

61148

The World Bank

Asia Sustainable and  
Alternative Energy Program  
ASTAE

Annual Status Report 18  
Fiscal Year 2010  
July 1, 2009 – June 30, 2010



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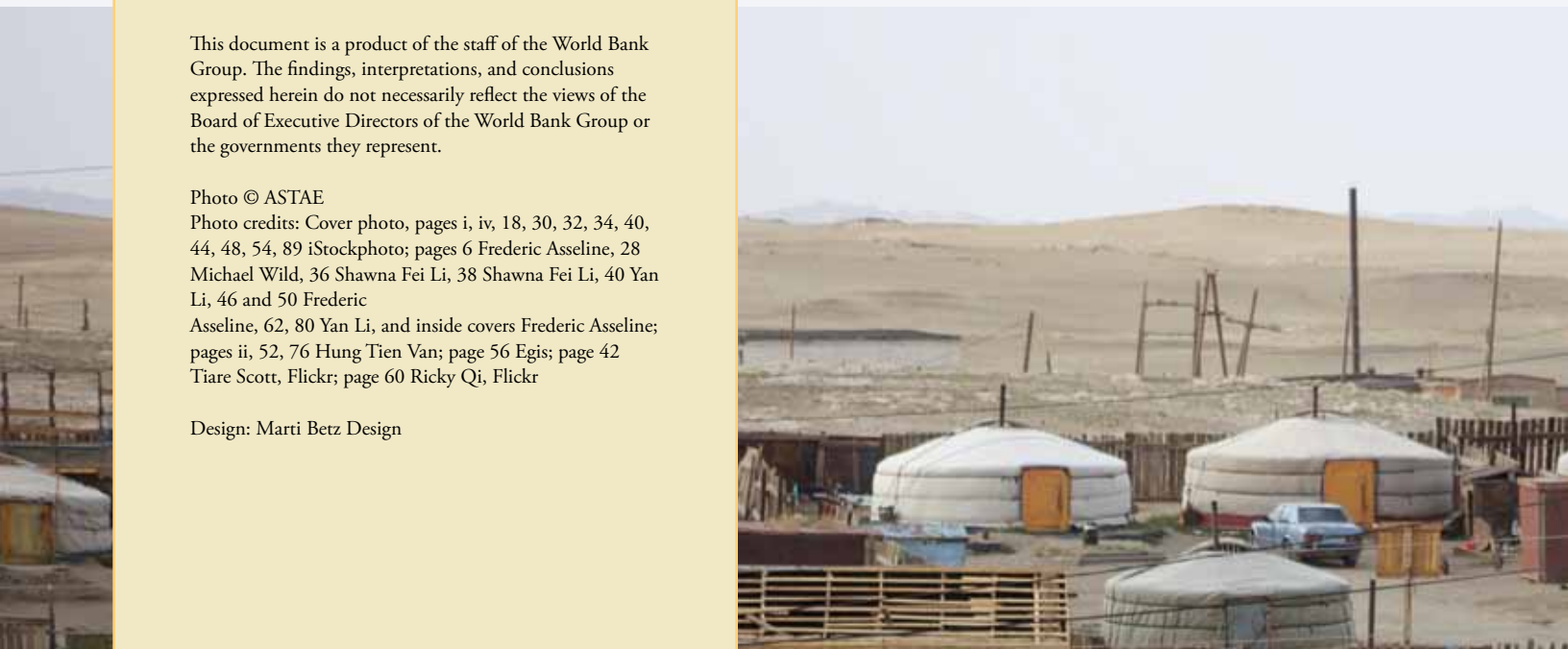
First printing: December 2010

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## Acronyms, Abbreviation, and Units of Measure

AFREA	Africa Renewable Energy Access	IEA	International Energy Agency
APL	Adaptable Program Loan	IS	Improved services
ASTAE	Asia Sustainable and Alternative Energy Program	km	Kilometer
BCC	(private) Biodigester Construction Company	KP	Knowledge products (WB internal abbreviation)
BEE	Bureau of Energy Efficiency	kWh	Kilowatt hours
BNPP	Bank-Netherlands Partnership Program	LED	Light-emitting diode
CDM	Clean Development Mechanism	PDR	(Lao) People's Democratic Republic
CIDA	Canada International Development Agency	M&E	Monitoring and evaluation
CO <sub>2</sub>	Carbon dioxide	MDTF	Multi-donor trust fund
CRÉSP	China Renewable Energy Scale-Up Program	MEMR	Ministry of Energy and Mineral Resources
CTF	Clean Technology Fund	MSME	Micro, small, and medium enterprise
DECDG	Data Group of Development Economics	MW	Megawatt
DFID	Department for International Development (UK)	NGO	Nongovernmental organization
DSM	Demand-side management	O&M	Operations and maintenance
EAP	East Asia & Pacific Region	OECD	Organisation for Economic Co-operation and Development
EASIN	World Bank East Asia and Pacific Infrastructure Unit	PIC	Pacific Island country
EC	Electricity cooperative	PNG	Papua New Guinea
EE	Energy efficiency	PPIAF	Public-Private Infrastructure Advisory Facility
EdL	Électricité du Laos	PV	Photovoltaic(s)
EIA	Energy Information Administration (U.S. Department of Energy)	RE	Renewable energy
ESMAP	Energy Sector Management Assistance Program	REDP	(Vietnam) Renewable Energy Development Program
FY	Fiscal year	SAR	South Asia Region
GDP	Gross domestic product	SEFP	Sustainable Energy Finance Project (Pacific Islands)
GE	Global Environment Facility Grant (WB internal abbreviation)	SIDA	Swedish International Development Agency
GEF	Global Environment Facility	SIEA	Solomon Island Electricity Authority
GHG	Greenhouse gases	SKr, SEK	Swedish krona
GoC	Government of China	SMEs	Small and medium enterprises
Gol	Government of India	SNV	Netherlands Development Organization
Gol	Government of Indonesia	t	Ton (metric)
GPOBA	Global Partnership on Output-Based Aid	TA	Technical assistance
GWh	Gigawatt-hour	TF	Trust fund
IBRD	International Bank for Reconstruction and Development	TWh	Terawatt-hour
IDA	International Development Association	W	Watt
		WB	World Bank





OVER THE PAST  
FOUR YEARS OF THE  
EXTENDED BUSINESS  
PLAN PERIOD 2007-10,  
ASTAE SUPPORTED 17  
WORLD BANK PROJECTS  
WITH A TOTAL LENDING  
IN THESE PROJECTS  
BEING AROUND  
US\$2.2 BILLION.

## Foreword

ALTHOUGH ASIAN COUNTRIES HAVE MADE SIGNIFICANT STRIDES IN PROMOTING ACCESS TO ELECTRICITY AND IN EXPANDING SUSTAINABLE ENERGY, MANY CHALLENGES REMAIN AT INDIVIDUAL COUNTRY LEVELS, NOTABLY IN TERMS OF ENERGY ACCESS AND MOVING ENERGY POLICIES TO LOW-CARBON PATHWAYS.

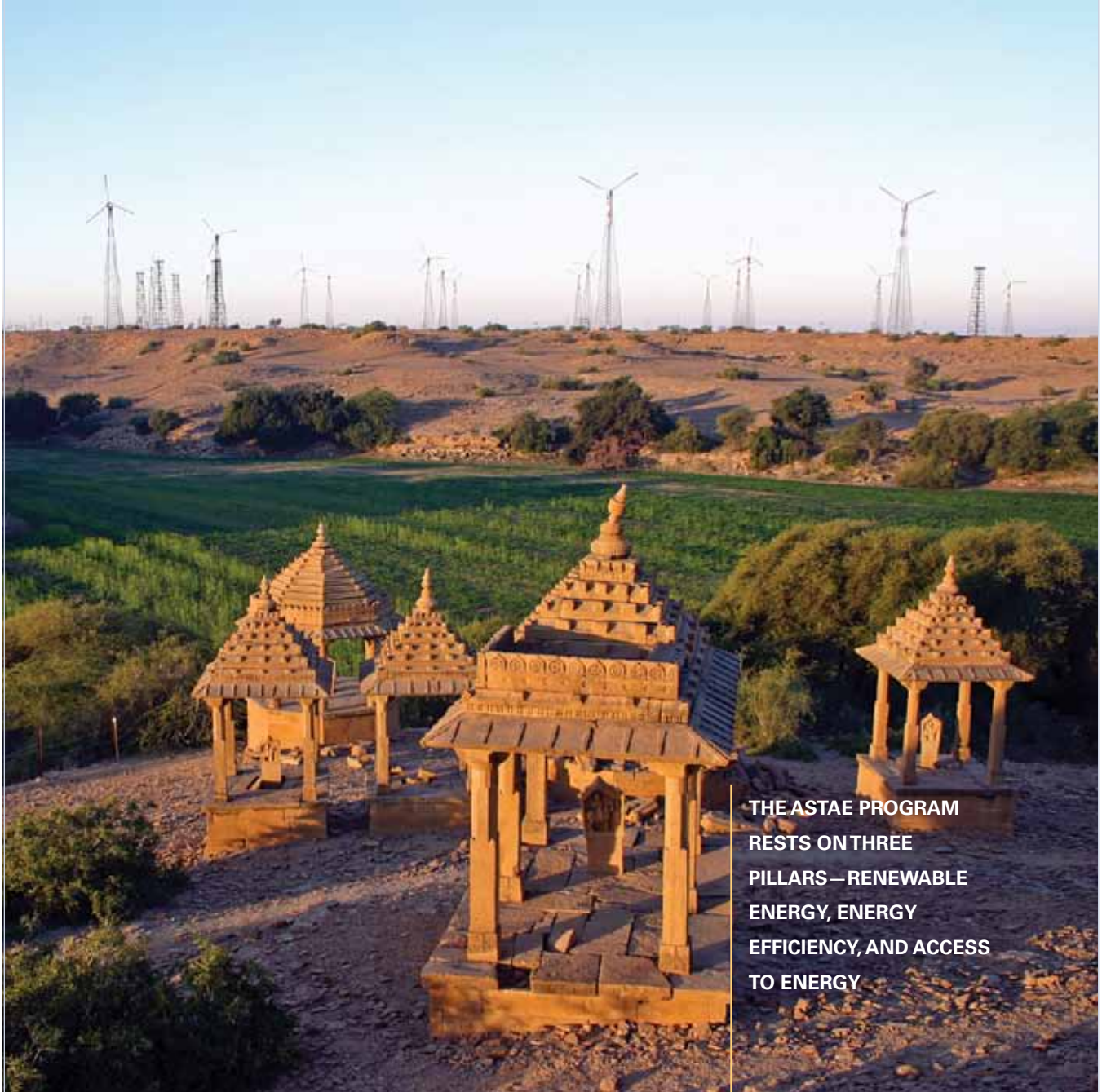
In fiscal 2010, ASTAE continued to fulfill its role of operationalizing the energy strategy of the East Asia and Pacific Region. The regional team has recently completed a flagship report, *Winds of Change: East Asia's Sustainable Energy Future*, and is finalizing a second flagship report—*Two Paths, One Goal: Energy Access in East Asia and Pacific*. Based on the consultations conducted during the preparation of the flagship reports and their findings, six priority areas of focus in the energy sector in the coming years were identified for the region: scaling up renewable energy, improving energy efficiency, increasing access to energy, introducing new technologies and low-carbon energy solutions, promoting regional energy trade and market integration, and advancing sector reforms and financial viability.

Over the past four years of the extended business plan period 2007–10, ASTAE supported 17 World Bank projects that focused on the above areas. The total lending in these projects was around US\$2.2 billion, which points to a substantial leveraging ratio for ASTAE funding: every dollar of donor resource provided to ASTAE resulted in US\$298 in World Bank-related financing. As a result, ASTAE succeeded in substantially exceeding its targeted impact indicators (such as increase in renewable energies, energy saving from improvement of energy efficiency, increased or improved access, greenhouse gas emission reduction, and well diversified support to countries). Although countries of East Asia and the Pacific have overall made significant strides in promoting access to electricity and in expanding financially sustainable services, many challenges remain at individual country levels, notably in terms of energy access and moving energy policies to low-carbon pathways.

ASTAE's support has been very useful in helping client countries begin the process of operationalizing policies to promote low-carbon pathways within the framework of green growth. These policies center around developing mechanisms that enable Asian countries to continue their rapid economic growth while maintaining harmony between economy and environment. More specifically, the objectives are to promote economic growth while reducing emissions, minimize waste and inefficient use of natural resources, and maintain biodiversity—all ideas that are fully consistent with ASTAE's three pillars and cross-cutting themes.

Support from the donor community is of the utmost value in supporting projects and programs that address the challenges above. We wish to express our great appreciation to the government of the Netherlands and the Swedish International Development Cooperation Agency, and look forward to their continued support to meet the challenges ahead. We also welcome participation of other interested donors in these exciting and topical programs, as Asian countries grapple with the challenges of how best to implement a low-carbon, green-growth strategy while also ensuring energy services for their populations.

N.Vijay Jagannathan  
 ASTAE Program Manager/Sector Manager  
 Infrastructure Unit  
 Sustainable Development Department  
 East Asia and Pacific Region  
 The World Bank



**THE ASTAE PROGRAM  
RESTS ON THREE  
PILLARS—RENEWABLE  
ENERGY, ENERGY  
EFFICIENCY, AND ACCESS  
TO ENERGY**



## Executive Summary

### ASTAE At A Glance

■ Created in 1992, the Asia Sustainable and Alternative Energy Program (ASTAE) has been instrumental in moving the World Bank East Asia and Pacific Region portfolio toward sustainable energy.

■ Embedded in a regional unit to maximize its leverage and operational impact, the program covers South and East Asia client countries.

■ ASTAE works in close cooperation with the Energy Sector Management Assistance Program (ESMAP) and other World Bank Trust Funds.

■ The ASTAE program rests on **three pillars—renewable energy, energy efficiency, and access to energy**—with progress measured by impact indicators:

- New MW and GWh of renewable energy;
- GWh avoided through energy efficiency;
- Number of household connections to improved energy sources; and
- Avoided CO<sub>2</sub> emissions.

■ ASTAE funds Bank-executed activities and will soon fund recipient-executed activities.

■ Current donors countries are The Netherlands and Sweden. Past donors include Australia, Canada, Finland, Japan, Switzerland, the United Kingdom, and the United States.

# Executive Summary

## ASTAE-Supported Activities in Fiscal 2010

### OVERVIEW OF ASTAE

The Asia Sustainable and Alternative Energy Program (ASTAE) was created in 1992 as a Global Partnership Program (GPP). Its mandate is to scale up the use of sustainable energy options in Asia to reduce energy poverty and protect the environment. Achieving this objective rests on promoting ASTAE's three pillars for sustainable development: renewable energy, energy efficiency, and access to energy. The program has been instrumental in increasing the share of sustainable energy projects in the World Bank energy portfolio in Asia; it has been especially successful in the East Asia and Pacific Region (EAP). Today, ASTAE covers client countries in the EAP with renewed engagement in the South Asia Region (SAR). ASTAE is focused on downstream and operations-oriented activities that directly support and enhance World Bank lending projects related to the three ASTAE pillars.

ASTAE objectives, history, delivery mechanism, indicators, and targets are described in chapter 1.

### OVERVIEW OF DISBURSEMENTS IN FISCAL 2010

During fiscal 2010, ASTAE disbursed a total of US\$2,123,893 — a result essentially stable from the previous year. This provided funding for 21 activities in 12 countries.

ASTAE disbursed US\$1,726,905 toward project implementation in fiscal 2010, or 81.3 percent of its total disbursements; the remainder of the budget was used to cover administrative and reporting costs. Disbursements reflected a good balance among all three pillars in terms of number of activities, with slightly more emphasis on renewable energy and access to energy (around forty percent each).

Also in fiscal 2010, ASTAE continued its active involvement in priority countries, with 39 percent of its allocations to China, Indonesia, and Vietnam (figure 2-5). Indonesia received the most funding—US\$326,323, or 19 percent of total activity-related disbursements.

### ACTIVITIES HIGHLIGHTS IN FISCAL 2010

Of the 21 activities that were funded by ASTAE in fiscal 2010, the following are highlighted to represent the range of activities supported by the program, and to explain the relevance of their focus areas that contribute to achieving ASTAE's overall mission. All activities that registered significant disbursements in fiscal 2010 are described in chapter 2.

*In Indonesia, the Geothermal Power Support Program activity* continued to provide support to a World Bank team helping the government undertake major reforms to enhance the investment climate in its geothermal sector while helping stimulate rapid investments by supporting developers that are at an advanced stage of project preparation. This is aimed at multiplying by six the geothermal power capacity to a total of 6,000 MW by 2020. Following successful support in fiscal 2009, ASTAE funding was extended into fiscal 2010 to scale up policy dialogues and the Bank's advisory support to the government, in particular to develop a pricing and compensation policy for geothermal development. ASTAE grants provided follow-up work on carbon finance with training of ministry staff and consensus building among stakeholders and with drafting of an operations manual. Finally, ASTAE helped support project developers' capacity to prepare and undertake geothermal investments that meet industry good practice standards. All of these substantially helped the timely delivery of the World Bank project on schedule, which increased the likelihood that the government will meet its targets. The ASTAE-supported Geothermal Clean Energy Investment Project is expected to receive a US\$125 million allocation from the Climate Technology Fund.

*The Regional Carbon Mitigation in Road Construction and Rehabilitation Toolkit activity* focuses on energy efficiency in the transport sector. Over the next decade, developing countries in Asia will be substantially expanding and restoring their extensive highway networks. Many steps involved in road construction contribute to the production and release of greenhouse gas emissions, which vary with the types and specifications of roads and construction methods. The Toolkit, known as Roadeo, with the support of a User Manual, will guide users through various stages and activities of road

## Executive Summary

### ASTAE-Supported Activities in Fiscal 2010

construction and rehabilitation, help them identify areas sensitive to greenhouse gas emissions, and present various mitigation options, with cost and benefit implications noted. Roadeo lets decision makers, designers, and technicians in the highway sector easily compare various alternatives in construction, and optimize their practices to maximize energy efficiency (EE). It focuses on China, Indonesia, and Vietnam, countries that are undertaking large programs of road expansion, but is relevant for many countries across Asia. It has already garnered a high level of interest from the transport community, ahead of its expected delivery early in 2011, and will be presented at high-level international symposia. Roadeo is expected to be used in Bank operations as well as directly by client countries. It also will be very relevant in countries with rapidly growing economies in other regions.

*The Regional East Asia Pacific Flagship Study activity*, highlighting the prospective energy-sector challenges in the region and how to meet them, was delivered and disseminated during a wide range of national consultations to academics, policy researchers, government officials, nongovernmental organizations (NGOs), civil society, the private sector, and donors. The study and consultations contributed to developing and prioritizing project pipelines in the EAP infrastructure sector. The study finds that it is within the reach of the region's governments to maintain economic growth, mitigate climate change, and improve energy security. In other words, simultaneous large-scale deployment of EE and low-carbon technologies can stabilize EAP's CO<sub>2</sub> emissions by 2025, significantly improve the local environment, and enhance energy security—without compromising economic growth. However, the study also warns that the window of opportunity is closing quickly, as delaying action would lock the region into a long-lasting high-carbon infrastructure. The study recommends that the region's governments take immediate action to transform the energy sector toward much higher energy efficiency and widespread utilization of low-carbon technologies.

*In Timor-Leste, the Rural Energy Access and Efficiency activity* aimed at helping the government tackle two key rural energy sector challenges: first, addressing the potentially serious health and environmental problems associated with continued heavy

dependence on biomass fuels, and second, providing improved access to modern fuels, particularly electricity, to all segments of the rural population. ASTAE financed an assessment of rural and renewable energy options, with complete technological and economic analyses of the different options, and identified and prepared the design of practical solutions for implementing its recommendations

*In India, the Energy Efficiency in MSMEs activity* focuses on the nearly 3 million micro, small, and medium enterprises (MSMEs), that constitute more than 80 percent of the country's industrial enterprises. Many of these are energy intensive, employing inefficient and outmoded technologies and modalities. The MSME activity supports the preparation of a World Bank project that addresses the barriers to implementation of EE measures in those MSMEs. ASTAE funding was used to identify a subgroup of industrial MSME clusters and pilot the selection and implementation modalities to be employed for later project-wide replication. This meant identifying pilot clusters, finding a focal organization in each selected cluster, providing training to the focal organizations, supporting project pipeline development, and establishing local monitoring and evaluation (M&E) systems. This pilot work, which includes cluster mobilization, pilot-unit-level audits, and project report preparation for investments, resulted in pre-identification of eight projects, representing more than US\$2.9 million in energy-efficiency and fuel-switching investment, with payback periods ranging from 5 to 20 months. This helped kick-start project implementation by proceeding ahead of schedule with detailed specifications analysis with vendors and with financing mobilization activities.

The flagship study identified the World Bank EAP energy business strategy focusing on energy efficiency, renewable energy, and new technologies. This reaffirms ASTAE's relevance as a major instrument to support increased Bank lending and improved policy changes in the region. This aligns with the commitment of the World Bank Group (WBG) to scaling up policy advice, sharing knowledge, and financing sustainable energy to help client countries make such a shift.

# Executive Summary

## Program Outputs and Impacts in Fiscal 2007–10

The original 2007-09 business plan period was extended into fiscal 2010. By the end of fiscal 2010, the total donor resources engaged by the ASTAE program during the fiscal 2007–10 extended business plan period reached US\$8.5 million, including disbursed funds and committed expenditures. This represented 92 percent of the US\$9.3 million budget provided by ASTAE donors, i.e., the Netherlands and Sweden, under the extended business plan period. A detailed analysis of the outputs and impacts of the 2007-10 extended business plan period is provided in chapter 3.

### ASTAE-SUPPORTED WORLD BANK PROJECTS IN FISCAL 2010

Over the four years of the extended business plan period, 17 World Bank projects that promoted sustainable energy and that have benefited from ASTAE support were approved. The total lending in these projects amounted to just over US\$2.2 billion. This lending, focused on developing sustainable energy, was enabled or facilitated by ASTAE support and illustrates ASTAE's leverage on World Bank lending. In short, over the four years of the extended business plan period, every dollar of donor resource disbursed by ASTAE resulted in US\$298 in World Bank-related loans or grants (details provided in chapter 2).

Four such ASTAE-supported World Bank projects were approved in fiscal 2010 for a total of US\$199 million and will be implemented over the next five fiscal years.

*The China Energy Efficiency Financing II Project* was approved in June 2010 for a total of US\$101.6 million. The project is a financial intermediary lending operation, whereby Bank loans will be on-lent by China's Ministry of Finance, on the same financial terms and conditions, and with no interest rate subsidy, to a participating local financial institution. The project will finance only EE rehabilitation subprojects. This will catalyze EE lending and help the local finance institution develop and sustain that business line by building on its sector knowledge and client base. Furthermore, a very high average leverage ratio is expected to lead to US\$1 billion allocated to energy efficiency over the project period.

*The India Financing Energy Efficiency in Micro, Small, and Medium-Sized Enterprises Project* was presented to the Board of Directors in April 2010 as a US\$57.6 million Global Environment Facility (GEF) project. The project will begin with technical assistance that will increase awareness of energy efficiency on a large scale at cluster and plant level. It will also increase the capacity of energy auditors, financial consultants, chartered accountants, vendors, service providers, and local banks through training programs and other efforts to build internal capacities. Finally, it will support the uptake of risk-mitigation instruments, such as guarantees, that are currently available on the Indian market. The project will also provide grant support to cover the "soft costs" of an initial pipeline of about 500 projects, including at least 1,000 initial project assessments.

*The Lao PDR Rural Electrification Phase II* was presented to the Board in January 2010 for a total of US\$35.8 million. Following key triggers met by 2009, phase two of this Adaptable Program Loan project began with further expansion of access to on- and off-grid electricity supply to 106,000 rural households targeted. It will focus on final implementation of the sustainability action plan to achieve its final targets, that is, scale-up of the alternative generation technologies and alternative delivery models for both on- and off-grid rural electrification (RE) piloted during phase one; and scale-up of the demand-side management program throughout the country.

*The Vietnam System Efficiency Improvement, Equitization, and Renewable Additional Financing* was presented in May 2010, for US\$26.1 million, to complete what was targeted in the original project: system efficiency improvement, including demand-side management activity; improved rural energy access; improvement of sub-transmission systems; rehabilitation of small hydropower; development of off-grid or mini-grid supply using renewable energy; and sector reform and institutional development. The objectives of the additional financing are to continue enhancing electricity system efficiency, help improve power quality in selected rural areas, and sustain the reform and institutional development of the country's energy sector.

## Executive Summary

### Program Outputs and Impacts in Fiscal 2007–10

#### INDICATORS AND PROGRESS AGAINST BUSINESS PLAN TARGETS

ASTAE tracks a set of indicators showing the trajectory of its impact in supporting sustainable energy development. The indicators were chosen to convey the predominant trend within each pillar. For each new World Bank project that receives ASTAE support and is presented to the Board of Executive Directors, the impact indicators are accumulated over the business plan period to produce the aggregated indicators described below. These are discussed further in chapter 3.

*Indicator 1: New capacity and increased generation of renewable electricity.* By supporting projects that directly facilitate investments, ASTAE activities led to increased capacity and generation from renewable sources, primarily wind power in China and geothermal power in Indonesia. These projects, once implemented, are expected to directly install 1,030 MW of renewable energy that will generate 1,579 GWh every year—158 percent of the original ASTAE target.

*Indicator 2: Electricity savings resulting from efficiency improvements.* Annual savings estimates are calculated based on direct savings through World Bank loans. The ASTAE business plan's targets for both direct and indirect annual electricity savings have been exceeded. Direct savings will be 1,586 GWh annually—150 percent of target. Most results are achieved in Vietnam and China.

*Indicator 3: Households with access to modern energy services.* Access to electricity remains the major component of the indicator, but space heating is also represented in Mongolia, as well as improved cooking stoves and biogas

in Cambodia and Timor-Leste. The largest contribution was provided by the rural electricity energy project in Vietnam.

Direct targets have been met, with ASTAE-supported World Bank projects financing improved services to two million households (four times the target of 500,000) and new access to modern energy services to an additional 648,450 households (130 percent of the target of 500,000).

*Indicator 4: Avoided greenhouse gas emissions.* This indicator estimates the quantity of CO<sub>2</sub> emissions that would be avoided over 20 years (the conventional lifespan of projects or equipment) through ASTAE-supported World Bank projects. The CO<sub>2</sub> targets have been met. The direct impact value is estimated at 114 million tons of CO<sub>2</sub>, or 163 percent of the original target, and the indirect savings are estimated to be 1,097 million tons of CO<sub>2</sub>, or 141 percent of the target.

*Indicator 5: Countries benefiting from ASTAE support.* This indicator ensures that ASTAE resources are used in a balanced manner across all ASTAE countries, giving equal funding opportunities to large countries (Indonesia, China, and Vietnam) as well as to smaller countries (Pacific Islands). ASTAE financed activities in 13 countries and many regional activities.



## 1. Overview of the ASTAE Program

**DURING THE LAST TWO DECADES, ASIA RECORDED EXCEPTIONAL ECONOMIC GROWTH, LIFTING MILLIONS OF PEOPLE OUT OF POVERTY AND EMERGING AS ONE OF THE WORLD'S MAJOR ECONOMIC ENGINES ALONGSIDE EUROPE AND NORTH AMERICA.**

As a consequence of this growth, many countries in the region have experienced high and accelerating fossil fuel consumption. This has led to substantial growth in the carbon dioxide (CO<sub>2</sub>) emissions that make up the largest share of greenhouse gases. Yet at the same time, hundreds of millions of people in the region still lack access to modern energy services and cannot enjoy the related health, social, and economic benefits that could improve their quality of life.

### WHY ASTAE?

According to the U.S. Department of Energy's Energy Information Administration (EIA), which tracks world energy statistics, the Asia and Pacific region's CO<sub>2</sub> emissions from consumption of energy increased 68 percent between 2000 and 2008—more than two times faster than the world average. While there are other sources of greenhouse gas emissions, it is commonly acknowledged that the utilization of fossil-fuel-based energy remains by far the largest and central origin of emissions. With 128 percent growth during this period, China became in 2007 the world's largest source of CO<sub>2</sub> emissions, ahead of the United States. In 2008, it emitted 6.5 billion tons—21 percent of the world's total. Today, while Vietnam, Indonesia, Thailand, and India are still far behind in terms of absolute greenhouse gas emissions, their emissions growth rates are much higher than the world average.

However, the growing consumption of energy is not evenly distributed among households across the world. Accessing and consuming modern energies remain very concentrated both among and within countries. While the access challenge might seem greatest in Africa, the sheer size of Asia's population indicates that it cannot be ignored. The United Nations estimates that more than half of 1.4 billion people are still without access to electricity live in developing Asia,

400 million of them in India. Similarly, over 70 percent of 2.3 billion people that still rely on biomass for cooking live in developing Asia. The lack of access to modern energies hinders human and economic development opportunities, puts an often unsustainable pressure on local natural resources, and contributes to local and global pollution. The human cost is real: the World Health Organization estimates that 600,000 premature deaths annually are related to cooking using biomass in the East Asia region alone. The gender dimension of that sobering fact should also be noted, as cooking-related indoor air pollution disproportionately affects women and children.

These access and consumption issues have led the world community to engage in expanding the utilization of renewable energies while promoting a more efficient utilization of energy in general, and to call for universal access to modern energies. These issues constitute the three pillars on which ASTAE builds its development work.

### Brief History, Challenges, Beneficiaries, and Donors

The Asia Sustainable and Alternative Energy Program (ASTAE) was established in 1992 by international donors as a three-year pilot program with the objective of "mainstreaming" alternative energy in the World Bank's lending and technical assistance operations in the South Asia and East Asia and Pacific Regions.

ASTAE grew out of the Financing Energy Services for Small Scale Energy Users (FINESSE) Project, initiated in 1989 by the Energy Sector Management Assistance Programme (ESMAP) and bilateral donors, including the U.S. Department of Energy, the Netherlands Directorate General for Development Corporation (DGIS), and the United Nations Development Programme (UNDP).

ASTAE's original target was to increase the share of alternative energy in Bank lending to the power sector in Asia to 10 percent of total power sector lending. This goal was achieved during the fiscal 1997–2000 business plan period. ASTAE's life was extended by mutual agreement among the Bank and donor countries. It was redefined from a unit to a program in 1998, and has been merged with the East Asia Energy and Mining Development Sector Unit, while continuing to provide support to South Asia.

### Leverage on Bank Operations

ASTAE's original task to promote the utilization of alternative energy included energy efficiency and renewable energy, which formed ASTAE's two original pillars. To ensure a strong operational focus, ASTAE was implanted directly into the regional operation level rather than at the central level

ASTAE began its work by providing supplemental funding to forward-looking World Bank Task Team Leaders eager to undertake small peripheral tasks to help address alternative energy-related issues encountered during the development of their projects. This was often done through the addition of an alternative energy-specific component to a broader energy project. As these ASTAE-funded activities increased in number and delivered positive impacts on regional development objectives, renewable energy and energy efficiency activities eventually became standalone projects as opposed to components of a project. These projects were often supported by Global Environment Facility (GEF) financing. ASTAE's operational success led its donors to replenish the trust fund at the end of each business plan period. Alternative energy, a fringe activity when ASTAE was created, has evolved into one of the Bank's main lending themes, exceeding 40 percent of energy commitments in fiscal 2009.

### Scale-Up and Expansion

In 2002, ASTAE started a scale-up phase. Scaling up entailed continuing its mission of mainstreaming alternative energy, as well as expanding its reach from within the World Bank to the client countries' stakeholders themselves, and broadening its core business from alternative energy to sustainable energy by adding a third pillar—access to modern energy services—designed to address energy poverty and its impact on the environment. Scaling up also meant departing from project-to-project activities to a more programmatic approach at the sector or country scale. During this transition, ASTAE focused primarily on the East Asia and Pacific Region.

As ASTAE's funding and scope expanded, measuring its reach and impact became more challenging; a broad set of indicators was designed to assess progress toward fulfilling its three pillars. These sustainable energy indicators—access to modern energy services, increased use of renewable energy, and improved energy efficiency (described later in this chapter)—track progress made through ASTAE activities, both as a direct result of related World Bank loans and as an indirect result of ASTAE-funded technical assistance to country stakeholders.

### Achievements and Beneficiaries

Since its inception, ASTAE has directly contributed, through its leverage on World Bank-funded projects, to installing about 1,900 MW of renewable energy—nearly the equivalent of the combined installed capacity of the Lao People's Democratic Republic, Mongolia, and Cambodia (EIA 2007). It has helped avoid the generation of about 65 TWh of electricity through energy efficiency, the equivalent of Vietnam's total generation in 2007. It has also contributed to providing new access to modern energy to more than 2.5 million households in Asia, or about the equivalent of the population of Cambodia (13.5 million people with an average household size of 5.3).

These quantifiable achievements have resulted in substantial mitigation of global greenhouse gas emissions, as well as significant decreases in local pollutant emissions that directly and adversely affect the health of the local population. Estimates indicate that the projects ASTAE has supported to date will prevent the emission of 360 million tons of CO<sub>2</sub> over the projects' 20-year lifetimes, equivalent to the 2008 emissions of Thailand and Vietnam combined.

Furthermore, during the scale-up phase of the last six years, ASTAE's indirect impact, through its influence on country stakeholders' investment decisions, has had an even wider reach. While ASTAE is only one of many players at the country level, it contributed to concerted efforts focusing on renewable energy development that led to an additional 17,000 MW installed in the region, and additional potential energy savings of up to 50 TWh annually—the equivalent, respectively, of the Philippines' total installed capacity and annual generation in 2007.

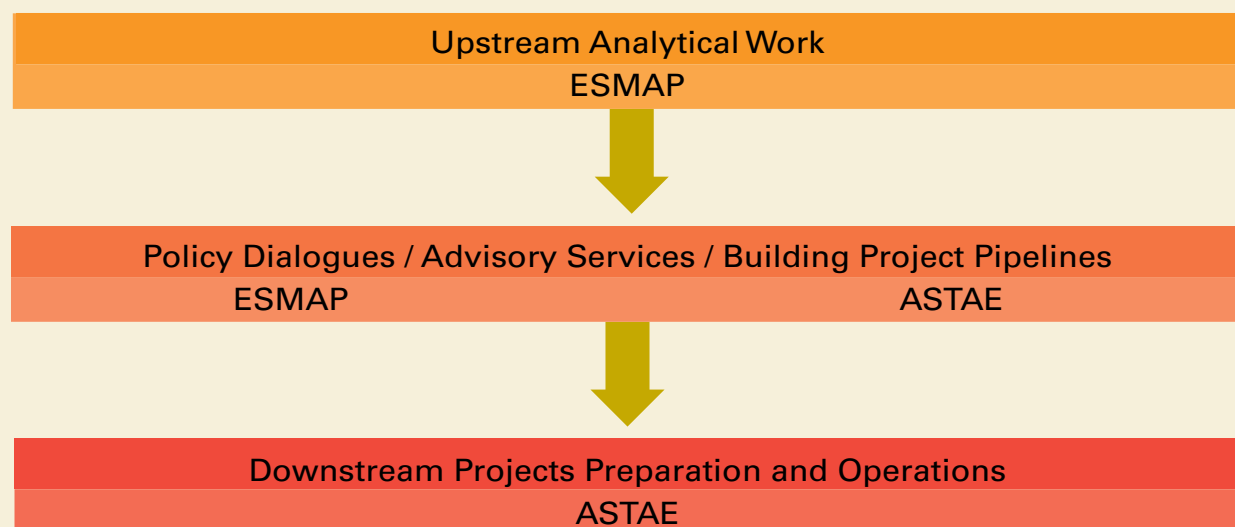


### BOX 1.1 ASTAE’s Active Cooperation with Other World Bank Trust Funds

ASTAE actively coordinates with other World Bank trust funds covering Asian countries. It seeks to avoid overlapping efforts, as well as to ensure that funds from donors are coordinated to complement each other and improve aid effectiveness in the energy sector in order to ensure optimal services to the client countries.

The Energy Sector Management Assistance Program (ESMAP) is the main trust fund with which ASTAE cooperates on a regular basis. ESMAP funds can provide support to upstream analytical and advisory activities that help determine a client country’s overarching strategy, or identify a specific sector issue for which ASTAE can provide funding to adapt the analysis to operational requirements and support preparation of a corresponding World Bank project.

For example, ESMAP will support upstream work, such as broad policy and technical studies, that may not necessarily be linked to a country program, yet may provide knowledge and suggest potential directions for policy dialogue. ASTAE then follows up, relays, and helps operationalize the results of ESMAP’s upstream work. Furthermore, ASTAE supports downstream work and country operations such as lending and grant projects. ESMAP and ASTAE sometimes work together to incorporate results and build project pipelines, where ESMAP’s global knowledge and upstream work must be applied to develop and prioritize projects in the country program.



Other important trust funds with which ASTAE cooperates, either directly in cofinancing or in parallel financing, include the GEF, the Public-Private Infrastructure Advisory Facility (PIIAF), the Clean Technology Fund (CTF), and the Global Partnership on Output-Based Aid (GPOBA). Cross-regional ties are also being established with Africa Renewable Energy Access (AFREA), a trust fund similar to ASTAE established in 2009.

## OBJECTIVES AND DELIVERY MECHANISMS OF ASTAE

ASTAE's stated objective is to scale up the use of sustainable energy options in Asia to protect the environment and reduce energy poverty.

### Three Pillars to Support Sustainable Development

#### A Trend of Unsustainable Development

Asia accounted for a large percentage of the growth in global demand for energy during the last two decades, with China's and India's shares of that percentage continuously expanding. The International Energy Agency (IEA) expects that the region will continue to account for about 30 percent of global energy demand growth until 2020.

In the power sector, coal, with a share of about 75 percent, will likely continue to dominate generation, with oil and gas at around 10 percent each. While China sets the pace, other countries, such as Bangladesh, India, Indonesia, and Vietnam, have rapidly rising, medium-term needs for additional generation capacity to sustain their economic growth. With the dominance of traditional fossil fuels as the primary generation option, and numerous obstacles to positioning renewable energy sources as credible and reliable base-load substitutes, the power sector is expected to remain a large contributor to greenhouse gas emissions. Other energy subsectors, such as heating, also contribute substantially to local and global environmental issues.

Despite impressive achievements in Asia to increase total installed generation capacity (for example, Vietnam increased its installed capacity by 6,400 MW [69 percent] between 2003 and 2008, a large segment of the population, primarily those living in rural and remote areas, have not benefitted from this growth. East Asia and Pacific Region's rate of unelectrified households remains approximately 12 percent, a low percentage compared with Africa, but still sizable considering that it affects 170 million people. In the South Asia Region, overall access to electricity remains lower, with about 40 percent of households across the region unelectrified and nearly 600 million people affected.

When taking into account heating fuels, whether for cooking or space heating, the numbers are of an order of magnitude higher, with well over 2.1 billion people in Asia dependent on polluting solid cooking fuels—primarily wood, charcoal,

coal, and dung. Unlike for electricity, the numbers are almost evenly split between East and South Asia, showing that the scale and importance of the cooking fuel challenge has not yet been perceived by the authorities. Consequences are real however, from health, gender and environmental points of view, including contribution to premature deaths, especially among women, increased local pollution, and contribution to global warming through emission of black carbon. Moreover, population growth can stretch the demand for traditional fuels (wood, charcoal, straw) beyond their regeneration capacities.

#### Countering the Trend

ASTAE has responded to these human and environmental challenges. Its efforts to champion sustainable development in the Asian energy sector reside in three pillars.

##### *First Pillar: Renewable Energy*

Supporting energy generation growth by means of renewable energy technologies slows the depletion of natural resources, limits global environmental damage, and can contribute to the substitution of domestic resources for imported ones. Renewable energy resources include hydroelectric power, biomass, wind, geothermal, and solar energy. Several countries in the region have set ambitious targets for renewable energy generation, but much remains to be done to reach these targets.

##### *Second Pillar: Energy Efficiency*

Given that most energy today is generated from finite fossil fuels, using less energy to reach the same desired outcome is an effective way to contribute to sustainable development. Energy intensity per unit of GDP produced is high in most Asian countries, which indicates that room for efficiency improvements exists in all sectors of the economy. Energy-efficiency improvements can be in electricity generation, energy demand management, central heating, or individual stove use. Efficiency in the energy sector is the primary target, but ASTAE also reaches out across sectors to promote this agenda, with examples of work done in water, buildings, and transport sectors.

##### *Third Pillar: Access to Modern Energy Services*

Access encompasses new access (for example, connecting a previously unelectrified household) and improved access (for example, construction of a biogas stove to replace charcoal for

cooking). Access to modern energy can significantly improve the quality of life for end users, providing benefits such as light, heat, and power for electrical appliances and tools in a much more efficient and less polluting fashion than the displaced resources, often at a fraction of the cost. While in the past decade, some countries, such as China and Vietnam, have made dramatic progress in providing electricity access to their citizens, others lag far behind. Additionally, most countries in the region have insufficiently tackled the negative impacts of using the traditional domestic heating fuels, whether for cooking or space heating, and have lagged in devising strategies to transition households to modern fuels or to improve the efficiency and cleanness of traditional fuels.

To track the contributions and achievements of ASTAE-funded activities relative to each pillar, pillar-specific indicators have been defined (detailed later in this chapter). These help monitor annual progress against specific targets defined for each business plan period. Over time, ASTAE has expanded its monitoring from only input-based indicators (linking ASTAE funding to World Bank lending) to output-based indicators (that is, final impacts delivered through ASTAE's lending, measured in megawatts, gigawatt-hours, or number of connections).

## Mode of Operation: Approaches, Support Mechanisms, and Structure

### Close Collaboration with Donors

The key to ASTAE's success is its dual partnership model—partnering with World Bank task teams to undertake the operational aspects of its activities and partnering with its donors to determine and fund its strategic goals. The resulting synergy allows all parties to explore and seize opportunities to achieve common goals, that is, ASTAE's mission. Donor countries, including the Netherlands and Sweden, Canada, Finland, Switzerland, the United Kingdom, and the United States, have over the years endowed ASTAE with block grant funding that advances the agreed-upon themes and targets. In turn, ASTAE provides Task Team Leaders with resources that are then used to support important activities in a timely and flexible way, and ultimately help demonstrate the validity and feasibility of integrating sustainable energy into the Bank's project portfolio. As ASTAE management is located in the regional operational unit, decisions on which proposed activities to be funded fully reflect the country or regional assistance strategy and the priorities of the country or regional assistance program, while at the same time aligning with donors' overarching priorities.

The ASTAE Trust Fund covers only a small portion of the costs of project preparation or technical assistance to client countries. However, the strategic use of these funds enables far greater impact than otherwise would be possible on which projects enter the World Bank pipeline and on the dissemination of operational experience. ASTAE also cooperates with other World Bank donor trust funds to ensure optimal use of donor funding.

### Organized to Deliver

To reinforce the effectiveness of its three pillars promoting sustainable development and to achieve substantive results, ASTAE's overall strategy is to focus on supporting program development and project implementation in World Bank operations, that is, "downstream" activities.

Three approaches—innovative investment delivery mechanisms, improved policy and regulatory frameworks, and effective knowledge sharing—characterize ASTAE's operational means of implementing its overall strategy.

ASTAE provides a wide range of support mechanisms, such as early program and project identification work, quick response and troubleshooting, project-related capacity building, and funds mobilization.

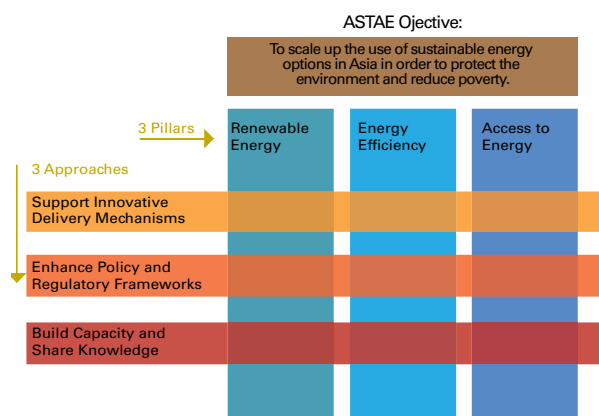
These support mechanisms are provided by ASTAE staff and World Bank Task Team Leaders. Their constant interaction forms the backbone of ASTAE's operational structure. Other important elements of the structure include the Consultative Group on World Bank Energy Trust Funds, representing donor countries, and a Technical Advisory Group that evaluates ASTAE activities on an annual basis and reports to the donor community represented in the Consultative Group.

### ASTAE Approaches

Financing for sustainable energy is available through many avenues, although the complexities of fund allocation and recipient designation for each financing option make finding the right channel a challenge. ASTAE seeks to provide practical and operational solutions to obstacles created by lack of awareness, institutional blockages, or inadequate delivery mechanisms.

The connections among the ASTAE objective, the three pillars, and the three approaches are shown in figure 1-1 on the next page.

**Figure 1-1: Interlinking Objective, Pillars, and Approaches**



### **Improved Policy and Regulatory Frameworks**

ASTAE supports the development of institutional and regulatory frameworks. Allocations to this approach have grown steadily since initiation of the scale-up phase, because framework development is well suited to the needs of programmatic schemes that can be scaled up. Today, around 48 percent of ASTAE funding is primarily linked to institutional and regulatory framework development that primarily supports specific projects with impacts that are replicable, scalable upwards, and sustainable. ASTAE provides an enabling environment through improved policy, financial, and regulatory frameworks; this helps attract capital from international financial institutions, export credit agencies, and the private sector.

Recent work includes high-level policy dialogues and advisory support (geothermal energy in Indonesia, access in Timor-Leste); pricing policy and regulation (access in Mongolia); design and implementation of standards (energy efficiency in Thailand and Vietnam); and assessment of the social impacts of reform (access to electricity in India).

### **Innovative Investment Delivery Mechanisms**

ASTAE helps introduce innovative financing delivery mechanisms; this was a major approach in ASTAE's work during its initial years, as mechanisms designed for conventional energy investments did not fit the needs of ASTAE's intervention areas and had to be adapted. As sustainable energy projects became more mainstreamed, related markets matured and projects became more complex and sophisticated. ASTAE continues to provide innovative financing delivery mechanisms, but the share of this approach has decreased to around 15 percent of allocations in the current business plan. This approach is carried out either by supporting design, build-up, and testing of new mechanisms from the start, or by helping to introduce existing mechanisms and tailoring them to the specific context of a new host country.

Recent examples of improved investment delivery mechanisms include developing on-lending guidelines for commercial banks (done for an energy-efficiency project in China), structuring on-lending funds (for example, renewable energy in Vietnam), and transferring business models among neighboring countries (energy efficiency from China to Vietnam). Delivery mechanisms can also apply to organizational, technical, and business models that can facilitate development and scale-up of an activity (cookstoves model production facility in Cambodia).

### **Knowledge Sharing**

ASTAE supports capacity building and knowledge sharing. They are at the core of ASTAE's mission, in the sense that knowledge sharing underpins the success and effectiveness of the other two approaches. Around 37 percent of ASTAE's allocations in the current business plan are primarily focused on knowledge sharing, and 60 percent of activities include this dimension as secondary. As a result of its positive outcomes in project and program design, implementation, and replication, ASTAE is able to draw upon a pool of expertise and consolidate its knowledge base to provide just-in-time advice to other groups engaging in the same activities across the region. The knowledge-sharing approach can be run as a stand-alone activity or as an integral part of a project if the need for capacity building or knowledge sharing goes beyond normal project-related expectations.

Recent work includes training seminars for officials and policy makers (Mongolia, Indonesia, Thailand, and Bangladesh); workshops to share technical knowledge between countries (China and Vietnam); knowledge products, technical guides, methodologies, and atlases made available nationally and internationally; dialogue facilitation with the nongovernmental organization community; and donor coordination.

## ASTAE Support Mechanisms

ASTAE provides depth of knowledge and flexible, just-in-time funding to successfully shape the design of new projects and programs, to help implement them, or to adapt them to rapidly evolving conditions. ASTAE's presence in most Asian countries has helped enable cross-fertilization among different operations, to develop a strategic, programmatic approach to broadening the impacts of investment projects. This cross-cutting position, in turn, has helped create enabling environments in which ASTAE shares best practices to improve institutional, policy, financial, and regulatory frameworks in recipient countries. The seven support mechanisms described below are often provided in conjunction with other partners, trust funds, and donors, so the activity benefits from the comparative advantage of each player.

### *1. Early Program and Project Identification Work*

Best practices and new business models for alternative energy and access deployment are still being established; ASTAE helps support the development of this global knowledge base. Renewable energy is now a feasible technology model, but best practices on alternative energy deployment are among those still being established. Large populations in Asia remain without access to electricity. This indicates that current business models of delivery still need adjustments or improvement to serve these populations. Households' needs, what they can afford, and their readiness to adapt to innovative technologies may be unknown. ASTAE support to Task Team Leaders and stakeholders is critical in assessing and overcoming these barriers.

### *2. Program and Project Development and Implementation Work*

For especially complex or innovative projects and programs, ASTAE can provide planned or unplanned support during identification and implementation. ASTAE support is provided only when circumstances require additional budget or expertise that are above and beyond normal project funding.

### *3. Quick Response and Troubleshooting*

ASTAE provides just-in-time response to support the urgent needs of Task Team Leaders during project development (for example, responding to stakeholders' specific issues and identifying market segments) and supervision (for example, troubleshooting unexpected regulatory barriers). ASTAE's flexibility in taking on such issues on short notice has proven

indispensable in devising and delivering solutions that prevent projects from being halted.

### *4. Project-Related Capacity Building*

When capacity-building needs go beyond the reasonable expectations of normal project preparation or implementation (for example, strengthening capacity of new counterparts due to unexpected political changes), ASTAE can provide assistance with training programs, workshops, consensus-building conferences, twinning, study tours, and access to subject matter advisors.

### *5. Funds Mobilization*

ASTAE provides assistance to Task Team Leaders in mobilizing additional funds by helping to clarify funding requirements for a given sustainable energy project. Careful use of a relatively small amount of ASTAE support can persuade new partners to join, leveraging initial financing levels to magnify the impacts that they would have had in the absence of the additional partners.

### *6. Global Knowledge Interface*

Early barriers to a project including a sustainable energy component are often lack of awareness of an alternative option or technology and lack of understanding of how the option can be implemented. Providing support to Task Team Leaders or stakeholders to raise awareness is the first step in addressing this barrier. Such support is provided upstream or midstream during the project cycle—when existing expertise is made available through ASTAE's network of subject matter consultants—and downstream when the new information generated by the project or the ASTAE activity is analyzed, monitored, and packaged for dissemination. ASTAE's monitoring and evaluation of project or program impacts is becoming an increasingly important task.

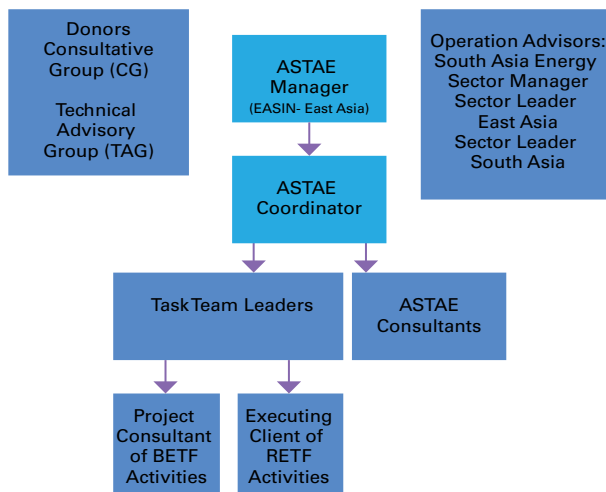
### *7. Impact Monitoring & Evaluation*

ASTAE's monitoring and evaluation of project or program impacts are increasingly necessary to ensure that new information generated by projects or ASTAE activities is analyzed and packaged to be imparted to others. Given its long experience in supporting sustainable energy projects, ASTAE is well positioned to commission ex post studies and analysis of its past projects to capture and share lessons learned that may be of great value to other countries.

## ASTAE Structure

The ASTAE management structure, shown in figure 1-2, includes both functional and hierarchical interactions.

Figure 1-2: ASTAE Management Structure



### Hierarchical Structure

As ASTAE is embedded within the World Bank East Asia and Pacific Infrastructure Unit (EASIN), the Infrastructure Sector Manager also serves as the ASTAE Program Manager and coordinates with the South Asia Manager whenever needed. The ASTAE Coordinator is a World Bank staff member who provides day-to-day operational and administrative supervision of the ASTAE program, supports Task Team Leaders, acts as a liaison with donors, and coordinates with local counterparts.

ASTAE can also employ local staff in the Bank's partner-country offices to gain better insight into country-specific challenges and to support project implementation. A part-time budget administrator supports the ASTAE coordinator in monitoring financial information.

### Functional Structure

The contributions of three types of contributor (darker boxes in figure 1-2) complement ASTAE's efforts within the ASTAE framework:

- *Donors* set the agenda for the specific funding lines made available to ASTAE, and as members of the Donors Consultative Group, help the ASTAE Program Manager guide the program. They receive support from the Technical Advisory Group, which includes specialists with expertise in each ASTAE pillar. Depending on specific trust funds' agreements, donors may provide non-objection to ASTAE activities that require allocations above a predefined ceiling.

- *Task Team Leaders* are World Bank staff who identify needs for ASTAE funds to support sustainable energy in their spheres of activity and submit requests for funding. Each proposal is evaluated on its expected contribution to ASTAE objectives, the availability of alternate funding, and the novelty or complexity of the project to be assisted. Once an activity is approved, Task Team Leaders are responsible for its timely, cost-effective, and high-quality delivery. ASTAE funds are used to cover the incremental costs of developing pillar-related activities that go beyond the standard preparation and supervision costs covered by World Bank budgets.

- *Consultants* are hired by Task Team Leaders, using ASTAE-allocated funds, to carry out the necessary tasks for the implementation of the ASTAE activity. Consultants may be activity-based—that is, hired for a given duration to undertake activity-specific assignments for specific project-related tasks—or program-based. Program-based consultants often provide more direct support to Task Team Leaders for project preparation and implementation, as well as support for the management of ASTAE-related activities. Consultants can be individuals or firms. Standard Bank procurement rules are applied to all ASTAE-funded activities.

## PERFORMANCE AND TARGETS

ASTAE provides funding allocations to Task Team Leaders who have substantiated the nature of the incremental activities they will undertake, the related costs, and the expected impacts. The activities are then carried out, yielding outputs that, whenever possible, are recorded and formatted for knowledge sharing. In addition to tracking these outputs, the progress toward ASTAE program objectives is measured against a set of indicators and targets developed to reflect the objectives outlined under the three ASTAE pillars. The collective contribution of all activities to reaching ASTAE targets is measured annually.

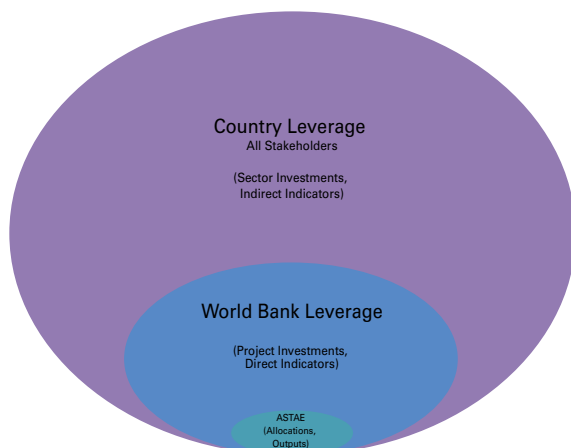
### Tools for Leverage

Budget, allocations, and outputs are the elements over which ASTAE has direct control and with which it measures its administrative effectiveness. The smallest ring of influence and impact in figure 1-3 represents this sphere.

Leverage indicators and their related targets are beyond ASTAE’s direct control, but within its capacity to influence. In ASTAE’s early years, leverage of World Bank operations was the chief indicator monitored. It was measured by tracking the dollar amounts of World Bank loans allocated to ASTAE pillars. Measuring the leverage of Bank operations today consists of quantifying actual impacts in addition to lending amounts. The impact on Bank lending is considered direct, because the support to Task Team Leaders in project design or implementation directly results in improved operations and, therefore, impacts. These direct impacts are represented by the middle ring in figure 1-3.

Broader leverage, at a country’s sector level, is far more difficult to measure; direct attribution to one activity or player should be made cautiously. However, once a decision to acknowledge ASTAE’s contribution is made, some formal assessment of related impacts in the field is necessary to gauge whether funds have been used efficiently. The impacts and indicators used to inform this assessment are derived from activities and programs that support enabling legislation, decrees, or behavior modifications by key stakeholders that could result in large-scale effects on the three ASTAE areas of intervention. This leverage is represented by the larger ring of influence and impact in figure 1-3.

**Figure 1-3: ASTAE Influence and Impacts at Different Levels**



### Budget, Allocations, and Outputs

ASTAE’s budget is agreed upon with donors on a three- to four-year basis, normally covering one business plan period. ASTAE’s business plan discusses its goals and focal areas, as exemplified in this chapter for the 2007–09 business plan period. ASTAE then comes to an agreement with its donors on the budget necessary to undertake its defined mission and on a set of indicators to measure its success in leveraging its funding to influence stakeholders’ commitments to the ASTAE pillars. The budget allocated to ASTAE during the original 2007–09 business plan period was US\$7.4 million, complemented by additional funding that raised the budget to US\$9.3 million and permitted extension of the business plan period into fiscal 2010.

As noted earlier, ASTAE allocations are provided to Task Team Leaders based on the merits of their proposals to undertake activities supporting ASTAE’s pillars. Activity duration varies according to the nature and complexity of the tasks involved, but most are completed in one or two years. In the 2007–10 extended business plan period, ASTAE allocated an average of US\$90,000 to each of 63 activities, with most allocations ranging between US\$50,000 and US\$250,000.

ASTAE activities deliver outputs under multiple formats, depending on the audience targeted. These outputs vary from stakeholder-specific notes (confidential policy notes, country strategies, or draft standards and labels, for instance), to broad public case making (population awareness and project information). Outputs are discussed at stakeholder meetings, workshops, and conferences, and whenever suitable, are also published, printed, and widely distributed to a broad audience, including through ASTAE’s Web site.

### Indicators and Targets

Five indicators track the impacts of ASTAE-supported activities on advancing the development of sustainable energy. Three indicators are related to the pillars renewable energy, energy efficiency, and access to modern energy services; two cross all pillars.

ASTAE pledges to achieve specific targets for these indicators by the end of each business plan period. Target achievement is measured both as a direct result of related World Bank loans and as indirect impacts of World Bank and ASTAE technical assistance to stakeholders in client countries.

Most activities contribute to the indicators’ targets. Estimated values for direct indicators are derived directly from World Bank project information documents, project appraisal documents,

and formal ASTAE proposals. Because final figures can only be known years after the end of a project, initial values are target estimates. Although indirect impacts, too, are difficult to attribute, ASTAE identifies published sources (such as project information documents, project appraisal documents, and midterm reviews) that provide information on the indirect benefits of ASTAE-funded activities.

***Indicator 1: New capacity and increased generation of renewable electricity***

The first indicator measures the contribution of ASTAE activities to increasing utilization of renewable energy in client countries. New renewable energy generation capacity is expressed both in installed capacity, to reflect the actual investments made, and in actual energy generation indicators, expressed in gigawatt-hours (GWh), to reflect actual utilization of the installed capacity. The relationship between a megawatt of renewable capacity installed and the number of GWh generated (and, therefore, the quantity of fossil fuel not used) differs from one project and one country to another because capacity factors and dispatch rules vary from one technology or country to another.

More specifically, this indicator integrates two subindicators: (1) new installed capacity in renewable energy (in megawatts, all technologies included); and (2) estimated quantity of electricity generated annually resulting from using the added renewable energy capacity (in GWh).

In the 2007–09 business plan, targets were set for the second subindicator only, with a set objective that by the end of the business plan, ASTAE-supported projects would have directly contributed to the annual generation of 1,000 GWh and indirectly contributed to the annual generation of 10,000 GWh.

***Indicator 2: Electricity savings resulting from efficiency improvements***

The contributions of ASTAE activities to saving energy through efficiency improvements are also measured. Energy-efficiency improvements can result in reduced peak load demand (and thus reduced or deferred investments) and in decreased consumption of energy (less fuel used for an equivalent level of services or output provided). The electricity and heat-generation sectors record the most energy savings. A transformation coefficient is used to convert all savings, including of heat, into equivalent GWh of electricity. Efficiency improvements resulting in avoided capacity can provide relief to a constrained system, but a given megawatt of avoided

capacity can result in different energy savings, depending on the type of fuel utilized and country conditions.

More specifically, this indicator is the estimated annual quantity of electricity saved (in GWh) resulting from the efficiency improvements.

In the 2007–09 business plan, targets were set so that ASTAE-supported projects would contribute to continuing annual savings of 1,000 GWh directly and 10,000 GWh indirectly.

***Indicator 3: Households with access to modern energy services***

The third indicator measures the improvement in quality of life as households transition from traditional fuels (such as charcoal, wood, and dung) or inadequate modern fuels (such as kerosene for lighting) to modern, clean, and sustainable energy sources. When switching fuels is not possible or desirable, the indicator measures the improvement in delivery of energy services resulting from the project, such as improved quality or reliability of an electricity connection (for example, fewer blackouts and brownouts) or improved efficiency of a given activity (for example, using improved stoves to decrease wood consumption).

More specifically, this indicator comprises four subindicators: (1) the number of households receiving new access directly resulting from a Bank project; (2) the number of households receiving improved services directly from a Bank project; (3) the number of households receiving new access indirectly from a Bank project; and (4) the number of households receiving indirect improved services indirectly from a Bank project.

In the 2007–09 business plan, targets were set so that ASTAE-supported projects would contribute to (a) 500,000 households receiving new access directly; (b) 500,000 households receiving improved services directly; (c) 50,000 households receiving new access indirectly; and (d) 250,000 households receiving improved services indirectly.

***Indicator 4: Avoided greenhouse gas emissions***

The indicator for avoided greenhouse gas emissions cuts across the previous three pillar-specific indicators. Utilization of renewable energy and implementation of energy-efficiency measures directly decrease greenhouse gas emissions. Access to modern energy services has a more complex effect. In increasing access, some renewable fuels (wood, for example) may be displaced by fossil fuels, thus increasing



emissions, but at the same time increasing caloric efficiency or improved sustainability of resources (less deforestation, for instance). The two effects may offset one another. As a result of that uncertainty, the indicator for avoided greenhouse gas emissions is based primarily on the first two indicators. This indicator, as well as the energy efficiency-related indicator, is often achieved through cross-sector work, such as when ASTAE funds projects in the water or transport sector.

More specifically, this indicator estimates the quantity of CO<sub>2</sub> emissions avoided over 20 years (the conventional lifespan of projects or equipment) through renewable energy generation and energy savings registered under indicators 1 and 2.

In the 2007–09 business plan, targets were set so that ASTAE-supported projects would contribute to emissions avoidance over 20 years of 70 million tons of CO<sub>2</sub> directly and 780 million tons of CO<sub>2</sub> indirectly.

***Indicator 5: Countries benefiting from ASTAE support***

An indicator for equitable support was added because the four indicators above can be met most simply by concentrating ASTAE interventions in larger countries. However, ignoring small countries is inequitable and prevents regional cooperation and sustainable development in the region as a whole. In addition, in some countries, small-scale project operations rather than broader national policy programs are still the norm. While such projects may not add much quantitatively to the first four indicators, they have a large impact on the quality of life of local populations.

The requirement for this indicator in the 2007–09 business plan was that a minimum of 10 countries receive ASTAE support.



## 2. ASTAE-Supported Activities During Fiscal 2010: Expenditure and Country Updates

IN FISCAL 2010, ASTAE PROVIDED FUNDING FOR 21 ACTIVITIES IN 12 COUNTRIES, MEETING ITS COMMITMENT TO DIVERSIFYING ITS ACTIVITIES AND RECIPIENT COUNTRIES.

### ASTAE DISBURSEMENTS AND ACTIVITIES IN FISCAL 2010

In fiscal 2010, ASTAE activities were endowed from two trust funds:

- The Government of the Netherlands Trust Fund for ASTAE from the Bank-Netherlands Partnership Program (BNPP) (TF057088); and
- The Swedish International Development Agency (SIDA) Trust Fund for ASTAE (TF091618).

### Overview of Disbursements and Budget Leverage

During fiscal 2010, ASTAE disbursements reached a total of US\$2,123,893; with a mild 2 percent decrease over last year, disbursements were essentially stable.

#### Overview of Disbursements

In fiscal 2010, ASTAE provided funding for 21 activities in 12 countries, meeting its prior year commitment to diversifying its activities and recipient countries. One-third of these activities began disbursement this year and three activities (in Cambodia, Lao PDR, and Indonesia) received additional funding for a subsequent phase to reinforce the successful impacts of an activity begun in the prior year.

Consistent with the agreement with its donors, ASTAE funds are primarily allocated to support activities, with the remainder used for administrative and reporting purposes (table 2-1). ASTAE disbursed US\$1,726,905 toward project implementation in fiscal 2010, or 81.3 percent of its total disbursements; this is explained in further detail in the next section. The remainder of the budget was used to cover administrative and reporting costs.

**Table 2-1: FY2010, Major Disbursement Categories**

Disbursement category	Amount (US\$)	Percent
<b>PROJECT-ASSIGNED DISBURSEMENTS</b>		
Country-specific	1,391,481	65
Regional projects, knowledge sharing	335,423	16
<b>CROSS-CUTTING DISBURSEMENTS</b>		
Reporting	158,726	8
Administration	238,262	11
<b>TOTAL</b>	<b>2,123, 893</b>	<b>100</b>

Administrative costs, including ASTAE staff costs and administrative support provided by World Bank assistants, decreased by 39 percent compared to fiscal 2009, to US\$238,262. This decrease brings non-activity costs well below the ceiling agreed with ASTAE donors, while keeping levels of disbursements close to the levels in fiscal 2009.

Reporting costs, which include service by the Technical Advisory Group, annual reporting, Web site management, and dissemination of reports, remained stable at US\$158,726. These costs, which increased in fiscal 2009, reflect the reorganization of reporting outputs, including streamlining the production and publication of technical reports for activities outputs deemed to be of general interest. The broader distribution of these technical reports and of the annual status report also contribute to creating a visually distinct identity to ASTAE.

### ASTAE Budget-Related Leverage

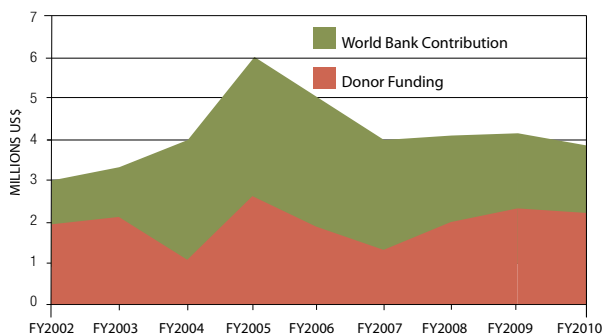
When ASTAE funds activities, the World Bank Group also contributes from its various budgetary sources to help carry out project tasks. This fund matching shows the budget-related leverage that donor funding exercises in influencing World Bank projects.

In fiscal 2010, US\$2,123,893 disbursed from donor trust funds was complemented by US\$1,820,321 from the World Bank, or 54 percent and 46 percent, respectively, of the total US\$3,944,214 allocated to developing sustainable energy as a result of ASTAE-related projects.

It should be noted, as shown in figure 2-1 and detailed in appendix 2, that both the absolute value of resource mobilization and the ratio of World Bank-to-donor contributions vary over the years. The two main reasons for these fluctuations are changes over time in the pattern of donor contributions and variation in the number of sustainable energy projects in the World Bank lending pipeline or under implementation.

For example, the total ASTAE-related budget remained stable during the fiscal 2007–10 extended business plan period, at around US\$4 million per year, while World Bank budgetary support accounted for a larger portion in fiscal 2007 (70 percent) than it did in fiscal 2010 (46 percent). This is in part because there were fewer ongoing ASTAE-supported activities in fiscal 2007—and because those underway had lower funding. Additionally, in fiscal 2010 some ASTAE activities linked to knowledge sharing and cross-fertilization did not receive matching funds from the World Bank's project-related budget.

**Figure 2-1: ASTAE Resource Mobilization, by Origin of Funding**



Overall, since its inception, ASTAE budget leverage has resulted in doubling, to nearly US\$63 million, the identification, development, and supervision budget allocated to sustainable energy by the World Bank in Asia.

This highlights the value of donor funding that enables World Bank task teams to undertake challenging activities for which Bank budgets are normally very limited, but that are nonetheless necessary to identify and prepare future sustainable energy projects to include in the pipeline or to troubleshoot problems in ongoing projects to ensure realization of intended benefits.

### ASTAE Investment-Related Leverage

The budget-related leverage mentioned above results in much greater investment-related leverage once ASTAE-supported projects are appraised, approved, and implemented. In fiscal 2010, four projects that had received ASTAE support were presented to the World Bank Board of Executive Directors, totaling an investment of US\$199 million, of which 65 percent was sourced from IBRD, IDA, or GEF, and the rest from borrowing countries' governments and private sectors.

In fiscal 2010, the US\$2.1 million ASTAE disbursements contributed to US\$199 million in World Bank projects. In short, in fiscal 2010 every dollar of donor resource disbursed by ASTAE resulted in US\$95 in World Bank-related loans or grants to sustainable energy. This dollar leverage amount varies every year, both due to the level of ASTAE disbursements and to the number and size of World Bank projects presented to the Board. Over the fiscal 2007-2010 period, with ASTAE related projects presented to the Board adding to US\$2,202 millions and ASTAE disbursements of US\$7.4 million; the average ASTAE investment-related leverage was US\$298.

### Distribution of Disbursements

ASTAE allocated US\$1,726,905 to project implementation in fiscal 2010, or 81.3 percent of its total disbursements. In order to provide additional analysis of the use of donor funds, ASTAE's project-related disbursements in fiscal 2010 are broken down below according to ASTAE priorities (figure 2-2) and approaches (figure 2-3), and to World Bank classification of activities (figure 2-4) and countries (figure 2-5). This section focuses only on the project-related portion of disbursements; it does not include administrative and reporting disbursements.

**Introductory Note to the Figures**

In figures 2-2, 2-3, and 2-4, the outer circle represents the amount disbursed; the inner ring represents the number of ASTAE activities related to an intervention area, ASTAE approach, or World Bank activity classification. In many instances, an ASTAE activity has several components related to various pillars or approaches, for example, a project promoting both renewable energy and access. Hence, the sum of activities may exceed the total number of activities supported by ASTAE. However, in this report, in order to avoid double counting of disbursements, the entire amount of the activity is attributed to the primary pillar or approach.

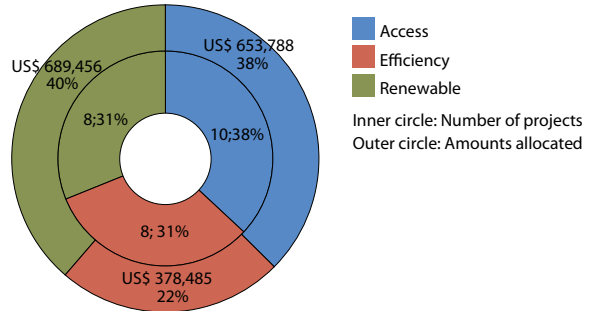
This somewhat distorts the reality, as an ASTAE activity with a 60 percent renewable energy component and a 40 percent access to energy component, for example, is registered in figure 2-2 as 100 percent renewable, but it nonetheless illustrates the overall strong alignment with ASTAE’s core goals. In fact, the reality of ASTAE’s relative disbursements according to pillars (or approaches) lies somewhere between the percentages in funding amounts (where 100 percent is allocated to a given pillar) and the percentages in number of projects (where each pillar mentioned in a specified activity is given the same weight). For example, in figure 2-2, renewable energy represents between 31 and 40 percent of allocations.

This minor imprecision will be eliminated under the upcoming new business plan period, as new and more precise disbursement tracking systems will be put in place.

**Project-Related Allocations, by Pillar**

ASTAE disbursements in fiscal 2010, by pillar (figure 2-2), reflect a good balance among all three pillars in terms of number of activities, and slightly more emphasis on renewable energy and access to energy. The renewable-related activities tend to have higher allocations than those where access or energy efficiency are the primary focus, which reflects ASTAE’s continued commitment to promoting alternative energy. At the same time, allocations to each pillar reinforce each other, as activities often cut across pillars, such as when increasing access to modern sources of energy is incorporated as a subcomponent in energy-efficiency or renewable activities.

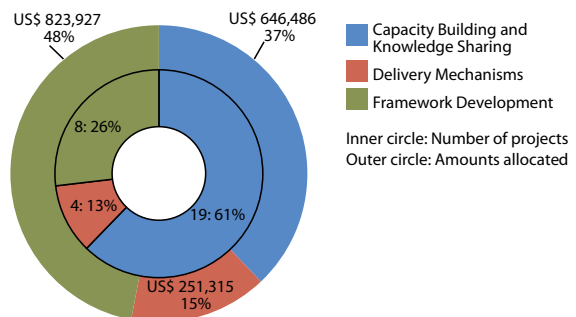
**Figure 2-2: FY2010 Disbursements, by ASTAE Pillar**



**Project-Related Allocations, by Approach**

Disbursement by approach (figure 2-3) shows that capacity building and knowledge sharing are well integrated in ASTAE activities, even if often as a secondary approach. In terms of funding amounts, the approach related to framework development received close to half of the disbursements in support of setting sustainable, development-friendly policies and regulations in partner countries through specific projects to promote scaled-up and lasting impacts. This confirms ASTAE’s shift from a project-based delivery mechanism approach (core to ASTAE’s early work) to program-focused framework development in order to align with the scale-up strategy of the last two business plans.

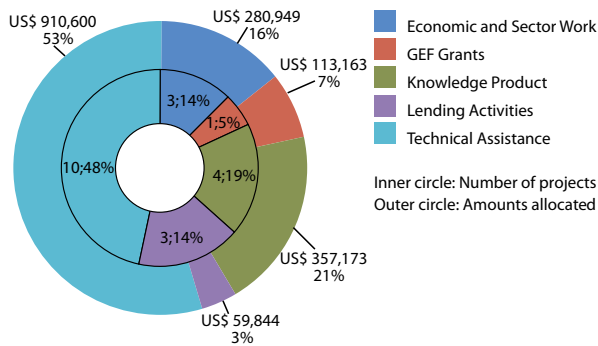
**Figure 2-3: FY2010, Disbursements by ASTAE Approach**



### Project-Related Allocations, by World Bank Line of Activities

This shift from project- to program-based activities is also reflected in the breakdown by the World Bank’s type of activities in figure 2-4, albeit under a different label. Technical assistance supporting framework-development or capacity-building approaches, in line with the overall shift in scaling up delivery by increasing direct involvement with recipient countries’ stakeholders, now represents over half of disbursements. At the same time, pure lending-focused activities (GEF grants, supervision assistance for lending projects) represent about 10 percent of disbursements. Economic and sector work, as well as knowledge products (one-third of disbursements), ensure that the relevant technical and operational knowledge generated from or generated for specific projects is available to partner countries and sufficiently disseminated to other potential beneficiaries.

**Figure 2-4: FY2010, Disbursements by World Bank Activity**



### Project-Related Allocations, by Country

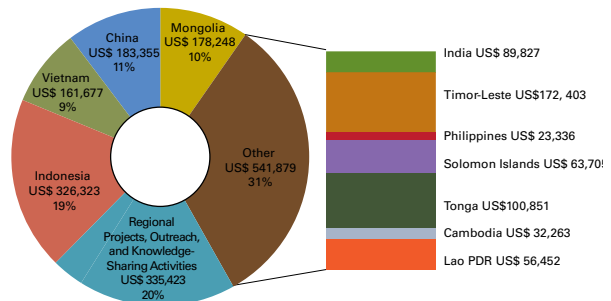
In fiscal 2010, ASTAE continued its active involvement in priority countries, with 39 percent of its allocations to China, Indonesia, and Vietnam (figure 2-5). Indonesia received the most funding—US\$326,323, or 19 percent of total activity-related disbursements.

China, Mongolia, Timor-Leste, and Vietnam received similar levels of funding and around 10 percent of total disbursements. In China and Mongolia, the disbursements were spread across three projects; Timor-Leste and Indonesia each had only one active project.

Regional activities that are not country-specific and that benefit several countries in the region remained significant in fiscal 2010, holding steady with 20 percent of disbursements after their substantial growth in fiscal 2009.

Small countries were not overlooked, however, with Pacific Island countries receiving 20 percent of ASTAE funds collectively. Activities in the South Asia Region continued, but remained limited with 5 percent of total expenditure.

**Figure 2-5: FY2010, Disbursement by Country**



### Detail of ASTAE Fiscal 2010 Activities and Disbursements

Table 2-2 provides an overview of all 21 ASTAE activities that disbursed in fiscal 2010, as well as a short description of the support mechanisms provided by ASTAE for these activities. A summary of disbursements throughout the extended business plan period of fiscal 2007–10 is also provided for reference.

Table 2-2: Detail of ASTAE Activities and Disbursements, FY 2010

ASTAE Project	Type and details of activity	Total disbursements	
		FY 2010	Period FY 2007-10*
Period Total		<b>\$ 2,123,893</b>	<b>\$ 7,365,439</b>
<b>CHINA AND MONGOLIA</b>		<b>\$ 361,603</b>	<b>\$ 1,534,552</b>
<b>China</b>		<b>\$ 183,355</b>	<b>\$ 840,635</b>
1	China: Renewable Energy Scale-Up Program (CRESP)  PE: Supervision of IDA/IBRD Credits • Provide capacity building and support to RE law • Support provincial resource assessment (biomass, wind) • Build investors' capacity to enable RE scale-up	\$ 20,523	\$ 159,363
2	China: Energy Intensity Strategy  ESW: Economic and Sector Work Policy notes to support China's energy intensity reduction • Update cost-benefit analysis of renewable energy targets following changes in energy sector outlook • Improve cement sector energy intensity in three provinces	\$ 38,109	\$ 130,763
3	China: Urban Transport Climate Change Strategy  ESW: Economic and Sector Work • Review energy and carbon footprint of urban transport • Disseminate best practices on energy efficiency and energy security concerns in the urban transport sector	\$ 128,270	\$ 128,270
<b>Mongolia</b>		<b>\$ 178,248</b>	<b>\$ 693,916</b>
4	Mongolia: Energy-Efficient Heating in Poor Areas of Ulaanbaatar  TA: Technical Assistance • Introduce energy-efficient stoves in the poor areas of the periphery of Ulan Bator	\$ 6,432	\$ 210,073
5	Mongolia: Energy Sector Project  TA: Technical Assistance • Improve efficiency in the electricity distribution system • Increase awareness and capacity among stakeholders	\$ 27,152	\$ 247,737
6	Mongolia: Documentary Energy Project  KP: Knowledge Product • Create video on the achievements made under the 2001–10 energy sector project	\$ 144,664	\$ 144,664

**Table 2-2: Detail of ASTAE Activities and Disbursements, FY 2010**

ASTAE Project		Type and details of activity	Total disbursements	
			FY 2010	Period FY 2007-10*
Period Total			<b>\$ 2,123,893</b>	<b>\$ 7,365,439</b>
<b>CAMBODIA, LAOS, THAILAND</b>			<b>\$ 88,716</b>	<b>\$ 561,628</b>
<b>Cambodia</b>			<b>\$ 32,263</b>	<b>\$ 183,735</b>
7	Cambodia: Biodigester Private Sector Development	TA: Technical Assistance <ul style="list-style-type: none"> <li>• Define a service delivery model and licensing procedures for private biodigester construction companies</li> <li>• Support to the emergence of such companies, and creation of a trade association</li> </ul>	\$ 32,263	\$ 96,822
<b>Lao PDR</b>			<b>\$ 56,452</b>	<b>\$ 56,452</b>
8	Lao PDR: Lessons from the Lao rural electrification program	TA: Technical Assistance <ul style="list-style-type: none"> <li>• Identify factors that contributed to electrification successes</li> <li>• Advise to government on next steps toward universal access</li> </ul>	\$ 56,452	\$ 56,452
<b>INDONESIA</b>			<b>\$ 326,323</b>	<b>\$ 579,426</b>
9	Indonesia: Geothermal Power Support Program	TA: Technical Assistance <ul style="list-style-type: none"> <li>• Assist in review, design, and consensus building on policy reforms in the geothermal sector</li> <li>• Enhance GoI capacities to integrate CDM in geothermal development</li> <li>• Assist in identifying and preparing geothermal projects to be financed by WB loan</li> </ul>	\$ 326,323	\$ 501,576
<b>PHILIPPINES</b>			<b>\$ 23,336</b>	<b>\$ 98,380</b>
10	Philippines: Power System Loss Reduction Project	TA: Technical Assistance and GEF: GEF Grant <ul style="list-style-type: none"> <li>• Screen proposed investments by cooperatives</li> <li>• Build capacity of cooperatives and local authorities</li> </ul>	\$ 23,336	\$ 82,026
<b>VIETNAM</b>			<b>\$ 161,677</b>	<b>\$ 757,531</b>
11	Vietnam: Documentary on Rural Electrification	KP: Knowledge Product <ul style="list-style-type: none"> <li>• Create a documentary on rural electrification in Vietnam for television broadcasting</li> </ul>	\$ 41,734	\$ 152,387
12	Vietnam: Renewable Energy Development Project	TA: Technical Assistance <ul style="list-style-type: none"> <li>• Prepare and supervise the Vietnam Renewable Energy Development Project</li> </ul>	\$ 117,057	\$ 416,249



Table 2-2: Detail of ASTAE Activities and Disbursements, FY 2010

ASTAE Project		Type and details of activity	Total disbursements	
			FY 2010	Period FY 2007-10*
Period Total			<b>\$ 2,123,893</b>	<b>\$ 7,365,439</b>
<b>PAPUA NEW GUINEA, TIMOR-LESTE, AND PACIFIC ISLANDS</b>			<b>\$ 340,000</b>	<b>\$ 1,219,312</b>
<b>Pacific Islands</b>			<b>\$ 3,038</b>	<b>\$ 125,925</b>
<b>Fiji</b>			<b>\$ -</b>	<b>\$ 111,472</b>
<b>Solomon Islands</b>			<b>\$ 63,705</b>	<b>\$ 379,090</b>
13	Solomon Islands: Tina River Hydro-power Development Project	TA: Technical Assistance • Provide technical and methodological support for procurement procedures and consultations with affected populations	\$ 51,537	\$ 51,537
14	Solomon Islands: Sustainable Energy Project	PE: Lending • Preparation support for the sustainable energy lending project	\$ 12,168	\$ 258,212
<b>Tonga</b>			<b>\$ 100,851</b>	<b>\$ 149,717</b>
15	Tonga: Renewable Energy Development	TA: Technical Assistance National energy plan with use of renewable energy options • System and load forecast analysis to assess the suitability of intermittent and firm renewable sources to the system	\$ 100,851	\$ 149,717
<b>Timor – Leste</b>			<b>\$ 172,406</b>	<b>\$ 453,108</b>
16	Timor-Leste: Rural Energy Access and Efficiency	TA: Technical Assistance Help prepare an integrated pre-investment package with • Solar PV dissemination options • Candidate micro-hydro sites • Improved stoves models	\$ 172,406	\$ 172,406
<b>SOUTH ASIA REGION</b>			<b>\$ 89,827</b>	<b>\$ 145,706</b>
<b>India</b>			<b>\$ 89,827</b>	<b>\$ 145,706</b>
17	India: Energy Efficiency in MSMEs	GE: GEF Grant Raise energy-efficiency awareness and build energy-efficiency capacity in MSMEs • Increase capacity of local bank branches to identify and appraise EE projects	\$ 89,827	\$ 145,706

Table 2-2: Detail of ASTAE Activities and Disbursements, FY 2010

ASTAE Project	Type and details of activity	Total disbursements	
		FY 2010	Period FY 2007-10*
Period Total		<b>\$ 2,123,893</b>	<b>\$ 7,365,439</b>
<b>Regional Projects, Outreach and Knowledge Sharing</b>		<b>\$ 335,423</b>	<b>\$ 750,045</b>
18	Regional: Mapping Wind Resources in the Pacific and PNG TA: Technical Assistance • Produce a Wind Survey for Papua New Guinea, Solomon Islands, Fiji, and Vanuatu, with predicted mean wind speed for 6, 12, and 35 meters above ground and at 1 km grid spacing	\$ 47,280	\$ 175,620
19	Regional: Carbon Emission Mitigation Toolkit for Highway Construction KP: Knowledge Product • Analyze activities associated with design, construction, and rehabilitation of highway projects identify those sensitive to energy consumption and carbon emission • Estimate carbon footprint and provide mitigation options • Carbon Emission Mitigation Toolkit for Highway Construction	\$ 92,510	\$ 108,385
20	Africa: LED Light Quick Screening Methodology KP: Knowledge Product • Develop a quick screening methodology for LED lights • Pilot-test up to 30 LED systems using the methodology	\$ 78,264	\$ 78,264
21	Regional: East Asia Pacific Flagship Study KP: Knowledge Product • Analyze regional potential of renewable energy sources and energy efficiency improvements • Review existing policies, identify gaps • Recommend regional policy development	\$ 114,569	\$ 149,969
<b>Administration and Reporting Activities</b>		<b>\$ 396,988</b>	<b>\$ 1,718,860</b>
	Reporting Activities • Technical Advisory Group support • Printing, editing services	\$ 158,726	\$ 507,073
	Administration • Administrative support	\$ 238,262	\$ 1,211,787

\* The table lists only activities with significant disbursements in fiscal 2010. Therefore, in some countries the total may be higher than the sum of each project listed.

Given the diversity of countries in the South Asia and the East Asia and Pacific Regions, a map and an at-a-glance country-context summary in relation to each of ASTAE's pillars are provided as a reference in appendix 1, including the following for each country:

- Basic information: population and GDP;
- Renewable energy: capacity, generation, and market share;
- Energy efficiency: power and GDP energy intensity in terms of CO<sub>2</sub> emissions;
- Access: population electrified in number and rate; and
- Greenhouse gas emissions: annual CO<sub>2</sub> emissions and ranking.

The following sections are dedicated to the countries in which ASTAE-supported activities were active in fiscal 2010. For each country where significant disbursements were recorded in fiscal 2010, as shown in table 2-2, two sets of information are provided:

- A simplified country-specific context in which the ASTAE activity is undertaken. This can include country-specific challenges in the energy sector and the World Bank's involvement in tackling these issues.
- An explanation of ASTAE's activity goals, their contribution to the related World Bank projects, and an update on the progress of these activities over fiscal 2010.



## Key Challenges and Focus in CAMBODIA

Cambodia is one of the poorest countries in the region, with about 35 percent of its population living below the national poverty line of less than US\$0.60 per day. With a population of 13.4 million in 2008 that was approximately 80 percent rural, its GDP per capita remains low at about US\$650.

Electricity access is limited, with 26 percent of households electrified nationwide in 2008 and only 3.5 percent in rural areas. Cambodia's annual per capita electricity consumption is around 106 kWh and, because diesel-based generation predominates, tariffs are very high—in the range of 9–23 USc/kWh, and as high as 30–90 USc/kWh in rural areas.

The overall energy sector remains very oriented toward biomass, with more than 90 percent of energy used for cooking coming from wood and charcoal. This contributes to increased deforestation. Inadequate access to energy services has entrenched poverty, slowed improvements in health and education, and contributed to environmental degradation and socioeconomic inequalities. In Cambodia, the immediate emphasis is on improved use of and access to traditional fuels to decrease waste and losses.

## Continued Support to the Cambodia Support to Private Sector Development of Biodigesters

Anaerobic biodigesters, fed with animal dung and other organic waste, produce methane gas that can be used for both cooking and lighting. Rural families with 4 or 5 cows, or around 10 pigs, have sufficient dung to produce enough gas to cook 3 meals a day for a family of 6, as well as sufficient gas for an entire evening of lighting. Biodigesters help reduce deforestation, eliminate harmful indoor smoke from wood fires, and improve sanitation in and around the house when connected to a latrine.

A Cambodia National Biodigester Program was established in mid-2006 to adapt the existing techniques to the Cambodian context and develop a self-sustaining biodigester market. It was advised by the Netherlands Development Organization (SNV) and received donor support from the Dutch government. By 2008, it had installed 750 biodigesters in 5 provinces and was targeted to expand its activities dramatically in the following years.

However, it was found by the Cambodia National Biodigester Program office that training masons to sell, plan, build, and install biodigesters focused on technical aspects, without providing the basic business skills needed to estimate costs and revenue. As a result, masons were unable to calculate

whether their work had made a profit or a loss, and therefore considered the biodigester business a risky one. It was recommended, as the pilot phase was successfully completed, that development and implementation responsibility be removed from the provincial authorities and transferred to the private sector. Private construction companies would be established and staff trained to be responsible for the entire business supply chain: marketing, contracting, construction and installation, quality assurance, maintenance, and after-sales services, including the provision of lamps and other spare parts.

ASTAE provided technical assistance in fiscal 2009 and 2010 to develop such a service delivery model, from both business and regulatory perspectives, and to implement it in three test provinces by establishing and training private biodigester contracting companies. Support was also provided to create a trade association that would share business experiences and standards improvements.

By the end of fiscal 2010, the result was the privatization of biodigester services in eight provinces. Twenty-one biodigester construction companies (BCCs) had been created, well above initial targets. All used the business model developed by the project, which replicable franchises, mason training, and business mentoring. The replicable micro-franchise business model included an operations manual for BCCs, a standardized project control folder for installations (quality control checklist), and a three-party franchise agreement among the national biodigester program office, the BCCs, and the provincial biodigester program offices. In parallel, training targeting the development of business and entrepreneurship capacities for semiskilled rural laborers included customized training focused on concrete business outcomes, and business coaching and mentoring for BCC owners.

This resulted in a sixfold increase in the number of biodigesters installed—to 5,600 by the end of fiscal 2009—and the decision to target the installation of 21,800 biodigesters in 12 provinces by 2012. Each biodigester avoids burning about two tons of wood and kerosene annually and is estimated to reduce CO<sub>2</sub> emissions by four to six tons, or about the equivalent of removing a U.S. car's typical annual emissions (5.5 tons per year, according to the U.S. Environmental Protection Agency).

# CHINA



## Key Challenges and Focus in CHINA

China's accelerated growth in the last three decades has driven a boom in power generation to meet ever-growing energy demand. The country has sustained its growth during the present financial crisis, and future growth is expected to be robust. Under current policies, energy use patterns, and economic growth, China's energy consumption is expected to double in 20 years.

China's energy intensity, defined as energy use per adjusted GDP, recently began an upward trend after a period of significant decline. Energy elasticity, defined as the change in energy consumption per change in GDP growth, soared to twice that of ratios observed in the last 20 years and is now above 1.0, indicating that energy consumption is growing faster than GDP. Because of a vast natural endowment, the energy that fuels China's economy is based on coal. Only a few other countries around the world rely so heavily on coal, although it is important to note that the power sector consumes only 55 percent of total coal consumption, whereas the rest goes for feedstock to industries.

Industry-led demand growth was an important driver of this observed trend, as the share of secondary industries in the economy is much larger than in OECD countries. But another emerging driver looming on the horizon is the emergence of the middle class, with its demands for more electric appliances and more comfortable housing in urban areas and increased transportation needs.

The Chinese government's response to these challenges has included the introduction of major policies and programs in energy efficiency, including a commitment to reduce energy intensity by 20 percent by 2020; ambitious renewable energy targets; increased nuclear capacity; and a greater presence in the overseas market for oil and gas. It has also promoted renewed focus on energy-efficient transportation modes, such as public transport, cycling, and walking, to counter rapid growth in car ownership and use.

Support to energy efficiency and renewable energy development is at the core of the World Bank's energy program in China.

The Bank's China Energy Practice has invested US\$8.2 billion in IBRD, IDA, GEF, and carbon financing funds over nearly 30 years of partnership with China; the green portfolio of renewables and energy efficiency represents 35 percent of this total. Over the last decade, the concentration in China

on sustainable energy has deepened, as 90 percent of World Bank investments in energy have been to support the development of its renewable energy and accelerate energy-efficiency investments.

## China, Beijing Urban Transport Climate Change Strategy

Beijing has announced ambitious plans for improving the energy efficiency of its urban transport systems. A white paper, made public in mid-2009, has announced targets for the adoption of energy-efficient modes—public transport, cycling, and walking. In a large, built-up metropolis like Beijing, a key challenge to improving the energy efficiency of the transport system is to improve the performance of existing systems.

Beijing's bus system is the largest in the world. With over 20,000 buses, it carries more than 13 million passenger on an average weekday. While it has greatly expanded in recent years in response to a growing, more affluent population traveling more, it has done so without a comprehensive, scientifically developed plan, and is suffering from other external issues: as auto ownership and congestion have increased, more and more buses are needed to provide essentially the same net people-moving capacity.

At the same time, declining performance has also meant that bus services are becoming increasingly unattractive as an alternative to buying and using a personal vehicle. Beijing's Metro has and is expanding to meet this challenge. But the bus system will still carry the majority of public transport trips, even after the planned 500-kilometer Metro system, one of world's largest, becomes operational in 2015.

The Bank has been working with Beijing on a two-pronged strategy in this regard: developing incremental solutions that refine and improve the performance of existing public transport in key corridors; and developing analytical tools that allow the city to deploy new public transport investments in a manner that maximizes their impact. Ongoing work includes first, training technical officials and senior decision makers on international good practice for incremental improvements, based on Seoul's experience; second, extending the current work to detailed design stage; and third, supporting Beijing in planning the integration of the rapidly expanding Metro network with the bus system. ASTAE activity focuses on these last two issues.

ASTAE finance is to (i) review the Beijing bus route system and use of multi-criteria analysis to suggest modifications that will

# CHINA

CHINA'S ACCELERATED GROWTH IN THE LAST THREE DECADES HAS DRIVEN A BOOM IN POWER GENERATION TO MEET EVER-GROWING ENERGY DEMAND.





provide an energy-efficient (in terms of direct fuel used and attractiveness to induce modal shift) public transport system; (ii) conduct a gap analysis of key investments in terminals and integration facilities needed to operationalize bus-rail integration; and (iii) recommend a transition plan to implement these changes.

The work is expected to lead to potential World Bank investment components in a new, multisectoral, Beijing integrated energy efficiency project under discussion that could lead to the saving of 20 million tons of CO<sub>2</sub>. It is also expected that the demonstration effects of a successful bus-route reform project in Beijing that leads to better integration with the urban rail system will have significant impact in China and lead to replication across the country.

### Continued Support to Energy-Efficiency Intervention Options in the Cement Sector

Fiscal 2010 saw the final disbursements for this activity, which was finalized in fiscal 2009. China's cement industry accounts for nearly half of the world's total cement production; approximately 40 percent of this production is produced by obsolete plants. Cement production consumes 10 percent of total domestic coal consumption and 5 percent of electricity used in China. This sector also contributes to more than 10 percent of the country's CO<sub>2</sub> emissions and 40 percent of its industrial particulate emissions.

A study on improving energy efficiency in the cement sector in Shandong Province, the leading producer in China, was completed in 2009, jointly funded by ASTAE and the China Sustainable Energy Program of the Energy Foundation. It covered two important areas of energy-efficiency intervention in China's cement industry: (1) phasing out of obsolete production capacity, and (2) investing in energy-efficiency improvements in plants with modern rotary-kiln production

technologies. Another study assessed the social and economic impacts of closing down antiquated cement plants.

### Continued Support to the China Renewable Energy Scale-Up Program (CRESP)

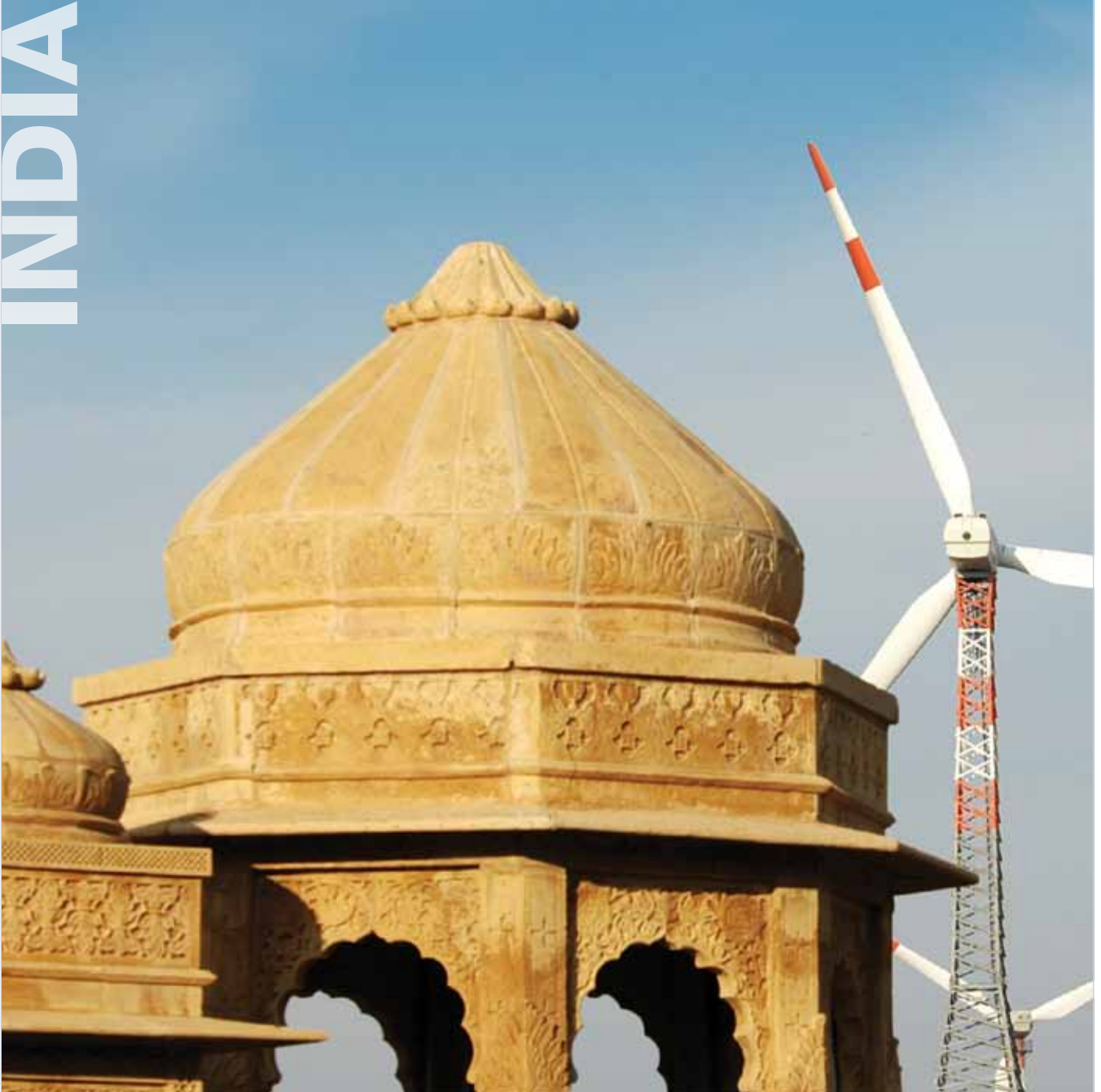
Large investments in coal-fired generation have masked China's achievements in developing renewable energy. With the adoption of the Renewable Energy Law in 2006, passing mandatory targets, setting up subsidies, and recently, feed-in tariffs, China's wind installed capacity has doubled every year since 2005, from 1.3 GW to 25.9 GW in 2009. The country's installed wind capacity is now surpassed only by the United States and expected to overtake it in 2010 (confirmed data not yet available at the time of print).

Complementing these large-scale programs, small hydropower and later photovoltaic (PV) solar were promoted by the government over the years to electrify rural counties and remote areas far from the grid. Wind, and to a lesser extent, biomass have begun to boom because of recent policy improvements. In 2008, installed capacity of small hydropower reached 51 GW, the largest in the world, while biomass reached 3.1 GW and photovoltaic 140 MWp. These are remarkable achievements by any standards.

In fiscal 2010, ASTAE provided limited support to the implementation of the second phase of the China Renewable Energy Scale-Up Program, a large operation with investments in wind energy, biomass-fired power generation, and small hydropower. Building on the success of the first phase, the CRESP-II investment component focuses on large-scale, offshore wind farms; small hydropower and biomass projects (likely through financial intermediaries); and low-carbon cities, integrating compact urban design, public transport, and green buildings. ASTAE supported the offshore wind power development dialogue and discussions among the Bank, the National Energy Administration, and investors on preparations for offshore/intertidal wind power projects.

# INDIA

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## Key Challenges and Focus in INDIA

It is estimated that by 2030, India will need to increase its available power supply by a factor of five to six times if it is to meet its stated annual growth target of 8 percent. This will in turn increase emissions of greenhouse gases by a factor of four, as most of the demand is expected to be met by oil and coal. The industrial sector is particularly energy intensive, consuming more than 35 percent of the country's total energy. Improving the efficiency of energy conversion and use in this sector is therefore a necessity to allow the country to meet its energy, climate change, and growth challenges.

The government of India has initiated and implemented numerous activities to improve energy efficiency, including the establishment of a Bureau of Energy Efficiency (BEE) as a statutory body under the Ministry of Power to facilitate and coordinate energy-efficiency initiatives at the central and state levels. The primary goal of BEE is to reduce energy intensity in the Indian economy, with a target of increasing energy efficiency by 20 percent by 2017 through interventions across a variety of sectors.

## Continued Support to India Energy Efficiency in MSMEs

India has nearly 3 million MSMEs (micro, small, and medium enterprises), which constitute more than 80 percent of the country's industrial enterprises. Many are energy intensive, employing inefficient and outmoded technologies and operational modalities that threaten their competitiveness and future growth. Investments in cost-effective energy-efficiency measures could improve MSMEs' productivity and bottom-line profits. However, because of multiple market barriers and distortions, only a small number of EE projects have actually been implemented.

ASTAE provided project preparation support to a World Bank project (described in chapter 3) that is expected to address the barriers to implementation of energy-efficiency measures. These include the barrier that energy auditors and practitioners who prepare technical energy-efficiency proposals for MSME clients do not know how to communicate with local banks. A second barrier is that the energy-efficiency components of MSME loans are often limited, and carry higher transaction costs as a percentage of investment than larger loans. A third barrier is lack of information among banking sector stakeholders on the potential market for lending and on the benefits of adding energy efficiency-related projects to their portfolios. Finally, there remains imperfect information about

EE among MSMEs, who are unfamiliar with the benefits of readily available, efficient equipment.

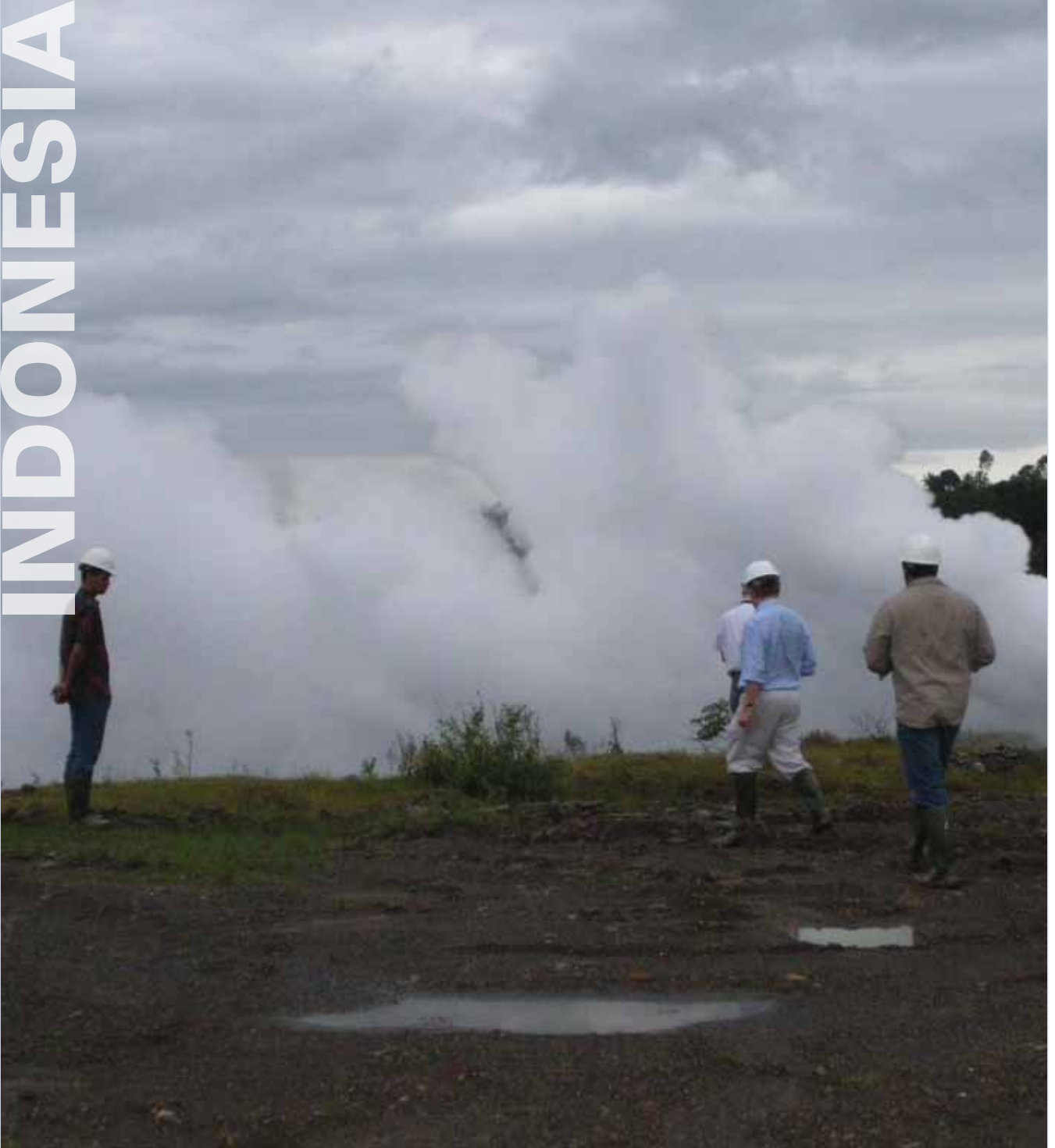
Given these market barriers, the project proposes to adopt a programmatic approach to process a large number of energy-efficiency investment proposals into clusters. This will aggregate demand for energy-efficiency investments to reach bankable size. To ensure sufficient focus and significant intensification of impact, the project targets five highly energy-intensive MSME clusters: forging, foundry, limekiln, chemicals, and one mixed industry cluster.

ASTAE funding in fiscal 2009 and 2010 was used to identify a subgroup of clusters that would be used to pilot the selection and implementation modalities to be later used project-wide. It provided consultant support for mobilization of the pilot clusters that included: forging in Pune; foundry in Kolhapur; mixed engineering in Faridabad; and chemical and petrochemical in Ankaleshwar. In addition, a lime cluster in Thirunaveli has been identified for future initiatives. The preliminary assessment of EE potential led to selection of clusters for expanding investments through larger projects, with proposed grant funds from the GEF. After identifying these pilot clusters, the project team found and trained each focal organization, supported pipeline development, and established local monitoring and evaluation (M&E) systems. ASTAE also funded workshops to present future GEF programs to banks offering EE lending schemes, to enlist new banks, and to mobilize lead banks for identified clusters. Finally, ASTAE provided outreach to improve energy auditor capacity, raise market interest, and prepare for replication of work done in the pilot clusters at the program level.

As a result of this pilot work, cluster mobilization, pilot-unit-level audits, and investment-grade project reports prepared in Pune, Kolhapur, Ankleshwar, and Faridabad, eight projects were pre-identified, representing more than US\$2.9 million in EE and fuel switching investment, with payback periods ranging from 5 to 20 months. These helped kick-start project implementation by proceeding early to thorough specifications analysis with vendors and by financing mobilization activities.

# INDONESIA

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## Key Challenges and Focus in INDONESIA

Indonesia's economy has been growing at a rapid 6 percent pace annually in recent years. Exacerbated by insufficient investment in new power generation capacity, however, national power demand has begun to outstrip supply. The government of Indonesia responded to this urgent need by devising and implementing a "crash program" to construct 10,000 MW of coal-based generation capacity by 2011, considered an immediately available option for expanding generation capacity at low cost.

Indonesia has the world's largest geothermal power potential, enough to fuel about 27,000 MW of generation capacity. Geothermal is a clean and efficient alternative that can diversify Indonesia's electricity generation mix. This largely untapped resource can be a good substitute for other base-load generation technologies such as coal, and it is not subject to the intermittency and variability of other renewable energy sources. As an indigenous and nontradable energy source, it can also enhance the country's energy security and serve as a natural hedge against the volatility of fossil-based commodity prices.

Therefore, a second 10,000 MW "crash program" was proposed to expand Indonesia's national renewable energy portfolio, thereby diversifying its energy mix. To facilitate this ambitious goal, the government designated that geothermal power will comprise up to nearly 40 percent of the second crash program. This midterm goal to scale up geothermal capacity echoes the 2004 "Blueprint for Geothermal Development in Indonesia," developed by the Ministry of Energy and Mineral Resources (MEMR) and intended as a long-term roadmap to progressively develop a total of 6,000 MW of geothermal power capacity by 2020. To enhance the regulatory support and oversight required for this major undertaking, MEMR also established a dedicated directorate for geothermal development to take the lead in coordinating various stakeholders to implement the geothermal initiative.

Despite ambitious geothermal objectives and recent reform initiatives, Indonesia's present geothermal capacity of approximately 1,000 MW remains far short of the interim target in the Blueprint. Only a handful of current geothermal fields in Indonesia have been expanded over the past decade, with no new development in unexplored geothermal fields that are seen to have greater risks. Major barriers keeping Indonesia from fully realizing its geothermal potential include


- the need for large-scale investment to achieve the Blueprint target,
- insufficient policies and regulations to support implementation of the Geothermal Law,
- inadequate incentives and pricing mechanisms to reflect geothermal's environmental benefits and account for upfront risks of developing unexplored geothermal fields,
- limited institutional capability to properly plan geothermal development and sufficiently engage suitable developers, and
- weak domestic capacity in resource exploration and in operation and maintenance of geothermal energy facilities.

## Continued Support to the Indonesia Geothermal Power Support Program

To support the government's commitment toward a greener energy-generation mix and its low-carbon growth strategy (under development), the World Bank has responded by developing a strategy with a two-pronged approach. On the policy side, the Bank is assisting the government in undertaking major reforms that will progressively enhance the investment climate in its geothermal sector. On the financing side, the Bank is helping to immediately stimulate investments by directly supporting geothermal developers who are at an advanced stage of project preparation.

In fiscal 2009, as part of an overall effort to address regulatory barriers in the geothermal sector, ASTAE provided consultants to support the GEF-funded policy-reform project activities by providing much-needed expertise to MEMR. With ASTAE's support, the Task Team also assisted MEMR in establishing a carbon finance framework as a programmatic approach to the Clean Development Mechanism (CDM). The framework aims to streamline and simplify geothermal projects for CDM registration and emission-reduction transactions. CDM revenues from sales of emission reductions will enhance cash flows for developers, helping meet the incremental cost of geothermal energy. Finally, the Task Team also used ASTAE funds to identify and begin preparation of an investment project to finance geothermal fields development with Pertamina Geothermal Energy (PGE), a leading geothermal developer in Indonesia. This project obtained Gol endorsement and confirmation of interest for the proposed related loan.

Given the successful achievement of the objectives set out in fiscal 2009, and the resulting scale-up of the World Bank's engagement in the sector, ASTAE funding was increased and extended into a second phase in fiscal 2010.



INDONESIA HAS THE WORLD'S LARGEST GEOTHERMAL POWER POTENTIAL, ENOUGH TO FUEL ABOUT 27,000 MW OF GENERATION CAPACITY. GEOTHERMAL IS A CLEAN AND EFFICIENT ALTERNATIVE THAT CAN DIVERSIFY INDONESIA'S ELECTRICITY GENERATION MIX.

The ASTAE grant was primarily used to scale up the policy dialogue with and the advisory support to the government. In particular, it provided critical support to the government's efforts to develop a pricing and compensation policy for geothermal development. It also helped the government provide intellectual input at the bi-decennial 2010 World Geothermal Congress hosted by Indonesia. This helped cement the government's resolution to continue on the geothermal development path.

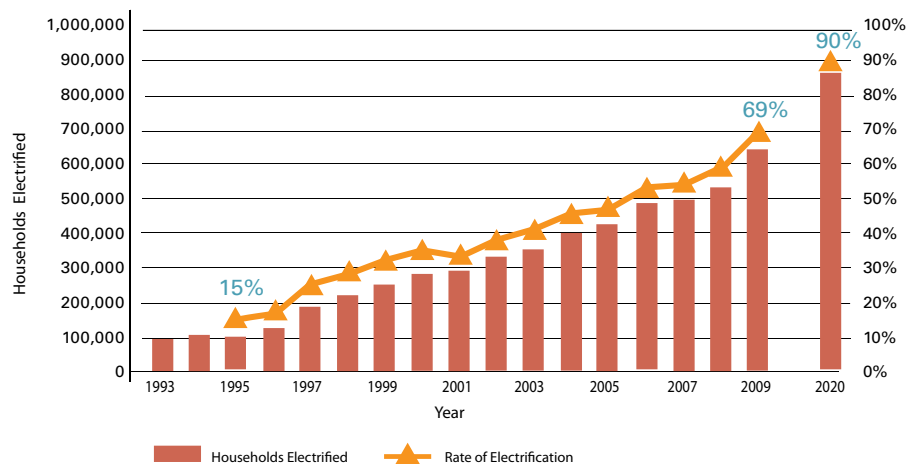
The grant was also used to complete considerable follow-up work on carbon finance, such as training MEMR staff, consensus building among stakeholders, drafting of an operations manual, and preparing a design note for a coordinating/managing entity for the carbon finance framework. These have helped ready the government for the due diligence that will be carried out by the World Bank.

Finally, the ASTAE grant also helped PGE develop its capacity to prepare and undertake geothermal investments that meet industry good practice standards. As a first-time client of the World Bank, and in the midst of a major scale-up in activities, more support than anticipated was required to support PGE in increasing its overall capacity in preparing for the proposed project. For example, the company experienced delays in selecting consultants to assist with project preparation, prompting the World Bank team to step in to fill some of the void, and ensure that the preparation schedule could be maintained and prevent the project grinding to a halt.

The ASTAE-supported Geothermal Clean Energy Investment Project was awarded US\$125 million allocation from the Climate Technology Fund (CTF), in addition to the IBRD lending pending presentation to the Board. CTF committee members were highly complimentary of this first EAP Region Bank project presented for CTF funding and regarded it as an example of good practice to be followed by future projects.



Figure 2-6: Lao PDR Remarkable Electricity Access Growth



Source: Ministry of Energy and Mines, Lao PDR, and Electricite' du Laos



## Key Challenges and Focus in LAO PDR

Lao PDR is a landlocked country, with thickly forested landscape consisting mostly of rugged mountains, steep terrain, and narrow river valleys. The Mekong River forms a large part of the western boundary with Thailand. With a population of 6.2 million in 2008, population density is low compared to neighboring countries. Around three-quarters of the population live in rural areas, mostly in valleys of the Mekong River and its tributaries.

With close to 80 percent of the population living on less than US\$2 per day and a 2008 GDP per capita income of US\$850, Lao PDR remains a poor country, although it has enjoyed strong 6 to 7 percent economic growth rate over the last decade.

The country is well endowed with renewable sources of energy. Close to 90 percent of the installed generation capacity and the electricity produced is hydroelectric; hydropower potential is estimated at 18,000 MW. Lao PDR is able to export electricity to neighboring countries, thus contributing to their substituting fossil fuels with renewable hydro.

Over the past two decades, Lao PDR has made remarkable progress in increasing its electrification rate. Currently, over 70% of the population has access to electricity, up from 16% in 1995. It has achieved this rapid growth despite being a least-developed country and having a low-density, mostly rural population; all this combines to make the country a rare case in electrification programs (Figure 2-6).

## Lessons from the Lao PDR Rural Electrification Program

Since 1987, the Bank has supported four successive rural electrification (RE) projects in Lao PDR, including grid extension to about 150,000 households and off-grid renewable energy technologies to more than 15,000 households. In addition to investment in grid-extension and off-grid RE programs, these projects have provided a platform for continued Bank support to the government of Lao PDR in policy dialogue, sector reform, and capacity building in the power sector, and are instrumental to the rapid expansion of RE and the remarkable improvements in financial performance achieved in the power sector.

In fiscal 2010, ASTAE activity identified the key factors contributing to the swift expansion of RE in Lao PDR;

shared lessons learned with the Lao PDR government; and identified future challenges and means to overcome them in pursuit of universal access. In fiscal 2011, ASTAE will provide a documented case study for other developing countries struggling with low electricity access can reference.

The case study assesses and documents the key factors and developments in the power sector—grid and off-grid—over the past two decades, and the drivers that contributed to rapid scale-up in national electrification. Such factors included, but were not limited to, aspects of the sector framework and policies put in place; the institutional structure and the roles and responsibilities of each institution; the commitment and engagement of the government; the financing, tariff instruments, mechanisms, and policies in place; the political environment; program planning and prioritizing; and aspects of implementation.

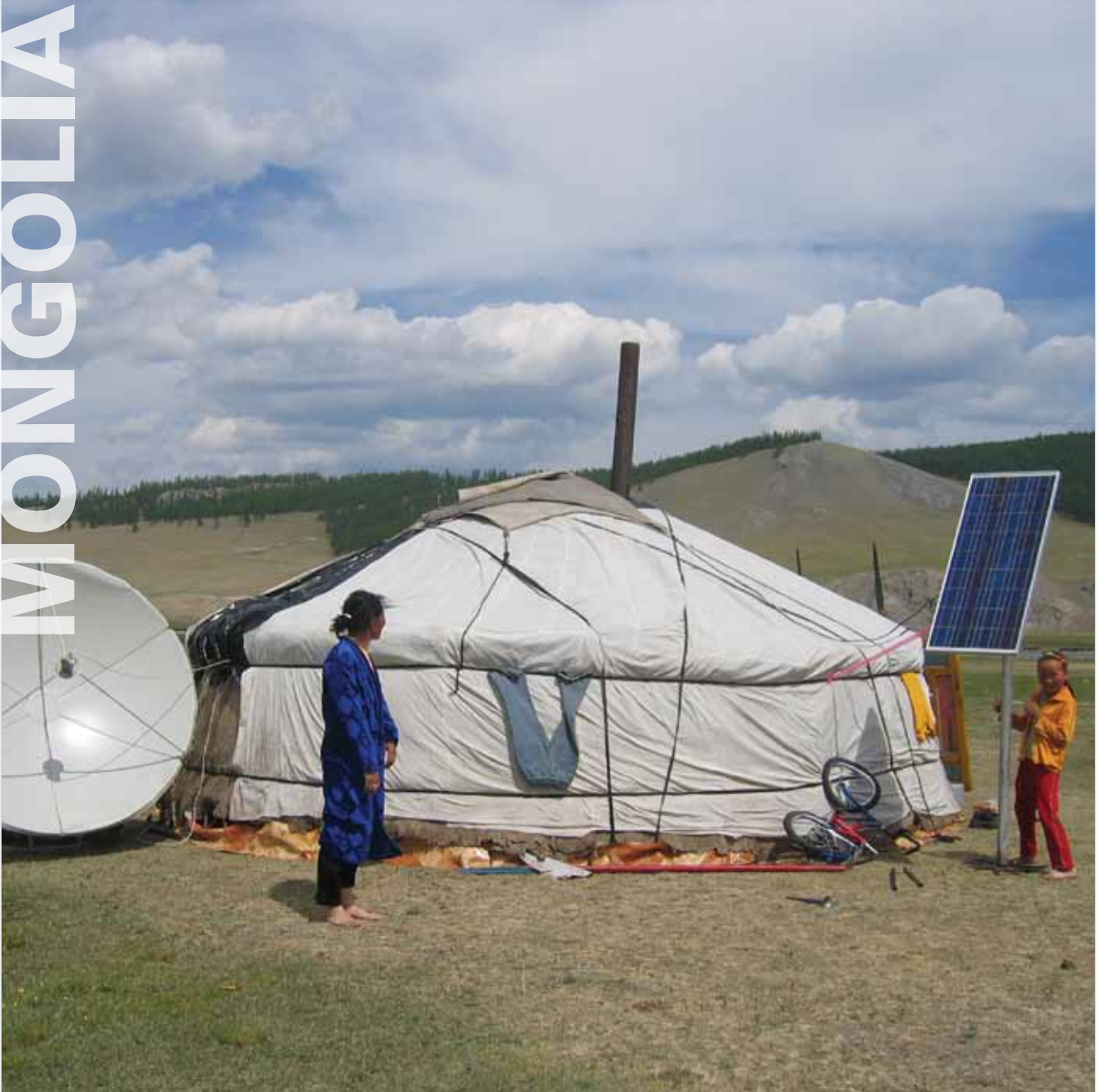
The study complements Bank sector work in Lao PDR in support of rural infrastructure development, which targets especially the poor rural population, and promotes sector-wide reforms and institutional capacity building. This support will contribute to meeting the GoL National Socio-Economic Development Plan's (NSED) goals of poverty reduction and establishment of an enabling environment for growth and development, especially in rural areas. As the grid spreads into less densely populated and less accessible areas, the current approach to electrification is becoming very expensive. Looking ahead, new demands on and expectations of the sector will pose challenges of greater scale and scope than were encountered earlier. To maintain the current rate of progress, it will not suffice—in both grid and off-grid electrification—to merely do more of the same.

The key lessons learned from the study are summarized by the six following success features:

1. Sustained government commitment (with strong donor engagement);
2. Effective institutions (and an effective utility);
3. Quality planning and low-cost solutions;
4. Ensured financing and operational viability (stable financing platform);
5. Focus on consumers and targeting the poor (include gender and equity dimensions); and
6. Off-grid electrification to complement grid extension.

# MONGOLIA

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## Key Challenges and Focus in MONGOLIA

As the world's largest landlocked country, between the two large economies of China and Russia, Mongolia is in a unique position to facilitate regional cooperation in the northeast regional energy market in the areas of trade, mining, and energy services. The national grid that is currently interconnected with the Russian electricity system can import power to meet incremental demand increases for future expansion in Mongolia's own electricity system, which is under severe financial constraints.

Another pressing energy-sector challenge that the government of Mongolia needs to tackle is to provide clean, affordable energy for space heating. The winter season in Mongolia lasts about three-quarters of the year, and temperatures often dip to 20–40 degrees Celsius below zero. At these temperatures, energy for heating is not just a matter of comfort; it is vital for survival. Heating is the single largest consumer of energy in Mongolia, amounting to about 35 percent of the total. A substantial disparity in the quality of heating services and costs exists between urban centers and periurban areas. Although families and businesses in urban centers have access to centralized district heating systems, households in the periurban ger (district) rely on coal- or wood-burning stoves for heating and cooking—a major source of outdoor and indoor air pollution. The low chimney stacks of the ger stoves, combined with unfavorable air flow conditions, further contribute to severe outdoor air pollution, especially during the long winter months. Furthermore, studies have shown that indoor air pollution from heating stove and heat-only boiler emissions plays a significant role in causing major health problems.

## Continued Support to the Mongolia Energy-Efficient and Cleaner Heating in Periurban Ulaanbaatar Project

To support the government of Mongolia's objective of improving heating in periurban ger areas, the World Bank Task Team is providing technical assistance to the Mongolian Ministry of Mineral Resources and Energy, through a series of activities to assess the air pollution problem in Ulaanbaatar and its periurban areas and recommend abatement options to improve air quality. During fiscal 2010, ASTAE finalized the report on "Energy-Efficient and Cleaner Heating in Periurban Areas of Ulaanbaatar." The report highlighted the city's rapidly deteriorating air quality, and focused on the heating and cooking stoves used by ger residents as among the main culprits. It has also been recognized that exposure to airborne pollutants, primarily fine particulates such as PM2.5 and PM10, is a health hazard for all city residents and has a serious negative impact on the economy. The findings of the ASTAE-funded activity led to the conclusion that it is possible to

develop a program aiming to provide cleaner, affordable heating to ger areas in Ulaanbaatar, but that there remain significant technical and financial barriers to an immediate successful rollout. These are being addressed through other World Bank project activities in collaboration with Mongolian counterparts.

## Continued Support to the Mongolia Electricity Sector Project

In fiscal 2010, ASTAE continued to support the implementation of the Mongolia Energy Sector Project. This project was designed to reduce power distribution system losses and improve revenue collection in electricity distribution companies throughout Mongolia. Implementation of the project has resulted in lower technical and nontechnical losses, from an average of 31 percent to 20 percent in Ulaanbaatar, and timely billing and revenue collection that significantly increase the financial viability of the utility. Based on these encouraging outcomes, the Mongolian government has requested additional funding to expand the original scope of the project to further enhance its impact and development effectiveness. The successes of this project were chronicled in the documentary described below.

## Mongolia Energy Project Documentary

Mongolia faces the critical challenge of improving the efficiency performance of existing distribution assets, some of which have up to 50 percent electricity losses. The World Bank is supporting this effort through the Mongolia Energy Sector Project (US\$30 million IDA), which focuses its efforts on the capital city's distribution company (UBEDN) and six additional provincial utilities. The project is under implementation and has had positive results, with a steady decline of losses from a 50 percent maximum in some utilities to 15 percent over a period of two years.

ASTAE supported the project during both the identification and implementation stages by procuring services to assess and supervise proposed technical and commercial loss-reduction programs in selected distribution utilities; then organized and coordinated with national and regional stakeholders to develop consensus for policy improvements, best practices, and knowledge dissemination; and finally, provided contingent advice on both technical and commercial practices and policies.

ASTAE created a documentary video to showcase project achievements. The 26-minute, high-resolution, TV-ready piece presents this success story and has been distributed to a wide international audience. It was shown on the national television network and made available as a DVD distributed at international conferences and seminars. It is available on the World Bank and ASTAE Web sites and on YouTube.

# PACIFIC ISLANDS



## Key Challenges and Focus in the PACIFIC ISLAND COUNTRIES

The Pacific Island countries (PICs) face similar complex development challenges, largely the result of their small, sparsely distributed populations and remote locations. Exacerbated in some countries by political instability, the PICs' unique challenges have resulted in weak economic growth. Even those countries with positive growth in average per capita income have difficulties translating this into sufficient job creation and poverty reduction.

The PICs have some of the world's most expensive energy services. High fuel price volatility is compounded by fragmented purchasing of relatively small volumes, high transport costs, and expensive storage and distribution charges. Such volatile energy costs contribute to increased poverty, political pressures, and instability. Power utilities in the PICs are the largest national users of imported diesel and are squeezed by fuel costs, but are unable to increase customer prices. Consequently, they are incurring significant losses and draining public finances.

The utilities have limited capacity to invest in energy efficiency, system maintenance (up to 80 percent of required O&M costs can end up spent on fuel), and expansion of access to electricity, which remains low overall in the PICs and varies widely—from 7 to 9 percent in Papua New Guinea (PNG) to about 65 percent in Fiji and 89 percent in Tonga. In addition, affordability on the household level remains a major problem. Reducing electricity's cost and increasing access are vital to promoting economic growth and improving the quality of life of PIC households.

Faced with looming foreign exchange and balance of payments crises, political support is strong in many PICs for urgent action to diversify power supply through an increased use of renewable energy sources. Avoiding such crises is critical to limiting currency depreciation, and increased costs of servicing foreign-denominated debts, as well as restrictions on further access to funds and related negative effects on private sector investment. Fortunately, many PICs are blessed with rich renewable energy endowments, such as solar, wind, and hydropower, and considerable energy-efficiency potential to further strengthen their power sector and reduce reliance on imported fuels.

## Continued Support to the Tonga: Renewable Energy Development

Well over half of Tonga's energy needs are met by imported petroleum. Although biomass remains important for cooking and crop drying, it is increasingly being replaced by kerosene and liquefied petroleum gas as the cooking fuel of choice. Tonga enjoys a high rate of access, with 89 percent of all households connected to grid electricity, which accounts for over 98 percent of electricity used. All grid-supplied power is generated using imported diesel fuel. Because of the lack of available options, petroleum imports, such as motor spirits, distillates, and liquefied petroleum gas, place a considerable burden on national finances. Oil price volatility is causing severe foreign exchange, balance of payments, and other fiscal challenges to the government; fuel accounts for around 25 percent of all imports and around 10 percent of GDP.

In 2009, Tongan authorities requested urgent support from the international donor community to help switch from diesel-based generation to renewable energy, with an ambitious target of 50 percent of grid electricity generated using renewable sources in three years. The World Bank responded by providing technical assistance to develop and reinforce energy policies, strengthen regulatory regimes, integrate supply-chain management, hedge fuel purchase costs, and develop energy-efficiency and power-system planning, including a mix of renewable energy- and fossil-fueled generation.

In fiscal 2009, under this technical assistance, ASTAE sponsored a study that assessed renewable energy potential and proposed alternative development scenarios in Tongapatu, Tonga's main island and home of its capital. In the past, Tongan authorities had proposed a wind farm far in excess of the absorptive and dispatch capacity of the main grid's current 13 MW. The study, published on ASTAE's Web site, included system and load forecast analysis to assess the suitability of both intermittent (such as wind) and firm (such as biomass) renewable sources to the existing grid system.

In fiscal 2010, the ASTAE funds contributed to the development of a 10-year Tonga Energy Roadmap aiming at reducing vulnerability to oil price shocks and increasing environmentally sustainable access to modern energy services. The first target is to have renewable resources supply 50 percent of electricity generation by 2012. To achieve this goal, the Roadmap presents policy, institutional, legal, regulatory, capacity-strengthening and data-gathering requirements; strategic environmental and social assessments and strategic investments in improved



IN FISCAL 2010, ASTAE FUNDS CONTRIBUTED TO THE DEVELOPMENT OF A 10-YEAR TONGA ENERGY ROADMAP WHICH INCLUDES THE DESIGN AND LAUNCH OF A FUNDING MECHANISM TO ALLOW FLEXIBILITY IN THE USE OF GRANT FUNDS TO COVER BOTH UPFRONT INVESTMENT AS WELL AS ONGOING COSTS FOR RENEWABLE ENERGY PROJECTS, INCLUDING FOR ON-GRID SOLAR PV SUPPLY AND FOR USING COCONUT OIL IN SOME INSTANCES TO REPLACE DIESEL FUEL.

efficiency of electricity supply; improved network safety; and improved end-use efficiency. It also includes the design and launch of a funding mechanism to allow flexibility in the use of grant funds to cover both upfront investment as well as ongoing costs for renewable energy projects, including for on-grid solar PV supply and for using coconut oil in some instances to replace diesel fuel.

The Tonga Energy Roadmap was showcased at the Pacific Energy Ministers meeting in Brisbane in July 2010 and at the International Renewable Energy Association (IRENA) Administrative Committee meeting in Abu Dhabi in June 2010.

### Solomon Islands Tina River Hydropower Development Project

The Solomon Islands are a double chain of 992 islands, of which one-third are populated. The estimated population of 500,000 lives primarily on six main islands. Ethnic tensions and rioting had a negative effect on the economy in 2003. The country later enjoyed a strong recovery, but still faces a number of challenges.

The majority of the population remain involved in subsistence cash crop agriculture, with less than 25 percent involved in paid work. Exports are commodity-based and include timber, fish, cocoa, and copra. Logging rates are around four times the sustainable rate. The energy sector also faces major issues, primarily linked to high costs and unreliable electricity supply, lack of access, and serious inefficiencies within the Solomon Islands Electricity Authority (SIEA), the national utility company. The current national household electrification rate is very low, at an estimated at 20 percent, or about 18,000 households connected, primarily in the capital.

This ASTAE activity builds on the hydropower generation component of a sustainable energy project that was restructured in fiscal 2008. ASTAE funded the creation of two handbooks on land use and land access for generation and transmission projects, and on community contribution to environmental impact assessments for infrastructure projects. In fiscal 2009, rather than financing a project executed by the government, the World Bank decided to support the proposed Tina River Hydropower Project as a private sector design-build-operate-maintain-transfer project.

The proposed project, also supported by Ausaid and the European Investment Bank, aims to develop a hydropower system (about 10-15 MW) to provide power to Honiara, the capital city. The immediate result would be replacement of current, very expensive, diesel-driven generation, resulting

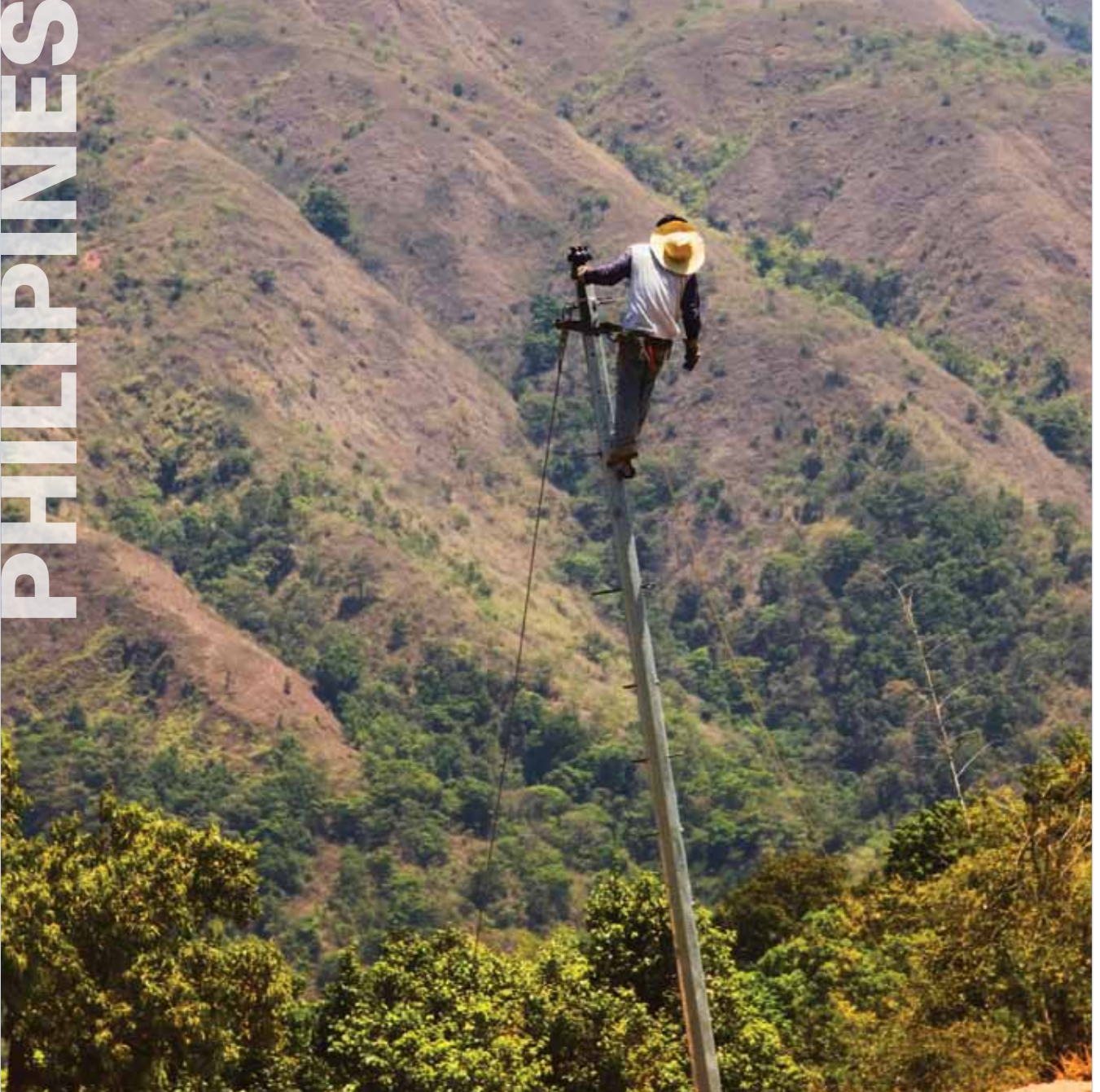
in increased foreign exchange reserves, as fuel imports would decrease significantly. Another result would be new or increased support for private-sector development by tapping the sector to develop, operate, and maintain the system. In the medium term, as SIEA becomes more efficient, finances would become available to better maintain and further develop distribution infrastructure and increase access.

During fiscal 2010, ASTAE funds financed a hydropower specialist for project preparation in designing feasibility studies of hydropower system options. The hydropower specialist advised the Task Team and the government, and participated in monthly progress meetings among International Financing Institutions through fiscal 2011. Also in fiscal 2010, ASTAE supported a review of the legal and institutional processes for land acquisition, and advised on a single process for project preparation that would integrate the Solomon Islands' requirements with those of the World Bank.

The Task Team Leader noted that ASTAE was a critical source of funding for the preparation of this flagship operation. This has enabled the Bank to undertake comprehensive social safeguards and technical work—essential for project development in this complex social setting, with its different and potentially conflicting land ownership arrangements—the scope of which would be difficult to fund within the normal Bank budget. This work is expected to continue into fiscal 2011.

# PHILIPPINES

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## Key Challenges and Focus in the PHILIPPINES

The Philippines has a diverse population of 90 million. It is reasonably well endowed with natural resources. It has limited commercial reserves of fossil fuel, mainly natural gas and coal. Commercial-scale geothermal energy and hydropower resources are being harnessed to help meet the country's power needs. Because of the projected increase in electricity demand, greenhouse gas emissions from the power sector are expected to increase dramatically, doubling over the next 10 years under a business-as-usual scenario.

The launch of the national Accelerated Barangay Electrification Program (ABEP) in 1999 has helped substantially increase the population coverage of the power grid in rural areas, raising the ratio of electrified barangays (administrative divisions equivalent to a district; not to be confused with household electrification) from 77 percent to 96 percent in 2008.

While the nationwide household electrification rate is quite high at 84 percent, there remains substantial work to be done in rural areas, where these rates leveled off at around 70 percent and have not substantially progressed since early 2000. Rural power, especially in remote island areas, is characterized by a high dependence on imported diesel or bunker fuel for generation, resulting in higher carbon intensity than in the rest of the energy sector.

## Continued Support to the Philippines Power System Loss Reduction Project

The World Bank's Electric Cooperative System Loss Reduction Project was started in fiscal 2005 with a US\$12 million grant from the GEF to test business models that would provide operating efficiency improvements in electricity cooperatives (ECs). The expected outcomes were a more reliable but least-cost power supply over the long term, and new capacity to invest in connecting additional households. Toward these ends, the project created a partial credit guarantee program to extend commercial loans aimed at developing financial and contractual mechanisms to support private-sector involvement in investing, managing, and operating ECs.

Most of the barangays benefiting from this effort are served by 119 ECs, with customer bases varying widely from about 1,000 to over 130,000 customers each. The financial and operational capacity of the ECs also varies widely, the result of low cost-recovery rates—the result of socially acceptable but economically unsustainable tariffs, poor financial management, a decline in bill collection rates, and increasing political interference. All ECs, regardless of the conditions in

their service territory, are required to meet the same financial efficiency standards; this imposes financial strains on those subject to unfavorable conditions (poor-performing ECs most often serve small islands or those with law and order problems, for example). In some cases, regulatory pressure on rates reduces efficiency by making sufficient spending on maintenance and rehabilitation impossible. It is estimated that one-third of ECs are not financially viable, given current tariffs, and many do not meet technical and financial requirements necessary for recovering costs.

ASTAE funding, approved in fiscal 2006, was intended to offer access to international expertise and lessons learned, as well as practical knowledge to support the various subproject proposals under the GEF project. However, for a number of reasons, the Electric Cooperative System Loss Reduction Project did not advance as originally planned. Consequently, while some ASTAE-funded work was done in fiscal 2007, the Task Team soon halted activities that were to be funded by ASTAE because of lack of progress in the GEF project.

In fiscal 2009, ASTAE provided support to the mission by undertaking the project midterm review, which looked for ways to restructure the project to avoid cancellation. As a result, a new road map, involving all key stakeholders, was agreed upon. ASTAE support was critical in the restructuring and in clarifying the way forward, which calls for increased involvement by the National Electrification Agency in project implementation.

In fiscal 2010, ASTAE continued to provide support to work that promotes the move toward ECs-tailored standards for distribution losses and reinvestment allowance. These standards would accommodate the fact that ECs vary widely in size and in the geographical conditions under which they operate. Better performing ECs serve large and progressive provincial cities while the poor-performing ECs normally serve small islands or those with law and order problems. The current regulatory approach of stipulating common standards for distribution losses and reinvestment allowances is ineffective in promoting efficiency, as regulatory pressure on rates can reduce efficiency by preventing ECs from spending enough on maintenance and rehabilitation.

# TIMOR-LESTE



## Key Challenges and Focus in TIMOR-LESTE

Timor-Leste, a new country of just one million citizens, is a picture of contrasts. On the one hand, it is generating and accumulating substantial revenues from offshore oil and gas resources. On the other hand, it is one of the least developed countries in the world, with much of the population living in poverty. For the rural energy sector, the key challenges to the government lie in addressing the potentially serious health and environmental problems associated with continued heavy dependence on biomass fuels, and providing improved access to modern fuels, particularly electricity, to all segments of the rural population.

### Timor-Leste Rural Energy Access and Efficiency

The electrification rate in Timor-Leste is low, at 21 percent nationally and only 5 percent in rural communities. Despite ongoing efforts, some 60,000 households in remote areas will remain without access to electricity for the next 20 years because of their dispersion and associated high connection costs. With regard to overall fuel consumption, biomass energy (fuelwood) exceeds that from all other fuels combined, including hydrocarbons, reflecting the still highly undeveloped and rural nature of the economy.

In 2007, ASTAE supported a household energy study that showed the predominant role of fuelwood in Timor-Leste's energy mix (98.7 percent all households use it as their main cooking fuel) and the need to address issues of potential deforestation and the adverse health impacts of indoor air pollution on women. Off-grid PV and decentralized microhydropower systems have been identified as least-cost solutions for off-grid electrification.

In fiscal 2010, ASTAE financed an assessment of rural and renewable energy options, with complete techno-economical analysis of the different options, and identified and prepared the design of practical solutions for implementing its recommendations. ASTAE also produced a report to help the government with its rural energy policy choices. The focus in particular was to assist the Secretary of State for Energy Policy in developing clear and coherent policies. These would guide planning of the subsequent phases of ongoing programs, initiation of new programs, and prioritization of projects competing for limited funds.

The ASTAE activity assessed various solar PV business models (such as dealer, fee-for-service, market package, and concession) and recommended the most adaptable to implementing a sustainable, private sector-led PV program focused on remote, off-grid populations. It also evaluated candidate microhydro sites, defined potential investment projects or pilot projects, evaluated community-based management options, and provided subproject design concepts. The study also evaluated options for sustainable dissemination of improved stoves, including commercial mass production and marketing, organized instruction for household-made stoves, or a combination of approaches. Finally, it carried out energy audits of some biomass-using rural industries, and estimated costs of potential energy efficiency measures.

The results of these ASTAE activities are expected to catalyze action on a project that would fill a crucial gap in current rural electrification plans and address key biomass energy issues. There had been agreement in principle by the World Bank and GoTL on the need for such a project, but no firm discussion or decisions for lack of specific discussion material. The ASTAE activities are expected to rectify this, as the key parties will be able to review concrete project details and costs.

VIETNAM



## Key Challenges and Focus in VIETNAM

Vietnam's strong economic development has resulted in rapid growth in the demand for electricity. Starting from an originally low level (11 TWh in 1994, or 156 kWh per capita), electricity demand grew at an annual average rate of 15 percent until 2006 and 13 percent thereafter. In 2008, it reached 76 TWh and 800 kWh per capita.

Residential consumption still represents 40 percent of demand, while industry led the recent growth, reaching 45 percent of the total as the sector began manufacturing more sophisticated products. According to current plans, hydropower and natural gas are each expected to contribute about 40 percent of power generation over the next few years, and coal-fired generation the remaining 20 percent. After 2011, most of the growth in generation is expected from coal-fired power plants.

This extraordinary growth has influenced the Bank's strategy in Vietnam's energy sector: It has focused on meeting demand with reliable and cost-efficient power, while strengthening social inclusion by expanding rural access to the poor, and improving natural resource and environment management through increased system efficiency and promotion of the utilization of renewable energy.

ASTAE has been deeply involved in all aspects of the Bank's intervention except conventional generation and transmission, and continues to provide support to the RE agenda in Vietnam. In addition to its past support to the design and implementation of Rural Electrification Projects I and II, which provided new or improved access to 2.5 million households, ASTAE provides knowledge sharing and dissemination of lessons learned from this exercise. "The Last Mile" documentary was produced with ASTAE support in fiscal 2008 to explain and illustrate Vietnam's accomplishments in increasing access to electricity from less than 50 percent to more than 95 percent of the population in 15 years. This experience was shared with other countries at a major World Bank conference on best RE practices in Mozambique in June 2009, and a companion book to the documentary was prepared in fiscal 2010. This book aimed to further share lessons learned from the Vietnamese case study and to provide a stock-taking of the last 5 percent of the population that requires access, an effort likely to include substantial off-grid and renewables-based options.

## Continued Support to the Vietnam Renewable Energy Development Project

In fiscal 2009, ASTAE provided support to the preparation of the REDP in Vietnam, which was presented to the Board in May 2009. This US\$318 million project, with US\$202 million in IDA financing and US\$114 million sourced locally, aims at increasing the supply of electricity to the national grid from renewable sources.

REDP was designed to address three issues that hinder the development of renewable energy electricity-generating projects in Vietnam:

1. The absence of satisfactory arrangements for selling power to the grid at an equitable price;
2. An inhospitable and nontransparent regulatory framework, with large numbers of approvals required and no satisfactory means of allocating project sites to those most able to develop them; and
3. The lack of available debt financing on terms and with maturities that meet the needs of renewable electricity projects.

To counter this situation, REDP provides regulatory framework strengthening, pipeline development, and investment support to private-sector, renewables-based subprojects not exceeding 30 MW. The core component of the project is making a refinancing facility available to participating commercial banks that provide loans to eligible subprojects. The facility can refinance up to 80 percent of the loans made by commercial banks. It is estimated that up to 25 subprojects, principally small hydropower, but also wind or biomass, will be supported by the refinancing facility. Subproject size is expected to average 10–11 MW and cost an average of about US\$12 million.

The financial intermediary makes wholesale finance available to leverage local capacity to sponsor, appraise, finance, procure, and construct individual subprojects. This allows rapid implementation of individual projects while creating the basis for a sustainable private renewable energy supply industry.

ASTAE provided support in fiscal 2009 to build capacity within the Ministry of Industry and Trade in charge of developing REDP, and to prepare frameworks and guidelines applicable to eligible subprojects with respect to environmental safeguards, dam safety, resettlements, and ethnic minority policies. In the same year, ASTAE funding also provided support to the World Bank team for project preparation and appraisal.



In fiscal 2010, following Board approval of the project, ASTAE shifted support to the implementation phase of the REDP, in the form of much-needed capacity building of the project's management board and administrative units, including by facilitating knowledge sharing with China, where ASTAE has supported a similar initiative, on policy establishment and implementation methods. With ASTAE support, the government drafted CDM documents that were submitted to the UNFCCC in December 2009 as planned.

Also in fiscal 2010, ASTAE financed the training of projects sponsors to help them identify and build a pipeline of potential subprojects. ASTAE also provided training to Vietnamese banks, which have limited experience with renewable energy projects and with commercially oriented project appraisal, to ensure they can follow international best practices. Specific emphasis was put on improving participating banks' and project developers' knowledge of environmental safeguard frameworks and procedures.

Finally, ASTAE funding also contributed to a life-cycle cost optimization study initiated to analyze the trade-off between initial capital investment and lifetime operation and maintenance (O&M) costs in small hydropower project development in Vietnam. This is intended to help design appropriate strategies and technical specifications in procuring equipment for these plants to ensure the least life-cycle costs. The study will extend into fiscal 2011.

# REGIONAL PROJECTS





## REGIONAL PROJECTS, OUTREACH AND KNOWLEDGE-SHARING ACTIVITIES

### Continued Support to the Regional Carbon Mitigation in Road Construction and Rehabilitation Toolkit

In the energy sector, ASTAE is supporting multiple projects that reduce CO<sub>2</sub> emissions. The transport sector consumes energy in the form of fuel, so it is closely linked to energy sector challenges. Transport contributes significantly to greenhouse gases—cars are responsible for more than 60 percent of road transport emissions. However, another contributor, less known, goes hand-in-hand with the development of road transport in developing countries: road construction. It is anticipated that over the next several years, developing countries in East Asia will substantially expand and restore their extensive highway networks. One result of these activities will be increased greenhouse gas emissions. Reducing these emissions will significantly decrease the negative impacts related to these infrastructure works.

There are several steps involved in road construction, each contributing to the production and release of greenhouse gas emissions: site clearing, preparation of the sub-grade, production of construction materials (granular sub-base, base course, surfacing), site delivery, construction, ongoing supervision, maintenance activities, and so on. The aggregate greenhouse gas emissions for each project (phase, section, alignment) can be calculated based on equipment, local conditions, and standard practice in a country.

The Greenhouse Gas Emission Mitigation Toolkit for Highway Construction and Rehabilitation (Roadeo) is being prepared to identify and quantify greenhouse gas emissions from current practices, and to develop a strategy for better planning, design, and construction of roads in order to minimize these emissions.

Roadeo, with the support of a User Manual, will guide users through various stages and activities of road construction and rehabilitation, help them identify areas sensitive to greenhouse gas emissions, and provide mitigation options, taking costs and benefits into account. Decision makers, designers, and technicians in the highway sector can use Roadeo to easily compare various alternatives in construction, and optimize their practices to minimize greenhouse gas emissions and maximize energy efficiency. It is envisioned that the Roadeo Toolkit will be used in both new and existing projects.

The work began in fiscal 2009, to be completed following an eight-tasks program. By the end of fiscal 2010, the first five tasks were completed: assessment and literature review; analysis of construction practices in focus countries and detailed cases studies; greenhouse gas emission calculations; and identification of gaps between best practices from developed countries and focus countries; and practices and propositions to remediate these. ASTAE, after consultation with the Task Team, decided to focus the case studies on China, Indonesia, and Vietnam, countries that are undertaking large programs of road expansion.

Upcoming work in fiscal 2011 is expected to assess costs and benefits of each alternative practice proposed, and to develop the final version of Roadeo for wide dissemination. The current Roadeo iteration has already garnered a high level of interest from the transport community; the final product is expected in early 2011, and will be presented at high-level international symposia and at several national stakeholders meetings.

### Continued Support to the East Asia Pacific Energy Flagship Study

In fiscal 2010, the East Asia Pacific energy flagship study, entitled *Winds of Change*, highlighting prospective energy sector challenges and how to meet them, was delivered and disseminated. ASTAE support was combined with funds from Australia, Japan, ESMAP, the Bank, and PPIAF to deliver the product. This broad-based funding source reflects the nature of this study, involving upstream and downstream work, as global knowledge and policies work are required to develop a regional strategy and future priority project pipelines based on the study. A wide range of national consultations were held to discuss the flagship's draft findings; participants included academics, policy researchers, government officials, NGOs and civil society, the private sector, and donors. Following these consultations, the East Asia energy team extensively disseminated the results and associated strategy to national and international stakeholders.

The study focused on six countries in the region: Indonesia, Malaysia, the Philippines, Thailand, Vietnam, and China. China was treated separately, as it accounts alone for 85 percent of regional energy consumption and CO<sub>2</sub> emissions.

The study finds that it is within the reach of the region's governments to maintain economic growth, mitigate climate change, and improve energy security. Simultaneous large-scale

deployment of energy-efficiency and low-carbon technologies can stabilize EAP's CO<sub>2</sub> emissions by 2025, significantly improve the local environment, and enhance energy security, without compromising economic growth—in fact, benefiting from sustainable environmental practices and conservation as an engine of economic growth.

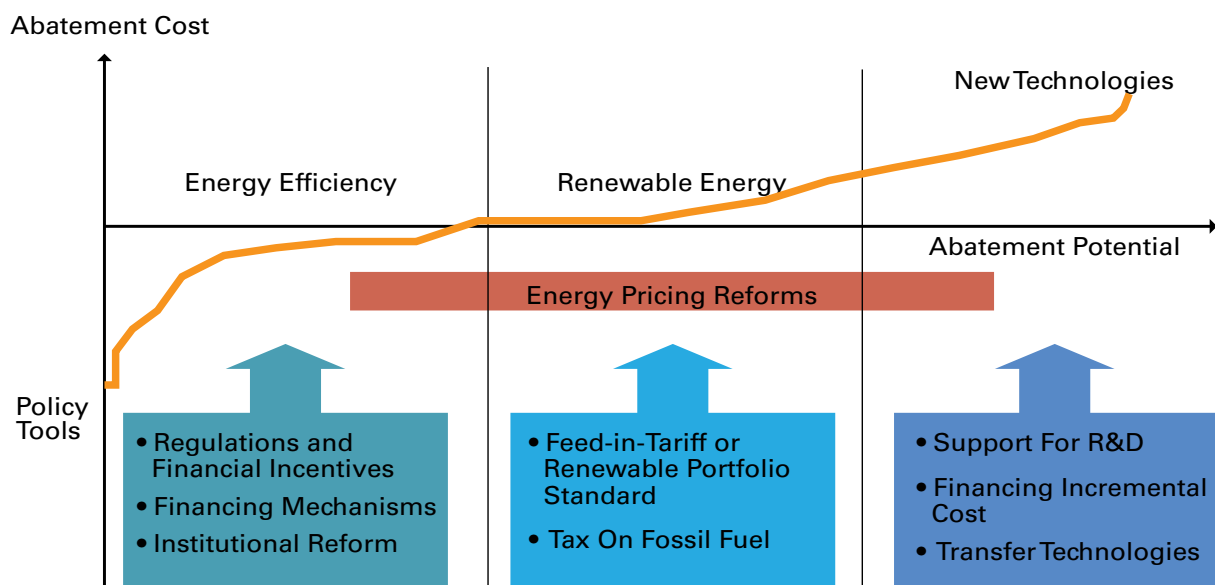
However, the study warns that the window of opportunity is closing fast, as delaying action would lock the region into a long-lasting high-carbon infrastructure. The study recommends that governments should take immediate action to transform the energy sector toward much greater energy efficiency and widespread utilization of low-carbon technologies. While many EAP countries are actively taking steps in this direction, accelerating the speed and scaling up the efforts are needed to move onto a sustainable energy path.

This shift to a clean energy revolution requires major domestic policy reforms and transfer of financing and technologies from developed countries. Fully realizing the huge energy efficiency potentials in the region depends on policy and institutional reforms to overcome market failures and barriers.

A major hurdle is in mobilizing financing for the net additional investment of \$80 billion per year needed to achieve this sustainable energy path over the next two decades, as estimated in the study. The study estimated that approximately \$25 billion per year would be required as concessional financing to cover the incremental costs and risks of energy efficiency and renewable energy. In addition, substantial grants are also needed to build capacity of local stakeholders. The technical and policy means exist for such transformational changes, but only strong political will and unprecedented international cooperation will make them happen.

The World Bank Group is committed to scaling up policy advice, knowledge sharing, and financing for sustainable energy to help the region's governments make such a shift. The study suggests that the Bank needs to increase efforts and keep focusing in EAP on EE, renewable energy, and new technologies. This reaffirms the relevance of ASTAE as a major instrument to support increased Bank lending and improved policy changes in the region.

**Figure 2-7: Policy Tools Need to Be Tailored to Maturity and Costs of Technologies**



## Continued Support to Regional Wind Resources Mapping for the Pacific Islands

Disbursements under this activity in fiscal 2010 are a payment spillover from fiscal 2009, under which the *Pacific Islands Wind Mapping Atlas* was delivered. Following requests from Fiji, Papua New Guinea, Solomon Islands, and Vanuatu, ASTAE funded and published this atlas of wind resources in the Pacific Islands, which provides necessary information on wind availability to foster the development of wind energy, both for utility-scale generation and for community-based power generation, including off-grid applications.

Potential users of the Atlas include government officials, international aid agencies, development institutions, and private developers. Because of the absence of existing reliable local wind data, the study was requested and carried out using the Wind Survey system, an advanced wind mapping system that operates without the need for existing surface wind data. The Wind Survey tool had already been used in 2001 for ASTAE's *Wind Energy Resource Atlas of Southeast Asia*, which was made available to the public on CD-ROM and via ASTAE's Web site, and which remains in high demand today. The system simulates important meteorological phenomena often not captured by other models (such as down-slope mountain winds, channeling through mountain passes, lake and sea breezes, low-level jets, temperature inversions, and surface roughness effects). It also directly simulates long-term wind conditions, eliminating the need for uncertain climatic adjustments using correlations between short- and long-term surface measurements.

Both atlases characterize wind resources in their respective regions by recreating actual weather and wind conditions for 365 days that are randomly sampled from a 15-year historical record. Its inputs provide a snapshot of atmospheric conditions at regular time intervals throughout the world over the past several decades. For each day, the wind speed and direction, the temperature, pressure, precipitation, cloud cover, and other meteorological variables at multiple levels above the surface were simulated and stored at hourly intervals. When the runs were finished, the data were compiled and summarized to produce maps of mean wind speed and wind power density, as well as databases containing wind speed and direction distributions.

ASTAE receives regular requests for the *Pacific Islands Wind Mapping Atlas* from government officials, universities, and practitioners in the field. While the Atlas is available on the ASTAE website, these requests are often for data in CD-ROM format, as bandwidth is limited in the Pacific Islands.

## Cross-Support to Africa LED Light Quick Screening Methodology

LED lighting is a possible entry point for electricity access for over 1 billion people in developing countries, with the potential to substantially reduce the amounts that poor households currently spend on inefficient kerosene lighting.

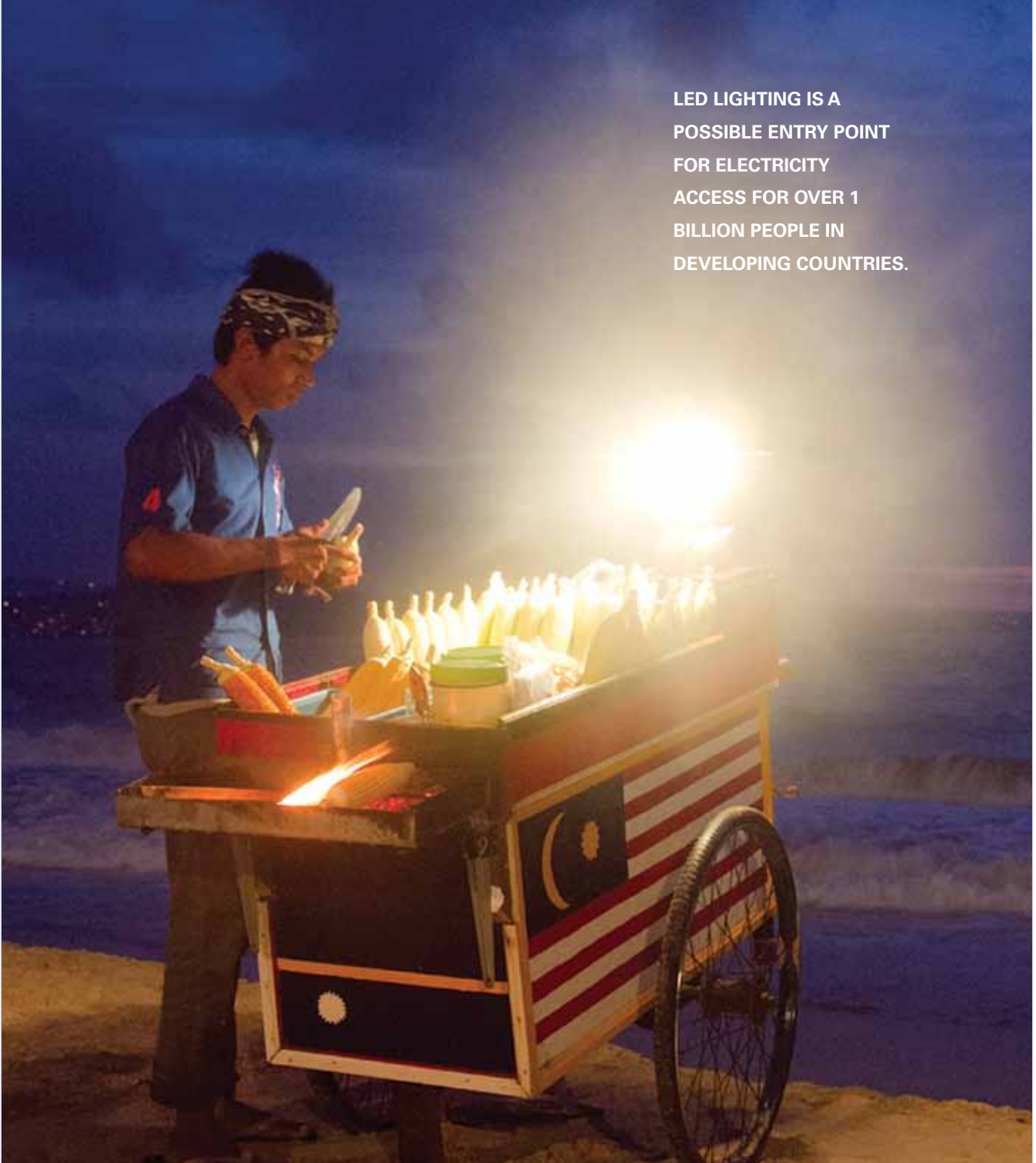
Rechargeable white LED lighting products consume as little as 0.5W of power, and may require solar panels as small as 1W. To date, however, solar projects in developing countries have focused primarily on systems requiring 30W panels or larger. Some projects have worked with as little as 10-15W, but these panels generally cost US\$200 or more, with batteries and solar controllers often adding an additional US\$10-20.

However, LED products best suited for household use off-grid mostly start in the 1-5W range, and there are currently no product specifications available to ensure acceptable levels of quality. There are, more specifically, two key areas where there is a knowledge gap—LED lifetimes and proper specifications for battery protection. Indeed, there is very little information available on lifetime LED lighting efficiency and lumen degradation. In addition, because of the much lower cost of systems under 5W, the price of standard solar controller systems (US\$10-20) is disproportional to the value of the batteries they protect (US\$2-5 range). Simplified battery protection specifications are therefore required to guide development of solar controllers in the US\$1-2 range.

Low-wattage LED systems have great potential to be used as an initial source of electricity for household lighting in the Pacific as well as in some ASTAE countries with low access (Cambodia, Papua New Guinea, and others) while waiting for a more traditional source of electricity (SHS, minigrid, or grid) to reach these households. In these low-access countries, the issue at hand is similar to one in many African countries, for which the Lighting Africa initiative was created. Lighting Africa is a World Bank Group initiative that supports the private sector in developing, accelerating, and sustaining the market for modern, off-grid lighting technologies tailored to the needs of African consumers.

In fiscal 2010, ASTAE teamed with Lighting Africa, in cooperation with ESMAP and the Bank's Africa Region (AFR), to finance an activity to develop a quick screening methodology for LED lighting. The activity handled by Lighting Africa on behalf of ASTAE reviewed current product specifications and testing procedures; developed a screening method; and provided a test report for about 30 LED lights.

LED LIGHTING IS A  
POSSIBLE ENTRY POINT  
FOR ELECTRICITY  
ACCESS FOR OVER 1  
BILLION PEOPLE IN  
DEVELOPING COUNTRIES.



Following the methodology report, test procedures are being transferred to testing centers in selected Sub-Saharan Africa countries so that testing can be undertaken there. The technology transfer includes the methodology, training, and essential test equipment. This project is expected to improve the ability of consumers and project implementation agencies to select high-quality white LED products that can provide efficient, clean, and cost-effective lighting in off-grid facilities, thus benefiting households in both the Africa and Asia regions.

### ASTAE PUBLICATIONS IN FISCAL 2010

ASTAE activities produce multiple outputs under various formats, depending on the audience(s) targeted and the best way(s) to deliver information to them. Most report outputs are byproducts of an activity funded by ASTAE, though some are the end products of such activity. Whenever suitable, they are published, printed, and widely distributed to a broad audience, including through ASTAE’s Web site. The purpose of the publications is to share the knowledge and experiences, especially innovative ones, generated from ASTAE activities within and among countries in the region and beyond.

In fiscal 2010, ASTAE continued its technical report series of peer-reviewed, professionally published, high-quality consultant reports. These publications are being widely disseminated in printed and electronic form. Many other reports are not published, either because their value to the general public is limited or because they were confidential outputs delivered to partner countries.

Following is a list of reports and publications produced in fiscal 2010.

- *Vietnam, Expanding Opportunities in Energy Efficiency*, June 2010
- *China, Strategic Guidance to Meet the Challenges of Offshore and Large-Scale Wind Power*, April 2010
- *East Asia Region, Winds of Change: East Asia’s Sustainable Energy Future*, May 2010
- *Cambodia, Improved Energy Technologies*, February 2010
- *China, Regulatory Review of Offshore Wind in Five European Countries*, January 2010
- *Tonga, Electric Supply System Forecast*, February 2010
- *Mongolia, The Next Steppe - Mongolia’s Energy Future*, Dissemination Video, March 2010





3

### 3. ASTAE Performance Assessment— Fiscal 2007–10 Extended Business Plan

CHAPTER 2 DEALT SPECIFICALLY WITH ASTAE’S ACTIVITIES IN FISCAL 2010. THIS CHAPTER REVIEWS THE OVERALL PERFORMANCE OF ASTAE-FUNDED PROJECTS DURING THE FOUR YEARS OF THE CURRENT BUSINESS PLAN PERIOD, INITIATED FOR FISCAL 2007–09 AND EXTENDED INTO FY10 TO COMPLETE DISBURSEMENTS.

#### ASTAE ACTIVITIES AND DISBURSEMENTS IN EXTENDED BUSINESS PLAN PERIOD 2007–10

During the last four fiscal years, ASTAE disbursements totaled US\$7,365,439 from two trust funds provided by the government of the Netherlands and the government of Sweden. This is equivalent to 99 percent of the US\$7.4 million budget that was initially requested for the fiscal 2007–09 original business plan period and was covered by the pledge by the government of the Netherlands in March 2006.

In addition, the government of Sweden pledged SKr15 million in May 2007, which became available in 2008 and allowed extension of the business plan’s reach for an additional year into fiscal 2010.

#### Overview of Disbursements

As shown in figure 3-1, annual disbursements grew from US\$1.2 million in fiscal 2007 to the current annual rate of over US\$2 million, which exceeds the average disbursement in the last decade.

By the end of fiscal 2010, total donor resources disbursed by ASTAE had reached 99 percent of the US\$7.4 million budget allocated under the 2007–09 original business plan period.

When combining these disbursements with the commitments made at the end of fiscal 2010, as shown in figure 3-1, the total figure of US\$8.5 million represented 92 percent of the combined budget available from both donors. This high level of commitments and disbursements led to the decision to extend the two trust funds into fiscal 2011 to ensure maximum disbursements before starting into a new business plan.

The details of disbursements by country and fiscal year in table 3-1 show that total disbursements grew steadily during the first three years and leveled in fiscal 2010.

Figure 3-1: Evolution of Annual Disbursements and Comparison with Business Plan Budget

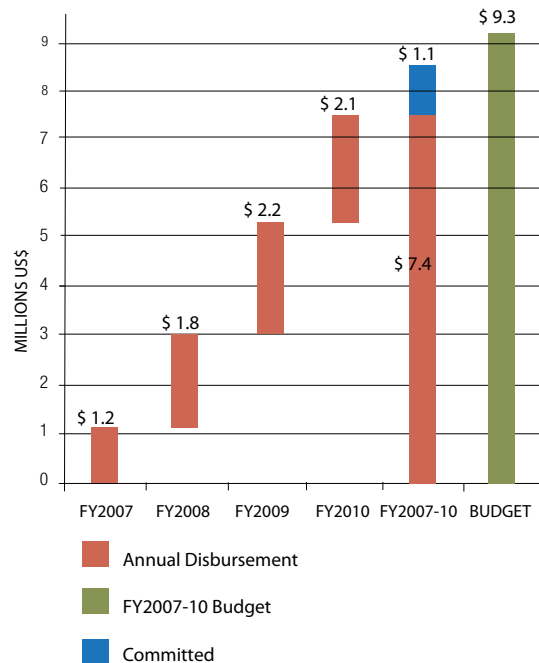


Table 3-1: Disbursements, by Countries over the Business Plan Period

Countries	Disbursements (in US\$)				Total
	FY 2007	FY 2008	FY 2009	FY 2010	Period FY2007-10
<b>CHINA AND MONGOLIA</b>					<b>21%</b>
China	129,628	238,736	288,917	183,355	\$ 840,635
Mongolia	125,891	290,159	99,618	178,248	\$ 693,916
<b>CAMBODIA, LAO PDR, THAILAND</b>					<b>7%</b>
Cambodia	0	43,012	108,459	32,263	\$ 183,735
Lao PDR	0	0	0	56,452	\$ 56,452
Thailand	234,736	79,508	7,197	0	\$ 321,441
<b>INDONESIA</b>					<b>8%</b>
Indonesia	77,850	0	175,253	326,323	\$ 579,426
<b>PHILIPPINES</b>					<b>1%</b>
Philippines	37,567	1,344	36,132	23,336	\$ 98,380
<b>VIETNAM</b>					<b>10%</b>
Vietnam	51,083	356,067	188,704	161,677	\$ 757,531
<b>PAPUA NEW GUINEA, TIMOR, AND PACIFIC ISLANDS COUNTRIES</b>					<b>17%</b>
Pacific	0	29,344	93,543	3,038	\$ 125,925
Fiji	0	41,987	69,485	0	\$ 111,472
Solomon Islands	0	238,936	76,449	63,705	\$ 379,090
Tonga	0	0	48,867	100,851	\$ 149,717
Timor-Leste	280,702	0	0	172,406	\$ 453,108
<b>SOUTH ASIA REGION</b>					<b>2%</b>
India	0	0	55,879	89,827	\$ 145,706
<b>REGIONAL PROJECTS, OUTREACH, AND KNOWLEDGE-SHARING</b>					<b>10%</b>
Regional, KS	6,212	34,765	373,644	335,423	\$ 750,045
<b>ADMINISTRATION AND REPORTING ACTIVITIES</b>					<b>23%</b>
Reporting	54,367	129,969	164,011	158,726	\$ 507,073
Administration	218,553	363,930	391,042	238,262	\$ 1,211,787
<b>TOTAL</b>	<b>1,216,589</b>	<b>1,847,757</b>	<b>2,177,200</b>	<b>2,123,893</b>	<b>7,365,439</b>
% increase	-	52%	18%	-2%	

n.a. Not applicable.



Figure 3-2: Disbursements, by Country and Financial Year

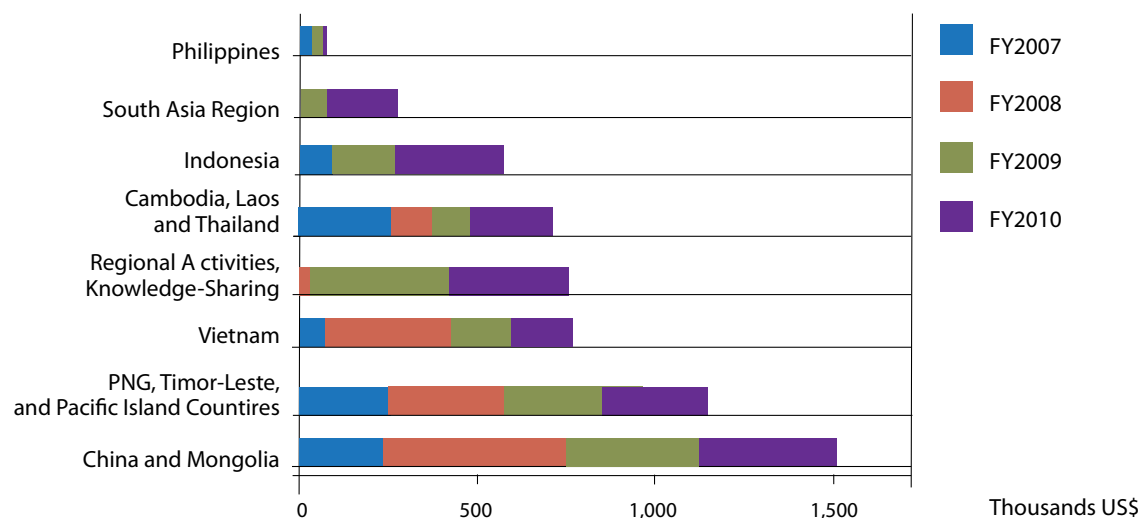


Figure 3-2 shows that China, Vietnam, and Mongolia received regular and significant ASTAE financial support (11, 10, and 9 percent of total expenditure, respectively). Indonesia also saw recent growth in disbursements that put it on par with other countries at 8 percent of total disbursements. Only the Philippines and South Asia lagged behind in disbursements.

The effort to reach out to smaller Pacific Islands countries increased over the business plan period; these countries are now a major part of the ASTAE portfolio, with 17 percent of the last four years’ disbursements. Timor-Leste and Solomon Islands represent the major portion of disbursements (6 and 5 percent, respectively). There has been no activity in Papua New Guinea.

The growth in the share of regional and knowledge-sharing activities, and in reporting activities (10 and 7 percent, respectively), reflect ASTAE’s new commitment to share good practices within the region and develop information that is of value beyond a single country by supporting regional activities and improving the means of outreach and external communication.

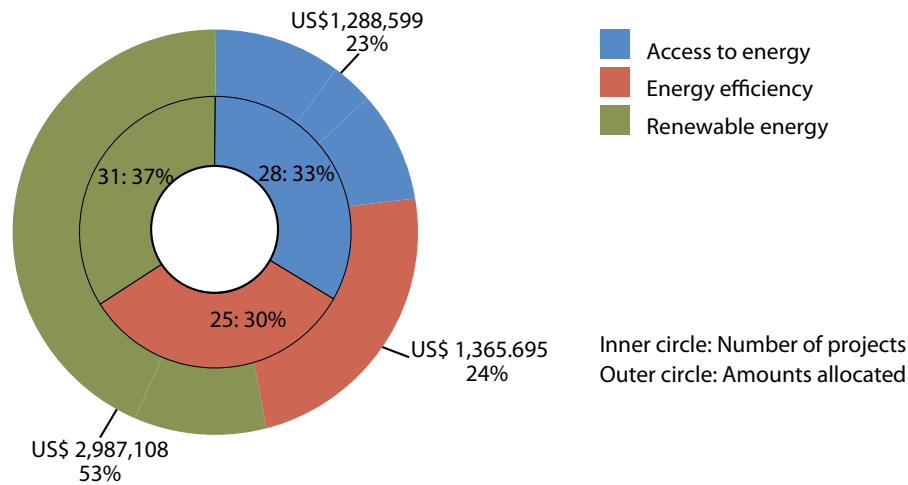
Abiding by the agreement with ASTAE donors, ASTAE’s administrative costs remained below 20 percent, in fact decreasing to 16 percent of total disbursements.

### Activity Repartition by Countries and Pillars

ASTAE funded 63 activities during the last four years. Many of these covered several pillars, which explains why the total of activities in figure 3-3 is more than 63 (see further details on this in “Introductory Note to Figures” in chapter 2).

ASTAE disbursements by pillar, shown in figure 3-3, demonstrate a strong position in the renewable energy sector, which is the primary focus of nearly half of the activities supported, with 28 of 63 activities receiving more than half of the funding. Access activities were the core focus of 16 activities, and were part of another 12 as a secondary theme; this explains the lower funding amount shown. Finally, energy-efficiency related activities were core in 19 activities and secondary in an additional 6. It should be noted that cross-sector activities, such as with the transport sector, are often linked to energy efficiency.

**Figure 3-3: Fiscal 2007–10 Disbursements, by ASTAE Pillar**



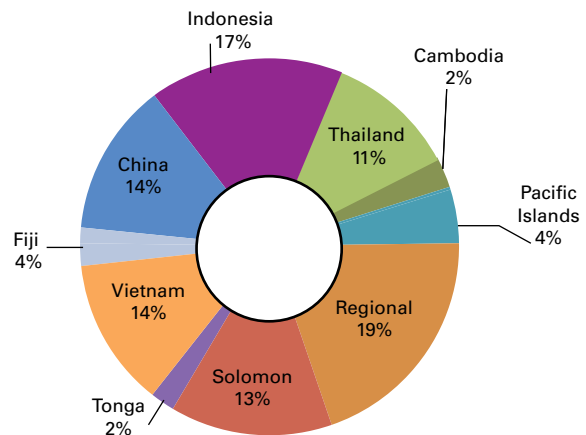
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Overall, while the primary focus of disbursements is on renewable energies, ASTAE task teams managed to keep a good balance among the three pillars in the global portfolio in terms of number of activities, when taking into consideration both primary and secondary themes of activities.

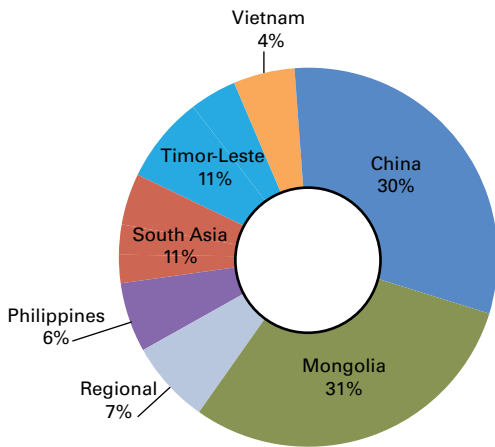
Figures 3-4 to 3-6 provide an overview of disbursements for each pillar, sorted by country, with the full disbursed amount allocated to the pillar of primary focus. These figures reveal the attention paid by ASTAE to channel funding in supporting the pillar that requires the most support for each country.

Figure 3-4 shows a well-spread distribution of renewable energy funding among countries in the East Asia and Pacific Region. This indicates that while interest in renewable energy is led by the efforts of large countries with robust domestic programs to reduce their carbon footprint, it is no longer limited to these countries. In fact, ASTAE's work in the Pacific Islands has dramatically increased, and now represents about a quarter of disbursements in renewable energy. This is driven by energy insecurity caused by fluctuations in international fuel prices and by the renewed interest in exploiting indigenous sources of renewable energy. Some significant regional activities were also undertaken—collectively representing 19 percent of disbursements—for the production of flagship reports as well as practitioners' tools.

**Figure 3-4: Renewable Energy Disbursements, by Country**

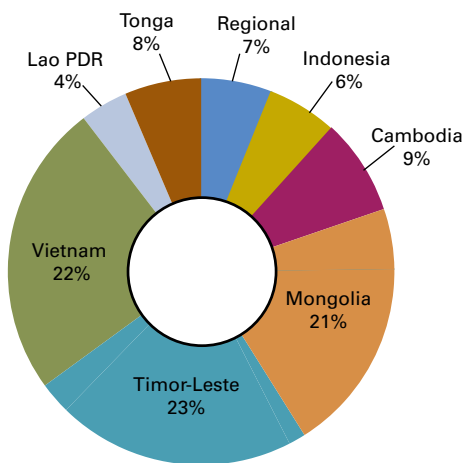


**Figure 3-5: Energy-Efficiency Disbursements, by Country**



Figures 3-5 and 3-6 show that the disbursements relative to the energy efficiency and access to modern energy services pillars are more narrowly focused on a smaller set of countries.

**Figure 3-6: Access Disbursements, by Country**



In energy efficiency, China and Mongolia represent more than 60 percent of total disbursements. This is the result of ASTAE’s continued involvement in helping China’s industries realize their energy savings potential, and follows a series of activities devoted to addressing heating-related issues in Mongolia. Promising activities have also begun and in South Asia, as has ground-breaking regional work related to energy in the transport sector. While the disbursements are the lowest in Vietnam, the activity that began has a very high impact potential.

In access to electricity, Timor-Leste, Vietnam, and Mongolia each represent over one-fifth of disbursements, and illustrate the variety of the realities and challenges that countries encounter in their efforts to increase access. In Vietnam, ASTAE provided assistance to the government’s work to improve the quality of service and to deliver access to electricity to the final 10 percent of population, primarily in remote rural areas. In contrast, access is much lower in Timor-Leste, where only 21 percent of the population have electricity; therefore, the support provided is of a different nature, focusing on basic new connections, increasing customer payments, and increasing the number of hours electricity is available daily. Finally, Mongolia is in a different position, with an aging network that covers urban and peri-urban populations quite well, but is in disrepair, and with a very dispersed rural population that can be reached only through individual systems.

Efforts to deliver improved access to energy are not limited to electricity. ASTAE plays a leadership role within the World Bank East Asia energy unit in promoting attention to energy used for heating, for both space heating and cooking. The work in Timor-Leste supported the establishment of a rural energy policy with practical recommendations in the areas of household energy and the development of biofuels from *Jatropha* crops. In Mongolia, ASTAE activities provided market-based approaches, as well as policy recommendations, for switching to energy-efficient heating stoves and cleaner fuels in ger households. In Cambodia, ASTAE supported activities that focused on creating sustainable businesses models, especially focused on empowering women, with strong scale-up potential for enterprises that produce affordable, energy-efficient products for local utilization, with provisions to train participants in the skills they require to participate in planning, working in, and managing those enterprises.

## STATUS OF 2007–10 PERFORMANCE INDICATORS

In addition to the ASTAE activities disbursements just described and to World Bank–related investment projects (covered at the end of this chapter), ASTAE tracks a set of indicators showing the trajectory of its impact in supporting sustainable energy development.

The indicators were chosen to illustrate each pillar. Although they may not cover the pillar’s entire spectrum—for example, renewable energy can be used to indicate more than generating electricity—they convey the predominant trend within each. They are usually available from World Bank project documentation and are therefore easily referenced from published sources. Achievements are measured as both a direct result of related World Bank loans and as the indirect impacts derived from World Bank and ASTAE technical assistance to country stakeholders. Whenever relevant, the aggregate value achieved for each indicator is put in context by comparing it to an equivalent output at the level of a country of the region, using U.S. Energy Information Agency (EIA) 2008 data.

Appendix 2 provides a table linking all ASTAE activities disbursed in fiscal 2010 to the related World Bank projects, and shows their contributions to ASTAE indicators. The contribution of each project is cumulative over the business plan period to derive the indicators described below.

### Renewable Energy Pillar

The renewable energy pillar is illustrated by an indicator for electricity generated using renewable fuel. Through support to projects that directly facilitate investments, ASTAE activities led to increased capacity and generation from renewable sources. As this indicator focuses on electricity, it precludes investments in renewable sources of heat (such as for cooking or space heating), but is nonetheless considered a good marker for investments in renewable energy in general.

#### **Indicator 1: New capacity and increased generation of renewable electricity**

Table 3-2 provides the renewable electricity capacity added during the four years of the business plan period, both directly through subsequent World Bank loans and indirectly from investments facilitated by World Bank projects and ASTAE activities.

**Table 3-2: Cumulative Renewable Electricity Capacity Added, by Country, FY2007–10**

Countries with ASTAE activity	Renewable electricity generation (capacity installed in MW)	
	Direct	Indirect
China	537	4,900
Mongolia	2	n.a.
Thailand	n.a.	1,500
Indonesia	260	6,000
Philippines	40	n.a.
Vietnam	180	n.a.
Fiji	5,6	n.a.
Solomon Islands	5,6	n.a.
Tonga	n.a.	10
Regional projects	n.a.	30.6
<b>TOTAL</b>	<b>1,030.6 MW</b>	<b>12,413 MW</b>

n.a. Not applicable.

This indicator is unchanged from fiscal 2009, as no major new projects related to renewable energy were presented to the Board of Directors in fiscal 2010. Most of the World Bank-funded renewable energy capacity growth over prior years was from wind in China and geothermal in Indonesia. Smaller contributions were added through solar or biofuels in other countries such as Mongolia and Tonga. Indirect capacity addition was also found in these two countries, where technical assistance to the governments in policy and sector reforms is expected to attract substantial private sector projects to scale up renewable energy.

ASTAE’s targets for renewable-based electricity were not expressed in installed capacity, but rather in annual electricity generation of 1,000 GWh directly and 10,000 GWh indirectly once projects were fully commissioned. However, as most Bank projects do not provide renewable electricity generated, but rather provide the number of MW installed and estimate the corresponding GWh, ASTAE follows the same process. As shown in the summary table 3-6 (following), these targets were met and exceeded during the business plan period.

World Bank projects supported by ASTAE during fiscal 2007–10 are expected to install 1,030 MW of renewable energy that will generate 1,579 GWh annually once commissioned. This is equivalent to the total installed capacity of Lao PDR and Cambodia in 2008 and all electricity generated in Cambodia in 2008.

In addition, ASTAE- and World Bank-funded support to frameworks, regulations, and investment mechanisms favorable to renewable energy development are expected to contribute indirectly to 12,400 MW being installed by utilities and private investors, which is expected to generate 18,000 GWh annually once commissioned.

### Energy-Efficiency Pillar

The energy-efficiency pillar is represented by an indicator of the quantity of electricity saved, or generation avoided, by decreasing consumption, reducing waste, or both. It illustrates the support to projects that limit the need for electricity generation throughout the year and limit the need for additional installed capacity to meet annual peak demand. Because this indicator focuses on electricity, it does not reflect the investments in heating, primarily space heating in northeast Asia, or in cookstove improvements. It is nonetheless considered a good marker for investments in energy efficiency.

#### **Indicator 2: Electricity savings resulting from efficiency improvements**

Table 3-3 provides a summary of cumulative annual electricity savings that derive from ASTAE-supported World Bank projects once fully implemented. These estimates are calculated based on direct savings through World Bank loans or on indirect support by way of investments facilitated by World Bank and ASTAE technical support.

As noted earlier, ASTAE activities related to improving efficiency in the power sector took place in fewer countries. This indicator also remains unchanged from the level reached in fiscal 2009, because while several projects presented to the Board in fiscal 2010 were related to energy efficiency, their impact was measured in decreased CO<sub>2</sub> emissions rather than GWh saved.

ASTAE provided significant financial support to electricity savings in the Vietnam rural electrification project, which has delivered direct impact, improving medium- and low-voltage networks and reducing losses dramatically—representing 95 percent of total program-wide direct savings. As for indirect savings, one major source of impact (76 percent of total) was

**Table 3-3: Cumulative Electricity Savings, by Country, FY2007–10**

Countries with ASTAE activity	Electricity savings (GWh electricity, annually)	
	Direct	Indirect
China	—	20,000
Thailand	—	5,750
Philippines	80	—
Vietnam	1,500	—
Fiji	3.3	400
Solomon Islands	3.3	—
<b>Total</b>	<b>1,586.6</b>	<b>26,150</b>
— Not applicable.		

the result of ASTAE-supported activity in China that led to banks creating new financial products to fund energy-efficiency projects; another important result came through ASTAE contribution to the energy-efficiency roadmap in Thailand that helped focus the government on priority sectors with the highest savings potential.

The summary table 3-6 shows that the business plan targets for both direct and indirect annual electricity savings will be exceeded. When all projects are operational, direct savings will be 1,586 GWh annually and indirect savings will be more than twice the target, at 26,150 GWh annually. The latter figure is equivalent to what would have been saved by halting electricity generation in the Philippines for six months in 2008.

### Access to Modern Energy Services Pillar

The access to energy pillar is measured in terms of number of households that received new or improved connections to modern energy services, regardless of the type of fuel used. Under this measurement method, an improved wood-burning stove that reduces smoke emissions and decreases consumption of raw wood for the same heat output counts the same as an improved electricity connection. Although the type of service differs amply—cooking and heating on one hand and lighting, information, and (sometimes) productive uses on the other—they are treated here as being of the same value to the beneficiary.

Distinctions made to differentiate connection types are based on whether they are new connections or improved ones, and whether they are direct or indirect connections.

**Indicator 3: Households with access to modern energy services**

New connections to electricity services have a life-changing impact, whether because of new opportunities opened by access to electricity or improved efficiency in daily tasks made possible by the use of powered tools and appliances. Improved connections also help remove constraints on households, often by lowering the amount of fuel needed or improving the reliability of existing services, thereby eliminating the need for backup service. For example, improved electricity connections in Vietnam helped reduce the need for alternative sources of lighting, such as kerosene lamps or candles, that were needed when unplanned blackouts were a frequent occurrence.

It should be noted, however, that the distinction between new and improved services is not always as obvious as it might appear, as a new connections is often in fact an improved connection to the same service using a more efficient fuel source. For example, a new connection to electricity displaces the use of kerosene for lighting or batteries for radios, and provides a much more efficient and less costly source, but does not bring new access to lighting services or radio use, as these were already in place.

Table 3-4 shows that the rural electricity energy project in Vietnam is by far the most important achievement in increasing household access under the ASTAE program in the East Asia and Pacific Region. This is because large numbers of people were not connected to the national grid and because the government took voluntary actions to provide universal access to electricity.

Access to electricity remains the major component of the indicator, but space heating is also represented in Mongolia, as well as cooking stoves and biogas in Cambodia and Timor-Leste. In fiscal 2010, ASTAE activities in Lao PDR contributed to a rural electricity project that will add 37,700 new households to the grid.

Direct targets have been met, with ASTAE-supported World Bank projects financing improved services to 2 million households (four times the target of 500,000) and new access to modern energy services to an additional 648,450 households (129 percent of the target of 500,000 households).

Indirect targets were partly met when assessing new and improved access to energy separately, but as an aggregate measurement, ASTAE's achievement in this regard has

**Table 3-4: Households with Access to Modern Energy Services, by Country, FY2007–09**

Region and country of activity	Households with access to modern energy services (number of households)	
	Direct	Indirect
China	—	300,000 (NA)
Mongolia	226,000 (NA)	150,000 (NA)
Cambodia	17,500 (NA)	—
Lao PDR	37,700 (NA)	
Indonesia	—	200,000 (IS)
Vietnam	150,000 (NA) 2,000,000 (IS)	—
Fiji	22,050 (NA)	—
Solomon Islands	92,200 (NA)	—
Tonga	—	20,000 (NA)
Timor-Leste	80,000 (NA)	—
Regional projects	23,000 (NA)	—
Total	648,450 (NA) 2,000,000 (IS)	470,000 (NA) 200,000 (IS)
NA: New access		IS: Improved services

exceeded the targets. ASTAE-supported projects fell 20 percent short of meeting the goal of 250,000 households with indirect improved services. However, the new access that resulted was more than nine times the modest target of 50,000 households, and with 470,000 households, would also have been well over target had it been set at the same level as the improved services target.

In sum, ASTAE's commitment to include access to energy as a new pillar, in addition to its historic pillars of renewable energy and energy efficiency, has been followed by bold action and impressive results.

### Cross-Cutting Indicators

A fourth and a fifth indicator that cut across the other three pillars also have been defined. One is dependent on the results from the three pillars' individual indicators, while the other is a more generic assessment of ASTAE's overall footprint across the region.

The fourth indicator measures reductions in CO<sub>2</sub> emissions, representing the overall impact on greenhouse gas abatement. It is an important metric to track because CO<sub>2</sub> emissions are considered the main contributor to the greenhouse effect. ASTAE activities have a direct impact on CO<sub>2</sub> reduction through World Bank project contributions to renewable energy, energy efficiency, and improved access to modern energy services.

The fifth indicator ensures that financial assistance is given to all countries in the region and avoids the unintended trap of focusing on large countries just to meet the earlier four indicators.

#### **Indicator 4: Avoided greenhouse gas emissions**

This indicator estimates the quantity of CO<sub>2</sub> emissions that would be avoided over 20 years (the conventional lifespan of projects or equipment) through ASTAE-supported World Bank projects. It determines the CO<sub>2</sub> equivalent saved directly and indirectly by replacing conventional thermal power plants with renewable energy and realizing the potential energy savings.

Table 3-5 shows that China brings in more than half of the direct CO<sub>2</sub> savings. However, projects in Indonesia and Vietnam contribute large shares of avoided CO<sub>2</sub> emissions. The table also confirms that to substantially scale up CO<sub>2</sub> emission mitigation, support to country programs that encourage sustainable energy use in energy-intensive economic sectors has the greatest effect. This is illustrated by the fact that indirect CO<sub>2</sub> savings overall are 10 times greater than direct savings. The indirect savings are led by savings expected from restarting a major investment in geothermal in Indonesia and by continued private sector investment in alternative energy in China.

The CO<sub>2</sub> targets have been met. The direct impact value, estimated at 114 million tons, or 162 percent of the target, would be roughly equivalent to all of Vietnam's CO<sub>2</sub> emissions in 2008. The indirect savings, estimated to be 1,097 million tons, or 140 percent of the target, would be equivalent to the total CO<sub>2</sub> emissions of the African continent in 2008.

**Table 3-5: CO<sub>2</sub> Mitigated, by Country, FY2007–10**

Region and country of activity	CO <sub>2</sub> mitigated over 20 years (million tons)	
	Direct	Indirect
China	61.42	510.00
Mongolia	0.18	—
Cambodia	1.52	—
Thailand	—	82.00
Indonesia	21.00	500.00
Philippines	2.00	—
Vietnam	20.28	—
Fiji	0.17	2.46
Solomon Islands	0.17	—
Tonga	—	0.32
Timor-Leste	2.20	—
India	4.80	—
Regional projects	—	0.50
<b>Total</b>	<b>113.74 (direct)</b>	<b>1,097.25 (indirect)</b>
— Not applicable.		

#### **Indicator 5: Countries benefiting from ASTAE support**

ASTAE provided financial support to activities in 13 countries, as well as to several regional activities, well exceeding the target of a minimum of 10 countries. Many of the Pacific Islands countries were well represented, in addition to the large continental countries. The differences among countries in the East Asia and Pacific Region where ASTAE is active are vast, ranging from China, the dominant economy of the Region, to the much smaller Tonga. All ASTAE activities are designed to adapt to the wide variety of issues throughout the region, as well as to the country context. Table 3-6 provides a summary of all indicators discussed in this chapter.

Table 3-6: Summary of 2007–10 Extended Business Plan Targets, Pledged and Achieved

Indicators		Unit	Value pledged for business plan period	Effectively achieved during business plan period	Achieved or pledged ratio (%)
<b>1. NEW CAPACITY AND INCREASED GENERATION OF RENEWABLE ELECTRICITY</b>					
Direct renewable energy	- Capacity - Generation	MW GWh/year	n.a. 1,000	1,030 1,579	n.a. 158
Indirect renewable energy	- Capacity - Generation	MW GWh/year	n.a. 10,000	12,413 18,018	n.a. 180
<b>2. ELECTRICITY SAVINGS RESULTING FROM EFFICIENCY IMPROVEMENTS</b>					
Direct energy savings	- Generation	GWh/year	1,000	1,586	159
Indirect energy savings	- Generation	GWh/year	10,000	26,150	262
<b>3. HOUSEHOLDS WITH ACCESS TO MODERN ENERGY SERVICES</b>					
Direct <sup>a</sup> new access (DNA)		Household	500,000	648,450	129
Direct improved services (DIS)		Household	500,000	2,000,000	400
Indirect <sup>b</sup> new access (INA)		Household	50,000	470,000	940
Indirect improved services (IIS)		Household	250,000	200,000	80
<b>4. AVOIDED GREENHOUSE GAS EMISSIONS</b>					
Direct CO <sub>2</sub> avoided over 20 years		Million tons	70	114	162
Indirect CO <sub>2</sub> avoided over 20 years		Million tons	780	1,097	140
<b>5. COUNTRIES BENEFITING FROM ASTAE SUPPORT</b>					
Number of Countries		Country	10	13	130

n.a. Not applicable.

a. Direct refers to values achieved, or expected to be achieved, in the course of World Bank-funded projects that benefited from ASTAE support.

b. Indirect refers to values achieved, or expected to be achieved, following actions engaged by countries' energy stakeholders that result from informed decisions to which ASTAE contributed through its funding.



## ASTAE-SUPPORTED WORLD BANK OPERATIONS IN FISCAL 2010

Over the fiscal 2007–10 extended business plan period, 17 World Bank projects that promoted sustainable energy and that have benefited from ASTAE support were presented to the Board. The total lending in these projects amounted to just over US\$2.2 billion with about US\$1.2 billion in IBRD-IDA-GEF grants and lending. A list of ASTAE-related projects presented and their financing details is provided in appendix 4.

This lending, focused on developing sustainable energy, was enabled or facilitated by ASTAE support and illustrates ASTAE's leverage on World Bank lending. This leverage is reinforced when its role in the successful delivery of Bank projects leads to second-phase or additional financing that further scales up the impacts of the initial project.

Four such ASTAE-supported World Bank projects (described briefly below) were presented to the Board of Directors in fiscal 2010 for a total of US\$199 million. The other 13 are described in prior annual reports. The four recent projects will be implemented over the next five fiscal years.

### China - Energy Efficiency Financing II

This project, presented to the World Bank's Board of Directors in June 2010 for a total of US\$101.6 million, follows up an earlier project, begun in 2008, that helped launch energy-efficiency lending business lines in China, in both a public bank and a commercial bank, through the operation of a line of credit.

Though the first project is advancing successfully, the energy efficiency portfolios of Chinese banks remain small compared to their total lending volumes and abundant liquidity, especially in light of the potential size of the energy efficiency market. Furthermore, a review of commercial banks' portfolios found that most of their energy efficiency investments are in fact in capacity expansion driven by advanced technologies, rather than focused on the demand side, or on energy-efficient rehabilitation of existing assets. This is because the perceived high risk of demand side industrial energy efficiency lending remains a common barrier among Chinese banks—a perception reinforced by the risk-adverse position banks took during the global financial crisis.

The new project is a financial intermediary lending operation, whereby the Bank loan will be on-lent by the Ministry of Finance on the same financial terms and conditions, with no interest rate subsidy, to the participating financial institution,

China Minsheng Banking Corporation, Ltd. (Minsheng). The project will finance only energy efficiency rehabilitation subprojects. Major types of subproject eligible for financing include

- replacement of inefficient industrial technologies with energy saving technologies, for example, more efficient industrial boilers, kilns, and heat exchange systems,
- recovery and utilization of byproduct gas, waste heat and pressure,
- installation of efficient mechanical and electrical equipment, including motors, pumps, heating and ventilation equipments,
- industrial system optimization to reduce energy use, and
- other energy efficiency projects agreed to between the Bank and GOC.

The project also includes a technical assistance component to Minsheng. It will catalyze energy efficiency lending and help Minsheng develop and sustain the business line by building on its sector knowledge and client base. Furthermore, a very high average leverage ratio of 1:10 of Bank funds is expected. Therefore, the US\$100 million Bank funding would be complemented by US\$500 million in debt financing by Minsheng, and with US\$400 million from borrowers (that are required to provide at least 40 percent of subproject costs in equity), this will lead to US\$1 billion allocated to energy efficiency over the project period.

### India - Financing Energy Efficiency in Micro, Small, and Medium-Sized Enterprises

This US\$57.6 million Global Environment Facility (GEF) project, directed toward Indian MSMEs facing high and rising energy costs, was presented to the Bank's Board of Directors in April 2010. Unlike sectors of the economy such as agriculture that benefit from subsidized energy prices, export-oriented Indian—MSMEs in particular are facing increased global competition. Many are energy-intensive, employing inefficient and outmoded technologies and operational modalities that endanger their competitiveness and future growth. Investments in cost-effective energy efficiency measures should improve their productivity and bottom-line profits.

Given India's current market barriers, a need was recognized to support development of numerous energy efficiency investment proposals, with an aim to a) aggregating demand for such investments in MSME industrial clusters and b) creating a sustainable mechanism to locally identify, prepare,

and finance these proposals. This particular project builds on the success of the recently completed World Bank global technical assistance project "Developing Financial Intermediation Mechanisms in China, India and Brazil".

The project will begin with technical assistance that will increase awareness of energy efficiency at the cluster and plant level on a large scale. It will also increase the capacity of energy auditors, financial consultants, chartered accountants, vendors, service providers, and local banks through training programs and other efforts to build internal capacities. Finally, it will support the uptake of risk mitigation instruments, such as guarantees, that are currently available in the Indian market.

The project will also provide grant support to cover the "soft costs" of an initial pipeline of about 500 projects, including at least 1,000 initial project assessments. Funding will also be available for incentives for demonstration projects and for early adopters of appropriate energy-efficient technologies. The average investment envisaged in individual MSME units is in the range of Rs 2 million to Rs 4.2 million (~US\$44,000 to 93,000) with a simple payback period of less than 2 years.

The project supports the global environmental agenda of stabilizing atmospheric concentrations of greenhouse gases (GHG) through an increase in EE investments and resulting energy savings. The key indicator will be CO<sub>2</sub> emission reductions resulting from energy savings in the designated MSME clusters. It is anticipated that the project will support EE investments that will reduce global emissions of CO<sub>2</sub> by 4.8 million tons over the lifetime of the equipment installed.

### Lao PDR - Rural Electrification Phase II

This project, presented to the Bank's Board of Directors in January 2010 for a total of US\$35.8 million, is phase two of an Adaptable Program Loan (APL) presented in June 2007. Under an APL, an overall program is financed in two or more phases with specific triggers set up to move (or not) from one phase to another.

#### The Lao PDR Program's aims were

- to provide access to electricity to some 106,000 rural households,
- to achieve financial sustainability of Électricité du Laos (EdL),
- to promote development of legal, regulatory, and institutional frameworks,
- to encourage new participants in sector development,

- to provide a sound planning basis for electrification, and
- to increase the efficiency of electricity delivery and consumption.

#### Phase one focused on

- implementation of the sustainability action plan, which includes a tariff reform program, settlement of past-due electricity bills, establishment of a rural electrification (RE) fund, and enhancement of utility operation efficiency,
- capacity building in rural electrification master planning and implementation, and safeguards management,
- development and piloting of sustainable sector financing strategy, alternative power generation technologies, and alternative delivery models for both on and off-grid RE, and
- creation of awareness of demand-side management and piloting a demand-side management program.

With key triggers met by 2009, phase two of the project began with further expansion of access to on- and off-grid electricity supply by rural households. It will focus on final implementation of the sustainability action plan to achieve its final targets: scale-up of the alternative generation technologies and alternative delivery models for both on- and off-grid RE piloted during phase one; and scale-up of the demand-side management program throughout the country.

#### Reaching project targets would bring about two key environmental outcomes:

- Substantial adoption of off-grid renewable energy in the rural electrification program, with the share of newly electrified households growing from a 7 percent baseline to a 20 percent share under this project; and
- increased efficiency of energy supply by EdL and of consumption by customers, resulting in increased exports of hydropower to Thailand and reduced use of thermal power.

### Vietnam - System Efficiency Improvement, Equitization, and Renewable Additional Financing

This project, presented in May 2010, provides additional financing of US\$26.1 million to the original project in order to complete what had been started. The original project, for an International Development Agency (IDA) amount of US\$220 million, consisted of three components: system efficiency improvement, focusing particularly on transmission systems and demand-side management activity; improving rural energy

access, sub-transmission systems, rehabilitation of small hydropower and development of off-grid or mini-grid supply using renewable energy; and sector reform and institutional development.

The electricity sector has met the challenge well. Since the start of the original project, GDP has grown over 7 percent annually; increasing and meeting overall demand will enable continued growth. Between 1995 and 2009, household access increased from 50 percent to around 95 percent; annual per capita consumption increased from 156 kilowatt hours (kWh) to about 800 kWh. Losses (technical and nontechnical) fell to an estimated 10.5 percent in 2009, down from over 20 percent 10 years earlier. The government of Vietnam passed a market-oriented electricity law in November, 2004, followed by the establishment of the Electricity Regulatory Authority of Vietnam in 2005. The government is implementing a roadmap for reform, the first step of which was scheduled to be completed in 2010. In recent years, a supply shortage has become more visible, though it narrowed in 2008 as growth in demand declined during the economic downturn.

The objectives of the additional financing are to continue enhancing electricity system efficiency, help improve power quality in selected rural areas, and sustain reform and institutional development of the country's energy sector. In addition, the financing has a global objective—to contribute to reduced greenhouse gas emissions by promoting use of renewable resources to produce energy.



4

## 4. Outlook for Fiscal 2011 and Beyond

ASTAE TRUST FUNDS WERE EXTENDED FOR ONE LAST YEAR OF DISBURSEMENT INTO FISCAL 2011 TO ENSURE FULL USE OF THE FUNDS PROVIDED BY DONORS UNDER THE CURRENT BUSINESS PLAN.

### ASTAE INDICATIVE PIPELINE FOR FISCAL 2011

Preparing for this last year of disbursements, ASTAE will approve new activity proposals and provide additional funds for some current activities. In fiscal 2011, ASTAE will also act on its decision to reengage in the South Asia region by approving two new activities in Bangladesh and in India.

The next paragraphs provide an overview of the ASTAE activities expected to start in fiscal 2011.

#### Bangladesh - Strengthening Rural Electrification Service Delivery

Rural electrification service delivery in Bangladesh, based on the rural cooperative model, has been a success story. The Rural Electrification Board (REB) and its rural cooperatives (PBSs) have connected some 8.5 million customers to the grid. In all efficiency measures (systems losses, collection efficiency, and so on), the performance of the PBSs has been much stronger than that of the state-owned urban utilities. Still, access to electricity in rural areas is only 30 percent; if the government's vision of 100 percent access by 2021 is to be achieved, a serious look needs to be taken at the efficiency of the organizational structure of the REB, and corresponding adjustments need to be made in its relationship with the PBSs.

An organizational effectiveness study was initiated in 2009 with Bank support that identified the problems/challenges in the rural electrification (RE) program in Bangladesh. It was followed by a unique stakeholder consultation process that culminated in a high-level workshop, attended by top decision makers and other stakeholders, where it was widely acknowledged that the RE program needed major changes. It was also apparent, however, that there was widespread disagreement over the course reforms should take.

The objectives of the ASTAE activity are to provide technical expertise to the government task force created to reach a consensus on the action plan for RE reforms and to assist the task force in developing a time-bound action plan for those reforms. Subject to the government's timely design and adoption of the plan, the World Bank is expected to provide support to its implementation through the next rural electrification lending operation, expected in early fiscal 2012.

#### India - Development Impact of Load Partition in Rural Areas

In India today, electricity tariffs for agricultural use amount to less than 10 percent of the cost of supply, while power shortages, due to insufficient investments in generation and transmission networks, routinely impact rural consumers. This situation is in large part the result of a policy of unmetered agriculture connections that mainly benefit large farmers, while most small and micro-farmers lack basic electricity connection. The lack of agriculture metering prevents cross-subsidy monitoring and limits effective estimations of distribution losses. This problem is being addressed by identifying the demand and partitioning the load as either agricultural, for irrigation, or rural, for nonagricultural domestic consumption. This allows separate monitoring of paid and nonpaid loads, which helps limit the subsidized power supplied for irrigation. This approach has been tried on an ad hoc basis in several Indian states. There is now a need for a national framework of methodologies, rules, and regulations on managing rural and agricultural supply

The World Bank is already funding a study of various methodologies to segregate rural and agricultural loads as well as a companion study analyzing the impact of rural load segregation on utilities. Absent in the companion study, however, is an analysis of the impact of such load partition on rural customers, knowledge of which is key to successful rollout of a load partition policy.

The proposed ASTAE activity will fund a consumer survey to confirm the technical findings of the companion study and to provide qualitative/quantitative perspective on how the rural population experiences load partition. The survey will focus on domestic and commercial customers who are given access after rural/agricultural segregation to identify any linkages between customer satisfaction and the technical performance indicators done in the companion study.

The ASTAE study will also provide insight into how customers use their improved power, whether for household benefits only, or in new income generating activities such as investing in small appliances and tools to increase productivity.

### Indonesia - Thousand Islands Solar PV

Starting from a very low base of 2 percent national electricity access in the late 1970s, Indonesia's national electricity company, PLN, set a scorching pace for electrification, especially in the 10-year period starting in late 1980s, exceeding 1 million rural area connections annually and achieving a national access level of over 65 percent by 1999. The rapid progress of the grid-based electrification rollout program was abruptly and unexpectedly interrupted by the onset of the East Asian financial crisis which led to the "lost decade"—national electricity access coverage is projected to have stalled around 65–67 percent, and likely even decreased on a percentage basis in many regions because of population growth. Today, as a result, nearly 80 million people still lack access to electricity in Indonesia.

The government of Indonesia aims to achieve near-universal access during 2020–30 and has included the Eastern Islands electrification program (referred to as the 1,000 Islands electrification program)—in its sector priorities. The Bank is preparing an investment and TA project lending operation supporting this program. The proposed project will be anchored around PLN's large number of operational grid systems and will be focused on a spatial least-cost grid rollout framework to provide the analytical and operational basis to rationalize and map the locations and scope of the complementary grid and off-grid "spaces." In the context of recent Bank re-engagement in this rural electrification subsector in Indonesia, ASTAE will support a subsector assessment to document the WB project concept note, by characterizing the current and future opportunities and potential, over the medium term, for scaling up service delivery in both PLN's grid systems and in off-grid areas in eastern Indonesian Islands. ASTAE support will assemble and review key sector data and relevant information to generate the comprehensive and substantiated factual knowledge—in scope and coverage—that is still missing,

but required for Bank engagement. It will provide operational input in the concept note, including project background and rationale; project objectives; investment and TA scope and components; implementation arrangements; technical issues and considerations; economic rationale; and staging strategy for achieving grid- and off-grid-based scale-up and delivery in a complementary and cost-effective manner, and consistent with government coverage targets and timeline.

## STAFFING AND UPCOMING FUNDING PERIODS

### Fiscal 2010 was a Transition Year

Fiscal 2010 was a year of transition, with changes in the ASTAE team and discussions on renewed funding with donors.

#### Substantial Staffing Changes in Fiscal 2010

The ASTAE team saw these changes in its composition over FY2010:

- Mr. Vijay Jagannathan, sector manager for the East Asia Infrastructure Unit (EASIN), has been the ASTAE program manager since July 2009
- Ms. Natsuko Toba became ASTAE Coordinator in May 2010, replacing Mr. Frederic Asseline, who joined the World Bank team in China.
- Mr. Dejan Ostojic became sector leader for energy in EASIN in early fiscal 2010. He provides strategic support to the program manager and the coordinator.
- At the end of fiscal 2010, Mr. Song Yanquin and Mr. Tendai Gregan, ASTAE energy specialists based in China and Australia, respectively, left the program to join their respective World Bank teams.

#### Funding Status in Fiscal 2011

In fiscal 2011, ASTAE activities remain endowed from the two trust funds that existed in fiscal 2010:

- Government of the Netherlands Trust Fund for ASTAE from the Bank-Netherlands Partnership Program (BNPP) (TF057088); and
- Swedish International Development Agency (SIDA) Trust Fund for ASTAE (TF091618).

The Netherlands Trust Fund was extended to the end of calendar year 2010 in order to enable full disbursement of the remaining budgets that were committed, or yet to be committed, in fiscal 2010.

The Sweden Trust Fund was also extended throughout fiscal 2010 into fiscal 2011, with an expected closing at the end of February 2011.

ASTAE is discussing throughout fiscal 2011 the modalities of an additional commitment from the governments of the Netherlands and Sweden that would allow both Bank- and recipient-executed activities and support activities in World Bank client countries in East and South Asia. Additional resources will be needed in fiscal 2012 and beyond; discussions are ongoing with several potential donors.

### Preparation of a New Funding Period for Fiscal 2012–15

In fiscal 2011, the ASTAE team will introduce a multi-donor trust fund (MDTF) to streamline the incorporation of new donors and modify its governance structure to allow for increased efficiency in disbursement and for implementation of recipient-executed activities. The MDTF will provide an efficient multi-year funding instrument, and will be the preferred financing tool to achieve ASTAE's goal of scaling up the use of sustainable energy solutions in Asia to reduce energy poverty and protect the environment.

The MDTF will finance all activities eligible under the ASTAE program, with specific focus determined by the upcoming business plan. Activities to be financed under Bank or recipient execution by the programmatic MDTF should positively affect one or more ASTAE pillars (renewable energies, energy efficiency, and energy access) through the five operational approaches (innovative delivery mechanisms; policy and regulatory frameworks; capacity building and knowledge sharing; new technologies; and cross-sector collaboration). The two latter approaches were already implicitly included in ASTAE activities but will become formal approaches. The new technologies approach relates to the introduction of technologies, both new and proven, which promote access, use of renewables, or increased efficiency, but are unavailable or inaccessible in ASTAE countries or markets. The cross-sector collaboration approach promotes such collaboration in developing energy-related activities that support mitigation of and adaptation to climate change.

Upon completion of the MDTF and approval by the Donors Consultative Group, the ASTAE team will prepare a new

business plan for fiscal 2012–15 that will serve as a fundraising platform. Based on recent World Bank analytical work, the plan will describe how ASTAE will help World Bank teams respond to new challenges in the South Asia and East Asia and Pacific Regions in ASTAE intervention areas. It will also encompass World Bank client countries in these Regions, and provide prioritization by pillar and approaches. As ASTAE operates programmatically, the plan will outline, but not define in detail, the type of activities to be funded for both Bank and recipient execution, and suggest how ASTAE will finance activities at regional, multicountry, national, and subnational levels. It will also delineate how activities will be selected in the energy sector, as well as how to determine relevant energy-related activities in other sectors. Finally, it will define the monitoring and evaluation mechanisms, including the redefinition of indicators.



APPENDICES



## Appendices to Annual Status Report

### APPENDIX 1: ASTAE COUNTRIES AT A GLANCE: REGION MAP AND PILLAR-RELATED STATISTICS

The map below shows the partner countries where ASTAE operates in the South Asia and East Asia and Pacific Regions.

Appendix Figure 1-1: ASTAE Presence in South Asia, East Asia and Pacific Regions



## APPENDIX 1: ASTAE COUNTRIES AT A GLANCE: REGION MAP AND PILLAR-RELATED STATISTICS

Appendix table 1-1 provides data to illustrate the diversity of South Asia and East Asia and Pacific countries in the context of ASTAE pillars.

Appendix Table 1-1: Background Data Providing Context to ASTAE Pillars

Region and countries of activity	Basic context		First pillar: renewable energy			
	Population (WB 2008)	GDP (WB 2008)	Installed capacity electricity (EIA 2008)	Annual electricity generation (EIA 2008)	Installed capacity renewable (EIA 2008)	Share of generation using renewable (EIA 2008)
	Million	Billion US\$	MW	TWh	MW	%
<b>EAST ASIA</b>						
Cambodia	14.7	9.6	386	1.38	18	4%
China	1,325.6	4,326.2	797,078	3,221.18	186,820	17%
Indonesia	228.2	514.4	27,802	141.19	5,801	14%
Lao PDR	6.2	5.2	723	3.98	673	92%
Mongolia	2.6	5.3	832	3.90	0	0%
Philippines	90.3	166.9	15,680	57.39	5,283	34%
Papua New Guinea	6.4	8.2	699	2.97	271	30%
Thailand	67.4	260.7	40,669	138.99	3,487	8%
Vietnam	86.2	90.7	13,850	69.97	5,500	37%
<b>SOUTH ASIA</b>						
Bangladesh	154.0	79.5	5,453	32.93	230	4%
India	1140.6	1,214.20	177,376	785.53	51,363	50%
Nepal	28.2	12.0	717	3.1	660	99%
Pakistan	171.9	163.9	19,769	87.74	6,464	31%
Sri Lanka	21.1	40.7	2,645	8.89	1,360	46%
<b>WORLD INDEX</b>						
World	6,692	60,587	4,624,767	19,103.20	1,056,413	19%
<b>PACIFIC ISLANDS</b>						
Fiji	0.8	3.5	216	0.93	95	71%
Solomon Islands	0.5	0.6	14	0.08	0	0%
Samoa	0.2	0.5	41	0.11	12	46%
Timor-Leste	1.1	0.5	-	-	-	-
Vanuatu	0.2	0.6	12	0.04	0	0%

Sources:  
 Population & GDP: World Bank 2008 Data Group of Development Economics (DECDG).  
 Electrification rate: World Bank EAP unit for East Asia, EIA for other.  
 Ranking CO<sub>2</sub> emissions: ASTAE, using EIA 2008 data.  
 Economic Intensity: Calculated by EIA using year 2005 US\$ market exchange rates.  
 All other indicators, US Department of Energy, Energy Information Administration, 2008.

These data are not updated regularly by any centralized entity and therefore may not even be available for the most recent years. They are primarily sourced from the U.S. Department of Energy's Energy Information Administration (EIA), as well as from the International Energy Agency (IEA), and are dated from 2008 unless otherwise noted. The footnotes provide further details.

Second pillar: energy efficiency		Third pillar: access		Greenhouse gas emissions			
Economy in- tensity (EIA 2008)	Power intensity (IEA 2008)	Population without electricity (2008)	Electrifica- tion rate (Word Bank, IEA 2009)	Annual energy-related CO <sub>2</sub> emission and ranking (EIA 2008)		Annual per capita energy related CO <sub>2</sub> emission and ranking (2008)	
tCO <sub>2</sub> /US\$1,000 GDP	tCO <sub>2</sub> / MWh	Million	%	Million ton	Out of 189	ton / capital	Out of 189
0.49	1.15	11.2	24%	3.9	130	0.27	164
2.12	0.76	13.3	99%	6,553.5	1	4.94	71
1.42	0.73	79.9	65%	434.1	16	1.90	113
0.35	-	1.9	70%	1.3	162	0.20	170
2.91	0.54	0.3	90%	7.2	110	2.77	101
0.68	0.46	9.0	90%	79.8	45	0.88	138
0.85	-	6.0	7%	4.9	123	0.77	139
1.27	0.53	0.7	99%	254.0	25	3.77	84
1.42	0.43	1.7	98%	93.7	42	1.09	129
0.70	0.57	90.9	41%	48.7	63	0.32	158
1.45	0.95	387.8	66%	1,494.9	4	1.31	123
0.40	0.03	16.1	43%	3.2	133	0.11	177
1.13	0.43	65.3	62%	147.7	34	0.86	136
0.45	0.38	4.9	77%	13.4	92	0.64	145
-	0.51	-	79%	30,377.3	-	4.54	Eq 76
0.94	-	-	-	2.7	144	3.43	97
0.64	-	-	-	0.2	-	0.42	140
0.41	-	-	-	0.2	-	0.84	153
0.85	-	0.9	22%	0.3	-	0.27	157
0.39	-	-	-	0.1	-	0.53	149

## APPENDIX 2: LINK BETWEEN BANK PROJECTS AND ASTAE INDICATORS IN FISCAL 2010

Appendix table 2-1 links all ASTAE activities that disbursed in fiscal 2010 to the related World Bank projects and shows their contribution to the global ASTAE indicators discussed in chapter 3.

Appendix Table 2-1: Link between Bank Projects and ASTAE Indicators, FY2010

ASTAE Project	Type and details of activity	INDICATORS					
		PERIOD TOTAL	Access households	Installed new re-generation capacity	Energy savings (electric)	C02	Origin of indicator
<b>CHINA AND MONGOLIA</b>							
<b>CHINA</b>							
1	China Renewable Energy Scale-up Program (CRESP)	PE: Supervision of IDA / IBRD Credits <ul style="list-style-type: none"> <li>• Provide capacity building and support to RE law</li> <li>• Support provincial resource assessment (biomass, wind)</li> <li>• Build investors' capacity to enable RE scale-up</li> </ul>	-	-	-	-	-
2	China: Energy Intensity Strategy	ESW: Economic and Sector Work—Policy notes to support China's energy-intensity reduction <ul style="list-style-type: none"> <li>• Update cost-benefit analysis of renewable energy targets following changes in energy sector outlook</li> <li>• Improve cement sector energy intensity in three provinces</li> </ul>	-	-	-	Up to 30 t / GWh produced (Indirect)	World Bank Project Information Document
3	China: Urban Transport Climate Change Strategy	ESW: Economic and Sector Work <ul style="list-style-type: none"> <li>• Review energy and carbon footprint of urban transport</li> <li>• Disseminate best practice on energy efficiency and energy security concerns in the urban transport sector</li> </ul>	-	-	-	-	-
X	China: Energy Efficiency Financing Promotion	TA: Technical Assistance <ul style="list-style-type: none"> <li>• Draft an on-lending operations manual for IBRD loan on-lending operation for Chinese banks on energy efficiency</li> <li>• Determine eligibility of sub-projects for financing, preparation procedures and appraisal, implementation arrangements, and general terms of sub-loans</li> <li>• Develop a draft monitoring and reporting system</li> </ul>	-	-	-	10 million tons (direct) 94 million tons (indirect)	World Bank Project Appraisal Document

Appendix Table 2-1: Link between Bank Projects and ASTAE Indicators, FY2010

ASTAE Project	Type and details of activity	INDICATORS					
		PERIOD TOTAL	Access households	Installed new re-generation capacity	Energy savings (electric)	CO <sub>2</sub>	Origin of indicator
<b>MONGOLIA</b>							
4	Mongolia: Energy-Efficient Heating in Poor Areas of Ulan Bator	TA: Technical Assistance <ul style="list-style-type: none"> <li>Introduce energy-efficient stoves in the poor areas of the periphery of Ulan Bator</li> </ul>	226,000 (D)	2 MW	-	9,000 t/year	ASTAE Proposal / World Bank Project Appraisal Document
5	Mongolia: Energy Sector Project	TA: Technical Assistance <ul style="list-style-type: none"> <li>Improve efficiency in the electricity distribution system</li> <li>Increase awareness and capacity among stakeholders</li> </ul>	-	-	-	-	-
6	Mongolia: Documentary Energy Project	KP: Knowledge Product <ul style="list-style-type: none"> <li>Create video on the achievements made under the 2001–10 energy sector project</li> </ul>	-	-	-	-	-
<b>CAMBODIA, LAOS, THAILAND</b>							
<b>CAMBODIA</b>							
7	Cambodia: Biodigester Private Sector Development	TA: Technical Assistance	17,500 (Improved)	-	-	76,713 t per year	ASTAE Proposal / World Bank Project Information Document
<b>INDONESIA</b>							
<b>INDONESIA</b>							
9	Lao PDR: Lessons from the Lao Rural Electrification Program	TA: Technical Assistance <ul style="list-style-type: none"> <li>Identify factors that contributed to electrification successes</li> <li>Advise government on next steps towards universal access</li> </ul>	-	260 MW (Direct) 6,000 MW (indirect)	-	21 million tons (direct) 500 million tons (indirect)	ASTAE Proposal / World Bank Project Information Document

## APPENDIX 2: LINK BETWEEN BANK PROJECTS AND ASTAE INDICATORS IN FISCAL 2010

Appendix table 2-1 links all ASTAE activities that disbursed in fiscal 2010 to the related World Bank projects and shows their contribution to the global ASTAE indicators discussed in chapter 3.

Appendix Table 2-1: Link between Bank Projects and ASTAE Indicators, FY2010

ASTAE Project	Type and details of activity	INDICATORS					
		PERIOD TOTAL	Access house-holds	Installed new re-genera-tion capacity	Energy savings (electric)	CO <sub>2</sub>	Origin of indicator
<b>PHILIPPINES</b>							
<b>PHILIPPINES</b>							
10	Philippines: Power System Loss Reduction Project	TA: Technical Assistance and GEF Grant <ul style="list-style-type: none"> <li>• Screen proposed investments by cooperatives</li> <li>• Provide cooperatives and local authorities capacity building</li> </ul>	-	-	80 GWh/yr	40,000 t/yr	ASTAE Proposal
<b>VIETNAM</b>							
<b>VIETNAM</b>							
11	Vietnam: Documentary on Rural Electrification	KP: Knowledge Product <ul style="list-style-type: none"> <li>• Prepare documentary on rural electrification in Vietnam for television broadcasting</li> </ul>	-	-	-	-	-
12	Vietnam: Documentary on Rural Electrification	KP: Knowledge Product <ul style="list-style-type: none"> <li>• Prepare documentary on rural electrification in Vietnam for television broadcasting</li> </ul>	150,000 (l)	180 MW	-	8.4 million tons of CO <sub>2</sub> over the 20 years	World Bank Project Information Document / ASTAE Proposal
<b>PAPUA NEW GUINEA, TIMOR-LESTE, AND PACIFIC ISLANDS COUNTRIES</b>							
<b>PACIFIC ISLANDS</b>							
<b>FIJI</b>							
<b>SOLOMON ISLANDS</b>							
13	Solomon Islands: Tina River Hydropower Development Project	TA: Technical Assistance <ul style="list-style-type: none"> <li>• Provide technical and methodological support for procurement procedures and consultations with affected populations</li> </ul>	-	-	-	-	-

Appendix Table 2-1: Link between Bank Projects and ASTAE Indicators, FY2010

ASTAE Project	Type and details of activity	INDICATORS					
		Access house-holds	Installed new re-genera-tion capacity	Energy savings (electric)	CO <sub>2</sub>	Origin of indicator	
<b>SOLOMON ISLANDS</b>							
14	Solomon Islands: Sustainable Energy Project	PE: Lending <ul style="list-style-type: none"> <li>• Provide preparation support for the sustainable energy lending project</li> </ul>	22,200 (D)	5,600 kW	3,285,000 kWh	8,325 t/year	World Bank Project Information Document
<b>TONGA</b>							
15	Tonga: Renewable Energy Development	TA: Technical Assistance <ul style="list-style-type: none"> <li>• National energy plan with utilization of renewable energy options</li> <li>• Analyze system and load forecast to assess the suitability of intermittent and firm renewable sources to the system</li> </ul>	20,000	10 MW	-	-	World Bank Project Information Document / Task Team Leader
<b>TIMOR-LESTE</b>							
16	Timor-Leste: Rural Energy Access and Efficiency	TA: Technical Assistance <ul style="list-style-type: none"> <li>• Help prepare an integrated pre-investment package with</li> <li>• Solar PV dissemination options</li> <li>• Candidate microhydro sites</li> <li>• Improved stove models</li> </ul>	-	-	-	-	-
<b>SOUTH ASIA REGION</b>							
<b>INDIA</b>							
17	India: Energy Efficiency in SMEs	GE: GEF Grant <ul style="list-style-type: none"> <li>• Raise awareness and build capacity in energy efficiency in MSMEs</li> <li>• Increase capacity of local bank branches to identify and appraise EE projects</li> </ul>	-	-	-	4.8 million t	World Bank Project Appraisal Document

## APPENDIX 2: LINK BETWEEN BANK PROJECTS AND ASTAE INDICATORS IN FISCAL 2010

Appendix table 2-1 links all ASTAE activities that disbursed in fiscal 2010 to the related World Bank projects and shows their contribution to the global ASTAE indicators discussed in chapter 3.

**Appendix Table 2-1: Link between Bank Projects and ASTAE Indicators, FY2010**

ASTAE Project	Type and details of activity	INDICATORS					
		PERIOD TOTAL	Access households	Installed new re-generation capacity	Energy savings (electric)	CO <sub>2</sub>	Origin of indicator
<b>REGIONAL PROJECTS, OUTREACH, AND KNOWLEDGE SHARING</b>							
18	Regional: Mapping Wind Resources in the Pacific Islands and PNG	TA: Technical Assistance <ul style="list-style-type: none"> <li>Produce a wind survey for Papua New Guinea, Solomon Islands, Fiji, and Vanuatu, with predicted mean wind speed at 6, 12, and 35 meters above ground and at 1 km grid spacing</li> </ul>	-	25 MW (Indirect)	-	-	ASTAE Proposal
19	Regional: Carbon Emission Mitigation Toolkit for Highway Construction	KP: Knowledge Product <ul style="list-style-type: none"> <li>Analyze activities associated with design, construction, and rehabilitation of highway projects; identify those sensitive to energy consumption and carbon emission</li> <li>Estimate carbon footprint and provide mitigation options</li> <li>Create a Mitigation Toolkit</li> </ul>	-	-	-	Up to 200t / km built	ASTAE Proposal estimate / World Bank Project Information Document
20	Africa: LED Light Quick Screening Methodology	KP: Knowledge Product <ul style="list-style-type: none"> <li>Develop a quick screening methodology for LED lights</li> <li>Pilot-test up to 30 LED systems using the methodology</li> </ul>	-	-	-	-	-
21	Regional: East Asia Pacific Flagship Study	KP: Knowledge Product <ul style="list-style-type: none"> <li>Analyze regional potential of renewable energy sources and energy efficiency improvements</li> <li>Review of existing policies, identification of gaps</li> <li>Recommend regional policy development</li> </ul>	-	-	-	-	-





## APPENDIX 3: ASTAE DONORS, RESOURCE UTILIZATION, AND FUNDING EVENTS

### ASTAE Donors

ASTAE currently relies on the Netherlands and Sweden as donor countries for its budget, as well as on matching funds from the World Bank (see the section “ASTAE Resource Utilization” below). Previous ASTAE donors included Australia, Canada, Finland, Japan, Switzerland, the United Kingdom, and the United States.

#### The Netherlands: Ministry of Foreign Affairs (Development Cooperation)

ASTAE’s principal funding source is currently the Netherlands, through its Ministry of Foreign Affairs (Development Cooperation). The Netherlands has been a founding donor as well as a core ASTAE donor, and since 1993 has contributed reliably to providing ASTAE with the capacity to engage in sustained activities. The most recent funding agreement was signed in 2006 for an amount of US\$7.4 million to be disbursed over a four-year period.

In June 1998, the Ministry of Foreign Affairs created the Bank-Netherlands Partnership Program (BNPP) to strengthen the development and institutional effectiveness of the World Bank by financing knowledge- and capacity-development activities at the global, regional, and cross-country levels.

ASTAE is funded through the BNPP and falls under two of its strategic priorities:

- *Environment.* The environmental priority encourages government policy dialogue on environmental damage and conservation of natural resources. Grant-funded activities are designed to raise the awareness of government policy makers and the general population on environmental assessment and good practices. They also suggest alternative methods of energy use and build strategies for improving water and sanitation services.

- *Energy and Water.* This priority aims to provide clean, safe water and energy to every person. The rural poor are especially disadvantaged because they often live in remote areas that are not served by public water and energy utilities. They also face greater health risks because of poor sanitation and the use of unsafe biofuels. The main areas of concern are reforming water and sanitation utilities, switching to cleaner, modern fuels, and increasing electricity access to all citizens.

The Ministry of Foreign Affairs is considering providing new funding to ASTAE, subject to the directions of the new policy that is being drawn in 2011.

#### Sweden: Swedish International Development Agency

Sweden joined ASTAE donors in 2007 with a grant of SKr 15 million (US\$2.0 million) to be disbursed over a three-year period. The overall goal of Swedish development cooperation in 2007 was to “contribute to an environment supportive of poor people’s own efforts to improve their quality of life.”

This support was provided as part of the Strategy for Development Cooperation with South-East Asia, covering the 2005–09 period, under which the Swedish government had defined the following subgoals for development cooperation with the East Asia region:

- To promote democracy and respect for human rights;
- To help reduce damage to the environment;
- To help improve the region’s ability to manage transboundary problems;
- To help reduce the risk of conflict and promote conflict management; and
- To promote cooperation within the region, and between the region and the European Union and/or Sweden.

More specifically, ASTAE activities fall within the “environment and sustainable use of natural resources” window. The priorities of this window are implemented with multilateral and regional support, as well as with bilateral cooperation, for which country-specific substrategies are defined. In the 2007 policy, environmental cooperation in Southeast Asia has three aims:

1. *Environment and institutional capacity.* To strengthen the capacity of institutions to handle natural resource issues effectively and to prevent environmental problems in a regional context. The aim is to help improve the ability of the region’s countries to comply with international conventions on the environment and other adopted environment-related regional agreements and action plans. Support may be provided for capacity building, transfer of knowledge, strengthening of institutions and civil society, and regional networking.
2. *Urban development and the environment.* To promote cooperation through regional forums to strengthen the capacity of countries and cities to mainstream environmental concerns in urban planning, thereby ensuring better living conditions for the poorer sections of the urban population, as well as health and environmental protection. Cooperation may include sustainable water and sanitation systems, initiatives relating to air quality and climate change, waste management and disposal, urban transport, and traffic safety.

**BOX 3.1****Extract from The Netherlands Development Cooperation Policy Note, 2007–2011**

The rise in greenhouse gas levels in the atmosphere is largely a result of energy consumption in the Organisation for Economic Co-operation and Development countries, although rapid growth in the largest developing countries is also increasingly contributing to emissions, even though their per capita emissions remain well below those of developed countries.

Those countries, including the Netherlands, must therefore take the first steps to reduce emissions. The European Union has shown more willingness to do so than other industrial countries. The government will make a strong plea over the coming years for intensive international climate diplomacy to call countries with high energy consumption, including rapidly growing economies, to account. It has also reserved extra resources for sustainable energy.

It is vital that rich countries and rapidly growing developing countries reduce their greenhouse gas emissions (mitigation). This will not be enough in itself, however. Mitigation is a matter for all countries, under the principle of “common but differentiated responsibilities.” According to the “polluter pays” principle, the obvious course is for Western countries to help pay the high costs that poor countries face in adapting to climate change. Little is known at this stage about the precise nature and scale of these costs, however. So before the “polluter pays” principle can be applied, the damage caused needs to be identified.

- The costs of adaptation must be made clear. The Netherlands, the United Kingdom, and the World Bank have initiated a multidonor study of the costs and benefits of measures countries might take to make climate risks manageable. The Netherlands is focusing specifically on developing countries.

- The Netherlands supports innovative forms of financing and statutory instruments needed to tackle climate change (mitigation and adaptation).

- The trade in emission rights with poor countries, under the Clean Development Mechanism (CDM), for example, could be extended to more countries, so as to include Sub-Saharan Africa. The Netherlands supports capacity building for poor countries to enable them to make better use of the benefits of emissions trading systems like the CDM.

- The Netherlands will work through the World Bank, the United Nations, and OECD to ensure that rich countries consider the risks of climate change and live up to their responsibility to find solutions. The Netherlands will also support developing countries in integrating the risks of climate change into their own policies, and help them build their capacity to adapt in such vulnerable sectors as land use, food production, water, and health. The adaptation strategies that these countries and poor population groups already use will form the basis. No new recipes will be imposed by outsiders. The Netherlands will commend this strategy in appropriate forums.

Source: “Policy Note, Dutch Development Cooperation 2007–2011.” Sustainable Energy section. Ministry of Foreign Affairs, October 2007.

## APPENDIX 3: ASTAE DONORS, RESOURCE UTILIZATION, AND FUNDING EVENTS

3. *Natural resource issues and environmental protection in the Mekong countries.* To foster environmental cooperation among the Mekong countries on their transboundary ecosystems.

The Swedish government is considering providing new funding to ASTAE under the specific directions of its new policy that was adopted in September 2010.

### ASTAE Resource Utilization

The use of donor funds by ASTAE totaled US\$2,123,893 in fiscal 2010. The use of World Bank resources for ASTAE-supported projects, including the GEF Bank Budget, totaled US\$1,820,321 in fiscal 2010.

Total donor funds utilized by ASTAE since fiscal 1992 amount to US\$31.7 million, an amount matched by the World Bank with US\$30.9 million over the same period. Details of resource utilization by year are in appendix table 3-1.

Appendix Table 3-1: Resource Utilization, World Bank and Donors, FY1992–2010

YEAR	US\$	%	US\$	%	US\$	%
FY92	108,000	32	226,400	68	334,400	100
FY93	827,087	66	419,100	34	1,246,187	100
FY94	1,399,635	67	688,100	33	2,087,735	100
FY95	1,309,063	56	1,046,000	44	2,355,063	100
FY96	2,057,058	56	1,618,924	44	3,675,982	100
FY97	1,705,817	59	1,197,128	41	2,902,945	100
FY98	1,617,777	59	1,126,683	41	2,744,460	100
FY99	1,782,576	61	1,156,346	39	2,938,922	100
FY00	2,627,480	63	1,524,004	37	4,151,484	100
FY01	955,281	46	1,106,035	54	2,061,316	100
FY02	2,108,541	66	1,106,035	34	3,214,576	100
FY03	2,205,111	64	1,239,633	36	3,444,744	100
FY04	1,014,358	25	3,013,893	75	4,028,251	100
FY05	2,704,306	44	3,450,703	56	6,155,009	100
FY06	1,959,983	38	3,169,070	62	5,129,053	100
FY07	1,216,589	30	2,827,968	70	4,044,557	100
FY08	1,847,757	45	2,258,369	55	4,106,126	100
FY09	2,177,200	53	1,915,042	47	4,092,242	100
FY10	2,123,893	54	1,820,321	46	3,944,214	100
<b>TOTAL</b>	<b>31,747,512</b>	<b>51</b>	<b>30,909,754</b>	<b>49</b>	<b>62,657,266</b>	<b>100</b>

## Funding Events

Appendix Table 3-2: Principal ASTAE Funding Events since 2001

YEAR	MONTH	AGENCY	EVENT	AMOUNT (US\$)
<b>2001</b>	April		ASTAE Donors Meeting # 10	
	April	Netherlands	Dutch Partnership Trust Fund	-1,250,000
	August	Netherlands	Dutch Partnership Trust Fund Tranche # 4	1,250,000
	August	U.K.	DFID Tranche # 2	745,193
<b>2002</b>	April		ASTAE Donors Meeting # 11	
	April	U.K.	DFID Tranche # 3	469,014
<b>2003</b>	January	U.K.	DFID Tranche # 4	117,014
	March	Canada	CIDA Climate Change Development Fund Commitment	-2,780,000
	April	Canada	CIDA Tranche # 1	1,675,141
	April		ASTAE Donors Meeting # 12	
	May	U.K.	DFID Tranche # 5	378,578
<b>2004</b>	March		ASTAE Donors Meeting # 13	
	March	U.K.	DFID Tranche #6	363,351
	March	Canada	CIDA Tranche #2	563,562
	May	Netherlands	Commitment ASTAE Phase 3 Funding 2004-6 (€ 3.3)	-4,000,000
	October	Canada	CIDA Tranche #3	591,871
<b>2005</b>	January	Netherlands	Dutch Partnership Trust Fund Phase 3 Tranche # 1	1,454,500
	February	Canada	CIDA Tranche #4	202,544
	March		ASTAE Donors Meeting # 14	
	May	Netherlands	Commitment for ASTAE II Funding 2006 - 2008	
<b>2006</b>	March		ASTAE Donors Meeting # 15	
	May	Netherlands	BNPP Agreement signed for ASTAE II, 2006 - 2009	(7,424,400) <sup>a</sup>
	July	Netherlands	BNPP Tranche #1, ASTAE II	2,598,540
<b>2007</b>	March	Germany	ASTAE Donors Meeting# 16	
		Sweden	Commitment by Swedish International Development Agency Commitment (SKr 15 million eq. 2,355,000 USD at that date)	
		Australia	Discussion to fund projects in Cambodia and Lao PDR	
	December	Netherlands	BNPP Tranche #2 - ASTAE II	1,113,660
<b>2008</b>	February	USA	ASTAE Donor Meeting # 17	
	February	Sweden	First Tranche of SIDA Commitment	553,435
	June	Netherlands	BNPP Tranche #3 - ASTAE II	1,856,069
<b>2009</b>	April	USA	ASTAE Donor Meeting # 18	
	February	Sweden	Second Tranche of SIDA Commitment	436,620
		Australia	Commitments to fund projects in Cambodia and Lao PDR, starting in FY10	
	June	Netherlands	BNPP Tranche #4 - ASTAE II	1,856,069
<b>2010</b>	April	USA	ASTAE Donor Meeting # 19	
	January	Sweden	Third Tranche of SIDA Commitment	389,414
	June	Sweden	Fourth Tranche of SIDA Commitment	489,256

## APPENDIX 4: ASTAE-SUPPORTED WORLD BANK INVESTMENT PROJECTS IN EAST ASIA AND THE PACIFIC

Appendix table 4-1 lists World Bank projects that have benefited from ASTAE support since its inception. It provides details on ASTAE's World Bank investment leverage (illustrated in figure 1-2).

Appendix Table 4-1: ASTAE-Supported World Bank Investment Projects

Country	Projects	Approval End date (Est.)	Sustainable Energy Project Cost (\$million)						Primary Project Component	
			Total cost	Source of financing						
				IBRD/ IDA	GEF	Govt.	Private	Other		
<b>CLOSED PROJECTS</b>										
1	Lao PDR	Provincial Grid Integration	10/92– 01/00	0.9	0.9				DSM, institution building	
2	Thailand	Distribution System and Energy Efficiency	04/93– 06/00	59.3		8.0	20.3	31.0	DSM, capacity building	
3	Indonesia	Second Rural Electrification	02/95– 09/00	19.3	13.3		6.0		Minihydro, geothermal resource assessment, and TA	
4	Vietnam	Power Development	02/96– 06/00	1.6	0.5			1.1	Renewable energy capacity building	
5	Indonesia	Solar Home Systems	01/97– 06/04	3.4	0.1	2.3		1.0	Solar home systems and TA	
6	Thailand	Metropolitan Distribution Reinforcement	06/97– 06/04	4.0			2.5	1.5	DSM capacity building	
7	Lao PDR	Southern Provinces Rural Electrification	03/88– 06/04	2.2	1.0	0.7	0.5		Solar battery charging and microhydro projects	
8	China	Passive Solar Heating for Rural Health Clinics	06/01– 06/04	1.5		0.8	0.8		Energy efficient building design	
9	China	Energy Conservation	03/98–6/06	150.8	63.0	22.0	7.0	54.3	4.5	Energy efficiency, TA
10	Vietnam	Transmission, Distribution, and Disaster Reconstruction	01/98– 06/07	3.3			0.5	2.8	DSM capacity building, equipment standards	
11	China	Renewable Energy Development	01/98– 06/07	205.4	13.0	27.0		165.4	Wind farms, PV, PV technology improvement	
12	Vietnam	Rural Energy I	05/00– 12/06	2.5	1.0			1.5	Renewable energy TA & pilot minihydro	
13	China	Hebei Urban Environment	06/00– 06/08	5.0	4.0		1.0		Energy efficiency in water utilities	
15	China	Energy Conservation II	10/02– 06/10	242.5		26.0		216.5	ESCO market development	
16	Vietnam	Demand-Side Management	06/03– 06/10	18.6		5.5	1.2	6.7	5.2	DSM support
<b>TOTAL CLOSED PROJECTS</b>				<b>720</b>	<b>97</b>	<b>92</b>	<b>40</b>	<b>444</b>	<b>48</b>	

Appendix Table 4-1: ASTAE-Supported World Bank Investment Projects

Country		Projects		Approval End date (Est.)	Sustainable Energy Project Cost (\$million)					Primary Project Component	
					Total cost	Source of financing					
				IBRD/ IDA		GEF	Govt.	Private	Other		
<b>PROJECTS UNDER IMPLEMENTATION</b>											
FY02	14	Vietnam	System Efficiency Improvement, Equitization, and Renewables	06/02–FY12	24.5	17.2	4.5	2.8			Renewable energy and DSM
FY04	17	Philippines	Rural Power	12/03–FY12	26.7	10.0	9.0	0.2		7.5	Renewable energy for rural applications
	18	Cambodia	Rural Electrification and Transmission	12/03–FY12	32.0	16.0	5.8			10.2	Renewable energy for rural applications
	19	Philippines	Power System Loss Reduction	06/04–FY12	62.3		12.0	0.3		50.0	Rural electrification & efficiency
FY05	20	Vietnam	Rural Energy II	11/04–FY11	329.5	220.0	5.3	70.0		35.0	Renewable energy for remote communities
	21	China	Heat Reform and Building Efficiency	03/05–FY11	52.6		18.0	0.9	33.7		Energy efficiency
	22	China	Renewable Energy Scale-Up Program	06/05–FY11	336.0	87.0	40.2	142.0		67.0	Renewable energy and energy efficiency
	23	PNG	Teachers' Solar Lighting Project	06/05–FY11	2.9		1.0	0.1	1.7	0.1	Renewable energy (PV) for teachers in rural areas
FY06	24	China	Renewable Energy Scale-Up Program Phase 1B	01/06–FY11	132.4	86.3		30.1	16.0		Wind farm and small hydro
	25	Lao PDR	Lao PDR Rural Electrification Phase I	01/98–06/07	205.4	13.0	27.0		165.4		Wind farms, PV, PV technology improvement
FY07	26	Mongolia	Renewable Energy and Rural Electricity	01/07–FY11	23.0	3.5	3.5	10.0		6.0	Renewable energy and rural electricity access

## APPENDIX 4: ASTAE-SUPPORTED WORLD BANK INVESTMENT PROJECTS IN EAST ASIA AND THE PACIFIC

Appendix table 4-1 lists World Bank projects that have benefited from ASTAE support since its inception. It provides details on ASTAE's World Bank investment leverage (illustrated in figure 1-2).

Appendix Table 4-1: ASTAE-Supported World Bank Investment Projects

Country		Projects		Approval End date (Est.)	Sustainable Energy Project Cost (\$million)					Primary Project Component	
					Total cost	Source of financing					
				IBRD/ IDA		GEF	Govt.	Private	Other		
<b>PROJECTS UNDER IMPLEMENTATION</b>											
FY07	27	Timor-Leste	Gas Seep Harvesting	03/07-FY12	1.5	0.9	0.6				Gas seep for power generation
	28	Timor-Leste	Energy Service Delivery	06/07-FY11	8.5	4.5		2.0	2.0		Loss reduction, RE development and community-based access
	29	Pacific Islands	Sustainable Energy Financing	05/07-FY16	58.5		9.5	20.2	22.1	6.7	Renewable energy scaling up
FY08	30	Indonesia	Geothermal Power Generation Development	05/08-FY11	9.0		4.0	5.0			Geothermal power scaling up and capacity building
	31	China	Energy Efficiency Financing	05/08-FY13	593.6	200.0	13.5	6.3	373.8		Energy efficiency financing
	32	China	Liaoning Third Medium Cities Infrastructure	05/08-FY13	375.9	191.0		184.9			Improve efficiency of heating and gas services
FY09	34	Solomon Islands	Solomon Islands Sustainable Energy	07/08-FY13	4.5	4.0		0.5			Electricity losses reduction and increased access
	35	Philippines	Additional Financing for Rural Power	04/09-FY11	48.4	40.0	0.5			7.9	Renewable energy for rural applications
	36	Vietnam	Renewable Energy Development	05/09-FY15	318.0	202.0		64.0	49.7	2.3	Increase RE share in electricity mix, TA and lending
	37	China	Thermal Power Efficiency	05/09-FY16	109.0		19.7	15.5	73.8		Efficient dispatch and increase thermal plants efficiency
	38	Vietnam	Rural Energy II - Additional Financing	05/09-FY16	250.6	200.0		38.8		11.8	Improved and new electricity access

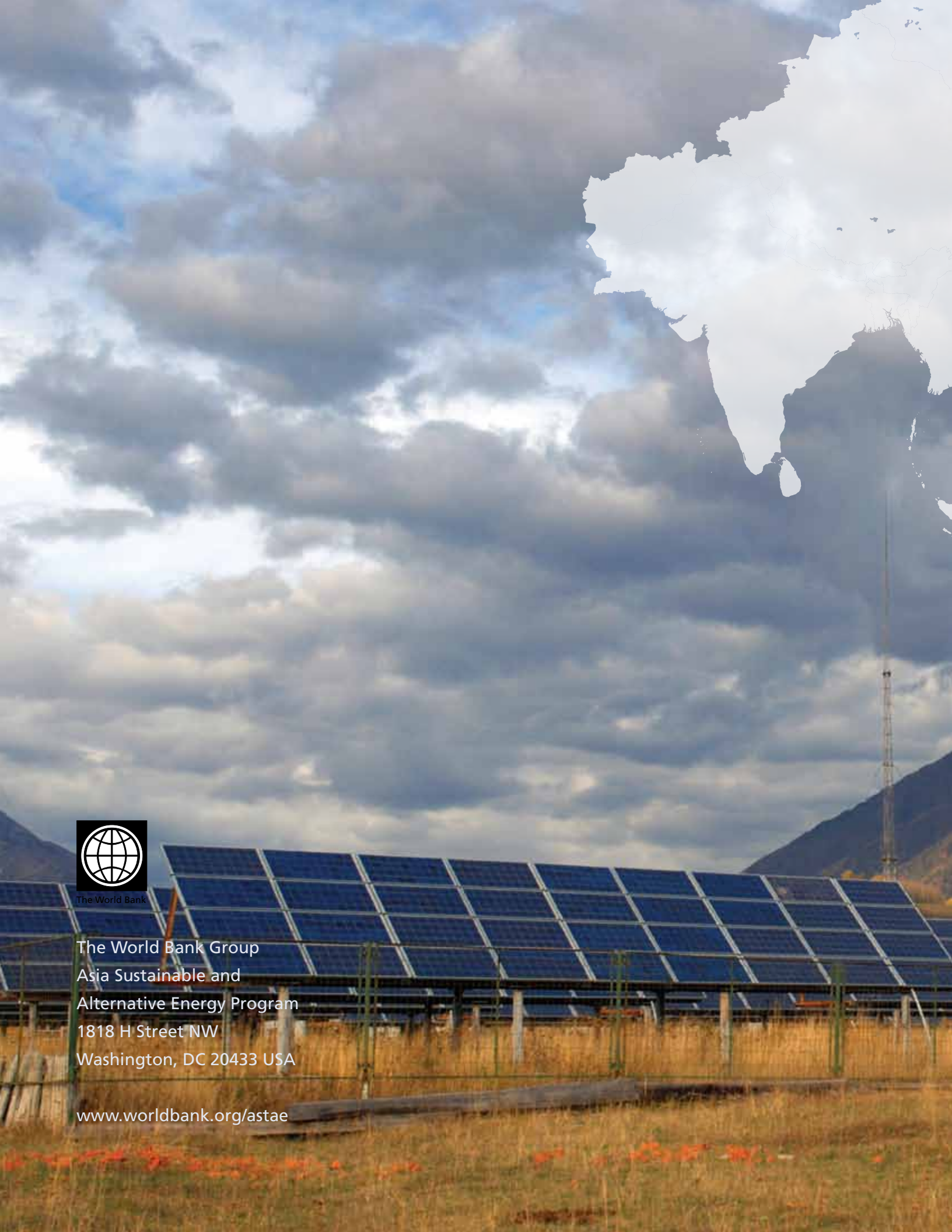


Appendix Table 4-1: ASTAE-Supported World Bank Investment Projects

Country		Projects	Approval	Sustainable Energy Project Cost (\$million)					Primary Project Component		
				End date (Est.)	Total cost	Source of financing					
			IBRD/IDA			GEF	Govt.	Private	Other		
<b>PROJECTS UNDER IMPLEMENTATION</b>											
FY10	39	China	Energy Efficiency Financing II	06/10-FY15	101.6	100.8		0.8		Catalyze commercial investments in industrial energy efficiency	
	40	India	Financing Energy Efficiency in MSMEs	05/10-FY14	57.6		11.3	0.3	46.0	Increase energy efficiency in micro, small, and medium enterprises	
	41	Lao PDR	Rural Electrification II	01/10-FY14	35.8	24.4		4.0	3.4	4.0	Increase rural households access to electricity
	42	Vietnam	System Efficiency Improvement, Equitization, and Renewables - Additional Financing	06/10-FY13	3.5	3.5					Renewable energy and DSM
<b>TOTAL CURRENT FISCAL YEAR</b>					<b>199</b>	<b>129</b>	<b>11</b>	<b>5</b>	<b>49</b>	<b>4</b>	
<b>TOTAL PROJECTS UNDER IMPLEMENTATION</b>					<b>3,186</b>	<b>1,571</b>	<b>162</b>	<b>661</b>	<b>622</b>	<b>226</b>	







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The World Bank Group  
Asia Sustainable and  
Alternative Energy Program

1818 H Street NW  
Washington, DC 20433 USA

[www.worldbank.org/astae](http://www.worldbank.org/astae)