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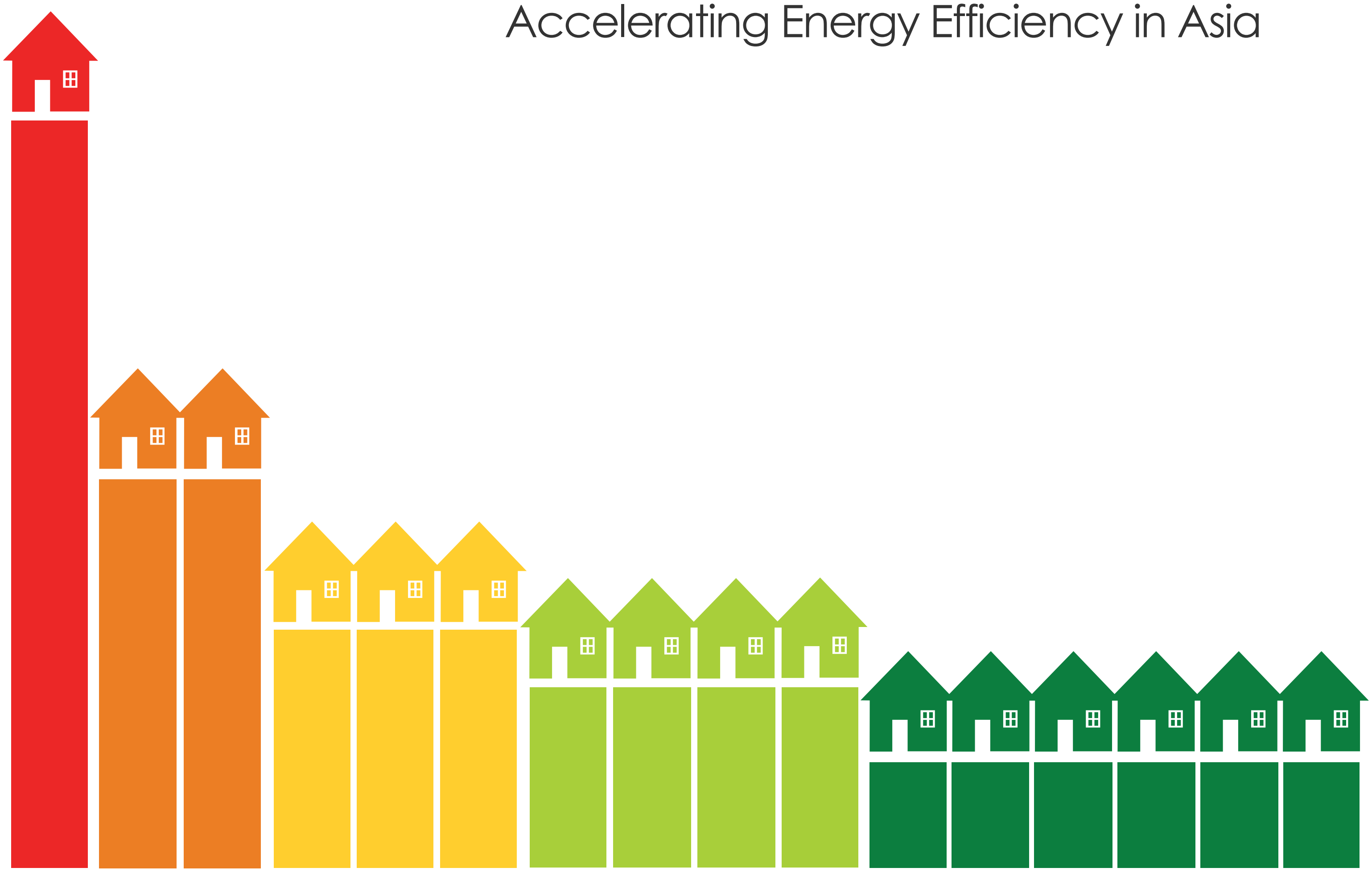
SAME ENERGY, MORE POWER

Accelerating Energy Efficiency in Asia



Asian Development Bank

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Printed in the Philippines.

ISBN 978-92-9254-163-7 (Print), 978-92-9254-164-4 (PDF)
Publication Stock No. RPT135828-3

Cataloging-In-Publication Data

Asian Development Bank.
Same energy, more power: Accelerating energy efficiency in Asia.
Mandaluyong City, Philippines: Asian Development Bank, 2013.

1. Clean energy 2. Energy efficiency. I. Asian Development Bank.

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In this publication, "$" refers to US dollars, unless otherwise stated.

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Printed on recycled paper

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Foreword

Asia's remarkable economic expansion over the last 2 decades has lifted millions out of poverty. With continued growth, by the middle of this century, an additional 3 billion Asians could enjoy living standards similar to those in Europe today. This future, however, is not preordained, and must be strategically supported by an energy system that is sustainable, affordable, and accessible for all Asians. New energy resources must be developed to include low-carbon renewable options, and greater emphasis must be given to energy efficiency, the lowest-cost energy resource of all.

Energy efficiency is a key solution to meeting energy and economic challenges in developing Asia. Unlike approaches that simply expand energy supply, such as building new power plants, energy efficiency prioritizes actions that first reduce the need for energy. Such reductions may occur by decreasing energy losses in the supply chain, an approach known as supply-side energy efficiency (SSEE). Another approach is to consume less energy for the same level of service, for example, when operating buildings, tools, products, and machinery. This strategy is known as demand-side energy efficiency (DSEE).

SSEE imperatives often take precedence in resource planning and related investment decisions. DSEE, by contrast, which may require interventions at hundreds or thousands of homes, businesses, industrial sites, and government facilities, can appear daunting. As a result, inertia often limits efforts to act on energy efficiency's potential, in both developed and developing countries. Yet its value cannot be ignored in a finance- and resource-constrained world. The continued rise in global carbon dioxide (CO_2) levels and the implied threat of climate change, as linked to reliance on fossil fuels, add still greater urgency to calls for a new emphasis on energy efficiency, as a key strategy by which to curb burgeoning energy demand.

As this report identifies, a 1%–4% investment in energy efficiency, as a share of overall energy sector investment, can meet as much as 25% of the projected increase in primary energy consumption in developing Asian countries by 2030. This cost-effective investment, in turn, can boost regional energy security by tempering the need for imported energy, as most countries in the region, 2 decades from now, will produce 50% or less of the energy they require. More generally, robust deployment of energy efficiency can relieve pressure on existing energy infrastructure while reducing emissions and other pollutants that harm air quality and contribute to climate change.

Over the past decade, the Asian Development Bank (ADB) has succeeded in quickly scaling up its investment in energy efficiency and the development of renewable resources within its developing member countries (DMCs), through its Clean Energy Program. In recent years, ADB has been channeling approximately 50% of its energy sector investments into clean energy. ADB achieved an initial target of $1 billion in clean energy investment per year by 2008, then reached $2.1 billion in 2011—realizing its 2013 target 2 years ahead of time. In 2012, ADB achieved clean energy investments of $2.3 billion. DSEE investments ($721.5 million) represented 30% of all clean energy projects, while SSEE investments ($252.4 million) accounted for 11%. These results for 2012 show a significant role for DSEE, overall, in ADB's clean energy investments.

A more in-depth analysis of ADB's investments in energy efficiency, based on comprehensive data available on projects through 2011, sheds greater light on the types of initiatives and funding levels supported over the years as part of this investment. While the general trend in ADB's clean energy investments has been positive, investments in energy efficiency have lagged behind, particularly on the demand side. Building sector interventions, in particular, have been underutilized relative to their potential.

ADB has significant scope to scale up its technical assistance and funding for energy efficiency in Asia toward a more even portfolio of SSEE and DSEE interventions. Energy efficiency improvements at the level of households, commercial businesses, and industrial facilities may in turn be complemented by a focus on "green" city design. As Asia continues to urbanize, integrated planning for infrastructure can maximize efficiencies across the built environment, for mixed-use development in combination with renewable energy, new public transport options, and more efficient vehicles. Together, these changes promise to capture the next level of dramatic energy savings, toward vast economic and environmental gains.

This effort is critical in meeting growing regional energy demand in a sustainable manner, according to ADB's Strategy 2020. Based on recent in-depth analysis, further support for an expansion of ADB's energy efficiency investment and lending in its DMCs will be considered.

The following report accordingly identifies key areas of interest for accelerating energy efficiency investments. The report also examines global and regional trends that are driving Asia's energy demand and the resulting policy and regulatory environment for energy efficiency. It is hoped that this report and the strategy proposed within can help to unlock energy efficiency's potential toward an accelerated pace of investment in Asia and the Pacific. This notion—i.e., unlocking Asia's clean energy future—aims at providing more energy service with the same amount of energy.

Asia's future is one of near limitless possibilities. But cost-effective, low-carbon energy resources must be tapped to end poverty, expand energy access, and improve the quality of life for all. As a growing number of countries in Asia turn to energy efficiency as a least-cost, priority solution to meet energy demand, ADB stands ready to build on—and ramp up—its existing achievements in the sector. The cost of doing otherwise is simply too high.

Bindu Lohani
Vice President
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Acknowledgments

This publication documents the results of an analysis of past efforts by the Asian Development Bank to support energy efficiency interventions across multiple sectors in its developing member countries. The report also includes an overview of energy efficiency policy and programmatic approaches in Asia and other regions throughout the world.

This publication was a product of team work, led by Aiming Zhou, Senior Energy Specialist, Sustainable Infrastructure Division, Regional and Sustainable Development Department (RSDD), with support and guidance from Anthony Jude, Senior Advisor and Practice Leader (Energy), RSDD; Ashok Bhargava, Director, Energy Division, East Asia Department; Gil-Hong Kim, Director, Sustainable Infrastructure Division, RSDD; Pil-Bae Song (retired), then Senior Advisor and Practice Leader (Energy), RSDD; Robert Guild, Director, Transport, Energy and Natural Resources Division, Pacific Department; Rune Stroem, Director, Energy Division, Central and West Asia Department; Yongping Zhai, Director, Energy Division, South Asia Department; WooChong Um, Deputy Director General, RSDD; and S. Chander, Director General, RSDD (concurrently Chief Compliance Officer). Other individuals interviewed for this report are listed in Appendix 4.

We also thank colleagues in the Energy Community of Practice (of ADB) for their comments on the report, and extend additional thanks to Peter Du Pont, Carina Paton, and Kristen Hughes for their contributions.

Abbreviations

ADB	Asian Development Bank
APERC	Asia Pacific Energy Research Centre
ASEAN	Association of Southeast Asian Nations
BAU	business-as-usual
BEE	Bureau of Energy Efficiency (India)
CCT	clean coal technology
CDH	centralized district heating
CDM	Clean Development Mechanism
CEP	Clean Energy Program (of ADB)
CF	cleaner fuels
CFL	compact fluorescent lamp
CHUEE	[People's Republic of] China Utility-Based Energy Efficiency Finance Program
CO_2	carbon dioxide
CSR	corporate social responsibility
DMC	developing member country
DSEE	demand-side energy efficiency
DSM	demand-side management
EC	European Commission
EE	energy efficiency
EEI	Energy Efficiency Initiative (of ADB)
EERS	Energy Efficiency Resource Standards
EETSU	Energy Efficiency Technical Support Unit
EIA	US Energy Information Administration
EPA	US Environmental Protection Agency
ESCO	energy service company
EU	European Union
GDP	gross domestic product
GEF	Global Environment Facility
GHG	greenhouse gas
IEA	International Energy Agency
IED	Independent Evaluation Department (of ADB)
IEEJ	Institute of Energy Economics, Japan
IFC	International Finance Corporation
IPCC	Intergovernmental Panel on Climate Change
M&V	measurement and verification
MVA	Manufacturing Value Added
OECD	Organisation for Economic Co-operation and Development
PSOD	Private Sector Operations Division (of ADB)
RE	renewable energy

RETA	regional technical assistance
RSDD	Regional and Sustainable Development Department (of ADB)
SSEE	supply-side energy efficiency
T&D	transmission and distribution
UN	United Nations
UNFCCC	United Nations Framework Convention on Climate Change
USAID	United States Agency for International Development
USDOE	United States Department of Energy

Weights and Measures

Gt	gigaton
ktoe	thousand tons of oil equivalent
kWh	kilowatt-hour
MTOE	million tons of oil equivalent
MW	megawatt
TWh	terawatt-hour

Executive Summary

Energy Efficiency in Asia: An Untapped Resource

Energy efficiency (EE) is often defined as delivered energy service per unit of energy supplied into a system. The value of EE is grounded upon its ability to aid energy systems in meeting end-user needs without requiring an expansion of system capacity. Unlike approaches that simply expand energy supply, such as building new power plants, EE prioritizes actions that first reduce the need for energy. Such reductions may occur by decreasing energy losses in the supply chain, an approach known as supply-side energy efficiency (SSEE), for improved performance in the production and delivery of electricity and heat (see Table 1 in Chapter 1, p. 1). Another approach is to consume less energy for the same level of service, a strategy known as demand-side energy efficiency (DSEE). DSEE (or end-use EE) relies on improved efficiencies at the point of final energy consumption, for example, when operating buildings, tools, products, and machinery.

Among the range of technology options that exist to provide energy service, EE approaches are the most cost competitive. As a resource by which to meet national or regional goals for development and economic growth, DSEE is growing in importance for many developing member countries (DMCs) of the Asian Development Bank (ADB). The appeal of DSEE or end-use EE comes from its ability to reduce the cost of energy service, as noted above, and to respond to a number of wider social and environmental concerns. These include the environmental risks that surround ongoing reliance on conventional fossil fuels, in particular the threat of climate change, and the need to develop energy resources that bolster national energy security and system reliability.

When pursued alongside efforts to decarbonize energy systems through the development of resources such as wind and solar, DSEE interventions offer an opportunity to transform the character of energy service. Greater sustainability, affordability, and reliability may be achieved, even as the energy system is able to reach a greater number of end users. Key changes in policy priorities and investment strategies will be necessary, however, to realize these outcomes, particularly in developing Asia where rapid economic growth is coinciding with urbanization impacts.

This report examines prospects for ADB to ramp up efforts in the region for greater utilization of DSEE, the most cost-effective source of energy supply. The report further identifies global and regional trends that are driving Asia's energy demand and the resulting policy and regulatory environment for energy efficiency.

Obstacles and Opportunities: Energy Efficiency Investment Strategies

Robust deployment of EE interventions can relieve national pressure on fossil fuel reserves and help reduce the need for energy imports, thereby conserving domestic expenditures for alternative investments in education, health care, and other amenities. Greater emphasis on end-use EE can defer the need for expansions of power plants and transmission and distribution infrastructure while reducing pollution impacts and contributions to climate change. As advanced smart grid networks emerge, EE will play a key role in balancing the system's equilibrium, allowing the integration of smart meters, distributed generation, intermittent renewable resources, and electric vehicles and charging technology.

Despite EE's remarkable potential to deliver high value to end users, its utilization has been disappointing for reasons that span economic, institutional, and behavioral factors (Taylor et al 2008, ADB 2012a, USAID 2012). Potential beneficiaries of EE investment may face price distortions and high transaction costs, or they may lack sufficient information to understand or proceed with EE projects. A lack of commercially attractive financing, high capital costs, and concerns about project risk also can dampen enthusiasm for EE uptake. In many locales, the institutional context for EE is characterized by the absence of governmental leadership, as well as the lack of a centralized authority or agency that can encourage or manage wide-scale EE implementation. Policy and regulatory approaches in the energy space also tend to favor supply-side options that respond to demand by expanding generation capacity.

These barriers can be surmounted or lessened through efforts to design EE interventions that more specifically meet the needs of diverse stakeholders. New institutional capacity can scale up targeted action across households, businesses, industrial facilities, public infrastructure, and the transport sector. Pursuit of larger EE interventions can further benefit from attention to delivery mechanisms for facilitating investment. Options include energy service companies (ESCOs), loan financing and partial loan guarantees, demand-side management (DSM) programs offered by distribution utilities in the energy sector, and bulk procurement programs as ordinarily led by government (Taylor et al 2008, NRDC 2012). Clarity and consistency of purpose, ongoing stakeholder engagement, careful monitoring and evaluation, and support for awareness campaigns are all contributing factors for effectiveness (ADB 2012d, Mani 2012). The larger goal is to ensure that policy and incentives, financing packages, and project design come together in ways that respond to the opportunities that exist in different market segments.

Current Energy Efficiency Activities in Asia

With projections for global economic growth and the emerging role of developing countries as centers of industrial activity, the need for greater efficiency in energy use is increasing worldwide. Energy demand between developing and developed countries reached parity in 2010. Over the next 2 decades, developing countries in total should account for some 90% of the increase in global primary energy demand (USAID 2011).

By 2035, the share of developing Asia, specifically in primary global energy consumption, is expected to increase from 34% in 2010, to as much as 56% according to some projections

(ADB 2013a citing IEA 2012 and Lee, Park, and Saunders [forthcoming]). This trend reflects Asia's increasing role as a center of manufacturing, and its status in claiming over half of all global megacities. Meanwhile, Asia's dependence on energy imports is growing. Most countries in the region, 2 decades from now, will produce 50% or less of the energy they require. Energy imports, and specifically imported oil, will continue to be critical in the region (ADB 2013a).

Against regional trends for growth, and in recognition of EE's benefits, large emerging economies, such as the People's Republic of China (PRC) and India, have launched initiatives resulting in significant EE improvements in the industry sector. More generally, countries throughout Asia have established commitments or targets to expand EE's role in meeting national energy needs.

The PRC, a leading player in Asia and an emerging global economic power, has emphasized the role of energy conservation in national policy since the 1980s (Information Office of the State Council of the People's Republic of China 2012). From 2006 to 2010, its energy use per unit of gross domestic product (GDP) declined by 19%. During the PRC's Twelfth Five-Year Plan Period (2011–2015), the State Council put forward proposals to significantly expand such efforts. The country's energy use per unit of GDP is targeted to decrease by 16% against a 2010 baseline, with carbon dioxide (CO_2) emissions per unit of GDP targeted to fall by 17% (Han and Yang 2012).

In India, the Energy Conservation Act of 2001 guides a national strategy to lower the energy intensity of the country's economy. The Bureau of Energy Efficiency is tasked with carrying out EE initiatives. From 2007 to 2010, its efforts resulted in cumulative verified energy savings of 22.5 million tons of oil equivalent (BEE 2010).

In Indonesia, the Directorate General of New Renewable Energy and Energy Conservation was created in 2010 to engage policy and regulatory development and to advocate for EE. In 2011, the Directorate created the Energy Efficiency and Conservation Clearing House Indonesia as a central source of information and best practice on EE (USAID 2011).

Thailand's 20-Year Energy Efficiency Development Plan, spanning 2011 to 2030, promotes energy savings with an emphasis on the industry and transport sectors. More broadly, robust implementation of the plan should achieve, each year, cumulative energy savings averaging 14,500 ktoe. The resulting cumulative reductions in CO_2 emissions should average 49 million tons each year (Thailand Ministry of Energy 2011).

Efforts in Asia to advance EE implementation further benefit from the provision of external aid assistance from a number of regional and international players. More broadly, clean energy investment—overall—has been increasing in the region. During the last decade, investment in clean energy in Asia expanded by almost fifteenfold (USAID 2011, UNEP/BNEF 2010). In 2010, Asia and the Pacific claimed the greatest portion—some \$59 billion—of worldwide clean energy investment, which totaled \$211 billion that year. The PRC (\$49 billion) garnered the largest investment, with India at \$3.8 billion. Indonesia, Thailand, and Viet Nam each claimed investment amounts that varied between \$200 million and \$700 million (UNEP/BNEF 2011).

The above figures are impressive, but the total \$211 billion invested worldwide in 2010 translated to investments in renewable energy. Investment in "energy-smart" technologies—e.g., EE systems and devices, electric vehicles, the smart grid, etc.—summed to \$23.9 billion in 2010. Of that amount, the financial new investment portion, not including research and development, was reported as $5 billion. North America, followed by Asia and Oceania, and then Europe, claimed the largest share of this investment (UNEP/BNEF 2011).

Driving Energy Efficiency Investment: ADB's Tools and Interventions for Asia

If end-use EE is to claim its rightful share among energy sector investments around the world and in Asia specifically, then greater efforts are necessary to marshal policy, markets, and stakeholder collaboration in support of such outcomes. Over the coming decade, national EE targets and policies in Asia and the Pacific will play a major role in advancing regional investment in EE technologies and solutions.

ADB estimates that a total of $944 billion of investment in end-use EE is needed for the PRC, India, and Southeast Asian countries, to meet their national targets for EE and greenhouse gas (GHG) emission reductions by 2020 (see Table 4 in Chapter 4). While the majority of this needed investment—$865 billion—is in the PRC, the investment required in other developing Asian countries is also quite significant, with $68 billion estimated for India and $11 billion for Southeast Asian countries. An additional $15 billion is needed to meet government targets in Southeast Asia by 2030.

The impact of EE investment on meeting energy demand by 2030, assuming that national EE targets are met, is compelling. In Brunei Darussalam, Indonesia, Malaysia, the Philippines, Thailand, and Viet Nam, an EE investment share of just 1%–4% of overall energy investment serves to meet at least 8% to as much as 25% of the projected increase in primary energy consumption. This dynamic reinforces EE's relevance as a least-cost solution to meeting Southeast Asia's growing energy demand.

In total, larger efforts for EE investment by the PRC, India, and Southeast Asian countries carry the potential for significant impact in the wider region. Under business as usual, their combined primary energy demand is projected to rise from 3664.6 million tons of oil equivalent (MTOE) in 2010 (totaling 73% of primary energy demand in Asia and the Pacific) to 6769.9 MTOE (81% of the regional total) in 2035.

In many countries of Central and West Asia, aging energy infrastructure is not improving, even as national economies have grown. These conditions point to largely untapped energy saving potential (Olshanskaya 2009). However, due to a shortage of data, this report cannot estimate the needed EE investment amount for these countries. Meanwhile, ADB's DMCs in the Pacific account for a very small share of final energy consumption in the larger region (ADB database 2013), and due likewise to a shortage of available data, their EE investment potential was not examined for this study.

Over the past decade, ADB has succeeded in quickly scaling up its investments in energy efficiency and the development of renewable resources through its Clean Energy Program. ADB achieved an initial target of $1 billion in clean energy investments per year by 2008, then reached $2.1 billion in 2011—realizing its 2013 target 2 years ahead of time. In 2012, ADB achieved clean energy investments of $2.3 billion (ADB 2013b).

In late 2011, ADB's Independent Evaluation Department (IED) published a review of ADB's clean energy investments, focusing on 2003–2010. The IED Report found that industry and buildings are responsible for more than 70% of total commercial energy consumption in Asia. They are further responsible for a remarkable 85% of electricity use in the region. However, in contrast with these percentages, ADB support to manage energy consumption in the two sectors has represented just 4% of its overall clean energy portfolio (ADB 2011b).

In light of these findings, the IED report made recommendations for strengthening ADB's efforts in DSEE, including a suggestion for an increased focus on EE investments in industry and buildings. Additional research undertaken more recently by ADB has also revealed imperatives to redress a lack of host country capacity and demand for end-use EE projects, and to mainstream EE into ADB's operations.

This report builds on the 2011 IED evaluation and more recent research, to assess the capacity of ADB in end-use EE and the challenges it faces in scaling up its EE investments. The report further considers options by which to support a more systematic approach to catalyzing EE investments in Asia and the Pacific, as summarized below.

Scaling Up ADB's Energy Efficiency Investments

In examining ways to expand its EE portfolio, ADB may draw upon a mix of tools and mechanisms employed at different scales around the world. Many of these approaches, listed below, are characterized by ambitious targets or mandates with goals for participation across sectors and stakeholders:

(i) EE policy and regulation,
(ii) EE standards and building codes,
(iii) utility DSM market activities,
(iv) innovative financing mechanisms,
(v) development of national and/or local institutional capacity,
(vi) EE information systems, and
(vii) awareness of EE means and benefits.

The lessons learned to date from the implementation of these approaches across countries and thematic areas point to key considerations for ADB in evaluating specific EE interventions for Asia. More systematized program support and investment can leverage existing resources to generate broader and deeper impacts while generating momentum for further EE market development. Areas where ADB may engage such activities to significant effect in Asia include (i) regional and country-specific thematic EE programs, (ii) investments in utility-sponsored performance-based EE resource programs, and (iii) investments in raising EE standards.

Regional and Country-Specific Thematic Energy Efficiency Programs

Public Buildings

In Asia, ADB could support a standardized program for public building improvements to be operational at a regional, national, or possibly provincial scale. Program development could benefit from cooperation with a local public entity. A procedural framework could be devised whereby interested energy service providers in the private or public sectors would compete to offer efficiency improvements. ADB could provide a funding mechanism, complemented by lending criteria that incentivize demand for the program.

Municipal Lighting

For street lighting, efforts in Asia may benefit from greater attention to development of administrative and legal frameworks to guide private sector involvement. ADB can contribute significant value to these initiatives, as the potential financial savings of public lighting efficiency projects are impressive, and the needed capital investment is also high.

Publicly Owned Industrial Facilities

For these facilities, program development in the region may benefit from a country-specific (rather than regional) focus, where designated EE public facility improvements are supported by a financing mechanism that is tailored to national policy and operational contexts.

Smart Metering

The key issue surrounds the amount of capital that is needed to support upgrades for millions of metering devices throughout a designated jurisdiction. With this challenge in mind, ADB's efforts can entail the development of a funding mechanism that is linked to a technical support component. This combination of assistance can help facilitate compliance with local rules and standards.

Investments in Utility-Sponsored Performance-Based Energy Efficiency Resource Programs

ADB can help extend the reach of these initiatives by serving as an investor partner and market development agent. This role may entail the provision of capital as a means to assist utilities in broadening their implementation efforts toward expanding the energy-saving impact of programs. ADB also may assist capacity development among market players such as ESCOs and other service providers, so that performance-based services reach a wider base of customers.

Investments in Raising Energy Efficiency Standards

Phasing Out Inefficient Products

In many developing Asian countries, the phasing out of inefficient products is likely to require efforts to assist manufacturers in altering their production lines. Other initiatives will likely be needed to shift any newly redundant technologies out of the marketplace. The financial interventions implied here can be supported by ADB through its design and offer of certain financing vehicles to advance program imperatives.

Local and Regional Testing Capability

In Asia, testing facilities could benefit from ADB's provision of funding resources, and any assistance to encourage facility development through collaborative activities with local partners or stakeholders. The facility and ADB could partner to support the piloting of new approaches for possible regional replication. Other shared efforts could focus on the creation of a labeling scheme specific to Asia or, alternatively, a recognized mark for dissemination across many countries.

Voluntary Energy Excellence

Voluntary initiatives for Green and Zero Energy Buildings serve as models for what the building industry in Asia could achieve, should such efforts be marketed and promoted by a regional player like ADB. This type of campaign fits with ADB's strategic commitment to lead on EE and clean energy initiatives with global visibility. The contribution by ADB to this effort does not necessarily imply a sizable investment of funding, but rather an emphasis on awareness building, creative marketing, and technical assistance. The last of these tasks could entail design assistance to engineers and architects, support for energy modeling, and sponsoring of design competitions. More broadly, efforts to lead on voluntary energy excellence can be viewed as part of ADB's corporate social responsibility.

Catalyzing Energy Efficiency

This report looks to ADB's historical investment trends to consider options for accelerating EE investment and implementation in Asia. Toward this outcome, it is proposed that ADB's Energy Community of Practice (Energy CoP) establish an Energy Efficiency Technical Support Unit (EETSU). As focused on end-use EE, three primary functions for the Energy CoP—via the EETSU—could include: (i) Institutional Expertise, (ii) Knowledge Management, and (iii) Capacity Building and Coordination.

The Institutional Expertise function could address issues of common regional interest in ways that enhance effective EE implementation. A database of experts could be maintained to support EE projects and activities. Together, these resources can serve to provide external knowledge support on demand for diverse EE initiatives.

The Knowledge Management function could support the tracking and monitoring of EE lending and investment. An EE Library could be established to consolidate EE-related data for all projects with end-use EE or SSEE components, with attention to technology availability and performance, key EE indicators, and data on GHG inventories. Meanwhile, the Capacity Building and Coordination function could support the development of regional workshops and collaborative capacity building devoted to EE proliferation in Asia.

These shared efforts could further help build awareness among senior government officials in the region, regarding the multiple economic and environmental benefits of EE. In tandem, they could provide support for the design and implementation of effective country programs that draw on a range of global best practices in EE policies, technologies, and financial innovation. More broadly, enhanced efforts for EE could more systematically advance DSEE initiatives in Asia, taking advantage of ADB's high profile and extensive networks in the region.

Breaking Energy Efficiency Barriers: Accelerating Regional Progress

Throughout Asia and the world, a critical emerging need exists for energy solutions that simultaneously conserve economic and environmental resources while bolstering the performance of existing energy infrastructure. EE initiatives are already delivering this value, and now require a more ambitious vision to drive their widespread deployment as a focal point of national and regional energy development. The options explored in this report support such a vision, so that Asia's rapid economic growth coincides with ever-increasing gains in the sustainability of its energy systems.

Through efforts that blend lessons from existing global best practice, with attention to current policy and market conditions in Asia, ADB stands ready to accelerate the pace of DSEE in meeting needs within its DMCs. The potential gains of this transformation are significant and compelling but will require consistency of purpose and willingness to engage change as necessary.

1 Introduction: The Energy Efficiency Imperative

1.1 Background: The Value of Energy Efficiency

Energy efficiency (EE) is often defined as delivered energy service per unit of energy supplied into a system. From the viewpoint of a business owner or household, the ability to operate lighting, machinery, or other equipment is not diminished if an electricity system, for example, can meet that demand with less inputs or units of energy. The value of EE is accordingly grounded upon its ability to aid energy systems in meeting end-user needs without requiring an expansion of system capacity.

Among the range of technology options that exist in the market to provide energy service, EE approaches are the most cost competitive. Unlike approaches that simply expand energy supply, such as building new power plants, EE prioritizes actions that first reduce the need for energy. Such reductions may occur by decreasing energy losses in the supply chain, an approach known as supply-side energy efficiency (SSEE), for improved performance in the production and delivery of electricity and heat (Table 1). Another approach is to consume less energy for the same level of service, a strategy known as demand-side energy efficiency (DSEE). DSEE or end-use efficiency relies on improved efficiencies at the point of final energy consumption, for example, when operating buildings, tools, products, and machinery.

Table 1 **Supply-Side versus Demand-Side Energy Efficiency**

Supply-Side Efficiency	Demand-Side Efficiency
Production and Delivery	**Consumption**
Improved efficiency in the production and delivery of electricity and heat • New efficient power plants • Power plant upgrades • Transmission and distribution system improvements	Improved efficiency at the point of final energy (end) use • Products and appliances • Building design and use • Industrial operations • Alternative transport
Uses less energy input and produces the same or more energy at the generation and distribution segment	Lowers energy consumption without compromising service quality (such as personal comfort) or organizational competitiveness

Source: ADB.

As a resource by which to meet national or regional goals for development and economic growth, DSEE is growing in importance for many developing member countries (DMCs) of the Asian Development Bank (ADB). The appeal of DSEE comes from its ability to reduce the cost of energy service and to respond to wider social and environmental concerns. These include the environmental risks that surround ongoing reliance on conventional fossil fuels, in particular the threat of climate change, and the need to develop energy resources that bolster national energy security and system reliability. DSEE can serve these goals in myriad ways, offering varied opportunities for cost-effective investments in the public and private sectors, with implications for industry, consumer products and appliances, buildings, the transport sector, and electricity systems and infrastructure.

When pursued alongside efforts to decarbonize the energy system through the development of resources such as wind and solar, DSEE interventions offer an opportunity to transform the character of energy service. Greater sustainability, affordability, and reliability may be achieved, even as the energy system is able to reach a greater number of end users. Key changes in policy priorities and investment strategies will be necessary, however, to realize these outcomes.

1.2 Environmental and Social Benefits

Without the prioritization of EE, it is unavoidable that the world's economy will require an ever-increasing stock of energy reserves. From mining and drilling activities to the combustion of fossil fuels in power plants and industrial facilities, the ever-increasing production and use of conventional energy can result in a range of negative impacts. The extraction of resources, such as coal and petroleum, can transform landscapes and ecosystems, and air and water quality may become degraded as pollutants, heavy metals, and particulates are released into the atmosphere. Reliance on nuclear power carries the risk of catastrophic accidents and requires significant government intervention to safely dispose of radioactive waste.

Notable risk, beyond the impacts noted above, also attends conventional energy systems when powered by fossil fuels. Emerging scientific evidence points to the existence of changes in the earth's global average temperature, attributed in significant part to increases in atmospheric concentrations of greenhouse gases (GHGs) from the combustion of fossil fuels and other anthropogenic activities (IPCC 2007). Atmospheric concentrations of carbon dioxide (CO_2) have grown steadily, from 280 parts per million (ppm) before the Industrial Revolution to approximately 388 ppm at present. The accumulated amount of GHGs in the earth's atmosphere has resulted in a certain amount of global warming that is "unequivocal" (IPCC 2007, p. 30). Stabilization of GHGs at or below 450 ppm is necessary if average global temperature rise is not to exceed 2°C (degrees Celsius). This rate of stabilization translates as a 50%–70% drop in worldwide emissions by 2050 against a 2005 baseline (Stern 2006).

The accumulated GHGs in the earth's atmosphere attributed to human activity are, in turn, largely the outcome of industrial processes set in motion by today's wealthy industrialized nations. This outcome has served as the basis among some governments and nongovernment organizations to focus on industrialized country action as the primary focus for first-wave efforts to significantly lower GHGs from energy use and related activities. The Kyoto Protocol, which entered into force in 2005, established binding limits on GHGs among participating industrialized countries (so-called Annex 1 countries). Annex 1 countries agreed to lower their emissions by an average of

5.2% from 2008 to 2012, against a 1990 baseline. Flexibility mechanisms under the Protocol permitted Annex 1 countries to utilize emissions trading, joint implementation projects, and the Clean Development Mechanism to meet their reduction targets.

With projections for global economic growth and the emerging role of developing countries as centers of manufacturing and industrial activity, the need for sustainability in energy systems is increasing everywhere. As economies continue their historic expansion in much of the developing world, demand for energy will jump dramatically. The share of developing Asia in primary energy consumption has been projected to increase from 34% in 2010, to as much as 56% in approximately 2 decades according to some estimates (ADB 2013a citing IEA 2012a and Lee, Park, and Saunders [forthcoming]). In the meantime, Asia's dependence on energy imports is growing. Most countries in the region, by 2035, will produce 50% or less of the energy they require. Energy imports, and specifically imported oil, will continue to be critical in the region (ADB 2013a).

Robust implementation of energy-saving measures by households, industry, commercial businesses, and public sector authorities can help temper this demand and the accompanying expenditures that will be necessary, at societal and individual levels, to secure access to energy sources. Such an outcome is especially important where domestic energy needs are met primarily through imported fuels.

Without aggressive action to reduce long-term growth in energy consumption, a country may transfer an increasing share of its national wealth to foreign energy producers. Opportunities for domestic investment in education, health care, public infrastructure, and other amenities may be lost or diminished. At the same time, domestic reliance on foreign energy resources can increase national dependence on major trading partners, exacerbating vulnerabilities and imbalances in international political power.

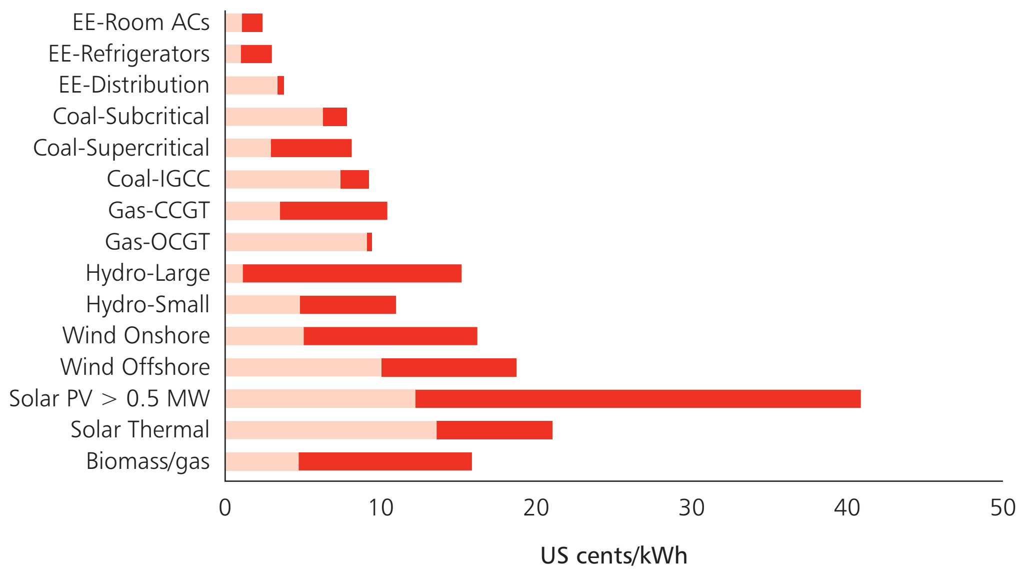
Efforts throughout Asia to deploy policy and investment strategies in support of DSEE interventions can help to conserve existing national energy resources. In some cases, ambitious EE targets may restrict the need for additional fuel imports, or delay the imperative for expensive additions to power plants. Either way, certain types of very large investments in energy infrastructure may be deferred, so that countries are better able to choose where to spend critical financial resources in support of national goals and objectives.

1.3 Technical and Economic Benefits

The cost effectiveness of EE, relative to other energy options, is another key factor supporting its prioritization for greater immediate action. Figure 1 depicts a range of costs recorded in the market for various energy-saving and energy-generating technologies. In comparing EE to alternatives, the figure illustrates that significantly less money is needed to save electricity, in most cases, compared to the cost of generating that electricity through both conventional and renewable energy options.

This emerging cost data for a range of technologies and applications has helped to clarify the potential role for DSEE in long-term GHG reduction at a global scale. On this topic, the International Energy Agency (IEA) in its World Energy Outlook 2012 provides estimations

Figure 1 Generation Cost Compared to Cost of Energy Efficiency



ACs = air conditioners, CCGT = combined cycle gas turbine, EE = energy efficiency, IGCC = integrated gasification combined cycle, kWh = kilowatt-hour, MW = megawatt, OCGT = open cycle gas turbine, PV = photovoltaic.

Sources: Data from United States Agency for International Development (USAID) 2007, figure 22, p. 54, with updated numbers from Organisation for Economic Co-operation and Development (OECD)/Nuclear Energy Agency. 2010. Projected Costs of Generating Electricity 2010. OECD Publishing © Paris: OECD/IEA and Issy-les-Moulineaux, France: OECD/Nuclear Energy Agency.

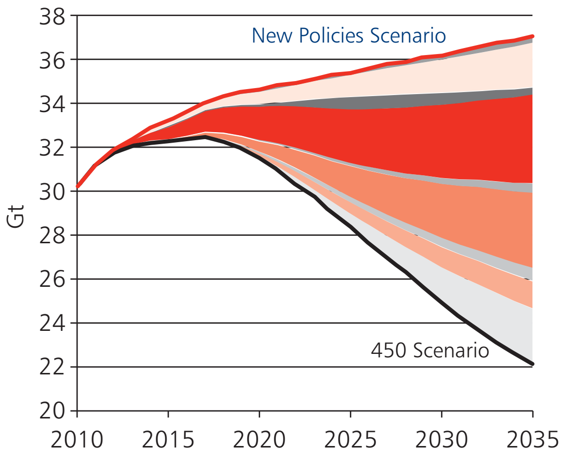
regarding global scenarios in 2020 and 2035 as GHG emissions are placed onto a trajectory to eventually curtail world average temperature rise to 2°C. As noted above, long-term stabilization of GHGs—or CO_2-equivalent emissions—at or below 450 ppm is necessary to hold average global temperature rise to this level.

The policy efforts needed to achieve this outcome coalesce under the IEA's so-called 450 Scenario. The technology outlook, in turn, for a range of CO_2 abatement measures under the 450 Scenario, against a 'New Policies Scenario' baseline, is projected in Figure 2. The New Policies Scenario reflects overall policy commitments, plans, and/or pledges made by countries to shift away from subsidies for fossil fuels and to lower GHG emissions.

Under the 450 Scenario, energy efficiency—to include power plant and end-use efficiency and electricity savings—accounts for about 75% of avoided emissions in 2020 (Figure 2). Global electricity demand in the buildings sector, specifically, falls by more than 800 terawatt-hours (TWh) through incorporation of advanced lighting, space heating equipment, and appliances. Electricity demand in industry declines by 600 TWh, primarily from use of more efficient motors. In absolute terms, EE's contribution to abatement grows from 2.2 gigatons (Gt) CO_2 avoided in 2020, to 6.4 Gt CO_2 avoided in 2035. Yet EE's share in CO_2 abatement decreases by 2035, as the contribution of renewable energy and carbon capture and sequestration expands.

The 450 Scenario implies a "transformation" in the world's energy system, at a cost of $16 trillion in cumulative investment that is additional to the costs implied in the New Policies Scenario

Figure 2 Mitigation Measures for CO_2 Abatement to 2035



CO_2 abatement	2020	2035
Activity	2%	2%
End-Use efficiency	18%	13%
Power plant efficiency	3%	2%
Electricity savings	50%	27%
Fuel and technology switching in end users	2%	3%
Renewables	15%	23%
Biofuels	2%	4%
Nuclear	5%	8%
CCS	4%	17%
Total (Gt CO_2)	3.1	15.0

CCS = carbon capture and sequestration, CO_2 = carbon dioxide, Gt CO_2 = gigatons carbon dioxide.
Note: "Activity" refers to altered demand for energy services, for example transport or lighting, from price responses. "Power plant efficiency" entails coal-to-gas switching that results in emissions savings.
Source: World Energy Outlook 2012 © OECD/IEA 2012, figure 8.7, p. 253.

(World Energy Outlook 2012, p. 241). This investment, however, also should result in gains such as improved local air quality and decreased costs for fossil fuel imports. Because EE accounts for more than 50% of the total emissions saved, followed by renewables at 21% and carbon capture and sequestration at 12%, the bulk share of investment would likely go to the EE sector.

Beyond its contributions to cost-effective mitigation of climate threats, the strategic deployment of end-use EE also can improve the overall performance of conventional electricity systems. When installed at homes, offices, and industrial facilities throughout a city or region, EE products and appliances can reduce energy demand at different locational points across the electricity network.

The resulting drop in consumption allows power plants to operate at optimized capacity, and helps avoid the need to bring additional generating units—sometimes known as "peaking units"—online at times of peak customer demand. Existing generation and transmission and distribution (T&D) systems will be better equipped to meet projected load, without drawing upon additional reserve capacity. In many instances, due to their short annual operations time, peaking units are the most expensive sources of power across the entire spectrum of generation options in a given electricity system. Avoided reliance on these expensive units can thus contribute a disproportionately high amount of savings to consumers when end-use EE is deployed.

Meanwhile, a reduction in the volume of electricity that is shipped over T&D lines, which may cover hundreds of kilometers, can further decrease pressure on the system. Less intensive use of T&D infrastructure can delay the need for line replacements and upgrades, and may serve to boost system reliability through the avoided incidence of blackouts and brownouts.

The benefits of EE to electricity system performance are even more obvious when considering the network losses that typically occur from the site of generation, to the point of final consumption. For example, with regards to traditional lighting, under normal circumstances, it is suggested that only 5% of the energy originally comprised in a unit of fossil fuel is delivered as illumination to end users. The other 95% is lost during transmission and conversion (European Commission 2012).

While the actual costs of EE may change across countries relative to the technologies and processes utilized, a trend exists for EE to require one-quarter to one-half of the investment needed to pay for otherwise vital energy supply (Taylor et al 2008). This remarkable cost savings from EE, when considering the range of losses that otherwise occur from fuel conversion and delivery to ultimate consumption, highlights the need for a new approach in prioritizing DSEE as a response to customer demand.

1.4 Energy Efficiency in Asia: Status and Prospects

DSEE can serve as a low-cost answer to the coinciding challenges of fast-growing global energy demand, particularly in Asia, and increasing international pressure to decarbonize the energy system. The field continues to benefit from an ever-expanding reserve of new technologies, professional expertise, policy innovations, and performance data. This body of knowledge, derived from current energy practice throughout the world, offers an abundance of information to guide strategic deployment of EE across sectors and at multiple scales.

Considering its apparent advantages, DSEE investment would seem to be an obvious priority for global action among the total range of available investment options that comprise the clean energy portfolio. Strides have been made in recent years, but a closer look at the sector shows that interventions have likely been underutilized relative to their indisputable economic value.

For example, clean energy yearly investment, worldwide, totaled approximately $211 billion in 2010, but this figure translates to investments in renewable energy (UNEP/BNEF 2011). That same year, investment in "energy-smart" technologies—e.g., EE systems and devices, electric vehicles, the smart grid, etc.—was reported as $23.9 billion.

Such funding levels are helpful steps in the right direction. Yet more generally, they remain inadequate to meet the demands of the IEA's 450 Scenario as earlier described. The lingering gap in funding to realize EE's potential in energy savings and GHG mitigation is due, in part, to the scattered nature of most EE opportunities throughout society. In addition, expertise or financial assistance may be difficult to locate or access. Broader economic and behavioral barriers also challenge greater progress at the micro and macro levels in ratcheting up EE investment.

If a range of EE interventions, to include DSEE, are to claim their rightful share among energy sector investments around the world, then greater efforts are necessary to marshal policy, markets, and stakeholder collaboration in support of such outcomes. Over the coming decade, national EE targets and policies in Asia and the Pacific will play a major role in advancing regional investment in EE technologies and solutions. ADB estimates that a total of $944 billion of investment in end-use EE is needed for the PRC, India, and Southeast Asian countries to meet their national targets for EE and GHG emission reductions by 2020. While the majority of this needed investment—$865 billion—is in the PRC, the investment required in other developing Asian countries is also quite significant, with $68 billion estimated for India and $11 billion for Southeast Asian countries. An additional $15 billion is needed to meet government targets in Southeast Asia by 2030.

Efforts for EE investment by the PRC, India, and Southeast Asian countries carry the potential for significant impact in the wider region. Under business as usual, their combined primary energy demand is projected to rise from 3664.6 million tons of oil equivalent (MTOE) in 2010 (totaling 73% of primary energy demand in Asia and the Pacific) to 6769.9 MTOE (81% of the regional total) in 2035.

In many countries of Central and West Asia, aging energy infrastructure is not improving, even as national economies have grown. These conditions point to largely untapped energy saving potential (Olshanskaya 2009). However, due to a shortage of data, this report cannot estimate the needed EE investment amount for these countries. Meanwhile, ADB's DMCs in the Pacific account for a very small share of final energy consumption in the larger region (ADB database 2013), and due likewise to a shortage of available data, their EE investment potential was not examined for this study.

As focused on the PRC, India, and Southeast Asian countries, this report considers how ADB may accelerate the pace of EE investment in the region to drive more ambitious change. Its particular focus is the promotion of end-use EE, the most cost-effective and rapidly deployable source of energy supply.

1.5 Scaling Up Energy Efficiency Action: ADB's Role

Over the past decade, ADB has succeeded in quickly scaling up its investments in energy efficiency and the development of renewable resources through its Clean Energy Program. ADB achieved an initial target of $1 billion in clean energy investments per year by 2008, then reached $2.1 billion in 2011—meeting its 2013 target 2 years ahead of time. In 2012, ADB maintained this upward trend, achieving clean energy investments of $2.3 billion.

In late 2011, ADB's Independent Evaluation Department (IED) published an assessment of ADB's clean energy investments, focusing on 2003–2010. The IED study found that industry and buildings are responsible for more than 70% of total commercial energy consumption in Asia. They are additionally responsible for a remarkable 85% of electricity use in the region. However, in contrast with these percentages, ADB support to manage energy consumption in the two sectors has represented just 4% of its overall clean energy portfolio (ADB 2011b). In light of these findings, the IED study made a number of recommendations for improving and strengthening ADB's efforts in DSEE, including a suggestion for an increased focus on EE investments in industry and buildings.

This report builds on the 2011 IED study and more recent research, to assess the capacity of ADB in end-use EE, as well as the challenges it faces in accelerating EE investment in Asia. The report reviews ADB's recent pipeline of end-use EE projects, and proposes a strategy for ADB's more systematic support of EE investment in the Asia and Pacific region. Issues explored in this regard surround the enhanced provision of institutional expertise, knowledge creation and management, and capacity building and coordination—all focused on accelerating end-use EE investment.

2 Causes of Underinvestment and Persistent Energy Inefficiency

2.1 Navigating the Investment Context

As noted in Chapter 1, the significant potential for cost-effective energy efficiency (EE) gains at a global scale has yet to be matched by a proportionate level of investment support. Within and beyond Asia, profitable opportunities for EE investment, to include demand-side energy efficiency (DSEE), struggle to compete with alternative investments for new energy supply. Some reasons for this lingering underinvestment in EE are considered below, with attention to economic, social, behavioral, institutional, and policy design factors.

2.2 An Economic View of Barriers to Energy Efficiency

When examined from an economic perspective, the barriers to greater EE investment can be formidable for a number of market participants (Taylor et al 2008, World Energy Outlook 2009, US National Action Plan for Energy Efficiency 2009, USAID 2012). Fundamentally, customers may face price distortions for energy when the market does not reflect its true cost. For example, energy tariffs may not reflect the costs of resource capture and delivery, or pollution and climate change impacts that harm human health and degrade ecosystems. Price distortions may result from incomplete prior knowledge of the full range of costs associated with energy production and consumption, or from poorly designed policy or regulatory interventions, as in the case of many energy subsidies.

Subsidies may be adopted with the official goal of decreasing the price of energy to consumers. Yet there can be undesirable outcomes. Subsidies may work to discourage adoption of more energy-efficient technologies, when energy users do not immediately experience the full financial burden of their energy consumption. If not adequately designed, subsidies are also likely to benefit higher-income populations who tend to consume more energy than lower-income groups.

Fossil fuel consumption subsidies in developing Asia have been increasing in recent years, reaching $161.7 billion in 2011 (ADB 2013a citing IEA 2011). Yet in many cases, the poor are not the primary beneficiaries of these subsidies. According to the IEA (2011), among nine

Asian countries with the largest fossil fuel subsidies, as well as two African countries, just 5% of the benefit of subsidies for liquefied petroleum gas reached the poorest 20th percentile. Similarly, only 9% of electricity subsidies and 15% of kerosene subsidies reached the poorest 20th percentile.

These outcomes suggest that interventions to rectify high cost energy burdens to lower-income populations should consider alternatives other than subsidies to improve service affordability and access. ADB is examining options to promote reform of inefficient fossil fuel energy subsidies in Asia, as appropriate social protection measures are established.

Capacity or willingness to pursue EE initiatives may also be limited by high transaction costs, as faced by providers of energy-related services or financing and their customers. Transaction costs refer to the investments of time and effort that must be made by individuals or firms to identify the best options for proceeding with a given purchase or project. Customers who might benefit from EE investments can additionally lack sufficient information by which to evaluate potential options. Similarly, where economically profitable and technically feasible projects are identified as worthwhile, individuals and organizations may struggle to access professionals with the appropriate managerial or financial expertise for project implementation. Beyond accessing information and skilled professionals in the field, the beneficiaries of EE investments may not be able to obtain financing for proposed projects, or the cost of capital may prove to be excessive.

Where customers identify theoretical savings from EE, they may experience lingering concerns about the larger impact of project implementation on the normal operations of their business or organization and the disruptions that might occur. Without sufficient evidence from prior experience that such disruptions can be avoided or minimized, customers may find the potential risk of project implementation to exceed its rewards. Likewise, where end users perceive risk to EE projects, or where they identify alternative (non-EE) uses for the expenditure of time and capital, they may assign high discount rates to their evaluation of EE options. The use of a high discount rate means that a party to a transaction assigns a higher value to money that is accessible now, rather than sometime in the future. Under such an assumption, the net present value of an EE investment that should generate monetary savings over time becomes less appealing to a potential investor.

Finally, the energy savings from a given EE intervention may simply appear to be too small, at least in the short term, relative to the cost of the immediate required investment. In essence, the economic savings of one project may be modest enough that households or firms forgo the opportunity. This characteristic of micro investment in EE points to the need for a broader perspective in identifying ways to encourage smaller projects that sum to large savings in total.

These economic barriers help to explain why many households and businesses fail to pursue profitable EE investments. Nevertheless, other forces also discourage more enthusiastic EE uptake. For a broader perspective on the challenge, it is helpful to reflect on additional considerations that set the context for energy use. Of interest here are the varied social conditions and developmental trajectories found throughout the world, as well as the particular characteristics and dynamics associated with institutions and human behavior. These considerations, and their implications for EE implementation in Asia and elsewhere, are discussed below.

2.3 Demographic Trends and Energy Demand Growth

Energy use is unavoidably necessary in fueling industrialized economic systems and the production of a near limitless range of goods and services to meet diverse consumer preferences. Energy consumption profiles among countries, in turn, are affected by a broad range of factors pertaining to population size, weather patterns, economic structure, scale of industrial development, national wealth, personal lifestyles, and the relative urbanization of populations.

Developing countries in Asia and throughout the world seek economic growth to increase personal and household incomes and to gain social access to modern amenities related to health, mobility, recreation, and education. This sought-after growth curve in economic expansion, fueled by an accompanying enlargement of energy supply systems and delivery infrastructure, has already occurred over the last 150 years in the currently industrialized countries. Already, many emerging economies in Asia have achieved impressive gains in capturing an increasing share of global manufacturing capacity and foreign direct investment. Their rapid economic expansion is coinciding with new consumer purchasing power for the rising middle class. To keep pace with this growth and the economic aspirations of their populations, developing countries often share a policy perspective that strongly values expansion in new energy supply as a means to achieve national goals.

Such perspectives, however, can benefit from a larger role for EE within national energy policy and planning, for reasons that speak to regional security and social equity. More specifically, despite the developmental achievements to date of many emerging economies, significant populations in various parts of the world continue to lack access to modern energy service. Table 2 shows the relative intransigence of the challenge, comparing global population without access to electricity service in 2008—or approximately 1.5 billion people—with projections for 2030. As the regional figures suggest, improvements will be made in many parts of the world over the next 2 decades. Yet without extra efforts to prioritize equitable access to electricity service, some 1.3 billion people may continue to be left behind (World Energy Outlook 2009).

Table 2 **World Population Without Access to Electricity in 2008 with Projections to 2030** (million population)

	2008	2030
Latin America	34.1	12.8
Middle East	21.4	5.1
North Africa	1.7	1.6
PRC and East Asia	195.1	72.5
South Asia	613.9	488.6
Sub-Saharan Africa	587.1	698.3
Total	**1,453.3**	**1,278.9**

PRC = People's Republic of China.

Source: Data reported in World Energy Outlook 2009 © OECD/IEA 2009, figure 2.10, p. 131.

The above dynamics, in renewing attention to the need for expanded energy access, do not negate the importance of EE at global and regional scales. To the contrary, an emphasis on low-cost EE will become even more critical to diffuse pressure on existing electricity systems and to defer or avoid the need for capacity expansion of power plants and T&D. With robust EE deployment, a larger number of people can receive energy service from the same amount of existing fuels, resources, and infrastructure. Financial and technical resources, in turn, can be deployed to expand access to critically underserved low-income populations or remote communities. At the same time, a greater share of expenditures on energy can be retained within national borders, as the need for energy imports is reduced. Such savings can free up domestic expenditures for alternative investments in education, health care, public transit, and other amenities that are vital to the long-term prosperity and well-being of populations everywhere, to include developing Asia.

2.4 The Institutional Environment for Energy Efficiency

In considering ways to overcome the EE barriers discussed, an examination of institutional characteristics takes on greater urgency. A study by the World Bank (Taylor et al 2008) clarifies this imperative, suggesting that barriers, such as risk perception and high transaction costs, can be viewed as institutional in their origin or operation. Individuals or businesses may find EE projects to be too risky or may encounter high transaction costs, due in part to institutional dynamics that engender these outcomes. If institutions, public or private, can be seen as systems that structure interactions and relationships, then an assessment of EE's underwhelming investment to date in the wider marketplace calls for attention to institutional practices—or the lack thereof—that impact EE's prospects.

Government and other public authorities may be compelled to encourage EE investment due to the wider social and environmental consequences of alternative scenarios where conventional fuels and resources continue to predominate. Recognizing the value of cleaner air or water, or the benefits of reduced reliance on energy imports, governments may choose to intervene on EE's behalf when markets do not form to capture existing opportunities.

In many places, however, the institutional context for EE is characterized by the absence of governmental leadership, as well as the lack of a centralized authority or agency that can lead, encourage, or manage wide-scale EE implementation. This absence is problematic, as noted previously, because achievement of DSEE reductions in any given locale entails capturing gains among thousands or even millions of households and businesses. At the same time, institutional actors that function in the energy space may be compelled to operate according to discrete designated lines of responsibility, so that their functional capacity to collaborate across sectors is limited.

For example, electric utilities are often considered a logical central point for dispersing EE information, programs, and expertise to energy consumers across the residential, commercial, industry, and public sectors. Yet electric utilities have historically operated under a model where earnings are attached to sales of kilowatt-hours, rather than the overall quality of service provided to customers through least-cost, low-carbon, demand-side resources (Crossley 2013). While this model is changing in many places (as discussed in Chapter 3), the larger tendency remains, so that utilities are incentivized to favor supply-side options to address immediate and long-term demand.

Leasing companies, infrastructure finance companies, energy service companies (ESCOs), and banks also may figure prominently in the financing of EE measures. An enthusiastic push by banks, for example, to expand EE lending could open up vast opportunities for wide-scale EE interventions while simultaneously contributing to bank profits. The challenge here is that many banks continue to lack familiarity with EE projects and the types of value streams, e.g., savings on energy bills, that are likely to result.

Other split incentives that curtail EE efforts pertain to building construction and occupancy. In many cases, the developers or owners of residential or commercial buildings will not occupy or utilize these facilities on a daily basis. Without incentives or requirements to the contrary, they may fail to incorporate EE improvements. Meanwhile, the cost of energy service in these dwellings is faced by the building's tenants or lessees, who often lack the capacity or authority to retrofit structures for better energy performance.

Overcoming split incentives and fostering a central institutional agent for EE action can be challenging to the public sector as well. The bureaucratic character of many government functions often results in the performance of planning and management duties according to very specific mandates, within discrete agencies or offices. Physical and jurisdictional distance in these settings can impede collaboration and information sharing among officials, contributing to a mind-set for specialized attention to narrow topics. With regards to EE initiatives, the challenge is to maintain expertise among public sector stakeholders and accountability for specialized tasks, while enhancing institutional capacity and rewards for joint action across traditionally separate sectors. Greater efforts here can maximize the capture of larger energy savings, while avoiding duplication of bureaucratic effort and the resulting waste of taxpayer funds.

The traditional narrow focus of many institutions in the energy space is being challenged for reasons that go beyond merely capturing EE gains. Technical advances point to transformations in the future architecture of electricity systems, buildings, vehicles, and urban infrastructure. Homes and businesses are increasingly fitted with photovoltaic panels and other distributed forms of energy generation. Electric vehicles may serve as mobile energy storage devices. Thanks to the smart grid, appliances may "choose" to power down when the system hits peak demand. The challenge of managing these diverse interactions, and EE's role in contributing to network equilibrium, will only grow with time, pointing to the need for broader cross-sector institutional action in pursuing EE opportunities (USDOE 2012b).

Whether dealing with existing institutions, or developing new ones, the need for organizational strategic support of EE is evident. Specifically, a broader comprehensive vision of EE's potential across traditional sectoral boundaries is required. As new institutions develop around the mission of supporting EE, or as existing institutions evolve in this direction, their effectiveness will depend upon their capacity to promote change in ways that match the exigencies of local conditions. Institutions must close gaps between EE potential and current conditions within given jurisdictions. This means developing institutional capacity that responds to available technology and professional expertise, the legislative and regulatory context, the legal environment, and the relationships that exist among various stakeholders (Taylor et al 2008).

With these factors in mind, new institutional capacities may contribute most significantly to robust EE improvements by providing a space—in either the physical or conceptual sense—that is dedicated to wide-ranging, ambitious, and more coordinated gains across sectors and at multiple scales. Such an effort can complement recent policy interest for greater EE gains and may deliver the scaled up action that is vital to achieve meaningful impacts.

2.5 Behavioral Factors

As greater attention is given to the market and institutional factors that impede EE's progress, consideration also should be given to the non-price factors that influence personal decision making related to energy. Individual choice can be influenced by morality, habits, community expectations, and social norms (Fuller 2009). Also significant are nonmonetary incentives and the manner in which options are presented.

In seeking to understand the behavioral factors that often limit EE action, a related consideration is the mind-set that has been cultivated over time among many consumers, regarding the way in which they experience access to and use of energy. Many potential beneficiaries of EE interventions are accustomed to simply "receiving" energy service. They assume the service will be available, at least most of the time, and beyond remembering to pay for the service at regular intervals, they are not accustomed to actively considering ways of altering or reducing their consumption. Where the price of energy service is seemingly inexpensive (or at least manageable relative to household or firm budgets), and where service reliability is adequate, individuals may rarely—if ever—stop to consider possibilities for substantially altering their usage. Under these conditions, the wider net benefits to society of such individual changes are also likely to escape consideration.

The phenomenon described here speaks to a mix of historical and economic conditions that have engendered in many consumers a passive attitude toward the notion of energy choice, as oriented in this instance to greater efficiency in energy use. Changing these passive mind-sets, and working against dynamics that cultivate subpar EE outcomes, will require efforts to generate awareness of the need for more active evaluations of all energy service options, to include EE.

2.6 Energy Efficiency Fundamentals: Design Considerations for Policy and Finance

With EE initiatives growing in popularity, a number of considerations should guide the choice and design of supportive strategies. The review of EE policy and investment action undertaken for this report, summarized in Chapters 3 and 4, points to the following imperatives.

From national to more local scales, public authorities may choose particular EE interventions based on their capacity or willingness to engage high levels of administrative and regulatory oversight. For example, traditional regulatory approaches, so-called "command and control" mechanisms, refer to standards that prescribe the use of particular technologies or processes as a means of controlling energy use. They may include, for example, mandatory energy performance standards for products and appliances, or building energy codes. These instruments can achieve significant reductions in energy use, but enforcement can be expensive and time-consuming. Some public authorities accordingly have expressed preferences for more market-based instruments, such as the use of tradable EE "white" certificates, which can spur market forces to drive reductions in energy use (ADB 2012a). Ideally, their utilization lowers the need for administrative and regulatory oversight for stakeholder compliance.

Where public authorities lack the will or capacity to pursue ambitious enforcement, then a better strategy may entail their facilitation of self-reinforcing markets for EE improvements. The EE strategies chosen should reflect the existing technical capacity of targeted sectors and groups, as well as larger economic conditions that may impact their ability to comply or participate. Discussions with stakeholders, as detailed later in this report, can help identify areas of action with high potential for energy savings, while revealing where support is needed for capacity building and financing, as described further below.

Public authorities should strive to act with clarity and consistency in policy design and implementation. Apart from any changes made in the face of monitoring and evaluation, policy and program stability can enhance stakeholder confidence in the credibility of EE initiatives. Consistent enforcement and implementation across stakeholders can help encourage robust compliance, particularly when stakeholders are able to obtain needed clearances, permits, or technical resources in a timely way, and where appropriate. Such efforts have been identified as important determinants of a desirable investment climate for EE and renewable energy projects (Mani 2012).

Awareness campaigns can help targeted sectors or groups to understand new EE initiatives and methods for compliance, or they may encourage participation by emphasizing EE's benefits, such as improved firm operations or profitability. Support for demonstration projects in targeted sectors, especially those that are highly replicable in design and implementation, can be valuable where EE technologies and financing are viable, yet stakeholders lack experience with their deployment and are reluctant to act. Support for research and development via government investment in laboratories can speed up technology advances for improved energy performance at a lower cost. In the face of such advances, targeted sectors for EE action, such as industry, may be more willing to take on ambitious energy cuts.

The World Bank (Taylor et al 2008) has sought to classify EE opportunities according to the particular characteristics of different economic sectors. Design of policy interventions will further vary according to the needs of subsectors (Table 3).

For example, existing facilities in the industry and buildings sectors can benefit significantly from changes to operational management, facility renovations, and technology replacement. In existing buildings, cost-effective measures to improve EE include upgrades in lighting, as well as heating, ventilation, and air conditioning. In new buildings, major EE improvements come from changes in (i) ventilation systems and thermal integrity; (ii) the utilization of efficient cooling, heating, and lighting technologies; (iii) high standards in construction practices; and (iv) building orientation and design. Among developers, designers, and construction companies, EE may be a consideration in proceeding with given projects, but the appearance, location, and cost of structures are often more important factors. With this in mind, mandatory EE codes for buildings may be easier to engage when they target changes that are amenable to low-cost integration (Taylor et al 2008).

Table 3 Interventions for Energy Efficiency by Economic Sector

Key Sector	Subsector	Principal EE Interventions
Industry	A. New plant	• Policy and planning • Equipment regulating standards
	B. Existing plant 1. Energy supply industries	• Restructuring investment • EE investment
	2. Industrial energy consumers	• Restructuring investment • EE investment
Buildings (commercial, public, and residential)	A. New buildings	• Building codes and standards • Policy and planning
	B. Existing buildings	• EE investment
Transportation	A. Motor vehicles	• Vehicle regulating standards
	B. Other	• Policy and planning • Restructuring investment

EE = energy efficiency.

Source: Taylor et al. 2008. *Financing Energy Efficiency: Lessons from Brazil, [People's Republic of] China, India, and Beyond*. © World Bank, table 2.1, p. 37.

In the industry sector, many possibilities exist to improve energy intensity through the use of cogeneration, recovery of waste heat, and installation of more efficient motors and systems. For industries such as chemicals, petroleum refining, and basic metals, energy use represents a major share of operating costs (UNIDO 2011). In designing interventions to encourage industrial EE improvements, a fundamental consideration in developing countries is that EE cannot realistically be a top objective for firms that lack a high quality (reliable) supply of electricity. Accordingly, initiatives are likely to gain greater support from stakeholders where electricity supply is reliable but the energy intensity of operations is high. Meaningful dialogue with industrial stakeholders can assist authorities in creating EE targets that are quantifiable, responsive to technological and business risks, and structured to produce interim gains toward long-term horizons. When targeting the energy performance of particular products and appliances, government can collaborate with manufacturers to devise labels and standards in ways that incentivize industry to take innovative leaps forward in research, demonstration, and commercialization.

For EE initiatives that go beyond the switching out of a handful of inexpensive technologies, stakeholders must have the technical and financial capacity to proceed. The extent to which technical and financial resources are developed internally within organizations will impact the amount of external resources that are required for advanced EE projects. Where expertise in auditing and engineering is lacking, or where professionals lack project development experience, the public sector can support training activities and certify professionals accordingly.

The need to expand technical and financial capacity for the pursuit of larger EE projects has focused attention on new delivery mechanisms for facilitating EE investment (Taylor et al 2008). Primary delivery mechanisms in this regard include energy service companies (ESCOs), loan financing and partial loan guarantees, demand-side management (DSM) programs offered by distribution utilities in the energy sector, and bulk procurement programs by government.

The commercial banking sector in many locales is already well positioned to support EE projects, and loan products may require only minor changes to the credit review process and loan terms. For EE projects, loan repayment can occur more frequently, with greater attention to the timing of cash streams that occur due to EE investments. As new projects generate savings, loan customers can be required to make payments into escrow accounts, over which lenders assume control. More careful preparation of EE project proposals can strengthen loan applications, with greater chances for matching the information requirements of finance professionals. Banks, meanwhile, may benefit from outside efforts to assist their identification of EE markets in ways that grow their business lines, expand service to valued customers, or promote their standing in the community. As financial institutions better understand EE's value to different customers, they may devote special attention to devising sophisticated financing mechanisms that encourage even more ambitious action in different sectors (Taylor et al 2008, ADB 2012d, USAID 2012).

Partial-risk loan guarantee instruments and more financially structured risk-sharing facilities, with backing from international financial institutions, have helped launch new programs for EE financing by reducing some of the risk of lending. They appear particularly effective when operating in locales where the banking sector is relatively robust with regards to the maturity of its lending practices. Also of interest are special revolving funds. Through their ability to merge project development with financial intermediation in service to EE improvements, they may be particularly useful in locales where the banking sector is undergoing restructuring or significant reforms.

ESCOs can provide clients with both technical and financial resources to invest in EE. They undertake energy saving improvements for entities of various sizes, earning remuneration through a fee for their services or through a share of the economic savings achieved from projects over time. To facilitate the ability of ESCOs to serve very large projects, as well as several smaller projects that may be bundled to increase the impact of energy savings, government can provide technical assistance to ESCOs to build capacity in the sector. Government can also assist ESCO sector development through: (i) amending procurement laws and regulations to allow performance contracts (which are neither pure goods nor pure services), (ii) accrediting qualified ESCOs, and (iii) mitigating risks associated with long-term performance contracts in the public sector. Particularly important are efforts to connect ESCOs with sufficient sources of finance, so that the cost of borrowing is minimized and otherwise valuable EE projects can be pursued (USAID 2012).

The benefit of utility DSM programs comes from the utility's ability to merge project development with financing options that serve a range of customer classes with whom the utility shares an ongoing business relationship (NRDC 2012). Policy or regulation can incentivize utilities to offer EE services, by breaking traditional arrangements that link utility revenue generation to volumetric sales of kilowatt-hours. The challenge for government is to work with utilities and energy providers to correct for biases in the system that favor supply-side, rather than end-use, solutions in meeting energy demand.

As EE improvements are pursued, it is important that market players utilize sound contractual arrangements to guide implementation and finance of projects and assignment of risk. Also useful are efforts by public authorities to create strong legal protections for enforcement and dispute resolution. Otherwise, parties may be less likely to enter into EE and other clean energy projects (Mani 2012).

3 Lessons Learned from Energy Efficiency Investment Experience

3.1 Promoting Energy Efficiency: A Survey of Tools and Mechanisms

Global experience continues to build around the creation and application of policies, programs, and incentives to support energy efficiency (EE) implementation. Action within and across countries is targeting the residential, commercial, industry, and public sectors, with increasingly ambitious approaches to capture EE gains in buildings, facilities, lighting systems, vehicles, and a range of appliances and products.

Utilizing mandatory and voluntary measures, these initiatives reflect the specific opportunities that abound in particular countries, as well as the resources available to stakeholders in pursuing desired gains. This chapter surveys many of the lessons learned from national and regional action to embrace EE and demand-side energy efficiency (DSEE) interventions. Their possible prospects for broader systematization are also considered, in light of emerging needs in developing Asia and ADB's role in the region as a facilitator for clean energy and DSEE investment.

3.2 Overarching Needs for Implementation

New policies and financial incentives for EE uptake are unfolding in a myriad of country settings around the world. This section reviews contextual elements that may impact the success or failure of national and regional interventions to promote EE, highlighting factors of interest to those engaged in the design of supportive mechanisms.

Financing Options

Potentially lucrative EE projects, as noted earlier, often must overcome a lack of sufficient financing. Banks and other providers may hesitate to support EE initiatives due to concerns about risk, high transaction and project development costs, and inadequate internal expertise for understanding technical and economic project components (USAID 2012). When financing is provided, care must be taken to design options that support a meaningful scale up of EE investment.

For certain sectors and projects, this objective may require more tailored loan products to meet the particular demands of various customers in the public and private sectors. Financing to support improvements in public facilities will need to respond to different project and institutional parameters compared to funding that advances industrial retrofits. In the utility sector, meanwhile, when EE performance-based resource programs are authorized, funding will be significantly influenced by the risk component of the program.

ADB is well situated to identify sound approaches to support the finance of EE interventions across these diverse sectors. International experience suggests that mechanisms for EE project finance span a number of alternatives (Rezessy and Bertoldi 2010, Barbose 2013). The following mechanisms have been utilized in developed and developing countries:

(i) **Utility (electric or gas) financing.** Options entail utility bill financing, subsidies, or other financing assistance.
(ii) **Special purpose funds.** These funds have been put to use in a variety of ways, and typically are created by donor agencies, governments, or regulators.
(iii) **Performance contracting.** Energy service company (ESCO)-type approaches can be undertaken by private or public sector actors.
(iv) **Equity funds.** These types of funds may come from public sector agencies or private sector venture capital firms to support investment in ESCO projects, serving as a form of "last mile" equity investment.
(v) **Dedicated credit lines.** These are typically funds made available to local banks and financial institutions by donor agencies, to expand accessible funding for investment in EE projects. The goal is often to leverage these funds by additional resources from participating financial institutions and banks.
(vi) **Credit guarantee mechanisms.** These may be provided as part of risk-sharing programs, to lower the risk of EE project financing for participating financial institutions and banks.

Regional Energy Efficiency Information Systems

National experience suggests that, as interest grows for EE investment, target setting and market design activities will require access to reliable data and information systems. Quantifiable data on sectors and initiatives can allow for the establishment of key indicators by project category, as well as baselines against which progress can be measured. A designated public or private entity can be tasked with maintaining an EE database that serves to collect, monitor, and update information, as required. Emphasis should go to the acquisition of supply and demand data covering targeted sectors for durations of time that facilitate assessment of longer-term trends.

Regionally, such a database can serve as a central location for accessing studies, evaluations, and other reports on national energy initiatives with applicability to DSEE. This type of information can be a resource for the EE industry and other players during the goal setting and market design activities. More broadly, energy indicators can be supplemented with greenhouse gas (GHG)-related data to facilitate sharing of information pertaining to global action and agreements. As ADB seeks to scale up its EE investments, a database knowledge resource incorporating key data and trends could support regional efforts for the preparation of regular reports, with additional revisions or updates by DMCs, to serve as yearly reviews of EE trends and statistics throughout Asia.

In-Country Institutional Capabilities

Where local resources to support EE markets are limited in some countries, donor funding is typically directed to critical capacity-building efforts. This can include training and certifying EE professionals, for example. In other countries, public authorities have shown an interest in creating specialized entities to engage the varied tasks associated with designing, launching, and administering EE programs. Responsibilities may range from the crafting of new regulations to monitoring compliance and securing funds. The rationale is often to facilitate more ambitious EE-related market development than might otherwise occur in the absence of specialized institutional support capacity.

Awareness of Energy Efficiency Means and Benefits

Despite the trend of increasing policy support for EE initiatives, many stakeholders continue to have limited awareness of EE options and benefits (ADB 2012d). They may lack knowledge of available technologies and project approaches. Consumers, investors, and policy makers could accordingly benefit from heightened attempts to generate awareness of the potential costs, risks, and payoffs of scaled-up EE investment, in ways that speak to local market and cultural conditions.

These elements increasingly comprise the broad basis of national and regional efforts in recent years to facilitate EE markets and investment around the world. As ADB defines its operational mode and support for such activities in Asia, careful attention to these factors can serve as guideposts for the design of technical assistance and financing tools that are appropriate to the diverse needs of member Asian countries.

3.3 Policy, Programs, and Incentives

The following section explores the various tools and mechanisms that have been employed throughout the world to facilitate EE interventions. More targeted attention to approaches in developing Asian countries is provided in Chapter 4.

Government Commitment to National Energy Efficiency Targets

Across most countries, targets or commitments to guide EE improvements are embedded in national strategies or action plans that specify concomitant goals for reductions in energy intensity or GHG emissions. An EE commitment is usually designed as a percentage reduction in energy consumption or energy intensity from baseline figures.

In advancing shared frameworks for economic development or climate change mitigation, national EE plans typically specify mandatory or voluntary objectives, designated annual achievements in relation to a starting point, tools or tactics for realizing targets, and metrics for assessing progress (or lack thereof). In general terms, tools to facilitate EE interventions may be very similar across countries but differ in how they are implemented, in accordance with the needs of different stakeholders and sectors.

Tools often encompass awareness programs, technical assistance, end-use tariff schemes, and supporting finance mechanisms. Other common tools include certification and accreditation of energy industry professionals, enforcement of efficiency codes and standards for buildings and energy-consuming systems, and financial incentives to suppliers of energy products and services as well as end users.

National EE targets, while emerging around the world, may be driven in significant part by larger regional imperatives. The European Union (EU) has embraced a comprehensive set of measures to reduce regional energy use and GHG emissions. Its Emissions Trading System (EU ETS), implemented in 2005, is currently operating in its third phase (2013–2020) with participation that spans 31 countries (European Commission 2013). As the world's largest international system for trading allowances in GHG emissions, the EU ETS applies to some 11,000 industrial plants and electricity-generating facilities and has grown to include airlines.

The EU aims to reduce its primary energy consumption by 20% compared to projections for 2020 through measures that may reduce the region's energy costs by €50 billion each year (European Parliament 2012a). An early 2006 directive called on EU Member States to devise national action plans to guide EE action. Governments were challenged to develop measures for the public sector and to work with energy distributors, retail businesses, and other actors to facilitate access to energy-saving services and programs (European Parliament 2006).

The European Commission adopted a new EE directive in October 2012, which establishes rules to guide more ambitious action in the public sector and to remove market impediments to efficiency services (European Parliament 2012b). Member States are compelled to refurbish some 3% of the total floor space (cooled or heated) of central government structures, where "useful floor area" exceeds 500 square meters. The threshold will later shrink to 250 square meters. Designated energy companies will be required to meet cumulative targets for end-use savings in energy sales. Energy audits will be mandatory for large enterprises, and Member States will have to encourage the creation or use of financing facilities in support of EE initiatives (European Parliament 2012a).

In the Republic of Korea, national targets for EE comprise a key piece of the country's low-carbon and "green growth" strategy, passed in 2009. "Green growth," more generally, refers to an economic strategy for industrial expansion and national productivity that is supported by initiatives for sustainable development, environmental improvement, job creation, and quality of life. For the Republic of Korea, EE is a focus of efforts to decrease national reliance on fossil fuels and increase energy independence. The country is pursuing a broad strategy to capture EE gains in transport, buildings, industry, and equipment and appliances (Presidential Committee on Green Growth 2013), as discussed later in this chapter.

End-Use Pricing Approaches to Promote Resource Efficiency

Energy end-use tariffs can nudge consumers toward considering ways of reducing their expenditures on energy. Where this price signal is missing, however, EE technologies or service options may fail to entice consumer interest. This situation can be a particular challenge in developing countries, when public authorities allow or implement energy subsidies to minimize price burdens for low-income populations. Whatever the stated goal or intent may be, energy subsidies, in practice, often benefit those groups that are most able to pay true economic prices for their energy consumption.

Where conditions suggest that energy subsidies will continue, then reforms should target the level of support provided so that excessive benefits do not accrue to higher-income energy users. In the residential sector, rising block tariffs can be complemented by the provision of affordable "lifeline" rates for low-income groups. In the industry sector, rising block tariffs can be applied to energy-intensive industries, designed around best practice efficiency levels and production output.

More broadly, energy price tariffs can encourage efficiency through designs that shift electric power loads to different periods of time, with a particular emphasis on reducing peak demand consumption (Crossley 2013). Time-based pricing approaches may include, but are not limited to, dynamic pricing models that reflect hourly changes in the utility's cost to acquire or produce electricity. These models provide strong price signals to curtail or shift consumption in ways that contribute to wider efficiencies in electricity system performance. However, their sensitivity to time-of-use changes in relation to both utility conditions and customer consumption necessitates complementary investments in advanced metering devices and related infrastructure.

Incentive Regulations for Utilities

For many years, energy utilities have faced structural disincentives that discourage their aggressive pursuit of otherwise cost-effective DSEE opportunities. Under traditional regulation, public authorities identify the amount of revenue that is needed to cover a utility's costs for serving customers, to include acquiring and operating facilities, equipment, and other infrastructure. If the utility is investor-owned, its costs also include a reasonable return on investment for shareholders. This information is used by regulators to set utility rates. In the aftermath, whatever revenue the utility earns beyond its authorized fixed costs represents a profit to the utility. As customers consume more energy, utility profits increase; this is known as the "throughout" incentive. Should customers use less energy, utility profits will drop. This mechanism undoubtedly works against any interest a utility might otherwise have to exploit all possible EE opportunities among its customer base (NRDC 2012).

In recognition of this problem, regulators have increasingly pursued alternative approaches to remove disincentives and create enticements for utility capture of EE opportunities. Options include the use of performance-based incentives for utility shareholders, mechanisms to recover EE program costs, and decoupling of utility revenue from increased energy consumption (USAID 2010).

Cost recovery mechanisms permit utilities to recapture their operating costs for any EE or demand-side management (DSM) programs that are in operation. Recoverable costs may include expenses related to marketing, administration, provision of rebates, and program evaluation. Popular approaches for cost recovery include (i) the use of tariff riders under regulatory approval, (ii) the embedding of costs in rates as part of utility budgeting for resource procurement, and (iii) the application of public purpose surcharges on electricity bills. In the United States (US), for example, public purpose surcharges are utilized in 14 states, after debuting approximately 10 years ago during the wave of restructuring in the electricity sector (Barbose 2013).

Under decoupling, utilities may continue to recover revenue that is sufficient to meet their authorized fixed costs. If utility revenue exceeds that threshold, then utilities must return money to customers. If utility revenue falls beneath authorized fixed costs, then utilities are allowed to collect the difference. This arrangement eliminates the utility disincentive to EE, as utilities no longer profit from ever-increasing electricity sales.

Ratemaking approaches to decouple utility profits from sales volume emerged in the late 1980s, as regulators in some US states began to require decoupling for investor-owned utilities. Later spreading to countries such as Australia (Crossley 2013), decoupling for either electric or natural gas utilities has been enacted in more than half of all US states (NRDC 2012). With regards to electricity sector programs, decoupling is in operation, or has been enacted, for seven of the 10 states reporting the most significant per capita EE investments.

Because decoupling breaks the link between utility profits and sales volume but does not necessarily require the creation or promotion of EE programs, its application often coincides with the passage of Energy Efficiency Resource Standards (EERS) as discussed later in this chapter (EIA 2011). EERS requirements call for utilities to lower electricity demand by a target year compared to an established baseline.

Mandatory Building Codes: Enforcement

Buildings are significant consumers of energy, but their performance can be improved by the enactment and enforcement of building energy codes. These codes set thresholds for building energy consumption through design and construction standards that apply to energy systems, equipment, and the building envelope. Applicable to both new and renovated structures, building codes may utilize a "prescriptive" or "performance" approach to drive changes.

With prescriptive approaches, a number of building elements must meet a designated standard as specified in the code. Under a performance approach, the building's energy performance in the aggregate must match a designated level. Ideally, building energy improvements pursued through code changes or updates should deliver energy savings within reasonable time frames for owners or occupants, while preserving or enhancing structural comfort and safety. They are applied to both public and private sector buildings.

Building energy codes require strong enforcement to ensure that targets are achieved. In developed countries, regulatory authorities exist to support compliance. In many developing countries, building energy codes have yielded more modest success primarily because of cost considerations and insufficient enforcement capabilities among regulators.

Where building energy codes have taken hold, the trend is for adoption of higher standards over time, with increasing requirements for disclosure of building energy usage and related costs. In the EU, by 2021, new buildings must be "nearly zero-energy buildings" as part of a wider May 2010 directive that calls for Member States to create minimum energy performance standards for both existing and new buildings. "Nearly zero-energy buildings" may be defined, in general, as buildings that—on net—consume a very small amount of energy, due to their highly efficient design and/or reliance on distributed renewable energy generation. Under the directive, building energy performance must be certified, and regular inspections must be undertaken to evaluate air-conditioning systems and boilers (European Parliament 2010).

In France, new regulations put forward in December 2012 require nonresidential buildings to shut off interior lights 1 hour following the departure of the last employee. Shop windows and building facades are required to turn off lights an hour after midnight (Ministère de L'Écologie, du Développement Durable et de L'Énergie 2013).

Since 2002, Germany has required that energy performance certificates be issued for buildings based on designated categories and age. They are mandatory for new buildings, and for existing buildings are required at the point of sale or rental. Financial resources to support EE improvements may be accessed through several venues, to include KfW, the federal and regional government investment bank. From 2006, KfW served as a conduit for federal funding totaling €1 billion each year, to support improvements to existing homes and additional building structures. Budgetary support increased from 2008 to 2011, reaching €1.4 billion a year (Power and Zulauf 2011 citing Gumb 2009). Through these efforts, since 2002, energy consumption in targeted buildings has decreased by 50%. From 2006 to 2009, approximately 1 million homes underwent improvements, and some 400,000 residences offering high efficiency performance have been added to the housing market.

Voluntary Building Initiatives

As building energy codes have advanced around the world, calling for mandatory improvements in building performance, voluntary approaches for "green buildings" are also increasing in favor. Their popularity speaks to a growing recognition that building energy costs, when managed intelligently, can be transformed into a significant source of economic savings for households, businesses, and public agencies. The metrics utilized to rate green buildings can vary based on region. Two examples are LEED and BREEAM.[1] Yet their larger function is to identify a building's environmental attributes according to energy and water use, the quality of construction materials utilized, proximity to public transit locations, and related factors.

Supportive measures across countries to promote or incentivize voluntary green buildings include tax support and market-based incentives, technical guidance, and greater exposure to comparative benchmarking standards. Other measures pertain to the promotion of tools for enhanced data gathering on building performance, better marketing of new energy management approaches, and public awareness campaigns (Anastasia 2010).

In the US, the Obama Administration has called on the private sector to voluntarily capture wider EE gains through the Better Buildings Initiative, launched in 2011. Its goal, by 2020, is to improve EE in industrial and commercial buildings by 20%. The initiative encourages private sector EE investment through the provision of workforce training materials, streamlined approaches to financing, and enhanced access to sophisticated data on commercial buildings (USDOE 2013a). By late 2012, some 110 organizations had joined the initiative, pledging to improve their energy intensity by a minimum of 20% by 2020. Their commitments span hundreds

[1] LEED stands for Leadership in Energy and Environmental Design (see http://new.usgbc.org/leed) and BREEAM stands for Building Research Establishment Environmental Assessment Method (see http://www.breeam.org/).

of industrial facilities and approximately 2 billion square feet of floor space. Some $2 billion in EE financing has been pledged by utilities and financial firms to support the improvements (USDOE 2012a).

ADB has also pursued its own voluntary initiatives for building improvements with a focus on its headquarters in Manila. In 2011, through EE renovations and upgrades to its existing procedures on energy and environmental management, ADB achieved a LEED Gold rating for its 20-year-old building. From 2005 to 2010, electricity consumption per person at headquarters fell from approximately 3,597 kilowatt-hours (kWh) to about 3,125 kWh (ADB 2011c). ADB additionally installed 2,040 photovoltaic panels on the roof of its main building in 2012. The panels will generate 613 megawatt-hours of electricity each year to help meet ADB's energy needs (ADB 2012c).

Appliance Minimum Efficiency Standards

The development of minimum efficiency standards for products and appliances, such as computers, televisions, motors, lighting, and other technology, is critical in decreasing energy demand. Without standards to move the product market forward, many consumers are unlikely to voluntarily purchase more advanced EE technology options if their initial costs exceed those of less efficient options. Appliance standards work to counter this market barrier to greater EE by nudging manufacturers toward the design and commercialization of higher-performing product models.

In the Republic of Korea, fines apply to products that enter the consumer market without meeting minimum energy performance standards, and product labels inform consumers about the energy consumption of devices even during sleep, passive, and "off"-mode status (Oh 2012). Elsewhere in Asia, Japan's Top Runner Program has been a model for ambitious energy performance in the products and appliances sector.

Top Runner emerged in the late 1990s following decades of national economic growth, which drove a ninefold increase in the country's energy use from 1955 to 2000 despite a near lack of indigenous energy resources. Following Japan's passage of the Energy Conservation Law of 1979, and its later commitment to GHG reductions under the Kyoto Protocol, energy conservation has come to occupy a central place in national policy. In earlier years, however, industrial EE outpaced gains in the commercial and residential sectors, as rising incomes empowered consumers to increase their use of a range of energy-consuming devices. In recognition of this achievement gap, the Top Runner Program was devised to spur further EE gains in residential and commercial technologies. The first group of products covered under the program included air conditioners and automobiles, with later additions as the program expanded. By 2010, Top Runner standards applied to 23 technologies.

Products are selected for program inclusion based on the extent to which they are (i) utilized in significant quantities, (ii) energy intensive in their operation, and (iii) challenging with regards to designing EE improvements. Under Top Runner, mandatory standards for EE (as applicable to various products and appliances) are established for given target years, based on the performance of the most efficient product presently available in the market. EE has improved by as much as 80% for computers, 72% for copy machines, 67% for air conditioners, and 55% for refrigerators as a result of the program (Ministry of Economy, Trade and Industry 2010b).

As with building energy codes, appliance standards must achieve compliance in order to deliver energy savings. Testing procedures and facilities, such as internationally certified laboratories, can aid enforcement efforts by generating valid and trustworthy ratings on product performance. In developing countries, enforcement has proven to be more challenging, and older, inefficient products tend to linger in the market. These challenges have been the focus of various initiatives by development organizations and international institutions, with some amount of progress. Greater planning and assistance may be needed to help support the ongoing phaseout of inefficient, older technologies. This task may be especially challenging where older products are very familiar and widespread in the market.

A timely example comes from the lighting industry. Despite the global proliferation of compact fluorescent lamp (CFL) technology to serve lighting needs in homes and businesses, incandescent lamps—which are less expensive in terms of their up-front cost, albeit less energy efficient—remain widely available to many consumers. Even so, as alternative technologies have advanced with improved energy performance, national initiatives have proliferated to restrict the sale of inefficient lighting.

In Australia, sales restrictions were imposed to phase out inefficient incandescent light bulbs beginning in 2009 based on minimum energy performance standards. General Lighting Service incandescent lamps and extra low voltage halogen non-reflector lamps are targeted. The new measures are projected to decrease electricity use by 30 terawatt-hours from 2008 to 2020, avoiding 28 million tons of GHG emissions. The annual cost savings should approximate A$380 million by 2020 (Department of Climate Change and Energy Efficiency 2012).

Australia also has introduced new standards and labeling for household products and appliances such as televisions, and has increased the stringency of standards for other products such as air conditioners and refrigerators (Department of Climate Change and Energy Efficiency 2010). Standards and labeling requirements for televisions imported into Australia came into effect in October 2009, with more stringent standards scheduled to begin in October 2012.

New or advanced standards for products and appliances are additionally being reinforced by efforts to ensure that performance meets applicable targets. For example, in the United Kingdom (UK), the Energy Information Regulations of 2011, active since July of that year, address the requirements of the EU directive for labeling of energy-consuming products (National Measurement Office 2011). They also respond to EU regulation pertaining to market surveillance activities for such products. The UK authorities have subsequently acted to meet the requirements of the Energy Information Regulations through unannounced visits to retail product locations and on-site assessments of label placement and accuracy (National Measurement Office 2012).

Minimum Efficiency Standards for Vehicles

In many countries, the transport sector is responsible for the fastest rate of growth in the consumption of fossil fuels relative to other sectors such as buildings and industry. Where reliance on automobiles for personal mobility is the norm, this trend is likely to continue. To reduce energy use in the transport sector, cities and metro areas can employ public transit modes such as rail and bus lines and dedicated walking or bike paths. However, these modal arrangements require a planning mind-set that works to curtail sprawl and increase population density in mixed-use residential and commercial areas, to make the use of public transit logistically and financially viable for inhabitants.

Where transport systems are primarily private in nature, that is, personal vehicles are utilized for mobility needs, vehicle and fuel taxes may be applied to increase the cost of driving and raise revenue for public transit projects. Another option is to enact minimum efficiency standards for vehicles as a means to reduce the sector's energy intensity. For example, requirements for increased miles per gallon over successive years have contributed significantly to better fuel performance in automobiles in the US, and are predicted to capture even greater gains in the future. Their use has coincided with improvements in vehicle weight and aerodynamics, decreased tire rolling resistance, advances in diesel and gasoline engines and transmissions, and more efficient air-conditioning systems.

The Obama Administration has set standards for cars and light-duty trucks that will raise fuel economy to approximately 54 miles per gallon by model year 2025 (The White House 2012). These advanced standards, finalized in August 2012, build upon an earlier increase in the standards that aimed for model years 2011–2016. In full, their joint impact should result in fuel savings of 12 billion barrels of oil, for an economic savings to consumers of $1.7 trillion. The standards were developed through consultations with a range of stakeholders from industry, labor, state government, and consumer and environmental groups. They facilitate investment in advanced technology by encouraging regulatory certainty, allowing compliance flexibility, and improving coherence between national and state mandates.

The challenge for vehicle efficiency standards, however, is that better fuel economy can result in more distance traveled, as the cost of driving is offset by efficiency gains. Such concerns have spurred interest in shifting to electric and hybrid–electric vehicles for personal use. The potential benefit of electric vehicle technology is based on its capacity to obtain power (fuel) from electricity generated from renewable sources such as wind and solar photovoltaic systems. Another benefit is its emerging ability to serve as a mobile source of power or to provide a backup for energy storage, when patched into electricity systems. As smart grid infrastructure is deployed, and as buildings integrate on-site distributed generation, electric vehicles can receive power at a home or business, and when driven to another location, that same vehicle may deliver electricity back into the system, should the network require or incentivize such delivery.

It is important to note that a shift to electric vehicle technology does not solve the challenges of traffic management or sprawl. In addition, widespread advancement and deployment of electric vehicle charging stations, in combination with smart grid infrastructure, will entail significant investment by utilities in partnership with public authorities.

Programmatic Demand-Side Management Market Activities

Energy efficiency and DSM programs have been a feature of electric and gas distribution utilities for 3 decades. From their beginnings in North America, these programs now operate in many parts of the world, reflecting a growing awareness among regulators of their contributions to alleviating network and grid constraints, balancing frequency regulation, and enhancing the integration of intermittent renewable generation (Crossley 2013). In light of these benefits, utility EE program funding increased markedly over the last decade. In the US, from 2006 to

2010, spending on customer-funded EE programs by electric utilities grew by $3.9 billion, and approved program budgets for 2011 targeted spending of $5.6 billion (Barbose 2013).

EERS, known alternatively as an Energy Efficiency Obligation or Commitment, is a particularly significant driver of DSEE improvements. The EERS mandates that utilities achieve designated levels of energy savings by deploying DSEE strategies for cost-effective EE improvements. In most cases, increasing energy savings are targeted for successive years. Such EERS and Obligation mechanisms are now in operation in some countries, and where mature, may demand an annual savings of 1.5%–2.0% (Crossley 2013). The UK's electricity retailers were placed under an Energy Efficiency Obligation in 1994, and countries such as Belgium, Denmark, France, and Italy later followed suit. Obligations have been adopted in Brazil and three Australian states, and some 26 US states enacted EERS mechanisms from 2007 to 2010.

More broadly, EE and DSM programs offer their customers a range of choices by which to manage or improve energy use across sectors. Examples include technical assistance for building design and operation; training and capacity building for EE expertise in the engineering, architectural, and design professions; support for rebates and other financial incentives to entice consumer purchases of EE products and appliances; promotional campaigns to encourage customer participation in taking advantage of EE programs and services; dissemination of EE products to utility customers; and support for EE saving funds (Crossley 2013, Barbose 2013).

Utility EE programs may experience yet another boost as a function of more recent national efforts to develop and promote smart grids and meters. In the US, smart grid development is pursued through a national framework for action authorized by the Energy Independence and Security Act of 2007. A key part of the Act is Section 1306, which permits the US Department of Energy (USDOE) to develop federal matching funds on costs related to smart grid investments. With leadership from USDOE (2012b), coordinated action is under way to facilitate research and development, regional demonstration projects, interoperability standards, and interconnection planning.

3.4 Engaging Stakeholders

In the countries and regions surveyed for this report, stakeholder consultation and engagement has been an ongoing component of EE planning and policy design. Dialogue with diverse stakeholders in government, industry, academia, and the general public can reveal where robust cost-effective EE opportunities exist and where policy, financial assistance, or other support is needed to accelerate their realization. As information is generated on policy or program performance, ongoing engagement with targeted sectors or customers can empower public authorities to pinpoint where initiatives require changes or reforms to improve outcomes.

As EE investments gather momentum, stakeholder engagement can help to ensure that policy and incentives, financing packages, and project design come together in ways that respond to the needs and opportunities that exist in various market segments. This entails special attention to local business practice and authority, as the larger goal of public interventions must be to encourage the formation of EE markets that drive wider-scale improvements. Without such customization and specificity, EE investments may deliver lackluster results compared to their actual potential.

3.5 Monitoring and Evaluation

National policy and planning efforts also have confirmed the need for careful attention to monitoring and evaluation (M&E) procedures. M&E activities allow for the comparison of conditions before and after the implementation of EE initiatives. From initial baselines in particular sectors as assigned by year, the performance of programs or projects can be assessed against the original expectations defined for the intervention.

Effective M&E requires that key indicators be identified as a means to measure policy or program impacts at noted intervals. Examples of indicators across sectors include the type and amount of EE technologies that are purchased and installed; the type and amount of operational, industrial, or behavioral processes that are impacted; the fuel and electricity savings achieved; the cost of technology or process improvements; and the size of any loan amounts for EE projects, the rate of loan recovery, and the payback period.

M&E further requires reliance on transparent and valid procedures, so that all concerned parties have confidence in the reliability and integrity of reported outcomes. Stable and adequate funding support from public authorities is also important, to facilitate the ongoing involvement of trained staff in M&E activities throughout the given stages of EE initiatives. Finally, as with the case of stakeholder engagement, sound M&E can allow for routine modification of EE efforts, as feedback is obtained. Initiatives should be able to respond more effectively to changing conditions, with the goal of correcting for errors or shortcomings before any significant problems arise.

3.6 Scaling Up and Systematizing Energy Efficiency: Some Ways Forward

The foregoing policy and programmatic approaches point to key areas of opportunity for scaling up EE initiatives at a country or regional scale. Greater efforts to systematize EE program support and investment can leverage existing resources to generate broader and deeper impacts while generating momentum for further EE market development. Areas where ADB may engage such activities to significant effect in Asia are explored below.

Regional and Country-Specific Thematic Energy Efficiency Programs

With its ability to combine technical assistance and financing, ADB can add significant value in support of EE program investments at a regional or national scale that reflect a thematic orientation. Compelling options abound in municipal lighting and public buildings, state-owned industrial facilities, and advanced electric metering systems. Across cases, a shared imperative exists for a systematic technical support function and generous capital investment. Issues of interest by thematic area are discussed below.

Public Buildings. Public sector buildings and offices can generate substantial energy consumption profiles, implying significant environmental impacts and the possibly inefficient use of public or taxpayer funds. However, where building occupants exhibit a standard pattern of use, EE programs may be designed and systematically deployed to achieve impressive energy and financial savings.

In the UK, the public sector has already achieved major reductions in energy use to support a central government goal for a 10% cut in GHG emissions from May 2010 to May 2011. With the participation of some 3,000 public buildings, technology and behavioral changes—combined with the application of a retrofitting program—facilitated a 13.8% cut in public sector emissions, with reduced energy costs of £13 million.[2] Going further, a new 5-year target aims for an additional 25% drop in government GHG emissions by 2014–2015 (Department of Energy and Climate Change of the United Kingdom 2012). A major focus of the UK government is to collect and share more detailed information with public authorities about the range of available financing options to support EE projects in the sector.

In Asia, ADB could support a standardized program for public building improvements, to be operational at a regional, national, or possibly provincial scale. Program development could benefit from cooperation with a local public entity. A procedural framework could be devised whereby interested energy service providers in the private or public sectors would compete to offer efficiency improvements. ADB could provide a funding mechanism (see Box), complemented by lending criteria that incentivize demand for the program.

Municipal Lighting. Scaled-up improvements in municipal lighting (or street and public area lighting) can be engaged in a manner similar to strategies for public buildings. In the US, the USDOE leads a Municipal Solid-State Street Lighting Consortium to facilitate more systematic uptake of high efficiency light-emitting diodes (LEDs) for streets and area lighting throughout the country. The consortium encourages sharing of technical information and methodologies for assessing advanced lighting options among "official" members that include utilities, city governments, and EE organizations from across the US. Topics include research and development, financing options, and market development support (USDOE 2013b). Makers of LED products are allowed to participate by joining a manufacturers' reference list and putting forward products for demonstration.

Where private sector actors may become involved in street lighting improvement projects, greater attention should be given to developing the administrative and legal frameworks required to guide their participation. This reflects the nature of government's responsibility in seeing to public safety through street lighting and related projects. As more systematic EE improvements in the sector are pursued, ADB can contribute significant value to these initiatives, as the potential financial savings of public lighting efficiency projects are impressive, and the needed capital investment is also high. ADB's strategic role can be to bridge this investment gap from both a finance and policy perspective.

Publicly Owned Industrial Facilities. These facilities may suffer from a lack of investment in improving process operations and switching out aging machinery and parts, as the expense to

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2 The retrofitting initiative is known as the "RE:FIT" program.

Box The Clean Energy Financing Partnership Facility

Energy use in developing member countries (DMCs) of the Asian Development Bank (ADB) is rapidly expanding to support economic growth and improved living standards in the region. The current energy path relies on increased use of fossil fuels, and is neither environmentally sustainable nor economically desirable. Under the Energy Efficiency Initiative, the Clean Energy Financing Partnership Facility (CEFPF) was established in 2007 to help ADB's DMCs improve energy security and transit to low carbon use through cost-effective investments, particularly in technologies that result in greenhouse gas mitigation. The CEFPF was one of the early partnerships established under ADB's Financing Partnership Facilities, set up with the aim of fostering multi-partner cooperation for long-term strategic activities in support of its operational work.

About 30% of CEFPF's resources are aimed for use in stand-alone technical assistance projects and for direct charges that fund capacity building and consulting services and minimal related equipment and works. Some 70% of resources are targeted for use on grant components of investments. These grant components of investments may also be used to procure equipment and works based on advanced technologies, and to back financing mechanisms, risk-sharing facilities to promote clean energy, and services to lower barriers. As of 31 December 2012, the CEFPF leverage ratio was 1:21, with $72.3 million in cumulative CEFPF commitments mobilizing $1.6 billion in clean energy investments.

Energy efficiency-related activities supported by CEFPF include demand-side management projects; energy-efficient district heating, buildings, and end-use facilities; energy-efficient transport and street lighting; manufacturing facilities of high efficiency appliances and industrial equipment, as well as clean energy system components; and energy service company development. Other CEFPF-supported activities include clean energy power generation, transmission, and distribution; biomass/biofuel/biogas; carbon capture and storage; and rural electrification and energy access.

Four trust funds provide financing under the CEFPF. They are the Clean Energy Fund, funded by the governments of Australia, Norway, Spain, and Sweden; the Asian Clean Energy Fund, funded by the Government of Japan; the Carbon Capture and Storage Fund, funded by the Carbon Capture and Storage Institute and the Government of the United Kingdom; and the Canadian Climate Fund for the Private Sector in Asia, funded by the Government of Canada. Total contributions to the CEFPF as of 31 May 2013 amounted to $230.8 million.

Source: ADB.

governments for these changes can entail very large up-front investments. Managers also may lack knowledge on current best practices for facility operations. Under these conditions, publicly owned industrial facilities are likely to be significantly energy inefficient, and may be a financial drain on public resources.

The US state of California supports an ambitious financing program to incentivize EE improvements in state and local public facilities. Maximum loan amounts per applicant are $3 million, with no set minimum. Eligible applicants range from cities, counties, public colleges, and schools, to public hospitals, special districts, and public care institutions. Supportive programs offer technical assistance to eligible applicants to evaluate on-site EE opportunities (California Energy Commission 2013). Examples of eligible projects include upgrades to higher efficiency pumps and motors, equipment controls and energy management systems, thermal energy storage, combined heat and power, and load-shifting projects. Payback of loan principal, with a 1% interest rate, must not exceed 15 years.

In Germany, federal initiatives provide for subsidies targeting EE improvements in government and military facilities. Additional federal support goes to the testing of combined heat and power and advanced EE applications. At the local scale, municipal energy investment companies facilitate improvements to energy infrastructure through a growing emphasis on reduced energy consumption (Power and Zulauf 2011).

These examples suggest that publicly owned industrial facilities offer promise as an additional area for more systematic investment in Asia. Program development in the region may benefit from a country-specific (rather than regional) focus, where designated EE public facility improvements are supported by a financing mechanism that is tailored to national policy and operational contexts.

Smart Metering. Advances in EE products and building energy management, alongside the increasing deployment of distributed renewable energy generation, have placed emphasis on the development of smart metering systems. Smart meters are part of an emerging advanced smart grid infrastructure that supports two-way communication between energy users and the utility. Their use not only permits utilities to collect data on electricity consumption from remote locations at different times, but also can facilitate or require changes in that consumption in response to network constraints, power shortages, or other imperatives.

In Japan, a national initiative is exploring the possible benefits of smart metering technology through deployment of pilot projects and collaboration with electric industry stakeholders. Japan aims to design information and communication technology networks and related smart grid infrastructure approaches that can assist the country in meeting its low-carbon goals while facilitating the emergence of new services. Study groups have been formed to investigate key issues for standardization with regards to technical regulations and conformity. Smart grid, smart house, and smart charge projects also have been funded (Ito and Ogawa 2009). Ideally, Japan aims to introduce smart meters and supportive energy management systems for all energy users "as early as possible in the 2020s" (Ministry of Economy, Trade and Industry 2010a).

In advancing smart metering technology, the key issue surrounds the amount of capital that is needed to support upgrades for millions of metering devices throughout a designated jurisdiction. With this challenge in mind, program efforts in Asia to advance investment in the sector can entail the development of a funding mechanism that is linked to a technical support component. This combination of assistance can help facilitate compliance with local rules and standards.

Investments in Utility-Sponsored Performance-Based Energy Efficiency Resource Programs

As the gains from EE programs receive wider attention, utilities in Asia are likely to be more enthusiastic in deploying these options to address a portion of their long-term growth. More generally, because of their relationship with customers, utilities have been deemed by multilateral financial institutions to be effective players for operating larger EE programs. In recognition of these trends, this section looks more closely at methods for implementing, and evaluating the benefits of, performance-based EE programs, including ways to assess their value as resources in an energy system.

A significant consideration in this context is avoided cost. Every unit of energy that is no longer needed because of EE deployment can be represented monetarily. Its specific value equals the expense required to generate and deliver that identical amount of energy. As EE programs can serve to take the place of supply-side options within an energy system, accounting must be conducted with rigor and methodological consistency. This necessitates highly developed measurement and evaluation approaches to certify that EE program outcomes deliver the savings specified in their design over the duration required.

Although sponsored by utilities, programs are often implemented by other market players. These include ESCOs, real estate developers, and customers, as well as lighting contractors and other product and service suppliers. These actors can access technical assistance and financial incentives from the utility. The utility, in turn, capitalizes these investments in its rate base. However, where energy savings are achieved according to levels specified at the outset, with verification through the protocols described earlier, then utilities may earn an additional reward based on the program's net benefits to the system.

ADB can help extend the reach of these initiatives by serving as an investor partner and market development agent. This role may entail the provision of capital as a means to assist utilities in broadening their implementation efforts, toward expanding the energy-saving impact of programs. ADB also may assist capacity development among market players such as ESCOs and other service providers, so that performance-based services reach a wider number of customers. Through these activities, market delivery channels can undergo a major transformation.

Investments in Raising Energy Efficiency Standards

The enforcement of building energy codes and minimum energy standards for various appliances has not proceeded without challenge in some developing countries. The higher initial costs that can result from more ambitious codes or standards can be a factor, and building owners may be unwilling to make changes despite the financial benefits that can accrue over a structure's lifetime. To help counter these challenges, ADB may consider ways to incentivize voluntary action among market players who are willing to exceed any existing minimum standards, looking to the example of Green Building program models. Alternatively, ADB may provide assistance to help develop regional or local capacity to measure and test efficiency ratings, or to facilitate phase out initiatives for older, inefficient technologies.

Phasing Out Inefficient Products. Many countries are taking steps to phase out inefficient products, particularly less efficient lighting technology. At a regional level, the EU, starting in 2009, has pursued a multiyear phaseout of traditional incandescent light bulbs in its Member States (European Commission 2012). The new regulations followed a 2-year process of outreach and dialogue with stakeholders to include industry. Timelines for product phaseout were designed to give manufacturers time to complete production line retrofits. Member States also had the option to utilize Cohesion Policy funds to assist local or regional industry with line conversions where such efforts met designated eligibility requirements (European Commission 2009).

In many developing Asian countries, the phasing out of inefficient products is likely to require similar, or even greater, efforts to assist manufacturers in altering their production lines. Other initiatives will likely be needed to shift any newly redundant technologies out of the marketplace. The financial interventions implied here can be supported by ADB through its design and offer of certain financing vehicles to advance program imperatives.

Local and Regional Testing Capability. New testing capabilities to evaluate and certify building materials and energy-efficient equipment will need to be conducted at certified laboratory facilities. Such assessments comprise a necessary step for approval and accreditation of EE measures.

In the Republic of Korea, such efforts are assisted by the government's provision of financial assistance to reduce the cost of testing fees for new EE appliances (Oh 2012). In California, the state's Public Interest Energy Research program supports collaborative relationships with utilities, laboratories, and other market players to advance EE technology development. Advances resulting from such initiatives have informed new California Efficiency Standards and should generate energy savings of $1 billion annually (California Energy Commission 2011).

In Asia, testing facilities could benefit from ADB's provision of funding resources and any assistance to encourage facility development through collaborative activities with local partners or stakeholders. The facility and ADB could partner to support the piloting of new approaches for possible regional replication. Other shared efforts could focus on the creation of a labeling scheme specific to Asia or, alternatively, a recognized mark for dissemination across many countries.

Voluntary Energy Excellence. Voluntary initiatives for energy excellence require achievements in excess of stated codes and standards—a challenging task in the absence of a regional supportive stakeholder. An interesting example of larger national or regional action to support voluntary energy excellence is the ENERGY STAR program, which began in 1992 as a public–private partnership between the US Environmental Protection Agency (EPA) and industry. Their collaboration resulted in the establishment of criteria by which to award ENERGY STAR status to high-performing products. Those with the ENERGY STAR label achieve as much as 30% savings in energy use compared with standard products in the market.

Thanks to an awareness campaign channeled through print, radio and television, approximately 80% of the US population recognizes the ENERGY STAR label. With 60 categories of items available to the public, some 300 million labeled products are purchased annually (EPA 2012b). ENERGY STAR purchases helped US consumers to decrease their energy utility bills by $23 billion in 2011, offsetting the GHG emissions of 43 million vehicles (EPA 2012a). More broadly, the US has partnered internationally to advance the reach of the program in nondomestic markets. Partners include Australia; Canada; the EU; Japan; New Zealand; Switzerland; and Taipei,China (EPA 2013). In Canada, the partnership over 10 years has reached 1,500 participants, with collaborative efforts for specification and branding, developing 50 categories of eligible products (EPA 2012b).

The European Commission acted in 2005 to establish the "GreenBuilding [sic]" program, a voluntary initiative to boost nonresidential, cost-effective gains in building efficiency. Targeted to new and existing structures, the initiative works with building owners in Member Countries through National Contact Points that provide direct assistance. Where contact points are not accessible within a country, building owners can instead work with the European Commission's Joint Research Centre, which also manages the program (Joint Research Centre 2013).

In the UK, the government's new Energy Efficiency Strategy of 2012 sets forth a plan to support widespread building improvements. A retrofitting program known as the "RE:FIT" program, applied previously in London to improve EE in public buildings by encouraging government's use of ESCOs, will be disseminated nationwide. The UK government also plans to create Energy Demand Research Centers and other resources for knowledge sharing, workforce training, and technology needs assessment to drive broader voluntary EE gains in homes and facilities (Department of Energy and Climate Change of the United Kingdom 2012).

Voluntary initiatives for Green and Zero Energy Buildings serve as models for what the building industry in Asia could achieve, should such efforts be marketed and promoted by a regional player like ADB. This type of campaign fits with ADB's strategic commitment to lead on EE and clean energy initiatives with global visibility. The contribution by ADB to this effort does not necessarily imply a sizable investment of funding, but rather an emphasis on awareness building, creative marketing, and technical assistance. The last of these tasks could entail design assistance to engineers and architects, support for energy modeling, and sponsoring of design competitions. More broadly, efforts to lead on voluntary energy excellence can be viewed as part of ADB's corporate social responsibility.

3.7 Building on Policy Experience: Next Steps

The foregoing examples point to key issues of interest in understanding the current policies and mechanisms utilized by many countries to drive EE improvements across sectors. In assessing strategies to accelerate EE investments in the developing countries of Asia, it is important to review existing policy conditions in the region as well as trends that stand to impact EE markets. Such considerations are the focus of Chapter 4.

4 Energy Efficiency State of Play in the PRC, India, and Southeast Asia

4.1 A Status Report on Asia

The broader trends worldwide for an increased focus on energy efficiency (EE) are likewise active in the People's Republic of China (PRC), India, and in Southeast Asia. National commitments and targets have been enacted, and a range of policies and programs seek to improve EE in commercial buildings, industrial operations, households, and in the public sector. Their performance has varied to date, but all reflect a growing awareness of the benefits of EE in responding to regional energy demand, reducing the cost of energy service, and contributing to wider social goals for improved environmental quality. This chapter reviews the state of play of the EE policy landscape with a focus on the PRC, India, and Southeast Asia, and the conditions that are influencing demand and markets for EE in the region.

4.2 Country Commitments to Energy Efficiency

National end-use EE policies in Asia will drive significant future investment in, and deployment of, EE technologies and solutions. To meet existing government end-use EE targets out to 2020 would require investments amounting to about $865 billion in the PRC, $68 billion in India, and $11 billion in Southeast Asian countries.

These figures bring the total amount of required investments to about $944 billion by 2020, combined across countries (Table 4). By 2030, an estimated additional $15 billion is required to meet government targets in Southeast Asia.[3]

Based on the 2020 targets shown in Table 4, 92% of the EE investment potential is in the PRC, 7% is in India, and 1% is in Southeast Asia. Indonesia makes up more than half of Southeast Asia's EE investment potential at 57%, followed by Thailand at 19%, Malaysia at 8%, Viet Nam

[3] Regarding figures for 2030 investment, estimates for the PRC and India were not calculated due to a lack of projected data.

Table 4 Investments Needed to Meet National Targets by 2020 ($ million)

Country	Energy Efficiency Strategy/Action Plan	Required Investment ($ million)
Brunei Darussalam	Attain 25% reduction of energy intensity from 2005 level by 2030	48
Cambodia	Reduce final energy consumption by 10% in all sectors	126
Indonesia	Decrease energy intensity by 1% annually and decrease energy–GDP elasticity to below 1% by 2025	6,019
Lao PDR	Reduce final energy consumption by 10% in all sectors	29
Malaysia	Reduce final energy consumption in the industry, commercial, and residential sectors by 10% from 2011 to 2030, and reduce final energy consumption of the transport sector by 1.4 ktoe by 2030	901
Myanmar	Reduce primary energy consumption by 5% by 2020 and by 8% by 2030 compared to BAU, and improve EE in all end-use by 16% by 2030	165
Philippines	Reduce final energy consumption by 10% in all sectors from 2007 to 2014	601
Singapore	Reduce energy intensity by 20% by 2020 and by 35% by 2030 from 2005 level; cap CO_2 emissions from fuel combustion at 63 Mt-CO_2 by 2020	97
Thailand	Reduce the energy intensity of GDP by 25% by 2030 relative to BAU	2,006
Viet Nam	Reduce energy consumption by 3%–5% by 2010 and by 5%–8% by 2010–2015	649
Southeast Asia Total		**10,641**
PRC	Reduce CO_2 emissions per unit of GDP by 40%–45% from 2005 level by 2020	865,260
India	Reduce emissions intensity of GDP by 20%–25% from 2005 level by 2020	67,830
Southeast Asia, the PRC, and India Total		**943,731**

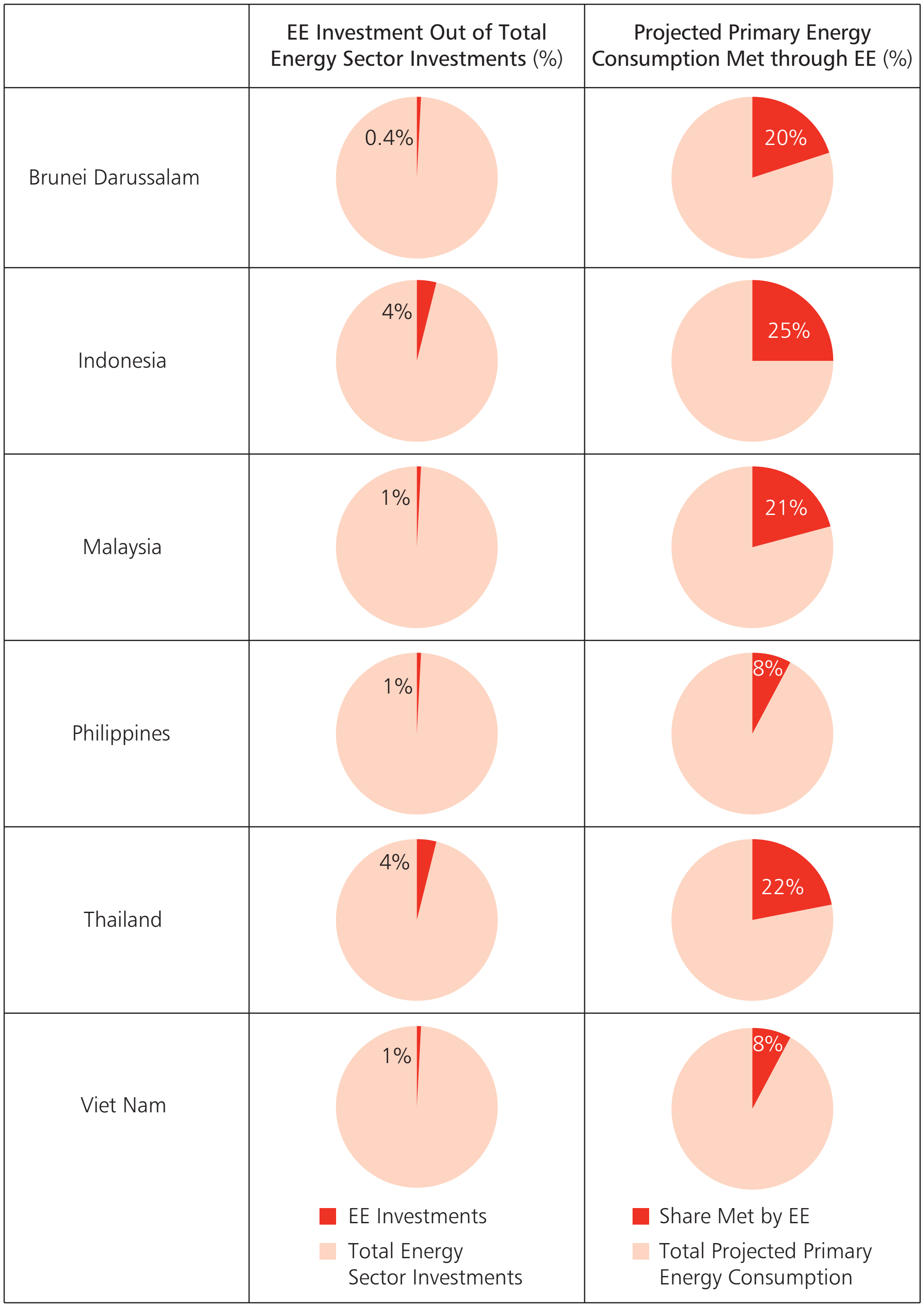
BAU = business-as-usual, PRC = People's Republic of China, EE = energy efficiency, GDP = gross domestic product, ktoe = thousand tons of oil equivalent, Lao PDR = Lao People's Democratic Republic, Mt-CO_2 = million tons carbon dioxide.

Source: ADB calculations based on national EE targets.

at 6%, and the Philippines at 5%. As national policies evolve, they will further drive investment in the region.

Figure 3 shows the impact of investment in EE on meeting energy demand by 2030, assuming that national EE targets are met. In Brunei Darussalam, Indonesia, Malaysia, the Philippines, Thailand, and Viet Nam, an EE investment share of just 1% to 4% of overall energy investment serves to meet at least 8% to as much as 25% of the projected increase in primary energy consumption. This dynamic reinforces EE's relevance as a least-cost solution to meeting Southeast Asia's growing energy demand.

Figure 3 Energy Efficiency in Projected Energy Investments and Primary Energy Consumption in Southeast Asia



EE = energy efficiency.

Notes:

1. Some percentages reflect rounding.
2. Projected impacts of EE investment by 2030 assume national EE targets are met.

Sources: Data from ADB 2009a and IEEJ © 2011.

4.3 Energy Trends in Asia

Energy use varies widely in Asia. Per capita, the PRC, India, Indonesia, the Philippines, Thailand, and Viet Nam, on average, consume just 25% of the amount of energy used in Japan; the Republic of Korea; and Taipei,China, and some 10% of the energy consumed in the United States (US). Yet with ongoing economic growth, these percentages are likely to change. International comparisons suggest that daily electricity use on a per capita basis jumps by 1.6 kilowatt-hours for every increase of $10,000 in per capita yearly income. Individuals tend to increase their energy consumption as they purchase services and goods and expand their use of televisions, computers, refrigerators, air conditioners, and other electronic devices. For example, in the PRC, one-quarter of the country's energy use now goes to power appliances, lighting, heating, and air conditioning (USAID 2011).

Urbanization is another cause of rising energy consumption, as populations shift from rural areas to cities with accompanying increases in electric grids, buildings, water treatment infrastructure, roads, and industrial facilities. With urbanization occurring rapidly in Asia, the region now claims over half of all global megacities, defined as "metropolitan areas with over 10 million inhabitants" (ADB 2012b).

Amidst these trends, Asia's dependence on energy imports is growing. Most countries in the region, 2 decades from now, will produce 50% or less of the energy they require. Energy imports, and specifically imported oil, will continue to be critical in the region (ADB 2013a).

More broadly, energy demand between developing and developed countries reached parity in 2010. By 2030, developing countries should account for some 90% of the increase in worldwide energy demand (USAID 2011). The share of developing Asia, specifically, in primary energy consumption could increase from 34% in 2010, to as much as 56% in approximately 2 decades according to some projections (ADB 2013a citing IEA 2012a and Lee, Park, and Saunders [forthcoming]). Trends for primary energy consumption in Asia among a number of ADB members are presented in Table 5.

Trends in the PRC and India figure prominently in setting the stage for Asia's energy sector. The PRC and India are two of the world's largest energy-consuming countries when considered in absolute terms, i.e., not on a per capita basis. By 2030, electricity generation should double for the PRC, India, and Southeast Asia. Coal is expected to remain the primary source for electricity generation, although its share among electricity sources will decline from 69% to 59%. From 1990 to 2010, the PRC trebled its claim among developing country Manufacturing Value Added (MVA), reaching 43%. Broadly, the developing countries of East Asia and the Pacific have moved more fully into worldwide production networks and have improved their market access, with MVA increasing by 7.7% in the region even during the recent financial crisis. In Central and South Asia, MVA jumped 4.8%. Countries, such as the PRC and Malaysia, are shifting from low value-added goods to more advanced production lines delivering higher-value products (USAID 2011).

In the face of this expansion, large emerging economies, such as the PRC and India, have launched initiatives resulting in significant EE improvements in the industry sector. The PRC, for example, has utilized negotiated agreements with industry to establish long-range EE initiatives

Table 5 **Survey of Primary Energy Consumption Among ADB Members to 2030**

ADB Member	2010 (Mtoe)	2030 Projected (Mtoe)	Change (%)
PRC	2,216	3,744	68
India	524	1161	121
Indonesia	154	344	123
Japan	497	475	(4)
Republic of Korea	250	297	19
Malaysia	70	128	82
Philippines	34	60	76
Singapore	33	48	45
Taipei,China	109	133	22
Thailand	98	212	116
Viet Nam	45	135	200

( ) = negative, ADB = Asian Development Bank, Mtoe = million tons of oil equivalent, PRC = People's Republic of China.

Note: Some percentages have been rounded.

Sources: IEEJ © 2013 All Right Reserved and IEA Online Statistics © OECD/IEA 2013.

across sectors. In Asia more generally, and particularly for developing countries in the region that still face significant obstacles in addressing poverty and lack of energy access, the challenge is to facilitate economic growth that raises standards of living while encouraging energy and resource use that limits negative social and environmental impacts.

A recent World Bank study (Mani 2012) of South Asia found that climate investment frameworks in the region remain, overall, somewhat new phenomena. Nevertheless, during the last decade, investments in clean energy in Asia expanded by almost fifteenfold (USAID 2011, UNEP/BNEF 2010). In 2010, Asia and the Pacific claimed the greatest portion—some $59 billion—of worldwide clean energy investments, which totaled $211 billion that year (UNEP/BNEF 2011). The PRC ($49 billion) garnered the largest investment, with India at $3.8 billion. Indonesia, Thailand, and Viet Nam each claimed investment amounts that varied between $200 million and $700 million.

The figures are impressive, but the total $211 billion invested worldwide in 2010 translated to investments in renewable energy. Investment in "energy-smart" technologies—e.g., EE systems and devices, electric vehicles, the smart grid, etc.—summed to $23.9 billion in 2010. Of that amount, the financial new investment portion, not including research and development, was reportedly $5 billion. North America, followed by Asia and Oceania, and then Europe, claimed the largest share of this investment (UNEP/BNEF 2011).

These conditions suggest that progress is being made in laying the foundations for a more sustainable energy future in Asia. Even so, significant gaps remain between EE's potential and its realization, and investment must be ramped up to narrow the divide. Such gaps have been an increasing focus of regional and national action in Asia's energy sector, with encouraging prospects for longer-term trends. A survey of country action to promote increased utilization of EE follows in the section below.

4.4 Policies and Projects of Note: A Regional Survey

During the last decade, many Asian countries have enacted policies or programs by which to advance EE, or have built upon existing measures to pursue greater gains. In many cases, EE strategy is guided by laws, institutional frameworks, targets, and action plans.

In the PRC, Indonesia, and Thailand, energy intensity goals have driven national action. The Philippines and Viet Nam have established absolute targets for energy reduction. In the Philippines, by 2014, final energy demand is targeted to decline by 10%. By 2015, Viet Nam seeks to lower overall energy use by as much as 8%. Reductions in greenhouse gases (GHGs) also drive national action to alter energy use, as in the PRC and India (USAID 2011).

The PRC has emphasized the role of energy conservation in national policy since the 1980s (Information Office of the State Council of the People's Republic of China 2012). This effort was reinforced in 2006 with the Decision of the State Council on Strengthening Energy Conservation, followed by the Comprehensive Work Plan on Energy Conservation and Emission Reduction the next year. The work plan devised strategies for EE gains in construction, industry, and transport. Through 10 major projects across sectors, targeting lighting, building practices, use of waste heat, innovations in boilers and motors, and improvements to government facilities, energy-saving capacity was expanded to the level of 340 million tons of coal equivalent. A larger push by the government focused on improvements to 1,000 businesses, for an energy reduction offsetting the need for 150 million tons of standard coal. From 2006 to 2010, the duration of the PRC's Eleventh Five-Year Plan, the country's energy use per unit of gross domestic product (GDP) declined by 19%.

During the PRC's Twelfth Five-Year Plan Period (2011–2015), the State Council put forward proposals to significantly expand efforts to reduce the intensity of energy use. Targeting the industry sector, which is responsible for 70% of the country's energy use, the PRC has devised a mandatory system of standards and targets to drive reduced energy consumption for every unit of production among selected industries. A reinforced system for evaluation and supervision of improvements supports compliance. These efforts are complemented by a supervisory system that targets energy-saving initiatives in the public sector. The country's energy use per unit of GDP is targeted to decrease by 16% against a 2010 baseline, with carbon dioxide (CO_2) emissions per unit of GDP targeted to fall by 17% (Han and Yang 2012).

The PRC has worked widely with international partners to facilitate new initiatives for EE investment. One example is an energy service company (ESCO) partial loan guarantee program established in 2003 as part of the Energy Conservation Project, Phase II, supported by the Global Environment Facility (GEF) and World Bank (Taylor et al 2008). In 2006, the International Finance Corporation (IFC) launched [the People's Republic of] China Utility-Based Energy Efficiency Finance Program (CHUEE). The aim was to encourage EE investment through the provision of bank guarantees for EE loans (Independent Evaluation Group 2010). Alongside the guarantee facility, supported by the GEF, technical assistance was provided to aid implementation efforts by utilities, energy service companies (ESCOs), and equipment vendors.

By 2012, more than 170 EE investments had been assisted by loans totaling $800 million from three participating banks. The annual GHG reduction was estimated at 19 million tons CO_2, moving beyond the program's initial targets (IFC 2013). Under CHUEE I and II, three partner financial institutions were engaged: Industrial Bank, Bank of Beijing, and Shanghai Pudong Development Bank. The Industrial Bank demonstrated particularly strong growth in its EE business due in part to its creation of a department specializing in EE lending, supported by the design of EE lending guidelines and procedures and capacity building for the utilization of project finance tools.

Efforts by CHUEE for technical capacity building and promotion of an energy management company network helped ESCOs to access financing for new EE projects. However, a majority of CHUEE's beneficiaries, among end users, were large companies. The World Bank Group's Independent Evaluation Group (IEG) May 2010 report on CHUEE I and II recommended a shift to down-market sectors, especially small and medium enterprises (SMEs). For this reason, IFC launched the third generation program -- CHUEE SME -- last year, targeting only SMEs through a new set of partner financial institutions. CHUEE SME is already operational, with at least two partner financial institutions engaged as of late 2012.

ADB, meanwhile, has acted to encourage private sector financing of energy-efficient buildings in the PRC, through a partial credit guarantee facility approved in 2007. ADB's goal is to incentivize lending to companies that seek to retrofit older buildings for reduced energy use compared to baselines, or to construct green buildings that optimize energy and water efficiency throughout their life spans. Additional details about the program, known as the Energy Efficiency Multi-Project Financing Program, are provided in Chapter 5.

In India, the Energy Conservation Act of 2001 guides a national strategy to lower the energy intensity of the country's economy. The Bureau of Energy Efficiency (BEE 2013) is tasked with carrying out EE initiatives. Activities engaged by BEE include the crafting of building codes, energy performance labeling requirements, standards for appliances and products, and certification and accreditation for energy managers and auditors. Since January 2010, mandatory labeling has been applied to room air conditioners, frost-free refrigerators, distribution transformers, and tubular fluorescent lamps (BEE 2010). The BEE also supports testing facilities, efforts for innovative project financing, development of pilot projects, and research and development. From 2007 to 2010, its efforts resulted in cumulative verified energy savings of 22.5 million tons of oil equivalent.

The National Mission for Energy Efficiency seeks to decrease the energy utilized for every unit of production, with a focus on nine industries with energy-intensive operations. Its primary strategies include (i) certification of energy savings to allow trading among industries, (ii) efforts to transform markets through provisions to improve the affordability of EE appliances, and (iii) assistance to facilitate finance of multisector demand-side management (DSM) programs. More broadly, the Indian Renewable Energy Development Agency, a nonbank financial institution with support from the national Ministry of New and Renewable Energy, develops and provides financing options for EE investments (IREDA 2013).

In Indonesia, the Directorate General of New Renewable Energy and Energy Conservation was created in 2010 to engage policy and regulatory development and to advocate for EE. In 2011, the Directorate created the Energy Efficiency and Conservation Clearing House Indonesia as a central source of information and best practice on EE. The government also started to enforce regulations mandating EE programs by public and private entities that utilize more than 6,000 barrels of oil equivalent annually. Seeking compliance by a minimum of 650 entities, the government aims to curtail energy use equal to the output of a 2,000-megawatt power plant. Elsewhere, in the Philippines, a regulatory framework for DSM was instituted in 1996. End-use EE measures are pursued at the national level through programs for energy management and audits, building award recognition, standards and labeling for residential appliances, voluntary arrangements, and peak demand reductions (USAID 2011).

Thailand has instituted a sweep of measures to pursue national EE goals. The Energy Conservation Promotion Act of 1992 established a significant role for energy conservation as part of national policy. National funds to support demand-side initiatives in the energy sector are channeled through the Energy Conservation Promotion Fund, known as ENCON (Thailand Ministry of Energy 2011). In accordance with plans devised every 5 years to guide the distribution of funds, ENCON provides support to an ESCO Fund which, in turn, acts to increase credit lines to ESCOs in order to reduce the financial and technical risks of EE projects in the private sector. An Energy Efficiency Revolving Fund, meanwhile, was established in 2002 with funding from ENCON, to facilitate the involvement of the commercial finance sector in the provision of loans for EE projects.

Thailand's Twenty-Year Energy Efficiency Development Plan, covering 2011–2030, aims to decrease energy intensity by 25% over that period against a 2005 baseline. Transport and industry are major focal points. Large energy companies will be required to implement Energy Efficiency Resource Standards, with Minimum Energy Performance Standards to be developed for buildings, vehicles, and appliances. A DSM bidding program offers subsidies for verified energy savings achieved by large businesses, and for verified energy savings or peak load reductions achieved by small and medium-sized enterprises.

Robust implementation of measures included in Thailand's energy efficiency plan should generate cumulative energy savings of 14,500 ktoe each year, on average, for a cumulative drop in CO_2 emissions of 49 million tons each year, on average (Thailand Ministry of Energy 2011). The country's DSM activities have benefited from stable funding over the last decade, translating to approximately 0.06% of the yearly budget of the Electricity Generating Authority of Thailand (USAID 2011).

Viet Nam, in 2006, created a National Program on Energy Efficiency and Conservation, and in 2010 enacted a National Energy Efficiency and Conservation Law. Applicable across economic sectors, the law calls for product labeling and standards, supportive financial incentives and institutional frameworks, and management of specified entities. The law additionally included provisions for the creation of a National Energy Use Database (USAID 2011 citing Toan 2011).

While EE implementation offers significant opportunities for improved living conditions in many parts of Asia, it is important to stress that countries differ with regards to their economic, technical, and demographic status. For some, identifying proper strategies to deploy EE action and demand-side approaches, from both a policy and finance perspective, may require resources and expertise that local or national authorities lack. Moreover, private sector interest and action to facilitate these investments also may be absent. In these instances, government leadership, as bolstered by external aid assistance, can be necessary to galvanize efforts for EE (Mani 2012). Partners for international development assistance and cooperation in support of EE in Asia are further identified below.

4.5 Supportive Regional Actors

When developing countries in Asia seek to devise EE strategies and action plans, they may rely on technical and financial assistance from regional and international financial institutions. ADB, which works regionally to reduce poverty within its developing member countries (DMCs), engages related efforts for EE improvements as part of its larger support for economic growth and improvements in infrastructure. ADB has specifically sought to reduce energy consumption in the region through demand-side initiatives implemented in a number of sectors, as explored in greater detail in Chapter 5 of this report.

The World Bank Group (2013a), comprised of five organizations including IFC, is a significant source of assistance to promote EE in developing countries in Asia. The Group utilizes instruments, such as loans, partial risk guarantees, and carbon finance, to facilitate EE investments. The World Bank, comprised by two of the five World Bank Group organizations (i.e., the International Development Association and the International Bank for Reconstruction and Development), provides capacity building and financial assistance in support of projects. EE initiatives have benefited from $3.1 billion in support from the World Bank Group (2013b) from 1990 to early 2013 in locations including Asia and the Pacific. Project growth in clean energy has been supported by an Action Plan seeking a 20% increase, on average, in yearly commitments. EE action is reinforced by the World Bank Group's Clean Energy and Development Investment Framework.

As part of the World Bank Group, IFC supports EE financing as a function of its environmental sustainability and climate change programs. Its EE financing efforts began in Hungary but have spread to include East Asia (Independent Evaluation Group 2010).

The GEF (2012) is an independent financial organization founded originally as a World Bank pilot program in 1991, with the mission to facilitate the provision of funding to support the capture of wider global environmental gains from nationally oriented projects. Early partners for GEF project implementation included the World Bank as well as the United Nations Environment Programme and the United Nations Development Programme. The GEF became independent in 1994 during the Rio Earth Summit. From 1994 through 2010, the GEF directed about $873 million to investments in EE projects that are economically and technically feasible, but have tended to receive only very modest investment support (Yang 2012). Asia has been a key region for this investment.

The United Nations Development Programme, United Nations Industrial Development Organization, and United Nations Environment Programme have implemented EE market transformation, policy reform, and capacity building programs in Asia and the Pacific. Another significant actor is the United Nations Economic and Social Commission for Asia and the Pacific (UNESCAP 2009), which works to improve institutional capacity for EE action in South, Central, and Southeast Asia. Project support has come from the Korea Energy Management Corporation and partners such as the South Asian Association for Regional Cooperation Energy Centre and the Eurasian Economic Community in Central Asia, with other assistance from the ASEAN Centre for Energy.

Through its flexibility mechanisms, the Kyoto Protocol to the United Nations Framework Convention on Climate Change (UNFCCC) has further facilitated energy improvements in Asia. In 2010, Clean Development Mechanism (CDM) projects in Asia and the Pacific represented 78% of total registered CDM projects (USAID 2011). The future ability of CDM projects and international carbon markets to contribute to EE improvements in Asia and elsewhere is uncertain, however, as international negotiations have yet to produce a binding agreement to follow the Kyoto Protocol’s first commitment period. In this regard, a significant source of future support for EE in developing Asian countries may come from the Green Climate Fund under the UNFCCC (Mani 2012).

Through its Environmental Cooperation-Asia (ECO-Asia) program (ECO-Asia 2013), the US Agency for International Development (USAID) supports a number of EE initiatives, including support to facilitate EE project financing and improved lighting standards in the region. With ADB as a partner, ECO-Asia also has supported the Asia Clean Energy Forum, a mechanism to advance knowledge exchange and cooperation between regional practitioners and policy makers. Meanwhile, the International Partnership for Energy Efficiency Cooperation (2012) promotes policy implementation and information exchange to support EE action including efforts in Asia. Support for the partnership, in the form of voluntary contributions, comes from members representing both OECD (Organisation for Economic Co-operation and Development) and non-OECD countries.

5 ADB's Energy Efficiency Activities and Investments

5.1 ADB's Value to Energy Efficiency Investments

Through its lending and investments, ADB plays a major role in the energy sectors of developing Asian economies. ADB's efforts for energy efficiency (EE) are guided by its Strategy 2020 (ADB 2008) and Energy Policy (2009b). Both acknowledge EE as one of the most cost-effective ways to meet increasing regional energy demand, while decreasing reliance on fossil fuels and reducing greenhouse gas (GHG) emissions. This key role for EE in the region is further reinforced in the ADB (2011a) publication *Asia 2050: Realizing the Asian Century*. The contribution of EE to greater energy security for countries relying on imported fuels is shown to be a foundational element of a long-term strategy to improve regional economic competitiveness.

In motivating public and private sector activities in the clean energy domain, ADB draws on a range of influential tools:

(i) capital investment in the form of loans or direct investment, including access to attractive financing or credit enhancement mechanisms;
(ii) awareness raising and catalyzing of government leadership;
(iii) technical assistance in policy and planning;
(iv) technical assistance in implementation, monitoring, and evaluation; and
(v) assistance with strategies for promotion and scale up.

ADB's ability to package lending with technical assistance can help to support and influence government actions related to the energy sector. Examples include public procurement of EE equipment and infrastructure, as well as policies and regulations in support of EE, though ultimately, the private sector makes many of the investment decisions and drives uptake. Additionally, through its private sector operations, ADB can directly add value in a number of ways, including direct equity investments, lower interest and/or longer tenor loans, and technical assistance. Financial institutions and companies that work with ADB's Private Sector Operations Department often build ADB projects into their corporate social responsibility approach and strategy.

Although EE is not an innovative concept, ADB has only recently been scaling up its efforts at technical assistance and investment in the sector. ADB is looking to other institutions and assessing its competitive advantage, as a means to identify where it can add value. As a bank, ADB can take a leadership role in areas that require financial interventions; however, the focus remains on how to move beyond direct lending to leverage more resources and wield a greater impact as a development institution. ADB draws strength from its cross-sector and regional coverage, and given that demand-side energy efficiency (DSEE) cuts across sectors, ADB can play a role in linking EE to its other Communities of Practice (CoPs) in Utilities, Water, Transport, and Urban Development. CoPs are knowledge networks within ADB that facilitate information sharing and problem solving among ADB personnel in designated thematic areas. More broadly, ADB can continue to play a leadership role in facilitating policy dialogue with energy and finance ministers by advocating for EE measures and identifying constraints.

5.2 Expansion of ADB's Clean Energy Investments

In 2005, ADB launched an Energy Efficiency Initiative (EEI) with the aim to expand its clean energy investments in developing member countries (DMCs). The initiative covered all stages—from inception and implementation to expansion—of EE investments in more than 10 priority DMCs. The EEI later evolved into the Clean Energy Program, which supports investments in clean energy in smaller DMCs and encourages the adoption of low-carbon technologies in the region.

ADB achieved its initial target of $1 billion in clean energy investments per year by 2008, then increased its target to $2 billion in investments per year by 2013. ADB has already achieved the $2 billion target—reaching $2.1 billion in investments by the end of 2011.

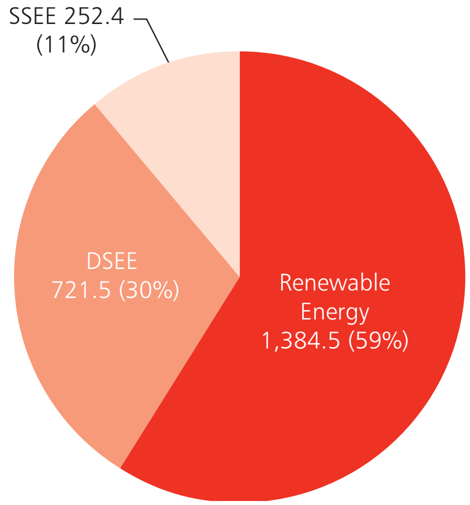
According to data published in March 2013, ADB's clean energy investments in 2012 climbed to about $2.3 billion, maintaining the upward trend (ADB 2013b). DSEE investments ($721.5 million) represented 30% of all clean energy projects, while supply-side energy efficiency (SSEE) investments ($252.4 million) accounted for 11%. EE investments ($974 million) claimed 41% of the total clean energy investment while renewable energy investments ($1.3 billion) claimed 59%. These latest results for 2012 show a significant role for DSEE, overall, in ADB's clean energy investments (Figure 4). Just one transport project in the Philippines, however, accounted for about $300 million of ADB's DSEE investments.[4]

A more in-depth analysis of ADB's investments in EE, based on comprehensive data available on projects up through 2011, sheds still greater light on the types of initiatives and funding levels supported over the years as part of this investment. Of interest here is the relative weight of SSEE versus DSEE investments; the breakdown of projects among industry, buildings, and other sectors; and clean energy investments as a share of total energy sector investments.

ADB's energy sector investments, including the portion applied to clean energy measures, increased sharply from 2007 to 2008, when ADB began to scale up its Clean Energy Program activities (Figure 5). ADB's clean energy investments, from 2008 to 2010, averaged $1.6 billion per year and accounted for nearly half (47%) of ADB's energy sector investments.

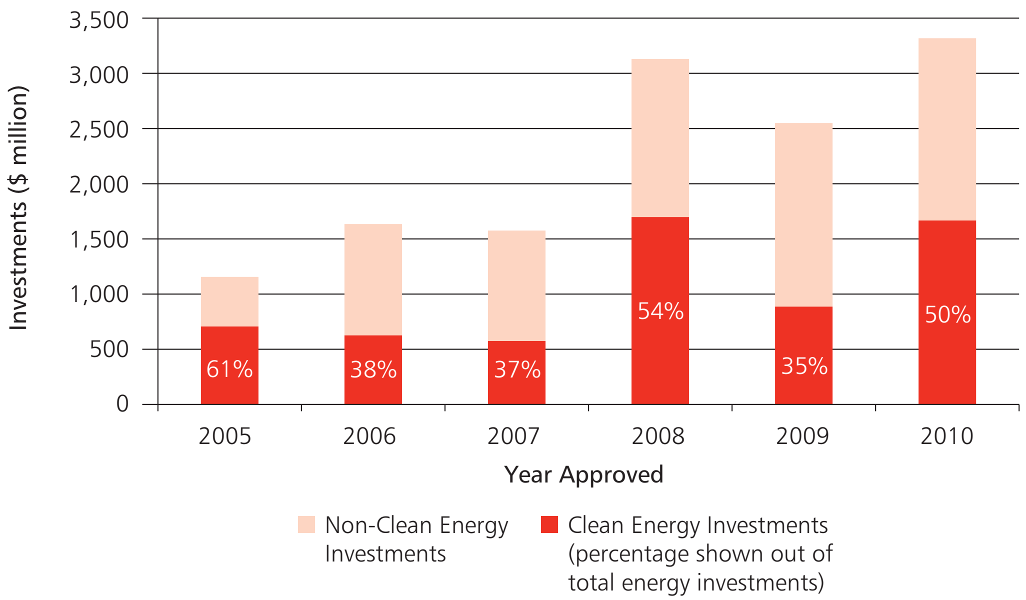
[4] The transport project aims to replace 100,000 gasoline tricycles with three-wheel, plug-in electric vehicles known as E-Trikes, which run on electric motors and rechargeable batteries.

Figure 4 Breakdown of ADB Clean Energy Investments, 2012 ($ million)



ADB = Asian Development Bank, DSEE = demand-side energy efficiency, SSEE = supply-side energy efficiency.
Note: Percentages reflect rounding.
Source: ADB. 2013b. 2012 Clean Energy Investments: Project Summaries.

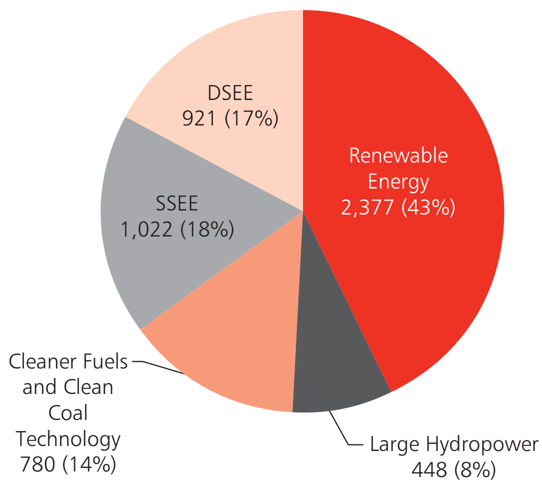
Figure 5 Breakdown of ADB Energy Sector Investments, Approved 2005–2010 ($ million)



ADB = Asian Development Bank.
Source: ADB.

More than 50% of the clean energy investment went to renewable energy and large hydropower, and another 14% went to cleaner fuels and clean coal technology (Figure 6). Just over one-third (about 35%) of the clean energy investment was allocated to SSEE or DSEE. More specifically, 18% of the total clean energy investment went to SSEE measures for power plants and upgrades of electricity transmission and distribution (T&D) systems. The remaining 17% of the total clean energy investment went to a range of DSEE measures related to centralized district heating, industry, buildings, transport, and water. While general trends in ADB's clean energy investments have been positive, investments in EE over time have lagged behind, particularly on the demand side.

Figure 6 **Breakdown of ADB Clean Energy Investments, Approved 2007–2010** ($ million)



ADB = Asian Development Bank, DSEE = demand-side energy efficiency, SSEE = supply-side energy efficiency.
Source: ADB.

While ADB has been a leader in investing in EE in Asia, with a recent expanded role for DSEE among its clean energy investments, ADB over time has primarily supported efficiency improvements in power generation and T&D on the supply side. Its combined investments in EE in key sectors listed in the International Energy Agency's 450 Scenario—i.e., buildings and industry, as well as transport—have not matched the level of its investment into T&D. A report on ADB's EE interventions, released in 2011 by ADB's Independent Evaluation Department (IED), explains the difficulties in using experience from the supply-side to support DSEE interventions:

ADB's rich experience in supporting energy supply-side projects provides few insights into the design of demand-side EE interventions. ADB has rich experience in supporting energy supply-side projects, which are mostly T&D projects and increasingly have EE improvement-related features as part of the project design. For such projects, reasonable estimates of changes in T&D losses can be made; and the effects of design changes during implementation can also be reasonably assessed. However, given the basic difference between a T&D system (a network) and industry and buildings (point consumers), such interventions provide little insight into the design of demand-side EE interventions. Likewise, ADB's vast experience in supporting district heating projects does not provide further guidance on the design of demand-side EE interventions (ADB 2011b).

5.3 ADB's Demand-Side Energy Efficiency Projects

From 2005 to 2011, 63 ADB projects entailed at least some component of DSEE.[5] Investments in DSEE over that period totaled $1.8 billion, accounting for an average of 28% of ADB's total project investment (Table 6). DSEE investments tended to consist of a few large projects, with annual totals ranging from $50 million to $608 million per year. Overall, DSEE investments showed an upward trend, doubling from $400 million in 2005–2007 to $800 million in 2008–2010.

Table 6 **ADB Demand-Side Energy Efficiency Projects, 2005–2011**

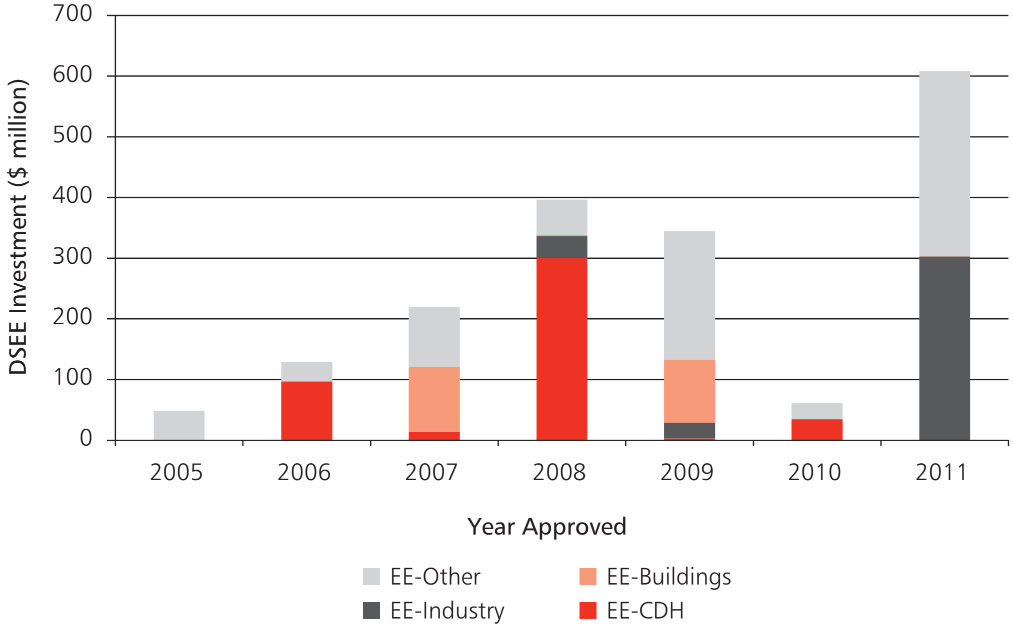
Year Approved	Number of Projects with DSEE Components	Total Amount of DSEE Investment in Projects ($ million)	Total Amount of ADB Assistance for Relevant Projects ($ million)	DSEE Component as % of ADB Project Investment
2005	3	49	681	7
2006	4	129	560	23
2007	9	219	630	35
2008	10	397	819	48
2009	16	345	1,158	30
2010	6	61	473	13
2011	15	608	2,059	30
2005–2011	**63**	**1,808**	**6,381**	**28**

ADB = Asian Development Bank, DSEE = demand-side energy efficiency.
Source: ADB.

From 2005 to 2011, DSEE investment in individual projects ranged from a low of $0.3 million to a high of $300 million, and the average investment was $28 million. The share of investment by type of DSEE varied from year to year (Figure 7), but in general was dominated by 40 transport and water projects, which consumed 43% of DSEE investment over the full study period (Figure 8). Of the remainder, 25% went toward 6 projects in centralized district heating and 20% went to 10 industrial projects (five of which were approved in 2011), with just 12% going to eight projects in buildings.

5 The following review is based on ADB investments (both loans and grants) in clean energy, using information from publicly available reports and other ADB data. See Appendix 1 for a presentation of the categories and classifications used in the analysis of ADB's clean energy portfolio. A full list of the 63 projects is given in Appendix 2.

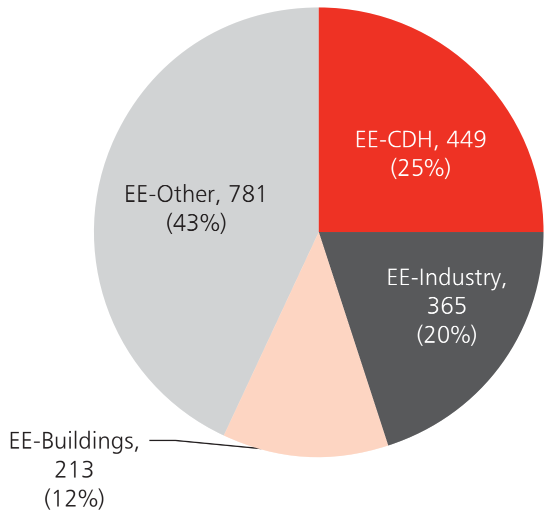
Figure 7 **ADB Demand-Side Energy Efficiency Investments by Year, 2005–2011** ($ million)



ADB = Asian Development Bank, CDH = centralized district heating, DSEE = demand-side energy efficiency, EE = energy efficiency, EE-Other = primarily covers water and transport.

Source: ADB.

Figure 8 **ADB Demand-Side Energy Efficiency Investments by Type, 2005–2011** ($ million)



ADB = Asian Development Bank, CDH = centralized district heating, EE = energy efficiency, EE-Other = primarily covers water and transport.

Source: ADB.

ADB has recently scaled up its DSEE investments. In 2011, 15 such projects claimed some \$608 million, out of total project budgets of more than \$2 billion (Table 7). However, nine of the 15 projects, totaling \$305 million in investments, fell into the category of water or transport projects. Five of the projects, with \$303 million investment in total, focused on industrial EE, while only \$0.3 million went toward EE in buildings. Accordingly, while DSEE is on its way to a greater balancing out, lags have existed, particularly in building sector interventions.

5.4 Demand-Side Energy Efficiency in Practice: Case Studies of ADB Action

ADB's experience to date with DSEE projects has yielded some insights regarding the challenge of pursuing initiatives that entail diverse sectors, goals, mechanisms, technical capacity, and institutional development. The following survey of DSEE projects is taken from data reported in 2011 as part of a review by ADB's IED (see ADB 2011b).[6]

The Guangdong Energy Efficiency and Environment Improvement Program. Approved in 2008, the program supported a \$100 million multitranche financing facility (MFF) to promote energy conservation projects in Guangdong Province, People's Republic of China (PRC). Its efforts aligned with EE priorities espoused by the Government of the PRC, and served as a response to conditions in Guangdong, where energy imports have played a key role in fueling economic growth. Implementation for the MFF program benefited from the creation of an institutional structure and management framework supported by national and regional government authorities. The project management office was tasked with technical appraisals of candidate subprojects, and only proven technologies were eligible for support. A financial intermediary, the Guangdong Finance Trust Company, was responsible for carrying out financial appraisals of subprojects, alongside appraisal of sub-borrowers. Its role did not extend to arranging cofinancing for subprojects from commercial sources. ADB retained final approval for subloans. The project benefited from the provision of a capacity development grant to raise awareness and engage outreach to commercial and industrial end users, as well as measurement and verification standards that aligned with current PRC approaches.

Potential sub-burrowers faced wait times of 6–8 months, sometimes longer, between finishing feasibility studies and filing applications for subprojects, until the time of the tranche release. Because of the delay, certain sub-borrowers chose to utilize their own funds, or funds from alternative sources, to proceed with identified subprojects. Even so, disbursals for Tranches 1 and 2, by the close of June 2011, had risen beyond 94% and 90%, respectively, of the available tranche support. By that same time, the subproject pipeline was identified for Tranche 3.

Results showed that several subprojects aided by support from Tranches 1 and 2 were effectively implemented, with consequent reductions in energy consumption. Those subprojects, and estimates for the subproject pipeline under Tranche 3, suggested that energy savings from the MFF were on track to outpace designated targets. In the wake of government priorities for EE, and ADB's support for the MFF, wider events suggest efforts will continue to capture gains

[6] The summary of the Energy Efficiency Multi-Project Financing Program was supplemented by additional ADB data.

Table 7 ADB Demand-Side Energy Efficiency Projects in 2011

Project	Country	DSEE Category	Total Amount of ADB Assistance for Relevant Projects ($ million)	Total Amount of DSEE Investment in Projects ($ million)	DSEE Component as % of ADB Project Investment
Industrial and Infrastructure Development Finance Company (IIDFC)	BAN	Industry	30.00	30.00	100.0
Gansu Tianshui Urban Infrastructure Development	PRC	Other	100.00	12.25	12.3
Guangdong Energy Efficiency and Environment Improvement Project – Tranche 3	PRC	Industry	42.94	42.94	100.0
Hebei Energy Efficiency Improvement and Emission Reduction Project	PRC	Industry	100.00	100.00	100.0
Qinghai Rural Water Resources Management Project	PRC	Other	60.00	45.32	75.5
Railway Energy Efficiency and Safety Enhancement Investment Program – Tranche 3	PRC	Other	250.00	50.00	20.0
Shandong Energy Efficiency and Emission Reduction Project	PRC	Industry	100.00	100.00	100.0
Xinjiang Altay Urban Infrastructure and Environment Improvement Project	PRC	Other	100.00	4.75	4.8
Bangalore Metro Rail Corporation Limited (BMRC)	IND	Other	250.00	50.00	20.0
Railway Sector Investment Program – Tranche 1	IND	Other	150.00	27.27	18.2
Indonesia Eximbank	INO	Industry	200.00	30.00	15.0
Sustainable Power Sector Support Project	SRI	Buildings	120.00	0.30	0.3
North–South Railway Project	TKM	Other	125.00	25.00	20.0
Ha Noi Metro Rail System – Line 3	VIE	Other	293.00	58.60	20.0
Viet Nam Water Supply Sector Investment Program PFR 1	VIE	Other	138.00	32.00	23.2
TOTAL	**7 PRC 2 IND 2 VIE +4**	**9 Other 5 Industry 1 Buildings**	**2,059.00**	**608.00**	**30**

ADB = Asian Development Bank; BAN = Bangladesh, PRC = People's Republic of China, IND = India, INO = Indonesia, SRI = Sri Lanka, TKM = Turkmenistan, VIE = Viet Nam; DSEE = demand-side energy efficiency; PFR = periodic financing request.

Source: ADB.

in industrial EE. Manufacturers of EE technologies have established energy service companies (ESCOs), upon assistance from ADB’s line of credit, and the Guangdong provincial government has created a reward system for exceptional energy-saving subprojects.

Energy Efficiency Multi-Project Financing Program. In December 2007, a partial credit guarantee (PCG) facility was approved to facilitate greater financing of building EE projects in the PRC by a number of chosen banks. The PCG aligned with goals of the Government of the PRC to lower GDP energy intensity, while the terms placed ADB’s aggregate liability at CNY800 million. The initiative supported ADB’s goals to devise financing and contractual approaches that advanced management expertise and involvement from the private sector. Its larger goal was to encourage commercial banks in their EE lending activities, so that building developers and operators could access financing for EE improvements. Savings from EE were to be guaranteed by the ESCO Johnson Controls.

In 2011, through the program, ADB provided Shanghai Pudong Development Bank with a PCG cover of CNY300 million to support private sector financing of energy-efficient buildings across the PRC. In sharing the credit risk with partner banks, ADB aims to ease the financing bottleneck and expand critical private sector investment in the building sector by providing banks with technical assistance to boost their capacity in EE lending. ADB has further called attention to the benefits of flexible credit terms as a means of responding to EE project diversity.

Energy Efficiency Investment Program. Authorized in August 2009, the program aligns with Pakistan’s goals to boost the nation’s EE. Tranche 1 was approved by ADB the following month. ADB’s Special Funds supported a $20 million loan to be used for program management. A $40 million loan went to the National CFL Project. A cofinancing agreement, for a sum of $25 million equivalent via an ADB-administered loan, was undertaken by the project with the Agence Française de Développement.

The National CFL Project, under its original terms, called on the government to purchase compact fluorescent lamps (CFLs) for delivery to customers, free of charge, by distribution utilities, which would also absorb the cost of distribution. The government was to follow monitoring and evaluation (M&E) procedures, so that energy savings could be projected. An independent entity was to provide verification of energy reductions, as well as certification of GHG reductions.

Some program delays occurred as the project management office was moved into a different government agency and as a result of compliance activities to address loan conditions. By June 2011, progress had been made toward finalizing supply contracts to guide the purchase, in two lots, of 30 million CFLs. Meanwhile, the majority of distribution companies had engaged a planning strategy. Early estimations suggested that the project would not be concluded in time to meet its original target deadline. Nevertheless, cost overruns did not appear likely.

The project was expected initially to generate sales of carbon credits, with the resulting revenue applied to the cost of CFL distribution and M&E. Progress on this front has been slow, due in part to “inadequate commitment and awareness of distribution utility and government personnel” (ADB 2011b, p. 20). Even so, goals to lower peak electricity demand appeared achievable, so long as utilities continued with CFL distribution, along with any additional efforts required for claiming carbon credits.

Clean Energy and Access Improvement Project. Approved in April 2009, the project encourages a demand-side strategy to reduce energy consumption in street lighting in Sri Lanka. The initiative benefits from supportive institutional frameworks, including the Sri Lanka Sustainable Energy Authority, launched in October 2007, which may devise and carry out EE policy. In April 2009, authorization was given to the Public Utilities Commission of Sri Lanka to regulate the electricity supply industry.

Under the project terms, the Lanka Electricity Company (LECO) and Ceylon Electricity Board (CEB) were to create internal units that operate as ESCOs. Those units would facilitate street lighting enhancements in urban settings located within their respective service areas. Larger goals included highlighting the value of the ESCO model in serving the country's needs, while also utilizing the ESCO business model to replicate lighting projects. While moving ahead with the creation of in-house ESCO units, efforts also have been made to train key personnel in designing street lighting projects. Pilot projects likewise had been launched. Consultants were asked to devise a feasible shared-savings mechanism in light of the relatively limited expertise of LECO and CEB in ESCO operation at the time the project began.

5.5 Recommendations for ADB's Clean Energy Program

In 2011, IED undertook a major evaluation of ADB's EE interventions up to the end of 2010 (ADB 2011b). Given that ADB support leading up to the time of the evaluation focused primarily on SSEE measures, the IED study aimed to assemble knowledge on the type and design of DSEE interventions that ADB could implement and scale up in the future. (Detailed findings from the IED study are summarized in Appendix 3.)

The IED study examined ADB's DSEE loans and investments in the industry and building sectors. Its analysis revealed that industry and buildings account for 70% of total commercial energy consumption and 85% of electricity consumption in Asia. Against these figures, however, ADB's support to manage energy consumption represented only 4% of ADB's overall clean energy portfolio (ADB 2011b). The evaluation also reviewed ADB's SSEE interventions from 2003 to 2010, which comprised about 40% of ADB's clean energy interventions during this period. The IED study found that a relatively small percentage of ADB's clean energy investment approvals (on the order of 12%–15%) were for DSEE interventions in industry and buildings.

The IED study made several recommendations for strengthening ADB's support of DSEE. A key suggestion was for ADB to make efforts to enhance its promotion of commercial financing for EE investments in industry and buildings. ADB also was encouraged to work with DMC governments to facilitate EE improvements in specific sectors and end-user categories.

More recently, additional analysis was undertaken to assess the knowledge gained from ADB's DSEE projects since the completion of the IED study. Interviews with ADB energy managers yielded key insights regarding overarching factors that tend to complicate efforts to scale up EE investment on both sides of the ADB-client interaction.[7] For example, scaled-up investment could benefit from greater mainstreaming of EE into ADB's operations. Meanwhile, ADB's loans

[7] Individuals interviewed are listed in Appendix 4.

and investments need to be country led, but in many DMCs, there is a low level of awareness of, and demand for, EE projects. In addition, cooperating agencies, such as electric utilities, are often supply side-oriented and most commonly request assistance with energy supply investments and interventions. Although EE potential may be recognized within a country, there is often no agency with the appropriate skills, authority, and mandate to design and disseminate any large-scale EE projects, or to negotiate large-scale EE investments with agencies such as ADB.

The above considerations have helped inform the evaluation of options for ADB, as part of its goal to accelerate EE investment and implementation in Asia. Possibilities in this regard, and ADB's strategic role, are explored in the next chapter.

6 Realizing Energy Efficiency Potential in Asia and the Pacific

6.1 Capturing Wider Gains for Energy Efficiency

ADB in recent years has been channeling about 50% of its energy sector investments into clean energy (see Figure 5, Chapter 5). Yet ADB has significant scope to scale up its technical assistance and funding for energy efficiency (EE) in Asia (ADB 2011b) toward a more even portfolio of supply-side energy efficiency (SSEE) and demand-side energy efficiency (DSEE) interventions. This effort is critical in meeting growing regional energy demand in a sustainable manner, according to ADB's Strategy 2020 (ADB 2008).

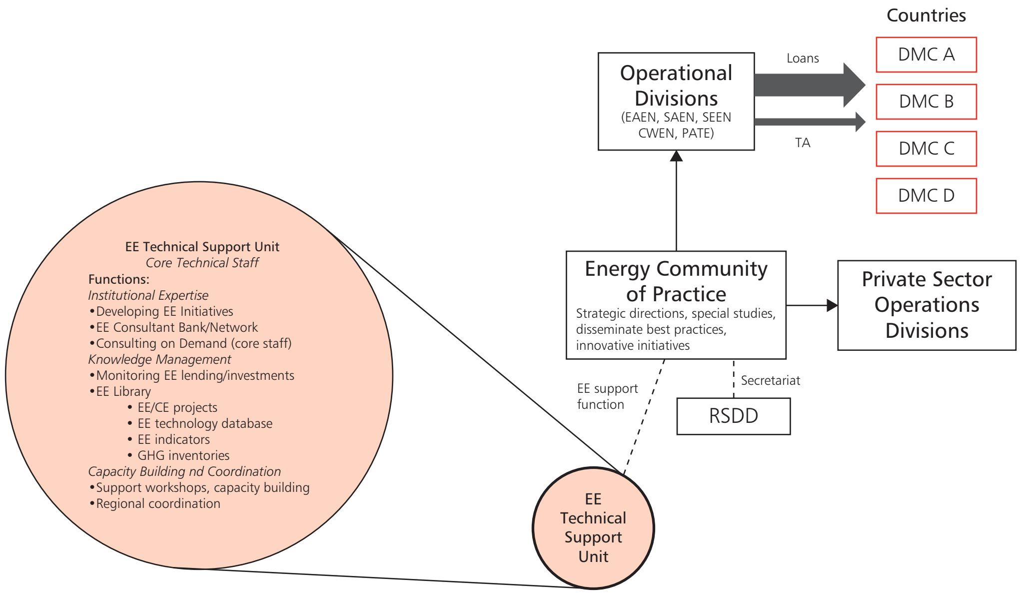
As noted in the 2011 study conducted by the Independent Evaluation Department (IED) and discussed in Chapter 5, ADB can take a number of steps to enhance the effectiveness of its EE interventions. The IED study suggested that ADB gradually increase support for stand-alone DSEE projects, and also offer policy advice and technical assistance to developing member country (DMC) governments. These actions were recommended as significant steps to help create a regulatory and institutional environment that fosters EE investment in a range of end-use sectors (ADB 2011b).

Following the completion of the IED study and in-depth analysis of its EE investments, ADB has examined possibilities to expand clean energy investment in its DMCs, with a major focus on DSEE projects. This chapter offers a proposal to support such a scale up, and describes its structure and orientation.

6.2 Enhancing Support Within ADB for Demand-Side Energy Efficiency

To increase lending and investment in end-use EE, ADB can build on its existing experience in the sector. It is proposed that an Energy Efficiency Technical Support Unit (EETSU) be established within ADB, to be guided by ADB's Energy Community of Practice (Energy CoP). A draft diagram of the proposed EETSU is shown in Figure 9.

Figure 9 **Proposed Design of the Energy Efficiency Technical Support Unit**



CE = clean energy; CWEN = Energy Division, Central and West Asia Department; DMC = developing member country; EAEN = Energy Division, East Asia Department; EE = energy efficiency; GHG = greenhouse gas; PATE = Transport, Energy and Natural Resources Division, Pacific Department; RSDD = Regional and Sustainable Development Department; SAEN = Energy Division, South Asia Department; SEEN = Energy Division, Southeast Asia Department; TA = technical assistance.

Source: ADB.

With the establishment of the EETSU, the Energy CoP can engage expanded efforts in the areas of (i) Institutional Expertise, (ii) Knowledge Management, and (iii) Capacity Building and Coordination. Primary responsibilities for each of the proposed functions are described below.

Institutional Expertise

Technical Assistance for Regional Energy Efficiency Initiatives. ADB's Energy CoP, through the proposed EETSU, can respond to issues of common regional interest, in order to enhance effective EE implementation. It is envisioned that resulting activities would cover issues such as policy and regulation, technology transfer, effective financing, and monitoring and evaluation.

Energy Efficiency Expert Pool and Network. The Energy CoP, via the EETSU, could maintain a database of EE experts. This would facilitate the prompt identification of qualified experts to support the provision of country loans, investments, and technical assistance related to EE.

Quick and Effective Demand Response. With the establishment of the EETSU, the Energy CoP could support the design of activities with any EE components, including awareness and capacity building as well as technical design of loan packages and investments, providing quick and effective demand response.

Knowledge Management

Monitoring Energy Efficiency Lending and Investments. A key function within ADB is to track and monitor loans and investments for the Clean Energy Program. The proposed EETSU, guided by the Energy CoP, could undertake this activity with a focus on all end-use EE lending and investments.

Energy Efficiency Library. An EE Library could consolidate an array of information that is currently tracked for clean energy. Its focus could be on the enhanced development and tracking of information related to EE in the following areas:

(i) EE and clean energy projects: The EETSU could track and categorize all projects with end-use or SSEE components.
(ii) EE technology database: The EETSU could develop a database on the availability and performance of technologies that may be applied in EE projects supported by ADB.
(iii) EE indicators: The EETSU could compile and maintain a database of EE indicators for ADB's DMCs. The indicators could be drawn from existing sources such as the US Energy Information Administration (EIA), the International Energy Agency (IEA), and the Asia Pacific Energy Research Centre (APERC). ADB may consider the application of these indicators in a more proactive manner, i.e., through the publication of an *Asia EE Status Report*. The report could track the main EE targets and indicators for ADB's DMCs, as well as noteworthy EE programs and initiatives. The intent would be to facilitate cooperation with other international donors and agencies when possible, with the aim of developing a "report of record" on EE in the region.
(iv) Greenhouse gas (GHG) inventories: The EETSU could compile and make available GHG inventories for selected DMCs, with expansion to nonselected DMCs once data are available. The purpose would be to enhance the ability to access information on GHG emissions from various energy sectors in DMCs, as they develop their respective projects and investments.

Capacity Building and Coordination

The proposed EETSU could act as a coordinating unit to run workshops, training events, and other activities that build EE capacity in the region. This effort could include activities related to the Asia Clean Energy Forum, the EE Global Forum, and World Energy Congress. The EE Global Forum is an event supported by the US-based Alliance to Save Energy. The World Energy Congress is organized by the United Nations-accredited global energy body, the World Energy Council.

The EETSU could further serve working partnerships between ADB and other actors in the region that support cooperation in related energy and environmental areas. For example, ADB has established a Memorandum of Understanding (MOU) with the New Energy and Industrial Technology Development Organization, a government agency under the Ministry of Economy, Trade, and Industry of the Government of Japan. The MOU promotes cooperation for the dissemination of advanced energy technologies. As another example, ADB has signed an MOU with the Korea Energy Management Corporation to promote cooperation in EE projects.

With the goal of serving as an EE center of excellence, ADB's Energy CoP—through the proposed EETSU and the activities noted above—could provide support on policy, on the technical side, and on implementation. This effort would allow quick identification of sector expertise, an improvement upon the current practice of hiring experts for projects in a relatively ad hoc manner.

6.3 Taking a More Systematic Approach

A broader imperative centers on the need for the EETSU to more systematically advance EE initiatives in Asia, taking advantage of ADB's high profile and extensive networks in the region. A more proactive approach to the development and dissemination of knowledge, similar to the approach taken by the World Bank, can assist ADB in maximizing the value of its sizable investments in the region. The above activities can help to broaden and diversify ADB's current knowledge resources in the EE sector, while expanding the reach and value of this experience to a range of regional stakeholders.

This transformation in knowledge sharing, toward a more systematic approach, could entail the following responsibilities:

(i) identify and catalogue the "low-hanging fruit" for EE and demand-side investment opportunities throughout Asia, which ADB could then target for investigation and assistance;
(ii) establish and update country technology status profiles for the convenience of operations;
(iii) track technology developments at the macro and micro scales, and provide updated technology assessments for many types of EE initiatives, helping ADB to make proper decisions on technology options for investment;
(iv) build ADB's expertise and knowledge on technologies, and maintain and expand access to that knowledge. This coordinated knowledge network could be cultivated both internally and externally, with experts kept on a retainer basis to provide information regarding particular technologies; and
(v) collect the lessons learned from EE investments and projects as undertaken in various countries and regions, reporting on what worked or did not work, and why. This knowledge set of diverse experiences can be the foundation for outreach to clients in the region, as discussed in more detail below.

To expand the knowledge base, greater emphasis could be given to the development of pilot projects, particularly for the most energy-intensive sectors, e.g., large cement, steel, textiles, food processing, automobiles, and public and commercial buildings. Key pilot projects in each sector could comprise case studies that depict the technical and economic aspects of the given approach and its resulting benefits. This strategy could be used to spur further EE uptake by governments, industry associations, or banks and financial institutions depending on the particular circumstances of given countries or locales.

An additional useful role could entail packaging of business models that could be promoted or disseminated in support of EE action in Asia. Although EE programs cannot be "one size fits all," ADB's valuable knowledge could be used to develop the larger concepts with customized features for each country or region.

Drawing upon enhanced EE knowledge and technical resources, the Energy CoP, through the EETSU, may undertake high-level activities with government officials and thought leaders in host countries, to raise awareness about EE's multifaceted benefits. Emphasis can be given to EE's role in addressing climate change, along with the significant and direct economic benefits that EE investments can yield across sectors and stakeholders. The result of these activities could be to develop high-level leadership and proponents of EE who can further drive the process from national to more local scales.[8] In turn, EE "ambassadors" with experience in ADB-supported initiatives can be encouraged to share success stories in other countries. For example, ADB can encourage a city mayor with an effective EE program to share the approach with other city officials, as a showcase to spur enthusiasm for similar projects elsewhere. This approach can provide positive pressure for changing mind-sets.

More fundamentally, an EE knowledge bank could serve a core part of ADB's approach to accelerate EE in Asia, particularly in combination with country partnership strategies. The Country Partnership Strategy is the main document guiding ADB's cooperation with a DMC. As updates are completed every 3–5 years, a plan for EE interventions could be integrated into the strategy. The process could entail identifying the sectors and areas of each country with the highest EE potential. A variety of interventions can then be discussed and prioritized in cooperation with the host country, based on its economic structure and other considerations.

As the one-size-fits-all approach will not help accelerate EE uptake, the development of more tailored EE strategies for DMCs could benefit from a tiered approach to the gathering, synthesis, and dissemination of resources, based on energy sector conditions among countries and their experience with EE initiatives. Technical assistance and financing for Asia's DMCs could be divided by tier as follows:

(i) **First tier countries.** These would include countries with advanced experience in designing and implementing EE programs. Assistance could be directed to more ambitious projects to deploy innovations in various sectors.
(ii) **Second tier countries.** This category would refer to countries with relatively advanced power systems and some experience in EE initiatives, e.g., India, Malaysia, the Philippines, and Thailand. Support for EE could focus on strategies and measures, both technical and financial, to accelerate improvements in factories and buildings.
(iii) **Third tier countries.** These would include lesser-developed countries with limited, inefficient, or aging power plants, and significant supply gaps, e.g., Bangladesh, Cambodia, Kazakhstan, the Lao People's Democratic Republic, Nepal, Pakistan, Sri Lanka, Uzbekistan, etc. Support for interventions could focus on priorities for reducing line losses; installing proper metering, billing, and collection systems; and improving the efficiency of power plants.[9]

Beyond these distinctions, countries may be further recognized as "hybrids" that occupy a middle ground between categories. Examples are India and the Philippines. Both offer great

[8] An example of action to develop champions in the sector comes from the Philippines EE Project. ADB worked through the country's Department of Energy to build support for a large-scale compact fluorescent lamp (CFL) initiative. This led to a relationship with, and strong support from, the Philippines Secretary of Energy, and eventually support from the President of the Philippines. A high degree of cooperation between ADB and the Philippine government helped to facilitate the process of project development.

[9] One example is the effort to modernize the power system in Azerbaijan. ADB supported the installation of prepaid meters in the worst performing areas of the country. Within 3 months, cash flow and economic performance improved with additional demand-side impacts, i.e., reduced energy use, because of the price feedback.

potential for effective implementation of demand-side measures in buildings and industry, but also retain significant potential for improving power plant efficiencies.

Through shared efforts, ADB's approach to facilitating EE projects and interventions could become more systematic. The larger result may be interventions that capture more targeted, ambitious, and wide gains across countries and sectors in the region.

6.4 Measuring ADB's Contribution to Energy Efficiency

As a part of ADB's clean energy investments, DSEE in some ways has been obscured through its inclusion with other clean energy activities. Going forward, ADB could take additional steps to spotlight EE and DSEE investments among the larger category of clean energy initiatives, while pursuing more targeted measures to assess the impact of efforts beyond the amount of investments made. Currently, two of the seven indicators used by ADB's energy sector are pertinent to EE: (i) energy saved (gigawatt-hours per year), and (ii) carbon dioxide emission reductions. Guidelines exist on how to perform the calculations. Other indicators such as energy intensity, for example, could be used to measure EE impact.

Additional incentives could be designed to encourage ADB personnel to spend time on EE, perhaps as part of the staff evaluation matrix. Currently, the targets assigned to managers can make it difficult to focus on EE initiatives, as these often require more time, bear higher transaction costs, and have resulted in fewer projects and less investments. To encourage a renewed emphasis on EE, quotas could be designed so that managers must meet defined targets for this category of initiatives.

6.5 Up-front Fund Facility for Energy Efficiency

Previously, clean energy group funding from the Clean Energy Financing Partnership Facility (CEFPF) was accessed for EE measures. Access to CEFPF that is specific to EE could help move DSEE into the pipeline, as such projects typically require more resources and attention up-front compared to other types of investment. With the expanded CEFPF resources utilization approved by the ADB Board in 2012, the up-front funding support for EE will result in a more balanced EE project portfolio in both the public and private sectors. Also equally important is the need for carve-out funding resources for policy interventions related to demand-side initiatives. Such policy advisory service support can generate benefits for DMCs in need of reshaping and enabling an EE-oriented environment.

6.6 Guideposts for Future Demand-Side Energy Efficiency Investments

ADB achieved its 2013 clean energy investment target of $2 billion in 2011, 2 years ahead of time. In 2012, ADB attained clean energy investments of $2.3 billion. These yearly figures include renewable energy investments, as well as a range of SSEE and DSEE interventions. To date, ADB has yet to set any specific targets for lending and investment in DSEE.

As ADB looks to future prospects for more clean energy investment, the analysis of past trends shows that the ADB pipeline of end-use EE projects has been characterized by a few large initiatives, with most concentrated in the People's Republic of China (PRC). Most projects, up through 2011, were unusually large, and accordingly do not represent the majority of commonly available end-use EE projects. One of the ADB managers interviewed suggested that because of the desire to move large projects into the pipeline, the portfolio of projects in the PRC was not necessarily transformative and replicable.

For example, in 2008, a centralized district heating project in the PRC accounted for 75% of the $396 million invested in end-use EE. In 2010, EE investment dropped off, and totaled only $61 million for the year. In 2011, projects in the PRC accounted for 58% of the $608 million end-use EE investment. In short, the pipeline of end-use EE projects has been dominated by a few very large projects in the PRC, without systematic distribution across sectors, or across DMCs. This situation points to the need for a promotion of EE projects that balances SSEE and end-use approaches, in ways that maximize buildable and replicable gains toward sustained growth in project development and investments in the sector.

6.7 Final Considerations: Moving from Concept to Action

Efforts to expand EE implementation in Asia will require more focused attention by a range of stakeholders to narrow the gaps between EE's potential and its realization. The options explored in this chapter can support a more systematic approach by ADB in advancing EE and demand-side initiatives. Enhanced institutional expertise, more targeted knowledge management, and greater capacity building and coordination, all can increase the prominence of EE in the regional energy sector.

The approaches considered here reflect the emerging need throughout Asia and the world for energy solutions that simultaneously conserve economic and environmental resources, while bolstering the performance of existing energy infrastructure. Many EE initiatives are already delivering this value and now require a more ambitious vision to drive their widespread deployment as a focal point of national and regional energy development. ADB's interest in DSEE supports such a vision, so that Asia's rapid economic growth coincides with ever increasing gains in the sustainability of its energy systems.

7 Conclusion

Despite increasing gains, energy efficiency (EE) in general, and demand-side energy efficiency (DSEE) measures in particular, remain underutilized within the options that comprise the clean energy portfolio. In Asia and around the world, EE's potential to cost effectively meet long-term energy demand, while reducing environmental and climate threats, demands greater action from both the public and private sectors.

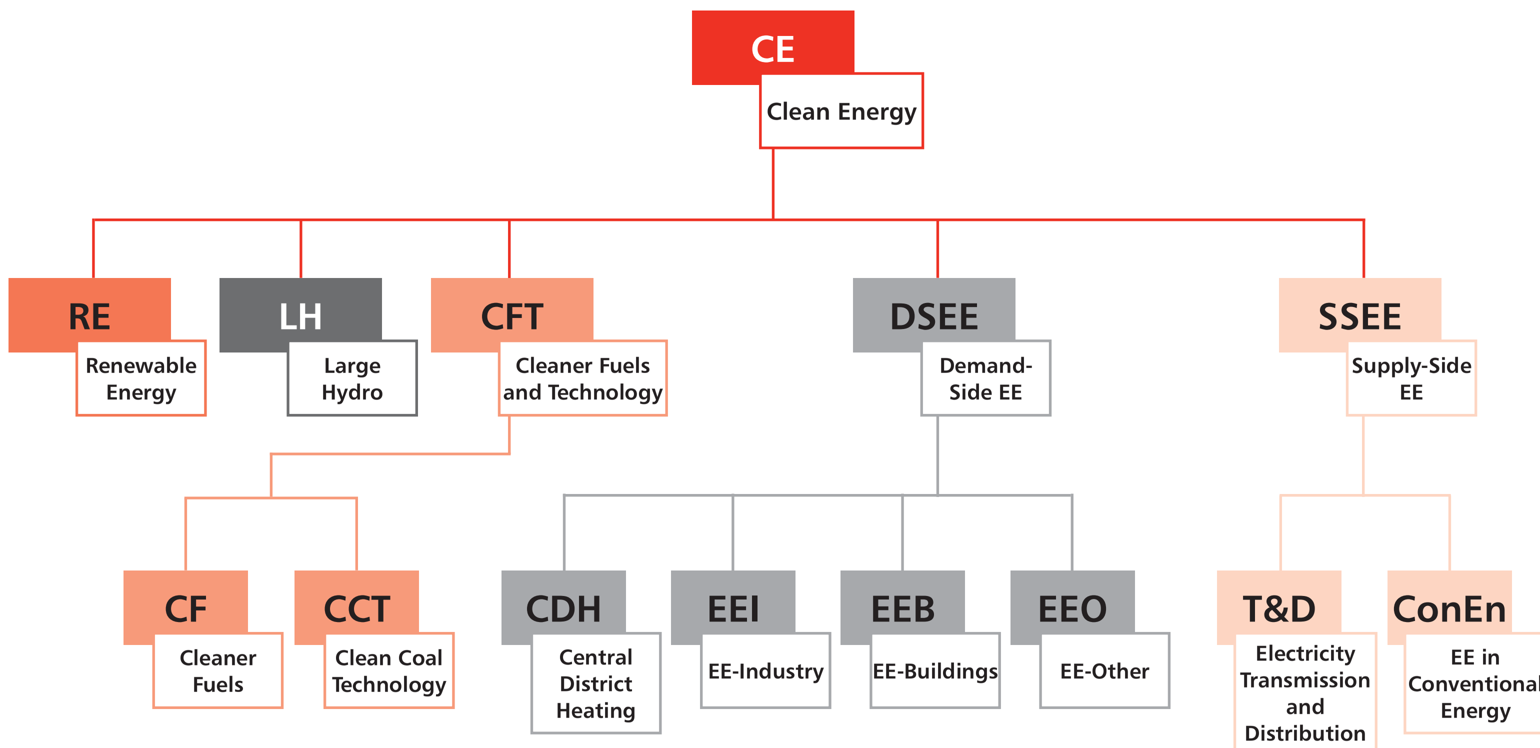
This report has reviewed current lessons from EE implementation to date, in attempting to clarify the barriers that often impede otherwise economically profitable and technically feasible action, and the strategies that may be deployed to overcome them. ADB, already a leading regional player in facilitating clean energy and DSEE investment among its developing member countries (DMCs), seeks possibilities for even more ambitious action. Conceptual and practical approaches for scaled-up DSEE investment in the region are now needed, and proposals for enhanced institutional expertise, knowledge management, and capacity building and coordination are steps in that direction.

Through efforts that blend lessons from existing global best practice, with attention to current policy and market conditions in Asia, ADB stands ready to accelerate the pace of DSEE in meeting needs within its DMCs. The potential gains of this transformation are significant and compelling but will require consistency of purpose and willingness to engage change as necessary. A perspective that extends beyond capture of the "lowest hanging fruit," and movement toward systematic and coordinated action within and across sectors, can allow DSEE to achieve its appropriate place as a leading solution to global and regional energy challenges.

Appendix 1

Analysis of ADB's Clean Energy Portfolio

Categories and Classifications Used in the Analysis of ADB's Clean Energy Portfolio



ADB = Asian Development Bank, EE = energy efficiency.

Appendix 2
ADB's Demand-Side Energy Efficiency Investments 2005–2011

Table A2 **ADB Projects with Demand-Side Energy Efficiency Investment, 2005–2011**

Project Number	Loan/Grant Number	Country[a]	Project Name	Category	Amount of ADB Assistance ($ million)	Total DSEE Investment ($ million)	% DSEE/ Total ADB Investment
Approved in 2005							
32300-01	2226	IND	Kerala Sustainable Urban Development (formerly Urban Infrastructure Development and Environment II)	EE-Other	221.20	2.84	1.3
37003-01	2211/2212	PAK	Rawalpindi Environmental Improvement	EE-Other	60.00	5.70	9.5
37487-013	2182	PRC	Zhengzhou–Xi'an Railway Project	EE-Other	400.00	40.00	10.0
Approved in 2006							
36433-01	2274	PRC	Taiyuan–Zhongwei Railway Project	EE-Other	300.00	30.00	10.0
36505-01	2237	PRC	Shandong Hai River Basin Pollution Control	EE-Other	80.00	0.30	0.4
37536-01	2245/2246	UZB	Land Improvement	EE-Other	60.20	1.81	3.0
39019-01	2260	PRC	Inner Mongolia Autonomous Region Environmental Improvement Project	CDH	120.00	97.07	80.9
Approved in 2007							
38254-03	2312	IND	MFF-North Karnataka Urban Sector Investment Program (Subproject 1)	EE-Other	33.00	8.25	25.0
39405-01/02	2382/2383	BAN	Dhaka Water Supply Sector Development Program (Program and Project Loan)	EE-Other	200.00	46.05	23.0
40031-02	2366	IND	MFF-Rajasthan Urban Sector Development Investment Program (Subproject 1)	EE-Other	60.00	14.48	24.1
40050-01	2360	PRC	Jilin Urban Environmental Improvement Project	CDH	100.00	12.74	12.7
40277-01	9109	MON	Community-Based Heating Supply in Rural Areas	CDH	2.00	1.10	55.0

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Table A2 *continued*

Project Number	Loan/Grant Number	Country[a]	Project Name	Category	Amount of ADB Assistance ($ million)	Total DSEE Investment ($ million)	% DSEE/ Total ADB Investment
40296-01	2363	ARM	Water Supply and Sanitation Sector Project	EE-Other	36.00	14.80	41.1
41907-01	7271	PRC	Energy Efficiency Multi-Project Financing Program	EE-Buildings	107.00	107.00	100.0
Unknown	7262	INO	PT PAM LYONNAISE JAYA (PALYJA) (West Jakarta Water Supply Development Project)	EE-Other	50.00	10.00	20.0
Approved in 2008							
36437-01	2428	PRC	Integrated Ecosystem and Water Resources Management in the Bayangdian Basin Project	EE-Other	100.00	6.60	6.6
38272-02	2410	IND	MFF-Uttarakhand Urban Sector Development Investment Program – Tranche 1	EE-Other	60.00	21.10	35.2
39228-03	2420	PRC	Xinjiang Municipal Infrastructure and Environmental Improvement	EE-Other	105.00	9.80	9.3
39653-02	2426	PRC	MFF-Guangdong Energy Efficiency and Environment Improvement – Tranche 1	EE-Industry	35.00	35.00	100.0
39653-03	0109	PRC	Capacity Building for Energy Efficiency Implementation	EE-Industry	1.20	1.20	100.0
40007-01	2466	UBZ	Surkhandarya Water Supply and Sanitation	EE-Other	30.00	7.50	25.0
40051-01	2407	PRC	Gansu Baiyin Urban Development Project	EE-Other	80.00	12.20	15.3
40573-01	2424	PAK	Preparing Lahore Rapid Mass Transit System	EE-Other	6.00	1.20	20.0
41957-01	7279	PRC	Municipal District Energy Infrastructure Development Project (Dalkia Asia Pte Ltd.)	CDH	400.00	300.00	75.0
42059-01	9127	MON	Energy Conservation and Emissions Reduction from Poor Households	EE-Buildings	2.00	2.00	100.0
Approved in 2009							
36173-01	2557 2558	SRI	Greater Colombo Wastewater Management Project	EE-Other	100.00	13.72	13.7
37269-02	2602	CAM	GMS Rehabilitation of the Railway in Cambodia (Supplementary)	EE-Other	42.00	8.40	20.0
39419-05	0149	SRI	Clean Energy and Access Improvement	EE-Buildings	4.20	4.20	100.0

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Table A2 *continued*

Project Number	Loan/Grant Number	Country[a]	Project Name	Category	Amount of ADB Assistance ($ million)	Total DSEE Investment ($ million)	% DSEE/ Total ADB Investment
39653-03	2611	PRC	MFF-Guangdong Energy Efficiency and Environment Improvement Investment Program – Tranche 2	EE-Industry	22.06	22.06	100.0
39653-04	0109	PRC	Capacity Building for Energy Efficiency Implementation (Supplementary)	EE-Industry	1.20	1.20	100.0
40031-03	2506	IND	Rajasthan Urban Sector Development Investment Program – Tranche 2	EE-Other	150.00	3.45	2.3
40553-02	0182/0183	NEP	Energy Access and Efficiency Improvement	EE-Buildings	4.50	4.50	100.0
40625-01	2601	PRC	Lanzhou Sustainable Urban Transport Project	EE-Other	150.00	27.40	18.3
40641-01	2574	PRC	Hebei Small Cities and Towns Development Demonstration Sector	CDH	100.00	3.10	3.1
41548-01	2556	KGZ	Issyk-Kul Sustainable Development Project	EE-Other	16.50	3.50	21.2
42001-01	2507/0142	PHI	Philippine Energy Efficiency	EE-Buildings	31.10	31.10	100.0
42001-02	0142	PHI	Philippine Energy Efficiency	EE-Buildings	1.50	1.50	100.0
42051-02/05	2552/2553	PAK	MFF-Energy Efficiency Investment Program – Tranche 1	EE-Buildings	60.00	60.00	100.0
42383-02	2606	PRC	Shanxi Small Cities and Towns Development Demonstration Sector	EE-Other	100.00	8.70	8.7
42489-02	2564	UBZ	Water Supply and Sanitation Services Investment Program – Tranche 1	EE-Other	60.00	21.20	35.3
43332-02	2605	PRC	MFF-Railway Energy Efficiency and Safety Enhancement Investment Program – Tranche 1	EE-Other	300.00	120.80	40.3
43924-01	7304	REG	Mekong Brahmaputra Clean Development Fund, L.P.	Various	15.00	10.00	66.7
Approved in 2010							
39298-01	2695	BAN	City Region Development Project	EE-Other	120.00	20.00	16.7
40634-01	2658	PRC	Inner Mongolia Autonomous Region Environment Improvement Project (Phase II)	CDH	150.00	34.50	23.0
42489-03	2633	UZB	Water Supply and Sanitation Services Investment Program	EE-Other	140.00	1.64	1.2
43931-01	7313/2637	AZE	Garadagh Cement Open Joint Stock Company (Garadagh Cement Expansion and Energy Efficiency Improvement Project)	EE-Industry	27.00	0.32	1.2

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Table A2 *continued*

Project Number	Loan/Grant Number	Country[a]	Project Name	Category	Amount of ADB Assistance ($ million)	Total DSEE Investment ($ million)	% DSEE/ Total ADB Investment
44031-01	2691/2692	PAL	Water Sector Improvement Program	EE-Other	16.00	0.89	5.6
44058-01	2656	NEP	Kathmandu Sustainable Urban Transport	EE-Other	10.00	1.80	18.0
44058-01	0212	NEP	Kathmandu Sustainable Urban Transport	EE-Other	10.00	2.00	20.0
Approved in 2011							
36330-013	2793	IND	Railway Sector Investment Program – Tranche 1	EE-Other	150.00	27.27	18.2
39415-01	2733/2734	SRI	Sustainable Power Sector Support Project	EE-Buildings	120.00	0.30	0.3
39653-04	2773	PRC	Guangdong Energy Efficiency and Environment Improvement Project – Tranche 3	EE-Industry	42.94	42.94	100.0
40080-01	2741	VIE	Ha Noi Metro Rail System – Line 3	EE-Other	293.00	58.60	20.0
40524-01	2771	PRC	Shandong Energy Efficiency and Emission Reduction Project	EE-Industry	100.00	100.00	100.0
41456-02	2754	VIE	Viet Nam Water Supply Sector Investment Program PFR 1	EE-Other	138.00	32.00	23.2
42016-01	2738	PRC	Qinghai Rural Water Resources Management Project	EE-Other	60.00	45.32	75.5
43024-01	2759	PRC	Xinjiang Altay Urban Infrastructure and Environment Improvement Project	EE-Other	100.00	4.75	4.8
43025-01	2760	PRC	Gansu Tianshui Urban Infrastructure Development	EE-Other	100.00	12.25	12.3
43332-04	2765	PRC	Railway Energy Efficiency and Safety Enhancement Investment Program – Tranche 3	EE-Other	250.00	50.00	20.0
43441-01	0280/0281/ 0282	TKM	North–South Railway Project	EE-Other	125.00	25.00	20.0
43912-01	7329/ 2748	IND	Bangalore Metro Rail Corporation Limited (BMRC)	EE-Other	250.00	50.00	20.0
44012-02	2835	PRC	Hebei Energy Efficiency Improvement and Emission Reduction Project	EE-Industry	100.00	100.00	100.0
44906-01	7327/2740	INO	Indonesia Eximbank	EE-Industry	200.00	30.00	15.0
45916-01	7349/2844	BAN	Industrial and Infrastructure Development Finance Company (IIDFC)	EE-Industry	30.00	30.00	100.0

ADB = Asian Development Bank, DSEE = demand-side energy efficiency.

[a] ARM = Armenia, AZE = Azerbaijan, BAN = Bangladesh, CAM = Cambodia, PRC = People's Republic of China, IND = India, INO = Indonesia, KGZ = Kyrgyz Republic, MON = Mongolia, NEP = Nepal, PAK = Pakistan, PAL = Palau, PHI = Philippines, REG = Regional, SRI = Sri Lanka, TKM = Turkmenistan, UZB = Uzbekistan, VIE = Viet Nam.

Source: ADB.

Appendix 3
ADB's Independent Evaluation Department Report: Findings and Recommendations

ADB's Independent Evaluation Department Report: Findings and Recommendations

This appendix summarizes the findings of an extensive evaluation published in October 2011 by ADB's Independent Evaluation Department (IED). The IED Report identified two key recommendations for ADB to consider as a means to improve the effectiveness of its demand-side energy efficiency (DSEE) initiatives:

(i) **Encourage commercial financing of energy efficiency (EE) investments in buildings and industry.** The report concluded that bringing together the financial expertise of commercial banks and the technical expertise of energy service companies (ESCOs) could facilitate commercial financing of EE investments. Perceived risks surrounding the financing of such investments, from the perspective of commercial banks, could be addressed with partial credit guarantees, whereby a portion of the credit risk is shared with ADB or another credible guarantor. Lines of credit also may be dedicated to the financing of EE projects. The report recommended a capacity development component, so that banks could improve their technical understanding and ESCOs could more fully understand financial requirements.

(ii) **Advance EE improvements in designated end-user categories.** The report suggested that ADB provide technical support for developing member country (DMC) governments to create a diversity of EE projects aimed at different sectors. Examples include minimum energy performance standards and appliance labeling, appliance testing laboratories, skills development and expansion of institutional capacity for verification and enforcement, and capacity development for government offices to support verification and enforcement of building codes.

The report offered the following findings based on ADB experience with DSEE:

(i) **Energy pricing and market imperfections require attention.** ADB and DMC governments can work to overcome barriers to EE investment, including limited public awareness about existing EE options; commercial bank perception of high risk; weak credibility of some energy service providers; and deficient capacity to audit, monitor, and verify energy savings.

(ii) **Little learning from ADB's supply-side experience can be applied to DSEE.** ADB's extensive supply-side experience is primarily in transmission and distribution, increasingly with EE improvement aspects, and in district heating. However, these offer limited insight regarding the nature of DSEE interventions in industry and buildings.

(iii) **Better measurement and verification is needed.** Efforts to systematically collect "before" and "after" data on energy consumption are lacking. For several lines of credit extended to development financial institutions, EE goals or targets were typically not stated up-front, and there was no evidence of efforts to estimate energy savings. For some direct investments to industry, when EE objectives were articulated up-front, data have not been consistent and the reliability of the measurement and verification system has been questionable.

(iv) **Lines of credit for industrial EE should be used for EE projects.** In one instance, a line of credit with an openly articulated objective for EE improvement supported a number of diesel-fired captive power plants rather than EE measures, because of problems with EE subproject origination; this type of occurrence should be avoided.

The report also included a number of general findings related to the implementation and financing of EE projects, based on the experience of other development partners:

(i) **Design of EE delivery programs would benefit from a diagnostic review of the local institutional context.** This could pertain to finance sector issues, project development and technical assessment capabilities, the EE market, government and development partner roles, and customs and contractual frameworks.

(ii) **Technical assistance support can bolster the effectiveness of lines of credit and partial credit guarantees for commercial banks when building EE project pipelines.** The technical assistance can be directed to improving the financial and technical appraisal skills of staff, and may entail the provision of a spreadsheet to allow staff to ascertain more easily whether projects meet EE criteria, with training to support staff efforts in collecting data for the spreadsheet.

(iii) **Commercial EE lending can be facilitated by partial credit guarantees, by lowering perceived risk, and by enhancing the credibility of small or new ESCOs.** This arrangement also can offer opportunities for ESCOs and commercial banks to interact.

(iv) **EE programs should align their objectives with the specific business interests of financial intermediaries.**

(v) **Development partner efforts to facilitate commercial EE financing can strive to cultivate sustainable schemes that are able to continue in the absence of indefinite assistance from development partners.** For example, partial credit guarantees or lines of credit may be crafted in ways whereby the participating commercial bank identifies, appraises, and approves subloans and starts to make sound EE lending business decisions.

(vi) **Capacity development for EE measures aimed at designated end-user segments should be long term and strategic.** In many instances, sector-specific EE programs develop by expanding to target a wider group of stakeholders. This dynamic calls for more diversified capacity development initiatives.

(vii) **Noted design principles should be followed for measures that aim to reach specific end-user segments.** Significant program design aspects in DSEE interventions by energy providers include aligning stakeholder interests to meet EE program objectives, establishing data collection and verification systems, and reducing the likelihood that stakeholders are unable to recover costs.

The report concludes by stating that in the context of Strategy 2020, ADB is expected to shift toward a balanced portfolio of DSEE and supply-side energy efficiency (SSEE) improvement interventions, and then ended with two recommendations:

(i) Support for stand-alone DSEE projects should expand in the coming years as a function of client demand and increasing expertise in the design of such interventions; and
(ii) ADB should engage the provision of technical assistance and policy advice so that DMC governments are able to design an institutional and regulatory context that facilitates EE investment in end-use sectors.

Appendix 4
Interviewees

The following individuals were interviewed to gather information on ADB's experience with demand-side energy efficiency projects since the completion of the Independent Evaluation Department's report.

Bob Finlayson, Principal Public–Private Partnership Specialist, Public Management, Financial Sector, and Trade Division, Southeast Asia Department

Sohail Hasnie, Principal Energy Specialist, Energy Division, Southeast Asia Department

Martin Jensen, Investment Specialist, Private Sector Operations Department

Toru Kubo, Principal Climate Change Specialist (Clean Energy), Climate Change Unit, Regional and Sustainable Development Department

Matthew Kuzio, Staff Consultant, East Asia Department

Martin Lemoine, Senior Investment Specialist, Private Sector Operations Department

Tika Limbu, Energy Economist, Energy Division, South Asia Department

Pradeep Perera, Principal Energy Specialist, Energy Division, East Asia Department

Pradeep Tharakan, Climate Change Specialist, Energy Division, Southeast Asia Department

Kapil Thukral, Principal Evaluation Specialist, Independent Evaluation Department, ADB

Jun Tian, Advisor, Regional and Sustainable Development Department

Samuel Tumiwa, Deputy Regional Director, North American Representative Office

Shigeru Yamamura, Energy Specialist, Energy Division, East Asia Department

Hongliang Yang, Energy Specialist, Energy Division, East Asia Department

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Same Energy, More Power
Accelerating Energy Efficiency in Asia

Energy efficiency is often defined as delivered energy service per unit of energy supplied into a system. Supply-side energy efficiency refers to decreasing energy losses in the supply chain, for improved performance in the production and delivery of electricity and heat. Demand-side energy efficiency (DSEE) is achieved through consuming less energy for the same level of service, for improved efficiencies at the point of final energy use. DSEE, in particular, offers vast potential to meet regional energy needs in Asia, yet supply-side strategies tend to be prioritized as a focus of investment and planning.

Over the past decade, the Asian Development Bank (ADB) has succeeded in quickly scaling up its investment in energy efficiency and the development of renewable resources within its developing member countries through ADB's Clean Energy Program. This report examines prospects to accelerate lending and investment for DSEE in Asia, in light of trends that are driving energy use and policy and regulatory change in developing countries. Such efforts can help realize the full potential of DSEE as a least-cost, low-carbon resource for energy security, environmental protection, and sustainable and inclusive growth benefiting all Asians.

About the Asian Development Bank

ADB's vision is an Asia and Pacific region free of poverty. Its mission is to help its developing member countries reduce poverty and improve the quality of life of their people. Despite the region's many successes, it remains home to two-thirds of the world's poor: 1.7 billion people live on less than $2 a day, with 828 million on less than $1.25 a day. ADB is committed to reducing poverty through inclusive economic growth, environmentally sustainable growth, and regional integration.

Based in Manila, ADB is owned by 67 members, including 48 from the region. Its main instruments for helping its developing member countries are policy dialogue, loans, equity investments, guarantees, grants, and technical assistance.

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Printed in the Philippines