



USAID
FROM THE AMERICAN PEOPLE

EMPOWERING DEVELOPMENT



Photo Credit: USAID/Winnock International

INTRODUCTION

Energy powers development. Energy is critical to boost crop production, drive industry, and increase jobs and income for small and medium industries. Energy moves water; brings schools into the 21st century, and lights, heats, and refrigerates clinics around the world.

Yet despite the critical role of energy, upwards of 1.7 billion people lack electricity for economic and social needs—over one-quarter of the world's population. A comparable number of people rely on traditional fuelwood (e.g., biomass and dung) for heating and cooking, with negative health and environmental consequences that include sickness, death, and massive deforestation. Further, global energy demand is expected to increase in the next 25 years by over 60%, with the major growth to occur in developing countries. The good news is that energy options exist today to meet these needs in a cost effective and responsible manner.

Expanding access to modern energy services to power economic and social development is the cornerstone of the U.S. Agency for International Development (USAID) energy mission. Affordable, reliable, efficient, and clean energy services empower people to take the leap from poverty to a better future. Access to energy: increases economic growth, employment opportunities, private sector investment, and competitiveness; strengthens democracy and fosters political stability through improved transparency and communication; enhances national security; improves quality of life by enabling better health care, education, and access to clean water; and protects the environment and public health.

The USAID Energy Team, located within the Bureau for Economic Growth, Agriculture, and Trade, Office of Infrastructure and Engineering, provides leadership and support to the U.S. Government and overseas missions in the provision of improved energy services for urban and rural populations. USAID is also the U.S. Government's lead agency for the Global Village Energy Partnership, a component of the Presidential Clean Energy Initiative announced in 2002 at the World Summit on Sustainable Development to increase energy access in developing nations.

USAID's energy strategy is to:

- Strengthen energy sector governance and energy markets through policy, legal, regulatory, and commercial reform.
- Improve the operational and commercial performance of public and private sector institutions.
- Pilot innovative business models, financing approaches, and public-private partnerships with businesses, entrepreneurs, and NGOs.
- Enhance public understanding and participation in the provision of energy services.

- Improve the efficiency and reduce the environmental impact of energy production and use.

This series of brochures offers brief, hands-on information on the role that clean energy solutions should play in meeting development challenges in various sectors such as agriculture, economic growth, and democracy and governance. Each publication includes relevant background information, facts, statistical data, and specific case studies from the field to better illustrate clean energy solutions and their impacts. This publication is intended for decision makers and development activity implementers (including USAID Mission officers and staff) working in international development where clean, reliable energy is a critical input in enhancing economic and social development.

Energy encompasses more than the lamp illuminating the rural street corner or the television in the community center. It is the fuel that powers industry and fosters economic wellbeing; the security that comes from having dependable public services such as information systems and modern healthcare; and the future for the world's children, whose educational and personal achievement depends upon it. Energy is a critical input into human development across the board. For this reason, understanding the energy connection in each of USAID's programs is a prerequisite to achieving the Agency's goals. The brochures included in this folder highlight the linkages between Energy and the following development topics:

- **Gender**
- **Small and Medium Enterprise**
- **Natural Resource Management and the Environment**
- **Health and Education**
- **Economic Growth and Trade**
- **Democracy, Governance, and Conflict Management**
- **Water and Agriculture**

In addition, this folder includes a fact sheet on energy options and applications for developing countries and economies in transition.

I encourage you to read the attached brochures and trust you will benefit from the information provided. More importantly, I hope that you will incorporate clean energy services into the work you perform, and as a result contribute to improving people's lives and livelihoods.

Gordon W. Weynand

Energy Team Leader

Office of Infrastructure and Engineering

USAID Bureau for Economic Growth,

Agriculture, & Trade

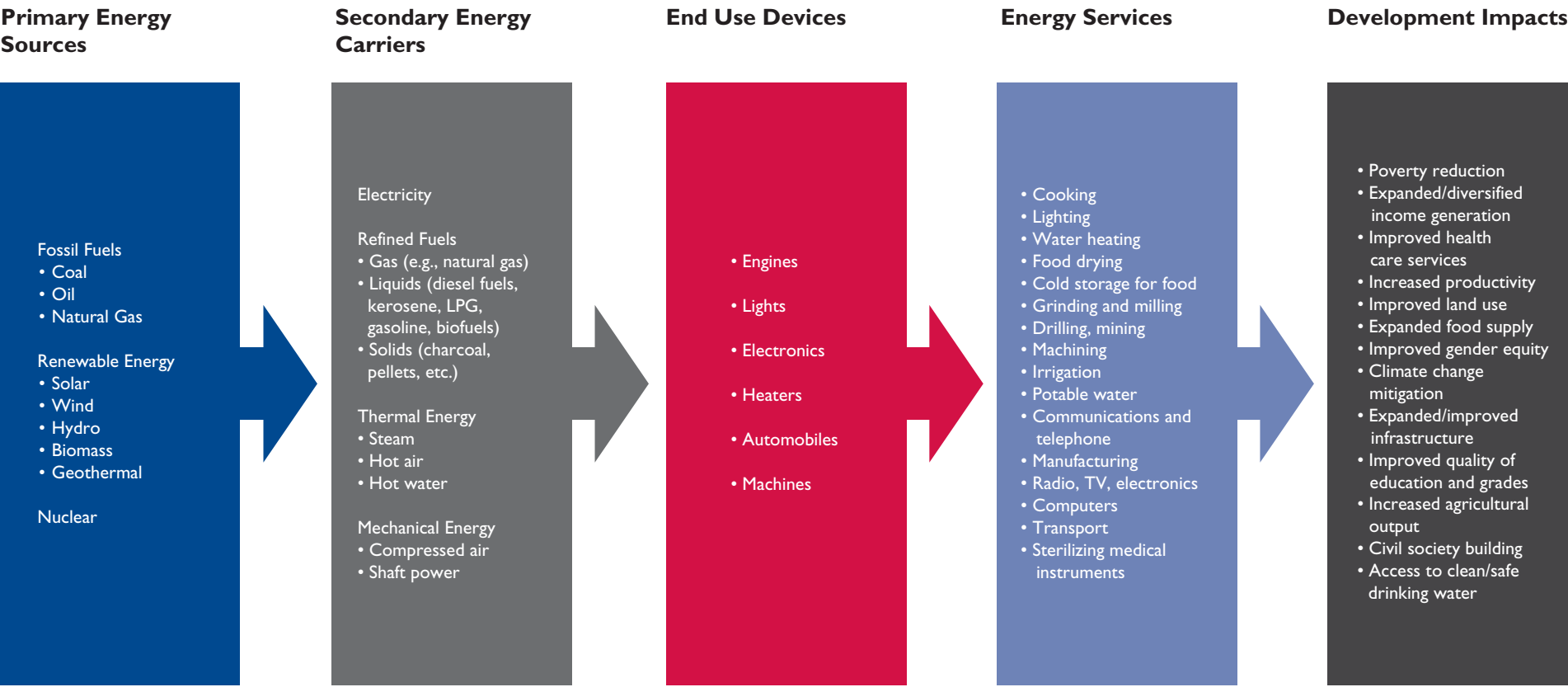
Internet: http://www.usaid.gov/our_work/economic_growth_and_trade/energy

MODERN ENERGY FOR DEVELOPMENT

With the exception of some traditional economic activities that rely solely on animal and human power; virtually all productive enterprises require primary energy sources that are converted to secondary energy forms (such as electricity and heat), which in turn are used for myriad end uses (see Figure 1). The same applies to many community and social services such as health, education, and clean water supply. The energy chain includes:

- **Primary energy sources.** The primary sources that power most of the modern energy used in the world are fossil fuels (primarily coal, oil, and natural gas), water, agricultural residues and energy crops, uranium, the earth’s heat, sunlight and wind. Table 1 briefly describes the various energy resources.
- **Secondary energy carriers.** To provide power, primary resources are transferred into a variety of forms including heat, mechanical, electrical, and chemical energy. For example, the process of combustion releases chemical energy from fossil fuels into heat; heat is transferred to steam, and steam is transformed from mechanical energy into electricity. The forms of energy primarily used by modern society are electricity, fuel combustion, thermal energy, and mechanical power.
- **End use devices.** The secondary forms of energy are used by engines, generators, electronics, heaters, automobiles, machines and more for consumptive, social, and productive end uses. Energy is delivered by various means, generally through intermediaries including electric utility companies, fuel distribution companies, district heating companies, and local energy services companies (ESCOs).
- **Energy services.** Energy services include lighting, cooking, space heating, operation of motorized equipment, and power for electronics, manufacturing, and communications. These energy services are central to economic and social development.
- **Development impacts.** Access to energy services helps improve peoples' lives in a number of ways, including poverty reduction, expanded and diversified income generation, better health care services, enhanced productivity, improved gender equity, increased agricultural yields, conflict resolution, reduced urban migration, improved performance and quality of education, and better use of natural resources.

FIGURE 1. FROM PRIMARY ENERGY TO DEVELOPMENT IMPACT



Adapted from *Energizing the Millennium Development Goals, A Guide to Energy's Role in Reducing Poverty*, (2005) United Nations Development Programme Report

TABLE 1: PRIMARY ENERGY SOURCES AND THEIR CONVERSION TO MODERN ENERGY FORMS

ENERGY SOURCE	DESCRIPTION
Fossil fuels	Fossil-based fuels include kerosene, diesel, gasoline, Liquefied Petroleum Gas (LPG), and natural gas. Use of fossil fuels has impacts on local air quality and global atmospheric conditions from power plant emissions; oil spills and leaks that affect soils, marine and coastal waters, freshwater rivers, lakes, and groundwater resources; and climate change.
Biomass*	Biomass includes agricultural residues such as rice hulls, straw, bagasse from sugar production, wood-processing residues, coconut shells and husks, etc. It also includes “energy crops” such as sugar cane for ethanol production. Biomass is often not used renewably; resources must be managed carefully for sustainable harvesting of biomass and biomass residues for energy purposes. Modern biomass fuels include pelletized, condensed woody biomass suitable for clean, high-efficiency gasification and combustion, gel fuels, and vegetable-derived liquid fuels for diesel fuel additives and substitution.
Geothermal*	Geothermal energy uses pressurized hot water and steam to drive turbines for electricity production in the range of single megawatts (MW) to tens of megawatts, with collective output of hundreds of megawatts. Geothermal energy is used to provide base-load power to a central grid. Geothermal heat can also be used directly for agro-processing.
Hydropower	Hydropower includes converting the power of flowing water into rotational mechanical power and energy, and coupling to an electric generator to produce electricity. Micro-hydro units (< 1 kilowatt [kW]) are used for battery charging. Mini-hydro systems (up to 1 MW) are used for community- and enterprise-specific alternating current (AC) mini-grid applications. Larger hydro systems are used for AC grid power.
Solar*	Photovoltaic conversion of sunlight to electricity. Solar photovoltaic (PV) panels are devices that convert sunlight to direct current (DC) electricity. These are often incorporated into systems combining batteries, electronic controls, and DC to AC conversion, to provide full-time DC and/or AC power (limited by the amount of solar-generated electricity produced each day). Typical applications include lighting, electronics, telecommunications, and small-scale water pumping (to 10 kW).
	Solar thermal energy conversion. Solar thermal technology uses flat and concentrating absorbers that convert incident sunlight into heat (hot air, water, and steam) for such processes as crop drying, food processing, water and space heating, and industrial process heat. Practical temperatures range from 50 degrees Celsius (C) to higher than 1,000 degrees C.
Wind*	Wind turbines generate electricity in three output ranges (0.1 – 10 kW; 10 – 100 kW; 100 kW – 5 MW). Small wind turbines are well suited for pumping water and supplying power to residences, schools, and clinics (usually with engine generator backup). Larger units are suitable for community power in hybrid configuration with diesel generators. Modern grid-connected wind “farms” range from 20 to 200+ MW using turbines of 1 MW or more.
Nuclear	Uranium-based, controlled nuclear fission in modern power reactors generates heat that produces steam to run large steam turbines. A typical power reactor has one or two power units of about 1,100 MW each. These plants are suitable for base load power generation in large power grids. Concerns about nuclear safety, long-term management of nuclear wastes, and the potential for proliferation of nuclear weapons limit the use of nuclear power in most of the developing world.

*Note: This table is illustrative. See the U.S. National Renewable Energy Laboratory (NREL) Web site—www.nrel.gov—for detailed information on the full range of renewable energy options.



USAID
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ENERGY AND SMALL AND MEDIUM ENTERPRISE



Kenya ©2001 Tom Furtwangler. Courtesy of Photo: [unclear]

ENERGY AND SMALL AND MEDIUM ENTERPRISE

Small and medium enterprises (SMEs) together make up over 90% of the businesses in the world and account for 50 – 60% of worldwide employment. In developing countries, encouragement of an expanded private sector and the creation of local business opportunities is a crucial aspect of economic and industrial growth and the key to successful poverty alleviation activities. Strategic efforts to support small, sometimes informal, businesses offer many people a way to work toward improving their own livelihoods and building a secure future for their families.

In both urban and rural areas of developing countries, however, SMEs are often constrained by lack of infrastructure, communications, and financial investment resources. Without these services, SMEs cannot function effectively, and their contribution to economic and social development is limited.

Given the significant contribution of SMEs to worldwide job creation and income growth, it is crucial that infrastructure services be targeted to support these enterprises. Access to reliable, affordable energy services is vital for SMEs to operate efficiently and profitably, yet

function efficiently and profitably. Electricity is needed to power tools, appliances, and productive equipment, and modern fuels are needed for heating, food processing, and transportation. In Angola, for example, an assessment of peri-urban areas found that 100% of SMEs invest in energy to support their business activities.

In cities, SMEs need energy to operate shops, restaurants, hotels, small manufacturing operations, and service industry applications. Better access to energy opens up broad opportunities for income-producing activities.

In rural locations, energy is needed to support agriculture, fishing, and aquaculture, which often dominate economic activities in these areas. Modern energy services provide a way for people to move beyond subsistence farming and out of poverty.

Dependable, reasonably priced energy services enable SMEs to strengthen their market position, enhance their product and service base, increase business opportunities, and augment income flows in local and export markets. Energy services contribute to the development and maintenance of SME activities in the following ways:

SMALL AND MEDIUM ENTERPRISES IN THE DEVELOPING WORLD			
Enterprise	Employees	Total Assets (US\$)	Total Annual Sales (US\$)
Micro-Enterprise (informal)	10 or less	\$100,000 or less	\$100,000 or less
Small Enterprise (formal business)	11 to 50	\$100,000 - \$3 million	\$100,000 to \$3 million
Medium Enterprise (formal)	51 to 250	\$3 million - \$15 million	\$3 million - \$15 million

such access does not exist in many countries. Chronic power shortages and poor-quality electricity services exact an enormous toll on economic development and constrain many of the services on which small businesses rely. Recent studies of energy and SMEs in the developing world have revealed that the highest prices for electricity and modern fuels are generally paid by the smallest enterprises. Energy costs run from 10% to more than 65% of the total cost of production for many SMEs.

The Energy-SME Nexus

SMEs require a range of modern energy services to

- **Increasing productivity through mechanization and energy efficiency.** Automated machinery and equipment upgrades for agricultural processing and small industries can transform labor-intensive, low-production enterprises into high value-added operations.
- **Improving food preservation.** Energy for refrigeration and freezing can help preserve agricultural products such as milk and fish for export or retail sales, and energy for drying can be used for improved processing of fruits and meats.

- **Promoting communications.** Telephones, radio, and educational television programs help entrepreneurs keep up-to-date on market conditions. Reports on weather conditions can help farmers determine the optimal time to shear animals, bale hay, or harvest crops.
- **Increasing operating hours.** Lighting allows entrepreneurs to extend their working day and thus increase their income by serving customers in the evening or operating workshops past sundown. Street lighting helps to extend selling hours for street vendors.
- **Improving working conditions.** Modern energy services are cleaner and safer than traditional means of heating/cooling, cooking, and lighting, which benefits both workers and consumers. Eliminating the use of smoky kerosene lamps, crude cooking stoves, and unstable electrical connections (such as in pirated electricity) reduces the incidence of accidents and indoor air pollution.
- **Creating marketplace attractions.** Lights, fans, radios, televisions, and other electrical appliances can draw people to a common location, creating new business opportunities.

Meeting SME Energy Needs

To satisfy SME energy needs, a number of solutions are available. Grid-based electricity, where it exists, is the likely choice. In areas that are not grid-connected, however, SMEs can obtain electricity from smaller-scale, decentralized generators run on diesel fuel, or renewable power sources such as wind, solar, micro-hydro systems, and/or biofuels. Modern petroleum-based fuels and biofuels provide transportation services as well as more efficient heating and food processing than do wood, charcoal, or dung. Technical assistance to SMEs in modernizing their production systems and making them more efficient can significantly reduce the energy inputs required for their operations, making them more profitable and economically competitive.

In addition, demand for improved energy services can provide opportunities for entrepreneurs. In areas unserved by the electric grid, energy supplies can be provided by small-scale, locally owned businesses. This allows for growth of new SMEs and creates an added source of employment in energy service provision and maintenance, agriculture, and business management.

How Is USAID Helping?

USAID works collaboratively with enterprises and host-country policy makers to strengthen the business environment for SMEs by increasing their access to modern energy services. This involves improving policies and legal and regulatory frameworks to promote the conditions necessary for effective energy service delivery and attracting investment capital. USAID also works with private voluntary organizations, local non-governmental organizations, and other development groups to extend much-needed services to underserved clients—especially women, the rural poor, and smallholder farm families.

SECTORS DOMINATED BY SMEs IN THE DEVELOPING WORLD
Agriculture and aquaculture
Business services
Energy industry (equipment, services, energy supply)
Finance
Fishing
Forestry and wood products
Hotels/tourism
Information and communications technology (ICT)
Manufacturing
Public services
Real estate
Transportation
Wholesale/retail businesses



NEW ENERGIES PHOTO

PROMOTING SMALL SCALE RENEWABLE ENERGY ENTERPRISES

ABOVE: Solar water heating at senior citizen housing in South Africa.

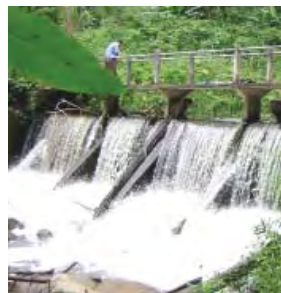
Since April 2000, E+Co has been implementing the Increased Use of Renewable Energy Resources Program (FENERCA), with the support of USAID. FENERCA is working in Brazil, Ghana, Guatemala, El Salvador, Honduras, Nicaragua, Panama, South Africa, Tanzania, and Zambia to ready enterprises for finance, implementation, and growth.

Examples include:

- An enterprise that distributes, sells, and provides maintenance for renewable energy systems—PV, micro-hydro, small-wind, and biomass solutions—in Brazil
- A small company responsible for manufacturing, installing, and maintaining solar water heaters in South Africa
- A firm that produces biomass-efficient stoves in Tanzania

Key results achieved to date include:

- Enterprise development services provided to 80 enterprises
- Forty-one business plans completed
- Nineteen FENERCA-supported enterprises secured over US\$36 million of investment from financial institutions
- More than 25 megawatts of new and clean energy from eight FENERCA-supported enterprises
- Assistance to the Energy Commission of the Honduran Congress in drafting legislation on “Incentives for Renewable Energy projects”
- Completion of one of the largest green certificates transactions involving a Guatemalan hydroelectric company and the largest Dutch utility
- Creation of a new, innovative mezzanine fund to support US\$60 million in investments, The Central American Renewable Energy and Cleaner Production Facility (CAREC)



USAID/CHRIS GREACEN, PALANG THAI

THAILAND— RENEWABLE ENERGY BOOSTS ECONOMY

ABOVE: In Thailand, small community- or entrepreneur-owned renewable energy generators may now connect to the grid and sell excess electricity to utilities

With the aim of reducing oil imports and pollution, and strengthening energy security and competitiveness, Thailand is exploring opportunities for water power, solar, wind, and biomass energy resources. Yet these technologies have faced various market obstacles, including a lack of support for small-scale renewable energy producers, who were not allowed to sell the electricity they generated to the electric utilities due to concerns over safety and compatibility.

With assistance from USAID, a group of volunteers drafted legislation to allow small community enterprises or energy entrepreneurs to connect to the grid and sell their excess electricity to the utilities. The new legislation encourages the development of clean energy resources, while providing essential energy services to entrepreneurs, thus helping to build up the local economies. To date, eight small-scale energy providers have sold power to the grid, while 40 others with a generating capacity of six megawatts received permission to connect to the grid. According to Chris Greacen, Palang Thai, “Our outreach efforts have led to at least three megawatts of additional planned installations in Thailand—enough electricity for 12,000 homes.”

“Supporting the development of small and medium-size enterprises does more than stimulate and diffuse economic growth. It creates a middle class.”

USAID, *Foreign Aid in the National Interest*

ANGOLA—EMPOWERING FARMERS THROUGH ACCESS TO CREDIT

In many rural areas of Angola, decimated or degraded after almost 30 years of war, people are just beginning to resettle and reestablish small farms. The Cooperative League of the U.S.A. (CLUSA), with financing from USAID, supports rural group enterprises to boost production of and revitalize local agricultural markets. One of the key factors in increasing production is access to energy and equipment needed for irrigation.

CLUSA provided loan guarantees to Banco Sol, which in turn provided in-kind credit agreements to small-scale farmers to supply them with water pumps and pipes for irrigation as well as seeds, fertilizers, and pesticides. Groups comprised of over 500 farmers collectively received equipment such as water pumps and pipes for irrigation. After three loan cycles, repayment rates have averaged over 98%. Through this program, Banco Sol can afford to give farmers a 10% annual interest rate—affordable in most cases despite high inflation.

MODERN ENERGY-ENABLED SERVICES AND IMPACTS FOR THE SME SECTOR	
Services	Impacts
Lighting, heating, cooking, cooling, computers, small machinery, radio/TV, clean water, training, market knowledge/access, information, communications, and technologies for small businesses/entrepreneurs.	Expanded and diversified incomes and employment, improved gender equity, reduced urban migration, development of an expanding middle class, and growing national and community incomes.

This document is one of a set of brochures developed by the U.S. Agency for International Development to highlight energy’s critical links to other sector priorities of USAID, its overseas missions, partner countries, and other stakeholders in the development community. The brochure set includes briefs on Energy and:

Gender | Small and Medium Enterprise | Natural Resource Management and the Environment | Health and Education | Economic Growth and Trade | Democracy, Governance, and Conflict Management | Water and Agriculture



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ENERGY, NATURAL RESOURCES MANAGEMENT, AND THE ENVIRONMENT



Philippines ©2000 L.R. Gilbert/David and Lucile Packard Foundation, Courtesy of Photoshare

ENERGY, NATURAL RESOURCES MANAGEMENT, AND THE ENVIRONMENT

The ability of developing countries to reduce poverty, grow sustainably, and maintain opportunities for future generations rests on the prudent management and use of their natural resources. Protection of land, forests, waterways, and wildlife is particularly important due to their contributions to food production, fuels, shelter, medicines, livelihoods, and cultural values. Preserving biodiversity by maintaining a variety of plant and animal species and protected ecosystems provides resilience in the face of environmental changes. As biodiversity is lost, communities become more vulnerable and valuable genetic resources are diminished.

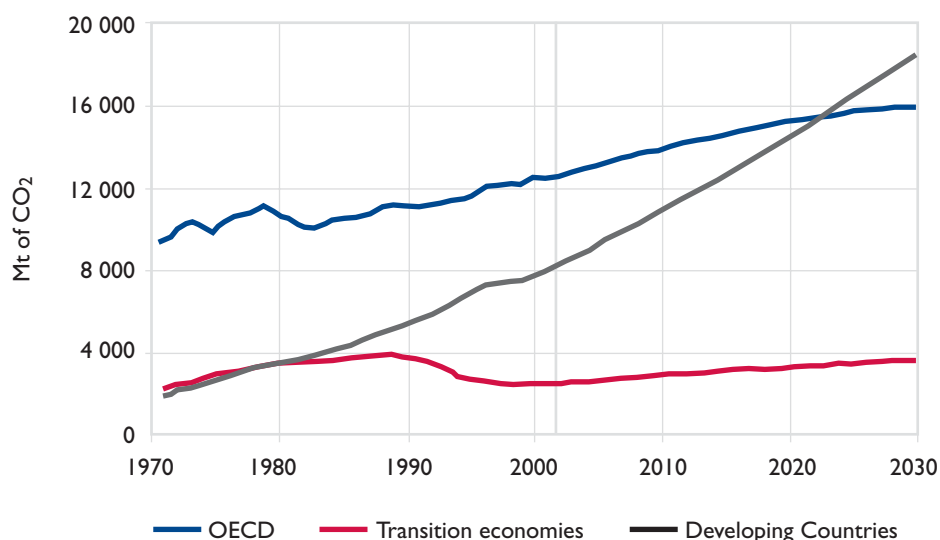
Those living in poverty are typically the hardest hit by degraded ecosystems and loss of biodiversity and forest resources, due to associated declines in clean air

species extinction, and pollution of the environment. Breaking this pattern requires a focus on more efficient resource use and environmental protection.

Energy plays a key role in the management of natural resources and the transition to environmentally sound economic growth. The selection, use, and development of cleaner energy sources has a direct effect on the environment, with related health, economic, and social benefits.

The Energy-Natural Resources Management and Environment Nexus

Much of the focus of the international community regarding natural resources and the environment is on the loss of biodiversity and the use of fossil fuels with their detrimental impact on the environment in terms of



Emissions of carbon dioxide, a major greenhouse gas, are expected to grow by more than 60% over the period 2002 – 2030, with over two-thirds of the increase to come from developing countries; an increase in the share of carbon free fuels can reduce emissions. International Energy Agency, *World Energy Outlook 2004*

and water, higher prevalence of disease, and increased vulnerability to natural disasters. Without alternatives, poor communities tend to overuse or underemploy natural resources that are important for the protection of beneficial goods and services for domestic use and export.

As economies grow, environmental quality tends to decline, with humans at fault for the bulk of environmental problems. Activities such as logging, mining, industrial development, the exploitation of plant and animal resources, and conversion of natural habitats into cultivated land lead to ecological degradation,

air pollution, acid rain, and atmospheric changes related to increased concentrations of greenhouse gases. Other concerns have been raised about land-use impacts when wood is collected for fuel use and charcoal production, and agricultural wastes are burned rather than being left to replenish essential soil nutrients. With improved access to energy services, environmental concerns related to a number of activities can be handled in a sustainable and cost-effective manner.

- **Fuelwood.** In most developing countries, wood fuels are the primary source of energy and a significant contributor to land degradation, with annual harvests

depleting forests at an alarming rate. Sustainable forestry practices and more efficient use of fuelwood through improved technologies can address these issues and turn traditional fuels that are harvested unsustainably into renewable energy resources that contribute to rural development, enhance ecosystem management, advance carbon sequestration, and minimize biodiversity loss.

- **Fossil fuels.** Using fossil fuels allows for significant improvements in living conditions, but comes at a cost to air and water quality, biodiversity, and land. With energy demand, primarily for fossil fuels, expected to grow by 60% over the next 25 years, the implications for the environment are enormous. These include impacts such as poor local air quality from power plant emissions; motor vehicle and industrial facility effluents; acidification of water from the combustion of fossil fuels; oil spills and leaks into soils, and water sources; and climate change. Reducing emissions and other environmental impacts from fossil fuel use requires a portfolio of cleaner, more efficient energy technologies.
- **Large hydropower.** Large-scale hydropower projects are in use throughout the world, providing a
- renewable source of electricity. Constructing dams, however, can result in the displacement of human populations, loss of forest and wildlife habitat, decline in species, and loss of aquatic biodiversity in both upstream and downstream fisheries. To protect natural resources, projects must be designed with attention to the local environment and the well-being of communities. Emphasis is now on developing smaller-scale hydropower projects that have less impact on the environment.
- **Biofuels.** Biofuels, such as ethanol, biodiesel, and biogas, are derived from sugar beets, sunflowers, and other crops and offer a potentially viable ecological alternative to conventional fossil fuels. Biofuel production creates employment opportunities, encourages fuel diversification, and promotes rural development using local resources, even for the poorest countries. However, widespread production of wood and crops for biofuels requires the protection of biodiversity in plant species, especially for breeding fast-growing native fuelwood.
- **Indoor air pollution.** An estimated 2.4 billion people rely on traditional biomass (fuelwood, dung,

EXTENT AND CAUSES OF LAND DEGRADATION GLOBALLY

Type	Current Extent of Damage (millions of hectares)	Causes and Recent Losses
Deforestation	580	<ul style="list-style-type: none"> • Vast reserves of forests have been degraded by large-scale logging and clearing for farm and urban use. • More than 220 million hectares (ha.) of tropical forests were destroyed during 1975-90, mainly for food production.
Overgrazing	680	<ul style="list-style-type: none"> • About 20% of the world's pasture and rangelands have been damaged. • Recent losses have been most severe in Africa and Asia.
Fuelwood Consumption	137	<ul style="list-style-type: none"> • About 1,730 million m³ of fuelwood are harvested annually from forests and plantations. • Fuelwood is the primary source of energy in many developing countries.
Agricultural Mismanagement	550	<ul style="list-style-type: none"> • Water erosion causes soil losses estimated at 25,000 million tons annually. • Soil salinization and waterlogging affect about 40 million ha. of land globally.
Industry and Urbanization	19.5	<ul style="list-style-type: none"> • Urban growth, road construction, mining, and industry are major contributors to land degradation. • Valuable agricultural land is often lost.

Source: United Nations Environmental Programme (2003), *Global Environment Outlook 3*

charcoal, and crop residues) for cooking and heating, which release toxic gases and particulates into the air and contribute to indoor and outdoor air pollution. With the expanded use of clean, cost-effective energy technologies and practices, it is possible to provide energy services that have less impact on the local environment. Less-polluting energy alternatives for cooking and heating include liquefied petroleum gas (LPG); solar cookers; biofuels produced from wood, crops, and agricultural residues; and more efficient stoves and chimneys.

Meeting growing energy needs in a way that balances the interests of people, plants, animals, and the environment is essential. Improvements in energy and fuel efficiency; switching from coal and oil to gas; greater use of nonpolluting renewable energy resources;

and enhanced efficiency in commercial, industrial, and transport sectors can help address many environmental concerns.

How Is USAID Helping?

USAID's programs in natural resources management are closely linked with programs to improve access to energy services, while at the same time protecting the environment and promoting sustainable development. The diversity of natural resource assets that are essential to the livelihoods of the poor can be better protected when improved energy services are available. Moreover, the sustainable production and use of energy is a key factor in forestry, land management, protection of biodiversity, water resources conservation, and emission reduction measures.

“Environmental degradation is an increasing threat to long-term development with severe effects on health, trade, and poverty reduction efforts in general. It is in our interest to ensure that policies and institutions actually support sustainable development.”

Andrew S. Natsios, Administrator, USAID



US CONSULATE CALCUTTA

INDIA—CLEANER AIR FOR 400,000 RESIDENTS

For years, 400,000 residents breathed air highly polluted by emissions from the 50-year-old, coal-fired power plant operated by Calcutta Electric Supply Corporation (CESC)—the largest private thermal power company in eastern India. The plant relied on old technology that emitted significantly more particulates than India's regulatory standard. The effects of such air pollution can be devastating, leading to fatal respiratory diseases and heart problems.

With USAID support, the power plant installed new air pollution system controls for all eight of its coal-fired boilers. The technology reduces emissions at the plant and improves the efficiency of the equipment. Meanwhile, people living in the area are breathing cleaner air and suffering fewer respiratory ailments.

INDIA—USING ENERGY TO IMPROVE RESOURCE MANAGEMENT, INCREASE INCOME, AND PROTECT THE ENVIRONMENT



NATIONAL PARKS BOARD, SINGAPORE

In India, USAID supports a project that helps communities use the seeds from a common tree to generate electricity as a way to improve natural resources management, generate income, and minimize emissions that contribute to climate change.

In this project, which is co-funded by USAID's Mission in India and USAID's Bureau for Economic Growth, Agriculture and Trade, indigenous people in the Indian state of Andhra Pradesh are using oil extracted from the seeds of a local tree to produce biofuels. The tree, *Pongamia pinnata* (or Indian beech), is found in abundance in South Asian forests. The oil is extracted from the seeds and used to power irrigation pumps and other household and agricultural equipment. The program also strives to ensure social equity, gender balance, and empowerment of disadvantaged populations. The activity is being implemented in partnership with the International Crop Research Institute for the Semi-Arid Tropics and a local NGO.

GHANA—REDUCING PRESSURE ON FOREST RESOURCES



EnterpriseWorks/VITA

To help reduce pressure on forest resources, USAID/ Ghana promotes the use of energy-saving stoves that require less charcoal. In 2004, the energy-saving program of USAID partner Enterprise Works reported that 37 metal workers produced and sold about 30,900 stoves, exceeding the original target of 10,000 stoves. An estimated 86% of the stoves are reportedly used as the primary means of cooking. Based on these results, this project avoided the deforestation of an estimated 1,000 hectares of forest and prevented the release of more than 7,680 tons of carbon dioxide into the air.

ABOVE: Top, USAID assistance reduced emissions at CESC plant. Bottom, leaves of the Indian beech tree. Right, energy saving stove retailers in Accra.

MODERN ENERGY-ENABLED SERVICES AND IMPACTS FOR NATURAL RESOURCES MANAGEMENT AND ENVIRONMENT	
Services	Impacts
Improved cook-stoves, cleaner fuels (including LPG and biofuels), traditional fuel resource management (woodlots), water pumping, sustainable production of charcoal from managed forests, and more efficient and cleaner electric power production.	Improved land use, conservation, and protected area management; reduced emissions; climate change mitigation (local/global); watershed protection; erosion reduction; improved soil fertility; improved agricultural methods and irrigation development; and higher rural incomes.

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ENERGY AND GENDER

ENERGY AND GENDER



India ©2002 Katie Richey Courtesy of Photoshare

Women account for roughly half of the world's population and have a key part to play in all aspects of development, including energy. Over the past decade substantial progress has been made with regard to women's rights, roles, and capabilities, and women are emerging as a stronger force in all aspects of political, social, and economic advancement. Women's health, education, economic opportunity, and human rights are at the core of successful, stable societies and economic growth.

Despite progress to date, much more needs to be done, particularly in developing countries, to bring women on a par with men. Gender-based obstacles in many parts of the world limit the effectiveness of poverty alleviation and economic growth initiatives. A majority of the 1.3 billion people living in poverty are women, and their ability to enhance wealth and social status is often hampered by legal and social structures that restrict their rights to own land, enter into contracts, receive education, find employment, or engage in business.

When women do participate in farming or entrepreneurial endeavors, they may not be permitted to own or lease property or borrow money without a man's signature or permission. It may also be difficult for women to receive training and extension services or acquire necessary equipment, supplies, and natural resources.

The biases begin early. In many developing countries, girls are more likely to be kept home from school to share the daily burden of domestic chores, because their education is considered of less importance than that of boys.

The Energy-Gender Nexus

Energy is essential in expanding economic and social opportunities for women. Looking carefully at the energy priorities of both women and men, and understanding the constraints that particularly affect women, helps ensure that the needs of families are better met, and earning potential is improved. Because women are household energy managers, energy users and suppliers, and budding energy-consuming entrepreneurs, including them in energy sector decisions that affect them can help ensure more effective use of resources and satisfied customers.

Some of the important ways that providing modern energy services can empower women include:

Poverty Relief and Economic Development

Because of traditional gender-based divisions of labor, women typically have fewer opportunities to seek employment outside the home. However, in both urban and rural communities, many women supplement family

ENERGY FORM	WOMEN'S NEEDS		
	Practical	Productive	Strategic
Electricity	<ul style="list-style-type: none">• Pumped water supplies reduce the need to haul and carry• Mills for grinding• Lighting to improve working conditions	<ul style="list-style-type: none">• Greater possibility to increase activities during evening hours• Refrigeration for food production and sale• Power for commercial enterprises	<ul style="list-style-type: none">• Make streets safer; allowing participation in other activities (e.g., evening classes and women's group meetings)• Improve health and increase income• Open horizons through radio, TV, and Internet
Improved biomass (supply and conversion technology)	<ul style="list-style-type: none">• Improved health through better stoves• Less time and effort spent in gathering and carrying firewood	<ul style="list-style-type: none">• More time for productive/ social /educational activities• Lower cost for process heat for income-generating activities	<ul style="list-style-type: none">• Control of natural forests in community forestry management frameworks• Children able to attend school, improve lives/livelihoods
Mechanical	<ul style="list-style-type: none">• Milling and grinding• Transport of water and crops	<ul style="list-style-type: none">• Increased variety of enterprises	<ul style="list-style-type: none">• Transport to facilitate access to commercial and social/political opportunities

Source: Adapted from Clancy, Skutsch, and Batchelor (2003) *The Gender – Energy – Poverty Nexus*

incomes by engaging in small-scale businesses that fit with, and are often extensions of, their household activities. Consequently, improved electrical services and better fuels not only lighten the burdens of women's daily chores, but also open up new opportunities

mechanized or motorized equipment for planting, watering, fertilizing, harvesting, storing, or processing their crops. This limits productivity, income, and the family's nutritional intake. Men engaged in commercial farming tend to control any available modern equipment.

“We must ensure that women acquire the political and economic access to become full participants in society. I’m inspired by the words of Farahnaz Nazir, founder of the Afghanistan Women’s Association. She said, ‘Society is like a bird. It has two wings. And a bird cannot fly if one wing is broken.’”

Laura Bush, First Lady, United States of America Remarks at the World Economic Forum, May 2005

to start or expand small-scale enterprises, thereby promoting economic independence and empowerment. Electricity enables women to increase their activities and information sources by supporting radios, TVs, phones, computers, and small enterprises such as sewing centers and grinding mills.

Water

Women are generally responsible for securing water for the household. When there is no indoor running water, women and girls go to wells, springs, rivers, and streams to fill water containers and carry them home, often over difficult terrain for many miles. Energy for water pumps from potable sources can ease this time burden for other activities and improve family health, sanitation, and hygiene.

Education

Girls are regularly kept home from school to help their mothers complete domestic chores. With electricity and modern fuels that reduce the time and effort required for household maintenance activities, girls are free to go to school, and women have time and opportunity for adult education and other activities.

Agriculture

In places where women are responsible for growing food for their families, they generally do not have

Women, too, benefit from access to irrigation pumps, transport systems, and modern processing equipment.

Natural Resources Management

Women in rural areas use plants, forests, lakes, rivers, and other natural resources to provide food, fuel, water, and medicine for their families. As a result, women are particularly vulnerable when ecological systems are damaged or destroyed. They also hold proprietary access to traditional practices that can be helpful in sustainably managing forests, agricultural land, and other sources of energy.

Health

- Lack of modern energy services has a disproportionate effect on women, whose traditional functions include supplying the household with fuel. In many rural areas women and children, primarily girls, spend long hours and suffer physical problems from gathering wood and agricultural wastes and carrying heavy loads over long and unsafe distances. Improved access to modern fuels, electricity, and transportation systems helps relieve women and their families from the time demands and physical exertion of collecting fuel for cooking, heating, and other household and income-generating uses.
- Most respiratory diseases and related problems (including acute eye infections) in women and children

in developing countries result from cooking over smoky indoor fires with poor ventilation. Even in cities and suburbs, wood or charcoal is often the primary fuel used for cooking and heating. Introduction of cleaner fuels, more efficient stoves, improved ventilation, and alternative energy sources has been shown to have positive impact on the health and well-being of women, small children, and other family members most frequently found at home near an open fire.

The types of energy sources and technologies used are generally less important than the types of services that they support. The need for cleaner cooking and heating fuels can be met in a number of ways, through better distribution systems for natural gas or liquefied petroleum gas (LPG), innovative biogas or biofuel systems, solar cookers, or improved stove designs with better ventilation. Water pumps can be hooked up to

electricity supplies or run directly by wind, hydro or solar power. Electricity can be supplied using grid-connected or stand-alone renewable energy technologies based on wind, water, solar power, and biofuels, or diesel generators.

How Is USAID Helping?

USAID recognizes that promoting a stronger and more productive role for women in development demands a broad and flexible approach designed to take both women's and men's participation into account. At USAID, the Women in Development program provides leadership on integrating gender considerations throughout all of the agency's key sectors. Increasing access to energy services is an important way of reducing gender-based constraints to economic growth, such as women's limited education and income-generating opportunities.

Indoor air pollution, caused in large part by traditional cooking practices, kills nearly 2 million women and children each year.

AHMEDABAD, INDIA—ACCESS TO ELECTRICITY BENEFITS POOR NEIGHBORHOODS

Very few families in India's poorest neighborhoods receive electricity. This has meant that women spend their daylight hours on menial chores that could be eased greatly with dependable access to power.

With the Ahmedabad Electric Company and local organizations, USAID helped plan a system to provide safe and reliable electrical service for 1.2 million people. After the program's initial success in providing high-quality, reliable service, the local utility expanded the program to another 30,000 households and aims to reach 200,000 more impoverished customers by 2007.

Reliable service means that family members, including women, can work or study in the evenings and use sewing machines and other appliances to increase productivity and earning potential.



USAID/Virginia Foley

ABOVE: Households in Ahmedabad's poorest neighborhoods now pay less for a more dependable electricity supply.

RWANDA—WOMEN EMPOWERED THROUGH BIOMASS ENERGY PRODUCTION

Ninety-eight percent of the Rwandan people use charcoal and/or wood fuel for cooking. Women in the community of SAM Muhima have received USAID support to produce high quality biomass briquettes from household garbage, which are used as cooking fuel and organic fertilizer. Their use has helped to reduce deforestation in the area and return soil nutrients to degraded land. The project has created new employment opportunities for women in the community, improved local health by disposing of household waste, and reduced costs of waste management.



M. Kithome/ARD

ABOVE: Rwandan women's group collects household garbage for conversion to organic fertilizer and biomass fuel briquettes.

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USAID
FROM THE AMERICAN PEOPLE

ENERGY, HEALTH, AND EDUCATION

ENERGY, HEALTH, AND EDUCATION



Kenya ©2003 RUINET, Courtesy of Photoshare

Energy services are essential for effective health and education systems throughout the world. Hospitals and schools cannot operate effectively without power for lights, equipment, running water, and communications.

ENERGY AND HEALTH

Safe, affordable, and effective health care is a priority for everyone. Despite significant progress in improving the health of people in the developing world, challenges remain.

- Millions of people, many in sub-Saharan Africa and South Asia, live in unsanitary conditions and do not have access to proper health services, leading to the spread of preventable diseases.
- More than 500,000 women die each year from causes related to pregnancy and childbirth.
- Over ten million children under the age of five die each year; four million of them in their first month of life.
- Malaria, tuberculosis, and other infectious diseases are still very common in many developing countries.
- The number of adults and children infected with HIV/ AIDS is increasing rapidly.
- Annually, nearly two million people, mainly women and children, die from illnesses linked to indoor air pollution—including pneumonia, respiratory illnesses, lung diseases, and cancer—caused by smoke from home cooking fires.

Better detection, response, and public information capabilities, as well as more accessible prevention and treatment programs, can help save millions of lives. With improved nutrition, enhanced health care during pregnancy and delivery, and access to currently available technologies and medicines, the majority of maternal and newborn deaths are preventable. In addition, the impacts of childhood diseases can be reduced through immunizations, vaccinations, and prevention or prompt treatment of pneumonia and diarrhea. Changes in cooking and heating methods and improvements in basic infrastructure to provide clean water could eliminate many of the health threats that are common in developing countries.

Energy has an important and compelling role to play in addressing health challenges and improving people’s lives.

The Energy-Health Nexus

Health issues should not be viewed in isolation but approached in an integrated way; energy inputs have much impact on establishing effective health care systems and maintaining healthy living conditions.

- Pumped water from clean sources, and/or energy for purifying water; reduces the spread of water-borne diseases. Some of the leading causes of child mortality can be eliminated with wider access to clean water.
- With improved access to energy services, health clinics can power lights, water pumps, fans, refrigerators for drugs and vaccines, sterilizers, and other medical instruments. Energy also powers

MODERN ENERGY-ENABLED SERVICES AND IMPACTS FOR HEALTH	
Services	Impacts
Incubation facilities for infants; refrigeration for vaccines, medicines, and blood banks; laboratory and diagnostic equipment, and equipment sterilization; indoor lighting for examination, surgery, reading, and ambient light, and outdoor lighting for security; clean water supply and water pumping/purification; pressurized water distribution; water heating; space cooling; cooking and improved cookstoves; transport; waste management; and powering of computers, radios, TV, single side-band radios, and rechargeable flashlights.	Reduced child and adult mortality and morbidity; improved newborn and maternal health; reliable access to clean/safe drinking water; enhanced communications (especially for emergencies); technologies and education for health data and information; combating HIV/AIDS, malaria, and other diseases; improved life expectancy; improved health service delivery (lab services and end uses); evening health training for local communities; reduced waste and environmental pollution; reduced indoor air pollution; improved nutrition; night birthing and safety; lower respiratory disease and macular degeneration; and cleaner living conditions at home. Health staff attraction and retention, motivation, and training.

computers to access medical information and data and to store and retrieve records. Energy services allow more effective community education about health care.

- Cleaner cooking fuels and improved stoves enhance indoor air quality, reducing respiratory illnesses in women and children.
- Providing energy-efficient systems and practices helps hospitals reduce energy expenditures allowing more investment in other critical supplies.
- Energy services enhance amenities for health care staff who are accustomed to basic access to energy services.

Many development activities seek to reduce indoor air pollution. These include projects that introduce new technologies such as solar cookers; better-contained and ventilated stove designs; and cleaner burning fuels like liquefied petroleum gas (LPG), natural gas, or biofuels produced from locally available wood, agricultural wastes, and livestock manure. In places where connection to the electrical grid is not feasible, micro-hydro turbines, wind or solar power, or biofuel systems can supply electricity and pump clean water; contributing to improved health conditions. In addition, in urban areas, the introduction of unleaded gasoline and emissions controls on cars, factories, and power plants can significantly reduce unhealthy living conditions and lower mortality rates.

How Is USAID Helping?

USAID's commitment to improving global health includes confronting global health challenges through improving the quality, availability, and use of essential health services, including enhanced energy services. USAID's activities have improved the health and quality of life of millions of people worldwide through investments in child, maternal, and reproductive health and reducing disease, especially HIV/AIDS, malaria, and tuberculosis.

ENERGY AND EDUCATION

The right to education is fundamental. Education is the primary vehicle by which economically and socially marginalized adults and children can lift themselves out of poverty and obtain the means to participate fully in their communities. The priority is to ensure that

educational opportunities are available for the millions of children who are deprived of primary school education.

In the development context, education and literacy are associated with improved health, child survival, improvements in the status of women, and better economic prospects for future generations. Public investments in the education sector have been instrumental in relieving poverty, creating competitive economies, promoting public participation in political affairs, and advancing self-reliance and empowerment.

Although education levels in developing countries are rising, there are still more than 100 million children of primary school age not in school. More than half of them live in India, Bangladesh, Pakistan, Nigeria, and Ethiopia. Providing primary school education for these children requires building safe, sanitary, and accessible schools; equipping and maintaining them; hiring and training teachers; and acquiring school books, supplies, and materials.

The Energy-Education Nexus

Because literacy and education are such key factors for achieving progress in economic and social development, it is extremely important for schools to have reliable electric power, basic heating, and water, and sanitation systems. In fact, schools often serve as general community centers and may supply drinking water, hot lunches, communications facilities, and civic meeting spaces. Energy in homes is important to education as well, because it enables people to have more time for pursuits beyond basic subsistence activities. The role for energy in education includes:

- **Lighting and equipment.** Lighting and educational equipment in schools and homes create conditions that make it possible to attract teachers, retain students, conduct proper classes, expand time available for reading and studying, and provide access to computers and other sources of information. Providing lights at night can furnish opportunities for adult and higher education programs and community activities. Electricity also enables teachers to use audiovisual equipment (televisions, VCRs, computers) that improves their ability to present a variety of subjects in a more appealing and informative manner. Outdoor lighting makes schools more accessible and safer at night.

- **Communications.** Power for phones, computers, televisions, radios, and other communication equipment provides more reliable and extensive access to information and opens up the possibility for distance education.
- **Food preparation.** In many locations, snacks and meals served at the school may be a student's main source of nutrition. As 95% of all staples need to be cooked, energy is a key component in providing this service. Meeting cooking energy needs through improved cookstoves or conventional sources—electricity, kerosene, bottled gas, etc.—facilitates food preparation. Refrigeration of food products and medical supplies also requires electricity, as does powering kitchen appliances.
- **Heating and cooling.** Energy is needed for space heating applications in cool climates, for water heating and washing, and to power fans.
- **Reducing women's household burdens.** Introducing electricity and modern fuels that cut down on the time and effort required for household maintenance activities improves the likelihood that girls will be allowed to go to school, and that women will have time and opportunities for adult education.

In urban areas, schools and homes in informal settlements need to be connected to electrical grids, and measures should be taken to increase the efficiency of energy use and distribution. In rural areas beyond the reach of electrical grids, decentralized sources of energy (including diesel, LP gas, solar, wind, micro-hydro, biofuels, and combinations of these technologies) can be used for generating the electricity needed for schools and rural households and for meeting cooking and heating needs.

How Is USAID Helping?

Because literacy and mathematics are fundamental requirements for social and economic activity, USAID emphasizes programs that support basic education, with special emphasis on improving opportunities for girls, women, and other underserved and disadvantaged individuals. Teacher training is an important element of this work. In addition, USAID supports a wide variety of workforce development and higher education programs and provides short-term training opportunities to hundreds of thousands of individuals in developing and transition countries each year.

“Healthy and educated citizens are the agents of development.”

**President George W. Bush, United States of America
Remarks at the Inter-American Development Bank, March 2002**

SOLAR ENERGY FOR HEALTH CLINICS AND COMMUNITY FACILITIES IN AFRICA



SOLAR LIGHT FOR AFRICA

ABOVE: Solar Light for Africa team members assemble solar panels.

With support from USAID, Solar Light for Africa (SLA) has helped bring electricity to hospitals using solar photovoltaic (PV) panels. The solar panels provide a clean energy source, eliminating the toxic fumes and safety dangers of kerosene lanterns. In 2004, SLA installed close to 100 PV systems at rural health clinics, community centers, churches, and schools throughout Uganda and Tanzania.

At Kakuuto Hospital in Uganda, solar-powered pumps, in addition to electrical power, provided pure water. A local youth volunteer recounted one experience noting, “Had it not been for this solar installation at the birthing center, the midwife would have delivered the baby utilizing the meager light of one kerosene lantern that produces noxious black fumes. Instead, the baby’s first breath was of pure air.”

ARMENIA—IMPROVING SCHOOL HEATING SYSTEMS BOOSTS SCHOOL ATTENDANCE

For many years, Armenian schools lacked the funds to maintain their heating systems, and as a result, many schools were closed during cold periods. USAID funded an energy efficiency demonstration project at Pushkin School #8 in Yerevan, Armenia, to enable the school to stay open all winter. The school’s internal and external heating systems were rehabilitated so that heat is now supplied from a new on-site boiler house, equipped with two high-efficiency, gas-fired boilers. A new natural gas line connects the school boiler house to the city gas supply, allowing teachers to regulate temperatures in each classroom and optimize overall gas consumption.

One of the largest schools in Armenia, Pushkin School #8 has nearly 1,800 students who now attend school year-round. They study in warm, comfortable classrooms and enjoy other activities such as indoor athletics, drama, and band practice during winter. Marietta Matkhashyan, school principal, said, “This is the first winter that our children study in normal conditions. It is a wonderful Christmas gift for us all.” Twenty other schools in Armenia also receive assistance to rehabilitate their school heating systems.

MODERN ENERGY-ENABLED SERVICES AND IMPACTS FOR EDUCATION

Services	Impacts
Electricity for lighting, computers, radio/TV, and telecommunications; thermal energy for cooking (students and staff); water pumping/purification; and energy-efficient lighting and appliances. Electricity and modern fuel services for both schools and for teachers' and students' housing.	Poverty reduction; income generation; improved quality of education and improved grades; enhanced school enrollment/retention rates; improved ability to attract and retain teachers and staff; improved sanitation; gender balance/equity; and facilities for evening classes and adult education.

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FROM THE AMERICAN PEOPLE

ENERGY, ECONOMIC GROWTH, AND TRADE

ENERGY, ECONOMIC GROWTH, AND TRADE



Bolivia ©Lutheran World Relief, Courtesy of Photoshare

Economic growth is critical in reducing poverty, increasing self-sufficiency, and achieving prosperity. Trade and investment accelerate growth, stimulating income and wealth generation.

Virtually all economic activity is dependent on energy, whether in urban, peri-urban, or rural areas. At the World Summit for Sustainable Development (WSSD) held in Johannesburg, South Africa, in 2002, leaders from around the world highlighted the critical role of energy in reducing poverty and enhancing sustainable development.

Electricity and modern fuels are integral to economic development and trade and underpin agriculture, industry, transportation, and commercial enterprises in all countries. Though energy is not sufficient on its own to achieve economic growth, it is a necessary prerequisite. Populations that lack access to energy services cannot create the conditions needed to lift themselves out of poverty.

The Energy-Economic Growth and Trade Nexus

Energy advances economic growth and trade activities via:

- **Industrialization.** As developing nations industrialize and move toward modern commerce, there is an urgent need for high-quality electricity and fuel services. The largest developing nations—China, India, Brazil, Mexico, and South Africa—have strong industrial and commercial sectors and corresponding high energy demand similar to those of developed nations.
- **Agricultural markets and trade.** For many developing countries, agriculture continues to be the dominant sector for employment and one with significant potential for growth as countries enter the global marketplace. Energy is key to expanding

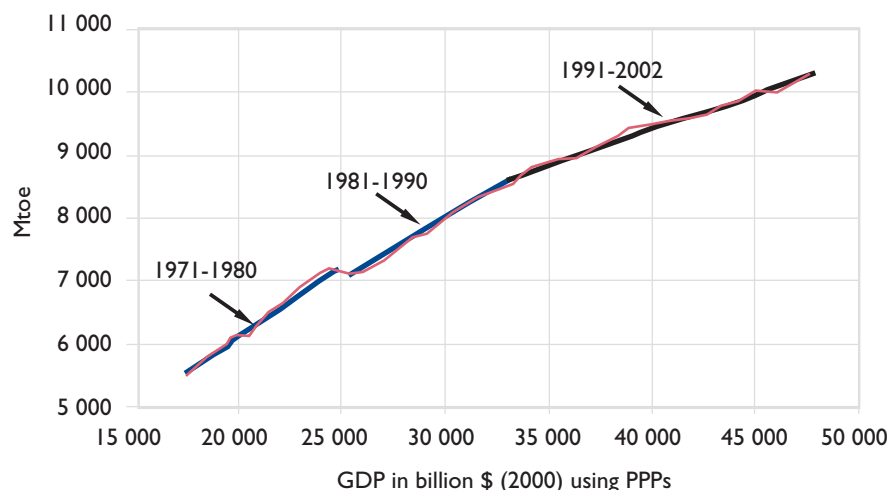
agricultural markets and trade by contributing to increased and diversified crop production, powering the chain of farm – to – shelf production, and transporting products to market.

- **E-commerce.** Electronic commerce and information and communication technologies (ICT) are often essential tools for economic development. E-commerce permits local businesses to access domestic and international markets and reduce transaction costs, thus facilitating trade. ICT provides valuable information for industry and agriculture, enabling businesses to make informed decisions about when and where to sell their products, and to design and adapt products to better suit customer needs. As large domestic and multinational companies begin to require their business partners to communicate via electronic means, enterprises in developing countries need to be able to respond or they will be at a competitive disadvantage. For e-commerce and ICTs to operate, reliable supplies of electricity are a necessity.
- **Increased productivity.** Used efficiently and effectively, energy services can enhance productivity, increase output, boost competitiveness, and strengthen local economies. Electricity can transform businesses from manual labor to mechanization and automation, stimulate uniform production, and improve quality, thus allowing for higher prices for goods and services. Consistent products also help to establish a more reliable clientele base.
- **Small, medium, and micro-enterprises (SMEs).** SMEs rely on energy services for a range of needs, including lighting, refrigeration, cooking, radios, phones, tools, grain mills, water pumping, and drying for food preservation. Access to energy is crucial to the establishment and growth of SMEs, particularly in rural and peri-urban areas where they can be a main source of employment for the poor.

“The bottom line is that you cannot attack poverty, improve food security, and build economic opportunity in poor countries without energy. You cannot have economic growth without energy, including in the rural areas. I go to the rural areas of the world all the time. I ask, ‘What do you want here? What would change your life in this village more than anything else?’ And they say, ‘We need energy to light our homes and classrooms, to pump water, to make bread, to power our small workshops, to listen to radios, to learn on computers and gain access to the Internet, to refrigerate vaccines in our hospitals...”

Andrew Natsios, USAID Administrator

World Primary Energy Demand and GDP, 1971-2002.



Economic growth is the primary driver of energy demand. Energy contributed significantly to economic growth in all countries studied in the World Energy Outlook 2004 report and was a leading driver of growth in many. Demand for electricity and transport fuels is closely aligned with gross domestic product (GDP), and they increase in a broadly linear fashion. Source: International Energy Agency, *World Energy Outlook 2004* (PPPs=Purchasing Power Parities)

- **Job creation and income generation.** Economic growth that creates jobs and enhances incomes relies on expanded use of energy. Electricity can extend the working day and increase production, improve safety and working conditions, and draw customers.

Energy Quality, Reliability, and Energy Efficiency

Simply ensuring that electricity is available for industry and commerce is not sufficient. If electricity is not highly reliable and of sufficient quality, the costs to industry of power outages and the need for investment in backup systems can be substantial and limit economic growth. In Eastern Europe and Central Asia, the existing, extensive energy infrastructure is deteriorating rapidly. In these regions, the primary challenge is not to expand access but to minimize the loss of existing supplies and improve dramatically the quality, reliability, efficiency, and affordability of the existing infrastructure.

Studies show the impact of power outages on economic productivity is substantial. In China, textile and electronic companies lose, on average, 1% of their output to power outages. Their Indian counterparts lose approximately 9.5%. In Nepal the overall economic impact of planned and unplanned outages in the utility supply translates into almost 4.5% of the industrial sector GDP or 0.5% of the national GDP in 2000 – 01. This underscores the importance of improvement in electricity supply reliability as a major factor in enhancing economic growth.

Finally, rising oil prices, which have more than doubled over the last two years from US\$25 per barrel to US\$67

per barrel (as of August 2005), have highlighted the need to focus on energy efficiency worldwide. Inefficient use of energy wastes both financial and natural resources. High oil prices, coupled with low efficiency in productivity per input of energy, limit the extent to which a developing country can engage in profitable international trade. Improved energy management by industry can lower production and operating costs and make products and services more competitive internationally.

Powering Economic Growth and Trade in Urban and Rural Areas

Around the world, people are moving from rural areas to cities and towns in the search for better jobs and financial stability. In 2000, about 2.85 billion people—nearly half of the global population—lived in urban areas. This figure is expected to swell to about two-thirds of the population by 2025, with the most rapid changes occurring in the developing world, where urban populations are growing at about 3.5% per year.

This population shift places additional pressure on already strained infrastructure, institutions, and natural resources in the urban areas. From the energy perspective, two key issues have emerged in urban areas—access and the environment. As urbanization continues to outpace energy service supply, meeting the demand of poor communities becomes increasingly difficult. Today, an estimated 25 – 50% of urban residents in developing countries live in slums and squatter settlements. Finding ways to provide access to affordable

energy services as well as opportunities for jobs, income, and economic development is essential.

It is critical that economic growth not occur at the expense of the environment. The World Health Organization reports that air pollution in cities has reached crisis proportions, with only 15% of the largest cities in developing countries reporting acceptable air quality. With the primary source of air pollution being fossil fuels used in vehicles, industries, and businesses, it is imperative to find other ways to meet these growing energy needs while reducing air pollution and climate impacts. Cleaner energy sources, including natural gas and renewable energy (biomass, geothermal, hydropower, solar, and wind), in combination with increased energy efficiency, must be an integral part of the solution.

In rural areas, access to reliable and affordable electricity and non-electric energy services significantly broadens opportunities for the development of many economically productive activities, including agro-enterprises and fishing. Providing energy for agricultural production and processing, often the largest source

of employment in rural areas, is an important way to grow beyond subsistence farming and out of poverty. Development of non-farm, income-generating activities is also an important element of building wealth in rural areas, and the availability of modern energy services is one essential ingredient in the operation of these businesses.

How Is USAID Helping?

USAID's energy programs seek to increase energy access and affordability in both urban and rural areas and promote more efficient use of clean energy, thereby enhancing economic growth and trade in USAID's partner countries. USAID works in concert with governments, the private sector, and non-governmental organizations in developing countries to inform policy, increase investment, and raise public awareness on the linkages of energy to economic growth, development, and trade. USAID energy programs also work in collaboration with other programs and sectors that support economic growth, including agriculture, industry, transport, and SMEs.

SOMALIA—ENERGIZING ECONOMIC GROWTH AND TRADE



USAID/ Jim Shanor, ADRA

LEFT: USAID helped Shariif and other energy providers in Somalia form an electricity cooperative.

Shariif Butaan is an enterprising man. A diesel mechanic in Berbera, Somalia, he used a reconditioned generator to supply electricity to his home and to his neighbors, whom he charged by the bulb. He became managing director of the Berbera Electrical Enterprise, which supplies almost all of the electricity for this port city, and head of the Berbera Fishing Cooperative. He owns commercial carpentry and mechanical workshops and is chairman of an umbrella group of all private electricity companies in Hargeisa. But he has not always been so affluent or influential.

Shariif was raised with little formal education, and after Somalia's civil war ended, he became frustrated with the limited sources of available power. He eventually came into contact with USAID, which is supporting an economic diversification project that promotes alternative and renewable energy technologies.

USAID helped Shariif engage other energy providers in the area to form an electricity cooperative. The providers invested in wind generators to supplement the patchwork system, and they now fulfill much of the area's electricity needs. To complement this system, Shariif is working to raise the standards for safety and efficiency in electric wiring across northern Somalia. Shariif also spearheads a USAID training program in solar cookery, a method that uses substantially less charcoal than traditional cooking techniques and, therefore, conserves scarce trees. The program uses a standard model of a solar cooker that Shariif himself improved.

Converting Shariif Butaan from a conventional energy magnate to a proponent of renewable energy has been one of the project's greatest achievements. While Somalis have creatively devised formal and informal economic systems to adapt to their state's collapse, the country remains extremely poor and

underdeveloped. Respected entrepreneurs like Shariif must be encouraged to take on active leadership roles if meaningful rehabilitation and development is to occur.

HONDURAS—ENHANCING ECONOMIC GROWTH AND TRADE WITH HYDROPOWER



USAID

LEFT: La Esperanza hydroelectric power plant.

In Honduras, USAID is advancing economic growth through supporting the developer of the La Esperanza Hydroelectric Plant, Consorcio Inversiones, S.A. (CISA). USAID provided business planning assistance and a US\$250,000 construction loan during the early stages of the project, enabling CISA to secure approximately US\$9 million in financing from a private Honduran bank, BGA, and the Central American Bank of Economic Integration (CABEI). La Esperanza began operation in June 2003 and is expected to reach full capacity in 2005. With three powerhouses located along the Intibuca River, La Esperanza sells electricity to the state-owned Honduran utility, ENEE, supplying much needed energy during peak hours when the country demands additional electricity, supplied for the most part from expensive, imported fossil fuels.

As a result of the project, CISA was instrumental in planting more than 18 hectares of new forests. The project provides direct employment to 40 local people and indirect jobs and economic activity for an additional 120 people. It is estimated that 45,000 tons of greenhouse gases will be displaced annually by avoiding the use of fossil fuels to produce electricity. As Ron Turner, president of CISA notes, "We have had good support from the central and local governments. In La Esperanza and surrounding communities, we have a strong labor pool and active business support. This positive development climate, plus USAID support, should make it possible to construct a number of similar projects in Honduras."

MODERN ENERGY-ENABLED SERVICES AND IMPACTS FOR ECONOMIC GROWTH AND TRADE	
Services	Impacts
High-quality reliable electricity, modern fuels, and thermal energy services for mining, manufacturing, and industrial processes; agricultural production, processing, packaging, and shipping; commercial enterprises (especially lighting, computers, office equipment); construction of infrastructure (e.g., roads, power plants and transmission systems, buildings); and information and communications systems.	Expanded and diversified industrial, commercial, and agricultural output; and improved infrastructures for water, telecommunications, transport, and trade. Increased GDP per capita.

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ENERGY, DEMOCRACY, GOVERNANCE, AND CONFLICT MANAGEMENT



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ENERGY, DEMOCRACY, GOVERNANCE, AND CONFLICT MANAGEMENT

Democracy, Good Governance, and Development

Good democratic governance is an indispensable means to sustainable development as well as an end in itself. Most observers and policy makers believe that development depends on good governance. Experience shows that democracy is the most certain, most reliable path to good governance. Conversely, poor governance has systematically undermined many of the policy prescriptions and programs designed for development.

Democracy provides the regular opportunity for the public to assert its views through voting rights and fair elections. Democracy institutionalizes a regime's accountability to its citizens. Democratic good governance also provides the structures, procedures, and attitudes that hold all citizens and institutions accountable to the rule of law and to various institutions within the state.

Democracy, Governance, and the Energy Sector

Improved governance in the energy sector has been shown to enhance the ability of developing countries to attract foreign direct investment and stimulate broad economic development with benefits for everyone. In general, good governance refers to how decisions are made, implemented, and enforced within a sector as well as how disputes are resolved. Good governance means more participation, coupled with the principles of accountability, transparency, and rule of law. Depending on the issues to be addressed, participation can include a range of players: civil society organizations, the private sector, parliamentarians, state and local authorities, scientific associations, educational institutions, and many others—groups not traditionally consulted by state-owned utilities.

Energy Sector Reform and Democratic Governance

Reform of the energy sector includes a number of objectives, key among them are increased access to energy services—especially among economically and socially disadvantaged populations—greater energy efficiency, and lower operating costs. One of the assumptions underlying many reform programs is that market mechanisms are the best way to achieve these objectives. However, market mechanisms cannot bring about the desired changes unless they are specifically designed to do so.

Putting markets in place requires reforms that provide incentives and initiatives to increase the flow of private capital and public sector extractive industry funds toward improved infrastructure serving the poor. Reforms are also needed to make utilities more transparent and reduce corruption. Moreover, market reforms mean developing regulations and enforcement mechanisms to achieve cost savings, which can be shared by suppliers and consumers.

Energy sector reform has also opened up new opportunities for civil society to contribute to the policy making process. Public participation in policy development and the regulatory process is an essential component of markets that seek to achieve the social and environmental objectives of reform.

Effective energy sector reform processes can also foster a broader culture of democratic governance, opening up new opportunities for civil society to contribute to policy making. In countries where energy is among the first sectors reformed, the process has been replicated across other sectors, providing a valuable example of good governance. By promoting participation and accountability, the energy sector can provide a platform for overall reform.

Achieving good governance, which requires the effective engagement of key stakeholders, calls for:

- **Political leadership.** Political leadership is needed to promote reforms that will improve the performance of the energy sector, in terms of both the quality and quantity of service provided. This obligates governments to understand the commercial nature of energy, the range of options for government administration of the sector, appropriate levels of intervention, the commercialization of state-owned utilities, and the creation of an enabling environment for private sector participation. It also necessitates serving as a steward of the public good in the expenditure of extractive industry revenue. Governments have a new and different role to play in mediating the interests of energy enterprises and energy consumers and in enforcing good governance and democratic processes.
- **Corporate governance.** Good corporate governance is needed to provide the operating framework within which businesses are directed and controlled, including adhering to international accounting standards, managing finances transparently, being accountable to shareholders, and making decisions on corporate affairs in an organized and

coherent manner. Good corporate governance is necessary for running the sector according to sound commercial practices, reducing risks, and increasing investor confidence.

- **Public awareness and participation.** It is important that citizens and consumers understand the benefits of energy sector reform. However, public participation is more than access to information; it is also the ability to participate in shaping policies and laws at national, state, and local levels, and ensuring effective enforcement. Public involvement, early and often, enhances the accountability of governments and the private sector involved in providing energy service.

Effective governance requires the active participation of each of these players in the design, development, and implementation of energy policies, reforms, and regulations.

ZAMBIA—CONSUMER ELECTRICITY CHARTER



LEFT: The Consumer Charter for Electricity Consumers developed by the Zambian Energy Regulation Board.

USAID supported the Zambian Energy Regulation Board in developing a Consumer Charter for

Energy Consumers. Developed through nationwide consultations with electricity consumers, the Charter is the first public outreach of its kind in Zambia. It lays out the rights and responsibilities of electricity consumers and the processes for addressing grievances. Poster-size copies of the Charter, in English and local languages, will be placed in utility payment centers throughout the country. This project contributes to good governance in the energy sector by increasing transparency and accountability on the part of the utility and the Energy Regulation Board, while also challenging consumers to be accountable for their electricity use. It also highlights an avenue for consumers to have a voice in the energy decisions that affect their lives.

INDIA—BROKERING UTILITIES AND SLUM DWELLERS IN NEW DELHI

When USAID's Energy Team began working with North Delhi Power Limited (NDPL) in late 2003, the utility indicated that slum areas presented its biggest challenge in terms of outreach and theft. In the spring, INDCARE Trust, a Delhi-based NGO, worked with two clusters in northwest Delhi to urge community residents to opt for legal electricity connections. INDCARE took a two-prong approach to the project. While NDPL had envisioned an outreach campaign around the legal and safety issues of electricity use, INDCARE persuaded them to be more proactive and offer legal connections as an alternative to theft. At the same time, INDCARE worked with the communities to communicate the safety risks of illegal connections and the benefits of a legal connection.

These efforts involved brokering a new relationship between the utility and the cluster residents. For the residents, a life of marginalization meant that legal access was an alien concept. The practice of applying and paying for service was one that INDCARE could facilitate. For the utility, the relationship turned the clusters into potential customers, not liabilities. Within a few months, 400 of the 850 households in one community requested legal connections for electricity. NDPL has committed to continue working with INDCARE and has asked to expand the program to three new clusters.

BRAZIL—CITIZENS MAKE DECISIONS ABOUT ENERGY



Ecologica Institute/Maria Tereza Rodriguez

LEFT: Ricardo Cerqueira leads community multipliers training in Taquaru'u district. "TEEP has completely changed the relationship between the community and the developers. Before, the developers did as they pleased. Now we have power in our hands." - Course Participant

The Tocantins, the newest of Brazil's states, came into existence 15 years ago and is the site of 13 planned hydropower projects under the Brazilian government's

national energy plan. The project will support the state's economy, based largely on agriculture and cattle ranching.

The Tocantins Energy, Education, and Participation Program (TEEP), funded by USAID, informs stakeholders of the impacts and benefits of hydropower project development and the rights of interested and affected persons under Brazilian law. TEEP also facilitates the participation of communities affected

by hydropower development through town hall meetings that invite citizens of affected municipalities, civil society organizations, government offices, and private sector representatives to be trained as “multipliers” to share what they learn about the hydropower projects with the others in the community.

To date, new community networks dedicated to active and constructive participation in the hydropower project planning stages have been formed. Citizens learned about the need for energy and the benefits and consequences of increased access to energy. They also gained knowledge and skills to participate actively in decisions that affect their lives. The TEEP program fostered civic organization and participation. Using their new skills and the social momentum, program alumni actively participated in a community summit to plan the management of a new lake created by the Lajeado dam.

Energy, Governance, and Conflict Management

Citizens look to governments to deliver basic services, including energy. A recent USAID study showed that investments in the energy sector increase the likelihood of country stability and have positive benefits on quality-of-life.

Poorly managed energy resources can cause inequities and economic distortions that trigger instability, strife, and—potentially—conflict. In many oil and gas producing countries, for example, mismanaged revenues have fueled corruption, benefited the prosperous at the expense of the poor, and led to political instability. This has resulted in a few taking a larger share of the profits, rather than sharing the wealth among many. For several countries, scarce resources are drawn from social programs, such as education, to pay for energy services that largely benefit the more capital-intensive sectors and produce a foreign exchange drain on

the economy. Fluctuating oil and gas prices further exacerbate the problem, contributing to debt and expanding the gap between the energy rich and energy poor. More effective energy sector management, good governance, and strengthening of energy enterprises to address access and affordability can enhance domestic stability, address inequalities, improve living standards, and increase job opportunities.

MINDANAO—FROM CONFLICT TO CONVERT



AMORE Staff/October 2002, Courtesy of Winrock International

LEFT: Installing solar panels for village electrification.

In the Philippines, USAID and its partner, Winrock International, have established the Alliance for Mindanao Off-Grid Renewable Energy Project (AMORE). Mindanao is a remote rural community. About 60% of the population lives below the poverty line, and many lack access to basic services for development, like electricity. The situation is also made difficult because many of the country's rural communities are located far from electricity grids, making grid connection costly and unfeasible.

The AMORE project is providing sustainable, renewable energy systems in at least 160 remote rural communities populated by former rebel combatants in western and central Mindanao. The project contributes to peace building and human development by improving the quality of life and building the skills of rural residents.

Abdulhil Alih, BRECDA Chairman (the Barangay Renewable Energy and Community Development Association), has said that the lights, trainings, and other socioeconomic interventions that AMORE has facilitated have given the community a new sense of security. He stated, “The people here are not as easily convinced anymore to join the Abu Sayyaf or other renegade groups, because they can really see now how the lives of people here are progressing.”

IRAQ—RESTORING POWER



LEFT: Several U.S. armored vehicles help guard the Baghdad South power plant. USAID is funding the repair of Iraq's nationwide electrical system. Baghdad South, like many other power facilities, is in great disrepair. Iraqi plant managers were forced to keep them online at any cost, often foregoing maintenance and safety procedures.

Decades of minimal repairs and no regular maintenance have left Iraq's national electric system with limited ability to light homes and power businesses. Before the conflict, access to power was extremely variable, with Baghdad having coverage up to 24 hours per day and other regions lucky to get three hours per day, if at all. U.S. government recovery efforts have resulted in most areas now receiving electricity 11 – 15 hours per day. Efforts have focused on large-scale power

plants in cooperation with the Ministry of Electricity as well as hundreds of smaller-scale energy projects engaging local communities. These efforts are resulting in restored and improved infrastructure, better health and education services, expanded economic opportunities, and enhanced governance.

How Is USAID Helping?

USAID is working actively with the public and private sectors, and civil society to enable them to operate better in an energy sector characterized by liberalized markets and democratic political institutions. Key activities include improving policy, legal, and regulatory frameworks to establish necessary conditions of energy service delivery; increasing institutional ability to provide or deliver energy management services; and increasing public understanding of and participation in decisions regarding energy services. Through the combined efforts of the key stakeholders, good governance in the energy sector is paying off, resulting in increased and better energy services that are improving people's lives and livelihoods.

“If the vicious cycle of energy poverty and human under-development is to be broken, governments must act to improve the availability and affordability of modern energy services, especially electricity. Good governance in the energy sector is critical to attracting infrastructure investment. Effective competitive markets give consumers choice and drive down costs.”

International Energy Agency, *World Energy Outlook 2004*

MODERN ENERGY-ENABLED SERVICES AND IMPACTS FOR DEMOCRACY, GOVERNANCE AND CONFLICT MANAGEMENT

Services	Impacts
Lighting, heating, cooling, cooking, biofuels, water pumping/purification and distribution, agro-processing, and information, and communication technologies (ICT).	Poverty reduction, civil society building, public participation, gender equity, legitimate/credible energy institutions, and political equity. Expanded infrastructure services and associated increases in human well-being and decreased conflicts. Former combatants taking up farming and manufacturing, leading to greater social and political stability. Participation in energy decision making, local governance, and expanded employment opportunities.

This document is one of a set of brochures developed by the U.S. Agency for International Development to highlight energy's critical links to other sector priorities of USAID, its overseas missions, partner countries, and other stakeholders in the development community. The brochure set includes briefs on Energy and:

Gender | Small and Medium Enterprise | Natural Resource Management and the Environment | Health and Education |
Economic Growth and Trade | Democracy, Governance, and Conflict Management | Water and Agriculture

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USAID
FROM THE AMERICAN PEOPLE

ENERGY, WATER, AND AGRICULTURE

ENERGY, WATER, AND AGRICULTURE



Nepal ©1995 CCP. Courtesy of Photoshare

ENERGY AND WATER

“Access to clean, secure, and sufficient quantities of water is vital to achieving adequate standards of food and goods production, sanitation, and health. Water is a necessary ingredient for households, commerce, industry, and agriculture to flourish. As populations have grown and development demands increased, the inter-dependent nature of water and energy has emerged.”

Jacqueline E. Schafer, Deputy Assistant Administrator, Bureau for Economic Growth, Agriculture and Trade, U.S. Agency for International Development

Water Needs in the Developing World

Clean water for drinking, washing, growing crops, cooking food, and operating businesses is a priority throughout the developing world. Currently, close to 2 billion people lack access to safe drinking water. It is no coincidence that the same proportion of the world's population lacks access to modern energy—the two issues are closely related.

Only half of the people living in cities have connections to municipal water supplies, and in rural areas many people must collect water from polluted streams, rivers, or shallow wells. This can lead to a major health risk, as bacteria and pollutants in drinking water directly cause illness and even death. Moreover, without clean water for washing, people cannot practice effective hygiene to prevent the transmission of infectious diseases.

Access to water for irrigation is critical to improve agricultural production and maintain food supplies. Approximately 70% of the water currently withdrawn from all freshwater sources is for agriculture and livestock watering. However, pumped water is often used inefficiently and drawn down in an unsustainable manner.

Most developing countries experience significant waste in their water management systems. It is not uncommon in many cities in developing countries to experience losses of up to 50% of pumped water before it reaches the consumer. Access to energy services is integral

in adequately addressing the water needs of these countries.

The Energy-Water Nexus

Energy is required to lift and pump water from underground aquifers; transport and distribute water to end users; boil, purify, and disinfect potable water; manage waste water treatment for reuse; and desalinate water for consumption and use.

Reliable supplies of pumped water for irrigation allow for more productive and profitable agro-industry and farming practices, and enhanced food security. Clean water is also vital for aquaculture, one of the fastest-growing forms of agriculture in some areas for both produce and fish. Further, pumped water from wells and springs has the direct benefit of reducing time spent on collecting and carrying water over long distances, especially for women and children, and eliminating associated safety risks.

Running water can also be a source of energy. Hydropower—large-scale, small-scale, and micro—uses falling water directed against a turbine to generate electricity for the power grid, to serve a local load, or to power rural communities.

Throughout the world there is a growing emphasis on integrated water resource management to balance demand for potable water; pollution control of waterways, and limit the depletion of groundwater aquifers. When combined with effective energy management programs, significant opportunities exist to

Water Facts: Did You Know?

- Less than 1% of the world's fresh water is readily accessible for direct human use
- Average annual global renewable water resources in 2000 were 40% per person less than in 1970, due to the growing world population
- 20 countries, primarily in Africa and the Middle East, suffer chronic water scarcity, hindering food production and economic development
- The cost of energy to supply water can consume half the total budget of a municipality

maximize efficiency gains in the water sector; reduce waste, trim costs, and enhance overall service to the customer. The Alliance to Save Energy predicts that “energy consumption in most water systems could be reduced by 25% through cost effective efficiency actions.”

How Is USAID Helping?

USAID has made the preservation and environmentally sound development of the world’s water resources a top priority. USAID investments have helped improve access to safe and adequate water supply and sanitation, irrigation technology, conservation of the natural environment, and water resources management. The importance of access to energy services in all aspects of the water sector is underscored in USAID’s rural and urban development priorities. A special emphasis is on improved water utility systems, where energy costs are second only to labor costs.

ENERGY AND AGRICULTURE

The agriculture sector remains the predominant source of economic growth and development in many developing countries. Processed agricultural commodities are a key source of income, foreign exchange, and jobs. Food production provides the basic nutrients to meet the health requirements of a nation and reduce hunger.

Across agricultural processing, production, and distribution systems, energy is essential. Yet, securing energy services can pose a challenge.

Large-scale agricultural processing industries require fuel, which is often imported and expensive. This can account for a significant proportion of production costs.

In rural areas, human labor and animal power are often the only sources of energy available, which limits people’s time to engage in secondary economic opportunities, compromises their health, and perpetuates substandard living conditions. Farmers often operate on marginal or ecologically fragile lands where soil erosion and degradation have reduced soil quality and productivity. Low productivity forces farmers to cultivate more land, overuse already fragile land, harvest lower yields, produce inferior products, and sell them without adding value through processing and packaging.

The Energy-Agriculture Nexus

Both large and small agricultural operations can profit from sustainable, efficient energy services. All aspects of food production require some form of energy, whether for plowing, applying fertilizers and pesticides, planting, watering, crop cultivation, harvesting, food processing, or transport. Modern crop drying, which requires energy, can decrease crop waste contamination and increase farm productivity. Power for improved communications can help farmers and herders gain access to timely market data and potential buyers and suppliers.

Use of more efficient energy practices and technologies by agroindustries can lessen production and operating costs and lower energy bills. Energy efficiency measures have been shown to generate electricity savings for the agricultural industry in motors, pumps, lighting, machinery, drying, curing, water heating, and transport.

Small-scale farmers can increase productivity through the use of machinery and irrigation. This diminishes the need to expand land area for cultivation and eases pressures on deforestation.

Additionally, like water, agriculture can serve as a source of energy. In many cases agricultural wastes and residues (biomass) have been turned into an economic source of energy to displace traditional, increasingly costly fossil fuels. Sugar mills, distilleries, food processors, and cotton mills around the world have used biomass technologies to turn unwanted wastes into heat and electricity for their processing activities, thus eliminating a disposal problem, increasing the supply and reliability of local power, and reducing costs. Biofuels industries are emerging around the world to use wood, agricultural wastes, and dedicated energy crops for on-site energy production and use. In addition, animal and livestock waste can serve as a fuel source to produce high-quality fertilizers and biogas for powering, heating, and cooling households and farms.

How Is USAID Helping?

USAID’s programs promote increased access to energy services and technologies as a means to enhance agricultural productivity and sustainability. By working with farmers and herders, community organizations (including cooperatives), regional trade organizations, agribusinesses, governments, schools and universities, and businesses, USAID is helping to develop higher-

yielding and more drought- and pest-resistant crops, make water and fertilizer use more efficient, promote soil conservation, and increase soil fertility to increase crop production. Agriculture extension services have an important role to play in educating communities and opening access to information, and USAID is supporting efforts in this area.

JORDAN—WATER AND ENERGY IMPROVEMENTS SPUR OTHER COMMUNITY ENHANCEMENTS



WEPIA PROJECT

ABOVE: Saleem Falah planted and irrigated his land using treated wastewater. He now sells the produce for additional income.

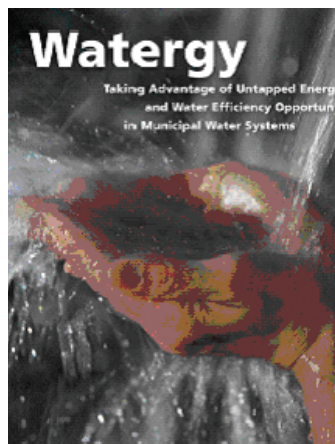
With 5.3 million people and a largely arid environment, Jordan suffers from a major water scarcity problem. Jordan is one of the ten most water-deprived countries in the world, and its rural communities, which depend on agriculture, suffer the most from the lack of water and energy infrastructure.

East Shigera, a village of 129,000 people in southern Jordan, is one of many rural communities where residents live below the poverty line due to large family size, unemployment, and their arid location.

USAID chose a community of 18 homes in East Shigera as the site of a comprehensive effort to rehabilitate the water and energy infrastructure to promote water efficiency. Households were fitted with rooftop water-harvesting systems, a cistern for storing water, and solar-powered systems for heating water. Water-saving devices were fixed on the taps and showers, and impermeable septic tanks were installed. Simple water treatment systems were also put in place, and women were shown how to operate and maintain them. This effort was instrumental in saving water, reducing electricity costs, and improving home values. With treated water,

residents can grow produce for the subsistence needs of their families or sell it at market, improving their income potential.

SAVING WATER AND ENERGY WITH WATERGY



The Watergy Handbook is available at www.watergy.org

The challenge of meeting the needs of 3 billion people estimated to lack water services by 2025 cannot be met by traditional methods. Meeting this challenge requires new approaches, local decision making, innovative finance, low-cost technology,

and energy efficiency. USAID and the Alliance to Save Energy launched Watergy in 2000 to promote energy and water efficiency opportunities in the municipal water sector. Results to date are impressive:

- In water-stressed South Africa, the city of Mogale has repaired pressure reduction valves, saving 12% of its total water use. With minimal investment, savings are about US\$1.2 million per year, and pressure on limited water resources is reduced.
- In Fortaleza, Brazil, the Watergy program enabled the local utility to provide service to 350,000 people who had not had in-home water connections. This was accomplished without increasing the amount of water entering the system while still reducing total energy consumption.
- In India, the World Bank has incorporated Watergy projects into its US\$50 million urban development program in the state of Karnataka.

“Through this Watergy approach we have been able to eliminate customer complaints while at the same time saving almost 50% over the amount of energy previously consumed by operations in these areas.”

**Ing. Efrain Deschamps, General Manager,
Sistema de Agua y Saneamiento de Veracruz
(SAS), Mexico**

INDIA—DEPENDABLE POWER TO PRODUCE DEPENDABLE CROPS

In the village of Surajpur, India, Raasoo Rahis farms wheat and barley. His fields depend on water being delivered reliably by an electrical pump. Rather than paying for electricity according to his consumption, Raasoo paid a flat rate, and his power was distributed in government-fixed blocks of time that were not predictable.

As a result, many farmers overused their water pumps, not knowing when electricity would flow again. As the farmers were not educated in resource conservation, they did not understand that measures could be taken to ensure the water resource did not run out. Accordingly, the water table dropped considerably. In addition, electricity theft was rampant, as residents could hook into existing systems without paying.

In 1992, Noida Power Company Limited, supported by USAID, started a program to distribute electricity to 118 villages in a 130-square-mile area near New Delhi. USAID helped Noida establish a distribution system that included efficient transformers, enhanced metering, and new low-tension distribution lines. To help economize groundwater pumping, a novel financing scheme offered farmers energy-efficient pumps in exchange for their existing sets. A reliable supply of power has brought social and lifestyle improvements to every resident of the 118 villages in Noida's program. Raasoo's water supply is now reliable, and his costs are lower.



USAID/Virginia Foley

ABOVE: “When I want to water my fields now,” says Raasoo, “all I have to do is just switch on my pump.”

BRAZIL—IMPROVED PRODUCTIVITY AND QUALITY OF LIFE FOR FARMERS



WINROCK INTERNATIONAL

ABOVE: In Bahia, the community constructs the reservoir.

In Bahia, Brazil, long dry periods limit agricultural productivity and create difficult living conditions. USAID funding provided assistance to the Bahia Small Rural Producers Association (APAEB) to construct a new water collection and irrigation system that is less expensive, larger, and more efficient than the traditional above-ground reservoirs currently in use. The new reservoir reduces water loss significantly and stores 24 times more water. A 100-watt solar-powered pump carries water from an underground reservoir to an elevated cistern, from which it is drawn by gravity into a micro irrigation system. Local people have been trained to maintain the system. They have also installed solar power for use in over 500 homes and a computer with Internet access for the community. Results have included increased crop output from commercial organic vegetable production, enhanced income, better access to markets, and improved quality of life at home.

“There is a close correlation between the quality and quantity of the food an agricultural enterprise produces and the quality of energy used to ‘turn the wheels’ of the agricultural process.”

Renewable Energy for Agriculture, USAID

MODERN ENERGY-ENABLED SERVICES AND IMPACTS FOR WATER

Services	Impacts
Water pumping for irrigation, livestock, and domestic use; water heating for health, schools, tourism, hotels, and processing needs; water purification; desalination; aquaculture; and energy efficiency. Water for sanitation; hydropower for lighting and refrigeration	Poverty reduction; income generation; jobs; improved health care/services; and improved nutrition. Decreased incidence of water-borne diseases

MODERN ENERGY-ENABLED SERVICES AND IMPACTS FOR AGRICULTURE

Services	Impacts
Power and modern fuels for food production, food processing, distilleries, oil processing, cotton mills, grinding, milling, drying, food storage, water pumping, lighting, heating, cooling, refrigeration and freezing, transport, communications, and marketing information.	Poverty reduction and expanded food supply from: enhanced crop yields, increased food security, agriculture mechanization and quality standards, agro-processing and marketing, post-harvest loss reductions, improved infrastructure, multi-cropping, enhanced value chain/markets, improved productivity, support and expansion of livelihoods, and increased per capita income.

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