A Review of ESMAP Energy Efficiency Portfolio

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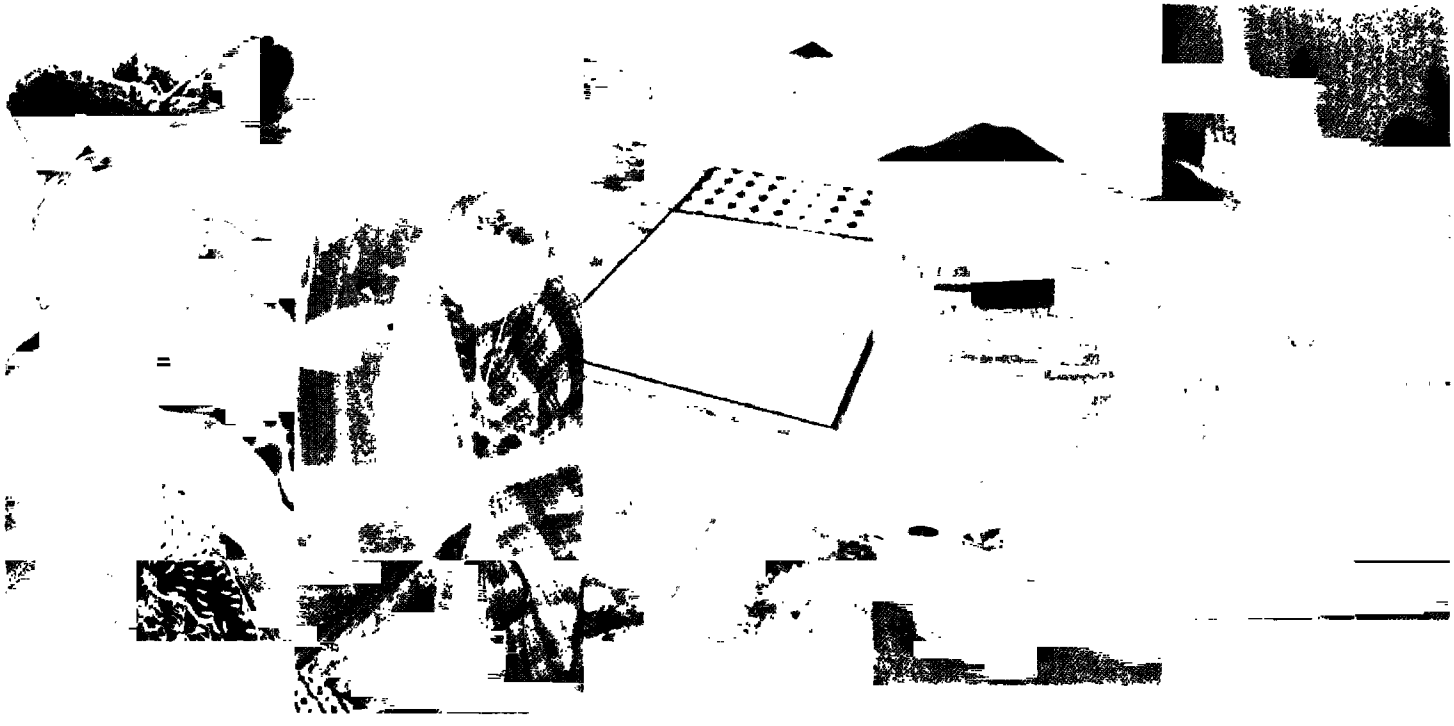

Energy

Sector

Management

Assistance

Programme

Report 271/03

November

ESMAP

JOINT UNDP / WORLD BANK

ENERGY SECTOR MANAGEMENT ASSISTANCE PROGRAMME (ESMAP)

PURPOSE

The Joint UNDP/World Bank Energy Sector Management Assistance Programme (ESMAP) is a special global technical assistance partnership sponsored by the UNDP, the World Bank and bi-lateral official donors. Established with the support of UNDP and bilateral official donors in 1983, ESMAP is managed by the World Bank. ESMAP's mission is to promote the role of energy in poverty reduction and economic growth in an environmentally responsible manner. Its work applies to low-income, emerging, and transition economies and contributes to the achievement of internationally agreed development goals. ESMAP interventions are knowledge products including free technical assistance, specific studies, advisory services, pilot projects, knowledge generation and dissemination, trainings, workshops and seminars, conferences and roundtables, and publications. ESMAP work is focused on three priority areas: access to modern energy for the poorest, the development of sustainable energy markets, and the promotion of environmentally sustainable energy practices.

GOVERNANCE AND OPERATIONS

ESMAP is governed by a Consultative Group (the ESMAP CG) composed of representatives of the UNDP and World Bank, other donors, and development experts from regions which benefit from ESMAP's assistance. The ESMAP CG is chaired by a World Bank Vice President, and advised by a Technical Advisory Group (TAG) of independent energy experts that reviews the Programme's strategic agenda, its work plan, and its achievements. ESMAP relies on a cadre of engineers, energy planners, and economists from the World Bank, and from the energy and development community at large, to conduct its activities under the guidance of the Manager of ESMAP.

FUNDING

ESMAP is a knowledge partnership supported by the World Bank, the UNDP and official donors from Belgium, Canada, Denmark, Finland, France, Germany, the Netherlands, Norway, Sweden, Switzerland, and the United Kingdom. ESMAP has also enjoyed the support of private donors as well as in-kind support from a number of partners in the energy and development community.

FURTHER INFORMATION

For further information, a copy of the ESMAP Annual Report, or copies of project reports, etc., please visit the ESMAP website: **www.esmap.org**. ESMAP can be reached by email at **esmap@worldbank.org** or by mail at:

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ESMAP Reports are published to communicate the results of ESMAP's work to the development community with the least possible delay. The typescript of the paper therefore has not been prepared in accordance with the procedures appropriate to formal documents. Some sources cited in this paper may be informal documents that are not readily available.

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Acknowledgments

This report was prepared and written by Ms. Xiaodong Wang of the Energy Sector Management Assistance Program, ESMAP. It could not have been written without the assistance of many colleagues inside and outside the World Bank, who contributed their time, insights, and material.

We would like to thank: Amarquaye Armar, Varadarajan Atur, Ede Jorge Ijjasz-Vasquez, and Rene Mendonca, Anke Meyer, Salvador Rivera, Anjali Shanker, Gary Stuggins, and Robert Taylor. The Grammarians Inc. provided editorial support and Mr. Sumit Kayastha desktopped this report. Ms. Marjorie K. Araya from the ESMAP Programme supervised production, printing, distribution and dissemination. Special thanks are due to Ms. Dominique Lallement, ESMAP Manager, for her support and guidance.

Abbreviations and Acronyms

AAA	Analytic and Advisory activities
ABCON	Brazilian Association of Private Water and Sanitation Utilities and Concessionaries
ADB	Asian Development Bank
ASTAE	Asia Alternative Energy Program
CENERGIA	Energy Efficiency Center (Peru)
DANIDA	Danish International Development Agency
DH	District Heating
DSM	Demand-side management
E&M	Energy and Mining Sector Board
EAP	East Asia and Pacific
ECA	Eastern Europe and Central Asia
EE	Energy Efficiency
EPM	Empresas Publicas de Medellin
ESCO	Energy Service Companies
ESMAP	Energy Service Management Assistance Program
FINEP	A Technology development Finance Agency of Brazilian Government
FREE	Romania Energy Efficiency Fund
GEF	Global Environmental Facility
IDB	Inter-American Development Bank
IFC	International Finance Corporation
IZDIHAR	Association of Economic operators of Industrial Zone of Sidi Bernoussi Zenata
LCR	Latin America and the Caribbean Region
m^2	Square meter
MDBs	Multilateral Development Banks
MENA	Middle East & North Africa Region
M&T	Monitoring and Targeting
NGOs	Non-Governmental Organisations
NOVACON	Novo Conceito em Servico Publico
ph4	Standardized Energy Consumption
PREPASSIST	A pre-investment facility managed by the Fiorello LaGuardia Foundation
QAG	Quality Assurance Group

SANEATINS	A Joint venture water Utility for the state of Tocatins in Brazil
SEBRAE – RJ/GTZ	Agency for Development of small and medium enterprises of the Brazilian federation of Industries
TA	Technical Assistance
T&D	Transmission and Distribution
UK	United Kingdom
UNDP	United Nations Development Programme
USAID	United States Agency of International Development
WB	World Bank
WBG	World Bank Group

Executive Summary

The Objectives

1. The Objectives This is a summary of a review of ESMAP activities in energy efficiency (EE) from 1997 to 2002 in addressing three questions: *(i) what have we done; (ii) what has the impact been; and (iii) what have we learned?* The objective of this review is to evaluate thematic impacts and lessons learned of the ESMAP Energy Efficiency Portfolio.

The Methodology

2. This study (i) evaluated intellectual leadership and innovations of the ESMAP Energy Efficiency Portfolio; (ii) assessed the impacts of ESMAP interventions in EE by identifying the outputs—capacity and knowledge, as well as downstream activities—World Bank Group (WBG) lending projects, investment and funding from other multilateral development banks (MDBs) and donors, and follow-up actions and replications by local governments, nongovernmental organizations (NGOs), and the private sector in client countries; and (iii) captured lessons learned and best practices. It was based on a review of ESMAP reports and project files as well as interviews with ESMAP task managers and other World Bank staff.

The Portfolio Overview

3. Over the past five years, ESMAP supported 21 EE projects, with a total cost of approximately US$4.4 million, representing 10 percent of total ESMAP project cost over the same period. The Energy Efficiency Portfolio accounted for about 30 percent of the total cost of the ESMAP Energy and Environment Thematic Area. Among the 21 EE projects, there are seven in the Latin America and the Caribbean Region, seven in Eastern Europe and Central Asia, three in East Asia, one in North Africa, and three Global.

4. ESMAP supports in improving EE have been focusing on four critical areas:

- Disseminating knowledge through global cross-exchange of experience and lessons.
- Conducting pilot activities in improving EE in the industrial sector, including applying the monitoring and targeting (M&T) approach in the industrial sector, reducing energy costs in water utilities, and engaging the private sector in the industrial parks in LCR, ECA, East Asia, and North Africa.
- Developing energy-efficient and cost-effective urban heating strategies in ECA, China, and Mongolia.
- Developing innovative EE financing mechanisms in Romania.

The Overall Impacts

5. ESMAP played a significant role in raising the profile and "mainstreaming" EE within the Bank and client countries. ESMAP's intellectual leadership in the EE area contributed to the World Bank Group (WBG) Energy Business Renewal Strategy in terms of direct poverty alleviation, environment and social sustainability, and governance and private sector development. ESMAP analytic work improved and expanded regional and anchor energy diagnostic work. The overall impacts of ESMAP activities in the EE area are as following:

6. ESMAP catalyzed a milestone shift of EE work at the Bank. ESMAP support to the 1997 Energy Efficiency Roundtable Workshop marked a milestone of the EE work at the Bank from the conventional, utility-driven demand-side management (DSM) approach to innovative energy service-driven institutional and financing delivery mechanisms.

7. ESMAP disseminated knowledge through well-designed "South-South" energy efficiency practitioner workshops. These cross-country workshops promoted exchange of information and best practices of implementing EE programs, substantially increased capacity and generated knowledge of practitioners from developing countries as well as the Bank staff.

8. ESMAP activities provided intellectual leadership in pioneering cross-sector work to reduce energy costs in the water utilities. ESMAP supported a series of pilot projects that adopted the M&T approach, an effective tool to improve systemwide EE and reduce energy cost, in the industrial sector, and more recently in water utilities. ESMAP activities in the water utilities concluded that low-cost measures to save energy and water would bring excellent financial benefits to host water utilities with a short payback period. These ESMAP projects increased the capacity of local utility staff in energy conservation. The earlier ESMAP EE activities in Brazil, for example, trained a group of competent local consultants, who then provided extensive transfer of know-how to the local water utility staff in the recent ESMAP Energy Efficiency in Medium and Small Water Supply Utilities in Brazil Project. These pilot activities have achieved substantial energy savings and financial benefits for host enterprises, and are scaled up through leveraging WBG lending projects, funding from other MDBs, and investment from the domestic private sector. For example, in Brazil, the results of the series of ESMAP EE projects were incorporated in the design of the US$250 million World Bank/Global Environmental Facility (GEF) EE loan project in Brazil. In Peru, the ESMAP pilot activity has scaled up to a US$7-10 million technical assistance package funded by the Inter-America Development Bank (IDB). In Brazil, Colombia, and

Uzbekistan, the local utilities have invested or are planning to invest in the energy saving measures recommended in the ESMAP studies.

9. ESMAP activities played intellectual leadership in developing energy-efficient and cost-effective urban heating strategies. The ESMAP report, "Increasing the Efficiency of Heating Systems in Central and Eastern Europe and the Former Soviet Union," is among the first to adopt a balanced approach that evaluates district heating and decentralized heating alternatives such as individual building and apartment boilers using natural gas. It generated a new methodology to choose the economically preferred heating options from a set of alternatives. ESMAP applied this approach in developing comprehensive and phased strategies and action plans for urban heating to provide sustainable and affordable heating services in low-income countries like Armenia. As a result, the heating strategies developed under the ESMAP project have led to the Armenia Urban Heating Project under preparation by the World Bank.

10. ESMAP activities demonstrated innovative energy efficiency financing mechanisms. ESMAP upstream work catalyzed the design and establishment of an innovative EE financing mechanism in Romania—a dedicated Romania Energy Efficiency Fund that combines project development services and financing facility. This ESMAP project has led to a US$10 million Bank/GEF project, Energy Efficiency Project in Romania.

11. ESMAP activities demonstrated a close link between energy, environment, and poverty and contributed to the poverty alleviation agenda. The ESMAP Global Efficiency in Sidi Bernoussi Industrial & Peri-Urban Area in Morocco Project, for example, engaged the private sector in improving EE in the industrial park and contributed a portion of the economic benefits from the energy savings to an Environmental and Social Fund to improve living standards for the poor in the slums.

The Lessons Learned

12. Global Cross-Exchange Programs: It is critical to choose the topics carefully and design the discussion questions well for an effective cross-country exchange, and a systematic and explicit follow-up plan is essential.

13. Industrial Energy Efficiency: There exist many "win-win" opportunities to improve EE using low-cost commercial technologies with excellent financial returns to host enterprises. The key success factor in realizing this potential is to establish sustainable institutional infrastructure that makes energy conservation a profitable commercial business.

14. Urban Heating Strategies: It is important to evaluate both centralized district heating and decentralized heating alternatives, and choose the most economically preferred options depending on heat density, climate, value of fuel savings, and consumers' ability to pay. Demonstrating energy-efficient heating options alone, however, would not be sustainable without reforms in the regulatory and institutional framework.

15. Energy Efficiency Financing: A lack of available financing or capability of project development is usually not the barrier for EE financing. The key success factor for EE financing is to establish financing intermediaries between project developers and financiers that can bridge the knowledge and perception gaps between the two, and bundle small-scale EE projects to reduce transaction costs.

16. ESMAP Instruments: Overall, ESMAP activities have influenced the Bank operations and client countries in the area of EE through instruments like pilot activities, special technical assistance, studies, and workshops. The pilot activities and technical assistance increased capacity of local stakeholders; leveraged scale-up investments from the WBG, other MDBs and donors, and the domestic private sector; and led to policy changes in client countries. The analytic studies generated new knowledge, and the results are applied in new project design. The practitioner workshops generated and disseminated knowledge on implementing EE programs. In the future, ESMAP needs to expand its knowledge dissemination activities from workshops and publications to applying its wealth of knowledge on innovative mechanisms, methodologies, and strategies to new project designs, and tailoring to specific client country demands.

17. Since the 1997 ESMAP Energy Efficiency Roundtable Workshop, the WBG has designed and implemented a series of projects on EE financing and institutional delivery mechanisms. It is recommended that ESMAP evaluate what has worked versus what has not and what has been learned over the past five-six years on Bank EE activities, and propose new ways forward.

1

Introduction

1.1 In many developing countries, numerous opportunities exist to improve energy efficiency (EE) by 10-30 percent (or more) using low-cost, commercial technologies with a short payback period on the investment. Promoting EE, one of the most cost-effective measures, offers significant opportunities to reduce both urban air pollution and greenhouse gas emissions. Improving EE also contributes to poverty reduction. Providing efficient and affordable heating services to the urban poor and generating economic benefits for the urban poor from the energy savings are only two examples in the ESMAP Energy Efficiency Portfolio that demonstrate the links between energy, environment, and poverty reduction, as described in section two of this report. In addition, EE technologies can bring local sustainable development benefits, such as reduced need for new power plants and increased product competitiveness in the market.

Objectives

1.2 This summary of a review of ESMAP EE activities from 1997 to 2002 addresses three questions: (i) What have we done; (ii) what has been the impact; and (iii) what have we learned? These questions correspond to the three principal review objectives, which are:

i) To review and evaluate the intellectual leadership and innovations of the ESMAP Energy Efficiency Portfolio;
ii) To identify and assess the impacts of ESMAP projects in the area of EE in building institutional capacity; influencing policy changes; and leveraging downstream investments by the World Bank, multilateral development banks, donors, the private sector, and country governments; and
iii) To capture and disseminate lessons learned from ESMAP projects in EE to identify better practices and areas for improvements.

Consistency with ESMAP and World Bank Objectives

1.3 EE is an important business line under the Energy and Environment Thematic Area at ESMAP. It addresses the local, regional, and global environment synergies. The ESMAP Energy Efficiency Portfolio is consistent with the WBG Energy Business Renewal Strategy, which focuses on (i) direct poverty alleviation (with the

instruments of "financial and institutional intermediation to promote EE"); (ii) environmental and social sustainability (with the instruments of "programs to promote EE through energy service companies and EE funds, and economic and sector analytics and knowledge dissemination in support of capacity building"); and (iii) governance and private sector development (with the instruments of "technical assistance to engage the private sector"). ESMAP upstream analytic work is also consistent with the new WBG's Infrastructure Action Plan, which calls for expanding the use of analytical work undertaken by global programs, and improving and expanding regional and anchor infrastructure diagnostic work.

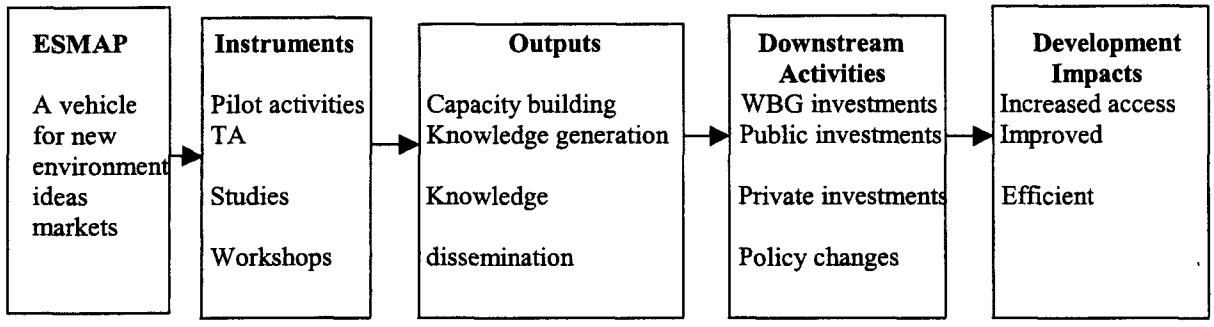
1.4 The objectives of this review are consistent with the strategy documents, "ESMAP Business Plan for 2002-2004," and the "E&M Sector Board QAG Recommendations for Sector Strategy." Both documents call for ESMAP to disseminate lessons learned across energy trust- funded programs; provide clearer guidelines on connecting strategy to project design; and identify ways to leverage the impact of a global program such as ESMAP on other areas of World Bank operations and other energy sector stakeholders, country governments, bilateral organizations, other multilateral institutions, and the private sector.

Methodology

1.5 The upstream nature of ESMAP work makes measurement of its impact difficult. In addition, ESMAP interventions are only one of many channels of forces shaping the development impacts. Figure 1 shows ESMAP interventions as a flow from new ideas, through a set of instruments, to immediate outputs that led to downstream activities, eventually resulting in development impacts. ESMAP outputs—knowledge and capacity—are difficult to quantify in judging ESMAP's success. Ultimately, ESMAP success should be measured by development impact, in this case, EE improvement. It takes a long time, however, to generate development impacts from a new idea.

1.6 This review focuses on assessing the outputs and downstream activities to measure the impacts of ESMAP interventions. It is to be noted, however, given the complex set of factors involved in creating the downstream activities related to ESMAP projects, it is usually difficult to claim that ESMAP was solely responsible for the follow-up WBG or partner investment operations. In some cases, however, the connections between ESMAP projects and their downstream activities are evident.

Figure 1. ESMAP: From New Ideas to Impacts



1.7 This study was based on a review of ESMAP reports and project files, as well as interviews with ESMAP task managers and other World Bank staff contributing to the projects. It did not consult in-country stakeholders, given the time and budget available. To achieve the three objectives, the framework of the review is organized by the following questions:

(i) Intellectual leadership and innovation:

- What are pilot activities and technical assistance (TA) provided to client countries?
- What are new methodologies, approaches, or mechanisms used in ESMAP projects?
- What analytical knowledge or advice was conveyed in the ESMAP interventions?
- What are the intellectual leadership and innovations in ESMAP activities?

(ii) Impacts (outputs and downstream activities):

- What are the major achievements of ESMAP activities?
- How did ESMAP interventions build local capacity?
- What new knowledge is generated?
- How is ESMAP knowledge disseminated?
- How did ESMAP support influence others and foster project development at the Bank and in client countries?
- What downstream activities are leveraged from ESMAP projects in terms of WBG lending projects, investment, and funding from other MDBs and donors, and follow-up actions and replications by local governments, NGOs, and the private sector in client countries?
- What are the thematic impacts of the Energy Efficiency Portfolio?

(iii) Lessons learned:

- What are the lessons learned and best practices?
- What is ESMAP's comparative advantage?
- Does ESMAP have the right instruments?
- What are the areas for improvements in the future?

2

ESMAP Energy Efficiency Portfolio

Portfolio Overview

2.1 Over the past five years, ESMAP supported 21 EE projects, with a total cost of approximately US$4.4 million, representing 10 percent of total ESMAP project cost over the same period. The Energy Efficiency Portfolio accounted for about 30 percent of the total cost of the ESMAP Energy and Environment Thematic Area, which also includes (i) Indoor Air Pollution; (ii) Urban Air Quality; (iii) Energy and Environment Review; and (iv) Fossil Fuel and Environment. Among the 21 EE projects, there are seven in the Latin America and the Caribbean Region, seven in Eastern Europe and Central Asia, three in East Asia, one in North Africa, and three Global (table 1).

Table 1. Summary of ESMAP Renewable Energy Activities by Region, 1997-2002

Region	Number of Projects	Combined Budget	% of Total Budget
ECA	7	$2,094,273	48%
LCR	7	$ 905,637	21%
Global	3	$ 695,031	16%
Africa	1	$ 340,000	8%
Asia	3	$ 318,618	7%
Total	**21**	**$4,353,559**	**100%**

2.2 ESMAP support in improving EE have been focusing on four critical issues:

- Disseminating knowledge through global cross-exchange of experience and lessons.
- Conducting pilot activities in improving EE in the industrial sector, including applying the M&T approach, reducing energy costs in water utilities, and engaging the private sector in the industrial parks, in LCR, ECA, East Asia, and North Africa.

- Developing energy-efficient and cost-effective urban heating strategies, mostly in ECA, and recently in China.
- Developing innovative EE financing mechanisms in Romania.

Disseminating Knowledge through Global Cross-Country Exchange Programs

2.3 In 1997, ESMAP supported the Second Roundtable on Energy Efficiency, which aimed to share experience and lessons learned outside the Bank with practitioners from the United States, Europe, Asia, and the LCR and ECA Regions. This workshop marked a milestone in the EE work at the Bank. It catalyzed a dramatic shift from the conventional, utility-driven demand-side management approach to innovative energy service-driven institutional and financing delivery mechanisms. With power sector reforms in progress in many of the Bank client countries, a transformation of the energy sector is underway from asset management to service provider. EE has emerged as a growing market with excellent opportunities for business. The workshop focused on four well-selected topics: (i) utility- and regulatory-based efficiency projects; (ii) project design and financing instruments; (iii) performance contracting and partnership; and (iv) the emerging energy service industry. This workshop, for the first time, provided the Bank staff a variety of innovative options in delivering EE services, focusing on institutional and financing mechanisms. Since 1997, the Bank and the International Finance Corporation (IFC) have initiated a series of GEF projects on different EE financing mechanisms and energy service companies (ESCOs).[1]

2.4 A wealth of knowledge and best practices in EE programs exist in developing countries. From 1999 to 2002, ESMAP supported a project to facilitate "South-South" EE practitioner networks and exchanges of information and best practices for implementing programs. This project held five well-targeted and designed workshops on (i) ESCOs; (ii) district heating (DH); (iii) energy efficiency funds; (iv) operating utility DSM programs in a restructuring electricity sector; and (v) developing financial intermediation mechanisms for energy efficiency projects, focusing on commercial banking windows. In particular,

2.5 The ESCO Workshop introduced ESCO experience in Brazil, China, Poland, Hungary, Spain, Canada, and the United States. Its key findings are:

- Essential factors for a functioning ESCO market include local availability of financing at reasonable terms, favorable government policies and programs, a business approach, successful case studies, and skilled people.

[1] "A Synopsis of the Second Roundtable on Energy Efficiency: Institutional and Financial Delivery Mechanisms." ESMAP Report No. 207/98. September 1998. Personal communication with Salvador Rivera.

- Possible financing models for ESCO include partial loan guarantee, direct financing, and revolving loan funds.
- Interested, creditworthy customers and participating banks are the two key factors for expanding the ESCO market.[2]

2.6 The Energy Efficiency Fund Practitioner Workshop introduced the EE fund experience in the Czech Republic, India, Hungary, Korea, Brazil, China, Thailand, and Romania. Some of its key recommendations include:

- Establish and operate the fund as a business, not a technology deployment system.
- Maximize the transparency of procedures and minimize government interference in financing decisions.
- Technical assistance to borrowers may be required to develop feasible, bankable projects.
- Use third parties such as ESCOs to market and develop projects for the fund and avoid high transaction costs.[3]

2.7 The DSM Workshop introduced DSM experience in restructuring power sectors in Argentina, Brazil, India, Peru, the Philippines, South Africa, Sri Lanka, Thailand, Uruguay, and North America. Its key conclusions include:

- DSM will generally be a casualty of restructuring process unless active steps are taken and the DSM model is established before the restructuring.
- The type of DSM programs will have a bearing on the roles for DSM implementation.[4]

2.8 This project increased the knowledge and capacity of practitioners from developing countries as well as of Bank staff. The five workshops provided support and key inputs to World Bank-GEF operation projects in Poland, China, Thailand, India, Brazil, the Baltic States, Romania, Uruguay, and Vietnam. As a result, a follow-on activity is now being implemented with support from ESMAP and the United Nations Foundation—Developing Financial Intermediation Mechanisms for Energy Efficiency Projects in Brazil, China, and India, which seeks to achieve major increases in EE investments by the domestic financial sectors in Brazil, China, and India. The lessons learned from the cross-country exchange program are: it is critical to choose the topics

[2]" Energy Service Companies (ESCOs) Practitioner Workshop." Workshop Summary. Washington DC, April 1999.
[3] "Energy Efficiency Fund Practitioners Workshop". Workshop Summary. Washington DC April 2000.
[4] "Operating Utility DSM Programs in a Restructuring Electricity Sector." Workshop Summary. Uruguay. October 2000.

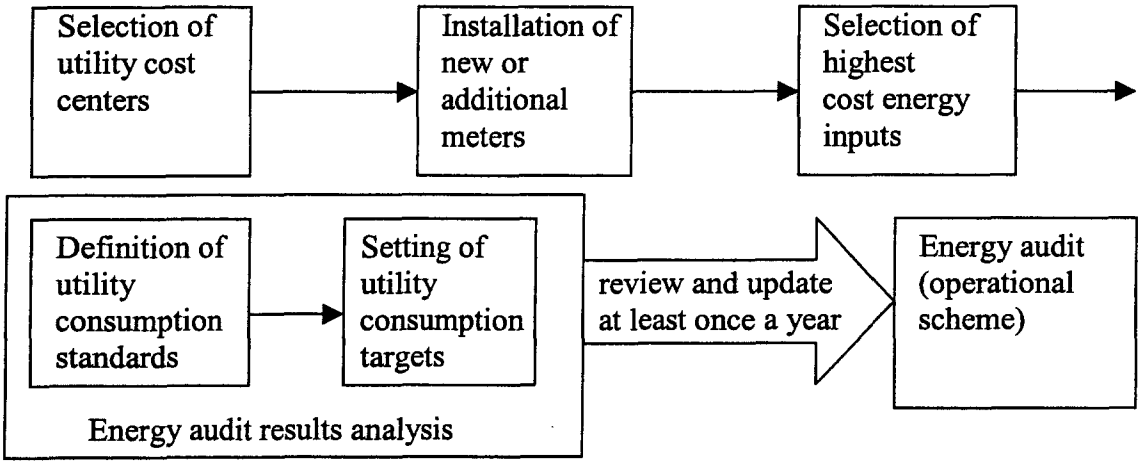
carefully and design the discussion questions well for an effective exchange, and a systematic and explicit follow-up plan is essential.[5]

Improving Energy Efficiency in the Industrial Sector

2.9 In many developing countries, the industrial sector contributes to a major share of energy consumption in the economy, and many opportunities for significant energy savings exist. ESMAP supported a series of activities to improve EE in the industrial sector: (i) applying monitoring and targeting (M&T) approach in LCR and ECA; (ii) reducing costs of energy and water in water utilities in Brazil, Central Asia, and China; and (iii) contributing energy savings from the industrial park to an environmental and social fund in Morocco.

Applying the Monitoring and Targeting Approach in the Industrial Sector

2.10 ESMAP supported a series of activities to apply the M&T approach in improving EE in the industrial sector and set up institutional arrangements to intermediate and sustain energy savings in Brazil, Peru, Colombia, and Slovakia. M&T, an energy cost management tool, was successfully implemented in the UK. Its implementation includes selection of cost centers, installation of meters, itemization of highest consumption and cost energy inputs, setting of energy consumption standards and targets, and verification and periodical updating. M&T methodology is detailed in the following chart:



2.11 With rising energy tariffs as a result of the sector reforms, these countries started to focus on improving EE in the industrial sector. The ESMAP activities provided training to local staff and implemented the energy management systems in pilot sites. The

[5] "ESMAP: Energy Efficiency Operational Exchange Program (UE-P065454)." Implementation Completion Memorandum. For more information, check out website: http://www.worldbank.org/html/fpd/esmap/ee_operational_exchange.htm. May 2002. Personal communication with Robert Taylor.

M&T approach provided an effective tool to assist the host enterprises in identifying and demonstrating no-cost and low-cost energy saving options. As a result, out of the total investment made by the host industries, about US$2.8 million, cumulative direct measured energy savings of about US$9.3 million have been achieved. These projects increased capacity of local staff in host enterprises, convinced the host industries to be receptive to the M&T approach through successful implementation of pilot sites, and developed strong partnerships with industrial trade associations.

2.12 These ESMAP activities have led to a series of important follow-up initiatives. The results of the Brazil project were incorporated in the design of the US$250 million Bank-GEF energy efficiency loan project in Brazil. In addition, FINEP, the development agency of the Brazilian Ministry of Science and Technology, has expressed interests in scaling up the Bahia Pilot Demonstration Project and its replication in other states. In Peru, the Inter-American Development Bank (IDB) funded a US$7-US$10 million technical assistance package to scale up the ESMAP activities, and CENERGIA, a local energy center sponsored by the private sector in partnership with the Ministry of Energy and National Trade Association, worked with European Union support to demonstrate the use of different contractual arrangements and financial instruments to be applied to 20 industrial sites. In Colombia, the local utility in Medellin (EPM), in partnership with a local university, adopted the recommendations made through the ESMAP study as one of its marketing instruments. In Slovakia, an industrial market survey identified an annual saving of US$50-US$100 million from implementation of M&T approach.

2.13 The important lessons learned from these activities are: it is critical to engage the local industrial and trade associations, who are a natural forum in implementing energy cost management systems in the industrial sector; and it is important to have continuity in funding and project team to ensure successful implementation and follow-up.[6]

Reducing Energy Costs in Water Utilities

2.14 ESMAP supported pioneering energy conservation projects in water utilities in Brazil, Central Asia, and China. Energy cost accounts for a substantial portion of the operating cost in water utilities—50-70 percent in Central Asia, 40-60 percent in China, and up to 40 percent in Brazil. Improving EE in water utilities offers significant potential for energy savings, up to 40 percent in Central Asia and China, and 25 percent in Brazil. Together, these projects demonstrated an effective multisector approach.

[6] "Regional Energy Management: A Set of Case Studies in Latin America (Brazil, Peru, Colombia) and Eastern Europe (Slovakia)." Activity Completion Report. July 2001. Personal communications with Salvador Rivera and Anke Meyer.

2.15 Compared to state-owned water utilities, private water utilities have different driving forces to improve EE and apply quite different principles, especially for municipal systems. In Brazil, private operators of municipal water supply concessions are driven to implement EE measures as a means to conserve water resources and bring down the operating costs below the ability to pay of local consumers. Because the municipalities are generally not inclined to allow them to increase rates, they no longer can afford to treat energy costs as an "uncontrollable fixed cost." They therefore are adopting approaches, such as energy M&T setting through which low-cost investment in submetering systems enables energy use to be managed as a semivariable cost in water treatment and delivery. On the other hand, the state-owned water utilities in Brazil continue to treat energy cost as a fixed cost, and therefore have been primarily interested in determining the most cost-effective investment options to upgrade the pumps to reduce operation and maintenance cost. The large-scale public water supply utilities in Uzbekistan also have the same perspective.

2.16 In Brazil, the Energy Efficiency in Medium and Small Water Supply Utilities in Brazil Project has been working with three ABCON members (Agua do Imperador, NOVACON, SANEATINS), a Brazilian association of private water supply utilities, to apply systemwide M&T approach to save energy and water in small-scale private water utilities in Rio de Janeiro State (Petropolis), São Paulo State, and Tocantins State (Palmas, Porto Nacional, Paraiso). The results to date have been promising, especially for the municipality of Petropolis. By strategically deploying additional water and electricity metering systems and implementing low-cost measures—resizing of pumps, power factor correction—Agua do Imperador is reducing annual electricity expenditure by about 15 percent. Moreover, the private concessionaire could exploit operational synergy between existing water and energy acquisition systems—in particular the installation of microhydropower turbines in the existing water intake structures—to self-produce 30 percent of electricity requirements. Overall, these measures can help the private water utilities reduce its annual electricity expenditure for operations by more than 50 percent in Petropolis.

2.17 As a follow-up, one private concessionaire is planning to invest in the energy saving measures recommended through this project. Working with the SEBRAE-RJ/GTZ Project and local financial institutions, ABCON intends to set up a sustainable dissemination mechanism that can provide outreach to enable other municipal water utilities to replicate this approach. In addition, they plan to collaborate with PREPASSIST, a pre-investment facility managed by the Fiorello LaGuardia Foundation, on a Sustainable Small-Scale Infrastructure Project to develop bankable proposals for presentation to international sources of financing, including the Community Development Carbon Fund. The following are important lessons learned: first, key barriers to improving EE in water utilities are the lack of managerial know-how and technical capacity to improve system efficiency. This project overcame these barriers by using

local consultants, who previously had received training under the earlier ESMAP M&T projects in Brazil,to transfer know-how in M&T methodology to the ABCON members. Second, analysis of water loss minimization and EE options should be conducted at the same time.[7]

2.18 The Energy Efficiency in Urban Water Utilities in Central Asia Project conducted a rapid technical and economic assessment of options to increase EE of pumps in public water utilities in Uzbekistan. One of the key achievements of this activity was to develop and test a field methodology for rapid evaluation of potential EE gains in investment projects. The project tested both network pumping stations and pumps on water production facilities; used performance indicators (indicator Ph4—standardized energy consumption); set annual targets of EE improvement for the utility operator to be hired under a service contract; and prepared high-priority, medium-term investments for an EE program.

2.19 In the former Soviet Union, the common assumption in water utilities was that all pumps were highly inefficient and their replacement was an obvious investment. The study found out that this is not the most cost-effective approach. First, there is great variability in the EE of individual pumps. Second, some simple low-cost technologies can save energy up to 20 percent of existing pumps with small investments that do not require replacement of pumps. Third, the extremely high water leakage levels measured in the water distribution network indicate that the sizing of any pump to be replaced should be carefully chosen to avoid overcapacity (a joint water loss and EE approach was recommended to bring the two perspectives in a single study). The project also provided training to local staff in water utilities. The results of the study are finding immediate applications in a management contract with the private sector that includes specific targets for reduction of energy consumption as part of a set of performance criteria that the private operator will need to achieve in order to receive a bonus payment. This project has been viewed with great interest by other countries in the region for replication, given the very similar challenges faced by urban water utilities in former Soviet Union countries.[8]

2.20 In China, ESMAP and ASTAE co-funded the Energy Efficiency in Water Utilities Project that conducted pre-investment analysis to improve EE at water supply and wastewater utilities in Hebei Province under an ongoing World Bank urban project, Hebei Urban Environment Project. This project adopted the M&T approach to establish a

[7] "Draft ESMAP Annual Report 2002." Personal communication with Amarquaye Armar.

[8] "Uzbekistan: Energy Efficiency in Urban Water Utilities of Central Asia: Consulting Services for Site Surveys and Testing of Equipment and Elaboration of Energy Efficiency Evaluation Methodology, Improvement and Specific Investment Strategies for the Bukhara and Samarkand Water Utilities." Draft Final Report. July 2002. Personal communication with Ede Jorge Ijjasz-Vasquez.

continuous monitoring effort for five selected water utilities and conducted engineering and financial analysis of proposed EE improvements. It concluded that the proposed measures to save energy and water, from replacing pumps to converting coarse bubble biological tanks, would bring excellent financial benefits to host water utilities with a short payback period. The host companies are receptive to this approach. The project team is planning to seek further ESMAP funding to scale up the effort in other provinces in China and develop the local technical, financing, and institutional infrastructure.[9]

Engaging the Private Sector in the Industrial Park in Morocco

2.21 An innovative ESMAP activity to improve EE in the industrial sector is the Global Efficiency in Sidi Bernoussi Industrial & Peri-Urban Area in Morocco Project, which aims to increase EE in the industrial park of Sidi Bernoussi in Casablanca, consisting of about 700 industrial enterprises, and contribute a portion of the economic benefits from the energy savings to an environmental and social fund. The industrial association, IZDIHAR (Association of Economic operators of Industrial Zone of Sidi Bernoussi Zenata), acts both as a lobbying agent vis-à-vis local and national public authorities and as the focal point for projects mobilized through international financing. They realized that improving the efficiency of water and energy consumption is consistent with the objectives of improved competitiveness. This project (i) worked through the association of industrialists as a whole and developed an energy and water efficiency services "market" to achieve economies of scale; (ii) completed an analysis of the potential of efficiency improvement and a social impact survey of slum dwellers (the estimated savings potential of water, electricity, and fuel is 18 percent, 7 percent, and 30 percent, respectively, with a simple payback period ranging from 10-20 months); and (iii) conducted pilot programs in three enterprises. A proportion of the energy savings are paid back to a special account for environmental and social activities managed by IZDIHAR. These funds would be used to support additional feasibility studies to improve EE, provide guarantees for relocation of residents in the slums, reinforce governance, and finance garbage removal and wastewater treatment. This project is planning a workshop to disseminate this approach to other countries in the region. As a follow-up, a GEF medium-size project of US$750,000, an additional US$800,000 from France, and approximately US$10 million from commercial banks are leveraged to scale up the approach demonstrated through this ESMAP activity from pilot phase into a full project dealing with the whole industrial zone. This project established a direct and clear link between energy, environment, and poverty reduction, and would have a wide replication potential in the region.[10]

[9] ASTAE Energy Efficiency for Water/Wastewater Sector Initiative: Hebei Pilot Phase II. March 2003. Personal communication with Salvador Rivera.

[10] "Draft ESMAP Annual Report 2002". Personal communication with Anjali Shanker and Rene Mendonca.

Developing Efficient and Affordable Urban Heating Strategies

2.22 Heating is a vital energy service in the countries of Central and Eastern Europe and the former Soviet Union, and an essential component of national poverty reduction strategies. However, the heating systems in most of these countries are highly inefficient, many households receive inadequate heating services, and in several poor transition countries low-income households are in danger of losing access to clean and affordable heating.

2.23 In 2000, ESMAP published a comprehensive report: "Increasing the Efficiency of Heating Systems in Central and Eastern Europe and the Former Soviet Union," which examined the factors under which district heating is the least-cost option for heat supply, and the investments and actions on the institutional, policy, and company levels that are required to make heat supply more efficient and affordable. Because solutions to heating problems are highly local in nature, preparation of this report was based on case studies in six cities of Central and Eastern Europe. This flagship study was among the first to adopt a balanced approach that evaluates DH and decentralized heating alternatives such as individual building and apartment boilers using natural gas. It provides a methodology to choose the economically preferred heating options from a set of alternatives. It confirmed the general superiority of established, modernized DH systems in densely populated areas supplied by cogeneration facilities, compared to investments in new building boilers.[11]

2.24 One of the first applications of this approach is ESMAP's Integrated Heat Demonstration Project in Ukraine. This project demonstrated cost-effective decentralized heating options from both the supply and demand sides. Two buildings were cut off from the district heating system. A more cost-effective separate boiler house was installed, and energy conservation measures, including reducing the heat load, improving the heat distribution within the building, and controlling the heat in each building, were implemented. The demonstration resulted in significant improvement in quality of heat and hot water supply and comfort for the inhabitants of the two buildings, and a reduction of an estimated 27 percent in energy consumption. This project proved the technical feasibility of the decentralized heating options, but was not sustainable and did not lead to follow-up actions. The reduced energy consumption did not result in reduced energy bills since the inhabitants still pay according to consumption per m^2. The lessons learned from this project are that stand-alone technical demonstration without reforms in regulatory and institutional framework would not be sustainable or have major impacts,

[11] "Increasing the Efficiency of Heating Systems in Central and Eastern Europe and the Former Soviet Union". ESMAP Report No. 234/00. August 2000. Personal Communication with Anke Meyer.

and demonstration projects that aim at the transfer of technologies that are not yet standard in our client countries encounter disproportional barriers.[12]

2.25 In many countries, poor urban households consume less heat and have lower heat expenditures than usually associated with a district heating system. Even though DH systems can be the most cost-effective heating mode given a high heat load, their high fixed costs make them potentially very expensive for consumers demanding less heat. To investigate sustainable and affordable provision of heat in those circumstances, ESMAP supported a project in Kyrgyz Republic and Armenia-Development of Heat Strategies for Urban Areas of Low-Income Transition Economies, which developed comprehensive and phased strategies and action plans for urban heating. This is one of the first efforts to apply the balanced approach in developing an efficient and affordable heating strategy for low-income municipalities.

2.26 Under this project, a demand assessment was first carried out on the basis of two household surveys, then a technical and economic assessment of heat supply options—rehabilitation of existing DH systems, autonomous heating systems (small-scale gas-based cogeneration), and individual heating of apartments and houses—was conducted, and finally a phased implementation strategy was proposed. The phased urban heating strategy recommended that a market-oriented framework of heating services should be put in place during the first phase; surviving centralized heating systems would coexist with new decentralized heating options during the second phase; and large-scale demand should be generated for affordable heating solutions—decentralized heating systems and possibly investments for DH modernization—during the third phase. This project, which enjoyed strong support from the Armenian government, is being followed up by several projects supported by various donors: the World Bank (the Armenia Urban Heating Project under preparation), USAID, and UNDP-GEF. The lessons learned from this project include that (i) it is critical to conduct demand surveys of households' income level and ability to pay, to provide consumers with heating systems that are flexible (that is, controllable and metered) so that they can choose the level of heat consumption and expenditures in accordance with their household incomes; and (ii) public support should be given to enable more providers of heating services to enter the market under less restrictive rules.[13]

2.27 This innovative approach is being applied in another ESMAP project in Lithuania, where in addition new technological options will be explored. The collective experience of district heating reform in Central and Eastern Europe informed the design

[12] "Energy Efficiency Measurements: Dnepropetrovsk District Heating Project." Draft Report. June 2000. Personal communication with Anke Meyer.

[13] "Development of Heat Strategies for Urban Areas of Low-Income Transition Economies: Urban Heating Strategy for Republic of Armenia with a summary of Heating Strategy for Kyrgyz Republic." Draft Report. February 2003. Personal Communication with Anke Meyer.

of a recently launched ESMAP project on heating reform in China. The ESMAP activity entitled Development of Pro-Poor National Heat Pricing and Billing Policy in China is designed to pilot and develop a national policy framework for heat pricing and billing, with special attention to preserving access to quality heating services for the poor. This ESMAP project is part of the multiyear GEF-WB analytic and advisory activities (AAA) China Heat Reform and Building Energy Efficiency Program under preparation.

2.28 Furthermore, the ESMAP Mongolia Energy Efficiency in the Electricity and District Heating Sectors Project analyzed the level and sources of losses in the electricity and district heating distribution systems in Ulaanbaatar and proposed a set of actions and investments to lower these losses to economic levels. This study was a departure from previously supply-oriented work. The project found that the transmission and distribution (T&D) losses increased from 27 percent in 1995 to 34 percent in 2000. In the DH systems, water loss is the major problem, with leakage rates well beyond internationally accepted standards. It recommended that integrating the analyses of the two sectors would achieve higher returns. As a follow-up, the results of the analyses in the electricity sector from this ESMAP activity were incorporated in the US$35 million World Bank Energy Loan Project, and Asia Development Bank (ADB) and DANIDA funded the district heating sector following the recommendations made through this ESMAP study.[14]

Developing Innovative Energy Efficiency Financing Mechanisms in Romania

2.29 Even though many EE projects have substantial environmental benefits with sound financial returns, this potential is not being realized. Availability of commercial financing is usually a major barrier inhibiting mainstreaming of EE investments. The main financing barriers include high transaction costs and high perceived risks associated with EE investment, and a lack of expertise in identifying and developing commercially viable EE investment projects.

2.30 ESMAP supported an upstream activity to identify the barriers to EE investments in Romania and aid in the design of a market-based EE financing mechanism. This project extensively reviewed experiences and lessons learned from previous EE activities in Romania, worldwide experience with EE funds, such as in Hungary, India, and China, and other international experiences with financing of EE and environmental investments. The important lessons learned from this review are: (i) the financing institution needs to be very proactive in the development of a project pipeline;

[14] "Mongolia: Improving Space Heating Stoves for Ulaanbaatar." ESMAP Report No. 254/02. March 2002. Personal Communication with Salvador Rivera.

(ii) EE financing should use existing market players where possible; (iii) EE financing mechanisms should initially focus on projects with high rates of return to demonstrate quickly the benefits of these investments to other market players and encourage them to participate in market-based EE schemes; and (iv) the preferred borrowers for the guarantee funds turned out to be project developers, rather than traditional customers from financial institutions.

2.31 This ESMAP upstream work has led to the design and establishment of the dedicated Romanian Energy Efficiency Fund (FREE), which was initially capitalized through the US$10 million GEF Energy Efficiency Project in Romania. FREE combines project development services and a financing facility that provides primarily debt financing to medium-sized EE projects within restructured and private industries. Several commercial banks have indicated that they are interested in undertaking parallel commercial lending with FREE. It is hoped that this first experience will contribute to a better understanding of the benefits of EE investments and the possibilities of structuring financing for different client groups. Based on the experience with FREE, the financing of EE investments is expected to become an attractive business for domestic financial institutions. This innovative financing model is now under replication in Tunisia and Bulgaria.[15]

[15] "Private Sector Participation in Market-Based Energy Efficiency Financing Schemes: Lessons Learned from Romanian and International Experiences". Draft Report for ESMAP. Anke Meyer. April 2003. Personal Communication with Varadarajan Atur and Anke Meyer.

3

Impacts of ESMAP Energy Efficiency Portfolio

Intellectual Leadership and Achievements (What We Have Done)

3.1 Table 2 summarizes project clusters, ESMAP instruments, project approaches, and project impacts of the ESMAP Energy Efficiency Portfolio.

3.2 Knowledge Dissemination: ESMAP support to the 1997 Energy Efficiency Roundtable Workshop marked a milestone in the EE work at the Bank from the conventional utility-driven DSM approach to innovative, energy service-driven institutional and financing delivery mechanisms. A series of well-designed "South-South" EE practitioner workshops promoted exchange of information and best practices of implementing EE programs, and substantially increased capacity and generated knowledge of practitioners from developing countries as well as Bank staff.

Table 2. Summary of Project Clusters, Instruments, Approaches, and Impacts

Project Clusters	ESMAP Instruments	Project Approaches	Project Impacts
Knowledge dissemination 2 projects (both completed)	Workshops	• Global cross-country exchange workshops with well-defined discussion topics	• Catalyzed a shift of EE work in the Bank • Disseminated EE knowledge among practitioners • Increased capacity of EE practitioners • Provided support and key inputs to WB/GEF EE lending projects.
Industrial EE 11 projects (all	Pilot activities TA	• Provided training to local staff • Adopted M&T approach to implement low-cost EE measures in pilot industrial sites and water utilities	• Increased local capacity • Generated new knowledge on reducing energy costs in water utilities • Leveraged scale-up investment from WBG,

completed)		• Conducted rapid evaluation of EE investment projects in water utilities • Engaged industrial association in contributing energy savings to social and environmental funds	GEF, IDB, other donors, domestic utilities, and commercial banks. • Achieved substantial energy savings • Contributed to direct poverty alleviation
Urban heating strategies 6 projects (2 under implementation)	Studies Pilot activities TA	• Evaluated district heating vs. decentralized heating alternatives • Implemented a pilot project of decentralized heating systems from both supply and demand sides • Developed sustainable and affordable urban heating strategies for low-income countries • Conducted diagnostic work on losses in the district heating systems • Develop a national heat pricing and billing policy	• Generated new knowledge • Demonstrated technical feasibility of decentralized heating options • Achieved substantial energy savings • Informed client government of a phased urban heating strategy • Leveraged scale-up investment from WBG, ADB, and other donors • Contributed to direct poverty alleviation
EE financing 2 projects (1 under implementation)	TA	• Designed a dedicated Romania EE Fund. • Open EE lending windows at domestic commercial banks	• Set up Romania Energy Efficiency Fund • Leveraged scale-up funding from GEF and commercial banks

3.3 **Industrial Energy Efficiency:** A series of ESMAP projects that adopted the M&T approach, which had been successfully implemented in the UK, proved that M&T is an effective tool to improve systemwide EE and reduce energy cost in the industrial sector, particularly in the water utilities, in developing countries. The M&T approach assisted the host enterprises in identifying and demonstrating no-cost and low-cost energy saving options through successful implementation of pilot projects. In particular, ESMAP supported pioneering cross-sector work to reduce energy and water costs in the water utilities. Energy cost accounts for a substantial portion of the operating cost in water utilities, and improving EE in water utilities offers significant potential for energy savings and cost reductions. ESMAP activities in the water utilities concluded that measures to save energy and water would bring excellent financial benefits to host water utilities with a short payback period.

3.4 **Urban Heating Strategies:** ESMAP's comprehensive report, "Increasing the Efficiency of Heating Systems in Central and Eastern Europe and the Former Soviet

Union," is among the first to adopt a balanced approach that evaluates district heating and decentralized heating alternatives such as individual building and apartment boilers using natural gas. It provides a methodology to choose the economically preferred heating options from a set of alternatives. Building on this balanced approach, ESMAP first demonstrated cost-effective decentralized heating options in Ukraine and proved its technical feasibility. Then, ESMAP successfully applied this approach in developing comprehensive and phased strategies and action plans for urban heating to provide sustainable and affordable heating services in lower-income countries like Armenia. In addition, the ESMAP project also examined the level and sources of losses in the electricity and district heating distribution systems in Ulaanbaatar, and recommended integrating the analyses of the two sectors.

3.5 **Energy Efficiency Financing:** ESMAP upstream work catalyzed the design and establishment of an innovative financing mechanism for EE in Romania—a dedicated Romania Energy Efficiency Fund that combines project development services and financing facility.

Impacts—Outputs and Downstream Activities (What the Impact Has Been)

3.6 ESMAP played a significant role in raising the profile and "mainstreaming" EE within the Bank and client countries. ESMAP's intellectual leadership in the EE area contributed to the WBG Energy Business Renewal Strategy in terms of direct poverty alleviation, environment and social sustainability, and governance and private sector development. ESMAP's analytic work improved and expanded regional and anchor energy diagnostic work. Specifically, ESMAP activities.

3.7 **Played intellectual leadership:** ESMAP-supported workshop in 1997 catalyzed a milestone shift in EE work at the Bank. ESMAP activities played intellectual leadership in pioneering cross-sector work to reduce energy costs in the water utilities and developing EE and cost-effective urban heating strategies. In addition, ESMAP activities demonstrated innovative approaches for EE financing mechanisms.

3.8 **Increased capacity of local stakeholders:** ESMAP pilot activities, technical assistance, and knowledge dissemination workshops have substantially increased the capacity of local stakeholders in improving energy efficiency in their host countries. The earlier ESMAP EE activities in Brazil, for example, trained a group of competent local consultants, who then provided extensive transfer of know-how to the local water utility staff in the recent ESMAP Energy Efficiency in Medium and Small Water Supply Utilities in Brazil Project.

3.9 **Generated and disseminated knowledge:** The ESMAP study, "Increasing the Efficiency of Heating Systems in Central and Eastern Europe and the Former Soviet Union," generated new knowledge and methodology to compare centralized district heating and decentralized heating alternatives and address regulatory and institutional reform options. ESMAP "South-South" exchange workshops disseminated knowledge on information and best practice of implementing EE programs among practitioners within and outside the Bank.

3.10 Leveraged WBG lending projects:

- The "South-South" EE practitioner workshops provided support and key inputs to World Bank-GEF operation projects, particularly in Poland, China, Thailand, India, and Romania.
- In Brazil, the results of the series of ESMAP EE projects were incorporated in the design of the US$250 million World Bank-GEF Energy Efficiency Loan Project in Brazil.
- In Mongolia, the results of the analyses in the electricity sector from the ESMAP project entitled Mongolia Energy Efficiency in the Electricity and District Heating Sectors were incorporated in the US$35 million World Bank energy loan project.
- In Armenia, the ESMAP activity entitled Development of Heat Strategies for Urban Areas of Low-Income Transition Economies has led to the Armenia Urban Heating Project under preparation by the World Bank.

3.11 **Leveraged funding from other MDBs and donors:**

- A follow-up activity of ESMAP's Energy Efficiency Operational Exchanges Program is funded by the United Nations Foundation (US$2.2 million) and ESMAP, entitled Developing Financial Intermediation Mechanisms for Energy Efficiency Projects in Brazil, China, and India. It seeks to achieve major increases in EE investments by the domestic financial sectors in Brazil, China, and India.
- In Peru, the ESMAP pilot activity to apply M&T approach in improving EE in the industrial sector has scaled up to a US$7-US$10 million technical assistance package funded by the IDB. In addition, CENERGIA is working with European Union support to demonstrate the use of different contractual arrangements and financial instruments to be applied to 20 industrial sites.
- In Mongolia, ADB and DANIDA funded the district heating sector following the recommendations made through the ESMAP study "Mongolia Energy Efficiency in the Electricity and District Heating Sectors."

- In Romania, the ESMAP upstream work has led to the design and implementation of a US$10 million Bank-GEF Energy Efficiency Project in Romania.
- In Morocco, a GEF medium-sized project of US$750,000, an additional US$800,000 from France, and approximately US$10 million from commercial banks are leveraged to scale up the approach demonstrated through the ESMAP Global Efficiency in Sidi Bernoussi Industrial & Peri-Urban Area in Morocco Project from pilot phase into a full project dealing with the whole industrial zone.

3.12 **Generated replications and investments in client countries:**

- In Colombia, the local utility invested in the recommendations made in ESMAP's "End-Use Energy and Effluent Management Strategy Study."
- In Uzbekistan, the results of the ESMAP study to improve EE in the water utilities are finding immediate application in a management contract with the private sector that includes specific targets for reduction of energy consumption as part of a set of performance criteria that the private operator will need to achieve in order to receive a bonus payment.
- In Brazil, one private concessionaire is planning to invest in the energy saving measures recommended in ESMAP's Energy Efficiency in Medium and Small Water Supply Utilities in Brazil Project, including installation of microhydroturbines at water intake points. Working with the SEBRAE-RJ/GTZ Project and local financial institutions, ABCON intends to set up a sustainable dissemination mechanism that can provide outreach to enable other municipal water utilities to replicate this approach.

3.13 **Demonstrated a close link between energy, environment, and poverty, and contributed to poverty alleviation agenda:** The ESMAP Global Efficiency in Sidi Bernoussi Industrial & Peri-Urban Area in Morocco Project, for example, engaged the private sector in improving EE in the industrial park and contributed a portion of the economic benefits from the energy savings to an environmental and social fund to improve living standards for the poor in the slums. The ESMAP project entitled Development of Heat Strategies for Urban Areas of Low-Income Transition Economies is among the first at the Bank to investigate sustainable and affordable provision of heating services to low-income urban households.

3.14 **Achieved substantial energy savings:** A series of ESMAP pilot activities to improve EE in the industrial sector achieved cumulative direct measured energy savings for about US$9.3 million, out of the total US$2.8 million investment made by the host industries, who adopted the energy conservation measures recommended by the

ESMAP studies. The ESMAP pilot project in Brazil helped the local water utility reduce its annual electricity expenditure for operation by more than 50 percent. The ESMAP demonstration project in Ukraine significantly improved the quality of heat and hot water supply and comfort for the inhabitants of the two pilot buildings, and reduced energy consumption by an estimated 27 percent.

Lessons Learned (What We Have Learned)

3.15 **Knowledge Dissemination:** It is critical to choose the topics carefully and design the discussion questions well for an effective exchange, and a more systematic and explicit follow-up plan is essential.

3.16 **Industrial Energy Efficiency:** It is essential to engage the local industrial and trade associations in implementing energy cost management systems in the industrial sector.

3.17 Low-cost measures can achieve substantial energy savings. In Brazil, deploying water and electricity metering systems and implementing low-cost measures would reduce annual electricity expenditure by about 50 percent. In Uzbekistan, the ESMAP project found that the common assumption in water utilities of the former Soviet Union that all pumps were highly inefficient and should be replaced, was not the most cost-effective approach. Some simple low-cost technologies can save energy up to 20 percent with small investments that do not require replacement of the pumps. To improve EE in water utilities, the analysis of water loss minimization and EE options should be conducted at the same time.

3.18 Compared to state-owned water utilities, private water utilities have different driving forces to improve EE and apply quite different principles, especially for municipal systems. In Brazil, private operators of municipal water supply concessions are driven to implement EE measures as a means to conserve water resources and bring down the operating costs below the ability to pay of local consumers. Since the municipalities are generally not inclined to allow them to increase rates, they no longer can afford to treat energy costs as an uncontrollable fixed cost. On the other hand, the state-owned water utilities in Brazil continue to treat energy cost as fixed cost, and therefore have primarily been interested in determining the most cost-effective investment options to upgrade the pumps to reduce operation and maintenance cost.

3.19 In sum, many "win-win" opportunities exist to improve EE using low-cost commercial technologies with excellent financial returns to host enterprises. The key success factor to realize this potential is to establish a sustainable institutional infrastructure that makes energy conservation a profitable commercial business.

3.20 Urban Heating Strategies: It is important to evaluate both centralized district heating and decentralized heating alternatives, and choose the most economically preferred options depending on heat density, climate, value of fuel savings, and consumers' ability to pay. Conducting demand surveys of households' income level and ability to pay is critical to providing consumers with controlled and metered heating systems so they can choose the level of heat consumption and expenditures in accordance with household incomes. Stand-alone technical demonstration without reforms in regulatory and institutional framework would not be sustainable with major impacts.

3.21 Energy Efficiency Financing: The dedicated EE funds should be established and operated as a business, and should maximize the transparency of procedures and minimize government interference in financing decisions. The financing institution needs to be very proactive in the development of a project pipeline. A lack of available financing or capability of project development is usually not the barrier for EE financing. The key success factor for EE financing is to establish financing intermediaries between project developers and financiers that can bridge the knowledge and perception gaps between the two, and to bundle small-scale EE projects to reduce transaction costs.

3.22 ESMAP Instruments: Overall, ESMAP activities have influenced the Bank operations and client countries in the area of EE through instruments like pilot activities, special technical assistance, studies, and workshops. The pilot activities and technical assistance increased capacity of local stakeholders; leveraged scale-up investments from the WBG, other MDBs and donors, and domestic private sector; and led to policy changes in client countries. The analytic studies generated new knowledge, and the results are applied in new project design. The practitioner workshops generated and disseminated knowledge on implementing EE programs. In the future, ESMAP needs to expand its knowledge dissemination activities from workshops and publications to applying its wealth of knowledge on innovative mechanisms, methodologies, and strategies to new project designs, and tailoring to specific client country demands.

3.23 Since the 1997 ESMAP Energy Efficiency Roundtable Workshop, the WBG has designed and implemented a series of projects on EE financing and institutional delivery mechanisms. It is recommended that ESMAP evaluate what has worked versus what has not and what has been learned over the past five-six years on these Bank EE activities, and propose new ways forward.

References

"A Synopsis of the Second Roundtable on Energy Efficiency: Institutional and Financial Delivery Mechanisms." ESMAP Report No. 207/98. September 1998.

"ESMAP: Energy Efficiency Operational Exchange Program (UE-P065454)." Implementation Completion Memorandum. For more information, check out website: http://www.worldbank.org/html/fpd/esmap/ee_operational_exchange.htm. May 2002.

"Energy Service Companies (ESCOs) Practitioner Workshop." Workshop Summary. Washington DC, April 1999.

"Energy Efficiency Fund Practitioners Workshop". Workshop Summary. Washington DC. April 2000.

"Operating Utility DSM Programs in a Restructuring Electricity Sector." Workshop Summary. Uruguay. October 2000.

"Regional Energy Management: A Set of Case Studies in Latin America (Brazil, Peru, Colombia) and Eastern Europe (Slovakia)." Activity Completion Report. July 2001.

"Uzbekistan: Energy Efficiency in Urban Water Utilities of Central Asia: Consulting Services for Site Surveys and Testing of Equipment and Elaboration of Energy Efficiency Evaluation Methodology, Improvement and Specific Investment Strategies for the Bukhara and Samarkand Water Utilities". Draft Final Report. July 2002.

"ASTAE Energy Efficiency for Water/Wastewater Sector Initiative: Hebei Pilot Phase II." March 2003.

"Increasing the Efficiency of Heating Systems in Central and Eastern Europe and the Former Soviet Union." ESMAP Report No. 234/00. August 2000.

"Energy Efficiency Measurements: Dnepropetrovsk District Heating Project." Draft Report. June 2000.

"Development of Heat Strategies for Urban Areas of Low-Income Transition Economies: Urban Heating Strategy for Republic of Armenia with a summary of Heating Strategy for Kyrgyz Republic." Draft Report. February 2003.

3.24 "Mongolia: Improving Space Heating Stoves for Ulaanbaatar." ESMAP Report No. 254/02. March 2002.

"Private Sector Participation in Market-Based Energy Efficiency Financing Schemes: Lessons Learned from Romanian and International Experiences" Final Report for ESMAP. Anke Meyer. June 2002.

"Romania: Energy Efficiency Project." Project Document. September 2002.

ESMAP Annual Report 2000-2001.

Draft ESMAP Annual Report 2002.

"A Review of the Renewable Energy Activities of the UNDP/World Bank Energy Sector Management Assistance Program 1993-1998." ESMAP Report No. 223/99. October 1999.

Eric Martinot and Omar McDoom. "Promoting Energy Efficiency and Renewable Energy: GEF Climate Change Projects and Impacts." Global Environmental Facility. October 1999.

"The World Bank Group's Energy Program – Poverty Reduction, Sustainability, and Selectivity." Energy and Mining Sector Board, the World Bank Group. December 2001.

In-person interviews with Amarquaye Armar, Varadarajan Atur, Ede Jorge Ijjasz-Vasquez, Rene Mendonca, Anke Meyer, Salvador Rivera, Anjali Shanker, Gary Stuggins, and Robert Taylor.

Annex 1

Term of Reference (TOR)

This TOR defines responsibilities and deliverables of the impact evaluation of projects under the ESMAP Energy Efficiency Portfolio that were approved from 1997 to 2002 and listed in the ESMAP database, including projects closed, to be closed, under publication, and under implementation.

The objective of this review is to evaluate thematic impacts and lessons learned of the ESMAP Energy Efficiency Portfolio. Xiaodong Wang, an Energy Specialist at ESMAP, will conduct the review and write the report.

The review deliverables will be composed of:

- An ESMAP report; and
- A presentation to ESMAP Consultative Group Meeting in April 2003.

The responsibilities will include:

- Review ESMAP projects and reports and project files;
- Interview ESMAP task managers and other World Bank staff contributing to the projects, interview or e-mail in-country counterparts when necessary and appropriate; and
- Evaluate (i) intellectual leadership and innovations of ESMAP EE portfolio; (ii) outputs and achievements of each project; (iii) ESMAP role and influence through downstream activities in terms of World Bank Group (WBG) lending projects, investment and funding from other multilateral development banks (MDBs) and donors, and follow-up actions and replications by local governments, NGOs, and the private sector in client countries; and (iv) lessons learned and best practices.

The evaluation should assess the following issues:

- What are pilot activities and specific technical assistance provided to client countries?
- What are new methodologies, approaches, or mechanisms used in ESMAP projects?
- What analytical knowledge or advice was conveyed in the ESMAP interventions?
- What are the intellectual leadership and innovations in ESMAP activities?
- What are the major achievements of ESMAP activities?
- How did ESMAP interventions build local capacity?
- What is new knowledge generated?

- How is ESMAP knowledge disseminated?
- How has ESMAP support influenced others and fostered project development at the Bank and in client countries?
- What downstream activities are leveraged from ESMAP projects in terms of WBG lending projects, investment and funding from other MDBs and donors, and follow-up actions and replications by local governments, NGOs, and the private sector in client countries?
- What are the thematic impacts of the Energy Efficiency Portfolio?
- What are the lessons learned and best practices?
- What is ESMAP's comparative advantage?
- Does ESMAP have the right instruments?
- What are the areas for improvements in the future?

Annex 2

List of ESMAP Energy Efficiency Projects, 1997-2002

By Regions

Status	Project ID	Title	Country	ESMAP Approved Amount	Task Manager
I. LCR			**21%**	**$905,637**	
Closed	P034782	Energy Efficiency and Environment	Bolivia	$376,022	Willem M. Floor
To be Closed	P075196	Energy Efficiency in Medium and Small Water Supply Utilities	Brazil	$160,000	Amarquaye Armar
Closed	P047023	Special Initiative on Energy Efficiency	Brazil	$143,294	Arturo S. Rivera
Closed	P045121	Bahia End-use Energy and Effluent Management Stratefy TA	Brazil	$64,400	Arturo S. Rivera
Closed	P044442	Energy Efficiency TA Phase II-FINEP	Brazil	$93,884	Arturo S. Rivera
Closed	P043319	Peru Training: Energy Management Services	Peru	$16,749	Arturo S. Rivera
Closed	P045122	End-use Energy and Effluent Management Strategy Study	Colombia	$51,288	Arturo S. Rivera
II. ECA			**48%**	**$2,094,273**	
Under Implementation	P073366	Lithuania - Heating supply to small cities/towns	Lithuania	$278,500	Gary Stuggins
Publication in Process	P064743	Energy Efficiency (Reconnaissance)	Romania	$101,329	Varadarajan Atur
Publication in Process	P070678	Heat strategies in low-income transition countries	ECA	$300,000	Sumter Lee Travers
Publication in Process	P073630	Energy efficiency in urban water utilities in Central Asia	Central Asia	$250,000	Ede Jorge Ijjasz-Vasquez
Closed	P043955	Central Europe: District Heating	ECA	$654,295	Anke S. Meyer
Closed	P053126	Integrated Heat Demonstration Project	Ukraine	$207,096	Anke S. Meyer
Closed	P040067	Energy Efficiency TA Monitoring and Targeting and Feasibility of third party financing	Slovak Republic	$303,053	Anke S. Meyer
III. EAP			**7%**	**$318,618**	
Under Implementation	P082160	Development of Pro-Poor National Heating Pricing	China	$250,000	Robert P. Taylor

		and Billing Policy			
To be Closed	P076471	Energy Efficiency in Water Utilities - Seed Funding	China	$9,993	Salvador Rivera
Closed	P044672	Energy Efficiency Program	Mongolia	$58,625	Salvador Rivera
IV. GLOBAL			**16%**	**$695,031**	
Under Implementation	P073016	Developing Financial Intermediation Mechanisms for Energy Efficiency Projects in Brazil, China and India	Global	$309,904	Robert P. Taylor
To be closed	P065454	Energy Efficiency Operational Exchanges Program	Global	$300,000	Robert P. Taylor
Closed	P050019	1997 Energy Efficiency Roundtable	Global	$85,127	Arturo S. Rivera
V. MENA			**8%**	**$340,000**	
Publication in Process	P065461	Global Efficiency in Sidi Bernoussi Industrial & Peri-Urban Area	Morocco	$340,000	Rene G. Mendonca
Total		**21 Projects**		**$4,353,559**	

By Strategic Areas

Status	**Project ID**	**Title**	**Country**	**ESMAP Approved Amount**	**Task Manager**
1. Disseminating knowledge			**9%**	**$385,127**	
To be closed	P065454	Energy Efficiency Operational Exchanges Program	Global	$300,000	Robert P. Taylor
Closed	P050019	1997 Energy Efficiency Roundtable	Global	$85,127	Arturo S. Rivera
2. Industrial EE			**42%**	**$1,808,683**	
Closed	P034782	Energy Efficiency and Environment	Bolivia	$376,022	Willem M. Floor
Closed	P047023	Special Initiative on Energy Efficiency	Brazil	$143,294	Arturo S. Rivera
Closed	P045121	Bahia End-use Energy and Effluent Management Stratefy TA	Brazil	$64,400	Arturo S. Rivera
Closed	P044442	Energy Efficiency TA Phase II-FINEP	Brazil	$93,884	Arturo S. Rivera
Closed	P043319	Peru Training: Energy Management Services	Peru	$16,749	Arturo S. Rivera

Closed	P045122	End-use Energy and Effluent Management Strategy Study	Colombia	$51,288	Arturo S. Rivera
Closed	P040067	Energy Efficiency TA Monitoring and Targeting and Feasibility of third party financing	Slovak Republic	$303,053	Anke S. Meyer
To be closed	P075196	Energy Efficiency in Medium and Small Water Supply Utilities	Brazil	$160,000	Amarquaye Armar
Publication in Process	P073630	Energy efficiency in urban water utilities in Central Asia	Central Asia	$250,000	Ede Jorge Ijjasz-Vasquez
To be Closed	P076471	Energy Efficiency in Water Utilities - Seed Funding	China	$9,993	Salvador Rivera
Publication in Process	P065461	Global Efficiency in Sidi Bernoussi Industrial & Peri-Urban Area	Morocco	$340,000	Rene G. Mendonca
3. Heating strategies			**40%**	**$1,748,516**	
Closed	P043955	Central Europe: District Heating	ECA	$654,295	Anke S. Meyer
Closed	P053126	Integrated Heat Demonstration Project	Ukraine	$207,096	Anke S. Meyer
Closed	P044672	Energy Efficiency Program	Mongolia	$58,625	Salvador Rivera
Publication in Process	P070678	Heat strategies in low-income transition countries	ECA	$300,000	Sumter Lee Travers
Under Implementation	P073366	Lithuania - Heating supply to small cities/towns	Lithuania	$278,500	Gary Stuggins
Under Implementation	P082160	Development of Pro-Poor National Heating Pricing and Billing Policy	China	$250,000	Robert P. Taylor
4. EE Financing			**9%**	**$411,233**	
Publication in Process	P064743	Energy Efficiency (Reconnaissance)	Romania	$101,329	Varadarajan Atur
Under Implementation	P073016	Developing Financial Intermediation Mechanisms for Energy Efficiency Projects in Brazil, China and India	Global	$309,904	Robert P. Taylor
Total		**21 Projects**		**$4,353,559**	

Joint UNDP/World Bank

ENERGY SECTOR MANAGEMENT ASSISTANCE PROGRAMME (ESMAP)

LIST OF REPORTS ON COMPLETED ACTIVITIES

Region/Country	*Activity/Report Title*	*Date*	*Number*
	SUB-SAHARAN AFRICA (AFR)		
Africa Regional	Anglophone Africa Household Energy Workshop (English)	07/88	085/88
	Regional Power Seminar on Reducing Electric Power System Losses in Africa (English)	08/88	087/88
	Institutional Evaluation of EGL (English)	02/89	098/89
	Biomass Mapping Regional Workshops (English)	05/89	--
	Francophone Household Energy Workshop (French)	08/89	--
	Interafrican Electrical Engineering College: Proposals for Short- and Long-Term Development (English)	03/90	112/90
	Biomass Assessment and Mapping (English)	03/90	--
	Symposium on Power Sector Reform and Efficiency Improvement in Sub-Saharan Africa (English)	06/96	182/96
	Commercialization of Marginal Gas Fields (English)	12/97	201/97
	Commercilizing Natural Gas: Lessons from the Seminar in Nairobi for Sub-Saharan Africa and Beyond	01/00	225/00
	Africa Gas Initiative – Main Report: Volume I	02/01	240/01
	First World Bank Workshop on the Petroleum Products Sector in Sub-Saharan Africa	09/01	245/01
	Ministerial Workshop on Women in Energy	10/01	250/01
	Energy and Poverty Reduction: Proceedings from a Multi-Sector And Multi-Stakeholder Workshop Addis Ababa, Ethiopia, October 23-25, 2002.	03/03	266/03
Angola	Energy Assessment (English and Portuguese)	05/89	4708-ANG
	Power Rehabilitation and Technical Assistance (English)	10/91	142/91
	Africa Gas Initiative – Angola: Volume II	02/01	240/01
Benin	Energy Assessment (English and French)	06/85	5222-BEN
Botswana	Energy Assessment (English)	09/84	4998-BT
	Pump Electrification Prefeasibility Study (English)	01/86	047/86
	Review of Electricity Service Connection Policy (English)	07/87	071/87
	Tuli Block Farms Electrification Study (English)	07/87	072/87
	Household Energy Issues Study (English)	02/88	--
	Urban Household Energy Strategy Study (English)	05/91	132/91
Burkina Faso	Energy Assessment (English and French)	01/86	5730-BUR
	Technical Assistance Program (English)	03/86	052/86
	Urban Household Energy Strategy Study (English and French)	06/91	134/91
Burundi	Energy Assessment (English)	06/82	3778-BU
	Petroleum Supply Management (English)	01/84	012/84
	Status Report (English and French)	02/84	011/84
	Presentation of Energy Projects for the Fourth Five-Year Plan (1983-1987) (English and French)	05/85	036/85
	Improved Charcoal Cookstove Strategy (English and French)	09/85	042/85
	Peat Utilization Project (English)	11/85	046/85
	Energy Assessment (English and French)	01/92	9215-BU
Cameroon	Africa Gas Initiative – Cameroon: Volume III	02/01	240/01
Cape Verde	Energy Assessment (English and Portuguese)	08/84	5073-CV
	Household Energy Strategy Study (English)	02/90	110/90
Central African Republic	Energy Assessement (French)	08/92	9898-CAR

Region/Country	Activity/Report Title	Date	Number
Chad	Elements of Strategy for Urban Household Energy	12/93	160/94
	The Case of N'djamena (French)	01/88	7104-COM
Comoros	Energy Assessment (English and French)		
	In Search of Better Ways to Develop Solar Markets:	05/00	230/00
	The Case of Comoros	01/88	6420-COB
Congo	Energy Assessment (English)	03/90	106/90
	Power Development Plan (English and French)	02/01	240/01
	Africa Gas Initiative – Congo: Volume IV	04/85	5250-IVC
Côte d'Ivoire	Energy Assessment (English and French)	04/87	069/87
	Improved Biomass Utilization (English and French)	12/87	--
	Power System Efficiency Study (English)	02/92	140/91
	Power Sector Efficiency Study (French)	09/95	175/95
	Project of Energy Efficiency in Buildings (English)	02/01	240/01
	Africa Gas Initiative – Côte d'Ivoire: Volume V	07/84	4741-ET
Ethiopia	Energy Assessment (English)	10/85	045/85
	Power System Efficiency Study (English)	12/86	062/86
	Agricultural Residue Briquetting Pilot Project (English)	12/86	063/86
	Bagasse Study (English)	12/87	--
	Cooking Efficiency Project (English)	02/96	179/96
	Energy Assessment (English)	07/88	6915-GA
Gabon	Energy Assessment (English)	02/01	240/01
	Africa Gas Initiative – Gabon: Volume VI	11/83	4743-GM
The Gambia	Energy Assessment (English)	02/85	030/85
	Solar Water Heating Retrofit Project (English)	03/85	032/85
	Solar Photovoltaic Applications (English)	04/85	035/85
	Petroleum Supply Management Assistance (English)	11/86	6234-GH
Ghana	Energy Assessment (English)	06/88	084/88
	Energy Rationalization in the Industrial Sector (English)	11/88	074/87
	Sawmill Residues Utilization Study (English)	11/92	148/92
	Industrial Energy Efficiency (English)	11/86	6137-GUI
Guinea	Energy Assessment (English)	01/94	163/94
	Household Energy Strategy (English and French)	08/84	5083-GUB
Guinea-Bissau	Energy Assessment (English and Portuguese)		
	Recommended Technical Assistance Projects (English & Portuguese)	04/85	033/85
	Management Options for the Electric Power and Water Supply	02/90	100/90
	Subsectors (English)	04/91	118/91
	Power and Water Institutional Restructuring (French)	05/82	3800-KE
Kenya	Energy Assessment (English)	03/84	014/84
	Power System Efficiency Study (English)	05/84	016/84
	Status Report (English)	02/87	--
	Coal Conversion Action Plan (English)	02/87	066/87
	Solar Water Heating Study (English)	10/87	076/87
	Peri-Urban Woodfuel Development (English)	11/87	--
	Power Master Plan (English)	09/96	186/96
	Power Loss Reduction Study (English)		
	Implementation Manual: Financing Mechanisms for Solar	07/00	231/00
	Electric Equipment	01/84	4676-LSO
Lesotho	Energy Assessment (English)	12/84	5279-LBR
Liberia	Energy Assessment (English)	06/85	038/85
	Recommended Technical Assistance Projects (English)	12/87	081/87
	Power System Efficiency Study (English)	01/87	5700-MAG
Madagascar	Energy Assessment (English)	12/87	075/87
	Power System Efficiency Study (English and French)		

Region/Country	*Activity/Report Title*	*Date*	*Number*
Madagascar	Environmental Impact of Woodfuels (French)	10/95	176/95
Malawi	Energy Assessment (English)	08/82	3903-MAL
	Technical Assistance to Improve the Efficiency of Fuelwood Use in the Tobacco Industry (English)	11/83	009/83
	Status Report (English)	01/84	013/84
Mali	Energy Assessment (English and French)	11/91	8423-MLI
	Household Energy Strategy (English and French)	03/92	147/92
Islamic Republic of Mauritania	Energy Assessment (English and French)	04/85	5224-MAU
	Household Energy Strategy Study (English and French)	07/90	123/90
Mauritius	Energy Assessment (English)	12/81	3510-MAS
	Status Report (English)	10/83	008/83
	Power System Efficiency Audit (English)	05/87	070/87
	Bagasse Power Potential (English)	10/87	077/87
	Energy Sector Review (English)	12/94	3643-MAS
Mozambique	Energy Assessment (English)	01/87	6128-MOZ
	Household Electricity Utilization Study (English)	03/90	113/90
	Electricity Tariffs Study (English)	06/96	181/96
	Sample Survey of Low Voltage Electricity Customers	06/97	195/97
Namibia	Energy Assessment (English)	03/93	11320-NAM
Niger	Energy Assessment (French)	05/84	4642-NIR
	Status Report (English and French)	02/86	051/86
	Improved Stoves Project (English and French)	12/87	080/87
	Household Energy Conservation and Substitution (English and French)	01/88	082/88
Nigeria	Energy Assessment (English)	08/83	4440-UNI
	Energy Assessment (English)	07/93	11672-UNI
Rwanda	Energy Assessment (English)	06/82	3779-RW
	Status Report (English and French)	05/84	017/84
	Improved Charcoal Cookstove Strategy (English and French)	08/86	059/86
	Improved Charcoal Production Techniques (English and French)	02/87	065/87
	Energy Assessment (English and French)	07/91	8017-RW
	Commercialization of Improved Charcoal Stoves and Carbonization Techniques Mid-Term Progress Report (English and French)	12/91	141/91
SADC	SADC Regional Power Interconnection Study, Vols. I-IV (English)	12/93	-
SADCC	SADCC Regional Sector: Regional Capacity-Building Program for Energy Surveys and Policy Analysis (English)	11/91	-
Sao Tome and Principe	Energy Assessment (English)	10/85	5803-STP
Senegal	Energy Assessment (English)	07/83	4182-SE
	Status Report (English and French)	10/84	025/84
	Industrial Energy Conservation Study (English)	05/85	037/85
	Preparatory Assistance for Donor Meeting (English and French)	04/86	056/86
	Urban Household Energy Strategy (English)	02/89	096/89
	Industrial Energy Conservation Program (English)	05/94	165/94
Seychelles	Energy Assessment (English)	01/84	4693-SEY
	Electric Power System Efficiency Study (English)	08/84	021/84
Sierra Leone	Energy Assessment (English)	10/87	6597-SL
Somalia	Energy Assessment (English)	12/85	5796-SO
Republic of South Africa	Options for the Structure and Regulation of Natural Gas Industry (English)	05/95	172/95
Sudan	Management Assistance to the Ministry of Energy and Mining	05/83	003/83
	Energy Assessment (English)	07/83	4511-SU

Region/Country	Activity/Report Title	Date	Number
	Power System Efficiency Study (English)	06/84	018/84
	Status Report (English)	11/84	026/84
	Wood Energy/Forestry Feasibility (English)	07/87	073/87
Swaziland	Energy Assessment (English)	02/87	6262-SW
	Household Energy Strategy Study	10/97	198/97
Tanzania	Energy Assessment (English)	11/84	4969-TA
	Peri-Urban Woodfuels Feasibility Study (English)	08/88	086/88
	Tobacco Curing Efficiency Study (English)	05/89	102/89
	Remote Sensing and Mapping of Woodlands (English)	06/90	--
	Industrial Energy Efficiency Technical Assistance (English)	08/90	122/90
	Power Loss Reduction Volume 1: Transmission and Distribution SystemTechnical Loss Reduction and Network Development (English)	06/98	204A/98
	Power Loss Reduction Volume 2: Reduction of Non-Technical Losses (English)	06/98	204B/98
Togo	Energy Assessment (English)	06/85	5221-TO
	Wood Recovery in the Nangbeto Lake (English and French)	04/86	055/86
	Power Efficiency Improvement (English and French)	12/87	078/87
Uganda	Energy Assessment (English)	07/83	4453-UG
	Status Report (English)	08/84	020/84
	Institutional Review of the Energy Sector (English)	01/85	029/85
	Energy Efficiency in Tobacco Curing Industry (English)	02/86	049/86
	Fuelwood/Forestry Feasibility Study (English)	03/86	053/86
	Power System Efficiency Study (English)	12/88	092/88
	Energy Efficiency Improvement in the Brick and Tile Industry (English)	02/89	097/89
	Tobacco Curing Pilot Project (English)	03/89	UNDP Terminal Report
	Energy Assessment (English)	12/96	193/96
	Rural Electrification Strategy Study	09/99	221/99
Zaire	Energy Assessment (English)	05/86	5837-ZR
Zambia	Energy Assessment (English)	01/83	4110-ZA
	Status Report (English)	08/85	039/85
	Energy Sector Institutional Review (English)	11/86	060/86
	Power Subsector Efficiency Study (English)	02/89	093/88
	Energy Strategy Study (English)	02/89	094/88
	Urban Household Energy Strategy Study (English)	08/90	121/90
Zimbabwe	Energy Assessment (English)	06/82	3765-ZIM
	Power System Efficiency Study (English)	06/83	005/83
	Status Report (English)	08/84	019/84
	Power Sector Management Assistance Project (English)	04/85	034/85
	Power Sector Management Institution Building (English)	09/89	--
	Petroleum Management Assistance (English)	12/89	109/89
	Charcoal Utilization Prefeasibility Study (English)	06/90	119/90
	Integrated Energy Strategy Evaluation (English)	01/92	8768-ZIM
	Energy Efficiency Technical Assistance Project: Strategic Framework for a National Energy Efficiency Improvement Program (English)	04/94	--
	Capacity Building for the National Energy Efficiency Improvement Programme (NEEIP) (English)	12/94	--
Zimbabwe	Rural Electrification Study	03/00	228/00

Region/Country	*Activity/Report Title*	*Date*	*Number*
	EAST ASIA AND PACIFIC (EAP)		
Asia Regional	Pacific Household and Rural Energy Seminar (English)	11/90	--
China	County-Level Rural Energy Assessments (English)	05/89	101/89
	Fuelwood Forestry Preinvestment Study (English)	12/89	105/89
	Strategic Options for Power Sector Reform in China (English)	07/93	156/93
	Energy Efficiency and Pollution Control in Township and Village Enterprises (TVE) Industry (English)	11/94	168/94
	Energy for Rural Development in China: An Assessment Based on a Joint Chinese/ESMAP Study in Six Counties (English)	06/96	183/96
	Improving the Technical Efficiency of Decentralized Power Companies	09/99	222/99
	Air Pollution and Acid Rain Control: The Case of Shijiazhuang City and the Changsha Triangle Area	10/03	267/03
Fiji	Energy Assessment (English)	06/83	4462-FIJ
Indonesia	Energy Assessment (English)	11/81	3543-IND
	Status Report (English)	09/84	022/84
	Power Generation Efficiency Study (English)	02/86	050/86
	Energy Efficiency in the Brick, Tile and Lime Industries (English)	04/87	067/87
	Diesel Generating Plant Efficiency Study (English)	12/88	095/88
	Urban Household Energy Strategy Study (English)	02/90	107/90
	Biomass Gasifier Preinvestment Study Vols. I & II (English)	12/90	124/90
	Prospects for Biomass Power Generation with Emphasis on Palm Oil, Sugar, Rubberwood and Plywood Residues (English)	11/94	167/94
Lao PDR	Urban Electricity Demand Assessment Study (English)	03/93	154/93
	Institutional Development for Off-Grid Electrification	06/99	215/99
Malaysia	Sabah Power System Efficiency Study (English)	03/87	068/87
	Gas Utilization Study (English)	09/91	9645-MA
Mongolia	Energy Efficiency in the Electricity and District Heating Sectors	10/01	247/01
	Improved Space Heating Stoves for Ulaanbaatar	03/02	254/02
Myanmar	Energy Assessment (English)	06/85	5416-BA
Papua New Guinea	Energy Assessment (English)	06/82	3882-PNG
	Status Report (English)	07/83	006/83
	Institutional Review in the Energy Sector (English)	10/84	023/84
	Power Tariff Study (English)	10/84	024/84
Philippines	Commercial Potential for Power Production from Agricultural Residues (English)	12/93	157/93
	Energy Conservation Study (English)	08/94	--
	Strengthening the Non-Conventional and Rural Energy Development Program in the Philippines: A Policy Framework and Action Plan	08/01	243/01
	Rural Electrification and Development in the Philippines: Measuring the Social and Economic Benefits	05/02	255/02
Solomon Islands	Energy Assessment (English)	06/83	4404-SOL
	Energy Assessment (English)	01/92	979-SOL
South Pacific	Petroleum Transport in the South Pacific (English)	05/86	--
Thailand	Energy Assessment (English)	09/85	5793-TH
	Rural Energy Issues and Options (English)	09/85	044/85
Thailand	Accelerated Dissemination of Improved Stoves and Charcoal Kilns (English)	09/87	079/87

Region/Country	*Activity/Report Title*	*Date*	*Number*
	Northeast Region Village Forestry and Woodfuels Preinvestment Study (English)	02/88	083/88
	Impact of Lower Oil Prices (English)	08/88	--
	Coal Development and Utilization Study (English)	10/89	--
	Why Liberalization May Stall in a Mature Power Market: A Review of the Technical and Political Economy Factors that Constrained the Electricity Sector Reform in Thailand 1998-2002	12/03	270/03
Tonga	Energy Assessment (English)	06/85	5498-TON
Vanuatu	Energy Assessment (English)	06/85	5577-VA
Vietnam	Rural and Household Energy-Issues and Options (English)	01/94	161/94
	Power Sector Reform and Restructuring in Vietnam: Final Report to the Steering Committee (English and Vietnamese)	09/95	174/95
	Household Energy Technical Assistance: Improved Coal Briquetting and Commercialized Dissemination of Higher Efficiency Biomass and Coal Stoves (English)	01/96	178/96
	Petroleum Fiscal Issues and Policies for Fluctuating Oil Prices In Vietnam	02/01	236/01
	An Overnight Success: Vietnam's Switch to Unleaded Gasoline	08/02	257/02
	The Electricity Law for Vietnam—Status and Policy Issues—The Socialist Republic of Vietnam	08/02	259/02
	Petroleum Sector Technical Assistance for the Revision of the Existing Legal and Regulatory Framework	12/03	269/03
Western Samoa	Energy Assessment (English)	06/85	5497-WSO
	SOUTH ASIA (SAS)		
Bangladesh	Energy Assessment (English)	10/82	3873-BD
	Priority Investment Program (English)	05/83	002/83
	Status Report (English)	04/84	015/84
	Power System Efficiency Study (English)	02/85	031/85
	Small Scale Uses of Gas Prefeasibility Study (English)	12/88	--
	Reducing Emissions from Baby-Taxis in Dhaka	01/02	253/02
India	Opportunities for Commercialization of Nonconventional Energy Systems (English)	11/88	091/88
	Maharashtra Bagasse Energy Efficiency Project (English)	07/90	120/90
	Mini-Hydro Development on Irrigation Dams and Canal Drops Vols. I, II and III (English)	07/91	139/91
	WindFarm Pre-Investment Study (English)	12/92	150/92
	Power Sector Reform Seminar (English)	04/94	166/94
	Environmental Issues in the Power Sector (English)	06/98	205/98
	Environmental Issues in the Power Sector: Manual for Environmental Decision Making (English)	06/99	213/99
	Household Energy Strategies for Urban India: The Case of Hyderabad	06/99	214/99
	Greenhouse Gas Mitigation In the Power Sector: Case Studies From India	02/01	237/01
	Energy Strategies for Rural India: Evidence from Six States	08/02	258/02
	Household Energy, Indoor Air Pollution, and Health	11/02	261/02
	Access of the Poor to Clean Household Fuels	07/03	263/03
Nepal	Energy Assessment (English)	08/83	4474-NEP
	Status Report (English)	01/85	028/84
	Energy Efficiency & Fuel Substitution in Industries (English)	06/93	158/93
Pakistan	Household Energy Assessment (English)	05/88	--

Region/Country	*Activity/Report Title*	*Date*	*Number*
	Assessment of Photovoltaic Programs, Applications, and Markets (English)	10/89	103/89
Pakistan	National Household Energy Survey and Strategy Formulation Study: Project Terminal Report (English)	03/94	--
	Managing the Energy Transition (English)	10/94	--
	Lighting Efficiency Improvement Program Phase 1: Commercial Buildings Five Year Plan (English)	10/94	--
	Clean Fuels	10/01	246/01
Sri Lanka	Energy Assessment (English)	05/82	3792-CE
	Power System Loss Reduction Study (English)	07/83	007/83
	Status Report (English)	01/84	010/84
	Industrial Energy Conservation Study (English)	03/86	054/86
	Sustainable Transport Options for Sri Lanka: Vol. I	02/03	262/03
	Greenhouse Gas Mitigation Options in the Sri Lanka Power Sector: Vol. II	02/03	262/03
	Sri Lanka Electric Power Technology Assessment (SLEPTA): Vol. III	02/03	262/03
	Energy and Poverty Reduction: Proceedings from South Asia Practitioners Workshop How Can Modern Energy Services Contribute to Poverty Reduction? Colombo, Sri Lanka, June 2-4, 2003	11/03	268/03
	EUROPE AND CENTRAL ASIA (ECA)		
Bulgaria	Natural Gas Policies and Issues (English)	10/96	188/96
	Energy Environment Review	10/02	260/02
Central Asia and The Caucasus	Cleaner Transport Fuels in Central Asia and the Caucasus	08/01	242/01
Central and Eastern Europe	Power Sector Reform in Selected Countries	07/97	196/97
	Increasing the Efficiency of Heating Systems in Central and Eastern Europe and the Former Soviet Union (English and Russian)	08/00	234/00
	The Future of Natural Gas in Eastern Europe (English)	08/92	149/92
Kazakhstan	Natural Gas Investment Study, Volumes 1, 2 & 3	12/97	199/97
Kazakhstan & Kyrgyzstan	Opportunities for Renewable Energy Development	11/97	16855-KAZ
Poland	Energy Sector Restructuring Program Vols. I-V (English)	01/93	153/93
	Natural Gas Upstream Policy (English and Polish)	08/98	206/98
	Energy Sector Restructuring Program: Establishing the Energy Regulation Authority	10/98	208/98
Portugal	Energy Assessment (English)	04/84	4824-PO
Romania	Natural Gas Development Strategy (English)	12/96	192/96
Slovenia	Workshop on Private Participation in the Power Sector (English)	02/99	211/99
Turkey	Energy Assessment (English)	03/83	3877-TU
	Energy and the Environment: Issues and Options Paper	04/00	229/00
	MIDDLE EAST AND NORTH AFRICA (MNA)		
Arab Republic of Egypt	Energy Assessment (English)	10/96	189/96
	Energy Assessment (English and French)	03/84	4157-MOR
	Status Report (English and French)	01/86	048/86

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Morocco	Energy Sector Institutional Development Study (English and French)	07/95	173/95
	Natural Gas Pricing Study (French)	10/98	209/98
	Gas Development Plan Phase II (French)	02/99	210/99
Syria	Energy Assessment (English)	05/86	5822-SYR
	Electric Power Efficiency Study (English)	09/88	089/88
	Energy Efficiency Improvement in the Cement Sector (English)	04/89	099/89
	Energy Efficiency Improvement in the Fertilizer Sector (English)	06/90	115/90
Tunisia	Fuel Substitution (English and French)	03/90	--
Tunisia	Power Efficiency Study (English and French)	02/92	136/91
	Energy Management Strategy in the Residential and Tertiary Sectors (English)	04/92	146/92
	Renewable Energy Strategy Study, Volume I (French)	11/96	190A/96
	Renewable Energy Strategy Study, Volume II (French)	11/96	190B/96
Yemen	Energy Assessment (English)	12/84	4892-YAR
	Energy Investment Priorities (English)	02/87	6376-YAR
	Household Energy Strategy Study Phase I (English)	03/91	126/91
	LATIN AMERICA AND THE CARIBBEAN (LAC)		
LAC Regional	Regional Seminar on Electric Power System Loss Reduction in the Caribbean (English)	07/89	--
	Elimination of Lead in Gasoline in Latin America and the Caribbean (English and Spanish)	04/97	194/97
	Elimination of Lead in Gasoline in Latin America and the Caribbean - Status Report (English and Spanish)	12/97	200/97
	Harmonization of Fuels Specifications in Latin America and the Caribbean (English and Spanish)	06/98	203/98
Bolivia	Energy Assessment (English)	04/83	4213-BO
	National Energy Plan (English)	12/87	--
	La Paz Private Power Technical Assistance (English)	11/90	111/90
	Prefeasibility Evaluation Rural Electrification and Demand Assessment (English and Spanish)	04/91	129/91
	National Energy Plan (Spanish)	08/91	131/91
	Private Power Generation and Transmission (English)	01/92	137/91
	Natural Gas Distribution: Economics and Regulation (English)	03/92	125/92
	Natural Gas Sector Policies and Issues (English and Spanish)	12/93	164/93
	Household Rural Energy Strategy (English and Spanish)	01/94	162/94
	Preparation of Capitalization of the Hydrocarbon Sector	12/96	191/96
	Introducing Competition into the Electricity Supply Industry in Developing Countries: Lessons from Bolivia	08/00	233/00
	Final Report on Operational Activities Rural Energy and Energy Efficiency	08/00	235/00
	Oil Industry Training for Indigenous People: The Bolivian Experience (English and Spanish)	09/01	244/01
Brazil	Energy Efficiency & Conservation: Strategic Partnership for Energy Efficiency in Brazil (English)	01/95	170/95
	Hydro and Thermal Power Sector Study	09/97	197/97
	Rural Electrification with Renewable Energy Systems in the Northeast: A Preinvestment Study	07/00	232/00
	Reducing Energy Costs in Municipal Water Supply Operations "Learning-while-doing" Energy M&T on the Brazilian Frontlines	07/03	265/03
Chile	Energy Sector Review (English)	08/88	7129-CH
Colombia	Energy Strategy Paper (English)	12/86	--

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	Power Sector Restructuring (English)	11/94	169/94
Colombia	Energy Efficiency Report for the Commercial and Public Sector (English)	06/96	184/96
Costa Rica	Energy Assessment (English and Spanish)	01/84	4655-CR
	Recommended Technical Assistance Projects (English)	11/84	027/84
	Forest Residues Utilization Study (English and Spanish)	02/90	108/90
Dominican Republic	Energy Assessment (English)	05/91	8234-DO
Ecuador	Energy Assessment (Spanish)	12/85	5865-EC
	Energy Strategy Phase I (Spanish)	07/88	--
	Energy Strategy (English)	04/91	--
	Private Minihydropower Development Study (English)	11/92	--
	Energy Pricing Subsidies and Interfuel Substitution (English)	08/94	11798-EC
	Energy Pricing, Poverty and Social Mitigation (English)	08/94	12831-EC
Guatemala	Issues and Options in the Energy Sector (English)	09/93	12160-GU
Haiti	Energy Assessment (English and French)	06/82	3672-HA
	Status Report (English and French)	08/85	041/85
	Household Energy Strategy (English and French)	12/91	143/91
Honduras	Energy Assessment (English)	08/87	6476-HO
	Petroleum Supply Management (English)	03/91	128/91
Jamaica	Energy Assessment (English)	04/85	5466-JM
	Petroleum Procurement, Refining, and Distribution Study (English)	11/86	061/86
	Energy Efficiency Building Code Phase I (English)	03/88	--
	Energy Efficiency Standards and Labels Phase I (English)	03/88	--
	Management Information System Phase I (English)	03/88	--
	Charcoal Production Project (English)	09/88	090/88
	FIDCO Sawmill Residues Utilization Study (English)	09/88	088/88
	Energy Sector Strategy and Investment Planning Study (English)	07/92	135/92
Mexico	Improved Charcoal Production Within Forest Management for the State of Veracruz (English and Spanish)	08/91	138/91
	Energy Efficiency Management Technical Assistance to the Comision Nacional para el Ahorro de Energia (CONAE) (English)	04/96	180/96
	Energy Environment Review	05/01	241/01
Nicaragua	Modernizing the Fuelwood Sector in Managua and León	12/01	252/01
Panama	Power System Efficiency Study (English)	06/83	004/83
Paraguay	Energy Assessment (English)	10/84	5145-PA
	Recommended Technical Assistance Projects (English)	09/85	--
	Status Report (English and Spanish)	09/85	043/85
Peru	Energy Assessment (English)	01/84	4677-PE
	Status Report (English)	08/85	040/85
	Proposal for a Stove Dissemination Program in the Sierra (English and Spanish)	02/87	064/87
	Energy Strategy (English and Spanish)	12/90	--
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Saint Lucia	Energy Assessment (English)	09/84	5111-SLU
St. Vincent and the Grenadines	Energy Assessment (English)	09/84	5103-STV

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Sub Andean	Environmental and Social Regulation of Oil and Gas Operations in Sensitive Areas of the Sub-Andean Basin (English and Spanish)	07/99	217/99
Trinidad and Tobago	Energy Assessment (English)	12/85	5930-TR

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Energy End Use Efficiency: Research and Strategy (English)	11/89	--
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Comparative Behavior of Firms Under Public and Private Ownership (English)	05/93	155/93
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Roundtable on Energy Efficiency (English)	02/95	171/95
Assessing Pollution Abatement Policies with a Case Study of Ankara (English)	11/95	177/95
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Best Practice Manual: Promoting Decentralized Electrification Investment	10/01	248/01
Peri-Urban Electricity Consumers—A Forgotten but Important Group: What Can We Do to Electrify Them?	10/01	249/01
Village Power 2000: Empowering People and Transforming Markets	10/01	251/01
Private Financing for Community Infrastructure	05/02	256/02

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	Stakeholder Involvement in Options Assessment: Promoting Dialogue in Meeting Water and Energy Needs: A Sourcebook	07/03	264/03
	A Review of ESMAP Energy Efficiency Portfolio	11/03	271/03

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