

93688

# 2014

---

## ANNUAL REPORT

Public Disclosure Authorized  
Public Disclosure Authorized  
Public Disclosure Authorized  
Public Disclosure Authorized



ASTAE

Asia Sustainable and Alternative Energy Program

 **ESMAP**  
Energy Sector Management Assistance Program



## MISSION

The Energy Sector Management Assistance Program (ESMAP) is a global knowledge and technical assistance program administered by the World Bank. It provides analytical and advisory services to low- and middle-income countries to increase their know-how and institutional capacity to achieve environmentally sustainable energy solutions for poverty reduction and economic growth. ESMAP is funded by Australia, Austria, Denmark, Finland, France, Germany, Iceland, Japan, Lithuania, Norway, Sweden, the Netherlands, and the United Kingdom, as well as the World Bank.

# CONTENTS

<b>1   COMPLEX CHALLENGES, DYNAMIC OPPORTUNITIES . . . . 1</b>	
Leverage and Impact . . . . .	2
Support to Regions . . . . .	4
New Business Plan . . . . .	5
WBG Energy Sector Directions Paper . . . . .	6
Working with Development Partners . . . . .	8
Reaching Out to Other Sectors . . . . .	10
<b>2   ACCELERATING THE TRANSITION TO CLEAN ENERGY AND LOW CARBON DEVELOPMENT . . . . . 13</b>	
Building the Global Commitment to Geothermal . . . . .	14
Mapping the Renewable Future . . . . .	15
Applying Clean Energy Knowledge to Policy . . . . .	16
<b>2A   WORKING TOWARDS A SUSTAINABLE ENERGY FUTURE FOR SMALL ISLAND STATES. . . . . 20</b>	
<b>3   CREATING PATHWAYS TO SUSTAINABLE ENERGY ACCESS FOR ALL . . . . . 25</b>	
Supporting New Ways to Measure Energy Access . . . . .	26
Scaling-Up National Energy Access Programs . . . . .	27
Reaching the Urban Poor . . . . .	27
<b>3A   AFRICA RENEWABLE ENERGY AND ACCESS PROGRAM. . . . . 30</b>	
Lighting Africa . . . . .	30
Africa Clean Cooking Energy Solutions . . . . .	30
Africa Electrification Initiative . . . . .	31
AFREA Gender and Energy Program . . . . .	32
New Initiatives . . . . .	32
<b>3B   GENDER AND SOCIAL INCLUSION IN THE ENERGY SECTOR. . . . . 34</b>	
<b>4   FOSTERING ENERGY EFFICIENT CITIES. . . . . 37</b>	
Building the Foundation for More Energy Efficient Cities . . . . .	38
Pinpointing Energy Efficiency Improvements in Urban Sectors . . . . .	40
Training Leaders to Take on Urban Transport Challenges . . . . .	41

Building a Global Knowledge Community on Urban Energy Efficiency . . . . .	41
Helping Western Balkan Countries Ease Reliance on Imported Fossil Fuels . . . . .	45

**5 | DEVELOPING EFFECTIVE ENERGY SECTOR POLICIES AND INSTITUTIONS . . . . . 47**

Building Partnerships around Energy Subsidy Reform . . . . .	48
More Power to India . . . . .	49
Open Access to Power Grids: Global Best Practices . . . . .	50
Power Generation Options: Improving Decision-Making . . . . .	51
Country-Level Results . . . . .	51

**5A | RESULTS-BASED APPROACHES TO ENERGY SECTOR DEVELOPMENT . . . . . 54**

**6 | ASIA SUSTAINABLE AND ALTERNATIVE ENERGY PROGRAM . . . . . 57**

FY2014: HIGHLIGHTS AND ACHIEVEMENTS . . . . .	60
Catalyzing Markets for Clean Cookstoves in Indonesia . . . . .	60
Sharing Best Practices for Regional Scale up of Clean Cookstoves . . . . .	60
Developing a Renewable Energy Market in the Philippines . . . . .	61
Building Capacity for Nepal’s First Large-Scale Solar Power Development . . . . .	61
Assessing Environmental Impacts of WB-IFC Hydropower Scheme in Nepal . . . . .	62
Promoting Private Sector Investment in Papua New Guinea’s Power Sector . . . . .	62
Exploring Mitigation Options for Short-Lived Climate Pollutants in South Asia . . . . .	62
ASTAE Knowledge Products . . . . .	63
New Initiatives . . . . .	63

**7 | FINANCIAL REVIEW . . . . . 67**

**ACRONYMS . . . . . 73**

**For the ESMAP-ASTAE 2014 Annual Report annexes, please go to:**

**<http://www.esmap.org/node/55386>**

**ANNEX I | PROCEEDINGS OF CONSULTATIVE GROUP MEETING FOR ENERGY TRUST-FUNDED PROGRAMS**

**ANNEX II | ESMAP RESULTS, FY2014: OUTCOMES, OUTPUTS, AND WORLD BANK OPERATIONS INFLUENCED**

**ANNEX III | ASTAE RESULTS, FY2014: INDICATORS ACHIEVED AND WORLD BANK GROUP OPERATIONS INFLUENCED**

**ANNEX IV | COMPLETED, NEW, AND ONGOING ACTIVITIES, FY2014**

**ANNEX V | PUBLICATIONS, FY2014**







## CHAPTER 1



# COMPLEX CHALLENGES, DYNAMIC OPPORTUNITIES

The developing world is presently undergoing an energy transition as fundamental as that of the late 1970s and early 1980s, when the Energy Sector Management Assistance Program (ESMAP) was founded to help countries navigate through the oil crises of the period.

This present transition, however, is characterized more by opportunity than by crisis. Countries face a wide range of choices when it comes to planning the future of their energy sectors. In some regions, renewable energy has become cost competitive with other sources and increasingly can provide utility-scale power to national grids. New possibilities for large-scale energy efficiency are being found in cities and industries. Smart grids, mini-grids, and new models for transmission and distribution hold out the promise of more reliable and affordable power and expanded access to energy, even in poorer regions of the world.

As it has for over 30 years, ESMAP works with its clients as a trusted partner, helping countries make informed choices and develop energy sectors that will be sustainable into the future. In recent years, ESMAP has devoted considerable resources to **strategic global initiatives** that could help spur

transformational impacts for the energy sectors of many countries. These include the Global Geothermal Development Plan (Chapter 2), Renewable Energy Resource Mapping (Chapter 2), the Sustainable Energy for All Technical Assistance Program for universal energy access (Chapter 3), the City Energy Efficiency Transformation Initiative (Chapter 4), and the Energy Subsidy Reform and Delivery Technical Assistance Facility (Chapter 5).

ESMAP has organized its work into four main focus areas:

- Clean Energy (Chapter 2)
- Energy Access (Chapter 3)
- Energy Efficient Cities (Chapter 4)
- Energy Assessments and Strategies (Chapter 5)

ESMAP has in recent years also instituted special work programs that address particular areas of interest to clients and partners. These include the SIDS DOCK Support Program focused on the energy transition in small island developing states (Section 2A), the Africa Renewable Energy and Access Program (AFREA; Section 3A), Gender and Social Inclusion in the Energy Sector (Section 3B), and Results-Based Approaches to energy sector development (Section 5A).

Starting in FY2015, the program management and administrative functions of the Asia Sustainable and Alternative Energy Program (ASTAE)—another longstanding World Bank-managed energy trust fund—are being merged with ESMAP. Focusing on renewable energy, energy efficiency, and energy access, ASTAE’s mandate is to scale up the use of sustainable energy in Asia to reduce energy poverty and protect the environment.

Starting with this FY2014 annual report, ESMAP and ASTAE will publish a joint annual report that includes information on budgets, outputs, and results. For more on ASTAE, see Chapter 6.

## LEVERAGE AND IMPACT

One of ESMAP’s key strengths continues to be its unique role in the “upstream” analytical work critical to the World Bank’s policy dialogue with clients and energy sector lending. For the period of ESMAP’s last business plan—FY2009 through FY2013—ESMAP activities are estimated to have informed \$14.7 billion of World Bank Group (WBG) lending. In FY2014, ESMAP activities contributed to the identification and design of \$1.83 billion in WBG energy financing.

A number of ESMAP activities in FY2014 directly contributed to follow-on WBG lending operations, as well as to new policies and programs in client countries. These include:

- In **Ukraine**, an ESMAP study of energy efficiency in the district heating sector informed a new WBG operation—the \$382 million District Heating Ukraine Project, which will help 10 municipal heating utilities across the country implement energy efficiency improvements to enhance service and cut production costs and emissions.
- In **China**, a capacity building activity on smart grids informed a new regulation by the State Electricity Regulatory Commission to apply smart grid technology to improve the integration of wind power into the North China Power Grid.
- In the **Kyrgyz Republic**, a comprehensive ESMAP power sector note has been used to

FIGURE 1.1

ESMAP Outcomes, FY2014

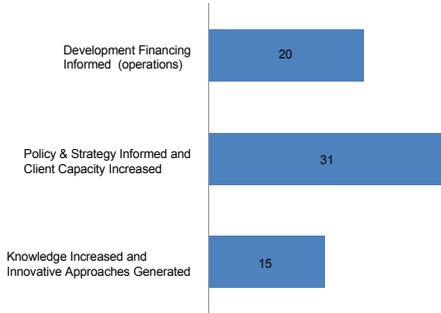
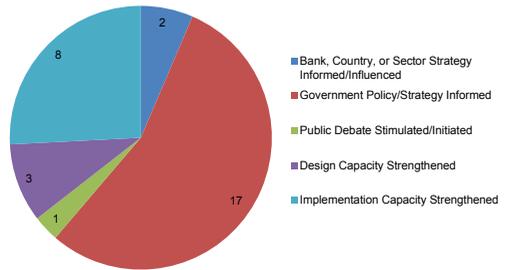


FIGURE 1.3

Policy & Strategy Informed and Client Capacity Increased, FY2014, by Outcomes



inform the government’s medium term tariff policy.

- In **Kenya**, the ESMAP Energy Access for the Urban Poor initiative contributed to Kenya Power’s expansion of electricity connections in slum areas as part of the \$5 million WBG/GPOBA-financed Slum Electrification project.

ESMAP counted a total of 66 outcomes from its activities in FY2014. This included development financing informed, client capacity increased, policies informed, and knowledge increased. A breakdown of these outcomes by categories is shown in Figures 1.1 through 1.4. For full details, please see Annex II.

FIGURE 1.2

Development Financing Informed, FY2014 (# of Operations)

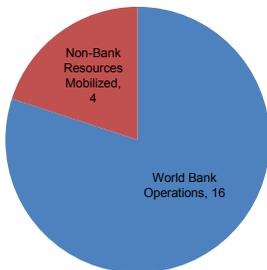
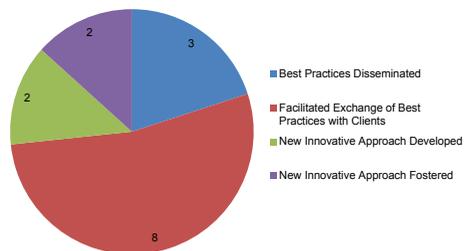


FIGURE 1.4

Knowledge Increased and Innovative Approaches Generated, FY2014, by Outcomes



## SUPPORT TO REGIONS

The bulk of ESMAP's work continues to be regional- and country-level technical assistance activities in response to targeted client needs, delivered through the regional energy units of the World Bank. While many countries are working to respond to the opportunities presented by the global energy transition, regional needs and priorities vary widely.

With the lowest rate of access to electricity of any region, and the lowest electricity use per capita, the energy needs of **Sub-Saharan Africa** are huge. Very large investments in generation capacity, transmission, and distribution will be required to meet growing demand and power economic growth. Of particular need is work on regulatory reforms, improving the performance of utilities, and innovative financing—including guarantees—to facilitate private investment. A number of recent ESMAP-supported activities have targeted emerging priorities in Africa, including work on electricity interconnections in East Africa, the role of mining companies as anchor customers to facilitate electricity expansion, and harnessing natural gas resources to help meet increased demand for power. These activities are in addition to work done under AFREA (Section 3A), which supports innovative approaches to improving energy services across Africa.

The **Middle East and North Africa** region is approximately 60 percent more energy intensive than developed countries, but electricity consumption is still relatively low. Power cuts are frequent in some countries, leading to citizen dissatisfaction. Energy underpricing is pervasive across the region, with large fuel subsidies

leading to unchecked demand for fuel and electricity, and poor incentives for energy efficiency. ESMAP-supported activities in the region include helping to develop a social accountability framework for the power sector in Egypt, assessment of the wind power potential of Lebanon, development of power sector reforms in Yemen, and quantification of energy efficiency opportunities in Iraq, along with region-wide work on energy subsidy reform (see Chapter 5).

The **South Asia** region is host to a significant share of the world's people without access to modern energy services. Even for those that have connections to electricity, there are challenges with reliability and quality of supply. Poor energy supply and inefficiencies translate into substantial economic losses for the region. Among the activities ESMAP is supporting in the region are a framework for power sector planning amid high uncertainty in Afghanistan, a study of scale up of mini-grids in Bangladesh, and a wide variety of sector governance activities in India, including institutional strengthening in poor states and spurring innovation in energy efficiency and low carbon technology (see Chapters 2, 3, and 5).

The **Europe and Central Asia** region includes some of the most energy inefficient countries in the world. Nearly 80 percent of generation capital equipment and about 50 percent of the transmission infrastructure in the region is over 30 years old. Energy affordability is a growing concern—average households in 13 countries spend more than 10 percent of their budget on energy. To address these challenges, the World Bank has undertaken policy dialogue and analytical studies supported by ESMAP that have focused on

optimizing the energy supply mix to provide affordable, reliable, and sustainable energy services. Work in the Kyrgyz Republic has helped to establish a transparent tariff-setting methodology aimed at ensuring adequate service quality, while in Belarus, analysis was conducted to mitigate the impact of a proposed heating tariff reform by improving energy efficiency and developing a more targeted subsidy delivery mechanism. ESMAP-funded studies in the Western Balkans, Uzbekistan, and Turkey have helped to assess energy efficiency measures for the urban building sector to improve provision of heating services and address winter power shortages.

**Latin America and the Caribbean** is a diverse region with both low- and middle-income countries at different stages of energy development. While energy access is still a challenge in a few countries, others are more focused on meeting growing energy supply needs sustainably. Increasing energy efficiency and developing market mechanisms for low carbon growth are priorities across a large swathe of the region. Regionally, electricity demand is expected to double in the next 20 years, requiring \$3 trillion in new generation, transmission, and power systems investments. ESMAP support focuses on upstream studies aimed at increasing integration of renewable energy in the energy generation mix; integrating lessons learned from comparison of energy sector approaches in different countries, including on pricing and subsidy issues; and assessments demonstrating the potential of energy efficiency measures and interventions.

Strategic priorities in the **East Asia and Pacific** region include scaling up energy efficiency as countries urban areas, expand industries and energy infrastructure; scaling up renewable energy

and integrating it into electricity grids; increasing access to modern energy services for underserved populations; and promoting new energy innovations and market reforms. About half of the ESMAP-supported analytical work in the region focuses on energy efficiency, particularly on energy efficient cities and greener urban infrastructure. Other work has focused on renewable energy scale-up, including support to Indonesia's geothermal development and renewable energy governance in the Philippines. Other activities have supported sector-wide development, such as support for national electrification plans in Myanmar and Papua New Guinea.

## NEW BUSINESS PLAN

FY2014 was the first year of ESMAP's new three-year business plan, agreed to by ESMAP's Consultative Group of donors and developed with the advice of the Technical Advisory Group (Box 1.1) in 2013. This business plan established three overall objectives for ESMAP for the FY2014-16 period:

- **Enhance Development Financing.** ESMAP will provide client countries with technical assistance for pre-investment activities necessary to resolve program design issues and offer additional options.
- **Influence Policy and Strategy and Increase Client Capacity.** ESMAP will seek to increase institutional capacity of client countries to plan, manage, and regulate the implementation of policies, strategies, and programs that deliver reliable and affordable energy services required by their citizens for poverty reduction and environmentally sustainable economic growth.



## BOX 1.1

### ABOUT ESMAP

ESMAP is a global technical assistance program administered by the World Bank and situated in the World Bank's Energy and Extractives Global Practice in Washington, DC. ESMAP's program includes both regional and country-focused activities implemented primarily by regional energy teams at the World Bank, and global initiatives managed by the ESMAP program unit. The ESMAP core unit of about 25 staff is responsible for the day-to-day management of the program, following the strategy detailed in ESMAP's Business Plan. The unit comprises teams working on energy access, clean energy, energy efficient cities, energy assessments and strategy, results-based approaches for energy sector development, gender, small island developing states, communications, and monitoring and evaluation. The ESMAP unit is also responsible for the management and administration of the ASTAE and SIDS DOCK Multi-Donor Trust Funds (MDTFs).

### Consultative Group

ESMAP is governed by a Consultative Group (CG) made up of representatives from contributing donors and chaired by the Senior Director of the World Bank's Energy and Extractives Global Practice. The CG meets annually to review the strategic direction of ESMAP, its achievements, use of resources, and funding requirements.

ESMAP's donors in FY2014 were:

Australia	Department of Foreign Affairs and Trade
Austria	Federal Ministry of Finance of Austria
Denmark	Royal Danish Ministry of Foreign Affairs (ESMAP and SIDS DOCK MDTFs)
Finland	Ministry for Foreign Affairs of Finland
France	Agence Française de Développement
Germany	Federal Ministry for Economic Cooperation and Development; Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety
Iceland	Ministry of Foreign Affairs
Japan	Ministry of Finance (SIDS DOCK MDTF only)
Lithuania	Ministry of Foreign Affairs; Ministry of the Environment
The Netherlands	Ministry of Foreign Affairs (ESMAP and ASTAE MDTFs)
Norway	Ministry of Foreign Affairs
Sweden	Swedish International Development Cooperation Agency (ESMAP and ASTAE MDTFs)
United Kingdom	Department for International Development (ESMAP and ASTAE MDTFs)
The World Bank Group	

### Technical Advisory Group

A Technical Advisory Group (TAG) of international experts appointed by the CG provides informed, independent opinions to the CG about the purpose, strategic direction, and priorities of ESMAP. The TAG also provides advice and suggestions to the CG on current and emerging global energy sector issues likely to impact ESMAP's client countries.

## BOX 1.2

### ESMAP KEY ACHIEVEMENTS FY2014

- Through the **Global Geothermal Development Plan**, mobilization of \$235 million from the Clean Technology Fund in investment funding for exploratory test drilling in developing countries—the riskiest and costly stage of geothermal development
- Launch of the **City Energy Efficiency Transformation Initiative**, a three-year, \$9 million program to help cities identify, develop, and mobilize financing for transformational investment programs in urban energy efficiency
- Development of the **Multi-Tier Framework for Measuring Energy Access**, which goes beyond binary metrics to look at the quality, affordability, and reliability of energy supply
- Publication of the **More Power to India** report, the result of a multi-year, comprehensive study of the Indian power sector, with specific recommendations to improve the efficiency and solvency of electricity distribution
- In Mexico, application of two energy diagnostics using ESMAP's **Tool for Rapid Assessment of City Energy** (TRACE) as the template for a nationwide program to improve energy efficiency in the country's cities
- Launch of the **Thirsty Energy** initiative, which looks at water constraints on energy sector development at the global level and through country case studies
- Expansion of the **Renewable Energy Resource Mapping** program to 12 countries, with initial mapping activities and client engagement underway in 9 countries
- Support for publication of **From the Bottom Up**, on how small power producers and mini-grid operators can deliver electrification in rural Africa, which has become the fifth most requested title in the World Bank's *Directions in Development* series

- **Deepen Knowledge and Generate Innovative Solutions.** ESMAP-supported research and analyses will aim to strengthen the sector's knowledge and evidence base to deliver increased energy access, energy efficiency, and sustainable energy services in developing countries.

The new business plan represents a significant program expansion at ESMAP. The previous business plan had a projected budget of \$55 million for the ESMAP work program for the five years between FY2009 and FY2013. The present business plan calls for a budget of \$149 million over three years. Additionally, ESMAP now administers

two other trust funds: ASTAE and the SIDS DOCK Support Program, with total paid-in contributions of \$24 million and \$16 million since FY2010, respectively. The business planning process for all three trust funds established the parameters for the activities undertaken in FY2014 along with results frameworks for assessing program performance.

### WBG ENERGY SECTOR DIRECTIONS PAPER

In July 2013, the World Bank issued a paper, ***Towards a Sustainable Energy Future for All***,



which sets the direction for the WBG's work and investments in the energy sector. The paper pledges that the Bank will support clients in delivering the affordable, reliable, and sustainable energy needed to achieve the WBG's twin goals of eliminating extreme poverty and promoting shared prosperity.

The paper directs the World Bank's engagements in the energy sector towards:

- supplying universal access to reliable modern energy services,
- accelerating gains in energy efficiency,
- expanding renewable energy,
- creating an enabling environment, and
- intensifying global advocacy.

ESMAP's Business Plan is aligned with these World Bank areas and ESMAP will play a significant role in the implementation of these commitments. Focus areas under the paper include: long-term system-wide planning; regional energy integration; assistance on pricing and tariff reform; urban energy efficiency; promotion of new technologies such as smart grids and concentrated solar power (CSP); clean cooking and heating solutions; and empowering women in the energy sector.

Overall the Bank's strategic directions are aligned with the targets of the global Sustainable Energy for All (SE4ALL) initiative—universal energy access, doubling the rate of improvement in energy efficiency, and doubling the share of renewable energy in the global energy mix—to be achieved by 2030. ESMAP continues to play a central role in the World Bank's engagement in SE4ALL (Box 1.3).

## WORKING WITH DEVELOPMENT PARTNERS

ESMAP collaborates closely with a wide range of development partners, including international non-government organizations, bilateral development agencies (including ESMAP's donor agencies), other multilateral institutions, and local and global think tanks. Such collaboration takes place at three levels—through global strategic initiatives, through joint analytical work, and by informing and feeding into follow-on work done by partners at the country level.

Examples of such country-level collaboration include:

- In Egypt, an ESMAP activity worked to build the capacity of the national gas regulator to improve development and implementation of regulations on natural gas. This in turn has informed and supported a project to expand natural gas connections to households, jointly financed by Agence Française de Développement (AFD) and the World Bank.
- In the Philippines, ESMAP co-financed an activity to help the Energy Regulatory Commission (ERC) review key regulatory parameters to make its processes more efficient. This effort has helped inform work funded by JICA to clear the ERC's substantial backlog of regulatory cases, as well as a proposed European Union-funded operation to help redesign the ERC's systems.
- In Tanzania, ESMAP's mapping of small hydropower resources has been used in the DFID-supported capacity building of the Tanzania Meteorological Agency by the UK Met

## BOX 1.3

### CONTINUING SUPPORT FOR SUSTAINABLE ENERGY FOR ALL

Since 2012, ESMAP has played a key role in the WBG's support for the global SE4ALL initiative. That support has expanded in FY2014 to encompass a wide range of activities undertaken by ESMAP, other WBG energy teams, and World Bank partners. One of the largest ongoing programs is the **SE4ALL Technical Assistance Program** (Chapter 3), which works to help countries achieve the goal of universal energy access by 2030. Complementing this program, ESMAP and the World Bank's Sustainable Energy Department established an **SE4ALL Global Knowledge Hub** in FY2014.

The Global Knowledge Hub, one of a number of regional and thematic hubs established by SE4ALL, is designed to facilitate the creation, enhancement, and exchange of knowledge for the overall initiative. As part of the work under this hub, ESMAP has developed a new "multi-tier" approach to measuring energy access, and is starting work on a comprehensive global report that will review the current status and emerging trends in energy access (Chapter 3).

Also under the Hub is a new program—**Readiness for Investment in Sustainable Energy**. This program will develop a suite of policy indicators to measure a country's readiness for sustainable energy access and clean energy technologies. These indicators will provide a global reference for policymakers to find best practices in institutional, regulatory, and legislative systems. These indicators will also serve as an objective comparison of the investment climate in different countries over time.

ESMAP is also supporting the development of the second edition of the SE4ALL **Global Tracking Framework**. The first edition, published in May 2013, established global benchmarks for the three overall SE4ALL goals of universal energy access, doubling the rate of improvement in energy efficiency, and doubling the share of renewable energy in the global energy mix (see ESMAP 2013 Annual Report). The next edition will update global data to 2012. A special chapter will look at "nexus" issues where energy intersects with water, food security, health, and gender. This chapter will look at possible future indicators for tracking nexus areas, and at how these issues could impact the SE4ALL goals.

- Office, which includes digitization of stream data.
- In Indonesia, ESMAP supported the capacity development of staff at Perusahaan Listrik Negara (PLN), the national electricity utility, in renewable energy system design and optimization, as part of a joint World Bank-KfW partnership on renewable energy and energy access in Indonesia.
- In India, the ESMAP study *More Power to India* identified capacity and resource constraints on utilities as a major challenge for the efficiency and viability of the power sector. To address this, the World Bank—with DFID support—engaged consultants to provide project implementation support to power distribution utilities in Bihar, which was identified as one of the states with the



greatest need. In addition, a DFID-supported pilot project in Bihar is implementing the recommendations of another ESMAP/ASTAE study, on the experience of rural load segregation schemes in India.

- In Macedonia, ESMAP's EFFECT model was used to produce results for a low carbon growth support program supported by the Government of Norway and Sweden's SIDA, with a particular focus on energy efficiency and building retrofits.
- In Vietnam, wind mapping as part of the ESMAP renewable energy resource mapping program has drawn data from the 10 wind masts funded by GIZ. Outputs of the program will be used to inform ongoing wind power work being done by GIZ and KfW in Vietnam.

## REACHING OUT TO OTHER SECTORS

Increasingly, ESMAP is involved in cross-sectoral work that looks at the intersection between energy and other development sectors such as water, transport, and health. Such work has expanded considerably in FY2014. Examples include:

- Programs that focus on improving the energy efficiency of urban transport, and that leverage knowledge from other disciplines such as information technology and urban planning (Chapter 4)
- The new Energy Subsidy Reform and Delivery Technical Assistance Facility (Chapter 5), which is informed by the work of, and brings together teams from a wide range of World Bank practice areas, including Poverty, Social Protection, Macroeconomics and Fiscal

Management, Communications, and Climate Change

- The new Gender and Social Inclusion in the Energy Sector program (Section 3A), which goes beyond the traditional focus on gender in regards to household energy to look at gender and energy in relation to issues such as infrastructure
- The Thirsty Energy initiative (Chapter 5), focused on water constraints on energy supply, development, and infrastructure
- An upcoming ESMAP-World Health Organization paper on how to improve access to modern energy services for health facilities in developing countries, particularly in remote, rural, and poorer areas (Chapter 3)

As of the beginning of FY2015, the World Bank has reorganized its operational and knowledge work into 19 Global Practices and Cross-Cutting Solution Areas. The new structure has potentially positive implications for ESMAP, ASTAE, and SIDS DOCK due to the increased emphasis on global knowledge flow within the Bank. Additionally, because energy is now part of the same Global Practices Vice Presidency as other practices such as environment, social protection, poverty, transport, urban, gender and water—and emphasis is being placed on cross-practice collaboration—ESMAP will have a strong platform for cross-sectoral initiatives (e.g., energy subsidy reform and clean cooking). Finally, with the establishment of the global energy practice, there is a move towards consolidating energy trust funds, especially their management and administration. This will ensure more efficiency in their management and better coordination across trust-funded programs. The new structure has potentially positive implications for ESMAP, ASTAE, and SIDS

DOCK due to the increased emphasis on global knowledge flow within the Bank. Additionally, because energy is now part of the same Global Practices Vice Presidency as other practices such as environment, social protection, poverty, transport, urban, gender and water—and emphasis is being placed on cross-practice collaboration—ESMAP will have a strong platform for

cross-sectoral initiatives (e.g., energy subsidy reform and clean cooking). Finally, with the establishment of the global energy practice, there is a move towards consolidating energy trust funds, especially their management and administration. This will ensure more efficiency in their management and better coordination across trust-funded programs.





CHAPTER 2



ACCELERATING  
THE TRANSITION  
TO CLEAN  
ENERGY AND  
LOW CARBON  
DEVELOPMENT

## BUILDING THE GLOBAL COMMITMENT TO GEOTHERMAL

ESMAP's **Global Geothermal Development Plan**, a \$7.5 million, three-year effort, is designed to mobilize international donors to support geothermal exploratory drilling in developing countries. Exploratory drilling is necessary to validate geothermal resources, but it is risky, costly, and time consuming. Historically, there has been very little public or private equity capital available in low-income countries for this stage of geothermal development, and no commercial capital. By the end of FY2014, ESMAP had identified 36 geothermal fields in 16 countries where surface exploration has now been completed and additional financing is needed to confirm the commercial viability of geothermal deposits.

As of July 2014, this ESMAP-led initiative had mobilized \$235 million in funding for test drilling investment projects through the newly dedicated Private Sector Program window of the Clean Technology Fund (CTF—part of the Climate Investment Funds). ESMAP is supporting project identification, preparation, and development activities in Armenia, Chile, Djibouti, Dominica, Ethiopia, Indonesia, Kenya, Nicaragua, St. Lucia, Tanzania, and Turkey. The commitments by the CTF mean that the Global Geothermal Development Plan has mobilized almost half of its ambitious \$500 million target in its first year alone.

The first Roundtable of the Global Geothermal Development Plan was held in The Hague, Netherlands, on November 19 - 20, 2013. Around 70

### KEY CLEAN ENERGY ACHIEVEMENTS, FY2014

- Under the **Global Geothermal Development Plan**, mobilization of \$235 million from the Clean Technology Fund in investments for exploratory test drilling in developing countries—the riskiest stage of geothermal development
- Expansion of the **Renewable Energy Resource Mapping** program to 12 countries, with initial mapping activities and client engagement underway in 9 countries
- Launch of the **Renewable Energy Project Resource Center**, in collaboration with EnergyPedia, designed to facilitate renewable energy project development by governments, development partners, and the private sector by bringing together project-level resources in a single online library
- Support to **South-South knowledge exchanges** that bring together client countries to share experience on topics of mutual interest, including events on concentrated solar power (Morocco) and integration of renewable energy into grids (Mexico)

participants from developing countries were joined by investors, technical experts, and multi-lateral and bilateral development partners to share knowledge, best practices, and information on scaling-up geothermal energy investments. The roundtable took stock of potential and ongoing projects to prioritize next steps. Sessions were also held on financing, and design and supervision of drilling programs.



## MAPPING THE RENEWABLE FUTURE

ESMAP’s \$22.5 million **Renewable Energy Resource Mapping** initiative also has grown in size and scope since its launch in FY2013, scaling up from 9 countries to 12 in FY2014, with new funding available for expanded work in many of these countries (Table 2.1). This

initiative is designed to give countries detailed data, at a national scale, about their wind, solar, biomass, and/or small hydropower potential—bringing together satellite data and supplementing it with ground-based measurements to produce high quality maps and the accompanying datasets that have a long shelf life. The goal is to help governments establish appropriate frameworks for renewable energy development, and

TABLE 2.1

Renewable Energy Resource Mapping Activities				
COUNTRY	BIOMASS	SMALL HYDROPOWER	SOLAR	WIND
Ethiopia, Lesotho, Nepal, Papua New Guinea				✓
Indonesia	✓	✓		
Madagascar		✓		
Malawi, Maldives, Zambia			✓	✓
Tanzania		✓	✓	✓
Pakistan	✓		✓	✓
Vietnam		✓		✓



to provide open access to mapping data to stimulate commercial development.

For example, in Vietnam, initial wind maps were presented to the government, and locations identified where further wind measurements are needed to produce a nationwide wind atlas. Initial outputs are expected for all participating countries during the course of 2015.

As part of this program, ESMAP has partnered with the International Renewable Energy Agency (IRENA) so that mapping outputs from participating countries are available through the IRENA Global Atlas. ESMAP is also working closely with the US National Renewable Energy Agency (NREL) and the European Space Agency (ESA) in this field. At the country level, partnerships are being initiated with local institutes of energy, meteorological departments, and universities to build a growing and representative community of practice around renewable energy resource mapping.

## APPLYING CLEAN ENERGY KNOWLEDGE TO POLICY

Demand for clean energy analytical and advisory services has grown in scope and complexity, and ESMAP is developing new ways to deliver the latest knowledge to clients. One emphasis is on **knowledge exchange**—particularly “South-South” exchanges—that allow client countries to exchange experiences and best practices in policymaking, regulation, and institutional development.

In October 2013, ESMAP helped organize a knowledge exchange in Morocco on concentrated solar power (CSP), bringing together

practitioners and policymakers from Egypt, India, Morocco, and South Africa. This event followed up on World Bank- and ESMAP-supported work on CSP in the Africa, Middle East, and South Asia regions (see ESMAP 2011 and 2012 Annual Reports) to ensure that countries are learning from each other as they implement this relatively new technology.

In Mexico, ESMAP supported an International Renewable Energy Forum organized by Mexico’s Ministry of Energy that brought together policymakers from across Latin America, the United States, and India. The Forum, held in May 2014, covered emerging technologies, financing, and social impacts of renewable energy development—with a particular focus on new models of integrating renewable energy into national grids.

Online, a major milestone was reached in March 2014 with the launch of the **Renewable Energy Project Resource Center**, which is designed to help governments and developers by making available actionable, project-level documents such as sample terms of reference, that are otherwise hard to find (Box 2.1). ESMAP is also developing an online platform for low carbon planning tools, which brings together ESMAP tools such as TRACE, META, MACTool, and EFFECT, in a wiki environment that allows users to modify, improve, and collaborate on these and other tools.

ESMAP continues to provide comprehensive renewable energy training for WBG energy staff, clients, and development partners. The latest training was held in Bangkok in April 2014 for staff in the East Asia and South Asia regions, with experts presenting the latest global thinking on the relationship between renewables and regional power markets, new models for distributed generation, and

## BOX 2.1

### KNOWLEDGE RESOURCES TO HELP SCALE UP RENEWABLE ENERGY

Renewable energy in developing countries reached \$112 billion in 2012, representing 46 percent of total global investment. Yet, even with this growth, governments and private investors still operate in an information vacuum when it comes to finding practical resources to support the design and implementation of projects.

In response, ESMAP launched the **Renewable Energy Project Resource Center**, in partnership with Energypedia, an independent non-profit energy information resource.

The Project Resource Center complements other tools available by focusing on working-level project documents such as sample terms of reference, sample procurement documents, surveys and questionnaires, examples of economic and financial analyses, and case studies with lessons learned. Having such documents readily available can reduce transaction costs associated with having to create, for example, new contract templates from scratch.

The Project Resource Center is hosted on Energypedia's open wiki-based platform, allowing anyone to easily locate documents through browse and search functions, and to add new ones, thus contributing to a shared body of knowledge. The platform also allows for facilitated interactions through dedicated spaces for discussion and private messages to other users. Other partners include the Public-Private Partnership Infrastructure Resource Center (PPPIRC), the Renewable Energy and Energy Efficiency Partnership (REEEP), and OpenEI.org.

Documents are tagged to specific technologies (e.g., hydroelectricity, wind, geothermal, storage), connection types (e.g., grid connected, off-grid, small island systems), language, and region/country. As the document library grows, additional categories can be added to better filter the global knowledge available.

The Renewable Energy Project Resource Centre is accessible via: [https://energypedia.info/wiki/Renewable\\_Energy\\_Project\\_Resource\\_Center](https://energypedia.info/wiki/Renewable_Energy_Project_Resource_Center).

successful national examples of renewable energy scale up.

At the country level, ESMAP-supported analytical work is targeted to meet the needs of clients as they face sometimes unforeseen challenges and access opportunities in expanding renewable energy. In India, an ESMAP report looked at the benefits involved in developing local supply chains to support CSP (Box 2.2). In Turkey, a groundbreaking ESMAP-supported report on cumulative

impacts of hydropower has been disseminated across ministries and is being considered by the government for implications for the current legal system. In Vietnam, a report on the country's options for low carbon growth focused on opportunities for energy efficiency improvements and investments in clean technologies. The report has informed the preparation and implementation of the government's Green Growth Strategy, as well as the World Bank's climate change development policy operations series for Vietnam.



## BOX 2.2

### **POWER AND JOBS: THE POTENTIAL OF CONCENTRATED SOLAR POWER IN INDIA**

Concentrated solar power (CSP) holds out the promise of stable, clean, and locally sourced power for countries with abundant sunlight. CSP has the added advantage of being able to dispatch a sizeable amount of power to the national grid as needed. The major drawback has been cost. In contrast to widespread solar photovoltaic (PV) technology, CSP still does not have the economies of scale to deliver electricity at competitive prices in most countries. However, an ESMAP report published in October 2013 argued that this situation could be turned around in at least one sunny country with a very large market: India.

The study, *Development of Local Supply Chain: A Critical Link for Concentrated Solar Power in India*, argues that India has great potential to manufacture its own components for CSP, given the right policy incentives, public support for demonstration CSP plants, and increased investment in research and development. This could give birth to a new industry, serving domestic and international markets. It could lower the costs of some components by up to 40 percent and it could create thousands of new jobs.

The study supported work being done under the Government of India's Jawaharlal Nehru National Solar Mission (JNNSM), launched in early 2010, with a goal of building out 20 GW of grid-connected solar power by 2022. Achieving that goal, by itself, would add 20 percent to currently installed worldwide solar capacity. Another goal of the government program is to reduce the price of solar-generated power to grid parity levels through policy changes, research and development, and domestic production of materials.

To achieve these goals, the study recommends that India needs to build domestic capacity to supply its own CSP components rather than import most of them, as is now the case. In addition to its energy benefits, such local manufacturing would also boost India's economic growth.

## BOX 2.3

### HIGHLIGHTS OF NEW ESMAP-SUPPORTED CLEAN ENERGY ACTIVITIES BY THE WORLD BANK'S REGIONAL UNITS, FY2014

**Deploying New Solar Technologies for Isolated Rural Areas in Bolivia.** Although Bolivia has been able to reduce both poverty and inequality, poverty remains high, particularly in rural areas, and varies widely across regions. Even with electricity coverage in the country at 80 percent, there is a large unserved population concentrated in the poorest Autonomous Departments. In light of this, the government has identified the need to provide universal access to electricity by 2025. The objective of this project is to expand electricity access to thousands of currently unserved areas of the country. The expansion will be carried out in a manner that supports the implementation of the national decentralized framework. The project will benefit a large number of households and public institutions (mostly schools) in predominantly rural areas of Bolivia, focusing on the poorest two and least served of the country's nine Autonomous Departments. Capacity building activities will also benefit institutions, both at the central and subnational levels. It is expected that by 2021, the project will have supported the provision of electricity to roughly 27,000 households, of which 14,500 would be connected to the grid and 12,500 would obtain solar PV home systems.

**Geothermal Project Preparation in LCR.** Electricity demand in LCR has been growing by 4 percent per year on average since 1990 and is projected to more than double by 2030 under modest gross domestic product (GDP) growth assumptions. Meeting this demand will require the addition of substantial new generation capacity from a mix of generation sources. Geothermal can play an important part in diversifying the power generation mix in a number of countries in the region. This activity will carry out a region-wide assessment of geothermal power generation potential and identify ways to scale-up its development. The results of this assessment, along with approaches applied globally to address the barriers to developing geothermal capacity, will be shared with clients. The aim is to expand utilization of geothermal energy to generate electricity in the region, in line with national goals.

**Uruguay Low Carbon Study.** A study on Low Carbon Development Options for Uruguay, undertaken in close cooperation with the government, will identify low-cost options and feasible mechanisms for reducing the country's net greenhouse emissions intensity while fostering high growth. The study will follow the organizational framework used by the ESMAP-supported low carbon growth studies undertaken by the World Bank in Mexico and Brazil. The study will take an in-depth look at specific sectors of Uruguay's economy and provide recommendations based on the significance of the emissions reduction potential and the national resources available to take on these measures. The study is intended to provide inputs into the Fourth National Communication to the UN Framework Convention on Climate Change (UNFCCC) and design of Uruguay's program of Nationally Appropriate Mitigation Actions.



## 2A | WORKING TOWARDS A SUSTAINABLE ENERGY FUTURE FOR SMALL ISLAND STATES

Small island developing states (SIDS) face distinct challenges and vulnerabilities in their energy sectors. Despite significant renewable energy reserves in wind, ocean, solar, geothermal, or biomass, many SIDS are dependent upon imported fossil fuels to generate power. This leaves SIDS vulnerable to price volatility, and the fiscal strain has significant economic impacts. This legacy, combined with a lack of institutional capacity and an often poor investment climate, constrains SIDS in their transition towards a more sustainable energy future.

To help small island states take steps towards securing a stable energy sector, ESMAP partnered with the UN Development Programme (UNDP) and the Alliance of Small Island States (AOSIS) to launch the **SIDS DOCK Support Program** in September 2011. The SIDS DOCK Support Program is financed by the Governments of Denmark and Japan.

### FY2014 Activities

In FY2014, ESMAP supported six clean energy projects in the SIDS.

**Dominica | Geothermal Project.** The Government of the Commonwealth of Dominica, with the assistance of development partners, has completed the drilling of exploratory wells in the Wotten Waven/Laudat field, which have indicated the viability of a geothermal power plant that could supply domestic demand. SIDS DOCK Support Program financing was used to perform a gap analysis to assist the government, which focused on five areas: (i) resource assessment and technical feasibility of the project; (ii) integration of the proposed project into electricity markets; (iii) finance and risk; (iv) policy and institutional implications; and (v) environmental and social safeguards. As a result of the gap analysis, technical assistance was provided to support geothermal development, including upgrading the project feasibility study to be more in line with industry standards, peer review of drilling operations, guidance on deal structure, and financial and tariff analyses.

**Eastern Caribbean | Energy Regulatory Authority Project.** A World Bank project is supporting the creation of a legal framework and building capacity for the Eastern Caribbean Energy Regulatory Authority (ECERA), which is intended to help harmonize policies, regulations, and guidelines for energy sector development in the Eastern Caribbean. A SIDS DOCK Support Program grant is being used to deepen the engagement of member countries in ECERA and support outreach to key stakeholders such as utilities, policymakers, and utility customers through regulatory training, workshops, and public awareness campaigns. This work includes development of sample policies, such as grid feed-in mechanisms and renewable energy portfolio standards, and organizing forums for policymakers and utility managers.

**Mauritius | Preparation of a Grid Code, Feed-In Tariffs, and Model Energy Supply Purchase Agreements.** Hydropower and biogas are Mauritius' primary renewable energy resources, and generate one-fifth of the country's total power. With most biogas and hydropower reserves already being tapped, the government is keen on diversifying its energy mix. In implementing its Long Term Energy Strategy 2009-25, the government is taking great strides to promoting renewable energy by enabling small independent power producers to integrate into the power grid. To facilitate the groundwork for this integration, ESMAP provided a SIDS DOCK recipient-executed grant for the development of a grid code for wind, solar and micro-hydropower; the design of feed-in tariffs for wind, solar, micro-hydropower, biomass, and waste-to-energy systems; and the preparation of a package of models and templates of power purchase agreements for renewable energy systems between 50 kW and 2 MW.



**São Tomé and Príncipe | Power Sector Efficiency Improvement.** Economic growth in Sao Tome and Principe is stymied by severe energy sector challenges, such as insufficient generation capacity to match demand, inadequate resources to cover fuel costs, limited electricity coverage, high transmission and distribution losses, and inadequate electricity tariffs. To help address these challenges, ESMAP supported a network protection study to improve reliability, as well as a detailed engineering study to rehabilitate the transmission and distribution network. These studies recommended a set of actions to upgrade the system and reduce commercial losses, including the replacement of all mechanical meters, new processes for meter reading and billing, and the replacement of a number of transmission lines. Another recommendation was the rehabilitation of the El Contador hydropower plant, an investment that could be recovered within two years.

**Seychelles | Technical Assistance to Support Integration of Renewable Energy into the Power Grid.** In the Seychelles, fossil fuels account for 90 percent of the country's energy supply, making the sector exposed to fuel price fluctuations. ESMAP is supporting the Seychelles to diversify its energy mix by preparing a grid code, designing feed-in tariffs, and designing models for power supply purchase agreements. The report's recommendations include a conservative approach to the integration of solar PV-generated power into the grid to allow the utility to better understand the impact in operations. This should be followed by evaluation of several alternatives to manage PV and wind generation and increasing demand, such as investment in additional diesel generators that may be required to operate at part load, and more advanced technological options such as battery storage.

**Vanuatu | Energy Sector Development.** ESMAP is supporting the development and implementation of a Vanuatu Energy Roadmap for coordinating investment in the energy sector by the government, private sector, and development partners in line with the priorities identified by the government. This work will include support to develop policy and frameworks for private sector investment, social and environmental safeguards, a compliance framework and monitoring, and proposals for amendments to legislation, regulations, and standards where required. Among the activities in FY2014 was a study tour to Fiji to review that country's experience in rural electrification and adoption of renewable energy.

### **New Activities for FY2015**

**Tuvalu | Electricity Sector Development.** In line with the Government of Tuvalu's vision for 100 percent renewable energy generation and a 30 percent improvement in energy efficiency by 2020, this work will focus on increasing renewable energy penetration and energy efficiency in Funafuti, Tuvalu. This will include installing additional renewable energy generators, battery storage, and an integrated power conditioning system, as well as conducting energy efficiency studies. The work is expected to result in an increase in renewable energy penetration in the grid by up to 25 percent.

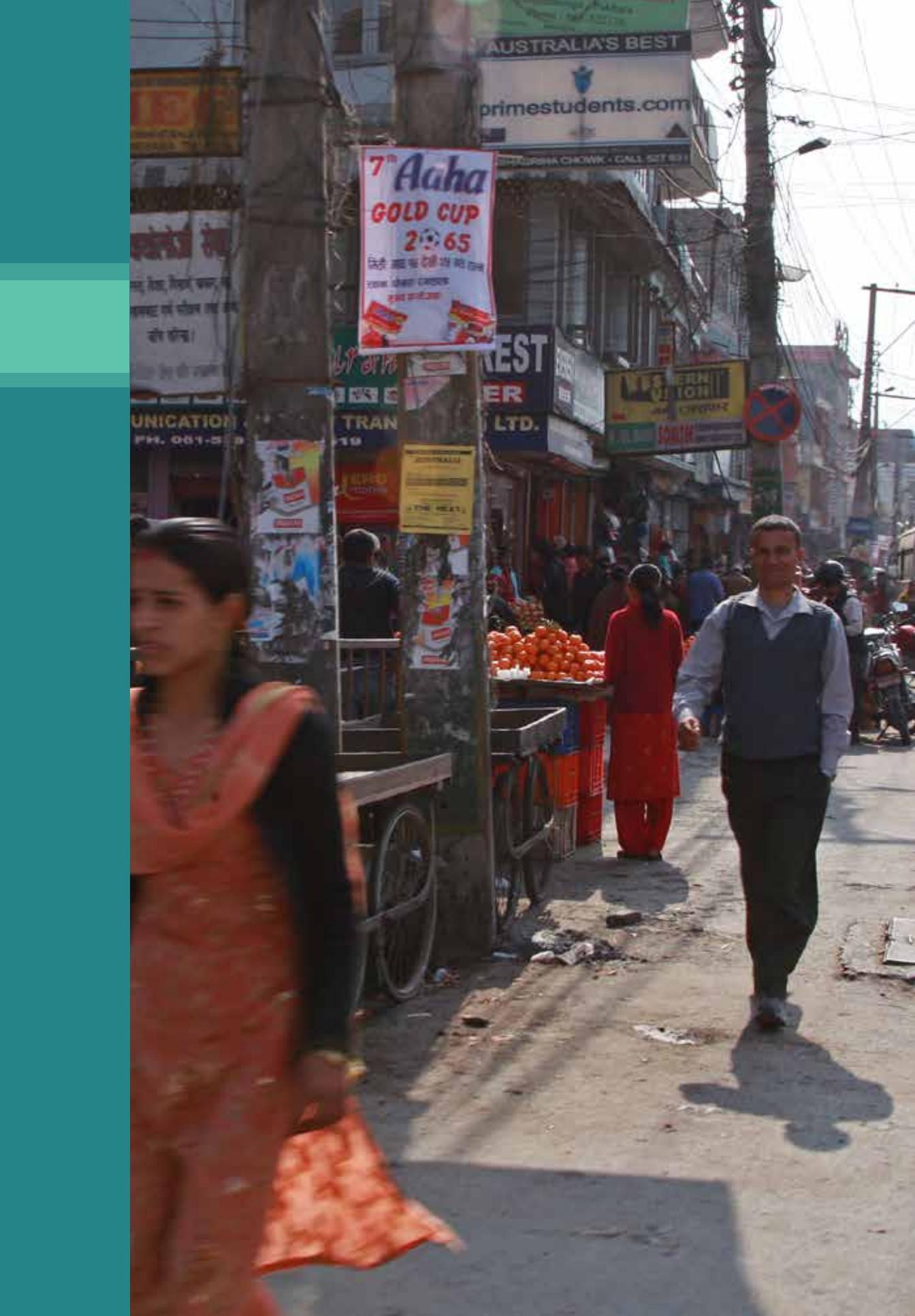
**Dominica/St. Lucia/Grenada | Geothermal Development for Base Load Power.** This support will build upon existing WBG/ ESMAP work to provide critical (i) upstream advisory assistance for developing favorable conditions for investment mobilization and strengthen the capacity of governments to make informed investment and transaction decisions; and (ii) boost the capacity for preparing exploration/resource confirmation investments in line with good industry practices and international standards. Together, this will support the three countries in developing “investment grade” geothermal projects.

**Caribbean | Regional Solar PV Scale-Up Project.** This project will support a regional pilot program with the objective of designing a sustainable technical approach and business model for the use of solar PV in hospitals and clinics. The program will support two demonstration projects—one hospital each in two countries—to assess how solar PV can be deployed at hospitals and clinics that are connected to the national grids. These installations will serve not only to facilitate a technical analysis of their suitability for Caribbean hospital applications, but will also be linked to a business model and replication study.

**Maldives | Renewable Energy on Island Grids.** The objective of this project is to support the government’s overall goal for a cleaner and greener energy sector. Electricity generation from solar PV, and wind in some locations, is less expensive than diesel-based energy generation on avoided cost of fuel. The project will support the installation of solar PV grid connected systems on the rooftops of the various public buildings on two islands. In addition, the project aims to provide system operation and maintenance training to utility staff and conduct public awareness programs on energy conservation and efficiency.

**Cabo Verde | Solar PV for Healthcare.** The proposed project focuses on the installation of PV systems for three healthcare facilities with the objective of scaling up of the program. Potentially, this model could be attractive for smaller Cabo Verde Islands where electricity supply is more expensive and unreliable than in the larger Islands. This activity is complementary with an ongoing World Bank energy operation which is supporting generation reinforcement in the two main Islands of Cabo Verde. The key expected outcome of the project is a successful demonstration of PV for health care facilities that enables scale-up through public-private partnerships in the islands.





AUSTRALIA'S BEST

primestudents.com

7<sup>th</sup> Aaha  
GOLD CUP  
2015  
किंग्स ऑफ द फील्ड  
एंड द गॉल्डन बॉल  
एंड द गॉल्डन बॉल  
एंड द गॉल्डन बॉल

WEST  
ER  
LTD.

WESTERN  
UNION  
SOUTH

UNICATION  
PH. 001-52

TRAN  
19

THE NEXT

## CHAPTER 3

# CREATING PATHWAYS TO SUSTAINABLE ENERGY ACCESS FOR ALL



## SUPPORTING NEW WAYS TO MEASURE ENERGY ACCESS

As part of its support for the SE4ALL initiative, ESMAP supported the development of a multi-tier methodology for measuring energy access. The new framework defines access as “the ability to obtain energy that is adequate, available when needed, reliable, of good quality, affordable, legal, convenient, healthy, and safe for all required energy applications across households, productive enterprises, and community institutions.” The multi-tier approach goes beyond the traditional binary measurement of access—for example, comparing those that have an electricity connection with those who do not—to a measurement approach that reflects all aspects of energy supply.

Under this approach, energy access is determined by examining how a household’s electricity and cooking technology measure up against the following eight attributes: capacity; duration and availability; reliability; quality; affordability; legality; convenience; and health and safety. Survey questionnaires have been developed to elicit information about each of these energy aspects, with results to be fed into the multi-tier analysis. By applying this framework, energy access diagnostic assessments may be compiled for selected geographical areas to identify shortfalls of energy supply and highlight opportunities for improvement.

In FY2014, the ESMAP team developed five different multi-tier frameworks for measuring (i) household electricity, (ii) modern lighting solutions, (iii)

### KEY ENERGY ACCESS ACHIEVEMENTS IN FY2014

- Development of the Multi-Tier Framework for Measuring Energy Access, which goes beyond binary metrics to look at the quality, affordability, and reliability of energy supply to inform global and national energy access programs
- Expansion of the SE4ALL Technical Assistance Program, which supports countries as they move towards universal energy access, from 5 countries to 10, including support to Myanmar’s National Electrification Plan
- The Energy Access for the Urban Poor scheme informed the \$5.1 million World Bank/GPOBA engagement with Kenya Power, which is addressing unmet demand for adequate and reliable energy services in Kenya’s fast-growing urban and peri-urban informal settlements
- Supported publication of *From the Bottom Up*, which provides practical guidance on how small power producers and mini-grid operators can deliver electrification in rural Africa. The study has since become the third most requested title in the World Bank’s Directions in Development series

household cooking solutions, (iv) energy for productive uses, and (v) energy for community uses. Preliminary questionnaires related to the electricity and cooking frameworks were tested and improved based on data collection in Democratic Republic of Congo (Kinshasa), Uganda, Ethiopia, Rwanda, and India (Bihar region).

The benefits of the multi-tier approach were presented at a number of knowledge exchange events, including a training for World Bank staff in February 2014 on how to use the ESMAP approach in planning energy access investments, project design, and tracking progress.

## SCALING-UP NATIONAL ENERGY ACCESS PROGRAMS

ESMAP's \$15 million SE4ALL Technical Assistance Program supports a targeted group of countries in achieving the SE4ALL goal of universal energy access by 2030. In FY2014, the SE4ALL Technical Assistance Program expanded beyond its first five countries— Burundi, Guinea, Liberia, Mozambique, and Senegal—adding Guatemala, Honduras, Myanmar, Nepal, and Nicaragua to the group of “opt-in” countries currently benefiting from ESMAP assistance. The program is working to help each country develop the policy frameworks, strengthen the institutions, and mobilize the financing necessary to expand and accelerate their national energy access programs.

A key component of this work is helping each country develop a prospectus of investment-ready projects that can substantially scale up energy access over a three- to-five-year period. The prospectuses will also estimate the investment funding requirements for each intervention and identify appropriate financing sources.

In Burundi, for example, the program carried out pre-feasibility studies and produced model

documents for public-private partnerships that will inform preparation of an investment prospectus for a least-cost electricity network expansion plan. In Myanmar, the program provided support for development of a geospatial least-cost National Electrification Plan, a universal access roadmap, and an investment prospectus for the next five years. In Guatemala, Honduras, and Nicaragua, the program helped initiate planning for investment prospectuses that will improve household uptake of clean, efficient cookstoves, in close cooperation with IDB and the Global Alliance for Clean Cookstoves.

## REACHING THE URBAN POOR

ESMAP's Energy Access for the Urban Poor Technical Assistance Program helps address unmet demand for adequate and reliable energy services in fast-growing, informal urban settlements and peri-urban population. The program seeks to increase or improve access to electricity and clean cooking solutions for the urban poor by bridging knowledge gaps and supporting the design and implementation of energy and urban investment projects of the World Bank and other development partners. The program also contributes to the implementation of the Cities Alliance's Land, Services and Citizenship Program in selected countries. In FY2014, ESMAP supported implementation of the World Bank and GPOBA-financed Kenya Slum Electrification Project. This support involved an assessment of the barriers preventing the uptake of electricity connections and a weeklong South-South knowledge exchange event in Nairobi that convened experts from Brazil, Colombia, Kenya, and South Africa (Box 3.1).

## BOX 3.1

### **SHARING GLOBAL BEST PRACTICES TO BRING ENERGY TO NAIROBI SLUM COMMUNITIES**

With 1.5 million residents, Kibera—in Nairobi, Kenya—is among the largest slum settlement in Africa. Like many poor urban communities, people in Kibera lack access to the same services that many of their more affluent neighbors take for granted, such as reliable sources of electricity. And while the country's national electricity utility, Kenya Power, has made several attempts to extend power to Kibera, efforts have been hampered by challenges, including electricity and equipment theft, and difficulties in revenue collection.

In May 2014, ESMAP and GPOBA organized a South-South Knowledge Exchange in Nairobi. Held in support of a \$5.1 million World Bank engagement with Kenya Power to extend electricity access to Kibera and other informal settlements, the event brought together experts from Brazil, Colombia, South Africa, and more than 50 representatives from Kenya Power.

Over the course of the week-long workshop, international experts from the LIGHT distribution company (Brazil), Empresas Públicas de Medellín (Colombia), and ESKOM (South Africa) shared experiences in bringing electricity to impoverished neighborhoods. Representatives from organizations working on improving services and infrastructure in Nairobi's slums brought a local perspective to the event. A visit to Kibera helped participants understand the full range of challenges faced by community residents and Kenya Power.

In a series of working sessions, teams were formed to explore specific challenges and develop solutions that would work in the Kenyan context. A major focus was on community engagement. Non-governmental organizations (NGOs) and civil society groups from Kibera and other slums attended a session to provide insights on how to work within slum environments and shared tips on engaging stakeholders in the slums.

As Gladys Juma, a social specialist working in informal settlements, put it, "Don't underestimate the people of the slums. Get to know them through their leaders. When people are on your side and trust you, they will do what's necessary to get the job done."

The World Bank project with Kenya Power will continue through early 2016, with a goal of establishing 40,000 new household connections. Elements of the international experiences presented at the event were picked up by Kenya Power and integrated into its slum electrification operations, as the utility strives to improve engagement with community-based organizations in order to encourage a switch to legal connections.

## BOX 3.2

### HIGHLIGHTS OF NEW ESMAP-SUPPORTED ENERGY ACCESS ACTIVITIES, FY2014

**Scaling Up Use of Clean Cookstoves in Central America.** An estimated 50 percent of Central American households rely on biomass to meet their cooking needs. ESMAP technical assistance through the Central America Clean Cooking Initiative is helping remove the barriers that have traditionally prevented the scale-up of clean cooking solutions in the region. Outputs include country roadmaps and investment prospectuses for Guatemala, Honduras, and Nicaragua that determine the policy and financing support required to meet each country's goals and targets. Based on the capacity requirements and knowledge gaps identified in the recent ESMAP-financed study, *What Have We Learned about Household Biomass Cooking in Central America?*, the initiative is also supporting research and development to improve the design of cookstoves.

**Developing a National Electrification Plan in Myanmar.** Although it is one of the poorest countries in Asia, Myanmar possesses an abundance of hydropower and natural gas resources. And with its geographic location between China, India, and Thailand, the country is well positioned to resume its traditional role as a regional trading hub and key supplier of electric power. This activity supports Myanmar's government in developing a National Electrification Plan to achieve universal electricity access by 2030. The Plan includes a GIS-based, least-cost electrification planning framework, a universal access road map, and an investment prospectus for the first five years to mobilize financing from development agencies, the government, and the private sector.

**Boosting Clean Cookstove Uptake in Nepal.** An estimated 80 percent of Nepal's population relies on biomass to meet its cooking needs, and indoor air pollution related to these practices causes more than 7,000 premature deaths every year. This grant supports technical assistance activities to help the government scale-up deployment and use of improved cooking solutions. Activities include development of: a roadmap and an investment prospectus to increase the penetration of clean cooking devices; prototypes for improved biomass cookstoves; and policy and regulatory recommendations to help the government create a credible enabling environment for private sector investment. Support is also being provided to the Alternative Energy Promotion Centre, the government agency responsible for promoting and developing renewable energy technologies, to help in the evaluation of the costs and benefits related to deployment of various cookstove models.

**Building Capacity to Expand Electricity Access in Niger.** The government has outlined a \$1.46 billion investment plan to increase domestic energy supply and expand electricity access from the current 10 percent level. Through AFREA, ESMAP is helping the national electricity utility NIGELEC prepare an investment program to ensure that new generation capacity translates into better electricity access for all sectors of society. This includes working with NIGELEC on a short-term \$100 million investment program to increase access in urban and peri-urban areas, address network bottlenecks, and extend first-time connections to 500 localities with populations of over 1,000. Additionally, the ESMAP activity will produce an analysis of average electricity costs, capacity building measures to strengthen the sector's legal and regulatory framework, and a list of areas to be targeted under a wider energy expansion program in the future.



## 3A | AFRICA RENEWABLE ENERGY AND ACCESS PROGRAM

Phase I of the Africa Renewable Energy and Access Program (AFREA I) came to a close in FY2014. Established in 2008 through a \$28.9 million contribution by the government of the Netherlands, AFREA I supported the development of scalable and innovative solutions to meet Africa's energy challenges.

Over the course of FY2014, AFREA II was launched with the objective of supporting the scale-up of energy access and clean energy through a combination of World Bank- and client-executed activities. Four of AFREA I's successful region-wide activities serve as the backbone for ESMAP's continued support to the region under AFREA II.

### Lighting Africa

Lighting Africa—a joint initiative of the World Bank and the International Finance Corporation (IFC) initiated in 2007—has stimulated the market for high quality, pollution-free, solar lighting products for homes and businesses across Africa.

To date, over 11 million Lighting Africa-certified lanterns and solar home systems have been sold in sub-Saharan Africa, and the program is actively supporting market development in Kenya, Burkina Faso, Ethiopia, Mali, Nigeria, Senegal, Tanzania, Liberia, the Democratic Republic of Congo, South Sudan, and Uganda. Eighty-four high-quality solar products have now been certified using International Electrotechnical Commission specifications developed under Lighting Africa. In FY2014, the program financed the preparation of a range of public service announcements to raise consumer awareness about the existence and benefits of quality-verified lighting technologies. The program also launched the expansion of a Quality Assurance Framework to develop technical specifications, standards, and testing methodologies for emerging plug-and-play, direct current, solar home systems. Lighting Africa's successful market transformation model has informed similar World Bank-funded programs currently underway in South and East Asia.

### Africa Clean Cooking Energy Solutions

Over the past three decades, donors and multilateral organizations have sought to bring affordable, fuel-efficient stoves into the consumer mainstream. But market uptake in Africa has remained stubbornly low due to a range of factors, including limited consumer awareness, a lack of willingness to pay, and a host of performance and quality issues. As such, more than 700 million people in Africa—an estimated 80 percent of the population—depend on inefficient three-stone fires or rudimentary stoves that require large quantities of firewood or other solid fuels such as charcoal, dung, or crop waste. This biomass exposes users and other household members to dangerously high levels of pollutants, including small soot particles that penetrate deep into the lungs.

In the Democratic Republic of Congo, ACCES helped design the component of a Forest Investment Program that will promote improved cooking solutions in the Kinshasa area. In Senegal, ACCES is providing technical assistance through PROGEDE2, a World Bank project that promotes the sustainable use of biomass resources. ACCES support includes recommendations on institutional arrangements for long-term sustainability and the commissioning of two preparatory studies, one of which looks at the potential for promoting alternative fuels in four different regions and the second which looks at the state of the market for improved cookstoves. The first report shows that alternative fuels, like briquettes, have high potential in certain cities and can be supported under ACCES' enterprise-based model, while other solutions, such as biogas, can be more effectively implemented if spearheaded through government initiatives.



In Uganda, ACCES commissioned two analytical studies that helped gain insight into consumer cooking preferences and explored potential for implementing a results-based financing mechanism to increase clean cookstove adoption. ACCES is currently helping set up a project for scaling up the market penetration of cleaner and more efficient cookstoves in Uganda by supporting working capital for distributors via a competitive grant mechanism.

### **Africa Electrification Initiative**

AFREA established the African Electrification Initiative (AEI) in 2008 to increase the effectiveness of rural electricity access programs in Sub-Saharan Africa through capacity building and knowledge exchange activities. In FY2014, the AEI convened a series of practitioner workshops that brought together energy practitioners—representing ministries of energy, electrical utilities, Rural Electrification Agencies (REAs), and energy regulatory agencies—from across the region.

The AEI Low Cost Electrification Technology Workshop held in Arusha, Tanzania, in September 2013, attracted practitioners from 16 English-speaking countries, and presented low-cost grid extension technologies that have been used to bring down electrification costs in countries such as New Zealand, South Africa, Namibia, Ghana, Tunisia, and the United States. A follow-up practitioner workshop targeting Francophone countries was held in Cotonou, Benin, in March 2014, bringing together nearly 80 practitioners from 17 countries in the region. The Arusha and Cotonou events included “hands-on” exercises where participants used practical models and tools developed by the AEI team to apply various low-cost grid extension technology options to a number of different scenarios.

In response to strong interest from the Ministry of Mines, Energy and Water Development of Zambia, the AEI team has commenced a technical assistance and advisory project in Zambia. The project aims to support the government’s efforts to assess the potential for incorporating low-cost electrification technologies into its grid extension program. As the first step of this activity, AEI held a targeted technology and policy workshop in Lusaka in May 2014, where representatives of energy stakeholders from Namibia, Ghana, Ethiopia, and Togo shared their countries’ experiences with implementing low-cost electrification technology.

In addition to capacity building and technical assistance work, AEI has also produced a range of knowledge projects. In FY2014, AEI supported the release of the handbook *From the Bottom Up: How Small*

*Power Producers and Mini-Grids Can Deliver Electrification and Renewable Energy in Africa*. Published in January 2014, the book is now the fifth most downloaded publication from the World Bank's Directions in Development series, with over 7,300 downloads to date.

### **AFREA Gender and Energy Program**

Since 2009, AFREA's Gender and Energy program has developed innovative approaches to integrate gender considerations into energy access operations across Africa. This work ensures that issues that disproportionately affect women are treated as an integral part of the energy access portfolio.

Over the course of FY2014, the Gender and Energy program worked with World Bank energy teams and government clients in Benin, Kenya, Mali, Senegal, Tanzania, and Zambia to pilot initiatives bringing gender considerations to the forefront of the project planning and implementation process. In Benin, AFREA supported a gender action plan that is increasing women's participation in strengthening institutional capacities, and informing the revision of the country's energy policy. In Kenya, gender assessments were completed and workshops supporting the development of gender action plans were carried out in support of the Ministry of Energy and Petroleum and the Kenya Power and Light Company. In Zambia, AFREA initiated a number of gender-mainstreaming activities under the Electricity Access for Low-Income Households Project that now enables women to enjoy the benefits of electricity access through participation in a connection-fee subsidy program.

In April 2014, AFREA held a knowledge exchange workshop in Dakar, Senegal attended by more than 60 representatives from AFREA gender programs in 6 pilot countries. The workshop focused on subjects such as working with rural energy agencies, developing institutional capacity, establishing gender focal points within organizations, carrying out community-level pilots, and working with electricity utilities to develop targeted gender training on electricity subsidies and access to finance.

### **New Initiatives**

The new framework developed for AFREA II supports the scale-up of energy access and clean energy built upon the following pillars: (i) supporting investments; (ii) improving policy and building institutions; (iii) leveraging markets; and (iv) knowledge and capacity. An additional two cross-cutting themes—gender and productive uses, and supporting post-conflict and fragile states—will enhance AFREA II's impact. Wherever possible, AFREA resources will be used to leverage the expertise and experience of staff working on the World Bank's Africa Energy Portfolio and IDA funding, which is the portfolio's primary source of financial support.

New AFREA II activities are being prepared in keeping with the following approaches:

**Regional Initiatives.** One of AFREA II's new regional initiatives is the Accelerating On-Grid Access Team, which serves as a rapid-response mechanism that provides just-in-time support to project teams seeking to increase the effectiveness of urban electrification and densification projects across the region.

**Regional Strategic Studies.** These address many of the overarching strategic challenges facing the region. For example, *The Role of Subsidies: Financing Electricity Supply & Providing Affordable Access in Sub-Saharan Africa* assesses the subsidy policies that are currently in place, as well as the need for power sector pricing reform.

**Country-Focused Activities.** AFREA II supports a number of country-focused activities. The Nigeria Electrification Access Program Development Project assists the government in planning for a national-level electrification scale up using GIS-based tools as part of the comprehensive planning process. The program builds upon successful Sector Wide Approaches (SWAp) pilot projects in Kenya and Rwanda. Another country-focused activity is the Uganda Clean Cooking Sector Support program, which is using ACCES tools to transform the country's clean cookstove market.



## 3B | GENDER AND SOCIAL INCLUSION IN THE ENERGY SECTOR

As part of its current FY2014-16 Business Plan, ESMAP has developed a new \$1.5 million global program on **Social Inclusion in the Energy Sector, with an initial focus on gender**. The primary objective of the program is to establish a core body of evidence to demonstrate that promoting improved gender equality in energy projects improves development outcomes. The program also seeks to develop state-of-the-art approaches for how to improve gender equality in energy projects.

In FY2014, ESMAP partnered with the World Bank's Social Development department to launch a report on *Gender and Electricity Infrastructure* to explore the gender-specific land and labor impacts of generation, transmission, and distribution projects.

ESMAP has also collaborated with the World Bank Institute to develop an e-learning module to address gender issues within specific topics such as energy access, energy infrastructure, and energy policy. The course will be offered to World Bank staff, clients, partners, and development practitioners starting in 2015. An online gender and energy forum has also been established to connect experts in this field and facilitate knowledge and exchange accessible via: <https://collaboration.worldbank.org/groups/gender-and-energy>.

ESMAP has continued to screen its portfolio for gender-informed activities and support Bank teams in integrating gender within their activities. In FY2014, ESMAP funded gender assessments of energy programs in India, Nepal, and Pakistan, as well as operational support to integrate gender considerations into Bolivia's rural electrification program. There is growing client demand for such work.

Going forward, the Gender and Social Inclusion in the Energy Sector program will continue to ramp up its effort to support foundational research on gender and energy issues. Dissemination of knowledge remains critical to this program, through the guidance notes, online tools, and videos produced under this program, as well as the various workshops and events to help share lessons and collaborate with other development partners engaged in this area.

vente:

-GROS  
-Detail

JIKO

NGUVUNYEUSI



UKITUMIA  
JIKO YA  
MAENDELEO  
NIKULINDA  
MAZINGIRA

« MAISON JIKO »







## CHAPTER 4



# FOSTERING ENERGY EFFICIENT CITIES



## BUILDING THE FOUNDATION FOR MORE ENERGY EFFICIENT CITIES

In November 2013, ESMAP launched its largest urban energy efficiency program to date: the **City Energy Efficiency Transformation Initiative**. This multi-year program provides support to help cities identify, develop, and mobilize financing for transformational investment programs in urban energy efficiency and to integrate energy efficiency considerations into the strategic planning process. Broadly divided into three areas of support—technical assistance, capacity building, and knowledge creation and dissemination—the program works with municipal governments to assess energy efficiency interventions and prepare investments for national, international, and private-sector financing. The program also produces knowledge products and hosts knowledge-exchange events, particularly between cities that have successfully implemented energy efficiency programs and cities that are just beginning the process.

In April 2014, the City Energy Efficiency Transformation Initiative allocated six grants totaling \$4.3 million to World Bank Group teams to finance a wide range of urban energy efficiency programs. The grants will support activities in various cities in Brazil, China, Macedonia, South Africa, and Ukraine. In Brazil, the initiative will support the development of business models to improve energy efficiency in three sectors: public lighting, public and non-public buildings, and industry, with a particular focus on Rio de Janeiro and Belo Horizonte. It will also analyze options for integrating land use and transport policies to reduce energy consumption and greenhouse gas emissions in Sao Paulo.

### KEY ENERGY EFFICIENT CITIES ACHIEVEMENTS, FY2014

- Launch of the **City Energy Efficiency Transformation Initiative**, a three-year, \$9 million program to help cities identify, develop, and mobilize financing for transformational investment programs in urban energy efficiency
- Allocation of **\$4.3 million in grants** under the City Energy Efficiency Transformation Initiative to support World Bank engagement on municipal initiatives, including water and sanitation efficiency, public lighting, buildings, and carbon-reduction roadmaps
- Support for capacity building and development of **Mexico's national municipal energy efficiency program**, which is getting underway in 30 Mexican cities
- Support to **international knowledge exchanges on energy efficiency**, including events in China on national targets and experiences, in India on public lighting, and in Mexico on municipal energy efficiency
- Allocation of **\$1 million in grants** to help World Bank transport and water teams integrate energy considerations into their programs, such as the continuation of the Leaders in Urban Transport Planning program, a bus-fuel efficiency scheme in India, and efforts to strengthen Kiev's public transport system

In China, the initiative will support Shenzhen as it develops a comprehensive roadmap to achieve its ambitious emission-reduction targets. Shenzhen is at the leading edge of national efforts to achieve a reduction of carbon intensity of 40 to 50 percent by 2020 from the 2005 level. ESMAP



support will finance a study that will rank carbon dioxide abatement measures across Shenzhen's major energy-consuming sectors. Areas covered will include transport, public lighting, buildings, industry, and urban planning.

In Macedonia, ESMAP teams are working on two components: the first involves the development of municipal energy efficiency action plans, and pre-feasibility studies on water and street lighting. The second component consists of scaling up and dissemination efforts via workshops, guidance notes, and training.

Another ESMAP grant is supporting three cities in Ukraine—Kiev, Ternopil, and Kamianets Podolski—with diagnostic assessments of energy efficiency potential to develop municipal energy efficiency programs, an investment pipeline, and pre-feasibility studies in selected sectors to be determined as a result of the assessments.

An additional grant was allocated to the IFC-led Excellence in Design for Greater Efficiencies (EDGE) program, which works with governments and the private sector to support a market shift towards resource and energy efficient (i.e., green) buildings. The grant will finance the development and rollout of a voluntary green building certification protocol and tool, and support the launch of a voluntary green building certification program in South Africa.

In FY2014, the initiative began developing a series of e-learning products that convert technical knowledge into easily accessible material that will be made available to a wide range of stakeholders through the World Bank's E-institute platform. The learning program is being developed in response to requests from city and government officials eager to expand and deepen their understanding of urban energy efficiency issues.

## PINPOINTING ENERGY EFFICIENCY IMPROVEMENTS IN URBAN SECTORS

Developed in 2010, the **Tool for Rapid Assessment of City Energy** (TRACE) supports the energy assessment process in cities by identifying potential energy efficiency improvements, targeting underperforming sectors, and then prioritizing from among a range of proven, cost-effective interventions. TRACE allows for the benchmarking of a city's energy efficiency performance against peer cities using a database of 28 key performance indicators collected from 93 cities around the world. To date, TRACE has been deployed in 32 cities around the world, including Nairobi, Rio de Janeiro, and Surabaya.

In FY2014, Bangkok became the largest city to date to undertake a TRACE-supported energy diagnostic process. There, the TRACE assessment led to the identification of energy efficiency potential in city's solid waste, public lighting, and

buildings sectors. In FY2014, TRACE was also deployed in the Indian cities of Bhubaneswar, Cuttack, and Puri as part of the Odisha State Climate Change Action Plan. In Mexico, TRACE was used to look at potential energy efficiency investments in the cities of Puebla and Leon. The TRACE process informed the Mexican government's June 2014 decision to launch energy use diagnostics in 30 Mexican cities, including the state capitals of Guadalajara, Monterrey, and Oaxaca. This effort will lay the groundwork for energy efficiency investments in key urban energy sectors, such as public lighting, municipal buildings, and water and wastewater pumping sectors, among others, and feed into a larger World Bank program that aims to scale up energy efficiency in Mexico's cities through a combination of technical assistance and targeted investments.

In Brazil, ESMAP helped the cities of Belo Horizonte and Rio de Janeiro build upon the results of TRACE deployments carried out in 2013. The tool had helped identify significant energy efficiency opportunities in both cities' building and public lighting sectors, and over the course of 2014 ESMAP helped conduct a series of pre-feasibility studies focusing on public lighting. The studies confirmed that Belo Horizonte and Rio de Janeiro municipal governments could each save as much as 60 percent of their electricity costs through lighting sector investments that would pay for themselves within 8 years. As a result, Belo Horizonte is developing a citywide light-emitting diode (LED) program and Rio de Janeiro is considering a plan to do the same.

Looking ahead, ESMAP is dedicating resources to develop TRACE 2.0. The upgraded tool will allow for the assessment of a greater range of



building types (adding residential and commercial to the existing public buildings module), and will add the industrial sector. The tool will put a special emphasis on being able to provide refined estimates, thus leading clients a step closer to pre-feasibility studies. TRACE 2.0, which will initially be tested in two or three countries, will also feature an improved data-collection interface, more prominent energy efficiency calculators, and updated recommendations. In addition, ESMAP is preparing a synthesis report based on the 32 TRACE deployments carried out globally to date.

## TRAINING LEADERS TO TAKE ON URBAN TRANSPORT CHALLENGES

Along with rapid urbanization, cities in developing countries have long been faced with the challenges of increasing congestion, deteriorating air quality, and ever-escalating road accident rates. Many municipalities attempt to tackle these problems on an ad hoc basis rather than as part of a comprehensive approach. Since 2012, ESMAP has supported the **Leaders in Urban Transport Planning** program, a World Bank global initiative that is training municipal officials at the leadership level to understand the comprehensive nature of urban transport challenges. To support this approach, the program organizes training events that enhance the capacity of senior planners to understand the linkages between factors such as land use, environment, energy efficiency, and affordability that city planners have traditionally tended to view in isolation. Over the course of 2014, close to 250 leaders took part in workshops in Ahmedabad, Dubai, Marseille, Mexico City, Seoul, Singapore, and Rabat.

## BUILDING A GLOBAL KNOWLEDGE COMMUNITY ON URBAN ENERGY EFFICIENCY

In June 2014, ESMAP supported Mexico's energy ministry, SENER, as it hosted the Conference on Energy Efficiency in Cities in Mexico City. The conference, which focused on helping identify opportunities and overcome obstacles in implementing energy efficiency programs and exploring ways to build bridges between national and local governments, gathered over 200 participants and 40 speakers from more than a dozen countries. Attendees included government officials from Brazil, Chile, Ecuador, France, India, Japan, Mexico, and the United States. The event provided a platform for policymakers, financial institutions, government agencies, municipalities, NGOs, and community representatives to share knowledge and experience on urban energy efficiency (Box 4.2).

Also in FY2014, ESMAP and ASTAE sponsored a China-ASEAN (Association of Southeast Asian Nations) knowledge exchange event in Beijing. China is a world leader in reducing energy intensity, and the event was an opportunity for participants from Cambodia, India, Indonesia, Laos, Malaysia, Myanmar, Singapore, Thailand, and Vietnam to learn how the country has worked toward attainment of its ambitious energy efficiency and emission-reduction goals (Box 4.1).

In March 2014, ESMAP co-sponsored the Global Conference on Energy Efficiency in Street Lighting in New Delhi. The aim of the international conference was to showcase successful street lighting projects in emerging and developed



#### BOX 4.1

### **BRINGING CHINA'S ENERGY EFFICIENCY EXPERIENCE TO THE WORLD: KNOWLEDGE EXCHANGE WITH ASIAN COUNTRIES**

China has long been a world leader in reducing energy intensity. Between 1980 and 2010—a period in which its economy grew 18-fold—the country managed to limit its energy consumption to a 5-fold increase. For this reason, China's energy efficiency programs have attracted the attention of its rapidly growing regional counterparts, such as India, Thailand, and Vietnam.

In June 2014, the World Bank and China's National Development and Reform Commission (NDRC) co-hosted a South-South knowledge exchange event to share lessons of China's energy efficiency efforts with attendees from ASEAN member countries. ESMAP and ASTAE supported the event, which was attended by representatives from regional governments, bilateral and multilateral aid organizations, energy service companies, and financial institutions from throughout the region.

At the outset, speakers at the workshop emphasized that China's achievements in lowering its energy intensity were largely the result of government commitment, ambitious targets, and the effective implementation of energy efficiency and emission-reduction policies. Top Chinese energy efficiency experts outlined how national energy intensity reduction targets had been set for each province, and for the nation's top energy-consuming enterprises. Other successful measures included the tightening of energy efficiency standards for appliances, buildings, and vehicles. In addition to national experts, a number of officials from Shaanxi province presented on how best to implement energy efficiency measures at the provincial level and in key energy-intensive industries.

## BOX 4.2

### **MEXICO CITY OPEN DATABASE IMPROVES TRANSIT EFFICIENCY, HELPS COMMUTERS**

Mexico City residents make 32 million vehicle trips a day, of which over 20 million are via public transport. These use 12 subway lines, 4 rapid transit lines, 8 trolleybus and light rail lines, 1 suburban rail line, 100 formal bus routes, and over 1,400 “colectivo” minibus routes, along with 260 public bike stations.

Since the 1970s, five separate agencies have supervised this network, grouped under SETRAVI, Mexico City’s public transit authority. And although each agency has made attempts to collect and store data on passenger counts, route licenses, travel times, and stop locations, these data have never been assembled in one place.

In November 2012, the Bank’s Latin America and Caribbean Transport Unit, with ESMAP support, began providing SETRAVI with technical assistance to develop a new digital platform to collect and manage urban transport data. This new system is built to the General Transit Feed Specification (GTFS), the de facto standard for cities in recording transit data.

Teams enrolled by SETRAVI crisscrossed the capital using an open-source application on their mobile phones to collect real-time data such as routes, speed, location of bus stops, and frequency of train departures. The data collected were then fed into a data management portal and converted into GTFS.

Despite its simplicity and ease of use, there was one major hurdle to adapting GTFS for Mexico City. The standard was too rigid to incorporate data related to non-scheduled services such as the thousands of minibuses traversing the city. As such, another objective of the World Bank scheme was to pilot a “GTFS-Lite” specification that could measure forms of transport that operated with flexible routes and stopping points.

With GTFS-Lite, Mexico City’s urban planners have access to comparable data on minibuses. This helps them visualize route configurations to determine where best to add or eliminate services, how to plan for integration with more structured transit services, regulate and improve service, and plan for the longer term future.

Mexico City’s GTFS data have been made public, so that third-party software developers can use them to innovate and create applications—such as trip planners and timetable publishers—that can be used on smartphones and other devices. Millions of transit users will soon be able to use these applications to make better informed trip choices, avoiding long waits at bus and train stops.

## HIGHLIGHTS OF NEW ESMAP-SUPPORTED ENERGY EFFICIENCY ACTIVITIES, FY2014

**Supporting Development of an Energy Efficiency Action Plan in Iraq.** Electricity supply in Iraq continues to fall well below the country's needs, with existing generation capacity satisfying only 73 percent of peak demand. The challenges faced in the electricity sector go beyond the infrastructural damage that resulted from years of conflict. They also include a range of financial, economic, legal, and regulatory issues and, more significantly, a lack of institutional capacity and coordination. The ESMAP activity is helping Iraq's Ministry of Energy develop a prioritized Energy Efficiency Action Plan to reduce demand growth over the short to medium term. The activity includes robust awareness programs to stem energy demand and a range of capacity building measures to overcome a lack of institutional expertise. The program complements the World Bank's earlier work on an Integrated National Energy Strategy.

**Improving Energy Efficiency in Uzbekistan's Urban Heating Sector.** The government of Uzbekistan has made great strides in reducing the energy intensity of its economy in recent years, with energy-use-per-unit of GDP declining an estimated 45 percent between 1998 and 2012. Nonetheless, Uzbekistan is one of the most energy-intensive economies in the world, with high levels evident across the entire energy supply chain, as well as in key sectors such as agriculture and industry. The World Bank has been supporting energy efficiency improvements through the Uzbekistan Energy Efficiency Facility for Industrial Enterprises Project. The objective of this activity is to improve the efficiency and quality of heating and hot water supply systems in the cities of Andijan, Chirchik, and Tashkent. This is being achieved by rehabilitating and renovating heating and hot water systems and introducing other energy efficiency measures. The three cities were selected by the government, which plans to replicate lessons and experiences from these pilot programs throughout the country.

**Strengthening Institutional Set-up for Energy Efficiency in Turkey.** In 2012, the government of Turkey approved a National Energy Efficiency Strategy that sets a target of reducing the country's energy intensity by 2023 by 20 percent from the 2011 baseline level. This activity includes an institutional review to enhance the Government's ability to more effectively manage energy efficiency policies and programs and, thus, contribute to helping meet their ambitious national targets. The review consists of: (i) a detailed assessment of the current institutional set-up, including roles and responsibilities for energy efficiency; (ii) a comparison with international experience and best practices; and (iii) a set of institutional options and recommendations to improve the overall effectiveness and impacts of the national energy efficiency program.



markets that could be replicated in India. More than 150 participants, including representatives from Brazil, India, Germany, the Kyrgyz Republic, Mexico, Thailand, and the United States, attended this South-South-North knowledge exchange event.

## HELPING WESTERN BALKAN COUNTRIES EASE RELIANCE ON IMPORTED FOSSIL FUELS

Energy supply in the Western Balkan countries is heavily dependent on imported fossil fuels that collectively cost the region over \$4.1 billion in

2012. And with demand in Albania, Bosnia and Herzegovina, Kosovo, the Former Yugoslav Republic of Macedonia, Montenegro, and Serbia expected to grow by as much as 70 percent over the coming two decades, policymakers are understandably eager to explore alternative options to meet their anticipated energy needs. In FY2014, ESMAP funded preparation of *Scaling-Up Energy Efficiency in Buildings in the Western Balkans*, a report that outlines how countries in the region can achieve significant and sustained energy efficiency gains in their public building sectors. The report estimates that improved energy efficiency measures in public buildings can bring savings of up to 40 percent of total energy consumption.





CHAPTER 5



DEVELOPING  
EFFECTIVE  
ENERGY SECTOR  
POLICIES AND  
INSTITUTIONS

## BUILDING PARTNERSHIPS AROUND ENERGY SUBSIDY REFORM

Energy subsidies have proved to be a drain on the resources of many countries. When prices are kept below cost-recovery levels, the overall viability of the energy sector can be adversely impacted, which, in turn, can impact efforts at improving supply quality, increasing access, or increasing efficiency. As well as creating unsustainable fiscal pressures, energy subsidies can be regressive and inefficient. They can also lead to the overconsumption of fossil fuels—reducing the incentive to use renewable resources, and boosting pollution and greenhouse gas emissions in the process.

Even though the negative impacts of energy subsidies are often well known, attempts to reduce or remove subsidies have been challenging, leading to social unrest and policy reversals, in many cases. Phasing out subsidies, particularly if done suddenly and without a strengthening of social safety nets, can have a negative impact on the poor and vulnerable.

To help countries manage this delicate transition, ESMAP in FY2014 developed a new **Energy Subsidy Reform and Delivery Technical Assistance Facility**. This \$20 million initiative provides a wide range of technical assistance for national subsidy reform programs, including:

- Assessment of the impact of subsidies at the household and macroeconomic levels
- Analysis of the poverty, social, and fiscal aspects of subsidy reform
- Design of reform approaches, including social protection schemes and other mitigation

## KEY ENERGY STRATEGIES AND ASSESSMENTS ACHIEVEMENTS, FY2014

- Launch of the **More Power to India** report, the result of a multi-year comprehensive study of the Indian power sector, with specific recommendations to improve the efficiency and solvency of electricity distribution
- Development of the **Energy Subsidy Reform and Delivery Technical Assistance Facility** to support energy reform programs in developing countries, with country engagements already underway and full launch scheduled for October 2014
- **Knowledge exchange organized between major emerging economies**, including Brazil, China, India, and Turkey in Istanbul in April 2014, on emerging models for opening up competition in electricity transmission and distribution systems
- Launch in January 2014 of the **Thirsty Energy** initiative, which looks at water constraints on energy sector development, at the global level and through country case studies (Box 5.1)

mechanisms such as energy efficiency measures

- Support for policy dialogue, consultations, communications strategies, and consensus building

As part of the facility, ESMAP will also organize conferences and knowledge exchange events on



subsidy reform at the global, regional, and country levels, to foster a dialogue on policy frameworks and country results.

The initiative will provide in-depth support to up to 15 countries in the initial 3-year period. Work has already begun at the country level in Asia, Latin America, Eastern Europe, and the Middle East. The facility will be fully launched at an international forum on energy subsidy reform organized by ESMAP in October 2014.

## MORE POWER TO INDIA

India has realized major achievements since power sector reforms were initiated in 2003. Three-quarters of the country's population now has an electricity connection, and generation capacity has tripled when compared to 1990s

levels. Yet, major obstacles remain. More than 300 million Indians live without electricity, and many of those with connections suffer from outages and unreliable supply. While generation and transmission capacity has grown, the distribution sector has seen limited progress and significant losses, with impacts rippling through the entire power system.

A major ESMAP-supported World Bank report, *More Power to India*, argues that power distribution will require sweeping reforms if the country is to continue its high-growth trajectory and meet the goal of electricity for all by 2019. The report was the result of a multi-year study requested by the Government of India, one of the widest ranging assessments of the Indian power sector to date. The study resulted in five stand-alone background papers on electricity access, governance, private-public





partnerships, electricity tariff subsidies, and utility performance.

Among the recommendations of the report are freeing utilities and regulators from external interference, increased accountability of all stakeholders for sector performance, and exploration by states of different power distribution models to improve service delivery. The report was launched in New Delhi in June 2014 and has received wide media coverage since.

## **OPEN ACCESS TO POWER GRIDS: GLOBAL BEST PRACTICES**

Open, nondiscriminatory access to power grid infrastructure has become an important topic globally, as countries look for new and increasingly competitive models of electricity market

design. An efficiently operating open access regime puts pricing signals to work and removes arbitrary influences from the marketplace. In November 2013, ESMAP published a report on *International Experience with Open Access to Power Grids*. The report looks at case studies from both developing and developed countries to demonstrate the potential benefits of open access, including cost reductions, increased service quality, and improved environment for investment in generation and grid infrastructure.

The report was followed by a knowledge exchange event in Istanbul in April 2014, attended by policy-makers, regulators, and power sector practitioners from Azerbaijan, Brazil, China, India, Indonesia, Tunisia, Turkey, and Vietnam. Participants presented their views and experiences in dealing with specific technical, institutional, and regulatory policy hurdles involved in opening access to power grids.

## POWER GENERATION OPTIONS: IMPROVING DECISION-MAKING

ESMAP developed the **Model for Electricity Technology Assessment** (META) in 2012 to help countries make informed choices among power generation technologies and fuels. META delivers a comparative assessment of over 40 different electricity generation and delivery technologies, including renewable sources such as hydropower, solar, and wind; and emerging storage options (i.e., carbon capture and storage). Since being launched, META has been deployed in Dominica, Egypt, Macedonia, Morocco, Kosovo, and Vietnam to support World Bank engagements in those countries, and by partner organizations in Jamaica and Haiti. A screening curve analysis function is being added to the tool to enable users to quickly estimate the least-cost mix of technologies for a given increase in future demand. In response to demands from users, work has also been initiated to add additional countries to the tool.

META is now being increasingly mainstreamed into World Bank operations, with the Bank's Africa and Latin America and the Caribbean regions using META to estimate the actual cost of national fossil fuel subsidies, as well as in training for partner organizations. Other users of META include IRENA, the Worldwatch Institute, and the World Institute of Sustainable Energy.

## COUNTRY-LEVEL RESULTS

As well as global knowledge resources such as META, ESMAP continued to support energy assessment and strategy work being done by World Bank teams in a wide range of countries. A number of these activities showed results in FY2014, including the following:

- In **Armenia**, a study on the structure of power sector tariffs and the methodology used to set such tariffs was presented to the government. The recommendations, particularly the implication on end-user tariffs of different financing scenarios, are now being considered by the government's Public Service Regulatory Commission.
- In **India**, recommendations from a study looking at new options for delivering power subsidies more efficiently to rural farmers were incorporated into a policy paper submitted by the World Bank's India country office to the new government that took office in May 2014.
- In **Tajikistan**, an assessment of the country's power supply options, which proposed new approaches to eliminating winter power deficits, is now being used by the government and the donor community as a primary input to policy discussions, and an action plan is being put in place to implement the recommendations.
- A comprehensive power sector note for **the Kyrgyz Republic** has been used to inform the government's medium-term tariff policy.



## BOX 5.1

### THIRSTY ENERGY

Energy and water security are crucial to human and economic development. The two resources are now more interconnected than ever—significant amounts of water are needed in almost all energy generation processes, from generating hydropower, to cooling and other purposes in thermal power plants, to extracting and processing fuels. Conversely, the water sector needs energy—mainly in the form of electricity—to extract, treat, and transport water. Both energy and water are used in the production of crops.

Water scarcity is already threatening the long-term viability of energy projects worldwide. In 2013 alone, water shortages shut down thermal power plants in India, decreased energy production in power plants in the United States, and threatened hydropower capacity in many countries, including Sri Lanka, China, and Brazil.

Nearly 93 percent of the Middle East's onshore oil reserves are exposed to medium to extremely high overall water quantity risks. Developing countries are the most vulnerable, as they often lack the capacity to meet the rapidly growing need.

An ESMAP-supported World Bank initiative, **Thirsty Energy**, aims to mitigate the risks of the water-energy challenge. Launched in January 2014 at the World Future Energy Summit in Abu Dhabi, Thirsty Energy is designed to help governments prepare for an uncertain future by breaking disciplinary silos that prevent cross-sectoral planning and quantifying tradeoffs and synergies between water and energy resource management.

One of the key aspects of this initiative is that the energy sector is the entry point for promoting the dialogue and devising solutions, and tailors approaches depending on the available resources and institutional and political realities of a country.

The initiative demonstrates the importance of combined approaches through demand-based work in several countries, thus providing examples of how evidence-based operational tools in resource management can enhance sustainable development. This created knowledge will be broadly shared with other countries facing similar challenges.

## HIGHLIGHTS OF NEW ESMAP-SUPPORTED ENERGY ASSESSMENTS AND STRATEGIES ACTIVITIES, FY2014

**Afghanistan | Energy Security Trade-Offs under High Uncertainty.** Afghanistan remains in the bottom 10 percent globally in electricity consumption per capita and only 25 to 30 percent of its population is connected to the grid, giving it one of the lowest rates of electrification in the world. The overall objective of this activity is to develop a policy framework for electricity power sector planning in Afghanistan that takes into account the high uncertainty of planning in the country and strikes a balance between economic efficiency, energy security, and environmental sustainability. Among the policy areas addressed will be the level of dependence on imported energy, identification of decision criteria for transmission line development, and a distributional analysis to look at the costs and benefits of the regional electricity trade.

**Regional | Benchmarking Electricity Utilities' Performance.** The Middle East and North Africa region (MNA) lacks a consistent cross-country database of key performance indicators of utilities in the electricity sector. In partnership with electricity sector institutions in the region, this activity aims to build up such a database with information on market structure and institutional data, governance, distribution, transmission, and generation. Benchmarking indicators will be used to compare utilities both within the region and other regions worldwide. An accurate analysis and comparison of utility performance based on a benchmarking database can provide a strong basis for institutional and regulatory reforms in the electricity sector.

**Moldova | Power Sector Note.** The power sector of Moldova has achieved important results over the last 15 years through a process of reform, privatization, and restructuring. Despite these achievements, the power sector faces a number of challenges. Less than 25 percent of Moldova's electricity demand is met by domestic generation due to few and deteriorating generation assets. This note will provide the Government of Moldova with a set of options for its power sector and for regional power trade to meet the objectives of the national energy strategy. The note will include recommended institutional and regulatory measures, as needed, for long-term regional power integration, and market pricing mechanisms for an efficient and stable electric power market.

**Jamaica | Emergency Integrated Resource Plan.** The Government of Jamaica has developed a National Energy Policy (2009-30) which presents a strategic framework to provide "affordable and accessible energy supplies with long-term energy security." The overall objective of this activity is to support a shift in Jamaica's energy sector to longer term sustainable development characterized by deployment of locally available renewable energy and energy efficiency programs. The activity envisions the development of an integrated resource plan and a road map for implementation. The integrated resource plan will include an assessment of the least cost electricity supply plan for Jamaica (including generation, transmission, and distribution), and options for reducing demand through energy efficiency.



## 5A | RESULTS-BASED APPROACHES TO ENERGY SECTOR DEVELOPMENT

While results-based approaches have been used in sectors such as health, communications technology, and transport, there is much more limited experience in the energy sector outside the relatively narrow remit of output-based aid. In response to growing interest, in 2011 ESMAP launched a work program to evaluate if and how results-based approaches could be used in the energy sector to improve outcomes and raise efficiency in the use of public funds.

In FY2013, ESMAP produced ***Results-Based Financing in the Energy Sector: An Analytical Guide***, which has provided a useful foundation for project teams experimenting with results-based financing both within and outside the World Bank, including two new ESMAP-funded technical assistance projects in the Asia Pacific region.

### FY2014 Activities

ESMAP continued its engagement with a DFID-funded results-based financing (RBF) pilot implemented by GIZ under the Energizing Development program. To date, the program has provided useful practical lessons related to some of the issues faced in the design of results-based programs. ESMAP also provided support to a number of World Bank-executed projects, including a technical assistance project on improved cookstoves in Uganda and a new activity that is exploring the potential for Program-for-Results (PforR) lending to finance rural electrification operations in Africa.

In FY2014, ESMAP awarded funding to two projects exploring the use of RBF to promote the uptake of improved and modern cookstoves in Lao PDR and Indonesia, respectively.

**Linking Stove Uptake to Positive Health Outcomes in Lao PDR.** Lao PDR has one of the highest rates of household air pollution in the world. Illnesses caused from inhaling indoor smoke are the country's primary cause of lost healthy life years, ahead of smoking, dietary risks, and high blood pressure.





In FY2014, ESMAP financed a pilot program to see if Lao PDR's high rate of lost healthy life years—otherwise known as Disability Adjusted Life Years (DALYs)—could be reduced through an RBF clean cookstove scheme. The basic concept involves verifying and monetizing the health benefits derived by women and children from the use of advanced cookstoves in the household and then compensating the stove provider whose products made the DALY reductions possible.

The first stage of the pilot RBF scheme began with the non-governmental organization SNV carrying out laboratory tests, controlled cooking tests, and trials using improved high efficiency wood burning cookstoves in Vientiane and Savannakhet. The studies helped assess a households' willingness-to-pay for improved cookstoves and identified the most common cooking techniques used in Lao PDR. These initial findings will inform the next stage of pilot surveys that will incrementally introduce the concept of improved health outcomes.

**Improving Cookstove Standards and Incentivizing Indonesia's Private Sector.** In Indonesia, ESMAP supported a pilot RBF initiative as part of the World Bank-supported Clean Stove Initiative (CSI). The program focuses on achieving access to modern cooking and heating solutions by compensating a pre-selected group of private sector 'aggregators' who will be tasked with marketing, distributing, and selling a range of quality-approved cookstoves. These aggregators will be paid after a two-step verification process, the first after an approved cookstove makes its way into a household, and the second once it has been confirmed that the product is still being used after a trial period. For more information, see the ASTAE section (Chapter 6).

### FY2015 and Beyond

In FY2014, ESMAP began work on a follow-on report to FY2103's *Results-Based Financing in the Energy Sector*. The new study explores the Results-Based Aid (RBA) approach. RBA differs from RBF in that the funding agreement is between a funder and recipient country, as opposed to a funder and service provider. Due to be finalized in FY2015, the *Results-Based Aid in the Energy Sector* report also builds on recent ESMAP work on measuring energy access (Chapter 3).





CHAPTER 6



# ASIA SUSTAINABLE AND ALTERNATIVE ENERGY PROGRAM

**A**s home to two-thirds of the world's population and more than 40 percent of its extreme poor, the Asia Pacific region is central to the attainment of the SE4ALL goals. The region's spectacular growth over the past two decades has lifted hundreds of millions of people out of poverty. Yet, millions of people still continue to lack access to electricity and clean, efficient cooking fuels, and have yet to enjoy the health, social, and economic benefits afforded by modern energy services.

The Asia Pacific region is also particularly vulnerable to the impacts of climate change, which, with its storm surges, cyclones, and coastal flooding from rising sea levels, now poses a major threat to the region's small island states, as well as to major population and economic centers in countries such as China, India, Pakistan, and Vietnam. The region also suffers the world's highest rate of deaths caused by household air pollution. A 2012 World Health Organization report attributed more than three million deaths annually to household air pollution in the Southeast Asia and the West Pacific regions alone.

Since 1992, the **World Bank's Asia Sustainable and Alternative Energy Program (ASTAE)** has been helping the East Asia and Pacific (EAP) and South Asia (SAR) regions transition to sustainable, inclusive, and low carbon green growth paths. To help countries make this transition, ASTAE's work program rests on three pillars: renewable energy, energy efficiency, and access to energy, which dovetails with the SEA4ALL objectives.

FY2014 marked the third year of ASTAE's 2012–15 Business Plan. Building on ASTAE's experience

## KEY ASTAE ACHIEVEMENTS, FY2014

- Development of a **Third-Party Access Code in Papua New Guinea** that enables third parties to connect to Papua New Guinea Power Limited's grid and ultimately provides customers with improved energy supply at more affordable prices
- Preparatory support for the **Kabeli A hydropower project in Nepal**, a joint WB-IFC program marking the re-engagement of the WBG in a greenfield hydropower project in Nepal after nearly two decades
- Capacity building and technical, social, environmental, and gender inputs to the Tuvalu Electricity Corporation (TEC) as it prepares for the **Tuvalu Electricity Sector Development Project**, the World Bank's first energy sector investment in the country (Box 6.1)
- Support to the Philippines' Electricity Markets Corporation as it finalizes the **design of a renewable energy market** through which utilities can purchase and/or sell renewable energy certificates
- **Production of a wide range of knowledge products and publications**, including *Geothermal Resource Risk in Indonesia; A Statistical Inquiry and Cumulative Impacts and Joint Operation of Small-Scale Hydropower Cascades in Vietnam; Lighting Rural India: Experience of Rural Feeder Segregation Across States; Mongolia: Development Impacts of Solar-Powered Electricity Services; and China: Accelerating Household Access to Clean Cooking and Heating*

in country-level intervention, the plan also devotes special attention to scaling up access to sustainable energy on a regional basis.

ASTAE currently helps shape the design of World Bank investment projects and provides technical assistance in 23 EAP and 8 SAR countries.

ASTAE uses six output-based indicators to track the impact of its activities on World Bank projects, which include IBRD, IDA, and Global Environment Facility (GEF) loans and grants:

- 1 | Total World Bank lending amount catalyzed by ASTAE activities
- 2 | New capacity (MW) and increased generation (GWh/year) of renewable electricity
- 3 | Electricity savings resulting from efficiency improvements (MW equivalent and GWh/year)
- 4 | Households with access to modern energy services, including (i) new access to electricity; (ii) improved access to electricity; and (iii) improved stoves for heating (cooking and space)
- 5 | Avoided greenhouse gas emissions (CO<sub>2</sub> avoided over 20 years, million tons)
- 6 | Number of countries benefiting from ASTAE support

ASTAE helps to promote regional collaboration by supporting knowledge exchange and study tours between countries as part of its country-specific activities, through dedicated regional programs (such as the East Asia Clean Stove Initiative) and by replication of approaches from one country to another (such as the ASTAE-supported Energizing Green Growth of Da Nang City in

Vietnam activity, which led to implementation of the process piloted in Da Nang in Surabaya, Indonesia).

ASTAE and ESMAP have long complemented each other, as ASTAE is focused on operational support and project preparation for World Bank and GEF projects, whereas ESMAP is focused on more upstream analytical, knowledge, and technical assistance work that informs follow-on World Bank lending. In a number of cases, World Bank country engagements draw on support from both trust funds.

In FY2014, the consultative groups of donors for both ESMAP and ASTAE agreed that, starting in FY2015, the program management and administration of ASTAE would be merged with ESMAP. Furthermore, it was agreed that ESMAP and ASTAE would publish a joint annual report—this being the first such joint report. (For more information on ASTAE’s financial and results reporting, see Annex III.)



## FY2014: HIGHLIGHTS AND ACHIEVEMENTS

In FY2014, ASTAE launched 21 new programs in 8 countries and 6 regional activities. In addition, over the course of FY2014, the World Bank's Board of Executive Directors approved four ASTAE-supported Bank projects totaling \$1.2 billion. This brings to \$3.25 billion the total value of ASTAE-supported projects approved by the Board since the beginning of the current business plan, an amount slightly exceeding the \$3.2 billion business plan target. ASTAE activities spanned the entire project cycle, from early stage exploration to critical support in the project implementation and evaluation stages.

Outlays in FY2014 saw 38 percent of total disbursement directed to renewable energy activities, 46 percent to energy access activities, with the remaining 16 percent disbursed to energy efficiency activities. (It should be noted that many activities span these categories, and these percentages are based on the dominant focus in each program.)

### Catalyzing Markets for Clean Cookstoves in Indonesia

An estimated 165,000 premature deaths are attributed to household air pollution in Indonesia annually. Despite the introduction of more than 50 million liquefied petroleum gas (LPG) stoves to households and small- and medium-sized enterprises in recent years, some 25 million mostly rural households still rely on firewood or other solid biofuels such as charcoal, dung, or crop waste to meet their cooking needs. In FY2014, ASTAE continued to provide support to

the Indonesian Clean Stove Initiative (CSI) as it develops a scalable market for affordable, energy efficient cookstoves. ASTAE assistance included preparatory work for a pilot subsidies program under which the Bank Rakyat Indonesia will help consumers in the Central Java and Yogyakarta areas purchase clean, fuel-efficient cookstoves. In addition, ASTAE supported fieldwork for a study on how the CSI can strategically address gender dimensions when marketing clean, fuel-efficient cookstoves. The study is important because although women in Indonesia tend to do the bulk of household cooking, it is their husbands who most often decide how major household expenses are allocated. A series of reports were produced as a result of interviews with more than 1,400 peri-urban households in Java's Yogyakarta Special Region that offer strategies to persuade men of the benefits of clean, fuel-efficient cookstoves and design specifications/modifications of stoves to be marketed under future CSI programs.

### Sharing Best Practices for Regional Scale up of Clean Cookstoves

In FY2014, ASTAE continued its support for the World Bank's EAP CSI Regional Forum Program, an initiative that promotes South-South collaboration in order to help countries scale up access to modern cooking and heating solutions, particularly for poor rural households. In April 2014, ASTAE co-financed the second EAP CSI Forum and South-South Knowledge Exchange Event in Beijing, China. The event was an opportunity to share early results from CSI activities in China, Indonesia, Lao PDR, and Mongolia. More than 50 delegates from Cambodia, Guatemala, Honduras, Indonesia, Lao PDR,



Mongolia, Nepal, Vietnam, and countries in Africa attended the event. A new CSI e-Forum was launched at the Beijing event that now serves as a venue for clean cookstove practitioners, technicians, policymakers, business vendors, and academics to network, exchange information, and collaborate.

### **Developing a Renewable Energy Market in the Philippines**

The Philippine government's national energy strategy aims to triple the country's installed renewable energy capacity to over 15,000 MW by 2030. In order to meet this goal, the government is working to establish a Renewable Energy Market (REM) through which utilities can buy and sell renewable energy certificates. In FY2014, ASTAE provided policy and technical assistance to the Philippines Electricity Markets Corporation as it finalized the REM's design, rules, and registry. The registry is an important part of the institutional framework for ensuring that compliance with the renewable portfolio standard can be monitored and enforced. A second component of ASTAE's assistance helped review the wholesale

electricity market rules that govern the operation of the Philippine electricity market in order to make way for the incorporation of the "must-dispatch" guidelines called for in the landmark Renewable Energy Act of 2008. Must-dispatch provisions ensure that all generated renewable energy is dispatched as a priority as soon as it becomes available. These ASTAE activities are supporting preparation of the Philippines Renewable Energy Development Project, a World Bank initiative aimed at helping expand renewable energy penetration and electricity access in a sustainable manner. This project will be one of the first IBRD guarantees financed by the Clean Technology Fund (CTF).

### **Building Capacity for Nepal's First Large-Scale Solar Power Development**

In FY2014, ASTAE provided a significant contribution toward construction preparations for Nepal's first large-scale, solar-powered electricity plant, to help reduce load shedding, running up to 18 hours a day. The World Bank-supported project will build a series of 25 MW solar farms near Kathmandu that will connect to the Nepal

Electricity Authority's (NEA) distribution network. As this is the first major project of its kind in Nepal, the NEA is eager to develop its in-house capacity in the area of solar technology. In February 2014, ASTAE convened a capacity building workshop that trained representatives from government and various public stakeholders on a wide range of design, construction, plant operation, and maintenance issues. The workshop included presentations by international experts (including instructors, regulators, consultants, and developers from Germany and Thailand), as well as domestic stakeholders (including a pilot solar project owner). Construction of the solar farms is expected to begin in early 2015.

### **Assessing Environmental Impacts of WB-IFC Hydropower Scheme in Nepal**

ASTAE provided preparatory assistance for Nepal's planned 37.6 MW Kabeli A hydropower development, a joint World Bank/IFC project that will help eliminate load shedding, improve electricity access, and promote regional integration for sustainable growth in Nepal. This will be the largest single IFC transaction committed to date in Nepal and will mark the re-engagement of the World Bank Group in a greenfield hydropower project in Nepal after nearly two decades. ASTAE assistance financed a review and update of the Cumulative Impact Assessment for the 14 hydroelectric projects planned for the Kabeli basin. The results are helping the project designers understand and mitigate the scheme's potential impacts on aquatic life, which could affect food-energy-water security nexus issues. Along with adding 37.6 MW of electricity generation capacity to Nepal's power system, it is expected that the Kabeli A plant will demonstrate a model of

public-private partnership in hydropower generation that can promote hydropower development in Nepal and can be replicated in other parts of the region and beyond.

### **Promoting Private Sector Investment in Papua New Guinea's Power Sector**

The vast majority of Papua New Guinea's (PNG) population lives in rural areas that have limited or no access to electricity. In order to broaden access, the government has launched the National Electrification Roll Out Plan (NEROP), an ambitious initiative that aims to boost the country's electricity access rate from 13 to 70 percent by 2030. Attracting private sector investment and making the energy sector more competitive is a key step towards achieving this goal. Over the course of FY2014, ASTAE supported development of a Third-Party Access Code that will enable third-party access and connection to the electricity network that is currently owned and operated by Papua New Guinea Power Limited (PPL). The benefits of the new access code, which went into effect in January 2014, are expected to include improved power system efficiency and performance, a level playing field for independent power producers, and increased transparency. ASTAE also assisted the government in developing a complementary Grid Code that is expected to be adopted in late 2014.

### **Exploring Mitigation Options for Short-Lived Climate Pollutants in South Asia**

In FY2014, ASTAE supported preliminary work on a study to help the governments of Bangladesh, India, and Nepal significantly reduce emissions of short-lived climate pollutants, such as black carbon, through the generation and

dissemination of policy-relevant knowledge on mitigation options. The study, which is being conducted by the University of California San Diego (UCSD) in partnership with India's Energy and Resources Institute (TERI) and the California Air Resources Board (CARB), is expected to be released in late 2014. A second component of ASTAE assistance worked to create a coalition of stakeholders and experts concerned with public health, environmental damage, climate change, environmental justice, economic development, and transport industry competitiveness. To begin the coalition-building process, multi-stakeholder workshops to consult on preliminary findings were held in California and New Delhi. Scoping work also began on extending the study in FY2015 to Bangladesh and Nepal, and equivalent components on brick kilns and clean cooking.

### **ASTAE Knowledge Products**

In FY2014, ASTAE produced a wide range of knowledge products and publications. Examples include *Geothermal Resource Risk in Indonesia: A Statistical Inquiry*, published in June 2014, which assesses the prospects for geothermal development in Indonesia as the government embarks on an ambitious scale-up plan. Based on case studies from six river basins in northern Vietnam, *Cumulative Impacts and Joint Operation of Small-Scale Hydropower Cascades*, also published in June 2014, provides valuable recommendations for policymakers and the planners and developers of small-scale hydropower plants. *China: Accelerating Household Access to Clean Cooking and Heating*, published in September 2013, synthesizes the knowledge gained to date through the implementation of the China

Clean Stove Initiative. The report emphasizes that market-based approaches are key to achieving sustainability and proposes strategies through which the country can achieve universal access to clean cooking and heating solutions. Undertaken at the request of India's Ministry of Power, *Lighting Rural India: Experience of Rural Load Segregation Schemes in States*, published in February 2014, analyzes the introduction of rural feeder segregation schemes in different Indian states. The rural feeder segregation approach provides separate electricity infrastructure for rural agriculture and non-agriculture power consumers. The study finds that the feeder segregation approach is improving both the availability and quality of power supply in rural areas, but that a standard "one-size-fits-all" implementation strategy may not work for all states. The study was cited in a subsequent National Policy Guidance Note. The ASTAE-financed study *Mongolia: Development Impacts of Solar-Powered Electricity Services*, published in January 2014, illustrates the positive outcomes that have resulted from providing solar-powered electricity services in rural areas.

### **New Initiatives**

In FY2015, a number of major World Bank projects for which ASTAE has provided preparatory assistance are expected to be approved by the World Bank's Board of Executive Directors. These include the \$731 million Vietnam Transmission Efficiency Project. In preparation of this project, ASTAE supported the National Power Transmission Company in defining and refining its smart grid strategy by preparing a detailed Smart Grid investment plan to improve the efficiency, resilience, and increase the transmission grid's



ability to absorb intermittent renewable energy resources.

ASTAE is also supporting the preparation of a major IBRD-KfW project in Indonesia to support PLN, the national power utility, in implementing the '1,000 island' electrification program through technical assistance and capacity building in technology mapping, least-cost grid roll out, and off-grid planning. KfW is supporting the connection of over 16,000 new

customers at 94 locations in Nusa Tenggara Timur using solar-diesel hybrid systems (19.7 MW). ASTAE funds were instrumental in the team's ability to prepare these subprojects in a timely manner.

Moving forward, ASTAE will intensify its long-standing focus on the gender-energy dimension, especially in advancing programmatic support to the World Bank's East Asia and the Pacific regional energy gender action plan.

## BOX 6.1

### HELPING TUVALU MOVE TOWARD 100 PERCENT RENEWABLE ENERGY GENERATION

By 2020, the Pacific island state of Tuvalu aims to become the first country in the world to generate 100 percent of its electricity from renewable sources such as solar, wind, and biofuel. At present, some 77 percent of the country's installed capacity comes from a power station on the island of Funafuti. On the country's outer islands, antiquated and inefficient diesel-run generators run 12 to 18 hours per day, meaning that blackouts—most often the result of shortages of fuel and spare parts—are a frequent occurrence.

In FY2014, ASTAE support financed a team of experts to help the Tuvalu Electricity Corporation (TEC) ensure that the proposed World Bank Energy Sector Development Project provides a path for Tuvalu to achieve its 100 percent goal. This included a range of technical and social studies that are helping identify the optimal combination of solar- and wind-power generation and storage necessary to reach the renewable generation target.

A number of other donors—including Japan, the European Union, the United Arab Emirates, New Zealand, and Australia—have activities underway to help Tuvalu replace diesel generation with renewable energy technologies. ASTAE financed a technical study to optimize the integration of renewables into the system in Funafuti in a way that best complements the existing efforts by donors.

ASTAE is also helping Tuvalu identify and evaluate a series of measures to bring about a 30 percent improvement in energy efficiency. This includes support for energy audits of buildings, public, and industrial and commercial facilities, and an evaluation of the availability of energy efficient electrical appliances and electric transport on the market.

In addition, ASTAE is supporting the design and installation of a satellite-based communications system in Funafuti and the outer islands that will enable the TEC—with continued support—to remotely monitor, control, and improve the operation and maintenance of its power systems.

ASTAE support is also helping ensure that the TEC takes social issues into consideration as a part of the project planning process. An example of this was an ASTAE-financed gender scoping study, gender action plan, and gender monitoring and evaluation system that aims to improve the participation of women in energy sector planning, implementation, and evaluation. Based on interviews with more than 100 men, women, and youth, the study found that, despite considerable gender mainstreaming efforts in Tuvalu in recent years, the concepts of gender, gender equity, and equality have yet to be fully integrated into the community decision-making process. This gender work directly contributes to the proposed Energy Sector Development Project, as well as to implementation of the Tuvalu National Gender Equality and Women's Empowerment Policy that was approved in early 2014.

Another major outcome of ASTAE assistance will be smoother and faster implementation of a World Bank project that could save the Tuvalu's government significant resources through avoided petroleum fuel costs. At current fuel prices, a 20 percent reduction in fuel usage represents a cost saving of \$460,000 per year.







## CHAPTER 7



# FINANCIAL REVIEW



Starting in FY2015, the program management and administrative functions of ASTAE (Chapter 6) will merge with ESMAP. As part of this merger, it was agreed that the two trust funds would publish a joint annual report, starting with this FY2014 Annual Report.

All FY2014 figures below detail financial information for the three multi-donor trust funds (MDTFs) that, as of the beginning of FY2015, will come under ESMAP's management and administration: **ESMAP**, **ASTAE**, and **SIDS DOCK** (see Section 2A).

## CONTRIBUTIONS

ESMAP received a total of \$47.2 million from nine donors, plus the World Bank, in FY2014. Total receipts for ASTAE were \$4.4 million from its three donors. Japan made possible the second tranche of the SIDS DOCK program with a contribution of \$9 million.

Table 7.1 shows actual receipts from individual donors for the three MDTFs for FY2014, as well as cumulative receipts since FY2010.

TABLE 7.1

### Overview of Donor Contributions to ESMAP, ASTAE, and SIDS DOCK MDTFs, FY2010-14 (\$, thousands)

Country	FY2014 Contribution			Cumulative Receipts Since FY2010			Total Receipts FY2010-14	% Cumulative
	ESMAP	ASTAE	SIDS DOCK	ESMAP	ASTAE	SIDS DOCK		
Australia				7,574.74			7,574.74	5.2%
Austria	2,061.60			4,741.27			4,741.27	3.2%
Denmark	8,929.91			23,597.53		7,093.12	30,690.64	21.0%
Finland				1,527.54			1,527.54	1.0%
France				844.04			844.04	0.6%
Germany	4,102.80			6,766.30			6,766.30	4.6%
Iceland	300.00			1,256.13			1,256.13	0.9%
Japan			9,000.00			9,000.00	9,000.00	6.2%
Lithuania	37.93			97.79			97.79	0.1%
Netherlands	9,500.00	2,000.00		18,200.00	12,000.00		30,200.00	20.7%
Norway	6,446.36			11,887.44			11,887.44	8.1%
Sweden	764.29	756.08		4,565.34	5,913.75		10,479.09	7.2%
United Kingdom	14,743.70	1,637.10		22,708.10	6,324.75		29,032.85	19.9%
World Bank	344.62			2,008.62			2,008.62	1.4%
<b>Total</b>	<b>47,231.22</b>	<b>4,393.18</b>	<b>9,000.00</b>	<b>105,774.82</b>	<b>24,238.50</b>	<b>16,093.12</b>	<b>146,106.44</b>	<b>100%</b>

## DISBURSEMENTS

ESMAP disbursed US \$21.7 million in FY2014—an increase of 29 percent from the year before.

Table 7.2 shows FY2012-13 disbursements for ESMAP, and for all three MDTFs for FY2014. (For FY2012-13, ESMAP disbursements include SIDS DOCK spending.)

Project costs are separated into (i) disbursements by region and for global programs, and (ii) disbursements for program management, administration, and other centralized functions.

Regional activities are those managed by World Bank regional units.

ESMAP global programs include analytical and advisory activities (AAA) managed by the ESMAP

TABLE 7.2

ESMAP Disbursements, FY2012-13 (including SIDS DOCK); ESMAP, ASTAE, and SIDS DOCK Disbursements, FY2014 (\$, thousands)								
	FY2012		FY2013		FY2014			
					ESMAP	ASTAE	SIDS	
<b>Project Cost</b>	<b>\$14,867.81</b>	<b>87%</b>	<b>\$14,636.94</b>	<b>87%</b>	<b>\$19,852.74</b>	<b>\$5,030.18</b>	<b>\$765.75</b>	<b>93%</b>
Africa	6915.75		5,199.04		7,681.48		179.77	
East Asia	517.91		706.64		2,132.92	3,847.86	74.88	
Europe & Central Asia	576.36		1,201.05		1,419.49			
Latin America & Caribbean	775.63		913.23		2,153.29		379.91	
Middle East & North Africa	600.23		839.36		448.13			
South Asia	867.32		346.01		878.73	965.59		
Global Program	4,614.61		5,431.61		5,138.70	216.73	131.19	
<b>Program Management &amp; Sustaining</b>	<b>\$2,129.08</b>	<b>13%</b>	<b>\$2,273.13</b>	<b>13%</b>	<b>\$1,910.43</b>	<b>\$77.55</b>	<b>\$82.31</b>	<b>7%</b>
Program Management	1,080.64		997.16		784.69	68.19		
Governance (CG, TAG)	91.57		83.53		98.58	9.36		
Resource Management/Trust Fund Administration	215.14		230.38		217.42			
Portfolio Management (Monitoring and Evaluation)	245.89		316.20		213.46			
Knowledge Forums	28.78		102.50		116.65			
Communication and Outreach (publications, website, and other dissemination)	467.06		543.36		479.62			
<b>Total</b>	<b>\$16,996.89</b>	<b>100%</b>	<b>\$16,910.07</b>	<b>100%</b>	<b>\$21,763.17</b>	<b>\$5,107.73</b>	<b>\$848.06</b>	<b>100%</b>
<b>Of which:</b>								
Funded by Donors	16,006.34		16,302.79		21,182.40	5,107.73	848.06	
Funded from World Bank budget	640.23		350.35		344.62			
Funded from Fee Income	350.32		256.93		236.15			

core unit, as well as those led by World Bank global departments such as Energy, Water, Urban, and Transport. (It is important to note that a portion of the expenditures under global programs is associated with work performed by ESMAP core technical staff for clients through the World Bank's regional units.)

## BREAKDOWN BY REGION AND PROGRAM AREA

Table 7.3 shows FY2014 spending by region for all three MDTFs, and by program area for ESMAP.

Annual block grants—grants to the World Bank's regional units for targeted technical assistance activities at the country level—remain the largest single area of ESMAP's portfolio, closely followed by AFREA. However, the proportion of the total ESMAP portfolio dedicated to annual block grants declined from 37 percent in FY2013 to 29 percent in FY2014 due to the growth of some of the strategic global programs.

Figures 7.1 and 7.2 show the breakdown in FY2014 of ESMAP disbursements by program area, and of ASTAE spending by ASTAE's pillars.

TABLE 7.3

ESMAP, ASTAE, and SIDS DOCK Disbursements, by Program Area, FY2014 (\$, thousands)															
	ESMAP										ASTAE	SIDS DOCK	Total		
	Annual Block Grants	Transport	Water	Sustainable Energy for All (SE4ALL)	Global Geothermal Development Plan	Results Based Funding	Renewable Energy Resource Mapping	Energy Subsidy Reform Facility	AFREA	City Energy Efficiency Transformation Initiative				Other Global Programs	
Africa	1,368,193			464,515			196,305		5,652,471				179,766	7,861,250	
East Asia	959,073	52,089		915,983	16,917	74,733	112,825			1,305			3,847,860	74,878	6,055,663
Europe & Central Asia	1,218,726		36,866				163,896								1,419,488
Latin America & Caribbean	1,239,743	202,667	15,252	301,958	351,934		41,731							379,913	2,533,199
Middle East & North Africa	311,094		72,589				64,444								448,128
South Asia	602,565	122,017		16,918			137,231						965,593		1,844,324
Global Programs		93,107	78,572	98,027	229,123	86,537	402,809	288,416		720,942	3,141,168		216,730	131,188	5,486,618
<b>Total</b>	<b>5,699,394</b>	<b>469,880</b>	<b>203,279</b>	<b>1,797,401</b>	<b>597,975</b>	<b>161,270</b>	<b>849,170</b>	<b>558,487</b>	<b>5,652,471</b>	<b>722,246</b>	<b>3,141,168</b>		<b>5,030,182</b>	<b>765,746</b>	<b>25,648,668</b>

FIGURE 7.1

ESMAP Disbursements, by Program Area, FY2014

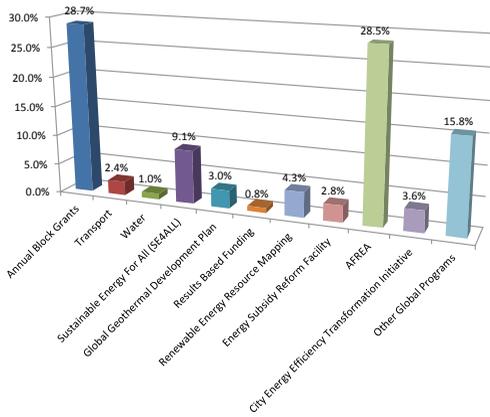
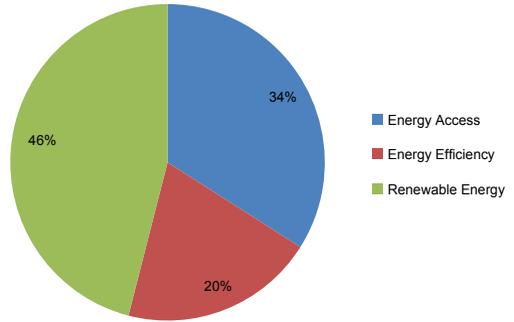


FIGURE 7.2

ASTAE Spending, by Pillars, FY2014





## ACRONYMS

ACCES	Africa Clean Cooking Energy Solutions
AEI	African Electrification Initiative
AFD	Agence Française de Développement
AFREA	Africa Renewable Energy and Access Program
AOSIS	Alliance of Small Island States
ASEAN	Association of Southeast Asian Nations
ASTAE	Asia Sustainable and Alternative Energy Program
CARB	California Air Resources Board
CG	Consultative Group
CSI	Clean Stove Initiative
CSP	Concentrated solar power
CTF	Climate Technology Fund
DALY	Disability adjusted life year
DFID	Department for International Development
ECERA	Eastern Caribbean Energy Regulatory Authority
EDGE	Excellence in Design for Greater Efficiencies
ERC	Energy Regulatory Commission (Philippines)
GDP	Gross domestic product
GPOBA	Global Partnership on Output-Based Aid
GTF	Global Tracking Framework (SE4ALL)
IBRD	International Bank for Reconstruction and Development
ICEIDA	Icelandic International Development Agency
ICT	Information and communication technology
IDA	International Development Association
IDB	Inter-American Development Bank
IFC	International Finance Corporation
IRENA	International Renewable Energy Agency
JICA	Japan International Cooperation Agency
KfW	German government-owned development bank
LED	Light-emitting diodes
MDFT	Multi-donor trust fund
META	Model for Electricity Technology Assessment (ESMAP tool)
NEA	Nepal Electricity Authority
NGO	Non-governmental organization
PGE	Pertamina Geothermal Energy
PHRED	Philippines Renewable Energy Development
PLN	Perusahaan Listrik Negara (Indonesia's state electric company)
RBA	Results-based aid
RBF	Results-based financing
REM	Renewable energy market
RREA	Rural and Renewable Energy Agency

SE4ALL	Sustainable Energy for All
TAG	Technical Advisory Group
SIDA	Swedish International Development Cooperation Agency
SIDS	Small island developing states
TEC	Tuvalu Electricity Corporation
TERI	The Energy and Resources Institute (India)
TRACE	Tool for Rapid Assessment of City Energy (ESMAP tool)
UN	United Nations
UNDP	United Nations Development Programme
WBG	World Bank Group

All dollar figures (\$), unless otherwise specified, are in United States dollars.

## WORLD BANK REGIONS

AFR—Sub-Saharan Africa

EAP—East Asia and Pacific

ECA—Europe and Central Asia

LCR—Latin American and Caribbean

MNA—Middle East and North Africa

SAR—South Asia

**Copyright © 2014**

The International Bank for Reconstruction and Development/  
THE WORLD BANK GROUP  
1818 H Street, N.W.  
Washington, D.C. 20433, U.S.A.

**All rights reserved**

Manufactured in the United States of America  
First printing January 2014

The findings, interpretations, and conclusions expressed in this paper are entirely those of the author(s) and should not be attributed in any manner to the World Bank, or its affiliated organizations, or to members of its Board of Executive Directors or the countries they represent. The World Bank does not guarantee the accuracy of the data included in this publication and accepts no responsibility whatsoever for any consequence of their use. The Boundaries, colors, denominations, other information shown on any map in this volume do not imply on the part of the World Bank Group any judgment on the legal status of any territory or the endorsement or acceptance of such boundaries.

The material in this publication is copyrighted. However, it may be reproduced in whole or in part and in any form for educational or nonprofit uses, without special permission provided acknowledgment of the source is made. Requests for permission to reproduce portions for resale or commercial purposes should be sent to the ESMAP Manager at the address listed above. ESMAP encourages dissemination of its work and will normally give permission promptly. The ESMAP Manager would appreciate receiving a copy of the publication that uses this material for its source sent in care of the address listed above.

All images remain the sole property of their source and may not be used for any purpose without written permission from the source.

**Production Credits**

Task Leader | Nicholas Keyes  
Production Editor | Heather Austin  
Design | Automated Graphic Systems, Inc.

**Photo Credits**

Cover: ©World LPG Association; p. iii: T. Georgiev/© World Bank; p. iv: F. Al Harazi/© World Bank; p. 15: D. Smillie/© World Bank; p. 24: S. McCourtie/© World Bank; p. 31, 35: M. Wrrright/© Ashden; p. 33: A. Hoel/© World Bank; p. 36: © Photodisc; p. 39 :D. Chavez/c. World Bank; p. 42: F. de Preneuf/© World Bank; p. 45: S. Zimmerman/© World Bank; p. 49: J. Hogg/© World Bank; p. 54, 59: © ASTAE; p. 55: B. Verweij/c. World Bank; p. 56: P. Karki/© World Bank; p. 61: © Earth Institute of Columbia University; p. 66: T. Hoa/© World Bank; p. 72: B. Balabanov/© World Bank.

All other images are © iStock.



[www.esmap.org](http://www.esmap.org)



Energy Sector Management Assistance Program  
The World Bank  
1818 H Street, NW  
Washington DC 20433 USA  
Fax: 202.522.3018 • Email: [esmap@worldbank.org](mailto:esmap@worldbank.org)