earmarked for each state. States that provide a matching contribution to the fund will be allocated another tranche of Rs20 million. The states have full operational freedom for setting their own energy efficiency priorities for utilizing their energy conservation fund. The option for the government to replenish the state energy conservation funds annually is under discussion.

Review of Energy Efficiency Interventions

This evaluation focuses on the Asian Development Bank (ADB) interventions to stimulate energy efficiency investments in industry and buildings. Among the key findings is that energy pricing and market imperfections need to be addressed to promote energy efficiency investments. ADB and governments in developing member countries should support the removal of various barriers to energy efficiency investments in Asia and the Pacific.

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Asian Development Bank
Independent Evaluation Department
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