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Energy, Poverty, and Gender

A Synthesis

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Acronyms and Abbreviations

ASTAE	Asia Alternative Energy Programme
BNPP	Bank-Netherlands Partnership Program
CDF	Comprehensive Development Framework
CFL	Compact fluorescent lamp
DFID	Department for International Development (U.K.)
EPGA	Energy, poverty, and gender assessment
HDI	Human development index
HH	Household
IMF	International Monetary Fund
IDS	Institute of Development Studies
IREDA	Indian Renewable Energy Development Agency
LPG	liquefied petroleum gas
M&E	Monitoring and evaluation
NGO	Nongovernmental organization
O&M	Operation and maintenance
P	Philippine peso
PJ	Petajoule
PPP	Purchasing power parity
PRA	Participatory Rural Appraisal
PRSP	Poverty Reduction Strategy Paper
PV	Photovoltaic(s)
RE	Rural electrification
RESCO	Rural energy service company
Rp.	Rupiahs (Indonesia)
Rs.	Rupees (Sri Lanka)
SBP	Sustainable Banking for the Poor (a World Bank program)
SHS	Solar home system
TWh	Terawatt-hour
UNDP	United Nations Development Programme

Executive Summary

Background

The Energy, Poverty, and Gender (EnPoGen) project of the World Bank's Asia Alternative Energy Programme (ASTAE) is a part of the ongoing redirection of development strategies toward poverty reduction. Funded under the Bank-Netherlands Partnership Program (BNPP), EnPoGen is an attempt to examine the energy dimension of poverty, with special attention to its gender implications. The project has focused on Asia, where 1.2 billion people—60 percent of the world's population—live without access to modern energy services, mainly in rural areas.

Objectives

Following are the objectives of EnPoGen:

- To identify the linkages between access to energy or electricity and poverty alleviation and gender equity in general—and specifically in the countries considered.
- To quantify the impacts of access to modern energy on poverty alleviation, development, and gender equity in the countries considered.
- To draw from them lessons that may improve the impact of projects of the World Bank and ASTAE on poverty alleviation and gender equity in the countries considered, and possibly in other countries.
- To contribute to the development of a methodology for monitoring the poverty impacts of energy projects.

Main Activities

In-depth studies were carried out in China, Indonesia, and Sri Lanka. The China study was led by a team of researchers from the Institute of Development Studies (IDS), University of Sussex, U.K. (IDS 2003). The Indonesia and Sri Lanka studies were led by Marchéage et Gestion de l'Environnement (MARGE) of Labastide-Murat, France. In all countries, quantitative and qualitative assessments were carried out through village-household surveys, interviews, discussions, and analyses in collaboration with national research teams, and in consultation with key national agencies responsible for energy development and poverty reduction.

Two special reports were commissioned under the project: (a) a report on the *gender aspects* of energy and poverty in the context of rural electrification by Elizabeth Cecelski (Cecelski 2003), and (b) a report on a *demand-oriented approach* to monitoring and evaluation of rural electrification projects by ASTAE-ESMAP in association with Winrock International and the Mallika Consultants (Winrock International, the World Bank, and the Mallika Consultants 2003).

Central Issues Addressed

The project addressed the following core issues:

- *Access* to modern energy services, especially electricity, by the poor.
- The *affordability* of these services relative to the poor's capacity-to-pay.
- The extent of *choice* that the poor have in acquiring and making use of these services.
- The social and economic *empowerment of women* through modern energy interventions.

Because poverty in Asia is largely a rural phenomenon, these issues were examined in the context of rural development with a special focus on electricity, which has been the predominant focus of ASTAE's activities to date.

Conceptual Reference Points

The following concepts provide the basic reference points against which the analyses under the project were carried out:

- The role of energy in *poverty alleviation*—representing improvements in lifestyles and living conditions—as distinguished from its role in *poverty reduction* through increased income and livelihood opportunities.
- The notion of energy as a *service* rather than a product by (a) extending the "energy chain" analysis to include "useful" energy, (b) recognizing the "energy ladder" whereby transitions to higher forms of energy accompany income growth, and (c) acknowledging the "income pyramid" where top-down market penetration approaches for energy services need to be combined with bottom-up market creation approaches for the poor.
- The *limits* of energy in contributing to poverty alleviation–reduction and gender equity, as imposed by (a) the presence or absence of several "complementary inputs" to development and (b) the location-specific availability of natural resources and their economic feasibility.

Overall Findings

Energy Needs of the Poor

The poor's energy needs include the following:

- *Basic needs* applications, such as cooking, heating, lighting, and comfort or convenience in households; and community uses, such as public lighting, health facilities, and schools.
- *Productive needs* applications in agriculture, home-based microenterprises, and rural industries and services.

Present Energy Sources of the Poor

The poor have access to the following energy sources:

- Fuelwood, biomass, and animal waste for cooking and heating.
- Kerosene, candles, oils, batteries, and other electricity substitutes for lighting.
- Human and animal labor for household chores, agriculture, and other productive activities.

Barriers to Accessing Modern Energy Services, Particularly Electricity

Following are some barriers to modern energy services that exist:

- *Remoteness*, which adds to the cost of all energy options, both centralized and decentralized.
- *Lack of economic capacity* to pay for upfront costs, such as capital costs of alternative energy technologies and connection costs of grid-supplied electricity.

Opportunities to Provide Modern Energy-Electricity to the Poor

A number of opportunities exist to provide modern energy services to the poor:

- *Willingness* of the poor to pay for modern energy services, especially electricity, for lighting and basic household needs.
- Reduction of monopolistic powers of public energy supply utilities under ongoing sector reforms, offering increased prospects for private initiative.
- Improved performance and lower costs of decentralized alternative energy technologies.
- Potential for poverty reduction, as well as enhanced sustainability of energy projects through financing and credit mechanisms tailored to the poor's conditions in *productive use* applications for income generation and asset-building.

Impacts of Electricity on the Poor

The lifestyles, living conditions, income, and livelihoods of the poor are all affected by electricity.

Impacts on Lifestyles and Living Conditions

Following are some of the effects on lifestyles and living conditions for the poor:

- Electricity is considered a *life priority* by the poor, who go to extraordinary lengths to obtain it.
- Even in minimal quantities, it brings about profound *lifestyle changes* in families, mainly by making home life more convenient and housework easier.
- *Illumination* in the form of electric lighting is the foremost benefit of electricity because it contributes to convenience, safety, and other benefits. It also results in cash savings because its alternatives (kerosene, batteries) are more expensive.
- *Alleviation of isolation*, through TV and radio, is considered the next highest benefit of electricity because it serves to bring remote rural communities closer to the outside world.
- *Home improvement* is made possible by electrical appliances, such as water heaters, clothes irons, cookers, and grinders.
- The *health impacts* of electricity are uncertain and conditional upon the availability of health facilities. In any case, electricity makes only a limited contribution to health because it does not replace health-harming fuelwood and biomass energy for cooking in households.
- The *impacts on education* of electricity are also conditional upon the availability of schools and educational facilities. In most cases, the very low level of illumination in electrified households does not add to children's study time.
- Electricity results in *time savings* in the daily lives of both men and women. Men use these savings primarily for recreation and leisure, whereas women redirect them to other household chores. On the whole, time savings from electricity do not reduce the overall workload of women, although they make work easier. Neither are they employed in income-earning activities, mainly because of the small amounts of electricity supplied.
- The level of *social interaction* within households and communities increases with electricity, which contributes in numerous ways to social capital development.

Impacts on Income and Livelihoods

Following are some of the effects on income and livelihoods for the poor:

- Electricity use in *agricultural activities*, for irrigation water pumping and agricultural product processing, increases productivity. This is applied mainly to grid supplies where the quantity of electricity is sufficient, however. Although the

resultant income growth is modest, it has a high impact among the poor because it forms a significant part of their income.

- Only a small proportion of households employ electricity in *home-based microenterprises.* Among them, poor households use it the least for such use because of the lack of capacity to acquire productive use appliances.
- Income from *village enterprises and businesses* depends on the quantity of electricity supply, the time lag since electrification, investment capacity, and access to markets. On average, income from enterprises and businesses that use electricity is double that of unelectrified enterprises and businesses.
- *Cash savings* of 30–40 percent are derived in pre-electrification expenditures on electricity substitutes, such as kerosene and candles. The savings could be greater if efficient appliances, such as compact fluorescent lamps (CFLs), were used. However, over time, these savings are offset by increased electricity consumption from greater appliance use.
- Electrification contributes to *asset building* through increases in the values of land and property. This is further enhanced when community facilities develop over time.

Role of Alternative Energy Technologies

The main drawbacks of alternative energy technologies, such as solar photovoltaics (PV), small hydropower, and wind power, are their limited supply capacity and relatively high initial investment cost. However, they are often the only solutions for remote communities with no hope of conventional electricity supplies in the foreseeable future. Highlights of the findings on the role of alternative energy technologies are as follows:

- Their *quality of service* is considered superior to that of grid supplies. However, they are prone to supply irregularities from resource fluctuations, poor component performance (for example, batteries), lack of know-how for maintenance, and poor project design and management.
- The poor are willing to pay for such technologies to obtain basic electricity services, but they often lack the *capacity-to-pay.*
- Solar home systems (SHSs) are the least poor-friendly technologies because of their high cost and limited power supply, which confines their use to basic needs applications.
- Micro or minihydro and hybrid systems (hydro-diesel) are more propoor because their lower costs and higher supply capacities allow productive uses.
- A new, poor-friendly, approach to alternative energy technology promotion will involve the following:
    - Shifting from a technology fixation to a more need-based strategy.

- Resolving tradeoffs between environmental goals and poverty reduction goals.
- Greater diversity of technological options, especially for fuels.
- Larger-scale systems to enhance supply capacity to cater to productive uses.
- Increased focus on "packaged" systems incorporating efficient appliances.

Beyond Energy

As mentioned earlier, energy per se is an insufficient condition to resolve problems of poverty and gender inequity. Although energy strategies certainly need to become more propoor and gender-sensitive, their impact on poverty and gender can be ensured only when the following other factors are present:

- *Complementary infrastructure*, such as roads, communication facilities, water supply, access to markets, and credit.
- Production equipment and livelihood assets.
- Good governance in the form of propoor policies, institutions, and delivery mechanisms.
- Integrated "bundled" projects that combine energy services with the above.
- The promotion of private initiative for energy supply.
- Greater focus on income generation, especially through microenterprises.
- The use of *microcredit* to overcome the poor's lack of purchasing power.

Monitoring and Evaluation of Poverty Impacts of Rural Electrification

The Sustainable Livelihoods approach of the Department for International Development (DFID) and the Poverty Reduction Strategy Papers (PRSPs) of the World Bank offer the most comprehensive conceptual frameworks for monitoring and evaluation of the poverty impacts of rural electrification. A new monitoring and evaluation mechanism should do the following:

- Provide national planners, managers, and other decisionmakers with an appropriate policy and regulatory framework to ensure the equity dimension of rural electrification through practical means of access and affordability.
- Establish quantifiable indicators of the economic and financial benefits of rural electrification.
- Set out, to the extent feasible, quantitative criteria for measuring the social benefits of rural electrification and, where necessary, consistent methods of qualitative assessment and evaluation.
- Determine and implement participative methods of project design, ensuring effective community involvement for optimal choice and project sustainability.

- Incorporate specific poverty and gender objectives in program-project design, and identify how and when they are to be measured.

Based on the above, a *user-centered framework*, combining participatory assessment methods with socioeconomic survey techniques has been developed. This incorporates and extensive "toolkit" for various aspects of implementing the proposed methodology.

Recommendations

This report organizes the many ideas and suggestions in the EnPoGen reports based on their similarities rather than the way in which they were presented in the individual reports with all their complexities.

Policy Issues

The role of the government in poverty and gender is of overriding importance because the poor are largely excluded from the market process. The following recommendations can help bring about the kinds of change expected from all other stakeholders.

- Create an enabling environment.
- Make use of "smart subsidies."
- Lower tariffs and connection costs.

Strategic Shifts

Several strategic shifts are recommended in the way energy is perceived by the development community and how, in turn, the energy community views its developmental responsibility:

- Emphasize livelihood and income-generating opportunities.
- Blend energy with complementary inputs under integrated projects.
- Include fuels, in addition to electricity.
- Enhance the scale and tailor the marketing strategies of alternative energy technologies to the poor's conditions.
- Promote demand management and appliance efficiency together with supply solutions.

Empowerment and Gender

The following recommendations will give more of a voice to the poor who are affected and will allow for more actions based on informed decisions:

- Decentralize planning processes and delivery mechanisms.
- Further explore the gender dimension of energy poverty through better data and analysis.

Institutions and Human Resources

The following recommendations will help institutions provide an economic and social environment more conducive to determining effective livelihood strategies and be better able to offer organized assistance to the poor when confronted by natural, economic, or social shocks:

- Promote institutions for financial, technical, social, and organizational *intermediation.*
- Undertake a comprehensive training needs assessment for policy formulation, planning, and implementation of a propoor, gender-sensitive energy strategy.
- Carry out training and capacity-building activities for, among others, multilateral and bilateral energy development finance agencies, national finance and microcredit institutions, governments and sectoral agencies, the private sector, nongovernmental organizations (NGOs), research and training institutions, and rural communities and poor women.

Refining Methodological Tools and Techniques

The EnPoGen outcomes suggest the need for an energy, poverty, and gender assessment (EPGA), to be carried out within the framework of designing new rural energy-electrification programs. The social benefits of rural energy-electrification programs and projects on health, education, safety, or housework are not easy to quantify—hence the need for simple impact assessment tools to guide public financing for rural energy-electrification. The following recommendations address these needs:

- Develop and implement an energy, poverty, and gender assessment (EPGA) methodology.
- Develop and implement tools to measure the specific impacts of energy on poverty and gender, specifically:
  - Reduction of consumption of and expenditure on kerosene and candles, and other electricity substitutes.
  - Gender-disaggregated time savings caused by different energy options, and the allocation of these savings to various productive and reproductive tasks.
  - Extent of household income growth from home-based microenterprises and community-scale enterprises.
  - Rate of penetration of common appliances and devices according to income, type of energy, and duration of access.

1 Introduction

Aims of the Project

The problem of persistent and acute poverty in developing countries has captured the attention of the international community in recent years. This is manifest in perceptible shifts in development strategies, culminating at the turn of the century in the *millennium development goals*, which place overarching importance on poverty reduction. Since an overwhelming majority of the poor consists of rural populations in the developing countries, these goals implicitly reflect a new agenda for rural development through measures to redress the most glaring of social and economic equity gaps affecting the rural people. The World Bank's PRSPs, the concept of Sustainable Livelihoods, and the World Summit on Sustainable Development (WSSD) are among prominent initiatives to have emerged in pursuit of this agenda.

The Energy, Poverty, and Gender (EnPoGen) project of the World Bank's Asia Alternative Energy Technology Program (ASTAE) is a part of the ongoing redirection of development strategies toward poverty reduction. Funded under the Bank-Netherlands Partnership Program (BNPP), EnPoGen is an attempt to examine the energy dimension of poverty, with special attention to its gender implications. The project has focused on Asia, where 1.2 billion people—60 percent of the world's population—live without access to modern energy services, mainly in rural areas. That most of them also happen to be poor is more than a coincidence; in many ways, it is a reflection of the difference that energy can make between being poor and not.

The absence of modern energy critically hampers the rural people's prospects of escape from poverty, whereas its availability offers a range of benefits capable of triggering wider transformations in their living conditions and livelihood opportunities. Modern fuels and electricity play a critical role in releasing the poor from their bondage to land-based, labor-intensive drudgery for sheer survival and, in its place, usher in a host of opportunities for their self-improvement. Within this broader energy context, alternative energy technologies, such as small-scale hydropower, solar PV systems and wind power, serve the needs of the poor effectively in many situations where the cost of providing modern energy through conventional means is prohibitive.

In spite of the significance of energy in addressing the needs of the poor, awareness of its impact on poverty has been confined largely to abstract conceptualization and anecdotal experience to date. As a result, the specific contributions that energy makes, or could make, to the lives of the poor are not well understood. For instance, it is virtually inconceivable to seek rural development without electricity, whose arrival in a village heralds not just light but the promise of far-reaching change in the lives of the poor.

Similarly, alternative energy technologies, which are a subset of modern energy, are more than vehicles to promote environmental agendas as they are also often the only practical short-term solutions to the poor's isolation from the mainstream of development. Understanding the nature and significance of the relationship between energy and poverty can, therefore, help sharpen the focus of future development strategies in the context of both energy initiatives and poverty reduction efforts.

Set against this backdrop, EnPoGen has revolved around a systematic assessment to identify and quantify as far as possible the potential benefits of energy in general, and of electricity in particular, to the poor so that future energy-electricity projects of the Bank could fit in better with its poverty reduction strategies. By extension, the project is also intended to increase the advantageous impacts of ASTAE's alternative energy projects on poverty.

The principal objectives of EnPoGen have been to:

- Identify the linkages between access to energy-electricity and poverty alleviation and gender equity in general—and specifically in the countries considered.
- Quantify the impacts of access to modern energy on poverty alleviation, development, and gender equity in the countries considered.
- Draw from them lessons that may improve the impact of projects of the World Bank and ASTAE on poverty alleviation and gender equity in the countries considered, and possibly in other countries.
- Contribute to the development of a methodology for monitoring the poverty impacts of energy projects.

Because poverty affects women differently and more acutely than it does men, EnPoGen has placed special importance on the gender impacts of energy. This is integral to each of the objectives listed above.

The EnPoGen Source Reports

The source reports that form the basis of this synthesis are derived from in-depth studies undertaken in China, Indonesia, and Sri Lanka under EnPoGen. The China study was led by a team of researchers from the Institute of Development Studies (IDS), the University of Sussex, U.K. The studies on Indonesia and Sri Lanka were led by Marchéage et Gestion de l'Environnement (MARGE) of Labastide-Murat, France. In each of the three countries, quantitative and qualitative assessments were carried out in collaboration with national research teams, and in consultation with key national agencies responsible for energy development and poverty reduction. The intensive village level surveys, interviews, discussions, and analyses featuring in the studies—in particular, their efforts to relate ground realities to national policies and programs—spotlight the poor's own perceptions of energy in their lives, and how approaches to rural energy development have both succeeded in and fallen short of meeting their expectations. The sense of new

discovery in these studies, the acuteness of their observations and the wealth of information generated by them form the backbone of the present report.

In addition to the country studies, two special reports were commissioned under the project. The first of these was on the *gender aspects* of energy and poverty in the context of rural electrification by Elizabeth Cecelski (2003), and the second was to develop a *user-centered approach* to monitoring and evaluation of rural electrification projects by ASTAE-ESMAP in association with Winrock International and Mallika Consultants (Winrock International, the World Bank, and the Mallika Consultants 2003). The two reports offer new conceptual direction and a set of practical tools to pursue a propoor, women-friendly energy strategy in the future. Whereas the former draws together a macro framework of current international thinking on energy, poverty, and gender, the latter offers a set of methodological tools that were tested under the Bank's Cambodia Rural Electrification Project and refined further to match the objectives of EnPoGen.

The EnPoGen source reports, especially the three country reports, taken together seek to answer a range of infrequently asked, but currently critical, questions. These questions, in summary, are as follows:

Livelihoods

- What are the principal livelihood strategies of rural communities?
- What are the main constraints on their livelihood strategies?
- How are the livelihood strategies of women distinct from those of men?
- In what ways are households poor or vulnerable?
- What are the livelihood strategies of the poor?

Energy Services

- How are energy services distributed within rural communities?
- Which energy services are most important to the poor?
- How is time allocated to human energy-consuming reproductive tasks?
- What are the implications of women's "time poverty" in relation to their livelihood strategies?
- What is the distribution of powered production equipment?
- Do poorer households benefit from gaining access to powered equipment owned by others?
- How are workloads related to ownership of or access to powered equipment?
- Which households and individuals have access to communication assets (radio, television, telephone) and what human or social capital benefits flow from such access?

Impacts of New Energy Services

- Do new energy services improve access to income-earning opportunities?
- Can improved energy services reduce poverty by enabling livelihood diversification?
- What is the impact of energy services on human capital (health, education) and social capital?
- Who gains and who loses from the introduction of new energy services?
- How do women and men differ in their energy service investment priorities?
- How can energy services be adapted to promote positive impacts that are relevant to the livelihoods of poor households and women?
- What aspects of the policy and institutional environment are likely to negate the beneficial effects of new energy services?
- What are the community-level processes for decisionmaking on energy services?
- How do women participate in these processes?

Rural Electrification

- Does conventional electrification reach the poor?
- Are alternative programs using renewable energy in a position to improve the poor's access to electricity?
- When the poorest obtain access, do they limit themselves to lighting? At which point do they get the stated advantages linked to electrical appliance ownership, or are these advantages limited to the better-off population?
- Do electric lighting and other potential benefits of electricity really weigh over their situation, and in which sense do they alleviate their poverty?
- Even if poor households have no direct access to electricity, do they benefit significantly from the electrification of more affluent households, public facilities and public lighting?
- Is there gender equity in access to electricity?
- Is there gender equity in the distribution of benefits of electrification?

Much of what follows in this chapter and in the rest of this report is derived from the answers to the foregoing questions as set out in the EnPoGen source reports. To a very limited extent, the synthesis draws upon experiences gained elsewhere in Asia either to reinforce the main findings and recommendations of the source reports or to make more explicit some of their discoveries that deserve better recognition.

Energy, Poverty, and Gender: The Central Issues

Poverty in Asia is largely a rural phenomenon. Even in China, which has had the greatest success in combating poverty among developing Asian countries, those pockets of poverty that remain are predominantly located in rural areas. Elsewhere in developing

countries of the region, including Sri Lanka and Indonesia (the latter having lost considerable ground following the Asian economic crisis of 1997), the incidence of rural poverty remains at unacceptable levels and progress with poverty reduction is constrained by a host of factors, energy among them.

The core issues in meeting the energy needs of the rural poor are as follows:

- Access.
- Affordability.
- Choice.
- Women's empowerment.

Access to Modern Energy Services

Modern energy services, such as electricity and fossil fuels, rely on capital-intensive distribution networks (transmission and distribution grids or pipelines and bulk transport by road or rail) to deliver centrally produced supplies to the rural areas. The farther these areas are from the reach of such networks, the greater the technical and economic difficulties faced by energy supply utilities that have to operate on financial sustainability principles in order to remain viable. Large numbers of low energy-consuming settlements scattered over wide and often hostile terrains render the task of utilities unenviable, especially in the present times of growing market liberalization in an increasingly competitive world. Under the circumstances, the primary problem for the poor is their inability to access modern energy because supplies simply do not reach them.

The access problem is mitigated considerably by alternative energy technologies whose small scale and portability make them more readily available to rural communities, especially those in remote locations. However, difficulties persist in ensuring their reliable operation, again because of distance and lack of scale. Service networks required for the purpose are often beyond the financial capacity of the suppliers of such systems, and so the problem persists, although perhaps at a reduced level.

Affordability: The Question of Capacity-to-Pay

Even if the question of access can be resolved, the issue of affordability poses a second, and more formidable, barrier for the poor. Their lack of purchasing power and the absence of financial assistance, such as credit, mean that even in villages where communities as a whole have access, the poor households among them have to forgo the benefits of modern energy. Perversely, this undermines the prospects of enhancing their economic capacity. Large numbers of people, in effect, suffer from a *vicious circle* of energy poverty whereby the inability to buy improved energy supplies or equipment results in low productivity, low quality of outputs, and an inability to release labor for economic activity. In turn, this leads to low returns on investment and labor inputs, again limiting the capacity to acquire modern energy services and appliances. The poor's lack of economic capacity thus goes to the heart of the energy-poverty nexus.

Choice

The rural poor depend largely on traditional biomass and animate sources of energy to meet their needs. As much as 95 percent or more of the energy consumed in rural households in some developing countries is in the form of fuelwood, agricultural residue, and animal waste. These are used in rudimentary devices of very low efficiency, as low as only 7–8 percent in many traditional types of wood stove employed for cooking. Furthermore, the energy used in farming activities, the mainstay of the poor's livelihood, is essentially human labor and animal power—in other words, *sweat energy*. To the extent that the poor are unable to move away from these primitive energy sources and devices to more efficient and less labor-intensive alternatives, their social and economic conditions remain stagnant.

Widening the energy choices for the poor implies two changes. First, the replacement of traditional biomass energy resources and human and animal labor by more efficient modern energy resources, technologies, and appliances calls for the introduction into traditional rural communities of a much higher degree of technological sophistication than the poor normally possess. Second, it invariably monetizes energy since all modern energy technologies and appliances carry a cash price, whereas traditional energy and human and animal labor do not. Choice, then, is not determined by the presence of modern energy options alone, but rather more by the ability to effectively cope with these twin transitions.

Women's Empowerment

Poverty in general—and rural poverty in particular—affects men and women differently, and women bear a disproportionate share of its hardships. In the energy context, women (together with their children) are responsible for the onerous and time-consuming task of collecting the traditional fuels that households rely on in the absence of modern energy. It is they who spend hours each day preparing meals on inefficient stoves using these fuels, and they are the ones who bear much of the adverse effects of it. The absence of modern energy has direct and significant consequences for women, ranging from serious health impacts from indoor pollution to lost opportunities for self-improvement and family well-being on account of the time spent on meeting basic household energy needs. Evidence around the developing world suggests that a focus on productive, often male-dominated, energy services has neglected the complementarity of productive[1] and reproductive[2] activities in rural households, and has led to interventions that are not only gender-biased, but are also less effective for poverty reduction. In a variety of ways, the sheer burden of ensuring energy to meet basic household needs stands in the way of women's social and economic empowerment.

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[1] Economic activities for income generation and wealth creation.

[2] The human resources and labor time required to enable households to reproduce themselves both intergenerationally and on a daily basis.

Notion of Energy as a Service

The idea of energy as a service, especially in the context of the poor, embodies three concepts:

- The energy chain.
- The energy ladder.
- The income pyramid.

The Energy Chain

Until recently, energy has been viewed as a product, albeit an invisible one. The familiar energy chain represents the flow of a natural resource from its primary state (for example, coal or water resources) to its eventual consumption as energy at the point of use after undergoing intervening technology-induced transformations (figure 1). A product view of energy tends to truncate the energy chain at the stage of *final energy*, that is, the point at which energy enters an end-use, energy-consuming device or appliance beyond which responsibility for it devolves on the consumer. Although this has the elegance of supply-side logic, its major flaw is that energy, in reality, is more than a shelf-based product: it is a critical input to all aspects of human activity. The notion of *energy service* reflects more contemporary thinking whereby the developmental responsibility for energy is captured by extending delivery efforts farther along the energy chain to the point of end use. This then draws attention to the remaining "useful energy" link in the chain. At this point, several factors that were traditionally overlooked enter the picture, most importantly the ultimate uses for which energy is needed as distinguished by the most cost-effective energy options to "serve" those needs.

The Energy Ladder

A wide range of devices convert primary sources of energy into various forms of useful energy at varying levels of conversion efficiency. The cost of useful energy can, therefore, be quite different from the cost of the primary energy or fuel, depending on intervening conversion processes that progressively result in lower levels of usable energy caused by a variety of losses. When energy options are weighed against user preferences, their efficiency and therefore their cost to the users—relative to their income—thus become key determinants of choice. For instance, the luminous efficiency of electricity is 1 (no loss in efficiency) at the point of use (bulb or fluorescent tube), which far exceeds the efficiency of candles (0.02) and kerosene (0.01). Similarly, liquefied petroleum gas (LPG) with an efficiency of 0.77 is distinctly more cost-effective than fuelwood, which has an efficiency of 0.15.

Figure 1: Product and Service Views of Energy in the Energy Chain

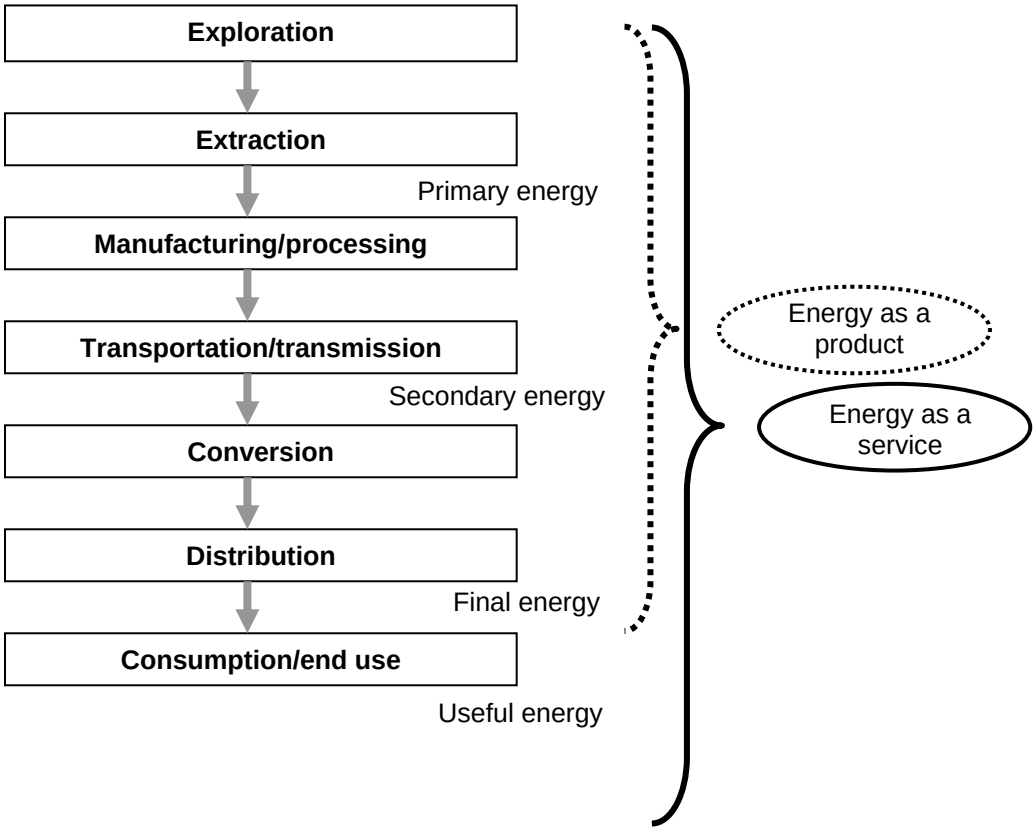
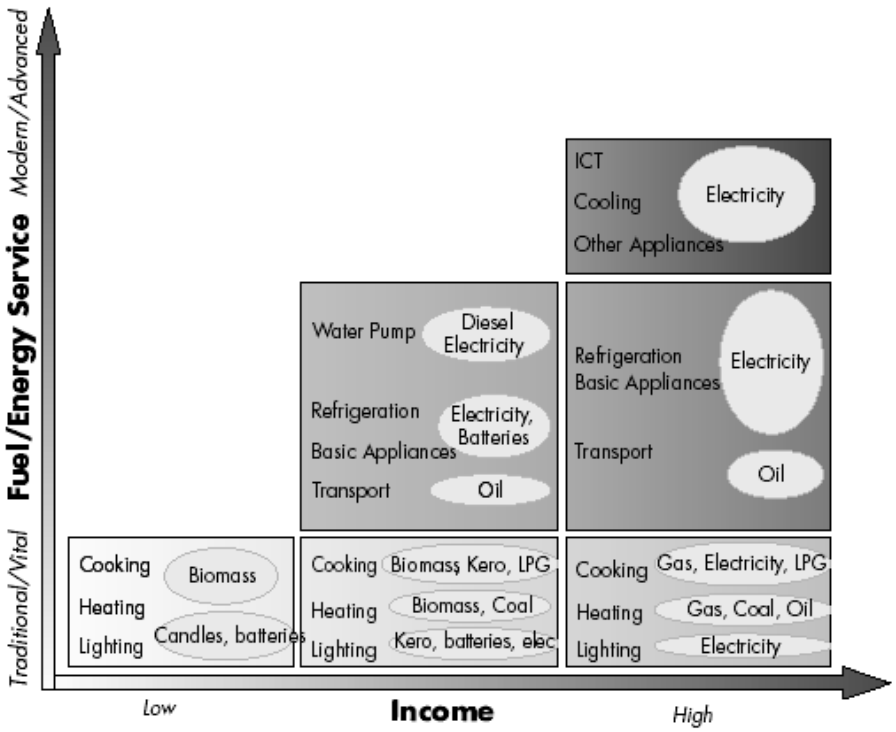


Figure 2: The Energy Ladder



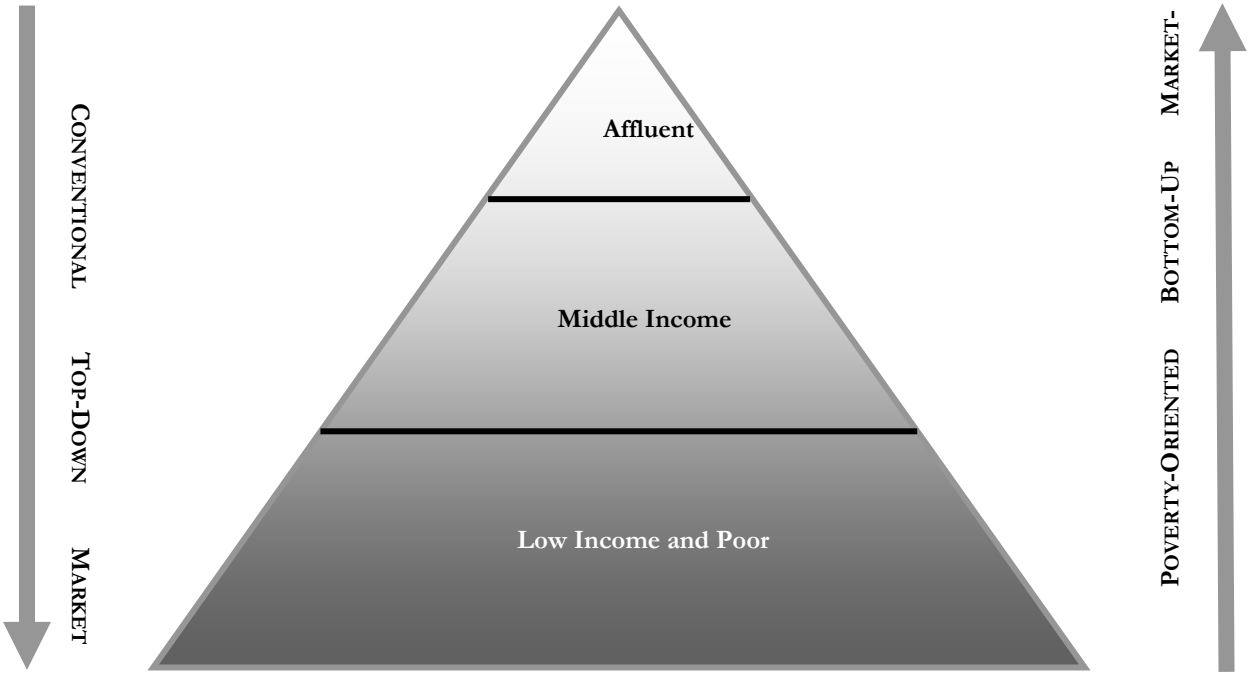
Source: IEA 2002.

If such data are combined with typical energy price data, the impact of energy on people's lives becomes clearer. For example, although the end-user market price of LPG is considerably higher than that of fuelwood, it can be as cheap per meal as fuelwood for cooking when the relative efficiencies of the two options are factored in. With the additional convenience offered by modern energy options, rural people have a strong desire to switch from traditional fuels or even less efficient modern fuels, such as kerosene, to more efficient energy forms like LPG and electricity. Their ability to make this energy transition is invariably circumscribed by their economic status; that is, more efficient and convenient energy choices can be exercised only when income levels grow. In effect, the transition takes the form of a climb up an *energy ladder* dictated by people's ability to afford successively pricier, but more efficient, forms of energy (figure 2). The poor are invariably stranded at the lower rungs of such a ladder.

The Income Pyramid

The significance of energy as a service in relation to the poor should be apparent from the above. All modern forms of energy invariably exert higher financial demands on the limited purchasing power of the poor who are inhibited from making those crucial energy transitions that are essential to escape their hardship. A product view of energy, pursuing a *market penetration* approach whereby products gravitate to purchasing power, typically starts at the top of the income pyramid. Although it can "eventually" reach the poor, the uncertain length of time this will take, often measured in decades, lies beyond the threshold of their patience. It also militates against contemporary development thinking, which places a premium on equity and social justice. By contrast, a service view of energy could simultaneously pursue a market penetration and a *market creation* approach, the latter directed at ensuring those enabling conditions that make it easier for the poor to make the energy transition within a predictable time frame (figure 3).

Figure 3: The Income Pyramid



The Case for Electricity

Although EnPoGen's objectives encompass energy broadly, the project has placed a special emphasis on electricity, specifically on rural electrification. This is not to undermine the importance of other forms of modern energy relevant to the poor, but because of two factors: one operational and the other factual.

Firstly, electricity has so far played a prominent role in ASTAE's alternative energy initiatives. A better understanding of its role in relation to poverty and gender would, therefore, have a direct impact on ASTAE's work in the immediate future.

Secondly, electricity is arguably the most sought after—and, therefore, the most controversial—aspect of modern energy service delivery to the rural poor. It is not only by far the most efficient source of lighting, but also frequently the *only* energy source that can drive many modern technologies, such as telecommunication, radio, and television.

Electricity has the unique distinction of being able to meet virtually all end uses,[3] an attribute that no other form of modern energy can claim. As a result, rightly or wrongly, rural electrification is deemed a barometer of progress with rural development, and awareness of its importance is illustrated by the fact that it even features in national constitutions, as in the case of Bangladesh. People without electricity go to extraordinary lengths and expenditure to get it. This contributes strongly to the equation of electricity with "modernization" and lends it a political importance, which is often out of proportion to the benefits it carries.

In spite of its being the collective concern of rural development and desired by all rural people, it does not automatically follow that electricity is unequivocally benefits the poor. In fact, most studies on the subject conclude that rural electrification benefits higher-income populations more than it does the lower-income ones, and that it often exacerbates rural poverty gaps and gender inequities. Although privatization and market-based approaches used to promote capital-intensive alternative energy technologies are often blamed for this, similar findings are true also for public grid extension programs whose high connection costs and recurring monthly charges tend to underscore rather than blur the demarcation between the rich and the poor. Given that alternative energy technologies cater to a fraction of the aggregate rural electricity demand in most developing countries, much of the responsibility for the negative impacts of electricity on poverty can be more rightly laid at the door of grid-based rural electrification.

Electricity draws the social map of communities, with a clear distinction between those who have it and those who do not, effectively becoming a parameter of poverty within a village community. Under prevailing approaches, rural electrification by the grid is subject to standard rules: the density of customers ready to be connected and to pay energy costs. Each household has to assess its willingness-to-pay according to standard

[3] Though not necessarily in the most cost-effective manner always when compared with other modern energy options.

price tables, and decide for itself. Under the situation, the fact that a portion of the poor get access to electricity is more a consequence of spatial coincidence rather than willful intent on the part of electric utilities. Whether the poor can afford to take advantage of such access is another matter altogether, and it is a central concern of EnPoGen.

In the balance, though, means exist by which access to electricity can be widened and the chances of the poor benefiting from it enhanced. The means revolve around the relationship between specific electrification strategies and poverty, and the effect on the poor of privatization and market reform in the power sector, including both grid electrification by utilities and rural energy market development by private suppliers. Indeed, resolving the problems of access and affordability in rural electrification is arguably the most critical challenge in the energy-poverty-gender debate.

Limits of Energy

The arguments for energy as an instrument to address the problems of poverty and gender inequity are compelling. Nonetheless, some words of caution are necessary to avoid exaggerating its role.

Firstly, the task of widening the energy choices for the poor is delimited by the location-specific availability of primary resources from which modern energy services are derived. The forms of feasible energy supply in a given country or rural area are determined largely by the presence of corresponding primary resources. For instance, whether gaseous fuels can replace traditional fuels for cooking depends on the natural resource endowment of the country concerned to begin with or its economic capacity to import such fuels from other countries. Similarly, the range of energy options based on alternative energy technologies is bounded by the presence of specific renewable resources in the vicinity of rural settlements. Choice is, therefore, subject to the variety of physical resources in convenient and economically feasible forms.

Secondly, energy by itself is capable of making only a beginning in rural transformation and poverty resolution. Beyond that, several complementary inputs, such as transport infrastructure, communication facilities, water supply, and health and education services, are necessary to bring about more profound changes, especially the elimination of poverty altogether. Expectations of energy should, hence, be tempered by these requirements, which are elaborated in subsequent parts of this report.

2 The Energy-Poverty-Gender Nexus

Emergence of Energy in the Debate on Poverty

The definition of poverty has expanded during the past two decades from a focus on command over market-produced goods (income), to a recognition of the importance of public goods and common property resources (entitlements), and the inclusion of other dimensions, such as health and literacy. Most significantly, much of poverty thinking has moved from defining poverty by the wants and needs of professionals to defining deprivation by the wants and needs of the poor. Methodologies for learning from the poor have become more rigorous, and learning from the poor has expanded the definition of poverty further to reflect a concern with vulnerability and risk, and with powerlessness and voice.

The debate on poverty as such and the place of energy in it have, however, waxed and waned over the years to arrive at their current crossroads in development thinking. In the 1960s, *integrated rural development* projects almost always included a major energy component, often in the form of rural electrification. Energy issues remained central to the growth agenda, which was the primary policy focus. Poverty was mainly regarded as a human or social development issue, to be addressed through projects implemented by ministries of labor or social development. The *redistribution with growth* paradigm of the early 1970s attempted to bring issues of income and wealth distribution into the debate around growth strategies. It argued that a more integrated approach to growth and public investment that included all sectors and a recognition of the distributional implications of alternative strategies could achieve a synergy between growth and a more equitable distribution of benefits. In the late 1970s, poverty issues were more directly addressed by the *basic human needs* approach, which urged—often in language that mirrors current discussions—that ensuring an acceptable level of living to all members of society, including the poorest, should be the primary task of any government. Growth, it was asserted, should be seen as a means to achieve this objective, not as an end in itself.

Whatever the merits of these arguments, they were largely swept away in the 1980s with the debt crises and the resurgence of neoliberalism. Economic growth was once again very much center stage. Short-term financial stabilization and longer-term structural adjustment policies dominated the agenda. Debates on poverty reduction mainly revolved around the possible consequences of stabilization (particularly in relation to reduced public expenditure), the extent to which adjustment policies promoted growth, and whether that growth had a direct impact on poverty.

The 1990s brought a gradual acceptance that it was not sufficient, even in growth terms, to focus exclusively on economic issues. Many countries that appeared to have

gotten the macroeconomic fundamentals right, including those that had followed standard International Monetary Fund (IMF) prescriptions relating to public expenditure, deregulation, exchange rates, and improving revenue collection, were not experiencing the expected returns in growth rates. It was evident that the measures followed were not translating into poverty reduction. Multilateral donors were put under pressure to justify their existence and come up with a coherent aid strategy, particularly given the increasing evidence of the wastage of money on ineffective projects.

In recent years, there has also been a fundamental shift in the aid agenda in response to the end of the Cold War. Now that development assistance cannot readily be justified for support for strategic alliances, the case has to be argued on other grounds. Basic humanitarian concerns are the most frequently cited. It is simply seen as intolerable that such a large proportion of the world's population lives in conditions of desperate poverty, lacking what would be regarded as the most essential elements of a reasonable life. This position is sometimes reinforced by reference to the implications of large-scale poverty for social stability, particularly concerning the costs of social instability and the potential effects of poverty-induced large-scale migration.

The humanitarian argument naturally focuses attention on the needs of the poorest. However, the priority assigned under this to extreme poverty creates a much more complex environment for a discussion of the role of the energy sector. The linkage between energy and output growth or between electrification and modernization needs little justification. Arguing, however, that any specific energy intervention should be seen as a priority for extreme poverty reduction, particularly given the more limited funds available, is a much more demanding undertaking.

The Bank's *World Development Report 2000/2001* identifies three common features of success in poverty reduction:

- *Empowerment* of the poor by addressing inequalities that prevent them from influencing policies and interventions that affect their lives, and that also impede overall growth and development (including gender inequalities).
- *Security* of the poor by addressing risk and vulnerability, which characterize the realities of the lives of poor people and of poor nations.
- *Opportunity* for sustained economic expansion and human development in the medium term in which the poor participate.

Empowerment, security, and opportunity, however, have not been part of the normal professional or bureaucratic concerns of many of those involved in energy policy and practice. The linkages of energy strategies with this framework have been little explored. Energy is not widely recognized as a "basic need" in development circles, and working relationships between macroeconomists, engineers, and other social scientists have been slow to develop in the energy sector in contrast to other sectors, such as health and agriculture. Different ways of thinking are partly responsible for this phenomenon. Poverty and gender thinking prioritizes people, whereas energy thinking often prioritizes other objectives, such as efficiency or environment.

At the international level, even the landmark United Nations Conference on Environment and Development (UNCED) in Rio de Janeiro in 1992 drew attention only to the linkages between environment and economic development. It placed energy concerns mainly in the context of climate change, and Agenda 21 focused on renewable energy and energy efficiency primarily as means for protection of the atmosphere. Not until 1997, at the U.N. General Assembly Special Session to review progress five years after Rio, were the essential linkages between energy and socioeconomic development presented in an integrated fashion (UNDP 1997), and a chapter specifically on energy was adopted in the program for further implementation of Agenda 21.

On the whole, little or no mention has been made over the years about rural energy poverty in the context poverty at large, with the exception of occasional references to strengthening of infrastructure and public services to the poor. Energy was not fully recognized as an "aspect of poverty" whose policies are relevant to fighting poverty. The few attempts to view energy primarily through a poverty optic are, however, quite startling, and they pose a challenge to alter conventional perceptions.

The beginnings of a shift toward a more explicit recognition of the role of energy in fighting poverty were signaled in international circles by the UNDP, which began advocating in April 2001 the adoption of a new global target for energy as a prerequisite to fulfilling other international development targets of the Millennium Goals adopted by the U.N. General Assembly in January 2001. The target was to help halve the proportion of people without access to clean and affordable fuels, and electricity by 2015. Rural electrification and liquid or gaseous fuels for cooking were the two main strategies advocated by the UNDP to achieve this target.

Later in the same year, energy was at the top of the agenda when the U.N. Commission for Sustainable Development met in its ninth session (CSD-9), and energy was identified at CSD-10 as one of the key themes to be discussed at the World Summit on Sustainable Development (WSSD) in Johannesburg, South Africa, in August 2002. WSSD subsequently adopted a wide-ranging plan of implementation, covering the gamut of energy actions with foremost priority to "improve access to reliable and affordable energy services for sustainable development sufficient to facilitate the achievement of the millennium development goals, including the goal of halving the proportion of people in poverty by 2015, and as a means to generate other important services that mitigate poverty, bearing in mind that access to energy facilitates the eradication of poverty."

The current thinking on energy and poverty is summarized in box 1. This consensus is broadly in line with major recent reports by the UNDP (1997 and 2000), the World Energy Council and FAO (1999), the Stockholm Environment Institute (1999) and the Bank's own *Rural Energy and Development: Improving Energy Supplies for Two Billion People* (1996).

Box 1: Current Thinking on Energy and Poverty

- Approximately 2 billion people have no access to "modern" forms of energy, such as electricity and liquid fuels.
- Modern forms of energy are a necessary input for economic development and the elimination of poverty. The substitution of inanimate energy for human energy has proved to be an essential element in removing drudgery and in increasing well-being.
- Improved forms of energy, however, are not sufficient conditions for development. Many "complementary inputs" are also required, including "end-use" technology to convert energy into useful outputs, such as illumination, milling, pumping, transport, and communication.
- Conventional modern forms of energy (fossil fuels and electricity) will remain the fuel of first choice for many poor people for many years to come, whereas traditional biomass fuels will remain the main fuels of necessity.
- Biomass fuels are not always "renewable" because sometimes they are harvested renewably and sometimes "mined" destructively.
- Poor people need energy for many tasks (lighting, cooking, mechanical power, heating and cooling, communication), and they require multiple fuels (electricity is not enough).
- Women and children usually form the majority of poor people in any community, and women are usually major users and suppliers of energy resources in marginalized communities.
- Poor people already pay cash for improved energy services, particularly for the convenience of electric lighting and radios. Beyond this, the additional income to pay for modern energy services will usually be associated with investment in sustainable (profitable) and productive energy end-use activities.
- The fuels and technologies traditionally available to poor people result in very low energy conversion efficiency. This efficiency, however, can be improved both domestically and in commercial and institutional uses through changes in technology.
- The energy supply sectors of many developing countries are in the process of being restructured to attract private capital. This poses both a threat and an opportunity for poor people. As energy supplies are delivered on a more commercial basis, their availability to poor people may reduce. However "unpackaging" energy supply systems opens up opportunities for the private sector to supply energy services to poor people who would not otherwise have access under current arrangements.
- Funds from tax revenues, aid agencies, and charities are unlikely to be able to provide energy services directly to any but the smallest fraction of poor people. This means that market mechanisms will have to provide the finance for improved energy services, but their extent and effectiveness will have to be massively expanded to meet current unmet needs and the needs of growing populations.
- The state has a vital role to play in providing the "enabling environment" that is necessary for the private sector to supply improved energy services to poor people. Subsidies, including aid, may well be essential, but they need to be applied with great care so that they may make markets rather than destroy them.

Poverty-Directed Energy Strategies of the Bank

The Bank's own focus on poverty reduction is laid out in its *World Development Report 2000/2001: Attacking Poverty*. Earlier, in 1999, the Bank had made it its mission "to fight poverty with passion and professionalism for lasting results." As explained in the World Development Report, poverty in this respect encompasses not only material deprivation, measured by income or consumption, but also by low achievements in education and health, vulnerability and exposure to risk, voicelessness, and powerlessness. Empowerment, security, and opportunity were thus identified as the measures of success with poverty reduction.

As a basis for providing assistance to reduce poverty, the Bank decided to initiate the development of country PRSPs. The PRSP approach built on the principles of the Comprehensive Development Framework (CDF) introduced in January 1999 whose underlying principles were that the countries are the leaders and owners of their development policies, that there is an interdependence of all elements of development—social, structural, human, governance, environmental, economic, and financial—and that to achieve sustainable results, a strong partnership will be required among governments, donors, civil society, the private sector, and other stakeholders. The CDF put into action concepts laid out during the 1997 and 1998 annual meetings of the Bank, and the PRSPs are intended to operationalize the CDF, providing the basis for all Bank and IMF concessional lending and debt relief under the enhanced Heavily Indebted Poor Countries (HIPC) Initiative.

Within the Bank's energy sector, the shift from energy as a product to energy as a service was articulated in *Rural Energy and Development: Improving Energy Supplies for Two Billion People* (World Bank 1996). However, this was not operationalized to a significant extent in the years that followed. The emergence of a new focus on poverty reduction required the energy sector to articulate how it could contribute to achieving this goal. Implementing the rural energy policy on a wider scale was, therefore, seen as integral to the Energy Renewal Strategy, which has four "lines of business": (a) direct poverty alleviation, (b) improving macro and financial balances, (c) promoting good governance and private sector development and (d) protecting the environment. Under this strategy, direct poverty alleviation is to be achieved by:

- Facilitating access to modern fuels and electricity.
- Reducing the cost and improving the quality of energy supplied to low-income households.
- Ensuring that energy subsidies are targeted at and reach the poor.
- Promoting energy-efficient and less polluting end-use technologies for traditional fuels.
- Creating energy service enterprises run by the poor.
- Supporting energy needed for social services (education, communication, health).

As a part of the Energy Renewal Strategy, the use of alternative energy technologies for both environmental protection and to address the needs of the poor is to be promoted. The focus of this effort will be on the removal of market and regulatory barriers to renewable energy and energy efficiency investments for power, and also for biomass, for example, improved cooking stoves for the poor.

Furthermore, the Bank has emphasized policies and tools that need to be used by developing country governments concerned with tackling poverty. The energy chapter of the draft *Poverty Reduction Sourcebook* has adopted the new thinking on poverty in the Bank and suggested five energy development goals and indicators:

- Expand access to improved energy services (to reduce poverty through increased income).
- Improve energy supply reliability.
- Ensure fiscal sustainability associated with energy supply and use (to increase capability).
- Improve energy sector governance and regulation (to improve security).
- Reduce health and environmental costs associated with energy supply and use (to increase empowerment).

Poverty Alleviation and Poverty Reduction

The foregoing developments have tended to broaden the definition of poverty beyond the income measure and brought into focus several other dimensions of deprivation and destitution. This has new and intricate implications for energy in that it now exhorts the energy community to step across its sectoral boundaries and, in turn, calls on other areas of development to accord explicit recognition to energy issues in their policies, strategies, and programs. From the viewpoint of measuring the impacts of energy on poverty, a crucial distinction emerges from this shift between *poverty reduction* and *poverty alleviation.*

The state of being poor has been commonly defined by an income cutoff or "poverty line," which is now acknowledged internationally as 1 U.S. dollar per day per individual. People whose incomes fall below an established threshold are considered poor. Poverty *reduction* would then mean reducing the numbers of those who live below the poverty line. In other words, income growth is the primary measure of escape from poverty. However, as noted in the preceding discussions, the income yardstick (income poverty) has been considered inadequate for a variety of reasons whose general thrust is that several other factors determine human well-being—health, education, safety, security, and empowerment—and they cannot be defined in monetary terms. By this definition, poverty signifies an all-round state of deprivation of which insufficient income is just one measure. This argument invokes the notion of poverty *alleviation* whereby a relief, to any extent, from any of the numerous hardships the poor face is equated with a lowering of the "intensity" of poverty by that extent. In practice though, the phrases *poverty reduction*

and *poverty alleviation* are often used interchangeably, which can cause to be overlooked the rather different aims but equally compelling arguments underlying each.

Although it is beyond the scope of this report to reconcile these differences, it is nonetheless important to grasp that poverty alleviation generally signals improvements in the *living conditions* of the poor without necessarily releasing them from the state of poverty as such. Such improvements mitigate the hardships of the poor and possibly render poverty less intolerable. By contrast, poverty reduction will invariably involve productive or *livelihood* enhancements that help people cross the poverty line by raising their incomes. One could argue that improved livelihood opportunities would, by implication, engender better living conditions, whereas the reverse is not assured.

More often than not, modern energy services make a distinct and immediate contribution to poverty alleviation, a case in point being the arrival of electricity at an erstwhile unelectrified poor household and the instant social benefits this triggers in the form of lighting and accompanying opportunities for recreation, communication, and other day-to-day activities that were not possible before. Obviously, this takes the edge off some of the most glaring hardships associated with the living conditions of the poor. Although it does not resolve the question of poverty conclusively, it nonetheless makes the burden of poverty more bearable and plants the seed of future opportunities to escape from it.

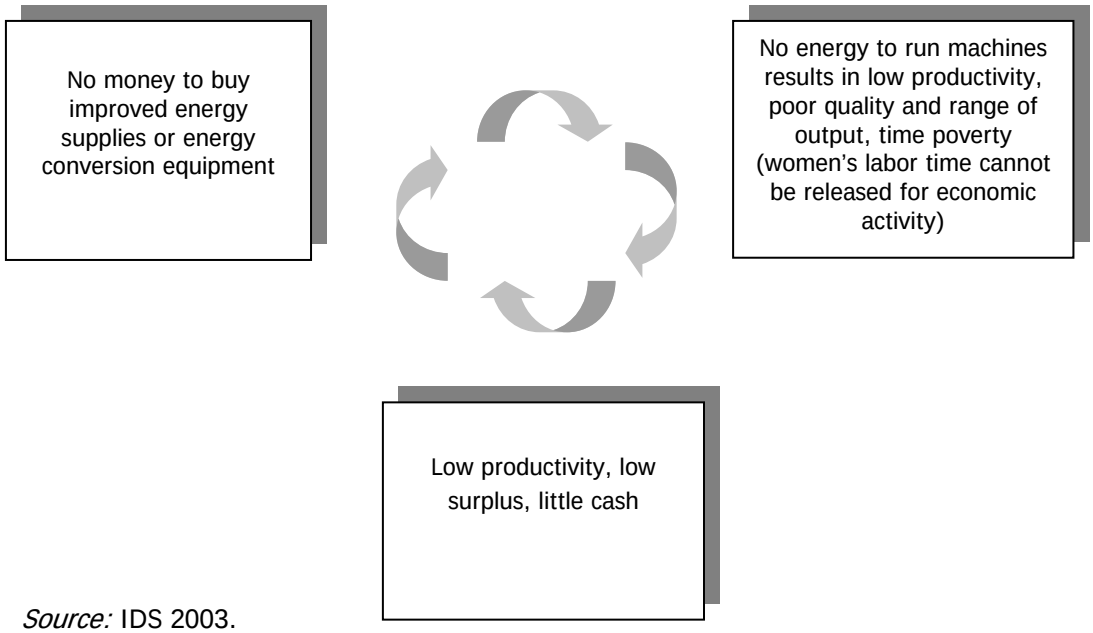
By contrast, if the same electricity is sufficient in scale and is joined by other complementary developmental inputs in a meaningful way, it can make possible the diversification and expansion of farming activities, and the creation of household and village enterprises that can effectively raise incomes and generate new wealth. In turn, this would enable the poor to afford greater quantities of modern energy in keeping with their rising demand, leading to their escape from poverty permanently. In other words, without additional cash income induced by, among other factors, the adequate supply of energy services at an affordable cost, the poor cannot move beyond a subsistence level of energy consumption even if the latter does carry distinct poverty alleviation benefits.

In the poorest parts of the world, the relationship between the volume of energy consumed and the level of economic output appears to be crucial. For instance, it has been shown that for Indian agriculture in the 1980s, a 1 percent increase in agricultural output was associated with a 3.5 percent increase in the use of modern fuels (Hurst and Barnett 1990). This is because increases in agricultural productivity were associated with mechanized land preparation and harvesting, and the pumping of irrigation water. Similar associations hold for the relationship between per capita energy consumption and changes in the human development index (HDI). A recent example is by Carlos Suarez (1995), which shows a very strong association between increases in modern energy consumption and increases in HDI.

An important conclusion follows from this. The cycle of *energy poverty* will often be broken only by combining improved energy services with end uses that generate cash income. These are likely to be the productive energy end uses that enhance production activities, either by increasing productivity, extending the range of outputs or improving

output quality. This might be labeled a “virtuous circle,” which contrasts with the “vicious circle” referred to in the previous chapter (figures 4 and 5).

Figure 4: The Vicious Circle of Energy Poverty

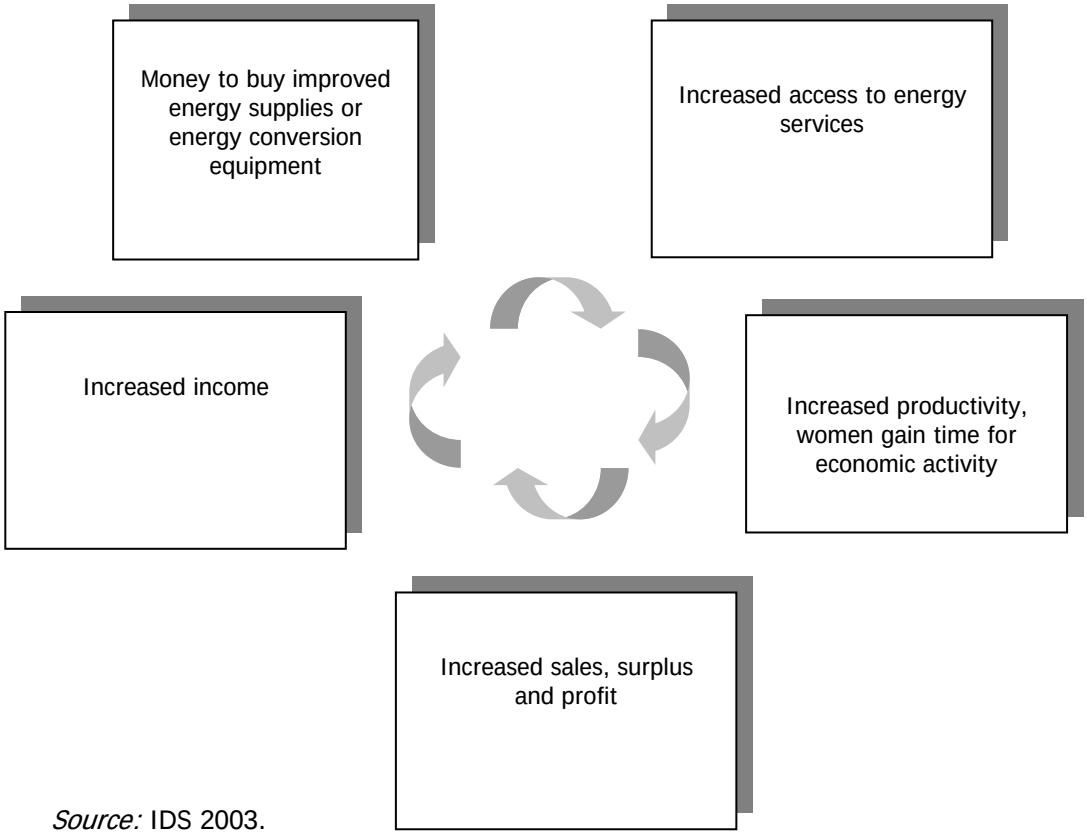


Source: IDS 2003.

Gender Dimension of Energy Poverty

Work on poverty has increasingly revealed that the social processes and trajectories by which people fall into poverty are differentiated by gender. That is, poor women and poor men do not necessarily become poor in the same ways through the same processes. They also have different capacities for accumulation. The impact of migration on poor rural areas is a particularly clear example of this in China, as discovered by the EnPoGen country study. Migration is usually gendered. Whereas able-bodied men may move to work in other rural or urban areas, women may be left as the majority managing both food production and household based reproductive work. Remittances may or may not flow to individual households. In many rural areas, households are increasingly female-headed, lacking in labor and other resources, and prone to greater vulnerability from income fluctuation and shocks.

Figure 5: A Virtuous Circle to Break Out of Energy Poverty



Source: IDS 2003.

As a consequence of these differences, poor women and poor men may have different livelihood strategies. Thus, asset interventions that benefit poor men do not necessarily benefit poor women. This is because women and men are positioned differently in relation to the "productive" and "reproductive" economies. This, in turn, affects their assets and entitlements.

Poor women spend a disproportionate amount of their time on unpaid household and farming tasks. In the absence of modern energy services, especially modern cooking fuels, they devote long hours to gathering fuelwood and biomass for energy, often across distances where wood resources are scarce because of geographical characteristics or deforestation. Furthermore, the low efficiency of these traditional fuels means that women also have to spend longer hours cooking, in the process subjecting themselves to severe health hazards induced by smoke and particulate emissions from inefficient traditional stoves.

This time use pattern places gender-specific limits on the capacity of women to accumulate resources through value added economic activity. There has been a tendency to equate men with production-based needs and women with welfare-based needs. A

gendered analysis of poverty is not just concerned with welfare needs, but it also addresses women's, as well as men's, capacity to access productive resources.

Women generally work in both the *productive* and *reproductive* economies, bearing most of the reproductive tasks associated with child-raising, food processing and cooking, care of the sick, and management of the household's physical environment. Girls are more likely than boys to provide support in these tasks. The poorer the household, the greater the time, physical, and health burdens associated with these tasks. The absence of basic labor saving and "clean" technologies, such as fuel-efficient stoves, not only burdens poor women in these ways, it also has high opportunity costs, because it diminishes their capacity to undertake other productive activities. The disproportionate health impacts of traditional energy use on women, girls, and young children is a further consequence of the division of labor.

The greater the degree of gender segregation in rural divisions of labor, the greater the association of women and girls with traditional low-technology, low value added tasks using mainly human energy. A similar pattern is found in income-generating activities. Gender inequalities mean that women generally have less access to productivity-enhancing resources, such as labor, collateral, credit facilities, information, and training. These inequalities stem from household based discrimination and from broader societal and cultural constraints. For instance, women may need permission from senior men, there may be ideologies of appropriate and inappropriate roles for women, and female literacy rates are often lower. Hence, their capacity to increase their labor productivity and improve their incomes is limited.

Because of their different and unequal roles in the division of labor, women and men have different needs and may have different priorities. This means that they may make different tradeoffs between time and energy. For example, Dutta (1997) found in her studies of biogas that women valued smoke reduction on grounds of health and to reduce the drudgery entailed in cleaning smoky pots. Men, by contrast, valued fuel savings above other considerations. Communities are differentiated in a number of significant ways, including gender. It is important to look at who speaks for communities, how decisionmaking takes place, and whether the voices of minorities and women have been heard.

The critical conclusion that emerges from combining the gender perspective with the energy perspective is that the poverty impact of improvements in energy services is largely determined by the choice of end use[4] to which the energy is put, and by implication, by *who* chooses *what* the energy will be used for and *how* it is obtained. Women are less likely to benefit from energy interventions unless they are involved in the choice of energy end-use technology and can capture the benefits of the improved energy service.

[4] The choice of energy end use will also often determine the type of energy and conversion technology required.

Even though this appears so self-evident as to be almost trivial, little attention is given by analysts and policymakers to these choices. If energy services are directed to tasks that are traditionally considered in the woman's domain, (in many societies, this will include agroprocessing, textiles, pottery, and soap-making) or to new activities not yet dominated by men, it can have a considerable (targeted) impact on women's lives. However, circumstances clearly exist in which the introduction of improved energy services results in the task (and the surplus) being taken over by men. For example, in Bangladesh, the replacement of traditional paddy huskers operated by women with small-scale mechanized milling has displaced significant amounts of female employment. Men have largely taken over the jobs in milling. This underlines the need to produce gender-disaggregated analyses of energy-related impacts on the poor.

Perhaps equally important, in the case of electricity, even the impact upon people in unconnected households can be greatly affected by the choice of energy end uses. For example, it has been suggested that the addition of one type of mill (say, for chili) can produce more benefits to an excluded group (a group of women) than, say, the addition of a battery-charging station. Furthermore, women in households have been shown to benefit from access to TV (Dhanapala 1995; Hurst and Barnett 1990). In one case it was found that the advent of television had a significant cultural impact in that women said that they could see that they "don't have to remain as second class citizens" (Thumim 1999).

Against these realities, women have been largely excluded from participation in energy policy and in processes of decisionmaking. They lack access, or the equivalent access of men, to the resources needed for economic or political participation. Yet they are key stakeholders in producing sustainable, equitable development policies. There is a need for gender-specific data to inform policy on gender, poverty, and energy linkages. Women also need to be included in the design of energy interventions.

Lack of data is also one reason why gender issues have not been adequately addressed in macrolevel policies, such as energy investment, imports and pricing (although it can also be argued that lack of data is the result, not the cause of this neglect). Disaggregating information by gender about needs, preferences, income and expenditures, decisionmaking, access to credit, and information in market surveys; disaggregating information about benefits and impacts in monitoring and evaluation studies; and disaggregating information about staffing and employment in progress reports—all of these would improve the data on which projects are based, and very likely the benefits to women.

3 Energy, Electricity, and Rural Socioeconomic Transformation

The Need for a People-Centered Outlook

As stated in chapter 1, Introduction, poverty and its gender implications are largely a rural phenomenon in Asia. Energy strategies to address them are, therefore, mostly associated with rural development. Changes in perceptions concerning poverty at large and its special impacts on rural women call for corresponding shifts in the outlook for future rural energy development. How these shifts are conceptualized and, more important, set into motion will determine the effectiveness of energy as an instrument of a people-centered rural development that is responsive to the needs of the neediest.

If rural energy systems are to cater to the new propoor agenda for rural development, they must be able to ensure a minimum amount of energy to meet the basic needs of all rural people, particularly the poor and women among them, as well as adequate energy to facilitate economic growth and new opportunities for income generation in rural communities. They must do so in a user-convenient, technically sound, cost-effective, affordable, and environmentally congenial manner. These criteria cannot be fulfilled effectively by traditional biomass energy sources in direct combustion applications or by human and animal labor for traction. Rural energy development, therefore, essentially means a transition from traditional to modern energy forms, which can meet such criteria better through appropriate technological interventions.

Past research offers the following "gender-sensitive" profile of the energy needs of rural people, whereas table 1 provides a more systematic classification of rural energy needs by income level:

- Energy is needed for household uses, such as cooking, lighting, space heating, and other appliances; for agricultural uses, such as tilling, irrigation, and post-harvest processing; and for rural industry uses, such as milling and mechanical energy and process heat. Energy is also an input to water supply, communication, commerce, health, education, and transportation in rural areas. Much of this energy use and production is by women.
- Higher-income people generally use more efficient and more convenient sources of energy, such as gas and electricity, whereas the poor people use less efficient and less convenient sources, such as fuelwood and human energy. Multiple fuel use is common at all income levels, nonetheless, and the energy ladder is perhaps more accurately replaced by an energy pyramid of multiple fuels for different purposes and at different times. Poor people have fewer energy options than do

rich people, and they often pay more for them both absolutely (in higher unit prices) and relatively (as a percentage of their income) than do the nonpoor. Poor women nonetheless highly value and need multiple energy options to help manage their daily work and time.

- The main use of inanimate energy in rural areas is for cooking and heating. Biomass is the primary fuel used, and it will continue to be so for the foreseeable future. The major source of energy in rural areas is human labor, used for both survival activities and production. This dependence on biomass and human energy is an important factor in rural poverty, but it is not measured either in national accounts or in energy balances.
- The presence of a large number of female-headed households in many developing countries, as well as women's primary responsibility for energy procurement and management (and the invisibility of these tasks in national energy accounts) gives energy poverty a particular gender bias. The risk of poverty is greater for women, with about one-third of rural households in developing countries being female-headed.[5]
- Neither public nor private energy infrastructure provision are gender-neutral. Women use energy and electricity differently than men, because of their different household and productive activities. For example, decisions on how and where electricity and electricity services (such as information and communication technology packages) are provided to households and communities influence women's ability to take advantage of these services.
- Women's microenterprises (an important factor in household income, as well as in women's welfare and empowerment), are heat-intensive (food processing), labor-intensive, and/or light-intensive (home industries with work in evenings). The lack of adequate energy supplies—and other coordinated support—affects women's ability to use these microenterprises profitably and safely. Conversely, the provision of affordable energy can be a key factor in enabling rural enterprises.

[5] Some recent studies question whether female-headed households are necessarily poorer than male-headed ones, although they acknowledge that differences in power, nutrition, health, and time allocation may be more important indicators of differences in well-being along gender lines.

Table 1: Rural Energy Needs and Supply Sources by Income Level

	Income level		
Household	**Low**	**Medium**	**High**
Cooking	Wood, residues and dung	Wood, charcoal, residues, dung, kerosene, biogas	Wood, charcoal, kerosene, LPG, coal
Lighting	Candles, kerosene, none	Candles, kerosene	Kerosene, electricity
Space heating	Wood, residues, dung, none	Wood, residues, dung	Wood, residues, dung, coal
Other appliances: radio-television	None	Grid electricity and batteries	Grid electricity and batteries
Space cooling and refrigeration	None	Electricity (fans)	Electricity, kerosene, LPG
Agriculture			
Tilling	Human labor	Draft animals	Animal, gasoline, diesel,
Irrigation	Human labor	Draft animals	Diesel, grid electricity
Processing	Human labor	Draft animals	Diesel, grid electricity
Industry			
Milling-mechanical	Human labor	Human labor, draft animals	Grid electricity, diesel, gasoline
Process heat	Wood, residues	Coal, charcoal, wood and residues	Coal, charcoal, wood, kerosene, residues
Cooling-refrigeration	None	None	Grid electricity
			LPG, kerosene
Services			
Transport	Human labor	Draft animals	Diesel, gasoline
Telephone	None	Batteries	Grid electricity

Source: IDS 2003.

The pressing priority for rural energy development is, therefore, to ensure *universal access* to modern energy services to satisfy the basic needs of rural households and communities. In other words, a minimum amount of energy should be made available to all rural people regardless of income or location. However, “minimum” should not mean the satisfaction of only the immediate needs of subsistence. The lasting solution to rural poverty is to strengthen the self-reliance of the poor so that they not only escape the hardship of their present conditions, but do so permanently and with dignity. If this be the case, then providing energy to meet social needs such as lighting, cooking, drinking water supply is a beginning, but it is not enough. Energy services should also be made available to create jobs, generate income, and develop assets. Without these opportunities, no enduring freedom from want is possible. Thus, one has to look beyond *minimum needs*

and, therefore, *minimum energy services* and aim for a certain level of essential economic opportunities that would set the rural poor on the road to recovery.

The search for practical strategies under such a people-centered approach should be guided by an awareness of several realities, which are summarized as follows:

- First, in the foreseeable future, the chances of completely eliminating the dependence of the rural people on traditional energy sources, especially fuelwood, are slim. One can at best hope to reduce this dependence by increasing the supply of conventional commercial energy and/or introducing decentralized alternatives.
- Second, the use of traditional energy sources is not undesirable in itself. It is the manner in which these are currently used that needs to be improved. This is more a matter of technology rather than of resource, as indicated by the array of prevailing and emergent advanced technologies that are capable of delivering efficient and economical energy produced from traditional energy sources (biogas, methanol, ethanol, and electricity from the gasification of wood or rice husks, to name some). The accelerated dissemination of such technologies can offer profound developmental benefits to the rural populations.
- Third, any transition from traditional energy to modern energy should be consistent with the structural changes that are, or should be, taking place in rural economies. One such change is the gradual expansion of rural industries and enterprises. Another is the increasing energy intensity of agricultural activities because of mechanization and petrochemical inputs. A more profound change can be the transformation of erstwhile rural areas into semiurban areas or townships for a variety of reasons, for example, the siting of a large industrial facility in a rural area. It is, therefore, essential to recognize that many rural areas will not always remain rural and, even in those that do, the pattern and volume of energy demand would shift in a manner requiring greater amounts of modern energy supply. Future energy services must, therefore, be capable of not only delivering more convenient energy, but they must also be able to cope with a scaling-up of the demand over time.
- Fourth, efforts to meet the basic energy needs of the rural people should be seen as one aspect of rural energy development, but not the end of it. A parallel set of efforts, based on centralized supply systems or decentralized systems capable of higher output, would be necessary to engender and sustain the economic development of the rural areas. To that extent, future rural energy development strategies should rely on a combination of centralized and decentralized modern energy services, the share of which would increase steadily in proportion to the declining share of traditional energy and human and animal labor in the supply mix.

Energy Services for Basic Needs

Cooking

In rural households, energy is needed to meet basic subsistence needs essential for a minimum level of human comfort. These needs consists of cooking, lighting, space-heating, and the operation of household appliances and devices. Of these, cooking energy needs constitute about 80 percent of the household energy needs in rural areas.

Rural households use a number of different forms of energy to minimize both the costs and the risks arising from unstable supply and technologies. For example, in China, it is not unusual to find households with a solar cooker, biogas ring, and both coal and residue-burning stoves. Even though more than 96 percent of the villages and 94 percent of the rural population in China are connected to electricity (as opposed to 40 percent in Indonesia, for instance), there is still a heavy reliance on biomass for cooking and heating. Biomass, either from crop residues or in the form of locally collected fuelwood, provides a cash-free option to the rural poor, whereas electricity may cost as much as 10 times more than in urban areas. For lighting, kerosene is still much in use. Even in households with electricity supply in China, kerosene may be a preferred option because of the cost of grid electricity and the instability of supply.

Elsewhere in developing countries of Asia, a variety of traditional cookstoves fired by fuelwood, agricultural residue, animal dung, and charcoal is used, with fuelwood being the principal source of supply. The efficiency of traditional cookstoves using fuelwood is low, on average only about 10 percent. By comparison, the efficiency of stoves based on charcoal is about 20 percent, whereas the efficiency of those based on commercial energy sources, such as electricity, could be as high as 80 percent (table 2).

As stated earlier, the low efficiency of traditional fuels and cookstoves leads to higher smoke discharges and the deterioration of indoor air quality caused by a range of particulate and gaseous emissions. The health risks of indoor biofuel cooking are now well known (see box 2). In fact, the Bank has classed indoor air pollution in developing countries among the four most critical global environmental problems. The largest direct impacts seem to be respiratory infections in children and chronic lung disease in nonsmoking women. This is one of the few energy-development linkages that has been well-documented empirically. Other health impacts of biomass use include those caused by gathering heavy loads of biomass in distant and sometimes dangerous areas. Indirect health impacts from lack of fuel for proper cooking (malnutrition) and boiling water (diarrhea and parasites) may be significant, although difficult to document (based on Smith and Mehta 2000).

Table 2: Average Efficiencies of Cookstoves and Fuels

(%)

Fuel	Stove type	Laboratory	Field	Acceptable value
Wood	Open fire (clay pots)	n.a.	5–10	7
	Open fire (3 stone) aluminum pot	18–24	13–15	15
	Ground oven	n.a.	3–6	5
	Mud or clay stove	11–23	8–14	10
	Brick stove	15–25	13–16	15
	Portable metal stove	25–35	20–30	25
Charcoal	Mud or clay stove	20–36	15–25	15
	Metal (ceramic liner)	18–30	20–35	25
Kerosene	Multiple wick stove	28–32	25–45	30
	Single wick stove	20–40	20–35	30
	Pressurized	23–65	25–55	40
Electricity	Single element	55–80	55–75	65
	Rice cooker	n.a.	85	n.a.

n.a. Not applicable.

Source: WEC-FAO 1999.

Fuel and device efficiency considerations, therefore, play a major role in meeting rural cooking energy needs. These could be promoted by upgrading to more efficient fuels, such as biogas, kerosene, LPG, and electricity; by improving the efficiency of current wood stoves; and by introducing more efficient appliances, such as solar cookers. The promotion of efficient biogas digesters and improved cookstoves with an efficiency rating of up to three times that of traditional stoves is a common feature in the rural energy programs of several countries in Asia. In successfully implemented programmers, substantial savings in fuelwood consumption have been achieved.

Box 2: Linking Cooking Energy with the Millennium Development Goals

- Indoor air pollution (IAP) is estimated to kill 2 million women and children every year: about 500,000 deaths of women and children in India, about the same in China, and the other million in other developing countries.
- WHO will soon rank the sustained household exposure to burning solid fuels as the fourth or fifth highest global risk to health after malnutrition, bad water, and sanitation, and HIV/AIDS.
- The Millennium Goals for reducing infant mortality under five cannot be met without addressing IAP. Women obviously have a major role to play.
- Women of all developing countries spend anywhere between 2 and 9 hours each day collecting fuel and fodder and cooking. A study in Uttarachal, India found miscarriages to be five times the national average at 30 percent, and linked it to heavy load-bearing during pregnancy. In Nepal, women suffer a high incidence of uterine prolapse that is in all likelihood linked to carrying heavy loads of wood soon after childbirth. Men of the developing world spend about 10 times less on such daily drudgery. Since biomass fuels are used mostly by lower-income groups, and women do most of the cooking, health is a significant issue in energy, poverty reduction, and gender.

Source: TERI/World Bank Regional Workshop on Indoor Air Pollution, Household Energy, and Health, New Delhi, 8-10 June 2002.

Lighting

Lighting energy needs in rural households are met mainly by kerosene and electricity. Although electrical lamps are by far the more efficient and offer greater user-convenience compared to kerosene lamps, the choice between the two depends primarily on the extent of saturation achieved in household electricity supply in villages that are connected to the grid. In general, the percentage of villages electrified in a country is a poor indicator of the extent to which the demand for household lighting has been satisfied. This is illustrated in many developing countries where the gap between the number of villages electrified and the number of households connected is often on an order of magnitude. The reasons behind this are the high cost of household connections and high monthly energy charges, which are discussed in greater detail in the next chapter.

Although lighting energy needs in rural households occupy only a small share of their total energy consumption, its importance owes to two factors. First, illumination is without question a fundamental requirement of life, irrespective of class, income, or gender. Second, in poor households, fuels or electricity for lighting are often their main *cash* expenditure on energy, and the proportion of this expenditure in the household budget can be significant.

Other Household Applications

The use of household appliances, such as rice cookers, fans, radios, and television sets, depends first on the availability of electricity and second on the income levels of the rural population *vis-à-vis* the costs of acquisition of such appliances. In fact, the poor's lack of

purchasing power to own appliances is a major inhibiting factor in rural equity. Again, this aspect is covered at greater length in the following chapter of the report.

It is argued at times that the uses to which such household appliances are put are not necessarily to meet their basic needs. For instance, whether a television set is a device for essential contact with the outside world or an "optional" recreation equipment depends on who is asking the question and who is answering it. Isolation from the rest of the society is more often than not a central characteristic of rural communities in general, and those in remote areas in particular. From their perspective, the ability to own and use a television set is a basic need to acquire a sense of belonging to the mainstream of development. The same may be said of several other household appliances of convenience that help reduce the labor intensity of rural life and allow people to redirect the time saved to other activities for self-improvement or economic betterment. Arguments to the contrary reflect a value judgment that can be challenged on the grounds of dualism.

Community Uses

Community uses for energy include public lighting, water-pumping, lighting, and appliances in health clinics and schools, and the requirements of common facilities for social interaction. Electricity is the most critical source of energy to meet these needs and, in its absence, other forms of energy like kerosene, mainly for lighting, are used. Energy to meet these essential community services is a part of the package of *public benefits* that governments are expected to provide rural populations. It is just as critical as energy for household needs as described above because many of the core conditions of poverty—such as poor health, lack of potable water, sanitation, and illiteracy—often stem from inadequate community services, and a number of these services cannot be dealt with at the level of isolated households.

In absolute terms, and based on the technological options already available, ensuring the basic energy needs of the rural people is not an insurmountable problem. According to the World Energy Council (WEC-FAO 1999), it has been estimated in India "that about 948 MJ of *useful* energy is needed per capita per year to meet cooking energy needs. Similarly, about 46 MJ of *useful* energy per capita per year is required to meet space heating needs, and the same amount again, 46 MJ of *useful* energy per capita per year, is needed to meet lighting needs. Thus, a total of some 1,039 MJ of *useful* energy per capita per year is assumed to be required at the household level to meet the three basic energy services—cooking, lighting, and space heating. Taking the Indian minimum useful energy norm as a basis, and multiplying it by the total developing country rural population in 1996 of 2.8 billion people, we would find their total annual useful energy requirement to be 3,325 PJ. If we were to stretch our imaginations and suppose that these energy needs could all be met by electricity, assuming an 85 percent conversion efficiency of the electrical appliances used, this would translate into 3472 PJ, or 964 TWh. This is equivalent to about 7 percent of the world's total electricity production in

1996 and is less than the 995 TWh consumed in the homes of the 260 million people living in the USA in 1993!"

Energy Services for Income Generation

Agriculture

The authors of the work, *Transforming the Rural Asian Economy: The Unfinished Revolution* (Rosegrant and Hazell 2000), conclude that "rapid agricultural and economic growth was the driving force behind the dramatic reduction in poverty in most of Asia.[6] Agricultural growth that raises agricultural productivity and the returns to farm labor has been particularly important in reducing poverty because of the high concentration of poverty in rural areas and the dependence of many of the poor on the farm sector for their incomes."

Energy statistics do not show agricultural activities as major energy consumers in rural areas, mainly because the energy involved in them consists largely of human and animal labor. Modern energy services essential to increase agricultural productivity and income invariably substitute the labor content of production, a fact that is frequently overlooked in traditional approaches to rural energy analyses. The energy needs of agriculture consist of (a) direct energy needs for land preparation, cultivation, irrigation, harvest, post-harvest processing, storage, and the transportation of agricultural inputs and outputs; and (b) indirect energy needs in the form of fertilizers, weedicides, pesticides, and insecticides.

Much of the direct energy inputs into agriculture is usually in the form of human and animal labor. Modern energy, such as electricity and diesel, replace labor for irrigation water-pumping, mechanization of agriculture, and transportation of agricultural products. Agricultural mechanization involves mainly the use of diesel for tractors, tillers, threshers, and other farm equipment, and the use of electricity in irrigation pump-sets. In general, irrigation needs are the primary targets of grid-based rural electrification.

Indirect energy inputs form on average nearly half the total energy consumed in agriculture, and the expenditure on modern energy inputs crucial for agricultural productivity, such as chemical fertilizers, is a substantial cash outflow for rural people. The very poor among them who cannot afford these inputs fall back on natural fertilizers like agricultural residue which has the effect of curtailing the productivity of the land and, therefore, income from it. Often, in areas of a scarcity of wood supply, it also poses critical tradeoffs in the use of agricultural residue as a fuel, fodder, or manure.

Rural Industries

Population pressures on finite agricultural land invariably impel a gradual extension of rural economic activities into nonfarm enterprises, broadly defined as rural industries.

[6] Where such reduction has occurred.

The development of rural industries is thus an essential component of rural economic transformation, not only to supplement agriculture-based incomes but also, in the larger context, to arrest rural-urban migration.

Available definitions of rural industries vary by country according to the criteria employed, such as the size of capital invested, strength of the labor force employed, production volume, and the use of modern energy sources. Often large-scale industrial facilities, such as sugar and palm oil factories, are sited in the rural areas side by side with medium- and small-scale industries. In addition, there are usually large numbers of household enterprises operated as family businesses on a microscale.

In general, rural industries can be broadly classified into agro-based and nonagro-based industries. The former would consist of such facilities as those for rice-milling, fruit and vegetable processing, tobacco-curing, and a range of skill-based household businesses, whereas the latter would include charcoal and brick manufacturing facilities, potteries, bakeries, blacksmithies, woodworks, and village workshops. Shops and establishments that do not fall under either of these categories form the services sector.

The energy needs of rural industries comprise lighting, process heat, and motive power. Lighting requirements are invariably met by electricity in electrified villages and by kerosene in unelectrified villages. The principal supply sources for process heat in facilities, such as blacksmithy, brick-making, and charcoal manufacture, are fuelwood and biomass. Motive power requirements are met by electricity, where it is available, and by human labor using mechanical equipment, where it is not. In agro-based facilities, such as crop-drying and rice-milling, the use of biomass is widespread.

Rural electrification and the greater availability of commercial fuels in the rural areas induce a steady transition from traditional to commercial sources of energy supply in developing countries—subject to the crucial condition of economic capacity. Improving the efficiency of heating equipment, such as boilers, furnaces, and dryers, is thus an important element of the strategy to meet the energy needs of this sector. Substantial opportunities for self-generation and cogeneration based on biomass also exist in facilities that have combined requirements of both steam and electricity.

Livelihood Activities of the Poor

Within the broader context of rural economic activities, the poor are usually limited to agriculture and to its allied activities, such as animal husbandry, poultry, fishery, and vegetable and fruit cultivation. The bottom poor among them who own no land of their own are even more restricted in their economic options. The poor's ability to generate income through activities other than these, for instance, through microenterprises, is constrained by several factors of which energy is one. Even if modern energy services were available and affordable to poor households, the absence of roads, communication, access to market, and credit pose formidable barriers for them.

Poor households and individuals adopt livelihood strategies that consist of a variety of both market-oriented and nonmarket-oriented activities. The aim of these strategies is to sustain and, if possible, improve their situation by appropriate use of their stock of assets,

both material (physical and financial capital) and nonmaterial (human and social capital). Poverty reduction implies the accumulation of assets over time. This can lead to both improved living standards and/or an increase in the range of possible future livelihood strategies. In difficult periods, it may be necessary to draw on the stock of assets to maintain minimum living requirements.

Focusing on the livelihoods of the poor provides a means whereby the balance between "productive" and "social" uses of energy can be understood. Both can be seen as the utilization of energy services to increase asset holdings—in one case economic, in the other human or social. To understand the potential role of energy services in poverty reduction, it is essential to have a clear understanding of the livelihood strategies currently adopted. This is necessary to determine if the lack of access to specific energy services may be constraining the range of livelihood strategies available to the poor, reducing both incomes and the possibilities for asset accumulation. Energy-related livelihood strategies for the poor and their potential outcomes are illustrated in tables 3 and 4.

Table 3: Energy-Related Livelihood Strategies

Livelihood strategy	Means
Gaining additional income by retailing energy services up the "energy ladder"	• Fuels (wood, charcoal, dung, crop residues, kerosene, LPG) • Conversion technology (stoves, lamps, batteries, motors, PV systems
Gaining access to improved energy services at the household level by saving time, or fuel switching	• Improved biomass stoves • Improved lighting (from candles to kerosene to electricity initially from batteries)
Gaining access to improved energy services, by increasing production efficiency	• Improved energy services result in increased productivity (e.g., through mechanization), which results in a greater ability to pay for improved energy services. Opportunities range from the lowest technologies and the smallest scales upwards (for example, agro-processing, small and microenterprises).
Grouping with others to obtain access to improved energy services, for production, household consumption or for community services (health centers, schools, security lighting, and information and communication technology).	• Community-based activities enable labor to be converted into capital (e.g., through civil works) and capture the economies of scale associated with energy supply technologies, such as connecting to the grid (transformers and distribution systems) and installing microhydro generators, small diesel engines or acquiring mechanized transport services, and the like, or "pooling demand" to provide political or commercial pressure to gain access to energy services.

Source: IDS 2003.

Table 4: Livelihood Outcomes

Outcome		Key issues for women
1. More income	• Income from the sale of energy services • Income from energy related productivity gains • Income from energy related expansion of supply options and quality (for example, doing things that are impossible without in animate energy) • Income from extending the working day through improved lighting. • Improved income from better access to fuel based transport	
2. Increased well-being	• Improved household and street lighting • Reduction of indoor air pollution (improved fuels or improved stoves) • Reduced burden from fuel collection and processing • Reduced drudgery by replacing human animate energy with inanimate energy • Increased education as a result of better lighting in schools • Better health from health services that have access to improved lighting, cold chain storage, and communication • Improved access to information through radio, television and other Information Technology. • Sense of inclusion in the “modern” electrified world.	• Reduction of time consuming tasks (including fuel and water collection, milling, grinding, food preparation, and other reproductive tasks). • Access to the outside world through radio and other information and communication technology • Better light for reading and other night time tasks.
3. Reduced vulnerability	• More secure water supply from pumped irrigation • Better security lighting • More secure fuel supplies • Production based on a wider range of raw materials	• Safer night time environment because of improved lighting • Reduced indoor air pollution • Less frequent pregnancy (high correlation of electric light with reduction in birth rates)
4. Improved food security	• Improved agricultural output from mechanization, and pumped irrigation • Improved post-harvest processing and	

	storage • Improved fuel-based transport
5. More sustainable use of natural resources	• More efficient and/or sustainable use of biomass fuels, • Replacement of “mined” biomass with more convenient, “efficient” fuels and/or renewable fuels

Source: IDS 2003.

Rural Electrification and Rural Socioeconomic Development

As mentioned in the Introduction, in spite of its relatively small share of the aggregate rural energy supply, electricity is viewed as symbolic of rural development itself. The unavailability of electricity is among the most visible signs of rural-urban and rural rich-poor socioeconomic gaps. The harshest criticisms of conventional approaches to rural energy development are often based on the shortcomings of rural electrification programs.

The crux of the rural electrification dilemma is that electricity is an expensive, high-quality energy source that practically all rural people want but only some can afford, subject to the overriding condition of its availability in the first place. Although other goods and services are equally expensive and, therefore, just as much outside the reach of the rural majorities, the case of electricity is special because it is identified with basic needs issues and notions, such as *universal access*, lend it a distinct human development role. This makes rural electrification a socially and politically sensitive topic.

Electricity is expensive because it involves capital-intensive technological interventions to transform a primary energy resource from its natural state to useful energy. It is considered qualitatively superior because of its ability to meet almost the entire range of energy end-uses, something that no other energy form can. In order to recover the initial investment and the running costs of an electric supply system over its lifetime, an appropriate pricing structure is needed. Market economic theory presents a persuasive reasoning for electricity to be priced in a way that reflects its scarcity and makes full cost recovery possible. Unfortunately, in most situations, what is considered a cost-recovering scarcity price lies beyond the average income levels of rural populations. Welfare-oriented development doctrines, therefore, militate against the notion of market prices for electricity on the grounds that they would inhibit rural socio-economic development, the benefits of which cannot be measured in financial terms alone.

National power utilities are caught in the middle of this argument. On the one hand, in order to obtain the necessary capital for supply expansion and stay in business, they have to operate on financial viability principles. On the other hand, because most utilities in the developing countries are state-owned, they are compelled to respond to social and political pressures by subsidizing electricity prices. In their attempts to appease these

opposing forces, utilities have generally struggled to satisfy both. Rural electrification proceeds, but with much diffidence.

The problems of centralized rural electrification by utilities may be stated as follows:

- Wide dispersion of consumers.
- Low levels of demand.
- Low load factors.
- High levels of power loss.
- High levels of revenue loss.
- Limited paying capacity of consumers for supply and appliance costs.
- Higher marginal costs of supply, requiring subsidies.

During the past two decades, it has been the hope that the problems of grid electrification by utilities could be overcome by shifting to a strategy of decentralized rural electrification based on renewable energy technologies. In spite of concerted efforts to promote these technologies, however, their share of the aggregate rural electricity supply remains a small fraction of it, less than 1 percent in the majority of developing countries. Although decentralized electricity options have a number of distinct advantages, they also suffer from certain unique disadvantages, important among which are their high initial investment costs and the intermittent nature of electricity supply from them. As a result, their contribution to rural electrification has faced its own distinct hurdles. This is discussed at greater length in chapter 5 of the report.

What then of the overall effectiveness of rural electrification in furthering rural socioeconomic transformations? The answer to this lies at the core of EnPoGen's findings, and it is detailed in the next chapter of the report. According to a World Bank report (World Bank 1995): "One of the most persistent claims for RE [rural electrification] is that it can induce industrial growth in otherwise lagging low-income rural economies. The evidence from developing countries does not support this claim; RE has not, by itself, triggered industrial growth or regional development…. The study found that where other prerequisites of sustained development were absent, demand for electricity for productive uses did not grow…. RE is economically justified only when the emerging uses of electricity are strong enough to ensure sufficient growth in demand to produce a reasonable economic rate of return on the investment. RE may be in a unique position to promote a paradigm shift in agricultural production, by making possible irrigation and associated modern technology and practices."

This builds up an image of rural electrification primarily associated with social welfare. A significant number of rural areas, most of them poor, do not get access to the main grid. Even in electrified areas, a poor households are not connected. Utilities perceive rural electrification as a social obligation and an economic constraint that they are not able to face alone anymore. Populations and politicians consider electricity as a social right that must be dealt with. Electrification is a priority and insufficient electrification rates are seen as social injustice, or a failure of energy policy and national

utilities. This alone justifies rural electrification to be more prominently included in poverty reduction strategies.

Another interpretation, however, more narrowly links rural electrification with productive development and reinforces its character of priority, not only for social, but also for economic, reasons. If rural populations realize a better life through access to electricity, they do not get it for free. They have to pay for access and consumption to the best of their ability, and that in itself could be the major economic impact of electrification. Electricity is a market and value builder, pulling rural dwellers into the consumption world. Clear, direct impacts are linked to the payment of electricity bills and investments in electrical equipment and appliances. Qualitative evaluations and surveys suggest that there is also an indirect impact on nonproductive household investments (such as investing in home improvements) and deeper consumption pattern changes. Economic development then relies on contributions from the community to the overall economy, and to a lesser extent on contributions from surrounding areas to the community—in a process that mainly drains financial resources from rural to urban areas.

Investments and consumption will have impacts more external than internal to the rural community. Market development rather than increased energy availability will also be responsible for the collateral emergence of village activities, such as the development of paid housework (mainly among women), cottage industries, and small commerce. The transformation of the rural economy will, in turn, have social consequences, not all of them positive, as newly concentrated modern activities will suppress more traditional ones (handicraft, part-time farm activities). Electrification monetizes village economies; the downside is that it also monetizes poverty.

The numerous problems with rural electrification and the generally ambivalent assessment of its benefits inevitably provoke questions over its future prospects. It should be noted, however, that most assessments of rural electrification are based on an initial set of expectations. Where the expectations themselves are misplaced, or the right expectations are not articulated, it is not surprising for the results to be discouraging. As observed in the report of a regional rural electrification survey carried out on behalf of the Asian Development Bank as far back as the 1980s: “We have cast a cold hard eye on rural electrification’s impacts and found them disappointing when we measured them against expectations. The nagging doubt lingers though: Are we asking the right questions? We cannot hide behind the cover of ‘quantification’ and aver that psychological impacts, intergenerational changes, and motivational factors are nonquantifiable so, therefore, we will tabulate only inputs and outputs. Economic development is more than inputs and outputs.” (Smith, Mehta, and Hayes 1983)

Such reflections underline the baffling paradox of being skeptical about rural electrification on the basis of its economic nonviability for the masses and, in the same breath, to also acknowledge that it is a social need with far-reaching effects that cannot be ignored. Indeed, they signify a much deeper struggle to reconcile long-held, and increasingly awkward-to-defend, notions of economic development independent of

human development. Clearly, the future prospects of rural electrification will not be decided in isolation of this larger context.

If the costs and benefits of rural electrification are to be measured against the yardstick of economic efficiency, it may be difficult to justify further investments in it. Unless the cost of electricity is recoverable from rural users, the losses from rural electrification would accumulate till a stage may come when even those who can pay for electricity would encounter difficulties in obtaining supplies. The logic of this argument lies in the reality that an investment—whether it is by utilities or by rural users—which does not yield a return liquidates the capital and effectively mortgages the future.

This hardly settles the issue, though. As is being asked now with increasing frustration, is the liquidation of physical capital more important than the stagnation of human capital? The question turns the issue on its head and forces one to re-examine rural electrification costs in a broader sense than merely in relation to utility or supply costs. If the cost of supplying electricity to the rural people is considered excessive, the cost of not supplying it can be enormous in human deprivation.

The findings of the EnPoGen country studies show that poor households do value highly and benefit from electrification. When they have access to electricity in their homes, it is accompanied by a range of lifestyle improvements. Improved public services, such as in health and education, likely have indirect positive benefits for the poor, too, although they rely very much on the development of complementary infrastructure and services together with electrification. Spin-off effects on wage employment of increased output (for example, from mechanization or irrigation), may also be considerable, but these effects depend on the overall growth dynamics in a region, not only on electrification. These aspects are dealt with at greater length in the next chapter.

Barriers to Extending Electricity Services to the Rural Poor

Although the issues surrounding role of electricity in rural people's lives are complex enough, the poor's economic status relative to the high cost of electricity imposes special barriers in the way of extending electricity services to them. Whether a poor household obtains electricity is mainly a matter of availability and the cost of access. It is not a matter of choice or, interestingly, at least for most people, of price once electricity is obtained.

Among unelectrified households that had never had electricity in the sample covered by the EnPoGen study in Indonesia, the main reasons for failure to connect were caused, first, by the cost of connection (high connection cost) and, second, by the lack of access (no electricity in the village, no poles). None of the unelectrified households suggested that they did not desire or need electricity, and only a very small minority (overall about 3 percent) indicated that high monthly fees were a major constraint (table 5). However, high connection fees penalize the poorest more than the better-off households, as shown in figure 6.

The “no poles” reason in table 5 refers to the lack of often relatively short extensions to existing distribution networks to serve additional households; this remains a major constraint, particularly for the poor. In Indonesia, one pole and associated wiring could cost up to Rp. 2 million (US$200), which is a large amount of money for poor households with total incomes of perhaps Rp. 400,000–500,000 (US$40–500) per month. It should be noted here that making new connections is essentially supply-driven, either by the extent of funds available for investment in system expansion for major grids or in the size of project budgets for many alternative energy projects. Demand can influence supply. However, where public funds for expansion are highly constrained (as is the case in Indonesia and most other developing countries), this is only to the extent that potential customers are willing to pay the necessary capital costs up front. This can be a prohibitive barrier. If, for example, those saying “no poles” are combined with those claiming “high connection costs” as reasons for not being able to connect, then a formal connection is simply beyond their reach of close to 70 percent of the Indonesian study sample.

Table 5: Reasons for Not Using Electricity among Unelectrified Households in Indonesia

(% of households)

Reason	Study location				Total
	Lebak	Tasik-malaya	Makale	Mamuju	
No electricity in village	0.0	3.2	2.1	81.8	22.3
High connection cost	60.0	44.7	50.5	5.1	39.7
High monthly fees	3.2	7.4	3.1	0.0	3.4
No poles	28.4	36.2	35.1	11.1	27.5
No need for electricity	0.0	0.0	0.0	0.0	0.0
Other	8.4	8.5	9.3	2.0	7.0
Total	*100.0*	*100.0*	*100.0*	*100.0*	*100.0*
No. of HHs	**95**	**94**	**97**	**99**	**385**

Source: ASTAE-EnPoGen Survey in Indonesia, August 2001.

Figure 6: Barriers to Not Being Electrified in Indonesia

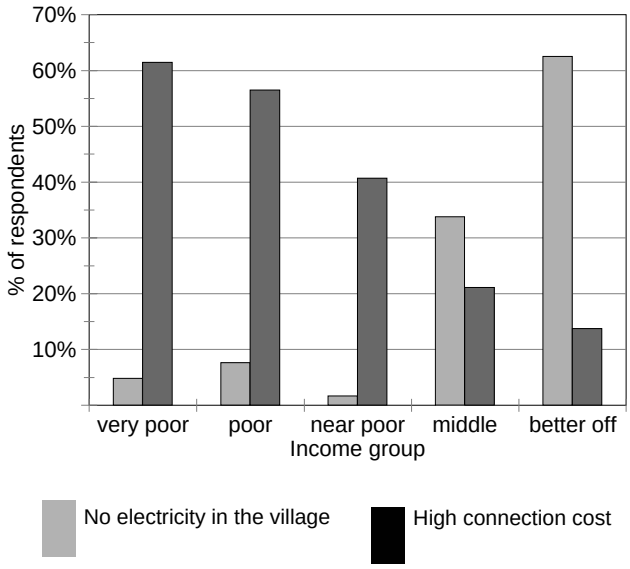


Table 6 confirms the linkage between poverty and not having access to electricity. Most (89 percent) of the poorest unelectrified respondents in Indonesia had an electrified neighbor, whereas this was only 21 percent among the better-off. This highlights the financial barrier for the poor.

Table 6: Unelectrified Respondents Having an Electrified Neighbor in Indonesia

	Income group					
	Very poor	**Poor**	**Near poor**	**Middle**	**Better-off**	**Together**
Yes	89%	79%	80%	43%	21%	64%
No	11%	21%	20%	57%	79%	36%
Total	100%	100%	100%	100%	100%	100%
No. of HHs	**90**	**92**	**64**	**67**	**76**	**389**

Source: ASTAE-EnPoGen Survey in Indonesia, August 2001.

Table 7: Unelectrified Households Applying Unsuccessfully for Electricity in Indonesia

(% of households)

Question	Location				Total
	Lebak	Tasik-malaya	Makale	Mamuju	
Have you ever applied for electricity?					
Yes	14	36	30	6	22
No	86	64	70	94	79
Total	*100*	*100*	*100*	*100*	*100*
How long ago did you apply?					
1 month		3	17	17	8
3 months		3	17	50	10
6 months	21		3	17	6
1 year	43	78	27	17	50
2 years	36		37		19
3 years or more		17			7
Total	*100*	*100*	*100*	*100*	*100*
What efforts have you made?					
Visit the provider	79	36	97		62
Save or collect money from village people		17	3		8
Others	21	47	0	100	30
Total	*100*	*100*	*100*	*100*	*100*
What kinds of difficulties did you encounter in making these efforts?					
High connection fees	29	11	0	0	9
Staff creates problems	7	6	97	0	37
House too far from the grid	64	78	3	0	44
Others	0	6	0	100	9
Total	*100*	*100*	*100*	*100*	*100*
No. of HH	100	100	100	100	400

Source: ASTAE-EnPoGen Survey in Indonesia, August 2001.

For grid electrification in particular, the high cost of access appears to have basically discouraged many unelectrified households from even trying to apply. Although having access to electricity is clearly desired, only about one-fifth of the unelectrified households in the Indonesia study sample had ever applied (table 7); and of those who had applied, more than 75 percent had applied one year or more ago, implying a high level of discouragement.

Finally, respondents who had applied for connections were asked about the problems they encountered. These included problems with the service provider's staff on issues associated with implementation of a mini-hydro project; capacity and budget limitations; and bureaucratic delays, extending from the funding agency to local consultants. The most critical problem was that applicants were simply told they were "too far from the grid" as a reason for not being offered a connection. Because these unelectrified households were basically drawn from currently electrified villages, the problem signifies the provider's inability or unwillingness to make small extensions to distribution networks to reach these potential customers ("no poles").

The Issue of Remoteness

To sum up, although modern energy services are capable of a range of social and economic benefits to rural populations at large, numerous barriers to providing them effective and affordable access exist, as illustrated in the context of electricity. Central to these barriers is the issue of *remoteness*, which affects the poor most acutely.

Even if improved energy services were affordable to poor people with easy access to equipment, advice, and credit, these options are more expensive and more difficult to obtain for those in isolated rural communities. People in these communities are likely to have more difficulty in obtaining sufficient information and contacts to identify credit sources, credit terms, existing technical alternatives, and so on. Development activities for such populations result in high transaction costs for both financial institutions and for the suppliers of equipment and technical assistance, making them unattractive to customers and suppliers alike. Consequently, this chapter of the population is likely to be most "excluded" from both market and state delivery systems.

Remoteness adds to the costs of all energy supply options, but not necessarily in the same way and to the same degree. Thus, remoteness is likely to increase the attractiveness (comparative advantage) of energy supply options that do not require the transportation of fuels relative to those that do. This will tend to favor options that rely on local energy resources (such as biogas, gasification, hydro, wind, passive solar, and PV systems) rather than on fossil fuel–based systems. However, this transport cost advantage may be offset by the cost of imported spare parts and the high cost of frequent visits from urban-based technicians required to maintain novel or delicate systems.

Policymakers face difficult choices in the tradeoff between providing improved energy access to the *most* people and to people in *specific locations*. Proponents of decentralized systems are often disappointed that utilities will not take them seriously. Certainly small decentralized systems often face unfair competition from a highly subsidized grid, and from subsidized fossil fuels. There is, however, a genuine tradeoff between maximizing the access of people to efficient and affordable energy, and doing so in those places where a particular technology (such as PV, wind, or microhydro) provides the least cost option.

The scarce resource in most countries is not energy, but rather the capital to make energy both accessible and useful. Therefore, if the objective is, for instance, to provide electricity to as many people as possible, the most cost-effective way of achieving this may well be through extensions of the existing grid or, more likely, “intensification” of the use to which the grid is put rather than to distribute electricity evenly across the country.

By contrast, if equity consideration forms a part of the objectives of energy policy, for example, between regions or population groups, then small-scale decentralized technologies are likely to have an important role, even if the intended users cannot meet the full cost. Certainly, people in remote rural areas in many countries can be expected to ask why they should not be entitled to at least the same levels of subsidy on energy services as those often provided to urban dwellers.

4 Poverty and Gender Impacts of Rural Electrification

Past approaches to assessing the impacts of rural electrification programs have largely been confined to grid extension by utilities with little, if any, coverage of decentralized electricity options. Also, their focus has generally been on rural populations at large without specific attention to the impacts of electricity on the poor and the women. However, it would be incorrect to assert that poverty dimensions did not feature in such assessments. A number of past exercises have tried to look at the poverty impacts of electricity as a part of overall social impacts. Few attempts, however, have been made to segregate these impacts from the rest. Neither have they been sufficiently detailed to isolate the expectations of the poor, their acute problems of affordability, and the distinctions between impacts on men and women.

Against this backdrop, the EnPoGen studies in China, Indonesia, and Sri Lanka have tried to break new ground by examining how electricity affects the rural poor and what special impacts it has on women. The studies in each country had their own approach and methodology, with the ones for Indonesia and Sri Lanka broadly similar, and the ones for the China study rather different. A brief background of the poverty situation in these countries and the way in which the impacts of electricity on their rural populations were assessed are briefly described in this chapter, followed by a summary of the most important findings of the studies on the impacts themselves.

Poverty Situation in Study Countries

China

Based on official figures, the number below the rural poverty line in China declined from 250 million (30 percent) in 1978 to 42 million (4.2 percent) in 1998. Although the poverty line is set at a stringent level,[7] these figures clearly indicate a dramatic reduction in the incidence of poverty. It is generally agreed that this has been achieved mainly as a consequence of rapid economic growth (averaging about 9 percent), combined with low population growth (less than 1.4 percent). However, the Chinese government has also adopted a wide range of specific poverty reduction policies during the reform period, partly in response to increases in regional and income inequalities.

[7] About US$0.75 per day. Some 106 million (11.2 percent) remained in poverty at the end of 1998 based on the international standard of US$1 per day PPP poverty measure.

Progress on poverty reduction has varied both over time and between regions. The most rapid decline, from more than 30 percent to about 11 percent, occurred from 1978, the start of the economic reforms, to 1984. Increased rural incomes during this period were usually attributed to increased agricultural productivity, following the introduction of the household responsibility system, and rising prices. Over the subsequent period, 1985–89, rural income growth fell back sharply because of stagnating crop prices and rising input prices, as farmers attempted to further increase productivity by increasing applications of fertilizers and pesticides. The absolute numbers living below the poverty line increased, whereas the proportion remained static. Inequality also rose as nonfarm incomes became increasingly important.

Poverty today is seen very much as a regional issue in China. The poorest are concentrated in the mountainous areas of the western provinces. Whereas economic growth, combined with a range of policies specifically aimed at improving rural incomes, has dramatically raised the living standards of most of the rural population, these remote and often economically isolated communities pose a major challenge to existing poverty reduction strategies. These populations, often ethnic minority groups, not only suffer severe income poverty, but often lack even basic health, education, and other social services. Although they have land use rights, the cultivated area is typically small and the soil quality poor. Agricultural production is further constrained by an unfavorable climate, for example, recurrent drought. Infrastructure, including roads, communications, and electricity supplies, is lacking or inadequate and badly maintained.

Rural poverty reduction policies in China, led by the State Council's Leading Group Office for Poverty Reduction, have focused on promoting economic growth in selected geographic areas—specifically, 592 nationally designated "poor counties." These counties have been targeted for central government assistance, typically in the form of production-oriented loan finance via the Agricultural Bank of China. However, in the light of the retrenchment of collective welfare activities post-reform, the implications of defining rural poverty on a purely geographic basis and the assumption that primarily market-oriented development will provide solutions are currently being debated within China.

Indicators that female poverty is more prevalent than male poverty in the country include uneven sex ratios at birth and higher female infant mortality rates; higher female unemployment rates; higher female suicide rates; and lower school enrollments for girl children. All domestic and some income-earning tasks, for example, caring for small livestock animals, are typically regarded as "women's work." Women also play a leading, and sometimes solitary, role in caring for aged parents or dependent children and may have to take on additional tasks, such as plowing and marketing, when male household members seek work outside the village. In remote areas, the absence of water supplies, roads, and electricity may necessitate many hours spent on fetching water, gathering and transporting fuel, traveling to health services or schools, and working on manual household tasks, such as milling flour or cutting fodder for animal feed.

With regard to rural energy, China can again be seen in some respects as radically different from other developing countries. Mainly in consequence of the astonishing growth of "township and village enterprises," a dramatic increase in rural energy supply and consumption has occurred. In particular, the expansion of rural electrification has led to a situation in which some 96 percent of the villages and 94 percent of the households are now served by large or small grid systems. Thus, the great majority of even poor households have access to grid electricity, though possibly (particularly for isolated grid systems) with capacity, reliability, or quality constraints on potential applications in relation to production activities.

In these circumstances, lack of access to electricity has become an important indicator of exclusion from the increasing prosperity of the majority. Those villages with no grid connection are typically in the most remote and sparsely populated regions with the most difficult terrain. They also have limited access to roads, markets, and other services. Not surprisingly, they are among the poorest in China. This minority that has no access to electricity or that relies on batteries or small diesel generators includes some 77 million people in 30,000 villages.

Indonesia

Until the East Asian economic crisis in 1997, Indonesia was recognized as a success story of rapid economic growth (7 percent annually from 1979 to 1996), steadily rising development indicators, and impressive achievements in poverty reduction. Since 1976, nearly 30 percent of the Indonesian population were lifted out of poverty, lowering the rate of those in poverty to 11 percent in 1996. The persistent economic crisis since 1997 has reversed these gains. Estimates indicate that, during the peak of the crisis (late 1998 to early 1999), the population below the poverty line doubled from its precrisis level. Despite the beginnings of a recovery since, the number of people below the line of poverty was estimated at 37.5 million in 1999, that is, 18 percent of the total population, approximating conditions in the mid-1980s. However, if all the dimensions of human well-being—adequate consumption, reduced vulnerability, education, health, access to basic infrastructure, and a chance to participate in social and political life as equals—were included, poverty concerns likely half the Indonesians.

Poverty reduction is, therefore, considered as the most important challenge facing Indonesia. A recently signed agreement between the government and the IMF, has emphasized boosting the development of micro, small and medium scale businesses and increasing the people's welfare in rural areas in order to strengthen sociopolitical stability by accelerating infrastructure projects in the district (*kecamatan*) and rural subdistrict (*pedesaan*) levels.

Indonesia is still largely an agricultural society. Its women enjoy fairly extensive freedoms with their active participation in the market, particularly the physical market. They work side by side with men and constitute a good proportion of traders in traditional markets. There is always a difference, however, in degree between groups depending on available opportunities. Typically, women do the "light" work and men the

“heavy” work, but men are involved in commodities and activities that are more lucrative, and women are associated with less lucrative commodities and jobs. Conditions do change depending on available income-earning opportunities within communities and elsewhere, which is a function of infrastructure.

With their individual earning abilities, women are generally used to holding the household purse strings. Husbands usually hand over their earnings to their wives, retaining “pocket” or “cigarette” money. As such, in cottage or home-based businesses, women are likely in charge of money matters, as well as managing the business, whereas men do most of the shopping. In situations of poverty, it is also the wits of women that keep households together. They are the ones who normally borrow money at times of financial difficulty, and work out the household budget and the menu of what the family consumes. Large purchases are decided by men, whereas day-to-day expenses are decided by women. Hence, women are more concerned about saving energy, for instance, turning off lights when not in use.

At the same time, Indonesian women shoulder a greater and more diverse workload than men, particularly in rural areas. They manage the housework; take care of the children; nurse the sick and the old; collect water, fodder, and fuelwood; take care of smaller livestock; work on crop fields; and handle manual post-harvest operations. In addition, they shoulder an important share of the voluntary work required by community development programs and most often develop earning activities to increase family income. They are also still largely excluded from community decisionmaking, even if in some areas they have developed their own community gatherings and activities, such as saving and credit schemes.

Turning to energy, the electrification transformation that has occurred in Indonesia over the past few decades has been impressive, with the percentage of households with grid-supplied electricity rising from 52 percent in 1993 to 84 percent in 2000. In rural areas, the progress made is even more striking, with 48,000 villages (82 percent of the total) being electrified by 1999. Where electricity was a rarity in rural areas in 1980, by the turn of the century nearly three-quarters of the population had access to grid electricity from the grid and, another 4 percent or so from other sources (including decentralized renewable energy systems).

However, rural electrification ratios vary significantly from one province to another. The highest rates are in Yogyakarta (94 percent), Bali (81 percent), East Kalimantan (79 percent), and West Java (70 percent), whereas the lowest are in East Nusa Tenggara (13 percent), South East Sulawesi (21 percent), Irian Jaya (21 percent), and Lampung (22 percent). The average number of customers per village has also increased more slowly than the village electrification rate, by about 30 percent over the last 10 years. A crude estimate shows that 35–40 percent of the households in grid-connected villages are still not connected. Many of them have resorted to informal (illegal) hookups.

Sri Lanka

Sri Lanka is a low-income country with a per capita income of about US$820. In 1996–97, between a fifth and a third of the population (representing 3.3–4.5 million out of 17.5 million people, excluding the population of the Northern and Eastern provinces) were classified as poor, depending on whether or not poverty is measured using a low poverty line set at Rs. 860 per person per month (that is, least cost diet) or a slightly higher poverty line set at Rs. 1,032 per person per month (that is, the prevailing diet among poor households). With its strong human resource base and natural endowments, Sri Lanka might have achieved substantially higher growth rates and poverty reduction had it not been for a history of ethnic conflict and political unrest.

As with the other two countries, poverty in Sri Lanka is predominantly rural in nature. Approximately 85 percent of the poor households are located in rural areas, whereas the total rural population is about 75 percent of the national aggregate. On average, about 26 percent of the rural population is poor. Slightly less than half the poor depend on agriculture for their livelihoods, whereas another 30 percent depend on other rural nonagricultural activities. The poorest household are not the landless, but rather the subsistence farmers who receive more than half their income from the value of food produced for their own production. There are sharp disparities in poverty levels among and within the different provinces (from Uva, the worst, to Western Province, the best), as well as among districts within the same province.

Poverty is not only manifested by an inability to afford basic consumption goods, but also by a lack of access to basic needs, such as education, health care, safe drinking water, safe sanitation facilities, and electricity. The 1998 UNDP Human Development Report estimates the proportion of population lacking access to education (nonenrollment at the basic, junior, and secondary levels) at 9 percent, to safe drinking water at 28 percent, to safe sanitation facilities at 24 percent, and to electricity at 56 percent in 1994. Overall 18 percent of the population did not have sufficient income to meet their basic needs in 1994.

Under the government's *Samurdhi* program, efforts are concentrated on breaking the vicious circle of poverty—low incomes leading to low savings, low investment, and low productivity; and low productivity, in turn, resulting in lower incomes, lower savings, and lower investment. The program is aimed at upgrading the standard of living of the people in rural areas, and at serving and guiding the underprivileged sections of society toward bringing about their own development. Some 30,000 *Samurdhi Societies* have been established for low-income earners in small villages, with nearly 50 percent of the population receiving a monthly cash allowance.

With regard to electrification, about 37 percent (14,000) of the villages in Sri Lanka were provided with electricity until 1999. On a national basis, only about 53 percent of the households enjoy the direct benefits of electrification. In addition to the national power grid, the government has promoted village electrification using mini-microhydro schemes and encouraged SHSs by reducing the import duties on PV systems from 30 to

10 percent. The ongoing SHS promotion targets the provision of electricity to 30,000 rural households by the installation of household solar PV systems. The target rural households are those not expected to receive grid connections in the foreseeable future and that rely on kerosene lamps, automotive batteries, and dry cell batteries for daily lighting, radio, and television.

Methodology of Impact Assessment and Study Communities

China

The EnPoGen fieldwork in China was conceived primarily as a series of case studies, using both qualitative and quantitative methods, in five poor and one nonpoor rural counties in two provinces. The opening phase of research included a review of relevant documents and in-country discussions with national, provincial, and county officials. The main fieldwork exercises were a series of in-depth studies during a period of 7–10 days in a selected village community in each county. Additional material was gathered from the corresponding township and county levels using document reviews and key informant interviews.

The provinces of Gansu and Hubei were selected as being of particular interest for the purpose of the study, although for somewhat different reasons. Gansu suffers from severe water shortages and arid soils that have impacted on agricultural productivity and household incomes. It is widely believed that deforestation, primarily a consequence of the clearance of land for agriculture, has been exacerbated by the widespread use of fuelwood as a primary source of energy for cooking and heating. This has encouraged policies targeted at the development of alternative and renewable energy sources. Hubei is one of the most important provinces for hydroelectric power generation, both in major dam developments and small-scale hydropower installations. The mountainous terrain of Western Hubei makes communications extremely difficult and there are a large number of remote, very poor villages, some of which have no electricity.

The study sites were selected to provide a wide range of circumstances, but with a strong bias toward poor, remote, relatively isolated rural communities. Such communities are the main focus of the current poverty agenda in China. They were also of special interest from the perspective of the study because of the obvious association between geography and access to energy services, particularly electricity. Furthermore, the villages were intended to represent diversity in the level of access to electricity. The main study villages surveyed were as follows:

Gansu

- Gaozui Village in Huining County: an isolated group of natural villages without road access or electricity.

- Zhaoshan Village in Yongjing County: a village in a poor county with good road access, but relatively recent access to grid electricity capable of powering production equipment.
- Xiapai Village in Yongchang County: the only nonpoor county studied, in one of the most productive agricultural areas of Gansu and with long-established grid access.

Hubei

- Xiaozhu Village in Lichuan County: a very remote mountainous village without electricity.
- Duiwotai Village in Xianfeng County: a village in a relatively remote location with electricity provided by a small, "run of river" hydroelectric generator.
- Housanxi village in Jianshi County: a village in a poor county with recent road access and grid connection.

Gaozui in Gansu and all three villages in Hubei were in mountainous areas, and many of their component natural villages[8] were not connected to roads. Where roads did exist, they were typically in very poor condition, often hazardous, and in many places accessible only to three-wheel diesel trucks. Xiaozhu had no primary school, with young children facing a daily walk of up to two hours each way. None of the villages had a health station or health extension worker, and villagers reported having to travel more than 10 kilometers to access their nearest formal health care facility.

Indonesia

The EnPoGen study in Indonesia was carried out through a case study approach, with representative cases being selected to encompass various situations in location, service provided, and age of electrification. The field work was carried out in two phases: a qualitative phase, designed to let people freely express their opinions and concerns through individual interviews and group meeting, and a quantitative phase involving surveys to validate and quantify the main findings.

The investigation employed a combination of econometric and participatory techniques, including social mapping, fractal analysis, "day in a life" tests, and analysis of local socioeconomic trends. The measurement of the impacts of electrification on poverty used four complementary approaches:

- *Money metric*: impact in relation to income improvement or expense-cost reduction.
- *Basic services*: impact in relation to better access to some basic services, such as education and health.

[8] The word "village" in China is used to refer to an administrative unit typically composed of about 10 subvillages or "natural villages."

- *Gender*: impact in relation to redistribution of roles within a community and households.
- *Social capital*: social integration and participation, and access to basic human rights.

The qualitative phase consisted of 110 in-depth individual interviews and 6 focus group discussions in West Java and South Sulawesi. The quantitative survey focused on the same locations and energy systems that were covered in the qualitative phase, and covered 1,300 electrified households (800 with access to grid, 300 using SHSs and 200 supplied by microhydro systems), along with 400 unelectrified households and 100 small businesses for a total sample of 1,800 respondents.

The study locations were selected to encompass a diversity of situations regarding the following:

- Access to service, in relation to (a) electrified households in electrified communities, (b) unelectrified households in the same communities, (c) households in unelectrified communities, generally without access to service.
- Type of electricity supply: conventional rural electrification by grid extension, isolated local electricity grid supplied by a microhydro plant, individual SHSs, and isolated local grid supplied by a hybrid solar-diesel system.
- Time elapsed since electrification, in order to identify possible trends and longer-term effects.

The communities chosen for the study were from 20 villages located in four districts of three provinces—Tasikmalaya in West Java, Lebak in Banten, and Mamuju and Makale in South Sulawesi. The villages covered by the study were as follows:

Tasikmalaya

Sukahurip, Sukamenak, Padasuka, Sukarame, Cilamajang, Leuwiliang, and Gunung Tandala.

Lebak

Prabugantungan, Cipadang, and Prabugantungan.

Mamuju

Salugatta, Potana-Kayang, Tappilina, Salopangkang, and Tappilina.

Makale

Ta’ba, Bokin, Batu Buasa, Tallangsura, and Ponglu.

Sri Lanka

The Sri Lanka EnPoGen study also used a two-phase qualitative-cum-quantitative case study methodology. A number of tools and techniques adapted from Participatory Rural Appraisal (PRA) were used to generate information for the study. They included wealth ranking, impact diagramming, pair-wise ranking, structured formats, semistructured interviews, and observations. The process of generating information was carried out at different levels using different strategies, such as collective participants’ forums, focus

groups, and individual household level interviews. The methodology adopted focused on identifying as far as possible people's perceptions of the benefits and impact of electrification, and their potential and constraints to access electricity.

Secondary data and information were gathered at district and divisional levels. Information on the different electrification programs and their beneficiaries was obtained from the Ceylon Electricity Board (CEB), the Sarvodaya Economic Enterprise Development Services (Guarantee) Limited (SEEDS), and the Intermediate Technology Development Group (ITDG).

The participants and respondents under the study represented a cross-section of users and nonusers of the different types of electricity services in Sri Lanka, including the following:

- Grid electricity connections.
- Village microhydro schemes.
- SHSs.
- Consumers participating in demand side management programs, namely, the use of CFLs in households.

The participants and respondents represented families that have had access to the different types of electricity services in the recent past (two to three years), as well as those who may have benefited from such electricity services for a relatively long time (seven years or more), and those who did not have access to electricity services. In addition to household-level participation, the study also focused on electricity used in commercial ventures, hospitals, and other social institutions, and the benefits and impacts for these institutions.

The qualitative study was conducted in four sample areas taken from the larger sample of 35 villages selected for the quantitative survey because these sample areas were considered representative of many of the household characteristics intended to be addressed in the larger survey. The areas selected for the qualitative study were the Asmadala-Wakirigala rural electrification scheme (grid), village microhydro schemes in Oluwella and Berennawa in the Kegalla district of Sabaragamuwa Province, SHS users from five villages in the Moneragala district of Uva Province, and CFL users in Poojapitiya in the Kandy district of Central Province.

The quantitative survey was conducted in six provinces (Central, North Central, Sabaragamuwa, Southern, Uva, and Western) covering 10 districts (Anuradhapura, Badulla, Colombo, Kalutara, Kandy, Kegalla, Monaragala, Matara, Nuwara Eliya, and Ratnapura). Of the 1,820 respondents covered, 1,573 were households, and the remaining 247 were commercial and service establishments.

Impacts of Electricity on Living Conditions of the Poor

The nature and variety of the impacts of electricity on the living conditions and lifestyles of the people, and their criss-crossing effects on different aspects of daily life, make the

tasks of segregating them challenging.[9] Furthermore, the findings of the three EnPoGen studies do not always agree with one another. Although the Indonesia and Sri Lanka studies reach largely similar conclusions, there are differences between them and the findings of the China study. This is not surprising since China's very high rate of rural electrification and its remarkable success with reducing poverty set it apart from other developing countries of Asia. The following summary draws upon the outcomes of all three studies.

The foremost conclusion from the studies is that the rural people, the poor and the women among them, consider electricity to be a basic need in daily life. Evidence of the weightage given to electricity can be seen in the way it was ranked among a number of *life priorities* in Indonesia (table 8).

Although the classic essentials of food, shelter, and clothing were ranked the highest, electricity was ranked before education and health (which are generally considered key basic needs) by unelectrified respondents, not far behind by electrified respondents, and well ahead of transport and recreation. On this point, there is a common consensus among the three studies, including in China where even the poor communities living in the remotest mountain areas aspire for and are willing to pay the cost of electricity from whatever source that is available to them.

The overall impact of electricity on living conditions and lifestyles is again illustrated by the findings of the Indonesia study (table 9), which are similar to the findings of the Sri Lanka study and, though not in equal detail, in substance to the findings of the China study. The most significant benefits ascribed to electricity are that it makes home life more convenient and housework easier. These aspects are elaborated further, but it is worth noting here that the most crucial impact of electricity, and the reason why it is assigned the role of a basic need by the people, is the way in which it brings about certain profound changes in daily life, affecting in the process whole families.

[9] The tables and figures in this chapter are drawn selectively from the EnPoGen source reports to illustrate the most commonly observed impacts among all three countries. There are close similarities in the outcomes of the Indonesia and Sri Lanka studies. The results of the China study are at times different, and this is highlighted wherever applicable. For the purpose of this summary, the choice of tables and figures from one or the other of the source reports is more a matter of convenience rather than the lack of similar information in the other reports. In any case, the individual source reports are highly recommended for a more country-specific, in-depth understanding of the topics covered.

Table 8: Average Ranking of Life Priorities by Households in Indonesia

Life priority	Lebak	Tasik-malaya	Makale	Mamuju	Total
Electrified households					
Food	1.13	1.06	1.20	1.09	1.12
Shelter	3.34	3.18	2.30	3.30	3.10
Clothing	3.14	3.42	3.80	3.07	3.33
Health	4.48	4.02	4.64	4.13	4.36
Education	4.59	4.95	4.42	4.33	4.62
Electricity	**5.39**	**5.01**	**4.98**	**6.23**	**5.31**
Land (for agriculture)	6.56	7.97	6.87	6.50	6.96
Transport	9.00	8.02	8.67	8.16	8.60
Recreation	9.11	8.19	8.11	9.37	8.72
Religious observance (*haj*)	8.26	9.18	10.00	8.82	8.89
Total number of households	*575*	*325*	*250*	*150*	*1,300*
Unelectrified Households					
Food	1.04	1.05	1.16	1.42	1.10
Shelter	2.80	2.63	2.27	2.26	2.59
Clothing	2.99	3.48	3.51	4.32	3.37
Electricity	**4.72**	**4.11**	**4.35**	**4.26**	**4.40**
Education	5.15	4.47	4.45	3.21	4.62
Health	5.55	5.64	5.78	6.00	5.67
Land (for agriculture)	6.45	8.55	6.60	7.11	7.23
Recreation	8.86	8.00	8.22	9.74	8.50
Transport	8.82	8.20	8.76	8.26	8.56
Religious observance (*Haj*)	8.62	8.87	9.89	8.42	8.97
Total number of households	*92*	*83*	*55*	*19*	*249*

Table 9: Lifestyle Changes Made Possible by Electricity in Indonesia

	Lebak	Tasik malaya	Makale	Mamuju	Total
Rank 1					
Having more money	2.3	1.2	1.2	0.0	1.5
Makes me feel I live in a modern world	9.2	8.0	1.2	2.0	6.5
Links me with the rest of the world	3.0	5.8	0.8	6.0	3.6
More time for entertainment	4.7	8.6	0.8	2.0	4.6
More convenient home life	**60.9**	**39.1**	**58.0**	**34.7**	**51.8**
Housework has become easier	**9.0**	**28.9**	**20.8**	**25.3**	**18.2**
No risk of fire from kerosene lamp or candle	7.8	3.1	2.0	10.0	5.8
Increases the value of my property	0.2	0.6	0.4	0.0	0.3
Improvements in social services	0.3	0.3	1.2	0.0	0.5
Safer at night	2.6	4.3	13.6	20.0	7.2
Total	*100.0*	*100.0*	*100.0*	*100.0*	*100.0*
Rank 2					
Having more money	0.7	0.0	0.4	1.3	0.5
Makes me feel I live in a modern world	8.9	5.5	1.2	2.0	5.8
Links me with the rest of the world	2.1	9.8	0.0	4.7	3.9
More time for entertainment	7.3	16.0	2.4	7.3	8.5
More convenient home life	**14.8**	**20.3**	**31.6**	**22.7**	**20.3**
Housework has become easier	**21.4**	**23.7**	**46.8**	**21.3**	**26.8**
No risk of fire from kerosene lamp or candle	**31.1**	**6.5**	**7.2**	**18.0**	**18.8**
Increases the value of my property	1.2	0.6	0.0	0.0	0.7
Improvements in social services	0.2	4.3	0.8	0.7	1.4
Safer at night	12.3	13.2	9.6	22.0	13.2
Total	*100.0*	*100.0*	*100.0*	*100.0*	*100.0*
Rank 3					
Having more money	1.2	6.2	1.2	3.3	2.7
Makes me feel I live in a modern world	12.7	5.2	12.8	3.3	9.8
Links me with the rest of the world	2.3	12.3	2.0	5.3	5.1
More time for entertainment	5.6	16.9	10.4	12.0	10.1
More convenient home life	11.1	7.7	3.6	26.0	10.5
Housework has become easier	12.3	6.2	3.6	6.7	8.5
No risk of fire from kerosene lamp or candle	**23.0**	**18.5**	**19.6**	**18.0**	**20.6**
Increases the value of my property	0.9	3.1	0.0	1.3	1.3
Improvements in social services	2.6	9.5	1.6	1.3	4.0
Safer at night	**28.3**	**14.5**	**45.2**	**22.7**	**27.5**
Total	*100.0*	*100.0*	*100.0*	*100.0*	*100.0*
Number of households	**575**	**325**	**250**	**150**	**1,300**

The impacts of electricity on rural living conditions have been classified in various ways among the three studies. In essence, they refer to the following primary areas:

- Illumination (lighting).
- Alleviation of isolation (television, radio).
- Home improvement (household appliances).
- Education (lighting, television).
- Health (lighting, refrigeration).
- Women's time (lighting, television, household appliances).
- Building of social capital (lighting, television).

Illumination

Illumination offered by electrical lighting is unquestionably the most significant impact of rural electrification irrespective of the type of service, centralized or decentralized. It is the first priority for virtually all rural communities, and its many benefits are circumscribed by a sense of social "inclusion," well-being, and social capital building. The main impacts of electrical illumination are as follows:

- Improved well-being: the quality of lighting with electrical lamps is better, electrical lighting is easier to use, a single lamp provides sufficient lighting for all persons inside the same room, and electric lighting is cheaper than kerosene.
- Improved security for people and property against theft: families feel secure because the house is well lit (in rural areas, most households have their private wells and toilets outside).
- Improved security against accidental fires and burns from kerosene use.
- Monetary savings: electrical lighting is cheaper than kerosene, which is its closest substitute.
- More time for children's studies: evidence on this is mixed, however.
- Homestead crop protection against theft and wild animals, as compared to the difficulties of using kerosene lamps outside, especially during the rainy season and on windy days.
- Easier house maintenance: as compared to kerosene lamps that dirty the walls through soot emissions.
- Community safety: through lighting of houses, streets and shops.
- Social security: removal of the stigma of extreme poverty and other attendant effects, such as discouraging of outmigration.

Some of the above benefits, such as education and reading, are dependent not just on the availability of lighting, but also, importantly, on the quality of the illumination. In Indonesia (similar to the case of Sri Lanka), although electric lighting is a key issue for most people, rural families buy low-power (and low-efficiency) bulbs in the 5–10 W range, suggesting that the importance of electric lighting is not so much the quality of illumination, but rather the switch from kerosene and inferior lighting sources, such as

candles. The situation is both similar and different in the case of China. In China, the average capacity of incandescent (the most common) light bulbs used ranges from 15 W to 40 W, but lower capacities are normally associated with microhydro systems and higher capacities associated with grid supply. In Indonesia, it is the reverse because users of SHSs and microhydro-diesel hybrid systems have no choice but to use fluorescent tubes or CFLs that are part of the supply system package. Notwithstanding this difference, the fact remains that, given the choice, rural users do not place a premium on lighting quality. The resultant lighting conditions equal or barely exceed those provided by kerosene wick lamps and significantly dimmer than kerosene pressurized lamps, and they are just enough to assist a minimum level of night-time visibility.

Alleviation of Isolation

Along with lighting, television tops the list of benefits from electrification. Its most crucial contribution is to end the geographical and social isolation of the rural people, enabling them to overcome their sense of "exclusion" from the world around them. Even among poor communities, the sense of exclusion of those people "left out" may imply that lack of access can reasonably be defined as a component of the newer, multidimensional view of poverty. As reported in China, poor men will walk many kilometers over rough tracks in the dark to watch television in a neighboring village. Access to electricity for lighting and television is closely associated with a minimal quality of life in all three countries. Its absence is seen as sufficient cause for a number of negative social phenomena, such as children desiring to leave their home village as soon as possible or women not wanting to "marry in."

Television offers the following range of lifestyle benefits:

- Improved well-being: switching from battery-operated black-and-white to color TV with no interruptions for two-day battery recharging; unrestricted TV watching time (connected families spend one to two or more hours watching TV together every night using extra time gained with electrification).
- Gender impacts: for the first time, women share hours of relaxation with their husbands every night, which enhances gender equity with regard to entertainment and access to information; both men and women feel that watching TV is a way to get information to improve women's situation.
- Cash savings: except with SHSs, powering TV sets with electricity is cheaper than with batteries.
- Education and awareness: children increase their knowledge and learn from TV programs at night; adults improve their awareness of the happenings in the outside world, weather conditions in their area and other aspects of development that were previously shut out to them.
- Easy access to day-to-day information for all family members: This increases family awareness and provides a sense of equality with others.

The importance assigned to television and, to a lesser extent, radio-cassettes is evident from the rapid penetration rates of these devices, as illustrated in the case of Indonesia. Even in the absence of electricity, battery-operated black-and-white television sets are popular among rural people. With the arrival of electricity, TV and radio-cassette ownership rises rapidly—in the case of Indonesia, to 30 percent within the first two years, to 40 percent within the next five years and to more than 60 percent thereafter (figure 7).

The Indonesian study assessed what people watched and what value they gained from TV. The highest value was attached to news and (especially in female-headed households) children's programs (table 10). Sports programs were rated second in importance in male-headed households. However, the overall benefits were almost equally divided between entertainment and information. There was also little difference in views between women and the family as a whole. In short, although entertainment might be a prime motive for watching TV, it is equally, if not more, important as a medium of information and communication in improving people's lives. These findings are echoed by the China and Sri Lanka studies.

Figure 7: Levels of Penetration of TV and Radio-Cassette: Indonesia

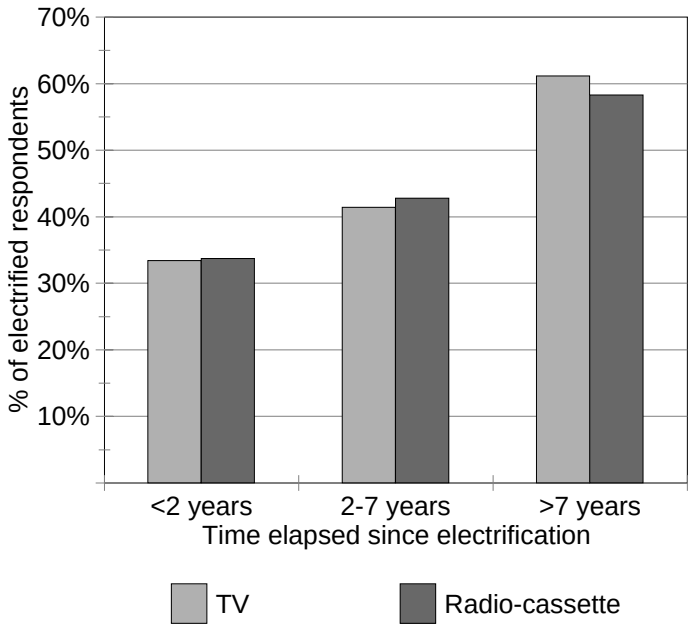


Table 10: Ranking of TV Programs Watched: Indonesia

(% of households)

Programs watched	Lebak			Tasik malaya			Makale			Mamuju		
	1	2	3	1	2	3	1	2	3	1	2	3
Weather forecasts	0	0	0	0	0	0	2	0	5	6	2	2
News	69	15	9	59	24	11	91	4	5	77	13	2
Sports	5	33	14	2	31	18	2	40	38	4	21	23
Music and films	19	35	33	25	13	20	4	47	35	8	49	30
Soap operas	4	9	19	9	18	25	0	2	2	4	8	15
Political debates	0	2	6	0	3	7	2	4	13	0	2	6
Children's programs	2	5	18	4	10	15	0	4	0	0	4	23
Technical information programs	0	0	1	0	0	3	0	0	2	2	2	0
Total	100	100	100	100	100	100	100	100	100	100	100	100
Number of households	246			218			55			53		

Home Improvement

Although lighting and television are a part of the parcel of household appliances that contribute to improving the living conditions in rural homes, their high level of popularity, especially of lighting, lends them special importance among all rural people, including the poor. However, several other electrical appliances enhance household convenience, the difference in their case being that they are closely related to income levels and, therefore, acquired only to a very limited extent by the poor (with the exception of radio-cassettes, the ownership rate of which exceeds that of television because of its desirability and lower cost). The findings of the Indonesia and Sri Lanka studies[10] suggest that the most significant of these appliances and their impacts are as follows:

- Radio-cassettes: 92 percent of connected households own a radio or radio-cassette as the first item of family equipment; 19 percent of women, 23 percent of men, and 7 percent of children listen regularly to the radio, which provides them with entertainment and information about the world; whereas radios and radio-cassettes can be powered by dry cell batteries, electricity is cheaper.
- Electric irons: these replace traditional charcoal-burning irons in nearly three-fourths of grid-connected households; in unconnected households, 65 percent of the women interviewed ranked electric irons as the second priority among all

[10] The percentages against individual appliances are drawn largely from the Indonesia study, but they are similar to the findings of the Sri Lanka study. Refer to the source reports for country-specific details.

home appliances; several benefits were reported, including safe ironing by all adult family members, ease of use because there is no need to prepare burned charcoal to power them, and time savings.

- Electric water heaters: in unconnected households, 65 percent of the women interviewed assigned third priority to water heating among the various uses for electricity at home; after electrification, 52 percent of households have a small water heater whose ease of use makes it possible for every adult family member to boil water and saves time.
- Electric grinders, rice cookers, kettles, and hot plate cookers: Although these appliances are equally desired, their prices make them less widespread within rural households than electric irons or water heaters.
- Refrigerators: in unconnected households, refrigerators rank ninth in order of priority for women and sixth for men; however, only the better-off households can own a refrigerator and the majority cannot; for those who can afford them, refrigerators provide for better food conservation, positive impacts on health, and a new lifestyle; families with refrigerators can change their dietary behavior, and are able buy and consume commercial dairy products and foodstuffs.
- Standing, ceiling, and table fans: 24 percent of connected households own fans, whose impacts are improved well-being and household comfort, especially in hot dry rural areas.
- Electric water pumps: within connected rural families, 38 percent own a well, and only 7 percent of them use an electric water pump because of cost considerations.
- Electric fences: to protect houses and subsistence crops from marauding wild elephants (Sri Lanka), offering financial savings, security for people, and reduced social tension between the people and local authorities.

As most of the above appliances are for use by whole families rather than for personal use, variations among the preferences expressed by women and men are not significant. The situation in China is rather different from the above, mainly because the study communities were largely the poor and their capacity to afford home appliances other than lighting and TV were considerably subdued. In all three countries, however, ownership of household appliances was largely associated with grid-connected households rather than with those supplied by decentralized systems.

Health

Interviews carried out under the Indonesia study noted that there is a strong belief among informants that electricity is safer because there is reduced risk of accidents or diseases from the use of kerosene lamps or candles. However, the importance and frequency of such accidents and diseases were not clearly established. The outcomes of the survey support the following findings:

- Only 8 percent of electrified respondents had experienced or heard about accidents or diseases caused by kerosene or gas lamps, or candles, whereas more

than 20 percent stated that they did not know; responses of unelectrified respondents were more cut-and-dried—88 percent stated that they had never experienced or heard about these problems.

- Half the respondents felt that electricity improves health services, but only a few stated that the improvement was significant; here again, numerous respondents did not know.
- An interesting finding of the survey was that the dissemination of water pumps because of rural electrification contributes to improving the quality of drinking water in rural areas as much as piped water supply. However, 60 percent of the electrified respondents used wells as the source of drinking water, and only 9 percent were supplied with piped water and 7 percent with electrical pumps.

The impacts of electricity on rural health service delivery were, however, found to be significant (table 11). According to at least 86 percent of the rural doctors interviewed under the Sri Lanka study, connection to electricity at rural health centers improved the quality of health center services, particularly the quality of medical treatment, and made possible the use of their facilities in the evenings. The principal benefits of electricity were stated to be the following by Sri Lankan respondents:

- The overall activity levels of connected rural health centers increased (although such trends are probably not only caused by electrification). The number of patients increased from 39 percent for family health offices up to 300 percent for maternity homes on average. As a result, 8 households out of 10 tended to trust village health facilities more since new treatment capabilities became available because of electrification.
- According to 69 percent of the people in charge of health centers, the use of electric sterilizers is the most important impact of electrification because electric sterilization is more efficient, reduces the number of accidents, and enables new medical treatments that were impossible or unsafe for patients earlier. Also, the use of electric sterilizers is stated to be much more convenient for the doctors, because they are easier, faster, and cleaner.
- Refrigerators allow vaccines and medicine to be preserved within health centers. Prior to electrification, only one of the 12 health centers surveyed used a gas refrigerator. After electrification, six use electric refrigerators, one an icebox, and the rest continue to have no preservation facilities. Local families enjoy financial savings from transportation costs and wage loss (for taking days off) because they no longer have to visit the nearest town to buy medicines each time they need them. Health center staff estimated the financial savings per patient to be Rs. 440 per year on average since vaccination in the village became possible, and the number of beneficiaries to be about 500 persons per year, per rural center on average (up to 31,000 for a rural hospital).

Table 11: Use of Electrical Equipment in Connected Rural Health Centers, Sri Lanka

Electric equipment	Number of citations	Percent of health centers
Water heater	13	81
TV, radio, cassette player	10	63
Cooling (fan)	9	56
Sterilization	8	50
Preservation of medicine (refrigeration)	7	44
Preservation of vaccines (refrigeration)	6	38
Telecommunications (telephone, fax)	5	31
Lighting the wards	5	31
Lighting the doctor's home	5	31
Medical equipment with a build-in lighting device	3	19
Computer	2	13
Rice cooker	2	13
Electrocardiogram	1	6
Air conditioning	1	6
Nebulizer	1	6
Other	1	6
No response	2	13
Total number of citations	*81*	

Although the above findings run parallel to those from the Indonesia study, the China study, by contrast, found little or no use of electricity in health clinics in the poor villages covered. The main reason for this was that it was too expensive. It is also possible that, in the case of villages supplied by decentralized systems, the volume of supply was insufficient to meet the needs of community facilities.

Education

According to the Indonesia and Sri Lanka studies, the educational benefits of electricity are distinct, but a cause-and-effect relationship is difficult to establish. There is also a distinction between the impacts of electricity on education at the household and school levels.

High proportions of children in Indonesia devote the additional time made available to them by household electrification to reading either in the morning or more in the evening. More than a third of the electrified households covered by the Indonesia survey stated that children use the additional time for homework in the evening. A large majority (over 70 percent) felt that electricity contributes to children's education through

information from TV-radio, and an even larger majority (79 percent) felt that it contributes to studying at home during the night.

These results at the household level, however, need to be handled with caution. First, as noted earlier, the quality of illumination provided by the low wattage lamps in popular use in rural households is generally insufficient for reading. Second, during the qualitative phase of the Indonesia study, respondents claimed that children study and do their homework in the afternoon, and at night they gather for *ngaji* (reading the Koran) or to watch TV before going to bed.

According to school directors interviewed under the Sri Lanka study, the availability of electricity contributed to better educational facilities in the following ways:

- Fifty-six percent of rural schools rely on electrical equipment after electrification to offer their services, and 82 percent consider the availability of electricity to have improved the quality of rural school services. The reasons for this included improved safety and working conditions in classes, allowing teachers to prepare courses under better conditions. However, only 23 percent of the respondents felt that electricity makes it more appealing to work in the rural areas.
- The electrification of rural schools contributes significantly to increasing the overall level of pedagogic and social activities in the buildings (although this is probably not caused by electrification alone). The number of pupils in electrified schools increased by 67 percent on average over the past five years, evening adult education programs were launched by half the rural schools, and all electrified school buildings were used in the evenings for other community purposes.
- Pupils' results improved for two-thirds of the enrollment, and the number of pupils continuing to study in secondary school increased or remained the same (however, electricity is probably not the only reason for these trends).

Notwithstanding the above findings, only about 17 percent of the poor children in Sri Lanka attend classes regularly. Although the majority (60 percent) of them attend primary schools regularly, their attendance at secondary schools and senior secondary schools is considerably lower (11 percent and 25 percent, respectively). This is because when children grow up enough to be able to help with housework or agricultural activities, they miss more classes. This implies that the main problem with education for the poor people is not energy, but rather time availability and affordability.

The outcomes of the China study are far less flattering of the role of electricity in education:

- Very little use was made of electricity in schools in poorer villages, even for basic lighting, on the grounds that it was simply too expensive.
- In one village, even though the school had electricity, teachers complained that they had to prepare lessons and mark homework each evening using small and very dim kerosene lamps.

- In another village, even though each classroom had a 60 W bulb, one teacher claimed that they had never been used. Teachers were reluctant to turn them on even during the dark winter afternoons because they were concerned about the cost of electricity.
- In yet another village, the school had no lighting apart from two oil lamps used by teachers, even though all the surrounding houses had electricity.
- Children from Xiaozhu, the poorest community in the study, had to walk to a school in the administrative district, up to two hours away. Even in this school, only two of the nine classrooms had electric light. Teachers reported that if it became too dark to do normal lessons, as occasionally happened in winter, children would do physical exercises instead. Interestingly, the headmaster's office had a 29-inch TV, DVD, hi-fi, and a recently connected telephone.
- Only the school used by pupils from the richest village, Xiapai, made formal use of television, radio, and video for teaching.
- Furthermore, even though winter temperatures could fall to zero and below in at least four of the villages surveyed, there was seldom any provision for heating. In Zhaoshan, primary school children were asked to bring fuel to school each day. In Duiwotai, they each took a small brazier and some coal. In Housanxi, where teachers said that burning fuel in the classrooms would be unhealthy, they would shut the doors and windows tightly on cold days and the children would jump up and down to keep themselves warm.

It would seem that the sharp contrast of the situation in China against that prevailing in Indonesia and Sri Lanka owes to differences among the respective study samples. This might not be obvious from the descriptions of the selected study areas because they all strike a balance between grid and off-grid, and between poor and nonpoor villages, but the remote mountainous locations of the China study samples lack the level of infrastructural development, including schools and clinics, prevalent in the samples for the other two studies.

Women's Time

The Indonesia and Sri Lanka studies conclude that women are the major beneficiaries of electrification. This, however, is within the clear limits of their traditional role of housekeeping and family care through reorganization of the daily routine, with no or low gains in empowerment, except for the right to enjoy leisure time, which is used for socializing or watching television.

The findings of the two studies indicate that significant changes are introduced in family routines because of the arrival of electricity. Lighting, not so much for reasons of better quality because there is only a limited use of it among rural users, but because of its convenience and ease of use, is no longer a constraint but a resource. Together with television, it pushes back nighttime and bedtime, whereas appliances facilitate tedious house chores. Women, who traditionally suffer from time famine, tend to have longer and

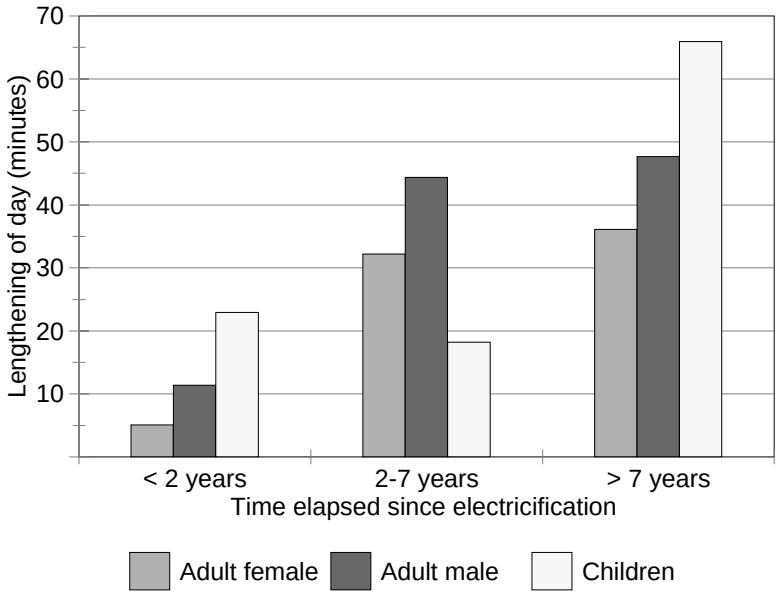
busier days than men. They are the first to take advantage of this extra available time. They invest it foremost in housework and family care, but also use it for socializing and entertaining, and sometimes to engage in paid activities. They gain better control over their schedules.

In Sri Lanka, the majority of households estimated that it has gained from one to three hours per day since it obtained electricity, and that women gained slightly more time than men. In Indonesia, 40 percent of the households also considered that they have a longer day because of electrification. A part of the gain comes from the extension of the day—television, in particular, tends to make people go to bed later. This extension may be negative, though, for some families because it means fewer hours of sleep. The surveys show limited time savings immediately after electrification (between a quarter and half an hour in both countries), but confirm progressive extensions in successive years as time use changes occur gradually.

A part of the gains in time also comes from better and more efficient use of time. This is caused first by changes of lighting conditions that repartition lighting spots across the house and ease of use. Switching to electricity reduces the time necessary for operating and maintaining lamps, from the purchase of kerosene to pumping and cleaning. It allows family members to make more efficient and flexible use of it.

Time gains are gender discriminated, however. Men tend to use them primarily as free time for entertainment and socialization, whereas women mostly invest them in housework and child care, before entertainment and socialization. If women gain time with domestic appliances, they invest it in taking care of children, and in shopping or managing their households in order to better their working conditions and be more efficient. On the whole, as suggested by the Sri Lanka study, lighting and electrical appliances seem to have an immediate to short-term impact on the time and effort dedicated to housework, although this impact does not increase significantly over the medium to long term (figure 8).

Figure 8: Lengthening of Day for Electrified Households as Compared to Unelectrified Households in Sri Lanka



Electricity-induced time savings also contribute little to the empowerment of women in income generation and participation in decisions concerning electricity. A gender bias undoubtedly exists in productive investment. When electricity generates new productive activities requiring even a small amount of initial investment, these activities are generally men-led. Even if there is no explicit discrimination, women-led income-generating activities are largely ignored and, being small and not capital-intensive, hardly given any importance. Furthermore, despite being the managers of electricity (and energy at large) in households, women are not considered relevant spokespersons by utilities or people in charge of alternative energy programs, which often consider them unable to handle the technical aspects of electrification such that they provide information mainly to men as the heads of households.

The findings of the China study are broadly in agreement with those of the Indonesia and Sri Lanka studies in relation to time savings for women because of electricity. However, women were not found to be the primary beneficiaries of this phenomenon in China. Although women in the study communities gained time, they did not gain as much of it as did men. Nor were they able to apply it for rest, relaxation, recreation, or productive activities to the extent it was possible for men.

The most significant post-electrification change for women in China was a reduction in time spent on preparing pig food because of the mechanization of pig fodder–cutting and corn-grinding. Women's resting time also increased substantially. However, these were partly offset by an increase in the time spent on working in the fields. The transfer of time from household to agriculture was in part caused by the migration of men who left their agricultural work to women. Women indicated that seeking work outside the

village became a much more realistic income-earning option with the arrival of electricity, because it enabled women to continue farming in the absence of male household members.

In relation to gender impacts in China, the main post-electrification time savings occurred in grinding and milling activities, where men play the major role, rather than in the preparation of fodder for pigs, which is women's responsibility. As a result, the total burden on women was greater in the villages with electricity. The arrival of electricity had little impact on the time spent on most major domestic chores. In the grid-connected village of Housanxi, cooking still occupied more than 24 hours each week, and fetching water and fuel gathering still required some 18 hours (table 12). As with the findings of the Indonesia and Sri Lanka studies, the China study also noted significant gender disparities in time savings from electricity (box 3).

Table 12: Time Allocation by Women before and after Electrification in Housanxi Village, China

Task	Ratio of time spent after and before electrification (%)
Housework (cook, sweep, fetch water, child care)	99
Pig food preparation	45
Working on the fields	157
Resting	132
Sleeping	101
Total	100

Box 3: Gender Differences in Perceived Benefits of Electricity

The responses of one couple interviewed in Duiwotai village in China suggest radically different gendered attitudes toward the benefits of electricity. The wife was very enthusiastic because she could work late into the night, whereas the man was equally pleased because he could sit around and talk to his friends in the evening. Similar comments might suggest that women worked longer hours than men, and that electricity might exacerbate this. However, questions to women about who was worse off, who worked harder, ate better, or who was poorer, usually elicited the response, "we are all poor, all tired." They did not declare that their husbands or men in general had a better life.

IDS 2003.

Perhaps the most crucial adverse impact of electricity on women is the lack of savings on the time spent by women on onerous and health-harming reproductive tasks. There was little evidence in China that electricity had reduced the time spent by women on a variety of household activities including, importantly, fuel gathering and cooking.

Women estimated that they spent an average of between 33 and 49 hours each week on these non-income-earning activities tasks and men between 10 and 31 hours. This does not include child care, because women found it impossible to estimate the time devoted solely to this activity (table 13). Clearly, the labor required simply to sustain the household from day to day was considerable. Adding the time spent on the "main activity" of crop production, plus the time needed to gather fuels and to cook, provides some indication as to why most households said that they had to work all the time and had no time to take on new activities. For example, preparing pig fodder—which required both cutting and then cooking into a swill—was a major time-consuming activity for women in China. This was a key constraint in deciding how many pigs the household could raise, even though they had identified pig-breeding as one of the few options for improving their situation.

Social Interaction

Social interaction subsumes a variety of activities that go toward a closer knitting of rural families, of households with one another, and of rural communities with the rest of the society. The results of the Indonesia and Sri Lanka studies show that electrification has a strong impact on social interaction, beginning with socialization between family members. Electrification reinforces family links and opens new space for family conversation and exchanges. With the arrival of electricity, more activities are possible with all family members together. Even television is considered as a way to strengthen family cohesion by keeping family members at home.

At the community level, evenings are primarily used for entertainment and family, talking with friends (male and female adults), and playing with other children (children). Even if electrification does not seem to have a significant direct impact on participation in community groups (such as women's organizations) or community activities, it has an indirect impact on this since community-building often begins with such informal linkages. Electrification is highly valued because of its contribution to improved social life and improved safety at night in the village. It is also valued when it is provided to religious buildings, because they often serve as community halls where people gather together to pray, as well as to carry out other activities.

Numerous respondents living in electrified villages, as well as in unelectrified villages in Indonesia, stated that electricity had other positive effects on the village in the form of improved village maintenance, more small businesses, a reversal of outmigration, and new public and private services, and commercial activities (figure 9). Many also felt that it had increased the quality of housing, as well as the values of land and homes.

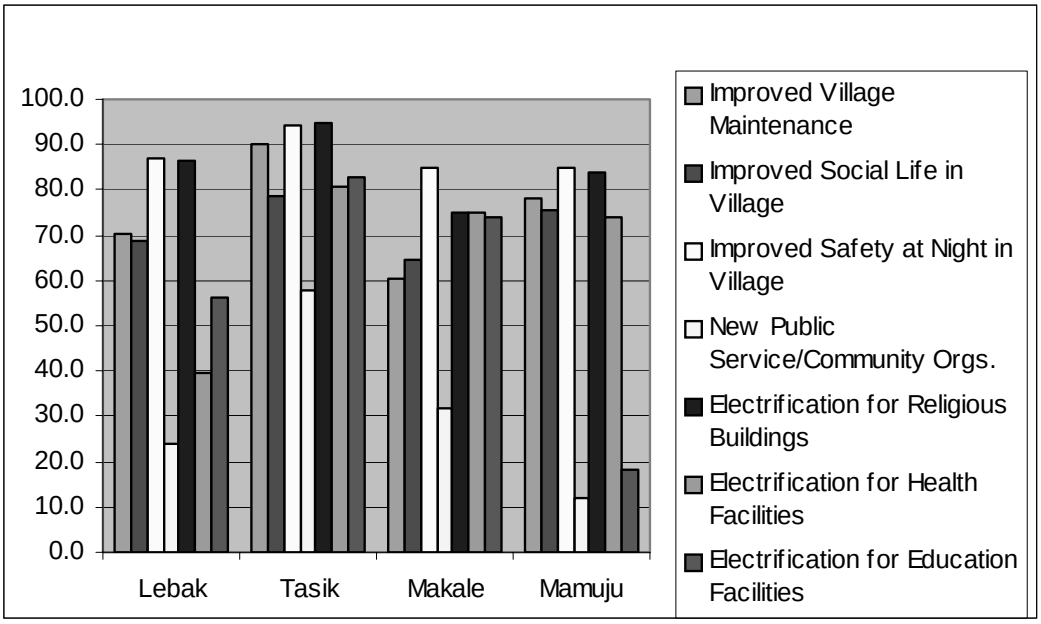
Table 13: Time Spent by Rural Women in China on Non-Income-Earning Activities Each Week in Winter

(hrs.)

Hubei	**Xiaozhu**		**Duiwotai**		**Housanxi**	
	Men	**Women**	**Men**	**Women**	**Men**	**Women**
Cooking	2.7	18.6	1.1	20.2	0.6	23.9
Fuel gathering	8.0	5.6	5.4	9.2	6.4	5.2
Fetching water	5.7	2.0	3.7	2.4	4.8	1.6
Washing	1.1	3.9	0.4	2.2	0.4	3.5
Grinding or milling	4.9	3.7	0.7	1.6	1.2	0.3
Prepare pig food	2.3	8.6	0.6	7.3	2.5	9.7
Prepare cattle food	0.3	0.5	1.3	1.8	0.3	0.1
Grazing cattle	5.0	0.5	1.9	4.8	6.8	0.4
Collect compost straw	0.0	0.0	0.0	0.0	0.9	3.0
Other	1.0	0.9	0.0	0.0	0.0	0.0
Total	*30.9*	*44.2*	*15.2*	*49.5*	*23.7*	*47.7*
Gansu	**Gaozui**		**Zhaoshan**		**Xiapai**	
	Men	**Women**	**Men**	**Women**	**Men**	**Women**
Cooking	1.1	11.9	2.5	12.6	2.7	18.8
Gathering fuel	1.4	9.6	2.8	4.6	1.2	2.7
Fetching water	2.4	2.2	1.1	0.6	1.0	1.7
Washing clothes	0.6	2.1	0.4	1.8	0.4	3.6
Feed livestock	3.5	2.8	6.7	2.2	4.2	2.3
Grazing sheep	0.5	1.6	5.3	2.4	3.3	1.2
Feeding pigs or chickens	0.0	2.1	0.3	3.7	0.1	3.1
Clean house or yard	0.0	2.5	0.4	3.6	0.4	4.3
Gathering dung	0.0	0.8	0.4	1.6	0.1	0.1
Total	*9.5*	*35.6*	*19.9*	*33.1*	*13.4*	*37.8*

Figure 9: Community Benefits from Electrification in Indonesia

(% of electrified HHs)



These social or communitywide impacts were also evident in China, the main distinction being that electrification encouraged rather than arrested outmigration. What is more important to note is that the intangible benefit of all these is the gradual development of social capital that might not have been possible otherwise. As mentioned earlier, the sense of exclusion that people in unelectrified villages suffer from has a major effect on their sense of well-being. Although the positive impact of electricity in mitigating this may not be measurable quantitatively, it is nonetheless a crucial contribution that cannot be undervalued.

Impacts of Electricity on Livelihood Opportunities of the Poor

The impacts of rural electrification on the livelihoods of the poor, that is, the extent to which electricity enhances their incomes and assets by creating fresh economic opportunities, have generally proved contentious. Past surveys of rural electrification have been unable to identify a clear correlation between the two or establish cause-and-effect relationships. The main problem in assessing livelihood impacts is that electricity is an important contributor to rural economic transformation, but it is by no means the only requirement. To the extent that other necessary inputs precede or succeed the arrival electricity, its impacts are greater or lesser as a previous study of rural electrification costs and benefits by the World Bank concludes (box 4). The time lag between electricity and other developmental inputs in poverty reduction is also crucial since the all-round

state of deprivation of the poor, especially the bottom poor, calls for simultaneous attention to their pressing problems on various fronts. Furthermore, because of factors of scale and service quality, there are sharp differences between the impacts of grid electrification and electrification using decentralized renewable energy systems.

Box 4: Rural Electrification, Income and Poverty Reduction

- One of the most persistent claims for RE (rural electrification) is that it can induce industrial growth in otherwise lagging low-income rural economies. The evidence from developing countries does not support this claim; RE has not, by itself, triggered industrial growth or regional development....The study found that where other prerequisites of sustained development were absent, demand for electricity for productive uses did not grow....RE is economically justified only when the emerging uses of electricity are strong enough to ensure sufficient growth in demand to produce a reasonable economic rate of return on the investment. RE may be in a unique position to promote a paradigm shift in agricultural production, by making possible irrigation and associated modern technology and practices.
- All the evidence to date, including that from Bank-financed RE projects in Asia, shows that RE does not directly reduce poverty by helping the poorest rural people. Most of the direct benefits from rural electricity go to wealthier people....Once connected, the amount of electricity consumed, and therefore the benefits obtained, depend on the ability to buy electrical equipment, whether light fixtures, televisions, fans, water pumps, or motor-driven machines....RE reduces rural poverty only through a general rise in rural income obtained by productive uses. And—again with the exception of irrigation pumping—these productive uses of electricity appear to come about only when other factors are already raising rural and national per capital income.

Source: World Bank Operation Evaluation Department 1995.

The EnPoGen country studies have tried to address these gaps to the extent feasible. Greater attention was paid to the productive uses of electricity in the Indonesia and Sri Lanka studies, and to a lesser extent in the China study. As a result, the following summary of the main findings relies more upon the former. Significant differences in the case of China are noted where they occur depending on the information available.

One of the difficulties with assessing the livelihood impacts of electricity is that they are not always easy to separate out from the impacts on living conditions and lifestyles. The reason is that many activities in rural households overlap one another in their purposes. For instance, although cooking might be considered a non-income-earning activity, which is generally true, there could be instances where it also includes food processing to generate additional earnings. Similarly, other routine household chores are performed by women, a part of which could contribute to additional income, but which are not readily recognized as such.

A Matter of Time

The preceding summary of the impacts of electricity on the living conditions and lifestyles of the rural people establishes two essential facts. First, virtually all available time in rural households is taken up by agriculture, the main economic activity, and housekeeping activities, which usually do not have an economic component. Second, any new income-earning activities must come out of time saved in one or both of the above, and the nature of these activities will depend on whether men or women gain the time from their traditional engagements.

The EnPoGen studies in Indonesia and Sri Lanka suggest that time gains from electricity will not necessarily be used for paid work for two main reasons. One is that women use these gains at least partly to compensate their deficit of housework, socialization, and leisure. The other is that even if they were willing to invest a part of the gains in time to paid work, women do not have access to markets or capital constraints prevent them from embarking on new activities. As a result, if some women develop a self-managed activity using electricity, they are likely to belong to the better-off population.

Paid work is also a double-edged phenomenon for women. On the one hand, women's earning power increases their decisionmaking power; income generated by women through new economic activities lead to an improvement of their status within the family and the community. On the other hand, it does not necessarily follow that this leads to an overall improvement of women's conditions. The Indonesia and Sri Lanka studies show that local entrepreneurs quickly raid these extra hours gained by poor women, finding a new opportunity to use cheap labor. As a result, hard and underpaid housework may generate some additional income, but it may not improve, or it may possibly even worsen, living conditions.

The Indonesia study indicates that women make use of time gains from electricity more often than men, especially when it comes to small businesses. They also devote more time to housework. Although this difference is less significant for agriculture-related activities, it is important enough for the poor. The main observations of the study on the topic can be summarized as follows (table 14):

- Ten to 18 percent of electrified respondents (only 4–7 percent of all respondents under the study) who stated that electricity lengthens the day of women and men use it in the mornings for activities such as agricultural product processing and animal care; the percentages drop in the evenings to 2–3 percent, or 1 percent if all respondents are taken together.
- Twelve to 13 percent of women, and about half this percentage of men, carry out small business activities with the additional time available, both in the mornings and in the evenings; the percentages are, respectively, 5 percent and 2 percent if all electrified respondents are taken together.
- The use of time for small business increases with income level, whereas the percentage of respondents devoting additional time to agricultural product

processing or animal breeding decreases. For instance, 14 percent of the very poor rank activities linked to agriculture or animal breeding as their first priority.

- Some 12 percent of the electrified households have a small business at home, with about 60 percent of them using electricity to support it. Thus, about 7 percent of households increase their incomes because of electricity.
- On the whole, electrification does support increased productive activities by households, but the scale of these activities tends to be limited. Although the additional income generated by small business activities is modest, it is of greater significance to the poorest, up to 32 percent of total household income against only 4 percent for the better-off households.

Table 14: Use of Additional Time for Income-Generating Activities in Indonesia

(%)

Time of day	Gender	Small business	Agricultural product processing	Animal breeding
Morning	Women	13	18	10
	Men	5	17	10
Evening	Women	12	2	3
	Men	7	2	3

The livelihood impacts of electricity are described at greater length in the following parts of this chapter. These are broadly divided into the following categories:

- Income from agriculture.
- Income from household microenterprises.
- Income from village enterprises and businesses.
- Savings in expenditure.
- Asset-building.

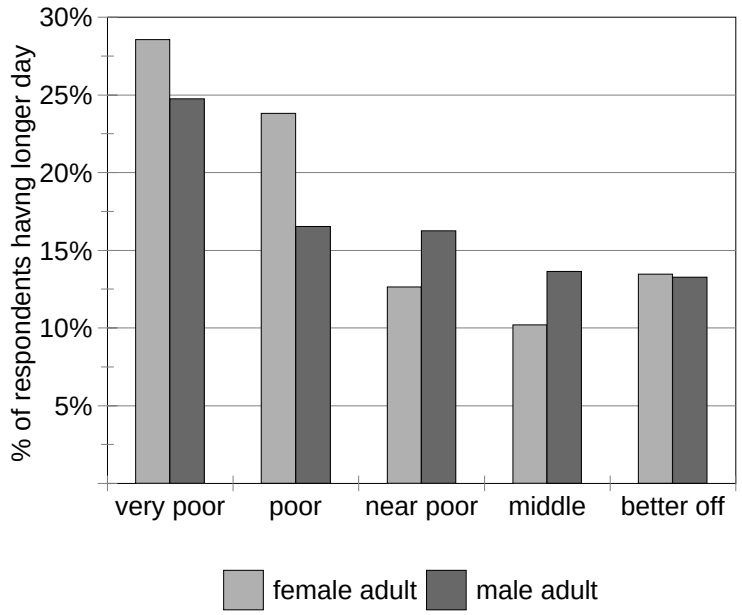
Income from Agriculture

The impacts of electricity on agricultural income arise from (a) increased agricultural productivity because of better irrigation water pumping and (b) new agriculture product processing activities. Electric water pumping is generally cheaper than water pumping through other sources of energy, such as diesel. It facilitates higher yields or even the introduction of new, more profitable crops. According to the Indonesia study, electric water pumps seem to be gradually replacing other types of pumps in equipping agricultural wells. Within the 18 electrified villages surveyed under the study, more than half the agricultural wells employed electric pumps. However, assessing the impacts of electric water pumping on the types of crops, agricultural growth, number of crops per

year, their social and financial aspects, and similar details proved beyond the scope of the study.

Agricultural product processing activities have benefited from electricity in Indonesia, as well as in Sri Lanka. According to local Cultivation Officers in Indonesia, on average at least two new agricultural activities have been launched in each of the 16 electrified villages considered since electricity became available. A more comprehensive survey is probably needed to assess in detail the impact of such activities. Nevertheless, an important finding of the Indonesia study is that the impacts of agricultural product processing are much more significant at the level of the very poor and the poor, very likely because of their subsistence levels of farming where even marginal increases in allied activities offer significant prospects of additional income relative to their current economic status (figure 10).

Figure 10: Use of Time Available for Agricultural Product Processing Activities: Indonesia



The China study is less clear on the role of electricity in raising agricultural income. Although the study observes the direct impacts of energy services on production in general and a clear correlation between powered production and transport equipment and living standards, it suggests that diesel is the primary fuel associated with production activities. However, this is not necessarily conclusive as the study also identifies the use of electricity for irrigation water pumping as a priority for production, although the matter is not addressed in further detail.

Income from Household Microenterprises

As outlined earlier, electricity is capable of inducing new income from small or micro-enterprises at the household level, but the magnitude of its impact on such activities is generally low. The main findings of the Sri Lanka study on this aspect are as follows:

- No more than 7 percent of the rural households in Sri Lanka have a workshop or a shop at home, less so in female-headed households (only 3 percent). It seems that connected households have about three times more workshops or shops at home, but the study sample is not large enough to reach a definitive conclusion.
- Only 3.3 percent of the respondents with electricity at home were involved in home-based activities, such as handicrafts, sewing-tailoring, rice milling, and similar ventures.
- Only 4.9 percent of the women and 8.3 percent of the men reported using the extra time made available through electricity to conduct small household enterprises.
- Of the households involved in home-based economic activities,[11] 50 percent use no energy and 34 percent use electricity. Twenty-eight percent stated that they use electrical equipment for their activities, whereas about 40 percent use electrical lighting and the rest use only day light.
- Thirty percent of the respondents stated that electricity improved the productivity of their economic activities because (a) they can work longer hours, (b) they have more time to work, and (c) they use more efficient electrical equipment.
- Although 20 percent of the 1,013 people interviewed stated that they needed electricity to support economic activities, very few of them actually undertook such activities once they obtained electricity. This suggests that income generation through small or micro-enterprises is not a function of electricity alone.
- The use of electricity for productive purposes is not a high priority even among those who have access to grid supply. Women identified electricity use for household enterprises and mechanization of economic activities as their seventh priority (in last place), and men identified it as their sixth priority. This may be caused by insufficient awareness on the part of rural people of the linkage between energy and economic development or because potential economic activities are determined by several factors, of which energy-electricity is only one.

The findings of the Indonesia study are largely similar to the Sri Lankan situation in the low level of home-based economic activities associated with electricity and

[11] "Home based activities" include informal activities, sometimes unremunerated casual activities. Less than half the observations made under the study are related to income-generating businesses. Ninety-five percent of the home-based, income-generating activities are managed by men. Therefore, the analysis of such data is open to interpretation.

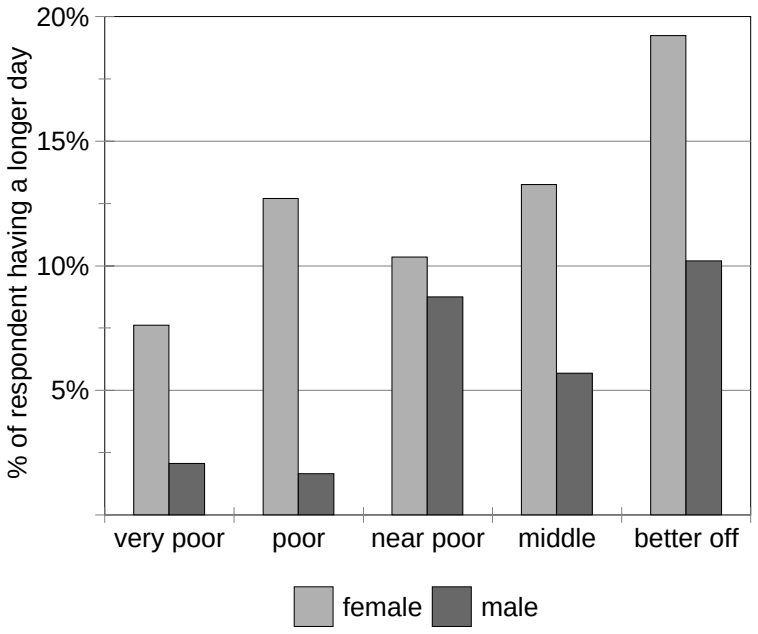
insufficient awareness among the people of the income-generating potential of electricity. Notwithstanding these, the Indonesian study concludes that electricity clearly supports the development of small or micro-enterprises. Average incomes from such enterprises with electricity were found to be double those of enterprises without electricity. In activities like embroidery, the use of electrical equipment increased output by as much as a factor of 10. The other observations of the Indonesia study are as follows:

- The most widespread type of home-based enterprise is a small retail shop in the house, followed by other types of home business, with less than 10 percent of the households engaging in animal husbandry or agricultural product processing.
- Although the proportion of households using electricity for small businesses or agricultural product processing activities is small, the economic impacts of such activities, where they exist, are significant.
- More male-headed households have a small business at home than woman-headed households. However, women who head households are much older and probably a significant number of them are beyond active working age.
- The percentage of households having a small business at home increases significantly with income level. It doubles between the poorest and the better-off, and even triples while considering only small businesses supported by electricity (table 15). This is because of the poor's lack of capacity to make the initial investment.
- The percentage of households having a small business at home rises also with time elapsed since they got access to electricity (figure 11).
- These patterns for income and time lag are also affected by the location of a village that determines the availability of markets and, therefore, the feasibility of household enterprises.

Table 15: Electrified Households with Small Enterprises Based on Electricity

	No. of house-holds	% of total house-holds	% of electri-fied house-holds		No. of house-holds	% of total house-holds	% of electri fied house-holds
Income				**Location**			
Very poor	18	7.5	50.0	Lebak	57	9.9	52.6
Poor	27	8.4	55.5	Tasik-malaya	72	22.2	69.4
Near poor	27	13.2	44.4	Makale	8	3.2	37.5
Middle	37	15.2	75.7	Mamuju	25	16.7	52.0
Better-off	53	18.3	60.4				
Years connected				**Electricity source**			
<2	64	10.0	59.4	Grid	127	13.9	62.2
2–7	61	13.6	52.5	Solar PV	18	19.6	50.0
>7	37	17.5	70.3	Hydro	8	4.0	50.0
Gender of head of household				Hybrid	9	9.8	44.4
Male	150	13.0	60.0				
Female	12	8.2	50.0	Total	162	12.5	59.3

Figure 11: Use of Time Available for Home-Based Enterprises in Indonesia



The additional income generated by home-based small enterprises because of electricity in Indonesia and Sri Lanka is shown in tables 16 and 17. As indicated by the former, although the increase in income from such enterprises is relatively low among the poorest, it amounts to 32 percent of their total income, a very significant increase as compared to the affluent households where the increase contributes to only 4 percent of the total income. In the case of Sri Lanka, although home-based small enterprises are equally important for electrified and unelectrified households, the more affluent households are able to take greater advantage of electricity for income generation.

Table 16: Estimated Income Generation from Home-Based Enterprises with Electricity in Indonesia

(Rp. per month)

	Income group					
	Very poor	**Poor**	**Near poor**	**Middle**	**Better-off**	**Total**
Additional income	87,611	111,607	82,333	145,000	121,672	118,868
Average total income	276,167	457,633	629,292	563,214	3,335,002	1,451,995
Impact on total income	32%	24%	13%	26%	4%	8%
No. of households	9	15	12	28	32	96

Table 17: Estimated Income Generation from Home-Based Activities in Sri Lanka

Household income (Rs. per month)	**Households with electricity**		**Households without electricity**	
	No.	**%**	**No.**	**%**
Less than 100	6	7.0	13	15.9
100 – <2,000	18	21.2	30	36.6
2,000 – <3,000	11	12.9	13	15.9
3,000 – <4,000	4	4.7	8	9.7
4,000 – <5,000	8	9.4	6	7.3
5,000 – <6,000	6	7.1	4	4.9
More than 6,000	32	37.7	8	9.7
Total	*85*	*100.0*	*82*	*100.0*

Income from Village Enterprises and Businesses

The impacts of electricity on larger-scale nonagricultural economic activities at the village level are a function of several factors, including volume of supply, time lapsed

since connection, investment capacity, and access to markets. The profitability of such ventures depends more on the demand for their products and services than perhaps on the availability of electricity, although the lack of electricity would be an obvious constraint where such demand exists.

The Sri Lanka study noted the establishment of several village level enterprises following electrification, especially grid electrification. Although these enterprises benefited from the availability of electricity, they also gained from the increased purchasing power of local households since they became grid-connected. The range of new village level enterprises set up included small restaurants and retail shops, grinding mills, battery charging centers, welding workshops and carpentry shops. In all cases, households that were engaged in the enterprises felt that electricity was a major reason for these ventures and it had, therefore, contributed significantly to their income levels. Some of these enterprises are run by women, generating a supplementary income of between Rs. 1,500 and Rs. 5,000.

The use of electricity in village enterprises was reviewed in greater detail under the Indonesia study, focusing on Tasikmalaya, which is known as a center for garments, particularly those decorated with machine embroidery, and wooden footwear (mostly sandals). Tasikmalaya is also the location for a World Bank program to increase electricity use among small enterprises. The quantitative survey under the study covered 100 businesses consisting of 66 embroidery and garment firms, 33 footwear firms, and 1 barber shop, all of which relied on electricity for their operations. The products of these businesses are sold in the domestic market, as well as exported, mostly to African countries. Some of the larger producers are also traders with shops in the well-known garment market in Jakarta, Pasar Tanah Abang. This market has also gained an international reputation as a location where African traders come to buy and place orders. African traders are also familiar with Tasikmalaya where they place orders directly with small producers, thereby shortening the trading chain. The main findings of the survey are as follows:

- In most cases (96 percent), the enterprises are home-based and comprise only one unit. They employ generally less than three paid workers, but also benefit from unpaid workers, generally, family members.
- Unlike larger factories producing branded garments or footwear, most of the workers are male (77 percent), presumably because traders prefer men who are believed to work faster.
- The enterprises are relatively recent, 27 percent of them having started within the last two last years and about a half having existed for less than 10 years.
- They generally have only one electricity meter, serving both the household and the enterprise.
- All enterprises rely on electricity, which is used for lighting and for operating tools and machines (table 18). Almost all the respondents stated that it is not possible to achieve the same product quality without electrical equipment and that

electricity increased productivity. Most of them were also satisfied with the volume of electricity supplied.

Table 18: Electricity Use in Village Enterprises in Indonesia

Use	%
Lighting	98
Tools	99
Machinery	82
Others	16
Requiring additional capacity for more machines or tools	19–21
Requiring additional capacity for more lamps	10
No. of respondents	100

The results of the survey in Indonesia establish the importance of electricity for the development of village enterprises and businesses. As shown in table 19, the average incomes of enterprise with electricity are double those of enterprises without electricity. In order to reduce the use of electricity, many enterprises resort to "putting out" the work, which has a spin-off effect on the incomes of other households in the village. Enterprises receiving large orders subcontract the work to other households, usually poorer households with limited access to employers or agents.

Table 19: Income from Village Enterprises in Indonesia

(Rp. per month)

	Embroidery	Footwear	Total
With electricity	854,716	7,601,515	3,301,357
Without electricity	74,912	4,521,212	1,687,307
Ratio	11.4	1.7	2.0
No. of respondents	66	33	100

Savings in Expenditure

The central feature of poverty is the lack of surplus cash because the major portion of the poor's income is in kind, usually through agricultural and related products that are largely self-consumed. Even without engaging in home-based or village-level enterprises, the poor can generate surplus cash through savings in cash expenditure because of electricity. In some cases, where income levels are not far below the poverty line, the substitution of kerosene or battery charging by electricity could itself be sufficient to help families rise above the poverty line.

According to a DFID survey in Sri Lanka (University of Reading 1999), a savings of Rs. 100 per month would have moved about 22 percent of the poor above the poverty

line. Savings on household energy bills in Sri Lanka are estimated to equal 12 percent of the monthly income. As such, their impact on poverty could be significant. The Sri Lanka study identifies the following cash savings or expenditure reduction through electricity:

- A family without a battery-powered TV spends between Rs. 166 and Rs. 240 per month for lighting and radio only using kerosene and dry cell batteries. It will spend about Rs. 100 per month for electricity once connected, with the possibility of buying and powering a TV for that price, saving between Rs. 66 and Rs. 140 a month.
- A family with a battery-powered TV spends between Rs. 280 and Rs. 565 per month on kerosene, dry cell batteries, and battery charging. It will spend about Rs. 100 per month once connected, with substantially higher savings of Rs. 180–465 a month.
- All electricity services, except those provided by SHSs, are at least two to four times less expensive than other alternatives, and they all provide a better quantity of energy and quality of service.
- Users of SHSs had a pre-electrification monthly expenditure of Rs. 335 on kerosene, car batteries, and flashlight batteries. However, they are unable to save on their expenditure because monthly installments on the systems far exceed their pre-electrification expenditure ranges between Rs. 650 and Rs. 1,250, depending on the system purchased.

These estimates confirm that the financial savings on kerosene and candles for lighting and car batteries for television sets because of grid connection are between 30 and 50 percent of pre-electrification expenditure. In fact, the savings could be higher if families did not reinvest a part of them in greater use of electricity through additional appliances. It should be noted, though, that the potential for savings would vary according to the location of a village, its distance from the nearest town or battery charging center, transportation costs, and similar factors. This is illustrated in figure 12, which shows the wide variation in battery charging expenditure in Sri Lanka.

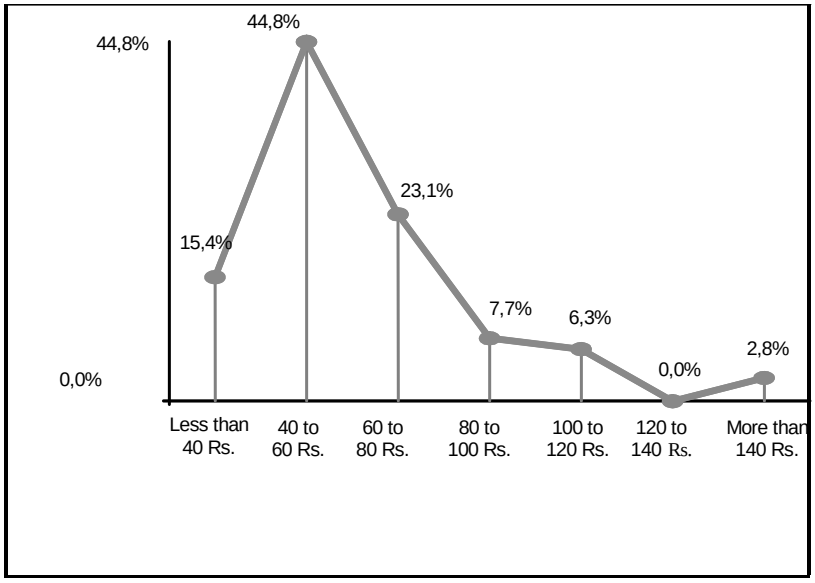
Another area of potential savings from electricity relates to appliance efficiency, in particular, CFLs that could cater to the ubiquitous lighting needs in all electrified households. CFLs offer high luminous efficiency, save up to 80 percent of the electricity used as compared to incandescent lamps, and last about 10 times longer than the latter. On average, they reduce the expenditure on lighting by 30–50 percent. However, CFLs are too expensive for low-income families when compared to incandescent bulbs. As their electrical consumption remains low, the interest in switching to CFLs is not as apparent for very poor and poor households.

The findings of the China and Indonesia study are largely similar to those of the Sri Lanka study. However, it should be noted that savings in expenditure on electricity substitutes are not only location-specific, but they are also conditional upon the quality and quantity of electricity supplied. In China, for instance, the unreliability of supply from thousands of micro or minihydro systems prompts even electrified households to

continue spending on kerosene and candles, although at a lower level. Thus, it cannot be readily assumed that all pre-electrification expenditure on electricity substitutes will be completely eliminated once access is gained to electricity. Furthermore, with growth in income, there is an increase in electrical appliance ownership that could, over time, significantly reduce or even rule out any cash savings.[12]

Figure 12: Monthly Cost of Battery Recharging in Sri Lanka

(Rs. per month)



Asset-Building

To the extent that electricity could increase incomes or reduce expenditure, it carries the potential for households to acquire or enhance their assets, such as increased livestock and appliance ownership. Although this aspect was not investigated in detail by the EnPoGen studies, responses under the Sri Lanka study suggest that electrification increased property values, both for land and houses. Of special interest is the phenomenon of institutional development in the form of new buildings and facilities in villages for health services, education, and the like. Although the emergence of these might not have a direct impact on the wealth of individual households, in the course of time it could.

In the final analysis, whether or not electricity leads to the building of assets in the hands of the poor depends, first, on what assets they have to begin with and, second, to which uses electricity is put. The bottom poor, who lead a subsistence life, would likely experience no distinct increase in their meager asset holdings with the arrival of

[12] This need not necessarily be viewed as a negative impact as greater use of electrical appliances would carry its own distinct benefits, both on living conditions and livelihoods.

electricity. To the extent that their resources are sufficient only to meet basic household electricity needs, as opposed to productive applications, their asset-building prospects would again remain constrained. This underscores the reality that electricity could provoke varied expectations, but more often than not it needs to be combined with other factors to break the vicious circle of poverty.

Lessons for the Future

The EnPoGen studies show that rural electrification has a strong positive impact on the living conditions and lifestyles of people, and a more modest and late impact on the economic development of communities. Through access to better lighting and electrical appliances, the arrival of electricity brings a new quality of life to whole families, in particular to women by relieving them of household chores. There are also important impacts on health, education, and safety. By contrast, the development of productive activities attributed to electrification is more difficult to recognize, and its effects are generally late and sometimes disappointing.

The ways in which rural electrification is pursued in the EnPoGen study countries are broadly typical of the situation in most other developing countries. The phenomenon of more than 1.2 billion people in Asia alone remaining without access to electricity today is but one issue. The other side of the coin is that those who do have access to electricity perhaps pay a much higher cost for it than they should and, in many instances, their expectations are unfulfilled. How then should one proceed? What are those critical gaps that need to be addressed in the future through new strategies and approaches?

Rationalizing Investments and Subsidies

The electricity business in developing countries has two important characteristics: (a) it is a dynamic business as it faces a permanent increase in demand because of demographic and economic growth, and (b) it has to invest, if only to respond to the needs of its existing clientele. It also has to develop toward rural areas, which is a highly capital-intensive exercise, paying for a considerable and ever-growing part of infrastructure and obtaining a decreasing part of energy revenues through tariffs. Unlike other businesses, utilities are fortunate enough to have a captive clientele, but they are also compelled to develop toward an ever more costly and less income-generating venture in the rural areas. Given that tariffs have limits, not only for political but also for sensible market reasons, there is a ceiling on their investments.

Public participation in investment, external grants and soft loans are total or partial subsidies. They are not only subsidies, however; they are financial commitments. They are not only a facility, they are a risk. They are moneys to be spent in addition to what is generated by a utility's own resources, pushing it toward and sometimes making them exceed the break-even point. This leads to high rates of illegal connections and an abnormal volume of protests about service quality among rural subscribers, more so since

users are required to pay for the service and invest in connections, with negative economic and social consequences.

If utilities actively invest in connecting households in already connected areas, this limits their prospects of developing the grid toward new villages. Investment priorities are, therefore, given to grid extension over densification, for political reasons and also because there are alternatives to the utilities' own investment in densification. Because of their own investment limitations, utilities then have no choice for densification, but to ask for the users' participation. A remote new client is, thus, expected to pay over basic connection fees, a participation in extension costs, or even the full cost of it, as soon as a certain distance is exceeded. Even illegal connections may be considered a convenient way to develop quick electrification because it allows millions of people to get connected without extra public cost, as in Indonesia where between 30 percent and 40 percent of the consumers are illegally connected. This strategy has a number of important drawbacks:

- First, as soon as it becomes an accepted practice, legally or illegally, utilities transfer to rural dwellers a significant portion of the investment responsibility for electrification. This contributes to the decapitalization of the lowest capitalized part of the economy, because these resources could have been used in investment or consumption elsewhere with greater benefits to the overall economy.
- Second, it is a bad business practice for the utilities themselves, because this is not joint capital investment, but rather access to expensive, short-term credit, possibly the worst way to fund infrastructure that is amortized over a long period. Households invest because they cannot avoid doing so, and they recover their investment by curtailing consumption in other areas.[13] They lose their capacity to invest in electrical appliances, reduce their energy consumption growth, and significantly reduce the utilities' income from newly gained clientele.
- Third, this leads to the sale of electrification (the connection, not the energy) as a commodity and, thus, impinges on the equity between customers. High requirements for initial investments create important spatial tariff inequities and leave out a significant proportion of poor customers in Sri Lanka. Low nominal requirements for initial connection fees is a false promise when supply cannot respond to demand, and if informal responses are given, this generates detrimental illegal practices, as in Indonesia. In both cases, a significant portion of the poor is excluded.

The lack of investment capacity on the part of utilities is a major reason for the slow pace of electrification and the inequitable distribution of its benefits. Two possible solutions to the problem could be thought of. One is to accept transferring a part of investment charges to consumers, but alleviating their investment capacity constraints through credit schemes. The other is to look for other investment sources.

[13] For instance, in China, many remote rural communities borrow heavily to get connected, some of them unable to afford school fees for their children because of the debt burden.

This then invokes the question of subsidies. If for reasons of equity, governments subsidize electricity, perhaps the best way to go about it is to separate investment means (access to credit) from subsidy schemes. This does not mean concretely giving money to consumers, but rather extend "smart subsidies" to providers according to results—actual operational parameters (connections, sales), diversification of actors (new suppliers), electrification mode (conventional, renewable), and so forth. This would be a more focused way to further public economic and social concerns. Subsidizing customers could be considered a cash subsidy, because it is recurring cost and is, therefore, likely to be maintained at reasonable level.

A Propoor Approach

Most rural electrification programs, whether they promote conventional or alternative energy, focus on the supply of electricity to stimulate economic productivity and to enhance the quality of life in rural areas. However, few of these programs start with an in-depth assessment of the markets for these services, including the needs of the people they are meant to serve. In addition, they often fail to evaluate the specific impacts resulting from these services. The majority of rural electrification monitoring and evaluation exercises measure strictly quantifiable information, such as the number of new grid electricity connections or the number of renewable energy systems installed. They are typically not designed to measure the socioeconomic impacts of projects or programs, often resulting in the masking of poverty- and gender-specific consumer choices and perceptions. This incomplete understanding of market forces and social pressures hinders the development of initiatives that respond to the poor's energy needs.

Rural populations tend to consider electricity as a basic service, a right for everyone, and not as a real commodity. Local politicians feel that obtaining electricity for their constituencies is one of their major missions. Getting electricity appears to be a long-lasting struggle, where villagers feel helpless against incomprehensible and arbitrary rules, and where politics might play an important catalyzing role. In Sri Lanka, for instance, where 24,000 villages are still to be electrified, access to electricity is felt to be discriminatory, and it tends to accentuate social differences between communities, favoring richer ones and leaving out the poorer ones. In Indonesia, where the utility has made a major effort to connect villages, people heavily complain about service quality and the utility's lack of concern for small rural customers. In China, an estimated 70 million people are still without access to electricity and the country's remarkable progress with rural electrification elsewhere only tends to intensify their feeling of "exclusion" from the mainstream of development.

In Indonesia and Sri Lanka, people mention discrimination against the poorest households within electrified communities that are often located farther from roads and village centers, in the form of higher connection fees and having to pay for grid extension. The arrival of electricity tends to increase land prices along the line and makes it even more difficult for the poor to settle down where they could have access to electricity at more affordable costs. One-time connection fee conditions penalize the poor

and they have the greatest financial difficulties to meet those fees. As a consequence, they are excluded from electrification as soon as more than one pole is required (Sri Lanka) or are forced to opt for informal hookups (Indonesia). Subsidies rarely reach the poor. In the case of the grid, subsidies linked to productive uses of power go to richer employers, who "put out" work to poorer families that require electricity, but pay the full price for their connections (Indonesia). Although more equitable in their conception, microhydro schemes favor immediate clients and segregate those that come afterward, mainly the poor (Sri Lanka).

If electrification is considered a march toward equity, the conditions of its realization are clearly discriminatory. This is illustrated in tables 20 and 21, covering two villages that were investigated under the Sri Lanka study. The middle column in table 20 presents global statistics as they might appear in a utility report, indicating satisfactory results of electrification; that is, the grid has reached the village and the electrification rates are not so bad. The right column of the table contains the outcomes of a social screening performed by the study team on the same villages, revealing a significant exclusion of the poor. Table 21 shows the strong linkage between income level and access to electricity.

On the whole, prevailing approaches to rural electrification have the following adverse implications for the poor:

- The poor suffer large-scale discrimination in the process of grid extension. The poorest communities tend to be the last served, and in electrified villages the poor are electrified "by accident" when they have the chance to be located near local distribution grids designed primarily to serve the better-off. Present electrification processes, therefore, lead to more inequitable development.
- In general, there is no specific concern with or policies for electrification of the poor. That electrification promotes inequity is either unknown to local authorities or is considered the logical result of economic dynamics whereby the responsibility for connection is left to the user on a cash basis.
- Alternative energy technologies, although catering often to the basic needs of the poor, are not propoor by design and seem to be driven more by environmental considerations. For instance, solar PV systems are not designed to target the poor because of their high initial cost. Although small-scale hydropower appears more poor-friendly, at least in theory, because of its lower cost per unit of electricity potential for community-scale systems, it does not seek specific poverty benefits, but instead caters to whole communities.
- Neither centralized nor decentralized electrification pays any special attention to the needs of poor women because this is not perceived to be a key determinant of consumer's choice.

Table 20: Statistics and Social Facts of Electrification in Sri Lanka

Village	Global statistics	Social screening
Asmadala	Electrified village; about 200 households, more than 85% electrified	100% of better-off and middle income electrified, 50% of poor without access
Wakirigala	Electrified village; about 280 households, more than 35% electrified	90% of better off and 35% of middle income electrified, 90% of poor without access

Table 21: Electrification Rate by Economic Status in Sri Lanka

Economic status	Electrification rate in connected villages (%)
Very poor	15
Moderately poor	71
Average	94
Above average	100

In spite of these serious constraints, the poor do derive a multiplicity of benefits from electricity once they get it. The complexity of assessing these benefits, and the largely subjective task of assigning them their relative importance, are the main reasons why the impacts of electricity on the poor have proved difficult to measure and contentious. This could be improved upon through more poor- and gender-specific monitoring and evaluation tools, as discussed in chapter 7.

Enhancing the Role of Alternative Energy Technologies

Experiences with rural electrification in *developed* countries show that a large number of poor communities often decide to take electrification initiatives into their own hands and develop solutions of their own. Rural electrification in these countries has been mostly based on the results of accrued local community initiatives and the intervention of sometimes very small private service providers. Governments have generally been late to intervene, usually around the time community and market dynamics begin to run out of steam. By that time, it also makes sense to interconnect many of these small local initiatives. It finally becomes cost-effective to build large grids to connect the concentrated demand centers. In most *developing* countries, it is the reverse of this trend over the past 40 years or so—the development of one main electricity grid reaching out from major cities to smaller towns, from smaller towns to rural areas, and so forth.

This centralized strategy of rural electrification through the grid has clearly failed to reach out to the millions of people who still lack basic access to electricity and, in many

countries, have no hopes of getting it in the foreseeable future. Among these millions are the poor who not only are “excluded” in more than one sense but are, in fact, actively discriminated against by prevailing utility strategies. Even in China, which has the highest rate of rural electrification among developing countries of Asia, the possibility of extending the grid to the remaining concentrations of the poor in remote mountainous areas is dim.

In these circumstances, decentralized alternative energy technologies often offer the only short-term hope for access to many without electricity. Although the subject is dealt with at greater length in chapter 5, it is worth noting here that the wisdom of a rural electrification strategy allowing a greater role for alternative energy technologies has largely remained stillborn in much of developing Asia. With the exception of China, the share of these technologies in aggregate rural energy supplies is less than 1 percent, in spite of protracted efforts over the past two decades to enhance their technological reliability, cost competitiveness, and user friendliness. Setting aside the inherent limitations of these technologies, a central barrier in their way is the bias of utilities toward grid extension and subsidized prices of grid-supplied electricity. Indeed, progress with alternative energy technologies has been prominent mainly in those countries in which conscious government policies have served to mitigate the market barriers encountered by these technologies.

However, alternative energy technologies, such as SHSs, push back spatial frontiers, but not social or economic frontiers. Most often, they, too, bring a solution to the better-off in a form that leaves no opportunity for energy or cost-sharing. The poor look forward to minimum services, as a beginning at least, whereas the not poor and affluent aspire for enhanced services to power more energy-intensive appliances and equipment. It is a moot point if the needs of the former deserve a higher priority. In theory, the top-down market penetration strategy pursued in the case of alternative energy technologies is intended to be equitable in the long term. That is, the better-off populations pay for market development costs that would allow the setting up of good commercial and after-sale logistics, in the course of time lowering technology costs through economies of scale to reach the poor and low-income groups. In practice, though, the shallow penetration of the market over more than two decades has rendered the strategy largely ineffective, associating alternative technologies with niche markets in the upper-income brackets or with unsustainable costs to poorer segments of the population who are driven to desperation in their quest for electricity.

It is clear that market logic alone is insufficient to meet the needs of the poor. The needs of the poor are special, and the poor are an especially large and vulnerable group that is not susceptible to private dynamics because of its lack of purchasing power. The electrification of this group can only be addressed at a high cost, but with access to soft credit and external funds. Subject to these requirements, there is an obvious need to break away from entrenched rural electrification strategies and instead look for new approaches that could scale up the promotion of alternative energy technologies.

Balancing Productive and Welfare Objectives

As stated in the Introduction (chapter 1), the distinction between poverty alleviation and poverty reduction is more often than not hazy. A key outcome of this is that although grid-based rural electrification tends to pursue productive uses of electricity, for reasons of utility economics, electrification based on alternative energy technologies appears to be concentrated on welfare-oriented basic energy services for reasons of market share. From the viewpoint of the poor, neither of these approaches addresses their needs in a manner compatible with their economic status and aspirations.

The Indonesia and Sri Lanka studies show that electrification as a direct means of increasing incomes is limited, particularly in areas where opportunities are also limited. Economic productivity depends on a multitude of conditions (skills, markets, finance) required to make such productive enterprises possible, with electricity as one among others that enhances the range of choice and the ability to reach higher levels of productivity than would otherwise be possible. And this would entail time, often several years, because the immediate impacts of electricity are social rather than economic, and rural economic transformation is a far more gradual process. The poor are invariably stragglers in this process, which is often protracted beyond their endurance.

Notwithstanding the above, and possibly because of it, the Indonesia and Sri Lanka studies suggest that the provision of electricity for the poor cannot and should not be conditional on immediate direct productive uses. Although electricity may well be needed to develop certain productive activities, electricity is simply not a sufficient condition for such activities to develop. Instead, the priority value of electricity, particularly for the poor, should be seen in the light of improving their quality of life.

By contrast, the China study—though not underestimating the value of the welfare aspects of electricity—points out that electricity intended to meet the basic needs of the poor makes only a marginal contribution to these needs, which are largely related to biomass cooking fuels that have no role to play in electrification. To that extent, it is questionable if those basic services that electricity caters really make a difference in the lives of the poor. To put it more squarely, do alternative energy technologies that place a premium on basic services miss the basic point?

In the balance, if the ultimate objective of rural electrification is poverty reduction, energy schemes that are integrated with other development activities and that operate on a full menu of options are required not only to provide support to the development of markets to supply energy, but also to promote income-generating end uses. Improving the efficiency and extending the reach of services that deliver grid-based electricity and fossil fuels are likely to remain a significant element in any attempt to reduce poverty. However, new mechanisms are needed to make these improvements financially sustainable and affordable to the poor. In the case of alternative energy technologies, this would mean that isolated projects associated with a particular technology or delivery mechanism are not likely to work unless the policy environment can also be changed to

ensure those complementary inputs that can allow the poor to make more effective use of available electricity beyond their basic household needs.

Greater Gender Specificity

It is evident from the EnPoGen studies in all three countries that the gender-neutral approaches pursued by rural electrification programs are inappropriate to cater to the gender emphasis in contemporary development agendas. A more gender-specific strategy is imminent to not only redress gender inequity issues, but also to address poverty at large. The evidence presented by the EnPoGen studies, as also by experiences around the developing world, suggests that women-operated household microenterprises made possible by electricity—in conjunction with substantial time savings through the resolution of their cooking fuel-related tasks—are one of important escape routes out of poverty. Should this be the case, a sharper focus on the role of electricity could help accelerate poverty reduction efforts.

The role of machines—for threshing, grinding, rice husking, oil producing, grass-cutting, noodle-making, and so on—driven by nonhuman and nonanimal sources of energy is critical. Since most of these tasks traditionally fall upon women, there is a clear potential for the introduction of electrical equipment that have a major impact on women's workloads, household division of labor, and household relations.

Taking gender into account means adopting a relational approach, as well as focusing on women as a specifically affected group. This is important in two particular respects:

- First, it is useful to disaggregate possible direct and indirect gender benefits mentioned earlier. Some interventions, such as fuel-efficient cookstoves, may directly benefit women and their households. Others may have an indirect benefit. For instance, interventions to improve infrastructure may benefit children's education and the health of household members, or provide greater household income security. Any of these may have benefits for women, even though they are not the direct beneficiaries.
- Second, improvements in the lives of the poor will always involve tradeoffs. Although women and men may have different perspectives and priorities, they also have common interests, particularly in relation to longer-term survival and well-being strategies. A gendered approach needs also to take this into account. For example, circumstances may arise where there are conflicting priorities in energy use or acquisition. An obvious case would be the possible introduction of technologies that enable men to gain more income, but place a higher workload on women. It is important to uncover these effects and their potential implications for poverty reduction. At the same time, judgments about the desirability or otherwise of these tradeoffs cannot be made by researchers. That is a matter for those making them.

5 Alternative Energy Technologies: Need for a New Approach

The Evolution of Alternative Energy Technologies

Over the past two decades, a range of small-scale decentralized energy technologies capable of producing fuels and electricity has emerged on the energy scene. These technologies are based on renewable natural resources, such as biomass, wind, water, and sunshine, and they offer alternatives to centralized energy supplies, including electrification through the grid. Because most of them are concerned with electricity, they are especially relevant for rural electrification and rural energy development.

The initial importance of alternative energy technologies[14] stemmed from the oil price crises of the late 1970s when developing countries were confronted with the challenge of minimizing their energy import bills through greater energy self-reliance. During the decade of the 1980s, a variety of alternative energy technologies was introduced into the majority of developing countries in Asia under demonstration and pilot projects, which had the effect of gradually improving their performance and reliability standards, as well as also reducing their costs. In some countries, progress achieved in alternative energy technology dissemination resulted in the launch of commercialization programs accompanied by the entry of a number of fledgling private sector initiatives. For the most part, though, this initial phase was supported largely by donor and governmental funds, with market instruments having a negligible role.

Following the decline and subsequent stabilization of global oil prices in the mid-1980s, the priority assigned to alternative energy technology development generally slipped down in the energy policies and strategies of developing countries, particularly in Asia. This was partly because of the largely foreign origin of these technologies and its import implications vis-à-vis reduced oil prices. There were also other reasons, such as the difficulties of operating and maintaining sophisticated technologies in rural communities lacking in know-how and skills, developing reliable servicing networks for them and, most critically, their high investment costs relative to the subsidized prices of conventional options, and other market barriers in most developing countries. In any

[14] Such as solar PV, solar thermal, passive solar (that is, greenhouse), small-scale hydro, wind power, biogas, biomass gasification, biomass-based liquid fuels, and hybrid systems (combinations of the preceding with one another or with conventional options like isolated diesel power and kerosene). Some of these technologies—such as windmills for irrigation and shaft power, and small hydro systems—have been in existence for decades, even centuries, before the oil price crises.

case, alternative energy technologies were rarely embraced with enthusiasm by national energy utilities because of their small scale, low returns (to utilities), and the requirement to devise new modes of delivery and consumer relations.

Environmental concerns triggered by the Brundtland Commission's report on sustainable development in the late 1980s revived attention to alternative technologies, which enjoy the advantage of a "clean" label as compared to conventional fuels and sources of electricity. During much of the 1990s, therefore, international initiatives—such as the Global Environment Facility (GEF), the Bank's own Asia Alternative Energy Technology Program (ASTAE) and other multilateral and bilateral programs—helped scale up the role of alternative energy technologies in the energy strategies of developing countries under the umbrella of climate change and local environmental management. Progress with their dissemination accelerated in a number of countries, and increased emphasis was placed on the development of self-sustaining markets for them. In spite of these developments, the share of alternative energy technologies in rural energy supplies remained a fraction (less than 1 percent) in most developing countries at the turn of the century.

The current global development agenda pursuant to the Millennium Summit and the World Summit on Sustainable Development has sharpened the focus on alternative energy technologies. In addition to their environmental benefits, it is now realized that these small-scale technologies could help mitigate the energy starvation of large population masses in the developing countries that lack access to modern energy services. With poverty being the central development concern now, and rural poverty foremost within it, alternative energy technologies have arrived at a new crossroads. Efforts to gain them a larger share of the energy market will not only focus on their environmental advantages, but also, perhaps more critically, on their ability to serve the needs of the poor more effectively than before.

Benefits and Limitations of Alternative Energy Technologies

The EnPoGen studies have sought to assess the role and impact of alternative energy technologies in China, Indonesia, and Sri Lanka. Because of the priority given to electricity under the project, the assessment has been concerned mostly with the role of these technologies in rural electrification. However, the China study has a more extended scope than the other two in that includes the nonelectric (fuel) needs of rural communities.

Before presenting the findings of the EnPoGen studies on the topic, it would be useful to summarize quickly the common points of understanding on the benefits and limitations of alternative energy technologies. Aside from their broader environmental benefits and capacity to promote local energy self-reliance, alternative energy technologies carry the following primary operational advantages:

- They can be installed quickly, and the supply of energy services from them can start immediately.
- Some of them, such as solar PV systems, are portable and, therefore, offer added suitability for nomadic populations and populations without access to other renewable resources.
- They are usually more cost-effective than conventional energy options[15] in remote areas to which the supply of grid or commercial fuel networks is often prohibitively expensive.
- By definition, they contribute to poverty alleviation by meeting certain minimum energy-electricity needs.

The capacity of alternative energy technologies to meet the energy needs of the poor varies considerably—from very small SHSs of 16 Wp in the case of electricity to megawatt-scale microhydro minigrids that are often hooked up to the main utility grid. Their impacts on poverty, therefore, fluctuate widely depending on the type of technology and the capacity of systems deployed. Although situations exist in which more than one type of alternative energy technology is feasible, location-specific resource availabilities restrict the choices available to the people, often to just one technology that has the best resource potential.

The role of alternative energy technologies in poverty alleviation, that is, in meeting the basic needs of the poor, can be illustrated using the World Energy Council's estimates of minimum energy needs in developing countries. According to a recent WEC-FAO study (WEC and FAO 1999), the Indian Advisory Board's energy consumption "norms" estimate that some 948 MJ of *useful*[16] energy is needed to meet energy needs for cooking, about 46 MJ to meet space heating needs and 46 MJ to meet lighting needs—a total of 1,039 MJ per capita per year, equivalent to 288 kWh of electricity. Based on these and similar figures from other developing countries, WEC estimates minimum energy needs in the developing countries to be 300 kWh per capita per year immediately, growing at an average annual rate of 2 percent to 500 kWh by 2020 (WEC 2000).

The WEC estimate of 300 kWh translates into a supply capacity of 137 W[17] per person. Of this, the capacity needed for lighting is only about 13 W. For a family of four, the system capacity needed for electricity producing technologies is, thus, 52 W. It is well within the ability of even small SHSs to cater to this minimum amount of electricity. By contrast, such a low volume of demand will be uneconomical for centralized grids,

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[15] With the possible exception of isolated diesel power generators whose financial viability against alternative energy technologies varies according to fuel price and transportation cost.

[16] Because the amount useful energy delivered depends on the efficiency of the conversion process and equipment, the "gross or primary" energy needed to meet these needs could vary significantly. For instance, biomass fuels, with their low conversion efficiency, could prove far more resource-extensive than modern alternative energy technologies to deliver the same amount of useful energy.

[17] Without considering resource availability fluctuations, conversion loss, and equipment performance factors.

especially if the user communities are located in remote areas, in which case to reach them, substantial investments have to be made in transmission and distribution networks. For poor communities that have no access to electricity, alternative "electricity-producing" energy technologies offer quick relief because of their short gestation and deliverability. All of them will, therefore, have a positive impact on poverty alleviation in various ways, subject to their supply capacity, because the aim is to mitigate the hardships of the poor to a greater or lesser extent.

The transition from basic household uses for lighting, TV, water heating, and other comfort or convenience needs to productive uses for income generation in home-based and community enterprises requires increases in the supply capacity beyond the bare minimum. Often, it entails a shift from one technology to another. There is also the crucial question of affordability in the case of the poor. In theory at least, as the scale of supply capacity increases, greater diversity in uses is made possible, as illustrated in figure 13 for some of the typical technology options.

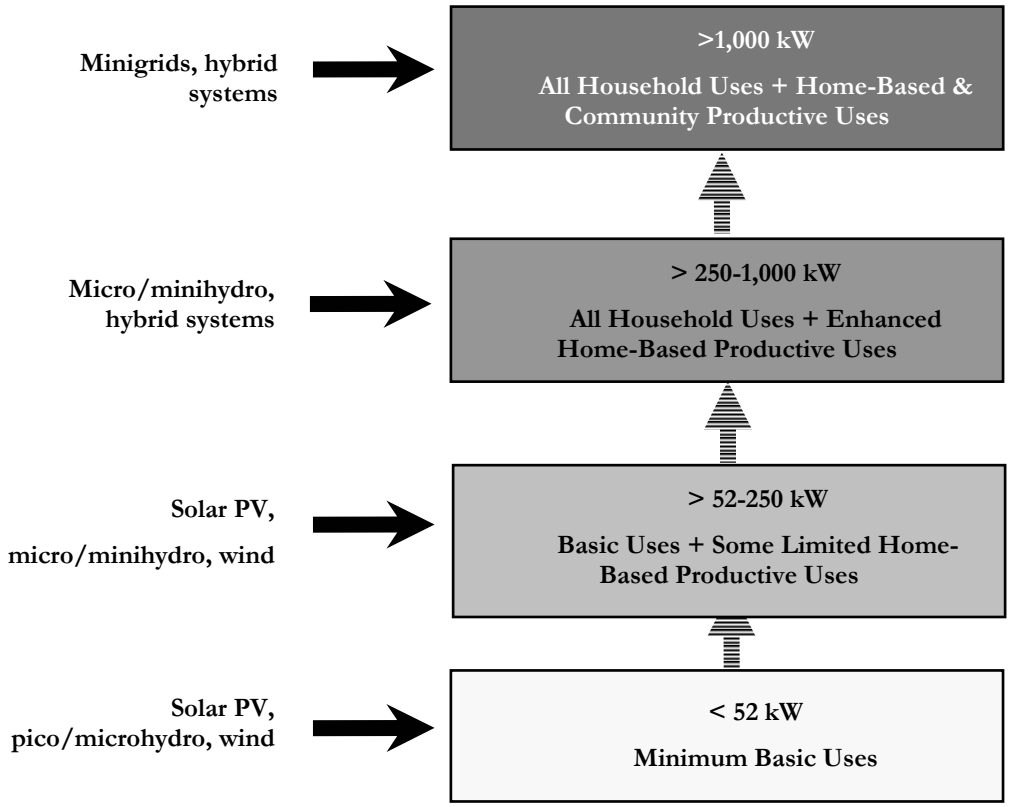
Alternative energy technologies are, however, commonly associated with technologies that produce electricity. Electricity use for basic needs in rural households generally forms a small portion (about 10 percent, if one goes by the WEC estimates) of their aggregate energy consumption, the bulk (80–90 percent) of which is for cooking even in grid-connected households. Because the latter involves the collection of traditional fuels over distances and their use in rudimentary cooking devices of very low efficiency, electricity-producing technologies contribute little to mitigating the fuel-related hardship from daily cooking faced by women and children in rural communities. By contrast, fuel-producing technologies, such as biogas, do cater to these needs.

The main limitations of alternative energy technologies are as follows:

- Their "intermittent" nature of supply, limited to certain hours of the day or certain months of the year according to the resource type.
- Difficulties with servicing and maintaining them in remote rural areas, especially for poor users who are handicapped by a lack of education and technical skills.
- Resultant low efficiencies in performance, leading to substantially less useful energy than implied by rated system capacities.
- Their high initial investment costs relative to the poor's lack of purchasing power to buy and maintain them, as well as to acquire appliances, especially productive appliances.

The most serious barriers to employing alternative energy technologies for the poor ultimately have to do with problems of access and affordability. As noted by the EnPoGen China study, remoteness adds to the cost of all energy supply options and is likely to increase the attractiveness of alternative energy technologies that do not require the transportation of fuels. However, this transport cost advantage may be offset by the cost of imported spare parts and the high costs of frequent visits from urban-based technicians that are required to maintain novel or delicate systems.

Figure 13: Illustration of Scale of Alternative Energy Technologies Relative to Type of Use



What this means is that although poor communities living in remote areas may find alternative energy technologies their "cheapest," if not only, option, they might have to incur more than the normal cost of acquiring and keeping these systems running in good condition, as compared to less remote rural consumers. So, although the comparative advantage of these technologies vis-à-vis conventional supply options is possibly true in most remote situations, this is not necessarily the decisive factor. The central feature of poverty remains the lack of purchasing power, especially cash income. The vast majority of the poor lead a subsistence life where the absence of surplus cash is their most serious handicap. Expecting these people to bear the initial investment in alternative energy technologies in one lump sum and to incur the higher recurring costs of service in remote locations is often asking too much. The cost of appliances—especially high-value productive use devices, such as grinders or refrigerators—further constrains the poor's ability to employ energy to enhance their livelihoods, even if they had access.

Impacts of Alternative Energy Technologies

Against the foregoing general background, the effectiveness of alternative energy technologies in rural electrification and their impact on the poor are presented here. The

findings and conclusions are based largely on the EnPoGen studies in Indonesia and Sri Lanka. References are made to the findings of the China study where available.

Supply Capacity

Alternative energy technologies have simultaneously acquired credibility and a relatively poor image among consumers. Although their technical capabilities are not usually challenged, they are reproached for their capacity limitations. With grid electricity, users begin a slow but continuous process of capitalization, increasing their electricity consumption steadily over time. Low-cost but high-value appliances, such as electric irons and fans, are within the reach of the people more or less immediately, and they serve to lighten the tasks of women and improve the quality of household life. Over time, subject to other conditions being met, income growth leads to the acquisition of additional equipment for productive purposes. These benefits are not readily available from alternative energy technologies because of supply constraints and/or investment constraints on upgrading to larger-capacity systems.

The Indonesia and Sri Lanka studies looked at three main alternative energy technologies—SHSs, micro or minihydro systems, and hybrid systems combining either of these with diesel. The participatory surveys and interviews conducted under the studies received a largely negative feedback. This is illustrated by the Sri Lanka study, which compares the level of satisfaction expressed by users from SHSs and micro or minihydro systems as compared against grid supplies, and their additional needs for electricity from these systems (figures 14–17).

As shown in figure 14, the satisfaction level is the highest with grid supplies, followed closely by micro or minihydro. SHSs offer a substantially lower level of satisfaction. The main reason for the relatively lower levels of satisfaction with the two alternative energy technologies in Sri Lanka was stated to be their inability to meet the needs of users. For instance, despite the fairly high level of overall satisfaction with village micro or minihydro power schemes, the users were of the view that the schemes covered only 40 percent of their needs. With SHSs, this was much lower, with only about 5 percent of the needs being considered met (figure 15).

The distinction between SHSs and micro or minihydro in relation to unmet needs was correspondingly sharp (figures 16 and 17). Nearly 70 percent of SHS users in Sri Lanka felt that their basic home comfort needs required additional electricity contrasted with about 45 percent of small-scale hydro users who felt the same way. These differences persisted for other household needs, such as TV, irons, and productive applications.

Figure 14: Level of Satisfaction from Solar and Micro or Minihydro Systems in Sri Lanka

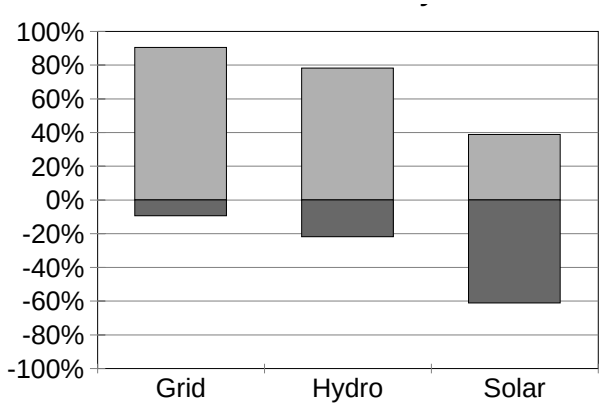
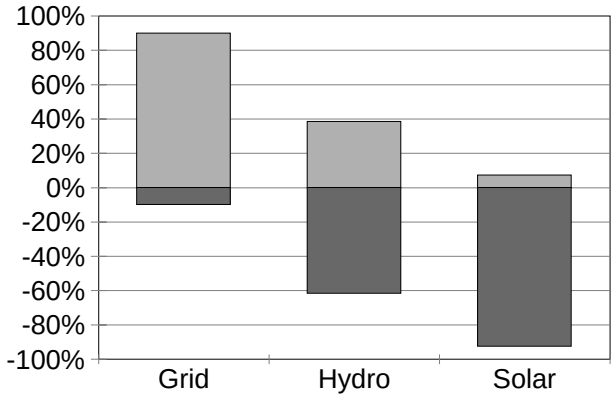


Figure 15: Coverage of User Needs by Solar and Micro or Minihydro Systems in Sri Lanka



Similar findings were derived from the Indonesia study, which discovered that 72 percent of SHS users claim that they require more power, against 14 percent of those supplied by the grid. SHS schemes in Indonesia (as also in Sri Lanka) mostly reach the better-off and middle-income groups. A portion of the systems sold in Indonesia have been to the poor and very poor households, but this has been through highly subsidized schemes that are not considered replicable. Micro or minihydro schemes, by contrast, have been able reach all types of households, and even poorer groups. This is because of their relatively lower costs to consumers. Solar-diesel hybrid schemes in Indonesia generally exclude the poor because they employ a pay-for-service system, although those who can afford it express a high level of satisfaction—86 percent against 37 percent—for the outright sale system used for SHSs.

Figure 16: Unmet Needs for Electricity among Solar Home System Users in Sri Lanka

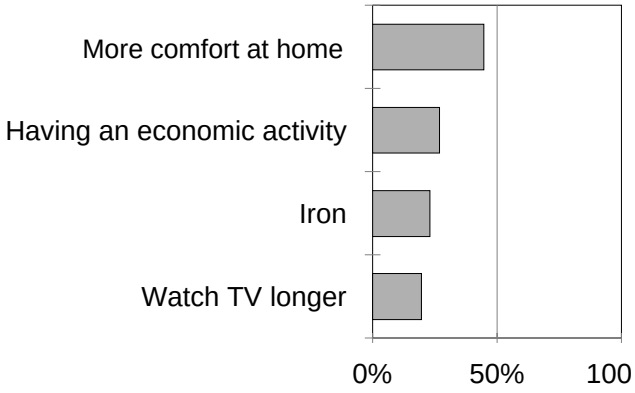
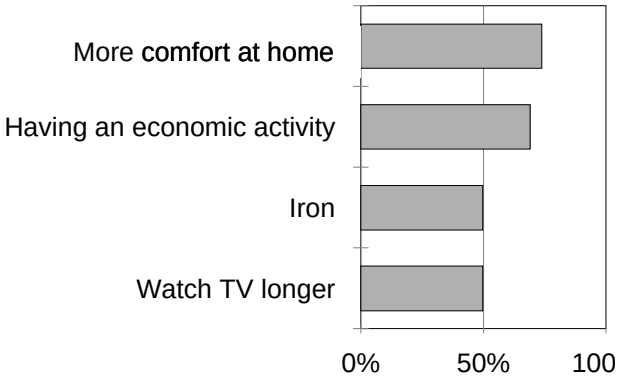


Figure 17: Unmet Needs for Electricity among Small-Scale Hydro Users in Sri Lanka



Quality of Service

The voiced criticisms over alternative energy technologies have more to do with the quantity of electricity supplied rather than with quality of service. Although there is a normal level of complaints about failure, maintenance problems, and scheme management, alternative energy technologies are generally considered more reliable than grid supplies, especially in Indonesia where most of the rural respondents were dissatisfied with the utility's service quality. By contrast, SHSs, which were stated to be the lowest performers for meeting the volume of electricity needs, were considered to provide a fairly good quality of service. By contrast, grid supplies were considered to offer the poorest service quality because of voltage fluctuations, blackouts, brownouts, and so on (tables 22 and 23).

According to 70 percent of the electrified households in Indonesia, occasional blackouts constituted the most common problem faced by them, and it was most

prevalent among users connected to the grid. Voltage fluctuations were stated as the second critical problem by nearly 50 percent of the electrified respondents, again mostly grid-connected users. With the national power utility affected by serious financial constraints, these problems may well be exacerbated in the future if no additional investment funds become available to improve service quality.

Table 22: Comparison of Quality of Service from Alternative Energy Technologies and Grid in Indonesia

	Grid	Mini / micro-hydro	SHS	Solar / diesel hybrid
Percentage of respondents with maintenance difficulties	60	22	13	5

Against this, recent users of hybrid systems in Indonesia were the least affected by blackouts (11 percent) and voltage fluctuations (7 percent). Of the users of SHSs and micro or minihydro systems, between 40 percent and 60 percent encountered these problems. An important finding of the Indonesia study was that the duration of connection does not improve service quality. The study also noted that service quality problems were more accentuated at the level of the poor and the very poor, although the causes of this were not clear.

Table 23: Service Quality Variations between Alternative Energy Technologies and Grid in Indonesia

	Blackout	Voltage fluctuation
Source of electricity		
Grid	78.3	58.3
Solar home systems	43.5	50.0
Micro/minihydro systems	65.5	40.0
Hybrid systems	10.9	6.5
Years connected		
< 2	73.1	51.6
2 – 7	64.4	50.8
> 7	66.8	51.2
Income class		
Very poor	84.1	60.7
Poor	73.9	55.6
Near poor	72.2	53.7
Middle	61.1	45.1
Better-off	55.9	42.1

The China study covered three remote villages with limited prospects of grid access that had been provided with SHSs. It found that in two of the villages, the projects seemed to have collapsed very soon after implementation, and in the third village in which the project was implemented only a few months prior to the study, some systems had already experienced failure. The household systems used in the villages could, in principle, power two 20 W light bulbs and one black-and-white television each. The life span of the battery was stated by the villagers to be about three years. The cost of installation was about Y 2,000 (US$250), although most systems were heavily subsidized. Initially, the users were happy with the system. It provided brighter lighting than kerosene, and was cleaner and easier to use. It provided the television, which was believed to be an important way to educate children. Within a relatively short period, however, most systems were no longer functioning. After installation, the farmers rarely saw the engineers again. The light bulbs tended to last about two to three months and could only be purchased in the county town, up to eight hours away along very difficult roads. When batteries or chargers failed, some after only a year, the users simply gave up on the system, knowing that replacements would have to be purchased out of their own pockets. They reported that they would prefer to save the money in case the opportunity for grid connection, which they now saw as much more beneficial, should arise.

Similarly, ambiguity over ownership of the microhydro station and the electricity generated led to problems over maintenance of equipment in another of the villages covered by the China study. In this instance, fuses were often blown when villagers used

powered equipment, and local men had learned how to replace them on the village transformer. However, problems that required outside help were not so easily resolved. At the time of the study, the transformer in the village had been out of action for two months, cutting off all electricity supply. It was only after the study team notified local officials of the team's imminent arrival that it was repaired.

Frequent power cuts, low capacity, fluctuating voltages, and uncertainty over when or even if repairs and maintenance would be undertaken appeared to be discouraging increased utilization and investment in powered equipment among users of alternative energy technologies in China. In fact, given the uncertainties over their effective operation and maintenance, many users were forced to maintain at least one month's supply of kerosene for lighting. Furthermore, the poor quality of supply was also reported to have direct cost implications in that, even at times when the voltage fell below what was required to power equipment or provide reasonably bright lighting, the meters would still be running.

Ease of Use

One of the principal characteristics of alternative energy technologies is that, save for larger systems such as village minigrids that are serviced externally—for example, by the utility in the case of grid-connected systems or by private suppliers—they require operation and maintenance skills at the user level. The complexity of a technology, the effectiveness of its servicing infrastructure, and user know-how determine the extent of its user-friendliness. Evidence on this, therefore, varies by the type of technology.

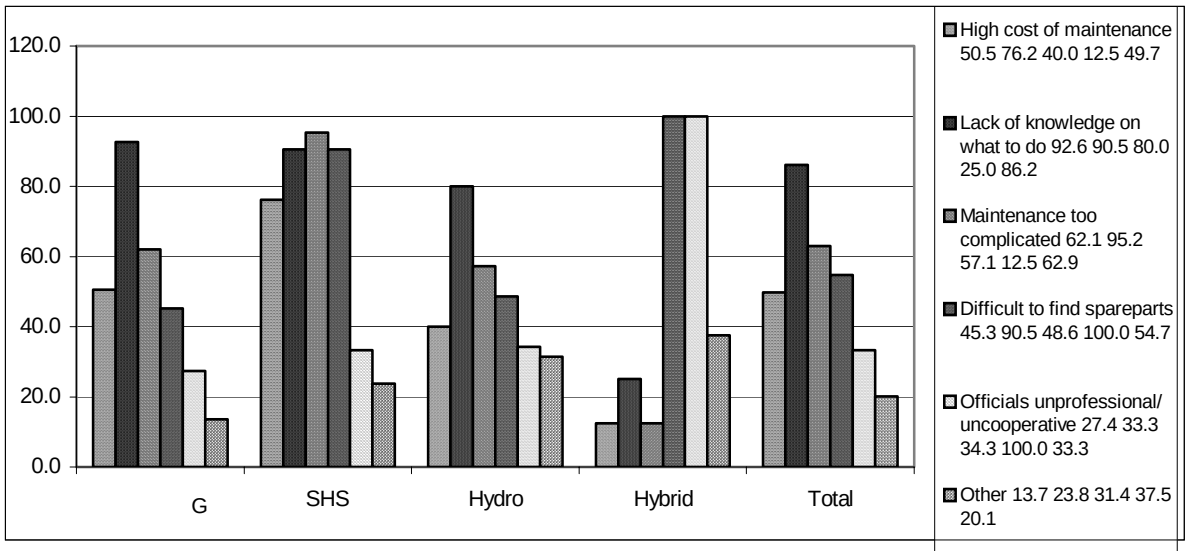
The Indonesia study encountered many complaints because the difficulties of maintaining household systems, with the most negative comments expressed by SHS users. However, when the survey respondents were asked about specific issues with maintenance, the proportion of users of alternative energy systems admitting to maintenance difficulties turned out to be relatively low. Overall, only one in eight electrified households was found to have serious maintenance difficulties. Among those, complaints were noticeably higher from SHS users (22.8 percent) and to a lesser extent from micro or minihydro users (17.5 percent). The proportions of grid and hybrid system users with maintenance problems was the lowest (10.4 percent and 8.7 percent, respectively) (table 24).

Table 24: Incidence of Maintenance Difficulties with Alternative Energy Technologies in Indonesia

	Source of electricity				Years electrified			
Households	**Grid**	**SHS**	**Hydro**	**Hybrid**	**< 2**	**2–7**	**> 7**	**Total**
No. of HHs	95	21	35	8	80	51	28	159
% of electrified respondents with maintenance difficulties	10.4	22.8	17.5	8.7	12.5	11.4	13.2	12.2

Users of SHSs in Indonesia stated that they had to make sure they do not overuse the batteries, thereby shortening the battery life and incurring high replacement costs. Of the maintenance difficulties, the most frequently mentioned was “maintenance too complicated” (95 percent of those with maintenance difficulties), followed by “lack of knowledge on what to do” (91 percent) and “difficult to find spare parts” (91 percent) (figure 18). Three-fourths of these respondents attributed their difficulties to “high cost of maintenance,” which might also mean that their monthly payments for SHSs are too high, because they are clearly much higher than for any other type of alternative energy technology. About half the SHS users expressing maintenance difficulties also claimed difficulties in finding spare parts, and one-third said that officials were unprofessional or not cooperative.

Figure 18: Specific Difficulties with Maintaining Alternative Energy Technologies in Indonesia



Difficulties with mini or microhydro systems are illustrated by the case of Bokin village in Indonesia, which is served by a 12 kW microhydro-minigrid system. At the time of the study, electricity had just returned to the village after a two-month blackout, although the village had first received electricity from the system only about a year before. The project established a “village electrification unit” to ensure the system’s performance. Existing business-oriented entities in the village were selected to undertake these responsibilities, including long-term management and operation of the plant and revenue collection from the villagers. Because of limitations in local skills, the project conducted various training sessions during the initial project mobilization and implementation phase on technical aspects, socialization of end users, and management.

Contrary to initial feasibility studies, the system in Bokin encountered potentially insurmountable problems, some of which could be attributed to poor planning and design. During initial feasibility surveys, the plan was to serve 218 households in 2 neighborhoods. During construction, it was realized that only 130 households in neighborhood could be served, and only about 80 households were connected to the minigrid even though house wiring had already been installed in the remaining 50 houses. The main reason for the sharp decline in the number of houses was caused by insufficient water supply to run the turbine and insufficient grid extension materials, particularly poles. Because the 50 or so households left out had paid their connection fees and were demanding electricity, they were given batteries instead. Since the village electrification unit is not trained to handle such substitutes, when batteries run low they are often kept for several days in the unit's office waiting to be charged. Furthermore, the water stream supplying the system was allegedly diverted by upstream villages. As a result of these difficulties, users in Bokin claim to have access to a maximum of only 50 W of electricity against the promised 100 W per household, which is sufficient for 2 or 3 bulbs of 5–10 W. Their TVs can hardly be turned on to avoid blackouts altogether. Also, the local technicians, even though their salaries had been raised by 25 percent, were still considered mostly incompetent.

It should be noted, however, that the problems with the microhydro system in Bokin cannot be attributed to the technology *per se* and are, in fact, more a combination of poor planning and management. This is true also of another instance involving hybrid diesel-solar systems in Indonesia, in Sulopangkang village, where users suffered from a variety of problems. The systems were technologically sophisticated and novel, with batteries theoretically expected to last for 10–12 years and panels for up to 20 years. Operationally, the scheme relied on a prepaid system, recorded at the central office and in a machine called "suncash" installed in the house of each of customer. For all its sophistication, the contractor for the scheme did not train any local technicians among the village residents. As a result, problems with suncash had to await technicians from faraway Jakarta. Besides, the village headman in charge of receiving payments had only a limited supply of suncash tickets. At times, he was left with more expensive tickets that only the better-off could afford. Until a new shipment of tickets came from Jakarta, the remaining users were left in the dark.

The main conclusions that could be drawn from the foregoing findings, which are similar to those of the Sri Lanka study and to experiences elsewhere among other developing countries, are the following:

- Alternative energy technologies are owned and operated by end users, as compared to grid electricity where the users are not responsible for the supply equipment or machinery; they, therefore, require careful planning ahead of the actual investment, the burden of which falls squarely on the users.
- Because of their sophistication, they are not readily transplantable among rural communities that lack the knowledge and skills to maintain them.

- Their lack of user friendliness is often a result of managerial shortcomings rather than inherent defects in the technologies themselves.
- Although this does not rule out instances of system failure or lack of performance because of design and material flaws, the performance characteristics and reliability of alternative energy technologies have improved greatly over the past two decades.
- Poor component or construction quality, for example, that of batteries in the case of SHSs and wind and hybrid systems, and that of civil works in the case of micro or minihydro systems could affect the performance characteristics of systems.

Impacts on Poverty

As discussed earlier, in spite of their high costs, alternative energy technologies are often the only short-term means of access to electricity for rural communities with no or low prospects of grid connection. As a result, the willingness-to-pay for them is generally high among such communities.

The Indonesia study found that more than half the SHS users were prepared to pay higher prices notwithstanding their numerous complaints over operation and maintenance problems. An even greater proportion (91 percent) of hybrid system users were willing to pay more, although they were already paying about 14 times per kWh of electricity as compared to grid users. However, among the micro or minihydro users, the majority of whom were poor or very poor, only a third were willing to payer higher prices.

Although these figures are impressive, they do not warrant the conclusion that alternative energy technologies are affordable and pose no problems in their price for rural users, especially the poor. The central issue, especially for the poor, is that there is a difference between *willingness* and *capacity* to pay. The poor without access to electricity do not really want technologies—they want electricity. Their willingness to incur the often exorbitant investment in alternative energy technologies relative to their income levels can obscure their underlying desperation to obtain electricity.

In a separate ongoing DFID-World Bank study of China,[18] it has been found that poor user communities in remote rural areas tend to borrow heavily to acquire micro or minihydro systems, at times foregoing other essential expenditure, such as children's school fees. Although this obviously reflects the higher value they assign to electricity, it is by no means an indication of their preference to these systems over other means of electricity supply, which could prove cheaper if they were available. Nor is their willingness-to-pay for electricity at the cost of other benefits, such as education, necessarily to their long-term advantage, although the point could be argued further.

On the whole, SHSs, which carry the highest cost per kWh among alternative energy technologies, are the least poor-friendly. The Indonesia study found that, although initial SHS programs were basically grant-based and virtually free of cost to users, more recent

[18] ECN 2002.

initiatives have been commercially oriented with only a moderate subsidy given to the service provider. This has effectively priced the 40–50 Wp systems currently on offer in the market out of reach of the poor. Most SHS users covered by the study fell into the highest expenditure categories, well above the poverty line. The same was true of hybrid systems, the users of which were virtually all among the better-off segment of the population. In Sri Lanka, even with subsidies and credit payment facilities, the majority of rural families was unable to finance its share of the investment and monthly repayments for SHSs, which represented three to six times the average lighting budgets of households. At this price, and given that SHSs do not allow any income-generating activities of significance, it is difficult to see their impacts on the poor in a positive light.

By contrast, micro or minihydro systems, although more expensive than grid electrification at current prices in Indonesia, were found to be a feasible option for the poor. Their users tended to be concentrated among the bottom end of the expenditure range, particularly in the poor and very poor categories that roughly represented those close to or below the poverty line. In Sri Lanka, the direct and indirect impacts of micro or minihydro systems was equally spread across large segments of the population, with village hydro schemes being owned, managed, operated, and maintained by the communities themselves. Furthermore, micro or minihydro systems were found particularly suitable for mountainous regions with water resources where the infrastructure was bad, agricultural productivity low, and grid connections prohibitively expensive—in other words, poor areas.

In the balance, because of its lowest cost per kWh, grid electricity seems the most favored by the people, although it is not necessarily the most economical from the viewpoint of the national economy, especially for remote areas where the investment requirements are disproportionately large. Of the sample of 1,300 electrified households that formed the sample for the Indonesia study, 137 (10 percent) had relied on a different source of electricity earlier. Of them, the majority consisted of SHS users who switched to grid connection once it became available.[19]

The perceptions of users and nonusers of electricity about the limitations of alternative energy technologies, as well as of grid electricity, in relation to poverty are summarized in table 25. Although it might appear from the table that SHSs have the least number of negative perceptions and grid supply the most, this should be interpreted against the preceding discussion, which indicates that SHS users are largely the nonpoor.

[19] There are, however, exceptions to this. In the ongoing ECN study in China (ECN 2002), microhydro users in one of the five villages studied had opted out of grid connection because of erratic and high monthly bills; they stated that they valued their self-reliance more.

Table 25: Perceived Limitations and Negative Effects of Electricity Services in Sri Lanka

Grid	Micro/minihydro	SHS
Objections by land owners to nonusers getting connections over their land leading to conflicts between families (NU) Sense of increased dependence on users by nonusers for TV watching, information and lighting during family functions and funerals (NU) Sense of inferiority among school children without access to TV (NU) Inability to invest in connections with more than one post (NU) No bills, do not know how much it will cost (refrain from using items like water heaters and iron) (U) Cannot afford electricity bills (use only for lighting, TV, radio and ironing) (U)	Increased dependence of nonuser families on users for TV watching (NU) Wider gap between the very poor and the rest in the community because of physical proximity (NU) Marginalization of the very poor as a result of their inability to pay the initial share of electrification costs (NU) Inequitable distribution among households though rental is uniform (U) Productive activities using electricity discouraged by the Electricity Consumer Society (U)	Limited use (NU & U) High installment rate (NU & U) Suspicion about solar panel companies as a result of reduced contact after purchase and not keeping initial promises with regard to services (NU)

U = Users of electricity services; NU = Nonusers of electricity services.

Directions for the Future

The preceding review of the role of alternative energy technologies leaves a mixed impression of their capability to cater to the poor. Their main strength lies in their ability to serve the poor's needs immediately and in a manner that places the control of the energy services provided in the hands of the users themselves. The latter, however, is a mixed blessing because control is accompanied by investment commitment and much of the responsibility for operating and maintaining these technologies—both of which are difficult for the poor. Growing commercialization trends, in fact, accentuate these features and tend to dilute the notion of energy as a service because most commercialization programs view energy technologies as products, however much it may be argued to the contrary. Although this could be viewed as a natural evolution following years of government- and donor-sponsored promotional measures, its implications for the poor are largely negative. Much as one would like to see the development of energy markets in which technological options compete with one another to provide energy services at the least possible cost to users, this is true only if all users were able to participate in such markets. To the extent that the poor lie generally outside the market

process, commercialization of alternative energy technologies without distinct provisions for the poor's needs would serve to further exclude than include.

The question then is whether or not one should pursue alternative energy technologies under the umbrella of poverty reduction. It is perhaps easy and convenient to answer this in the negative and let things take their course in the form of a trickle-down effect on technology prices that would "eventually" reach the poor. However, against the present developmental agenda, this would hardly find favor with anyone. What is needed is a proactive and propoor strategy that recognizes the advantages and limitations of alternative energy technologies, and seeks to find new ways and means to reach those who need them the most. The main elements of such a potential strategy are set out here.

From Technology "Fix" to Technology "Fit"

Alternative energy technologies suffer from technology-fixated project design, financing, and marketing that do not allow them respond to their clients' needs. The problems of supply capacity and service quality described earlier arise to a good measure from such an approach that expects users to limit their needs to the capabilities of specific technologies rather than finding technological solutions that satisfy the needs of users. In other words, a demand-driven rather than supply-driven approach is called for.

This means starting not with the question, "How can renewable energy be applied in rural settings?" but rather beginning with a series of questions addressed to various members of rural communities, such as "What are your needs?" "Can renewable energy be applied to best meet these needs?" "If so, how?" and so on. Rural energy projects that start with the assumption that a particular technological application is the only solution cannot possibly respond to the many pressing needs faced by rural populations.

An example of how this would affect present modes of energy service delivery to the poor is offered by microhydro schemes that are usually poor-friendly, with low connection fees. However, although they initially bring a real service to all users, a significant number of them soon begin to complain about not being in position to increase service levels. In addition, excluded populations are unable enter the scheme because it is a static mode of electrification, sharing limited hydro resources. The same scheme in a hybrid mode of operation through complementary diesel generation could bring services adapted to the needs of all users, repay itself through tariffs, and generate resources for further electrification.

Another example is that of SHSs that are clearly not considered poor-friendly. They need not be so. Within community schemes, cross-subsidized tariffs for the poorest out of revenues generated from the more affluent populations—a well-tested strategy for grid electrification in many developing countries—could generate financial resources to provide access to all. Instead of concentrating mainly on the development of the dealer sales mode of dissemination of SHSs, which could prove expensive to the users because of intermediation costs, one could focus more on community schemes to reduce intermediation costs and establish a larger customer base through long-term credit, including credit for appliances.

Resolving Environment-Poverty Tradeoffs

In a significant proportion of cases, the energy options that best meet the needs of poor people will involve fossil fuels, and their use can have a negative effect on the local and global environment. There are very few alternatives to fossil fuels for transport (although animals are extensively used), and the cheapest electricity for most people will come from large power stations fueled by gas, coal, or even oil. Even in remote rural areas, diesel engines will provide the optimal solution for both shaft power and electrical power for machines.

Such a view is not an argument against alternative energy technologies. Clearly, alternative energy will be the "best solution" for some people, at some locations, at some times. More, however, might be achieved in the context of poverty by focusing both on those options that best increase energy access and on those options that best reduce the environmental costs of energy conversion and use. Neither objective is likely to be effectively achieved if it is pursued with only one set of technology options.

There is, thus, an evident tradeoff between the objective of tackling energy poverty and the objective of reducing the environmental problems associated with energy conversion and use. In the medium term and certainly under current prices and other incentives, actions to reduce energy poverty can harm the environment. A great deal of the interest in alternative energy so far, and much of the funding for it, is driven by concerns over global environmental issues. It has to be understood that, if the primary objective is to meet the energy needs of the unserved and underserved populations, neither the optimal solution nor the most equitable solutions will be found if their energy options are restricted to renewable sources (either old renewables, such as biomass, or new renewables, such as, PV).

The move toward "empowerment" as a development objective implies that the excluded majority is allowed to make informed choices from a *full menu* of energy options, so that it can select the option that best meets its needs. The poor certainly cannot be expected to restrict their options willingly while northern industrial countries are not doing enough to reduce the pollution burden of their current and past energy consumption. It is also clear that if the poorer countries of the world were to consume per capita as much energy as the industrial countries currently do, global warming would be severe and probably irreversible. There is no longer much doubt that global warming is likely to exacerbate the problems of those parts of the world that are already deeply stressed, economically and environmentally. But the question remains whether the poorest people on earth should carry this burden in addition to others that they carry.

The complexity of the arguments over renewable and nonrenewable energy options is illustrated by a particularly important finding from recent empirical research. This suggests that if people who currently cook by using burning renewable wood fuels

inefficiently were to switch to "nonrenewable" gas (LPG), there would be strong positive environmental impacts and a massive reduction in greenhouse gases per person-meal.[20]

Greater Diversity of Technology Options

As mentioned at the beginning of this chapter, a central limitation of alternative energy technologies is their concentration on electricity. From the viewpoint of the poor, the most critical energy needs are for cooking and heating, and these needs occupy up to 80 percent, or more in some countries, of their current energy consumption. Meeting these needs through alternative energy technologies is possible, as illustrated by the following observations under the China study.

In the village of Gansu, solar cookers were much in evidence and heavily used for much of the year. Interestingly, they were not rated highly in relation to fuels used for cooking, probably because their use was largely limited to boiling water. In China, unlike most countries, the use of boiled water is extensive, which may have considerable health benefits. Solar cookers are well suited for this purpose. In the same village, many women used small hand-turned fans as bellows to increase the efficiency of the cooking fire. The stoves were clearly constructed to facilitate this process and it was very effective in producing both higher temperatures and more complete combustion, greatly reducing the volume of smoke produced. The main problem was that they could not both operate the fan and attend to the cooking. Whenever they stood up to stir the food, the temperature would fall and they would be engulfed in smoke. The obvious solution, which a number of women suggested, was an electrically powered version of the fan (possibly using a small PV panel in villages without grid connection).

Turning to more "mainstream" alternative energy technologies, the current narrow focus on solar PV, micro or minihydro, and wind power could be usefully expanded to encompass the following other options:

- Biomass power generation, including combined heat and power generation, thermal gasification, biogas power, and gasification-cum-fuel cell hybrid systems.
- Solar thermal electric power generation.
- Hybrid systems, such as PV-cum-wind generators and micro or minihydro-cum-diesel generators.
- Energy storage technologies, for example, flywheels.
- Biogas, both household and community scale.
- Biogas hybrid systems, such as biogas-cum-biogas power and biogas-cum-greenhouse.
- Solar cookers.

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[20] This is a result of the considerably greater efficiency with which liquid and gas fuels can be converted into heat for cooking. Burning wood fuel in a normal cooking fire or traditional stove is not "greenhouse gas neutral" because of the products of incomplete combustion. (K. R. Smith and others 2000).

Increased Scale for Productive Uses and Affordability

The EnPoGen studies offer little evidence of productive applications of energy from alternative energy technologies for reasons mainly of lack of scale and, therefore, of supply capacity. Among the current genre of alternative technologies, only micro or minihydro systems are capable, at least in theory, of producing sufficient electricity to support home-based enterprises and community ventures, such as grinding and milling. However, in practice, even they are often constrained if the number of users is large since the quantity of energy made available to each household is then constrained to levels similar to those of solar PV or wind power systems, barely adequate to meet basic household needs.

From a poverty viewpoint, it is necessary to go beyond these minimum system capacities to a "minimum +" approach that, from the outset, recognizes the need to provide energy services for both basic and productive uses. On the face of it, this might not be easy to achieve since even the low-capacity systems are already beyond the reach of the poor. However, if larger systems could be combined with income-earning activities that enhance the economic capacity of the poor, they could become more viable than currently thought of. This is a major new dimension of opportunity for alternative energy technologies, which is explored further in the next chapter of the report.

Appliance Efficiency

Improving the efficiency of appliances most popularly used with alternative energy technologies is an important means of both reducing costs and increasing supply capacity. CFLs are usually included in SHS packages, but not in the case of micro or minihydro systems. In spite of their considerably lower energy consumption and longer life cycle, their high costs inhibit poor users from acquiring them. However, the Indonesia and Sri Lanka studies suggest that if all member families in a microhydro scheme switch to CFLs, the available electricity supply from the system could be effectively doubled at an extra cost of only 3–5 percent of the initial investment costs.

Similarly, neon lights (tube lights) are more efficient, longer lasting, and less vulnerable to voltage fluctuations than incandescent bulbs. They are also more affordable than CFLs. Although the resultant savings of energy from them might not match the level of CFLs, at the level of the poor even a halving of the electricity bill for lighting carries an enormous impact. The same principle could be extended to other household and productive use applications that not only help enhance the capacity of alternative energy technologies, but also result in concrete cash savings in the hands of the poor.

Consideration of Public Benefits

Ensuring better energy access to the poor requires a perception of public benefits from such access and, conversely, the unacceptably high cost of depriving them of it. In many developing countries, the numbers of the poor are disproportionately large, representing unused or underused social capital that could, if allowed, make a significant contribution to the economy at large.

To maximize these public benefits, future alternative energy technology promotion will need to pursue a different set of measures than those associated with more conventional market penetration. Analytical or “smart” subsidies and access to concessional credit could greatly enhance the role of alternative energy technologies among the poor. They could help create special markets featuring enabling conditions that induce the poor’s participation.

6 Beyond Energy

Given the complexity of the issues surrounding energy, poverty, and gender, the outcomes of the EnPoGen studies are by no means definitive for all developing country situations. Nevertheless, they do bring out the common strategies, achievements, shortcomings, and impacts of different energy options in the countries covered—which might not be vastly different in most other developing countries. The question lingers though: if, for argument's sake, it were possible to extend adequate and affordable modern energy services to all the poor, would it resolve poverty conclusively? Even the most vehement critics of present-day energy strategies would hesitate to say "yes."

Clearly there could be no dispute over the fact that modern energy services have not measured up to the expectations of the poor and that there is much room for improvement from planning and technology design to marketing and final delivery. Evidence to the effect is compelling. At the same time, energy will remain one of several factors that contribute to development in general, poverty eradication included. Although it is a crucial—perhaps even a catalytic—component of development, it is not a sufficient condition to resolve poverty.

A case in point is drawn from the ongoing DFID-World Bank study in China mentioned earlier.[21] The Chinese province of Sichuan, with a population of 80 million, has achieved more than 97 percent rural electrification, with only some 1.9 million people without access to electricity to date. Many of those who have electricity were connected as far back as 10 years ago. Yet more than 10 million poor still reside in the province today. Some 3.4 million of them are considered the bottom poor with a per capita income of less than US$80 per year, far below the international poverty line of US$1 per capita per day. What difference did electricity make then? Since the majority of the remaining poor in the province is, in fact, connected to the grid, supply constraints do not offer themselves as the obvious explanation. It is more likely that the provision of electricity in this instance was not preceded, accompanied, or followed by several other developmental inputs. As a result, conditions of poverty persisted although, because of electricity, those conditions could be less harsh than they were earlier.

Experiences around the developing world offer countless similar examples where energy made an impact on the lives of the poor, but not conclusively so and rarely to an extent that, on its own, it made poverty go away. Could this then be the outer limit of what energy can contribute to reducing poverty and redressing gender disparities in development? That by itself it can blunt the edge of poverty, but cannot subdue it? The evidence presented by the EnPoGen studies seems to indicate this to be the case. The

[21] ENC 2002.

conclusion is chastening—both for those who claim that energy makes a distinct contribution to the fight against poverty and those who assert it is not doing enough.

What then lies beyond energy? With what other developmental inputs should energy services be combined in order to reduce or remove poverty altogether? It is outside the scope of this report to elaborate this at any great length. However, an attempt is made to present here a quick summary of those other aspects of development that have the closest linkages with energy services for poverty reduction, especially in the rural context.

Critical Nonenergy Inputs to Rural Development

The Importance of Complementary Inputs

Rural underdevelopment, by definition, means a pervasive lack of many infrastructure facilities that are readily available to urban populations. Because distance is a critical factor in the development of these facilities, remote rural communities are affected the worst by the lack of sufficient infrastructure that could take advantage of modern energy services once they were made available. From the energy viewpoint, these other facilities and services amount to "complementary inputs."

The need for complementary infrastructure, such as roads, communication facilities, markets, buildings, equipment, and skilled personnel—often not provided in tandem with modern energy services—has been emphasized often as a requirement to achieve economic benefits from electrification or modern fuel supplies. Detailed studies of health, education, and small and medium enterprise sectors in a recent policy research review of the development rationale for rural electrification in South Africa confirm that the rural development benefits of rural electrification in that country will be limited without a coordination of such other inputs (EDRC 1998). Some evidence even suggests that the provision of infrastructure in a complementary fashion provides not just additional, but exponential benefits, because of the synergies available (Barnes 2000).

The importance of these and other studies on the subject is that they show why the impacts of energy projects are so variable at the micro level and why, when it comes to the poor, the impacts of modern energy are so frequently disappointing. It is clear that, since the need for energy is a derived demand, the developmental impacts of energy (for example, of electrification schemes) are likely to be a function of the complementary inputs that are associated with it. The benefits of supplying electricity to water pumps, for instance, are likely to be far greater if a system of irrigation channels is already in place or is built together with electricity supply than if it is not.

Soil conditions and climate limit the possibilities for increased agricultural productivity or diversification of outputs. The distance from markets and employment opportunities and the absence of roads and poor transportation inhibit the growth of alternative income-generating activities. Limited water and fuelwood resources impose demands on domestic labor time that reduce the time available for productive activities. The lack of adequate water supply as a result of the remoteness of water sources means

that women have to carry drinking water, an occupation that consumes several hours of each day.

These findings suggest that the impact of poverty-reducing energy interventions will be a function of existing[22] complementary inputs—production equipment or other livelihood assets—and that, if these inputs are not in place, the impact will not be achieved unless additional investments in those inputs are made. They also suggest that, because no human activity is possible without the use of energy, all studies that purport to show an impact on poverty from one or more inputs (such as land reform, irrigation, microcredit, women's education, or agricultural improvement) are necessarily also affected by the use of energy (and probably many other inputs). Therefore, a *prima facie* case can be made that these interventions owe at least a part of their success to the presence of these energy services, or that they would have had a greater impact had they been associated with greater access to effective energy services.

This, in turn, means that there will be poverty benefits from considering how, and at what additional cost, improved access to energy services might "add value" in relation to poverty impact to other mainstream poverty reduction interventions. Or, to put it another way, the key "energy issues" relating to the development of any poverty reduction strategy are whether that strategy would be improved or worsened by adding an "energy perspective" to the diagnosis of the problem and whether the effectiveness of specific interventions would be enhanced significantly if they had access to improved energy services.

Which Complementary Inputs Are the Most Critical?

It is clear from the EnPoGen studies and evidence elsewhere that the potential of modern energy services to release people from poverty can be fully tapped only when several complementary inputs precede or accompany them. It is difficult to set universal priorities among these inputs because they differ from one location to another, depending on the overall development status of a country, its geophysical characteristics, and the prevailing socioeconomic conditions of its population.

One could name any number of complementary inputs, such as roads, water supply, communication, or market access, as the more important, but they are subjective and location-specific priorities that cannot be generalized. For instance, the EnPoGen study in China, which was carried out in remote mountainous villages, found that rural communities there assigned the highest importance to roads and water supply (in addition to energy), which is understandable in their circumstances. By contrast, the Sri Lanka study stresses the lack of credit facilities as a critical drawback to make effective use of electricity. There could be any number of variations in such circumstances, and it is neither feasible nor meaningful to list them all. One could, in fact, look at the issue of urban poverty where most such complementary inputs exist and yet the people remain poor because of other factors.

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[22] Or accompanying, or immediately succeeding.

What might be useful here, though, is to distinguish between "infrastructure" and "noninfrastructure" inputs that need to accompany energy services to make an impact on poverty. Infrastructure consists of facilities that usually fall within the domain of public benefits, the provision of which is primarily a responsibility of governments.[23] Noninfrastructure inputs comprise products and services that are available in the market and can be acquired subject to economic capacity and know-how. Access to the latter is most often conditional upon the availability of the former, but the difference between the two in investment responsibility can be important.

The development of rural infrastructure facilities that are public investment responsibilities depends on governmental resources, policy objectives, and budgetary allocations. It is here that the rationale for extending these facilities to one or the other of rural communities often gets caught in conflicting priorities. For instance, a government focusing strongly on poverty reduction might assign a high priority to the development of infrastructure facilities for populations that are the poorest. However, if these populations also happen to be located in remote areas, the cost of investment could lie beyond the capacity of the government in the short term and would require a selective and drawn-out process of budgetary allocations. In a typical situation, some communities might be provided with fertilizers and irrigation facilities, but not roads or communication. Others might get access to roads and water supply, but perhaps lack schools or health clinics. Indeed, the development of rural infrastructure is seldom smooth, and the simultaneous coincidence of various elements of it is rarely achieved. The more these elements are staggered across space and time, the lesser the chances of energy services having the desired impact on the people.

Infrastructural inputs consist not only of physical structures and buildings, but they also include intangible services that are again made possible as a consequence of public policy and investment. Notable among the latter are markets, financing and credit mechanisms, training and skills development institutions, and qualified personnel, such as doctors, teachers, and technicians. Ensuring that these resources are available to rural communities often marks the difference between whether or not they are able to take advantage of the physical facilities provided to them. For instance, the provision of electricity without the knowledge or skills to make use of it in productive enterprises can confine electricity usage largely to household applications.

Finally, there is the most intangible of all public domain infrastructure inputs: governance. "Governance" subsumes many critical factors pertaining to the functioning of the government and public sector machinery, whose effectiveness has a direct implication for rural development. It ranges from the efficacy of the administrative structure and the work ethics of the bureaucracy to more serious issues, such as corruption and nepotism. Good governance is largely the consequence of a responsible and accountable political process. To the extent that a country has it or lacks it, the

[23] Although this is changing in a number of developing countries, that is, the privatization of water supply or even electricity, this is still largely an urban rather than rural phenomenon.

prospects for an equitable distribution of complementary infrastructure inputs among its people are promising or uncertain.

Turning to the noninfrastructure inputs, these are generally in the private domain and, therefore, closely related to the capacity and capability of the poor. Again, a listing of these inputs or assigning priorities among them is difficult. In general, though, if one accepts the fact that the lack of financial resources lies at the heart of poverty, then acquiring those resources would seem central to the issue. Without financial resources, none of the other inputs necessary to mitigate or eliminate poverty is possible. These inputs will include education, technical knowledge, entrepreneurial skills, productive equipment, capacity for innovation and, above all, the ability to combine human capital with financial capital accordingly to create or grasp opportunities for lifestyle and livelihood improvement.

Access to these noninfrastructure inputs is a function of public infrastructure, but their effective use is a matter of choice and acumen of the people themselves. Where they exist, the availability of modern energy services could enhance the poor's prospects significantly.

Whose Responsibility Is It to Ensure "Complementarity"?

If poverty reduction is the objective, the need to plan and ensure a close complementarity between energy services and other developmental inputs is obvious. The question is how much of the responsibility for this should be laid at the doorstep of the energy community and how much of it should be expected from organizations responsible for providing other inputs.

An Asian regional study sponsored by the UNDP[24] on energy services and income-generating opportunities for the poor reviewed the policies and institutional mechanisms for energy, poverty reduction, and financing in eight countries. The outcomes of the study indicate that these three sets of activities were largely set in isolation of one another with little appreciation of the need for complementarity.

Considering especially that the above reviews included national poverty programs, the implication is that, although energy services will certainly need to more "propoor," poverty reduction initiatives will also have to be more "energy sensitive." This is born out also by the EnPoGen study of China where, in spite of the villagers identifying water shortages and energy services among their top infrastructural priorities, none of the officials, village leaders or communities in the two provinces linked the two issues.

Bundling of Services under Integrated Projects

In recent years, the idea of complementary inputs has been further developed by staff at the World Bank.[25] Their studies have found that the "bundling" of services, such as

[24] APDC 1998.

[25] Peskin and others 2000.

water, sanitation, and education, with electricity has disproportionate welfare benefits for local populations—the whole was substantially greater than the sum of the parts. In Peru, for example, the effect of bundling together a number of social services is said to be such that the impact of adding a fourth service for rural households is about seven times greater than the addition of the second service. In the Philippines, one year of education increases annual income by about P 13,000 on average. However, this increase is augmented by an additional P 2,000 if the household has electricity.

In principle, energy services can considerably enhance the most important asset the great majority of households possess—human resources. As discussed earlier, a close association exists between poverty and constrained labor supply in many poor households. Even where households themselves perceive possibilities for improving their incomes—for example by crop diversification, keeping more livestock, sideline activities, or seeking work outside the village—the evidence from the EnPoGen studies is that they often feel unable to take on the additional workload.

In cases where labor shortage has been identified as a major constraint on the potential success of an antipoverty strategy, energy services would appear to be one of the obvious potential solutions. Although construction of road, drinking water supply or irrigation systems may reduce the time spent traveling, fetching water, or irrigating crops, energy services may offer the possibility of both reducing labor time over a wide range of productive and reproductive activities through mechanization and through increasing the length of the working day via the provision of adequate lighting. They are also clearly relevant to the provision of communication services that, again, through the provision of education, training, and information may enhance existing human capital and further increase labor efficiency.

It seems, therefore, that there is critical need to move away, at least in the context of poverty and gender, from the current paradigm of technology-driven market penetration approaches to energy toward a more development-focused approach that consciously seeks a role for energy within larger development projects that combine energy with several other critical development inputs. Examples of success with the latter could be found in the Rural Energy Development Programme of the UNDP in Nepal, the Asian Development Bank’s pilot projects in China on poverty reduction, and other such instances where energy services formed a part of a package rather than being dealt with in isolation.

Private Initiative and Microenterprises

Although energy poverty is clearly a function of more general poverty, it has recently become clear that many rural people—and the urban poor—already pay significant amounts of cash to meet their energy requirements. In many cases the amounts they pay for energy form a much higher proportion of total cash income than is the case for richer

people.[26] And in some cases, the poor will even pay more in absolute terms than their richer compatriots.[27]

Evidence of what poor consumers pay for energy comes from a wide range of countries across the globe. One type of evidence is provided by data on the widespread use of batteries for lighting, radio, and TV where alternative sources of electricity are unavailable. Recent survey data from Uganda show that, in 1996, 94 percent of the households not connected to the grid used dry cell batteries, and were thought to spend about US$6 per household per month on them. Households that use both lead-acid and dry cell batteries for rural electrification (approximately 4.3 percent of rural households) spend US$16 per month or approximately US$192 per year on these sources of electricity. Similar World Bank data are available for other countries as diverse as India and Zimbabwe.

This "discovery" of significant cash payments for improved energy services even among relatively poor people means that in principle it may be possible to meet their needs with market-based solutions. Such people do not necessarily have to wait for the state, aid agencies, or NGOs to extend energy services to them. Although the supply of improved energy services to poor people is by definition unlikely to be the most profitable area for private sector investment, there is a new optimism that modest profits can be earned from such businesses, particularly if the relevant social, legal, and physical infrastructure is in place.

Fostering private participation in small-scale infrastructure is a relatively new approach advocated to meet the needs of the poor in a commercially viable way. In relation to equity in electricity provision, de Lucia (1998) observes the following:

- Small-scale private suppliers are already active; for example, electricity customers provide reseller service to neighbors, merchants in *bazaars*, minigrids, and so on.
- Small-scale infrastructure provision has both forward and backward linkages to local capital markets and suppliers, and hence carries local development benefits.
- Private suppliers are more customer-driven than public ones, and can tailor the level of supply to customer demands better, for instance, basic services for poor customers, higher-level services for higher-income customers.
- The approach provides greater access and is also financially sustainable.
- Although such differentiation has its drawbacks, it allows overcoming the most glaring inequity, namely, the inequity between those with access to services (often subsidized) and those without.

Private initiative in energy services is not confined to business firms or entities on the supply side. For the poor, microenterprises are often the means to augment an otherwise

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[26] See ESMAP 1999.

[27] This situation arises partly because it is the richer people who tend to benefit most from existing energy subsidies to both electricity and to kerosene, but it is also a function of the greater amounts of primary energy that poor people have to buy because of the low efficiency with which they can convert primary energy into useful energy.

agriculture-dependent income stream. Such enterprises are usually based on agricultural byproducts and local resources, and are subject to the availability of nearby markets. The level of income generated by them might be small, as indicated by the EnPoGen studies in Indonesia and Sri Lanka, but their significance lies in "cash" income and the proportion of that income to the aggregate household income at the level of the poor.

Combining energy services with microenterprise activities can increase income levels substantially, as indicated by the outcomes of the UNDP-sponsored project on energy services for the poor (Project ENSIGN) mentioned earlier. Under the project, energy-intensive microenterprise portfolios were developed through microcredit banks and institutions in seven countries. In urban areas, connecting to the grid and more efficient appliances were most important, whereas in rural areas, renewable energy, coal briquettes, and diesel fuels were preferred. In both rural and urban contexts, process heat and motive power were more crucial to income generation than lighting. The ENSIGN Revolving Fund offered 36 of the total loan funds, national financing institutions contributed 50 percent, and poor borrowers were able to provide up to equity 14 percent in the form of equity. A great many diverse activities were financed under the project:garment making, embroidery, felt and leather goods manufacturing, copper welding, utensils manufacturing, baking, cold storage, rubber stamp making, beauty salon, grain grinding, threshing, fish drying and powdering, soybean processing, rice husk cookstove production, spice drying, *beedi* wrapping, cinnamon peeling, rice processing, and so forth. With near commercial interest rates on the loans, the project yielded an average post-energy service income increase of 124 percent in the poor households. Higher levels of income growth tended to be among community-operated enterprises in which it was possible to pool together diverse skills and complementary resources. The lessons from the project were as follows:Although this was not planned, the vast majority of borrowers were women, who proved enterprising, innovative, and creditworthy. Significant benefits for women, in addition to income impacts, were time savings and enhanced self-confidence from improved ability to support household income and greater control over self-generated finances.

- Although the borrowers were usually not the bottom poor, the bottom poor were often employed as wage earners in the microenterprises.
- A need was apparent to promote on a more systematic basis "business facilitators," possibly NGOs, who could act as intermediaries between poor households or communities and financing institutions through the development of viable microenterprise activities.

Microcredit

Conventional banking has little interest and flexibility for lending even to the more affluent rural populations. It certainly has no outreach to the rural poor who most need access to capital not only to acquire energy services, but also to purchase other equipment

and appliances. This is where the role of microcredit, or door-to-door banking, has acquired new importance, as illustrated by the case of Project ENSIGN above.

Microcredit programs have gained increasing recognition in several countries, and a number of them are targeted at women. At the international level, the World Bank has its own program on Sustainable Banking for the Poor (SBP), and there are other initiatives, such as the Microcredit Summit, that seek to develop viable financing mechanisms tailored to the needs of the poor and low-income groups. Although the mechanics of operation vary from institution to institution, in general microcredit arrangements are geared to provide small-scale loans against little or no collateral requirements, and their repayment terms are matched against the financial capacity of poor borrowers.

Not all microcredit experiences around the developing world have been successful, but given their relatively recent origin, as compared to the centuries-old system of conventional banking, they are promising options capable of evolving into viable mechanisms to address poverty at large and to facilitate the provision of modern energy services to the poor. Within Asia, some of the noteworthy microcredit initiatives that have ventured into energy are discussed next (WEC-FAO 1999).

Grameen Shakti, Bangladesh

The Grameen Bank of Bangladesh, with more than 1,000 branches and 2 million members, initiated a program in 1996 to provide credit for renewable energy systems to serve those without access to electricity through a nonprofit rural energy company, Grameen Shakti. Loans are made for solar PV home systems, which call for a small down payment. Grameen Shakti's first initiative was a 1,000-unit project to determine a number of important points concerning household solar PV, which included the following:

- The technical performance of these systems in rural Bangladesh.
- Their acceptance by the poor.
- The income-generating potential of the extended workday.
- The affordability of such systems, especially when technical improvements and economies of scale are factored in.
- The training, monitoring, and evaluation expertise requirements to successfully expand this experience should it prove successful.

Grameen Shakti has since enlarged the scope of the program and plans to expand this service further by offering small loans for wind power and biogas plants. Demonstration projects are under way to determine the most appropriate financing packages for these technologies.

PT Sudimara Energi Surya, Indonesia

PT Sudimara Energi Surya, based in Indonesia, has been successful in selling SHSs in rural areas using innovative credit arrangements and services. Between 1993 and 1995, Sudimara sold more than 7,800 solar panels to rural customers through a network of local service centers that are responsible for sales, service, and credit. The average monthly

payment being made on these solar systems is less than the monthly costs of conventional energy systems. Additionally, consumers obtained improved levels of energy services. Thus far, there has been a 100 percent collection rate on the loans. By combining all the operational and financial functions at the local level, it has been possible to open up new markets and also serve the needs of rural communities. Sales and distribution are maximized by building a good relationship with the customers and providing service that is both inexpensive and easy to access. In addition, the program has helped to build capacity and expertise in the country by manufacturing and assembling system components in Indonesia. Once the appropriate mechanisms are set up to provide alternatives to the local community, experience has shown that there are significant numbers of consumers who are willing to pay the full cost to purchase these SHSs.

Indian Renewable Energy Development Agency

The Indian Renewable Energy Development Agency (IREDA) is the only financing agency in India developed specifically to promote renewable energy systems in India, with soft term loans varying at present from 2.5 to 14 percent. As the financing arm of the Ministry of Non-Conventional Energy Sources, IREDA is the major agency channeling funds into the Indian market. Set up in 1987, IREDA secured international funding within six years. The World Bank extended a line of credit of US$195 million in 1993–94, of which more than 95 percent has been rolled. This covers the solar PV and small hydro and wind sectors. A line of credit from the Asian Development Bank offered US$120 million to cover solar, thermal, and wind power projects. The World Bank has offered another line of credit for US$173 million to cover smaller hydro and energy efficiency projects. By mid-1998, IREDA had sanctioned 963 projects covering more than US$300 million with a loan recovery rate of 99 percent.

It should be noted, though. that IREDA is not a microcredit agency, nor does it offer loans to poor end users. It has, in turn, however, extended lines of credit to some national microcredit organizations, in effect acting as an upstream financing agency to promote small-energy services.

SELCO, India

SELCO is one of the solar energy services companies marketing small-scale PV power systems in southern India. The market for residential systems for rural households in Karnataka State and the neighboring states of Andhra Pradesh, Kerala, and Tamil Nadu is estimated to be 290,000 households. SELCO has established marketing, sales, installation, and service operations in three areas of Karnataka to begin to serve the market. To access funds for direct consumer financing, SELCO had to seek a bank guarantee from a U.S. not-for-profit company, E & Co. As a result of this guarantee, SELCO negotiated with IREDA to access World Bank Global Environmental Fund dollars for onlending to end users.

The important question to address, though, is whether microcredit should be deemed a vehicle for poverty reduction or a mechanism to sell energy services. Given the high

investment cost of alternative energy technologies in particular and their lack of an income impact, microcredit that is aimed simply at providing energy services is unlikely to be successful because it does not overcome the central barrier of lack of financial capacity among the poor. As the EnPoGen studies in Indonesia and Sri Lanka suggest, even if credit terms were such that they were extended over long durations and broken into small repayment amounts, they are unlikely to be effective.

By contrast, microcredit for energy services that either combines these services with other forms of income-earning assets, as in the case of Project ENSIGN, or that fits into the lending portfolio of mainstream poverty reduction loans, as with Grameen Shakti, is more likely to be successful in addressing the issue of poverty. In this context, a key area of focus should be the enabling of women's participation in improved energy services for home-based and community-scale microenterprises. Women need access to credit and other promotional strategies in order to benefit from modern energy services, to purchase household appliances or obtain connections, to improve energy efficiency in their microenterprises, and perhaps to benefit as energy entrepreneurs. The latter two are especially important because women use additional income from their enterprises for food, school fees, clothes, and other basic needs for their households.

A study by Women's World Banking identifies a number of financing programs that have been successful in providing microcredit to women: poverty-focused programs within commercial banks, poverty lending banks, nongovernmental organizations, and affiliate network institutions. Some of the factors that make these credit programs accessible to women include the following:

- Access to credit, not subsidies.
- Small loans with frequent and flexible repayment schedules.
- Alternative collateral requirements.
- Low transaction costs to the client (in money and time).
- An informal banking atmosphere where women are respected.
- Simple loan application procedures to accommodate illiteracy.
- The use of information channels accessible to women.

7 Monitoring and Evaluating the Poverty Impacts of Rural Electrification

One of the main objectives of the EnPoGen studies has been to contribute to the development of a methodology for monitoring the poverty impacts of rural electrification. This task was performed essentially by the special study[28] commissioned on the topic, but the country studies, especially the China study, drew on their findings on the ground to offer conceptual and operational insights into a potential new framework for monitoring and evaluation of the social and economic impacts of rural electrification.

The findings of the EnPoGen project as a whole show that current approaches and mechanisms for rural electrification generally exclude the poor and often discriminate against them. The needs and interests of the rural poor, and of women in particular, tend to be underrepresented in rural electrification projects. These needs vary according to the differing roles, customs, and lifestyles of the people. Matching them through appropriate energy services requires a focused approach that will not naturally flow under prevailing conditions that motivate rural electrification—whether it is grid-based or employs alternative energy technologies, both of which tend to marginalize the poor in their own ways.

Reduced to its bare bones, the EnPoGen project outcomes suggest that any new approach to monitoring and evaluating the impacts of rural electrification must fulfill the following minimum requirements:

- Provide national planners, managers, and other decisionmakers an appropriate policy and regulatory framework to ensure the equity dimension of rural electrification through practical means of access and affordability.
- Establish quantifiable indicators of the economic and financial benefits of rural electrification.
- Set out, to the extent feasible, quantitative criteria for measuring the social benefits of rural electrification and, where necessary, consistent methods of qualitative assessment and evaluation.
- Determine and implement participative methods of project design, ensuring effective community involvement for optimal choice and project sustainability.
- Incorporate specific poverty and gender objectives in program-project design, and identify how and when they are to be measured.

[28] By ASTAE-ESMAP in association with Winrock International and Mallika Consultants (Winrock International, the World Bank, and the Mallika Consultants 2003).

These requirements could be enhanced and embellished according to country- and location-specific conditions. For instance, economic and financial parameters might include tariff and investment guidelines set off against measures of capacity and willingness-to-pay of the poor, which will vary from one situation to another. They might also include how the avoided environmental costs of alternative energy technologies or household income growth are to be calculated. Social criteria might consist of such aspects as the rate of penetration of appliances and their impacts on time savings. Establishing a framework for monitoring and evaluation will itself be an intensive and evolutionary process in each country, subject to considerable empirical experience over time.

However, since poverty is the central consideration here, the boundaries of any new framework for monitoring and evaluating rural electrification must necessarily be set within the broader context of poverty monitoring and evaluation, especially so because, as discussed in the preceding chapter of this report, energy or electricity *per se* is not a sufficient condition to resolve poverty. The following discussion, therefore, provides an overview of the conceptual developments in poverty analysis and examines how they are relevant for lending a fresh poverty-focused thrust to rural electrification. Based on this, the key elements of a proposed new framework are presented in the subsequent section.

Conceptual Developments in Poverty Analysis

The most significant change to have taken place in poverty analysis is the definitional shift from income as the primary measure of poverty to a broader set of indicators that are concerned with several other social and equity dimensions that were traditionally either ignored or viewed as intangibles beyond measurement. This has tended to broaden the scope of analysis and offered new insights into aspects of deprivation—for example, reduced vulnerability to natural disasters or the empowerment of women. At the same time, it has also enlarged and diffused the definition of poverty to an extent that the task of measuring it has become infinitely more complex than before. Of the numerous approaches that have emerged in recent years, the Sustainable Livelihoods approach adopted by the DFID and the PRSPs of the World Bank are broadly representative of present thinking.

Sustainable Livelihoods

Following the earlier work of Chambers and Conway (1992), the DFID adopted the following definition of sustainable livelihoods (DFID 1999):

> A livelihood comprises the capabilities, assets (stores, resources, claims and access) and activities required for a means of living; a livelihood is sustainable which can cope with and recover from stress and shocks, maintain or enhance its capabilities and assets, and provide sustainable livelihood opportunities for the next generation;

> and which contributes net benefits to other livelihoods at the local and global levels in the long and short term.

The definition identifies three elements:

- *Human capabilities*, such as education, skills, and health.
- Access to *tangible assets* (financial, capital) and *intangible assets* (access to services, information, claims on relatives, the state, and so on).
- The existence of *economic activities*.

A "livelihood strategy" is defined by the interaction between these elements, and "livelihood security status" is measured in relation to both consumption and asset levels. The approach derives from Nobel Laureate Amartya Sen's entitlements model as modified by Swift (1989). With regard to poverty reduction, it focuses attention on the ways in which the capabilities of vulnerable people can be enhanced, such that specific households and individuals can secure their livelihoods, whether through production and income-generating activities or by other means.

The analysis of livelihoods focuses on households, but looks both outwards—to examine the relationships between households, community organizations, local government, and other actors—and inwards—to examine intrahousehold relationships, for example, between men, women, children, and the elderly. With regard to external relationships, a key element concerns the difference between household assets, whose use is determined solely by household members, and community assets in which the household may hold some interest and over which it may exercise some limited control.

Poverty Reduction Strategy Papers

Launched by the World Bank in early 1999, the CDF was seen as a means by which countries could implement integrated strategies for economic development and poverty reduction. It attempted to bring together current trends in development thinking with the aim of facilitating countries to achieve a balance between good macroeconomic management and sound social, structural, and human policies. The PRSP approach is based on CDF principles and aims to integrate poverty reducing policies within a coherent, growth-oriented macroeconomic framework.

As outlined in the *World Development Report 2000/2001*, a PRSP has three action pillars—empowerment, security, and opportunity*:*

- The *empowerment* agenda is a reflection of the remarkable rise of participatory approaches within the development community. It emphasizes the need for decentralization and support for poor community groups and organizations, and for giving the poor a "voice" in all stages of decisionmaking. It focuses on the institutional context, where institutions are defined very broadly as "humanly devised constraints that structure human interactions."

- The *security* element can be seen as deriving from earlier work on safety nets, risk management, and coping strategies, combined with elements of the rights-based approach to human development.
- *Opportunity* links economic growth to elements of the entitlements agenda and emphasizes the need to enable poor households to improve their livelihood strategies by asset building. This includes not only financial and capital assets, but also a range of nontangible assets, such as employment, education, health, and access to clean water.

Comparisons between the Two Approaches

The Sustainable Livelihoods approach has been developed into a major analytical framework by the UNDP and DFID. It has clearly influenced both the approach and language adopted by the World Bank in developing the PRSP approach. Broadly speaking, in the latter framework, income and capabilities would correspond to opportunities and how they are used. There are also similarities in the extent to which attention is focused on the role of institutions and on the definition of poverty. On the former issue, one key question in Sustainable Livelihoods can be seen as determining what it takes to translate different types of assets into capabilities. That process is mediated by institutions, defined in very broad terms to include rules, laws, norms, and markets. In relation to poverty definition, under the influence of Sen's thinking on the relationship between capabilities and functionings, the Sustainable Livelihoods framework encourages an exploration of the multidimensionality of human ill-being, rather than concentrating only on the material aspects.

The World Bank's *World Development Report 2000/2001* also stresses the need for a more sophisticated, multidimensional approach to the concept of poverty that recognizes the importance of nonincome dimensions, such as education, health, insecurity, and powerlessness. It also moves away from the prevalent use of national average figures for poverty incidence, and examines how economic growth might affect the poverty status of particular population groups.

Both approaches, however, run into similar problems when moving from concepts to measurement. For example, although they embrace the multidimensionality of poverty in theory, the monitoring agenda will usually adopt a much narrower perspective when there is a need to derive relatively simple indicators to determine, for example, the impact of specific poverty reduction initiatives. This is particularly evident in much of the econometric work undertaken within the PRSP rubric. The participatory methodology often adopted in studies on Sustainable Livelihoods is also problematic, in that it tends to have a community perspective and often fails to focus on poor individuals and households. Much of what is written in the name of poverty reduction is about community development. *Poverty mapping*, which attempts to combine participatory and money-metric measures, has been suggested as a way of determining the degree to which such measures converge in practice, but the evidence is not yet convincing.

Two major influences on the development of both the Sustainable Livelihoods and PRSP approaches have been the “good governance” and “participation” agendas. Driven by the neoliberal agenda of the 1980s and early 1990s, there was much emphasis on the failures of the state and the need to pursue market solutions. The tendency within some donor agencies was to identify “good” states with “minimal” states. Governments were often sidelined, with resources being channeled through NGOs. In many countries, the majority of development assistance was outside the state budget. Many of those working in the governance area were largely concerned with multipartyism, removal of corruption, downsizing and reform of administrative structures, and rethinking of judicial and legal systems.

More recently, both markets and government interventions in markets have been recognized as having strengths and limits. There is once again an attempt to define a role for government, particularly in its regulatory function, where markets are either failing to deliver or giving rise to major equity concerns. This has led to an emphasis on “good governance,” with a particular focus on the need for institutions that can effectively implement “good” policies. Governments are now seen as in need of “strengthening” with the aim of improving the quality of public decisionmaking and public expenditure in relation to the poverty reduction agenda.

The late 1990s also saw an increasing recognition of the potential role for strong grassroots movements in poverty reduction, a view that had long been promoted by those working on participation. Developments were also taking place in this area, with the realization that, to be effective, it was essential to involve both local and national governments in order to influence policy and budgetary allocation decisions that could either reinforce or undermine local community initiatives. Thus, in recent years, governance experts have tended to move away from promoting democracy and reducing corruption, and identified poverty reduction as central to their agenda. Advocates of participation have scaled up their activities to bring the voices of the poor and the marginalized into the mainstream. Both groups have focused on poor people as citizens and active members of communities, the need for analysis of the institutions that affect poverty, and the concept of an “enabling environment” structured around the concepts of regulation and accountability.

The PRSP agenda in particular can be seen as primarily concerned with poverty reduction through good governance that involves consultation and participation. As analysts of democratic local government have pointed out, however, typically no specific benefits for the poor result from democratic processes at the local level. Benefit often only accrues if, as a consequence of local government being more responsive to local demands, there is strengthened provision of a universal benefit. In practice, it may be even more difficult to direct resources to poor people through a local government that becomes accountable to local elites.

In general, lessons learned from poverty reduction do not indicate a strong link between governance, participation, and the well-being of the poor. In a number of countries, successful programs—drinking water, microfinance, family planning, and

agricultural planning—have been very much top-down; no participation or consultation has taken place, and yet massive poverty reduction has occurred. There is a risk that an exclusive focus on governance and participation may crucially divert attention away from issues of production, increased productivity, and associated infrastructure investment, which must remain central to any realistic poverty reduction strategy.

Similarity of Basic Concepts

Although differences exist in language and emphasis, there appears to be considerable agreement at least in core concepts between the Sustainable Livelihoods and PRSP approaches. Both clearly accept a broad concept of poverty that goes far beyond the traditional definition based on minimum income levels. Both speak of the "dimensions of poverty" and focus on the complex interrelationships between these dimensions.

Cause-and-effect relationships are seen as existing in both directions between the various dimensions of poverty. For example, low income tends to result in lower levels of human development, but is often also a consequence of poor education, sickness, and malnutrition. Increased income tends to reduce vulnerability and powerlessness, whereas greater participation in decisionmaking may lead to the creation of opportunities for improved income-earning. Both approaches emphasize the need to take a holistic view of the complexities of the lives of the poor and structure their arguments around three key areas:

- The assets (natural, physical, social, human, and financial) that allow people to "make a living." A sustainable livelihood is one that allows a household to at least maintain and hopefully increase its stock of assets.
- Resilience to the multiplicity of "shocks"—natural, economic, or social—to which the poor are particularly vulnerable.
- The institutions (from informal civil society organizations to the private sector and the state) and processes (ranging from social norms and gender relations to policies and laws) that influence both "livelihood strategies" adopted by the poor in an attempt to attain sustainability and "livelihood outcomes." Interventions will often target these institutions and processes, empowering the poor in order to expand the range of available livelihood strategies and/or reduce vulnerability.

Relevance for Rural Energy-Electrification

Energy Implications of Sustainable Livelihoods and PRSP Approaches

Neither the Sustainable Livelihoods nor the PRSP approach deals very effectively with energy in its current configuration. Both approaches, however, are under development and can be expected to improve and, probably, converge. A comparison of the categories used by both approaches shows that there is considerable overlap (table 26). Each approach has a slightly different focus, however.

Table 26: Comparison between PRSP and Sustainable Livelihoods Approaches

PRSP energy toolkit		Sustainable livelihood guidance notes	
Poverty alleviation outcomes	**Energy linkages and impacts**	**Livelihood assets**	**Sustainable livelihood outcomes**
Income	Essential input for businesses		More income
	Macro stability (increased tax revenues and reduced fiscal burden)		Increased well-being
	Enhanced labor and capital productivity		
Capability	Essential health care and education services	Human capital	More income
	Essential complementary infrastructure	Physical capital Social capital	Increased well-being
	Health improvements (reduced indoor pollution)	Financial capital	
Security	Energy price stability, illumination and personal security	Natural capital	More sustainable natural resources
	Environmental sustainability		
Empowerment	Choice of energy services, access to information (radio, TV and communication		Reduced vulnerability
	Increased accountability of service providers		

The PRSP approach is aimed primarily at the macro and mesoscale of development activity. This reflects the national focus of poverty strategies, but is also consistent with the World Bank's recent emphasis on sector reform rather than projects. The PRSP specifically deals with energy through an "Energy Tool Box" in the form of an "energy chapter" of the forthcoming guidelines for writing PRSPs. In the current version (2000), the energy chapter covers two main domains of activity: household welfare and growth. It provides a checklist of issues, including the interactions between energy policy and improved fiscal stability, and sets out the arguments for different fuel pricing principles and forms of subsidy. It does cover a number of issues at the micro level, though, particularly in relation to the health effects of biomass fuel use in cooking and the benefits of encouraging community participation.

The Sustainable Livelihoods approach, by contrast, emphasizes individual interventions at the micro level of projects and "participatory development," but it does

not deal adequately with the energy dimension of development. Energy supply and use systems are mentioned as forming a part of physical capital, which includes both "access" to basic infrastructure and the ownership of "producer goods" needed to support livelihoods. Because of this rather broad-based inclusion, however, energy is likely to impinge on all aspects of the approach and play a major part in determining the nature and range of livelihood strategies that are feasible.

The lack of a specific emphasis on small and microenterprise development seems surprising in the Sustainable Livelihoods approach. This may be a result of the approach's origins in the areas of natural resource and agricultural development, rather than periurban and nonfarm self-employment. By combining energy supply and use into the category of physical capital, the approach also appears to gloss over important distinctions between ownership of the means of production and the ability to gain access to energy inputs, such as fuel, in the process of earning a livelihood. In common with other existing frameworks, it does not deal adequately with the indirect nature of the demand for energy services and the complexities introduced by the fact that that some energy systems are privately and individually owned (for example, the self collection of wood fuels for cooking), whereas others are best provided either at the level of the community (small hydro systems) or the nation (large electricity systems or the supply of kerosene and LPG).

Integrating the Energy Dimension

Both the Sustainable Livelihoods and the PRSP approaches are sufficiently broad and conceptually sound to acquire an energy dimension. For instance, once the basic parameters of the energy links to poverty are laid out, they can be superimposed onto the categories used by the Sustainable Livelihoods approach. An attempt to track these poverty linkages to and from energy systems is made in tables 27–31.[29] The links specified in these tables are illustrative, and they show that, in practice, the scale and nature of each link will depend on the local physical, cultural, and political circumstances.

This exercise also has another effect. It serves to emphasize that, just as those conducting livelihood assessments need to be aware of the gender dimension, so, too, do they need to be aware of the ways in which energy (and other inputs) impinge on poverty-reducing strategies. In practice, this will mean understanding how their interventions could be improved with the addition of appropriate energy services (or, as important, how they could be constrained in their absence) and being aware of the wide range of options and mechanisms that might best meet the energy needs of particular groups (differentiated by gender, health, class, location, and so on).

The Sustainable Livelihoods approach offers the considerable advantage of forming part of a lively ongoing process of developing participative and other forms of monitoring and evaluation. These, combined with the specific energy focus illustrated in

[29] Developed by Andrew Barnett (IDS 2003).

tables 27–31, provide the foundations for systems to monitor and evaluate the impact of energy interventions on poverty and gender.

Table 27: Linkages between Livelihood Assets and Energy

Capital asset	Energy link
Natural capital (natural resource stocks from which resource flows useful for livelihoods are derived)	The main natural capital asset of poor people is likely to be biomass (wood, twigs, leaves, crop residues, dung, human waste) that can be used as fuels. In some cases, hand-dug coal and peat are natural assets for poor people. Access to these natural resources is affected by many factors (e.g., land ownership, climate) and their sustainability is affected not only by their use as fuel, but also changes in land use (fuelwood becomes less available when land is cleared for food production). Other energy-related natural capital assets include falling water, wind, and solar insolation. However, these sources require other forms of capital to convert them into useful energy. Animate energy in the form of human and draft animal power also form a significant “natural” energy asset. Changes in land use and improved access can increase exploitation of local natural resources, e.g., forests, and increased competition for land and resources.
Social capital (social resources on which people draw in pursuit of livelihoods, that is, relationships, membership of networks)	Networks and social relations often determine an individual’s access to natural resources (who can collect fuelwood from a particular location), access to energy conversion technology that is owned by others (grain mills, baking ovens, machines for preparing land, irrigation water pumps), access to other people’s skills (electricians, engine repairers), information about technical (and managerial) alternatives and so on. Because women are the main users and suppliers of inanimate energy in poor communities, their social capital of friendships and networks is likely to be particularly important.
Human capital (skills, knowledge, ability to work, and good health that enable people to pursue different livelihood strategies)	Formal and informal employment generation in construction, maintenance and provision of energy services. Indigenous knowledge of local energy sources and their use in a sustainable environment. Improved health of women and children as a result of access to improved energy services for cooking, which reduces indoor air pollution—one of the biggest causes of death and ill health. Improved healthcare, education and communication as a result of energy for lighting, pumping, communication and transport. Access required to skills for many aspects of energy service delivery, and for some aspects of energy use (e.g., people with knowledge of electric installations).

Capital asset	Energy link
Physical capital	Access to energy sources (electricity) and fuels (fossil and biomass fuels).
(basic infrastructure for the supply of energy, shelter, water, transport and communications, production equipment)	Access to the technology required to convert energy into a useful form, particularly end-use technologies, such as stoves, lamps, machines, radios, motors, and engines. Production technology that enables inanimate energy to replace the drudgery of human labor. Transport services depend on access to reliable and reasonably priced fuels.
Financial Capital (financial resources that provide livelihood options, e.g., savings, credit, remittances, pensions)	The "lumpiness" of the investment in energy conversion devices or the lack of enough cash to make bulk purchase of (lower cost) fuels means that poor people often cannot get together enough cash to buy them, even though there would be considerable cash savings over the medium-term future (kerosene is often bought by the cupful). Modern renewable energy conversion technologies share a characteristic that militates against their use by poor people—they generally have higher initial capital costs and lower recurrent (fuel) costs relative to fossil fuel based technologies. The increases in productivity and subsequent lower prices that result from increased access to improved energy services help improve savings and other financial capital.

Table 28: Linkages between Vulnerability Context and Energy

Vulnerability context	Energy link
Geography	Sets conditions for energy requirements and opportunities. Geography determines the extent and form of the biomass resource and the availability of falling water, wind, insolation, and other sources of energy (for example, coal, oil, gas, geothermal energy). Geography determines the choice of energy infrastructure, e.g., pipelines, power distribution. Geography influences the cost of improving energy infrastructure. Climate determines the need for heating and cooling.
Location	Remoteness adds to the costs of all energy supply options, but not necessarily in the same way and to the same degree. Remoteness increases the relative attractiveness ("comparative advantage") of renewable energy supply (such as, microhydro and PV systems) relative to other options that require transportation of fuels. However, this advantage may be insignificant compared to the cost of frequent visits from urban-based technicians required to maintain the systems.
Seasonality	The need for energy fluctuates in relation to ambient temperature, agricultural season, availability of raw materials, and so forth.

Vulnerability context	Energy link
	Transport-dependent costs of installing and maintaining infrastructure or delivering fuels, equipment and spare parts; maintenance varies according to season.
	Energy supplies dependent on water, biomass and wind also vary by season.
	The moisture content of biofuels and their combustion characteristics are affected by seasonality.
Population density	"Load density," or the amount of the service used (or better, purchased) along an electricity line or kerosene distribution route is a major determinant of its unit cost (and price). Low density favors modular options, such as PV systems, over grid extensions.
	Rapid changes in population, e.g., through refugees, puts particular pressure on the sustainability of biomass (and other) fuel systems.
Trends in governance (including politics)	Restructuring of the energy supply sectors is largely a political process resulting in both threats and opportunities for poor people's access to energy services, particularly the availability of safety nets to cover the high costs to poor people of the adjustment process.
	Political promises of grid electrification may undermine people's willingness to invest in alternative decentralized options.
Technological trends	Massive technical change in recent years has altered people's ideas of what is possible.
	Improvements in small-scale energy conversion technology have increased efficiency and reduced costs (particularly with PV cells, but also small fossil fuel engines, wind generators, microhydro—particularly electronic load controllers—biogas and biomass gasification.
	The use of gas for power generation using gas-fired combined cycle gas turbines has meant that electricity can now be generated on a relatively modest scale at costs that are competitive even with the largest coal-fired plant, reducing the power of "natural monopolies."
Shocks	The major energy-related shocks have tended to be associated with the availability and price of oil products, which affect both the macro- and the microeconomy.
	All energy delivery systems are vulnerable to natural and man made disasters, to war and conflict.

Table 29: Linkages between Structures, Institutions, Processes, and Energy

Institution or process	Energy link
National government	Often responsible for the supply of electricity and the regulation of all energy supply industries (electricity, fossil fuels and much of the monetized wood and charcoal markets).
	Responsible for much of the "enabling environment" required for efficient public and private sector development in the energy service industries.
	The main source of subsidies of energy-related services, for energy price control and for energy taxes, and taxes on imported energy conversion technology.
	The main regulator determining the type of ownership and degree of competition at each part of the energy supply chain.
Local government	Often responsible for smaller scale energy infrastructure at district or local level, and particularly the rate and direction of grid extension.
	Responsible also for transport infrastructure, which affects the availability, reliability and cost of fossil fuel delivery costs.
	Responsible for regulations and permits associated with small-scale energy retail businesses (e.g., electricity supply to rural *bazaars*, production and sale of charcoal), access to communal resources, such as water (for hydro); "way leaves" for electricity.
Community-level institutions	Often crucially important in the mobilization, organization and development of schemes to introduce decentralized energy supplies (diesel minigrids, microhydro) and in the regulation of such schemes.
	It matters less whether or not the community own these assets, than that they are run in a "business-like" manner.
Firms	Providers of energy services and, often in partnership with government, suppliers of energy-related infrastructure.
	Small and micro firms are likely to be the main actors in the supply and use of improved energy services that are used by poor people (e.g., illegal retailers of electricity in urban slums, sellers of kerosene, candles and charcoal
NGOs	Can play important role in interventions to improve energy services at the local level, e.g., introduction of appropriate energy technologies, organizing community-based initiatives to meet locally defined energy needs.
	Represent important sources of technical and other information.
	Sometimes restricted by funding, inclination or expertise to a limited range of technical options (e.g., specific renewables).
Laws	Regulate the provision of energy services, including public health and safety.
	Regulate contract tender procedures for infrastructure construction.
	Determine the monopoly powers of the state and utilities in the supply of energy services.

Institution or process	Energy link
Culture	Belief systems and religious beliefs are particularly significant in determining cooking practices and the use of certain types of fuel (such as pig waste and human waste).
Gender relations	Determine how energy assets and technologies are used. Women are the main users and suppliers of energy at the household level in poor communities. The poverty impact of energy-related interventions will be largely determined by the end-use technologies adopted, and the gender impact will, in turn, will depend on the extent to which women are empowered to choose.
Other power relations	Village hierarchies and caste systems play important roles in determining the "space" within which energy services can be improved (such as access to common property resources for fuelwood collection, access to credit, access to information, and "rights" to set up retail outlets).

Table 30: Energy-Related Livelihood Strategies

Livelihood strategy	Energy link
Gaining additional income by retailing energy services up the "energy ladder."	Fuels (wood, charcoal, dung, crop residues, kerosene, LPG). Conversion technology (stoves, lamps, batteries, motors, PV systems).
Gaining access to improved energy services at the household level by saving time or fuel-switching.	Improved biomass stoves. Improved lighting (from candles to kerosene to electricity initially from batteries).
Gaining access to improved energy services by increasing production efficiency.	Improved energy services result in increased productivity (e.g., through mechanization), which results in greater ability to pay for improved energy services. Opportunities range from the lowest technologies and the smallest scales upwards (for example, agroprocessing, small and micro enterprises).
Grouping with others to obtain access to improved energy services for production, household consumption or for community services (health centers, schools, security lighting, and information and communication technology).	Community-based activities enable labor to be converted into capital (e.g., through civil works) and capture the economies of scale associated with energy supply technologies, such as connecting to the grid (transformers and distribution systems), installing microhydro generators and small diesel engines, or acquiring mechanized transport services and the like, or "pooling demand" to provide political or commercial pressure to gain access to energy services.

Table 31: Livelihood Outcomes

Outcome	Energy link	Key issues for women
More income	Income from the sale of energy services	
	Income from energy-related productivity gains	
	Income from energy-related expansion of supply options and quality (e.g., doing things that are impossible without inanimate energy)	
	Income from extending the working day through improved lighting	
	Improved income from better access to fuel-based transport	
Increased well-being	Improved household and street lighting	Reduction of time-consuming tasks (including fuel and water collection, milling, grinding, food preparation, and other reproductive tasks)
	Reduction of indoor air pollution (improved fuels or improved stoves)	
	Reduced burden from fuel collection and processing	
	Reduced drudgery by replacing human animate energy with inanimate energy	Access to the outside world through radio and other information and communication technology
	Increased education as a result of better lighting in schools	
	Better health from health services that have access to improved lighting, cold chain storage and communication	Better light for reading and other nighttime tasks
	Improved access to information through radio, television and other information technology	
	Sense of inclusion in the “modern” electrified world	
Reduced vulnerability	More secure water supply from pumped irrigation	Safer nighttime environment because of improved lighting
	Better security lighting	Reduced indoor air pollution
	More secure fuel supplies	Less frequent pregnancy (high correlation of electric light with reduction in birth rates)
	Production based on a wider range of raw materials	
Improved food security	Improved agricultural output from mechanization and pumped irrigation	
	Improved post-harvest processing and storage	
	Improved fuel-based transport	
More sustainable use of natural resources	More efficient and/or sustainable use of biomass fuels,	
	Replacement of “mined” biomass with more convenient, “efficient” fuels and/or renewable fuels	

A User-Centered Framework

The "user-centered" framework for monitoring and evaluation described in this part has close similarities with the conceptual framework based on the Sustainable Livelihoods and PRSP approaches. Reasons of space prevent the inclusion here of the extensive "toolkit" prepared under the framework and tested in the World Bank's Cambodia rural electrification project.

The Main Techniques Involved

Two complementary but quite different techniques are reviewed and recommended as appropriate for use in planning and evaluating the impacts of rural electrification projects. They include a *participatory assessment* and a *socioeconomic impact survey*. The techniques are complementary to one another and are based on methodologies that have been developed and applied in existing World Bank projects. They incorporate qualitative methods to acquire in-depth insights from the consumers of energy services and more quantitative household surveys that can examine the patterns and use of energy services.[30]

The participatory method builds upon the Methodology for Participatory Assessments (MPA) developed by the IRC International Water and Sanitation Centre and the World Bank's Water and Sanitation Program (Dayal 1999). It is a comprehensive social assessment technique that links sustainability with energy demand and gender sensitivity. The technique involves the application of assessment methodologies at the community, institutional, and policy levels to evaluate the role of gender, poverty, energy demand, participation, and delivery of sustainable energy service in rural electrification projects. It links community level outcomes and the responsiveness of service delivery agencies to the needs of those participating in a rural electrification program. The main strengths unique to participatory approaches are as follows:

- They can help identify priority needs and capacities as identified by the end users or the communities themselves.
- They can provide softer kinds of information of importance to the project and project design, such as end-user perceptions, preferences, and opinions about the project.
- They assist in organizing the communities to express their views of how to implement the project better, so that it is better able to meet their needs.

The socioeconomic impact survey method builds on the rural electrification benefit assessment survey developed as part of a study on rural electrification in the Philippines. This more quantitative technique is a practical approach to understanding and quantifying the socioeconomic benefits of rural electrification interventions. The technique involves the measurement of prices and quantities of energy used by rural households and the

[30] Similar techniques were employed in the EnPoGen studies in Indonesia and Sri Lanka.

resulting estimated value to consumers. It assesses some benefits that were previously considered "too hard to measure," including benefits on education, health, productivity, convenience, security, and entertainment.

Quantitative surveys have been used widely in World Bank–funded activities. They can be especially useful in the context of strategies for poverty reduction. Most World Bank poverty reduction strategies involve the use of either Living Standards Surveys or Existing Income and Expenditure Surveys, which provide information on the poorest households. In addition, many household energy surveys have been conducted under World Bank energy programs, both in urban and in rural areas. The goals of these household energy surveys typically are to assess changing patterns of energy demand, identify possibilities for interfuel substitution, and understand the impact of energy policies on the poor.

One of the main strengths of quantitative surveys is that they provide valid information that can be generalized to a broader population with similar characteristics. Surveys can provide important information on markets for energy services, the rate of adoption of electricity, the impressions and attitudes of people toward electricity, and the benefits of electricity compared to other types of energy. Such instruments are common in market research, and they can equally provide important information to project planners and implementers.

A household energy survey is usually initiated when an individual or institution confronts energy issues or problems for which existing information is insufficient to formulate policies or justify actions in response to them. Once a policymaker believes that more information is required for project planning, a survey plan is developed to gather this information. Typically the survey will include baseline energy consumption data, including general information on the level and patterns of national or regional energy demand. The survey also assesses or evaluates the impact of a policy or technical intervention on energy issues. Finally, market research uses quantitative surveys to assess the overall level of demand for energy and the local population's willingness-to-pay for any new energy services contemplated under a project.

Application to the Rural Electrification Project Cycle

Under the user-centered framework, the monitoring and evaluation process begins at the preparation stage of a rural electrification project, so that the inputs of potential beneficiaries help shape the design of the project. Priority needs are identified and insights are gained from the beneficiaries, which are then incorporated into the project design and implementation.

The extent of application of the methodologies will vary according to the project. However, it is recommended that a participatory assessment be conducted at the outset of the project. This can be done in some typical communities that will be served under the project or program. The results of the participatory approach can be used not only to influence the project's design, but also in designing and pilot testing the socioeconomic impact survey, which is implemented during the later stages of the project. Market

surveys are also necessary early in the project cycle to assess the demand for the services offered by the project. Likewise, the participatory assessment can be used to identify potential problems that might be encountered later during project implementation. Both participatory and survey methods can be employed upon project completion to assess the impacts of the project and to provide lessons for future projects. However, the ultimate decisions as to how each methodology is applied at each stage will depend on the nature and objectives of the project.

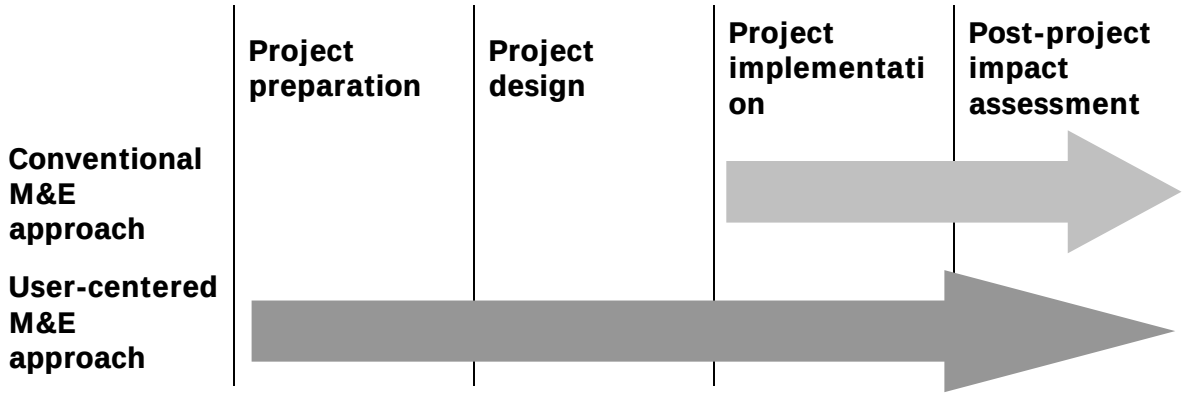
The project cycle for rural electricity projects has several different stages, and the assessment and evaluation techniques applicable to each stage are usually different. For instance, in the earliest stages of a project, it is likely that more informal input is necessary from the potential participants. This is because understanding the needs of those who will potentially be affected by the project is very important, and the methods of project implementation have not yet been fully defined. At the early stages of a project, it is difficult to specify the exact types of information necessary to evaluate the success or failure of the project. At this stage, the energy problems faced by the potential beneficiaries remain unknown, and a market assessment of service needs is essential for project preparation. Participatory techniques, which allow selected households to identify and discuss their energy problems with the researcher under the direction of a group facilitator, can reveal priority needs and the underlying causes of consumption behavior.

In subsequent stages, quantitative information is generally necessary to allow for more standardized analysis and comparison. Such information can be obtained through a survey. The specific topics to be addressed in the survey can be based on the earlier participatory assessments. These quantitative methods can be utilized in many parts of the project cycle, but they require the use of different evaluation techniques and provide different kinds of data. Thus, both approaches fulfill different needs at various stages of the project cycle.

The conventional approach to monitoring and evaluation (M&E) has been to develop a way to quantify different targets or project achievement goals following initiation of the project. Usually, a monitoring unit is created within the implementing agency, which develops a series of techniques to measure project effectiveness. In the case of a rural electrification project, for example, the technique may be to monitor project effectiveness by measuring the number of connections or number of systems installed. In most cases, the M&E component begins only after the project has been approved and financed. Once the project has begun implementation, important changes that affect the goals of the project are monitored and, at the end of the project, it is evaluated based on whether or not it achieved its targets.

The new approach advocated here begins the monitoring and evaluation process at the preparation stage of the project, so that the input of the potential beneficiaries is taken into consideration in the project's initial phases. Priority needs are identified and insights are gained from end users, which are then incorporated into the project design (figure 19).

Figure 19: Conventional and Proposed Approaches to Monitoring and Evaluation



Different levels of research are required at each stage of the project cycle. Table 32 illustrates one potential approach. The ultimate decisions on how each methodology will be applied at each stage will depend on the nature and objectives of the project.

Table 32: New Approach to Monitoring and Evaluation in the Project Cycle

M&E component	Project preparation	Project design	Project implementation	Post-project impact assessment
Participatory assessment	Development of the assessment design based on the issues and needs of the project	Extensive participatory assessment to shape project design	Less intensive follow-up assessments, including revisits of team to communities in project areas	Analysis and documentation of project impacts
Socioeconomic impact survey	Development of the survey design based on the issues and needs of the project	Market survey to assess market demand for energy service to be provided by project	Execution of baseline surveys and planning of any follow-up surveys based on need of post project evaluation	Post project survey and analysis and documentation of project impacts

Key Indicators for Monitoring and Evaluation

The user-centered approach is based on the assumption that the sustainability of improved rural energy systems and other rural infrastructure projects is positively associated with the degree to which all social groups and the two genders have access to and use the service. The approach also implies that a project cannot be considered successful if it does not meet the needs of all population groups and share the costs and benefits of the service equitably among these groups. It further assumes that success and

sustainability are positively influenced by institutional and policy environments where gender and poverty issues have been taken into consideration.

A set of key variables highlights the major social development issues that affect rural electricity project effectiveness and sustainability:

- Effectively sustained services.
- Equitable access to and use of services.
- Improvements in cross-sectoral social development indicators, such as education, access to health and other social services, and security.
- Equitable division of burdens and benefits.
- Equitable participation in service establishment and operation.
- Institutional and policy support for gender and poverty issues. A set of key indicators has been developed to measure these variables.

A number of key indicators have been developed against each of the above variables (table 33). Their focus is to offer a set of measurable criteria, both quantitative and qualitative, which could be applied in cross-project or cross-country analyses for further refinement.

Table 33: Key Indicators for Monitoring and Evaluation

Variables	Indicators
Effectively sustained	System Quality: Quality of design, components and installation.
	Effective Functioning: Quality of service operation, expected load being met, reliability and predictability of service.
	Financial Viability of Service Provider: Coverage of installation-connection and operation and maintenance (O&M) costs, universality and timeliness of payments, presence and nature of subsidies.
	Effective Management: Level of user awareness of fees-tariffs and expected O&M costs, end user awareness of system use and capabilities-limits, end-user capacity to troubleshoot problems, level of service, quality and timeliness of repairs, presence of complaints redressal mechanism, budgeting and accounting for service, metering, billing, and type and proportion of user contribution at time of service establishment.
Equitable access and use	Access: Choices in services, appliances, and equipment offered, choice in location of fixtures, and proportion of population using the service.
	Affordability: Installation and connection costs, fee-tariff structure, O&M costs, costs of appliances, including replacement parts, and existence and understanding of user financing options.
	Service Use: Knowledge and practice of efficient, safe and environmentally sound use services, knowledge and practice of recycling and disposal practices, and nature of use.
	Demand-Responsive Service: User voice in planning: end-use priorities, technology and service options, tariff structure and O&M, and user satisfaction.

Degree of change in cross-sectoral social development indicators	Education: Ability to attend school, time spent on education, quality of education and presence of teachers. Health Care and Safety: Access to and quality of health care, access to medicines, presence of doctor(s) or health worker(s), and safety in and outside the home. Domestic Productivity: Ability to conduct and efficiency of household (non-income-generating) responsibilities. Income-generating Activities: Ability to conduct income-generating activities, productivity-efficiency, and profitability. "Strategic" Needs: Ability to undertake new or desired activities, participation in household decisionmaking and voice in community decisions. Access to Information and Communications: Access to news and information on income-generating activities, health and safety and family planning, and access to communication with distant family members. Convenience and Comfort: Leisure time and time spent sleeping, socializing, watching TV, listening to radio, and reading for enjoyment.
Division of costs and benefits	Share of cost or contribution both between and within households, and division of decisionmaking.
Participation in service establishment and operation	Degree of control in installation and construction schedules and quality, capability of relevant local energy committee, coordination between local energy committee and service provider(s), level of skill created and practiced through end-user training, and perceived transparency in accounts.
Institutional support for gender and poverty sensitive demand-responsive participation	Service objectives, implementing strategies and project performance criteria reflect gender and poverty specific elements, gender and class disaggregated planning and monitoring systems in operation, poverty and gender expertise reflected in the type of agencies involved, field teams and team approach, extent and nature of staff training available for gender and poverty approaches, and capacity building, managerial support and staff performance incentives for using poverty and gender aware approaches.
Policy support for gender and poverty sensitive demand-responsive participation	National relevant sector policy present with sustainability and equity as explicit goals.

Conducting the Participatory Assessment

The types of activities involved in the participatory assessment include community mapping, stakeholder meetings, focus group discussions, and other participatory techniques (table 34). The perceptions and priorities of the target communities are solicited through these participatory exercises. Open discussion within and among community members and the various interest groups increases the chance of obtaining credible and relevant information, allowing biased or incomplete answers to be checked by group dynamics. Participants identify problems and solutions and are more likely to own the outcomes. Tools, such as social mapping and wealth classification, allow

villagers to assess and plan for equitable access to energy services. Self-scoring allows for instant feedback, which encourages transparency and joint action toward finding a solution. Community members also gain practical tools for monitoring infrastructure construction and service delivery.

Participatory assessments not only provide data for project managers and policymakers, but they are also an established learning tool for various interest groups within communities and agencies. The approach builds capacity through joint investigation and analysis and community participation in planning and managing the project. In this cycle, the different groups in a community assess the situation, identify areas for change, and take collective action. They can then repeat the analysis as needed later in the project. All participants, from community members to national policymakers, can obtain information generated by the user communities themselves, adding transparency to the entire process.

Conducting the Socioeconomic Impact Survey

Statistical approaches to the development of a monitoring and evaluation methodology for rural electrification projects often involve the use of surveys based on random samples of households or individuals. The typical approach taken for evaluating projects is to survey households in a project area with and without electricity. This establishes a baseline for the people living in the project area. A survey or a part of the survey can be conducted at periodic intervals during the execution of the project. The approach proposed here is to conduct cross-sectional comparisons that allow the examination of the impacts of rural electrification, and to use period samples to track the progress of a rural electricity project over time. The discussion here is confined to the cross-sectional approach, which can be wholly or partially replicated in later years to yield time series data on the impact of the project.

The survey is developed keeping in mind the priority needs identified by the communities during the participatory research. For rural electrification, several general categories of questions are important to address. They include questions designed to assess whether the market conditions are right for implementing or expanding projects or programs, questions on the socioeconomic impacts of rural electrification, and how a project or program will affect poverty and gender issues (table 34 and box 5).

Table 34: Summary of Participatory Assessment Tools

Tool	Main purpose	Gathers data for which variables
Community Data Sheet	To get general data on the participating communities and allow the identification of factors other than participation, gender and demand responsiveness that may explain the variation in quality and maintenance of service.	Used as perspective against which to assess other indicators
Wealth Classification	To classify the community's population into economic categories based on locally specific criteria, which are used for focus group discussions, community mapping and other activities.	Used as perspective against which to assess other indicators
Community Map	To learn about the community's current electricity systems and access of rich, poor, women, and men to them.	1. Effectively Sustained Service 4. Division of Burdens and Benefits 5. Participation in Service Establishment and Operation
Focus Group Discussions (FGD)		1. Effectively Sustained Service 2. Equitable Access and Use 3. Degree of Change in social development indicators 4. Division of Burdens and Benefits 5. Participation in Service 6. Institutional Support for Gender- and Poverty-Sensitive Demand Responsive Participation
Transect Walk (with Rating Scales and System Observation Form)	To determine extent and nature of electricity services present in community, and quality of installed systems	1. Effectively Sustained Service 2. Equitable Access and Use 4. Division of Burdens and Benefits
Pocket Voting	To determine preferences, behaviors, decisionmaking, and perceptions. This is particularly useful when the subject being assessed is sensitive and people are reluctant to state their views publicly.	Can be used to gather data on all indicators, but particularly: 2. Equitable Access and Use 3. Degree of Change in social development indicators 4. Division of Burdens and Benefits 5. Participation in Service 6. Institutional Support for Gender- and Poverty-Sensitive Demand Responsive Participation

Ladders	To assess the extent to which a service meets the users' demand and to which the users consider the benefits worth their costs, and the impact of the electricity service on women's time and workload in relation to those of men.	2. Equitable Access and Use 3. Degree of Change in social development indicators 5. Participation in Service
Stakeholder Meet	To examine institutional indicators and shares the findings of the community-level analysis with all stakeholders.	6. Institutional Support for Gender- and Poverty-Sensitive Demand Responsive Participation
Policy-level Assessment	To assess degree to which national sector policies are present to support demand-responsive renewable rural electrification projects.	7. Policy support for gender- and poverty-sensitive, demand responsive participation

Box 5: Possible Research Topics for Socioeconomic Survey Questionnaire

- Socioeconomic profile of actual and potential beneficiaries and customers.
- Fuel and energy use prior to improved electricity services, including energy from all sources, such as candles, biomass, batteries, the electric grid, and diesel generator sets.
- Monthly expenditures on fuels and energy by source.
- Potential and actual willingness-to-pay for energy services by application.
- Energy use as it relates to substitutes for improved electricity services (kerosene, candles, and others).
- Reasons for not connecting to the grid or purchasing improved energy devices.
- Barriers to the adoption of improved electricity technologies and services.
- Incentives to overcome barriers to adoption of improved electricity technologies and services.
- Appliances in rural households, including those with and those without electricity.
- Time use (for males and females) as it relates to existing energy use or appliances.

Observations on Implementing the Approach

The monitoring and evaluation process advocated under the user-centered framework uses both qualitative and quantitative techniques. The participatory assessment spans a variety of well-established qualitative methods, including focus group discussions, pocket voting, and other participatory tools. Community members take an active role in project design, and implementation and evaluation, and in offering their preferences and opinions at all stages of the project. The survey approach is a more quantitative approach involving the use of questionnaires, random samples of populations, and formal

interviews. In this case, project participants and, in many cases, nonparticipants are interviewed, and their patterns of energy use and opinions about electricity and the project are measured and analyzed. Inherent in the framework proposed by this report is the evaluation of potential project design approaches and project impacts on *all* segments of the target population, including different genders and social groups.

A weakness of participatory assessment methods is that they can be costly and time-consuming, and to function effectively they require well-trained, experienced, and sensitive staff. Because these methods generate detailed qualitative data specific to the communities being studied, they cannot easily be generalized to a broader area. Experience suggests that participatory methods can be manipulated and used in a purely extractive manner, whereas one of the primary objectives of such methodologies is to foster ongoing interactive communication between project staff and the target population.

Survey methods, by contrast, require good planning and organization to obtain satisfactory results. They are fairly expensive to implement and require specialized staff competent in survey design and analysis. The surveys themselves are not difficult to implement, but both the planning and the analysis take longer than many project managers expect.

8 Recommendations

This chapter organizes the many ideas and suggestions contained in the EnPoGen studies in some order of coherence. These were not presented by the studies in the same order or context, dispersed as they were among the complexities of the topics covered. However, based on their similarities, they are pulled together in a manner that should facilitate future actions by the World Bank and other interested organizations. The recommendations are drawn largely from the EnPoGen studies, but they have also benefited from ideas and suggestions made at an end-of-project workshop organized by ASTAE.[31] A number of them were featured topically in earlier parts of the report, but they are recaptured here for the sake of completeness.

Policy Issues

The role of the government in poverty and gender is of overriding importance simply because the poor, by their very status, are largely excluded from the market process. Government policies, therefore, have a catalytic significance in bringing about the kinds of change that are expected from all other stakeholders. They need to provide the framework for the development of energy services and determine which organizations are involved in the planning and implementation of such services. They must set out effective institutional arrangements for the supply of energy and energy-using devices—whether through state organizations, NGOs, major enterprises, or small private traders—because they will have a major effect on both access and accountability. In addition, as frequently indicated in the preceding parts of the report, energy is essentially an intermediate good whose benefits are realized only in conjunction with other complementary inputs. Energy policy must be considered in parallel with both policy on other sectors (for example, employment, education, health, agricultural extension, water, and transport) and specific policies on poverty and social security.

Creating an Enabling Environment

Although numerous solutions can be thought of to improve the effectiveness of modern energy service delivery to the poor, in most developing countries these solutions remain hampered by the lack of the right policy conditions. For instance, although the climate is growing more favorable to decentralized energy supply options, in most countries the existing regulatory framework is often the major barrier to such development. It can be hostile, contradictory, or uncertain. Taxes and subsidies frequently undermine markets, rather than encourage them. The supporting infrastructure of training institutions or

[31] EnPoGen Workshop, December 10, 2002, Washington, D.C.

financing may be non existent or inaccessible. Competitors may be able to gain privileged access to subsidies that enable them to sell their products below cost. Without changes to this policy environment, the flow of private sector finance and innovation will be stilted. These are the areas currently at the focus of much analysis, innovation, and reform.

Some promising directions for policy analysis and application are as follows:

- Appropriate tariff and connection policies, including for decentralized systems, credit, and leasing.
- The role of subsidies and the impacts of restructuring of the power sector on subsidies and access.
- Demand analysis, including gender-disaggregated analysis.
- Financing and institutional mechanisms, including microcredit, rural energy service companies (RESCOs), community- and NGO-based approaches, and private participation in the provision of small-scale infrastructure.
- Productive uses of electricity, especially uses that may only be possible with decentralized systems.
- Institutional coordination of complementary infrastructure.

The Use of Smart Subsidies

In addition to overall poverty, the number and range of intermediation tasks, low density of demand, and remoteness of location raises the costs and reduces the profitability of energy supplies to rural areas. Furthermore, a certain amount of "social overhead investment" almost always has to be put in place to support such schemes (training, technical assistance, and capacity-building within communities). The burden of these overheads will be particularly high for innovative schemes, although they may eventually be spread across a large number of enterprises.

A recent report from the World Bank (1999) confirms the view held by many people involved in the practical implementation of rural energy schemes when it says that "it is illusory to expect that increasing access to electricity for a significant part of the population traditionally excluded from grid based electricity can be financed only by the private sector."

If the cost of energy is too expensive for poor people who need it, the issue of subsidies and/or grants cannot be avoided. The political acceptability of subsidies has undergone wild fluctuations in recent years. All governments provide subsidies, and it is clear that some have done more harm than good (destroying markets and benefiting people who are already better off). However, the essential question that has emerged from the ideological posturing of recent years is less about the rights and wrongs of subsidies in principle than about whether a particular form of subsidy is actually likely to achieve its intended purpose.

The arguments for using money that is supplied at less than full commercial rates of interest are overwhelming if large numbers of people are to be given access to improved

energy services. This “soft money” will be required to enable people with insufficient purchasing power to gain access to electricity and to other more convenient forms of energy.

If the case can be made for subsidies, experience suggests that the use of soft money can both help the expansion of decentralized energy supply options and harm them. As always, the “devil is in the detail” and in the specifics of each context. Hence, the phrase “smart subsidies” has been coined to put some distance between current forms of subsidy and the earlier forms, for example, subsidies on grid-based electricity, kerosene, and diesel that have been shown to stultify innovation, destroy markets, and support the already affluent.

A large number of technology-driven schemes currently adopt a strategy of trying to increase sales through subsidy. This is particularly the case with PV. It is argued that increased sales will reduce the cost of production and, more importantly, enable the overhead costs of providing technical support and supplying retail credit to be spread over a larger number of unit sales. The evident danger of such an approach is that soft money intended for social investment is often used to subsidize the costs of these supply options for those who could readily afford to pay the true cost if they genuinely regarded this as a priority area of expenditure. Furthermore, the use of subsidies linked to a particular supplier can “pollute the well” for other entrants to the market.

Smart subsidies, by contrast, do the following:

- Follow pre-established rules that are clear and transparent to all parties.
- Focus on increasing access by lowering the initial costs (technical advice and capital investment) rather than lowering the operating costs.
- Provide strong cost minimization incentives, such as retaining the commercial orientation to reduce costs.
- Remain technology neutral.
- Cover all aspects of a project, including end-use investments, particularly to encourage propoor end uses.
- Use “cross-subsidies” within a project to pay for lifeline charges or tariffs and other “propoor” recurrent cost subsidies (for instance, enable transfer from richer sections of the community and commercial users to marginal connections).

Lowering Tariffs and Connection Costs

The poor people make substantial efforts to obtain modern energy services, especially electricity, and are willing to pay significant amounts of money to obtain them. Yet, access remains a problem, partly because of supply constraints, but partly also because of the high cost of access. Even if electricity were available at the village level, many households are not able to obtain a connection. The major reason for this is the perceived high cost of the connection. In-house wiring can physically be done over a certain period of time, which will gradually distribute the costs, but the connection fee has to be paid in full before the connection is made.

Policies on tariffs and connection costs are key to reducing upfront costs. One success factor in widening access to grid rural electrification in several countries (ESMAP 1999) was reducing initial connection charges or spreading them over several years by rolling them into the tariff (Barnes and Foley 1998). A study on the urban energy transition (Barnes and others 1998) suggests the use of block rate tariff structures, along with connection charges rolled into the overall price that the public pays for electricity, thereby reducing barriers to entry. Metering systems that enable the poor to pay in small quantities, such as prepaid cards used in South Africa, are another promising approach, especially as the costs for these decrease. Decentralized systems have tried to solve the problem of upfront costs through credit, leasing, and subsidies.

Yet another alternative is to include a service connection subsidy in the investment plan. The utility or service provider will not have to support the finance charge, whether during the investment phase or through the tariff structure. The utility or service provider will then be interested in connecting all possible rural households instead of only the nearest ones. In addition, from the households' point of view, they will only have to finance wiring costs and the standard tariff, which is something most poor households can afford. The goal should be to get as many people as possible into the system and to let use (which is largely a function of consumer choice) to take its own course—even if higher prices for use mean that, initially, consumption is reduced to some degree.

Strategies for the New Development Agenda

The poverty-centered development agenda that has provided the impetus for EnPoGen calls for several strategic shifts in the way energy is perceived by the development community and how, in turn, the energy community views its developmental responsibility in the fuller sense of the phrase. Given that poverty or gender concerns have had a marginal role in energy decisions so far, such shifts are bound to be pervasive, cutting across the entire decision chain from policy thinking to doorstep delivery of services. The more significant of them are described here.

Greater Emphasis on Livelihoods and Income-Generating Opportunities

In spite of the definitional changes it has undergone, poverty is essentially a state of all-round deprivation, whether it is expressed by an income threshold or other intangibles. Income as a measure of poverty has not been replaced by these additional dimensions, but rather only dislodged from its earlier position as the *only* measure of it. Although it may have lost the monopoly of attention, it still remains the most critical indicator of poverty. To argue otherwise, as has become increasingly fashionable, is to overlook the hard reality of what the poor themselves have to say about the lack of insufficient income, especially cash income, and income-producing assets.

Indeed, without discounting the importance of other, less tangible, indicators of poverty, one is left to wonder whether the underlying effect of bringing in these numerous other facets of the problem does not obscure the central issues. In many ways,

diluting the focus on income has been like widening the goal posts to such an extent that one could hardly fail to score with even the feeblest of kicks. Any effort that mitigates the hardships of the poor by however marginal an extent acquires the legitimacy of having made a contribution. That so many poor, in spite of these gains, are still classified as such is a fact that is often brushed aside. Even more delinquent is the phenomenon of "rediscovering" such gains from measures that are not new at all, but only now being linked to poverty in a way that acquits them of further, more onerous, effort.

At practically every important turn of the energy-poverty debate, the issue eventually boils down to the high cost of modern energy services and the lack of purchasing power among the poor. If this be so, increasing their purchasing power should be a genuine concern while shaping energy as an instrument of development. In the final analysis, *the creation of wealth is the only enduring solution to poverty*. Anything else might make poverty less intolerable, but it cannot extricate the poor from the trap they are in, often across generations. Within this context, raising the economic status of women is crucial, because women are the worst victims of poverty and also often the best routes of escape from it.[32]

Unfortunately, most energy initiatives for the poor have been typically concentrated on basic needs applications, such as cooking and lighting, with rural electrification programs incapable of even addressing the former. The level of energy services provided relative to the poor's economic capacity-to-pay is adequate for only a subsistence level of consumption in the majority of instances. Although these measures yield obvious social benefits, they have low or no impacts on the economic status of poor families. These conventional approaches have largely missed the point, which is to free people of poverty by placing in their hands viable means to earn income and build assets.

Energy strategies must focus far more on the livelihood opportunities for the poor to enhance their economic self-reliance, which will invariably bring about an improvement in their social conditions. The reverse is far less likely. What this implies can be put in a nutshell. Since most income-earning activities of the poor, including women, are based on human labor, greater attention should be paid to energy services that can directly substitute or reduce the extent of labor content in production—meaning efficient fuels or electricity *and* related equipment or appliances for process heat and motive power. Such a strategy will improve product quality and increase production volume, with a potential for significant breakthroughs in income levels. It will also represent a shift away from the present basic needs model to a poverty-reducing model with potentially widespread benefits, both economic and social.

[32] As, for instance, through their readiness to engage in home-based microenterprises to supplement family incomes.

Blending Energy with Other Complementary Inputs under Integrated Projects

The issue of complementary inputs and the need for integrated projects combining these inputs with energy has been discussed at length in the preceding chapter of the report. It is worth reiterating their importance here, especially against what has been stated above on the need to stress the livelihood impacts of energy services, as also their impacts on the lifestyles and living conditions of the poor.

An evaluation of energy and development projects carried out by the European Union in its first 25 years of operation concluded that energy activities need to be integrated into development projects and, therefore, agencies need to design administrative procedures to ensure that this happens.[33] It was suggested that it would be relatively easy to identify those development activities likely to have a significant energy dimension, such as the following:

- Projects that use considerable inputs of inanimate energy (agricultural mechanization, pumped irrigation, and rural transport).
- Projects that are highly dependent on small but secure supplies of energy (medical facilities, and telecommunication).
- Projects that are known to have a large indirect effect on local energy systems (land clearance, changes in land uses, and projects that increase the density of populations).

From the perspective of income generation, a key identifier of a development project in which an energy component will have a high priority is one that incorporates productive equipment that is energy-intensive. This could be a project that includes electric-powered sewing machines that can enhance the incomes of rural women engaged in garment stitching, or heat-intensive processes, such as spice drying and hatcheries.

Coverage of Fuels

Again, the need to extend the scope of energy services beyond electricity has been discussed earlier. Although the focus of EnPoGen has been primarily on electricity, it has been obvious that, first, electricity does not address the main time-consuming activity of cooking in rural households; second, its focus at the level of the poor on lighting and basic household appliances is insufficient to induce productive activities; and, third, it might not be the most appropriate energy option for all applications (for instance, transportation).

Efficient fuels—such as biogas for cooking, biogas for power, and LPG—not only focus on the more labor-intensive activities of women, they also, in relation to the limited supply capacity and "intermittent" nature of alternative energy technologies, offer more stable sources of energy. Biogas, in particular, has unique advantages that are not readily offered by other sources of electricity or other forms of energy because it meets cooking

[33] Hurst and Andrew Barnett 1990.

fuel needs, and the slurry from biogas systems offers a rich natural fertilizer. In rural communities dependent mainly on agriculture, one of the major cash expenditures of the poor is for the purchase of chemical fertilizers that could constitute as much as 50 percent of their cash income.[34] A savings on this expenditure effectively increases their cash savings by that extent, which has a direct positive impact on poverty. Future energy strategies need to recognize and attend to the fuel needs of the poor for reasons of releasing their time, enhancing their income or reducing their expenditure.

Approaches to Alternative Energy Development

Alternative energy technologies have come a long way since their modest beginnings more than two decades ago in the developing world. Many of them now cost much less, perform far better, and are economically viable solutions to meet at least the basic energy needs of the poor. Unfortunately, the barriers against them are still formidable in the majority of developing countries, especially those posed by market distortions in conventional energy-electricity supplies. A more enlightened strategy is now needed to ensure that these technologies have greater freedom to reach the poor.

For instance, even though solar PV technology costs the highest and, in practical conditions, is capable of providing only small amounts of electricity, it has some distinct advantages that are not easily matched by other options. They could be viewed as pre-electrification solutions for those who cannot realistically be expected to be connected to the grid in the foreseeable future, and the conditions of their dissemination among the poor be made more favorable, for example, through credit schemes and/or capital cost subsidies.

Other options, such as micro or minihydro, are both more affordable and capable of delivering a higher volume of electricity and motive power to the poor, which meshes well with their social and economic needs. However, micro or minihydro solutions are notoriously lacking in equipment performance and reliability, and supply from them is subject to steep declines during periods of low water availability. Ensuring their performance through greater attention to servicing and maintenance—and coupling them with other energy options, such as diesel—in hybrid systems would go a long way toward benefiting poor communities.

New strategies for alternative energy technology development for the poor must, however, recognize that they have genuine role to play in poverty alleviation and reduction. To begin with, they must encompass technologies other than those that produce electricity, for example, biogas and liquid fuels. They must also tailor their marketing strategy to match the poor's economic conditions by combining conventional top-down market penetration approaches with new bottom-up market creation approaches. They should further make an effort to scale up their capacity to be able to meet the productive needs of the poor by supplying energy in greater quantities. For many poor people, there *are* no other energy options, and their state of poverty will

[34] Based on an ongoing study in China (ECN 2002) cited earlier.

remain unmitigated if they were to look upon alternative energy technologies as only transient solutions. In remote rural communities, "transient" could mean decades of waiting for conventional energy services to arrive. It would be unrealistic and unfair to expect these communities to make do with minimalist strategies that have little impact on their economic status.

Demand Management and Appliance Efficiency

Promoting the efficient use of energy is always desirable, but it is even more so when it comes to the poor in rural communities because of their high reliance on biomass fuels in end-use devices of very low efficiency. Low efficiency on the demand side means a high gross primary energy consumption. Where such primary energy resources are based on expensive conversion technologies, such as alternative energy systems, their significance becomes even more acute because every watt of additional supply capacity costs that much more in relation to the poor's low capacity-to-pay. At present, with the exception of solar PV systems that are usually supplied with energy-efficient CFLs, most energy solutions for the poor are not overly concerned with demand management or appliance efficiency. Even highly relevant efficiency-oriented solutions, such as improved cookstoves, seem to have faded in importance in many developing countries because of the perceived complexity of their dissemination.

Efficient devices and appliances offer the following benefits for the poor:

- In the case of biomass fuels, they reduce the gross energy consumed, reduce usage time (as in cooking), and release valuable time, especially among the women.
- Appliances such as CFLs not only consume less electricity, but they also provide far more *useful* energy, in this instance better illumination that can directly affect activities such as studying and working in the evenings for additional income generation.
- They invariably lower the investment cost in supply capacity or, alternatively, deliver more useful energy for the same cost, thus widening the range of end uses, including those for economic activities.
- Even if their initial costs are higher than less efficient devices and appliances, they almost always pay back the investment within relatively short periods.

Strategies focusing on demand management and appliance efficiency are, therefore, imminent in rural electrification and in rural energy development at large. They are ideally integrated into "packaged" solutions for supply delivery. Because of the higher cost of efficient appliances and devices, it is also necessary to come up with appropriate financing schemes that make them attractive to the poor.

Empowerment and Gender

Recommendations for decentralizing the planning and delivery mechanisms, as well as for exploring the gender dimension further, will give voice to the poor who are affected and will allow for actions based on informed decisions.

Decentralization of Planning and Delivery Mechanisms

Although decentralization has been the buzzword in development for a long time now, genuine decentralization has yet to come about in rural energy service delivery. Conventional rural electrification strategies are planned and implemented using a top-down approaches in which rural users, particularly the poor, have little say. Even alternative energy programs are either imposed on the users according to decisions made elsewhere or they chase purchasing power beginning from the apex of the income pyramid. Moreover, they are often prompted by a sense of "technology advocacy" and environmental priorities rather than poverty or the end needs of poor users.

These drawbacks could be overcome if rural energy services and rural electrification are viewed as a part of local development privileges, ensuring that local communities have a say in electrification decisions. Such an approach would result in a better recognition of local priorities, notably concerning poverty aspects, because local representatives and decisionmakers are more concerned about local development than their national counterparts because of their sense of sociocultural belonging and solidarity and, if nothing else, for electoral purposes.

Furthermore, a decentralized planning and delivery approach based on local institutions and NGOs contributes to community empowerment. The participatory assessment methods suggested in the preceding chapter of the report offer potentially viable mechanisms, if seriously implemented, for the empowerment of the people and a socialization of the energy decision process. All available evidence suggests that there clearly *are* means by which access to energy can be widened, and the poor can benefit more if they are provided with more *choice* and more *voice* in acquiring and using energy. There is some experience now with a number of strategies in rural electrification that specifically target the poor and, in several cases, women. Such strategies for widening access could be examined, based on field investigations and case studies, for their actual impacts, not only on access, but on poverty reduction and gender equality.

Further Exploration of the Gender Dimension

Gender relations and cultural norms will have a major influence on both the involvement of men and women in energy service decisionmaking and the extent to which energy use in both marketed and nonmarketed activities is gendered. They may also largely determine the priorities for the application of new energy services and, hence, the distribution of benefits from their introduction.

Although there is now a rising appreciation of the gender dimension of poverty and its implication for energy, it is a long way from appreciation of the philosophical variety

to actions based on informed decisions. Current thinking on energy strategies for poor rural women suggests the following needs:

- *Data needs and analysis:* Disaggregation of energy use, supply and impacts by gender, in order to provide a better basis for applying well-known field methods and analytical tools for incorporating gender in project design and implementation, as well as at the macropolicy levels.
- *Wood energy, cooking, and health:* Seeking integrated approaches and various solutions (including fossil fuels and perhaps electric cooking) that recognize the importance of wood energy and cooking, especially for poor women, and their health implications.
- *Women's specific electricity needs:* In water pumping, agricultural processing, security, work productivity, and health—addressing them within the framework of sectoral development initiatives.
- *Equal access to credit, extension, and training:* To assure energy supplies for women's domestic tasks, as well as their microenterprise and agricultural activities.

Institutions and Human Resources

Institutions play a central role in the determination and effectiveness of different livelihood strategies. Central and local governments, community organizations, other informal community structures, and private markets determine the economic and social environment within which livelihood strategies must function. The associated policies, laws, customs, and incentives will have a major influence on access to livelihood assets and the possibilities for transformation of assets to generate livelihood outcomes. The institutional context also plays a major part in relation to vulnerability and security. For example, it will determine the extent to which the poor can expect to receive organized assistance when confronted by natural, economic, or social shocks.

The Role of Intermediation

Experience demonstrates that at the heart of the problem of developing decentralized energy supply options are the very high costs associated with putting together the various elements of technology, finance, community development, and management required to make such schemes work (often described as "transaction costs"). For many of the larger schemes, many hundreds of tasks are necessary to get them off the ground and running sustainably. The idea of "intermediation" offers a convenient way to group and understand these activities. The approach extends the idea of "financial intermediation" and considers three additional forms of intermediation: technical intermediation, social intermediation, and organizational intermediation.

Financial Intermediation involves putting in place all the elements of a financial package to build and operate a decentralized energy supply company. A process sometimes referred to as "financial engineering" covers the following:

- The transaction costs of assembling the equity and securing loans.
- Obtaining subsidies.
- The assessment and assurance of the financial viability of schemes.
- Assessment and assurance of the financial credibility of the borrower.
- The management of guarantees.
- The establishment of collateral ("financial conditioning").
- The management of loan repayment and dividends to equity holders.

Financial intermediation can also be used to cover entire schemes rather than just investment in an individual plant, and it is vital for energy services based on microcredit and/or microenterprise mechanisms. By assembling a large number of small financial requirements of poor borrowers, one could make them attractive to financing agencies; establish the supply of finance on a "wholesale" basis from aid agencies, governments, and development banks; and create the mechanisms to convert these flows into a supply of retail finance (equity and loan finance at the project level).

Technical intermediation involves both improving the technical options by undertaking research and development activities, and importing the technology and know-how "down" through the development of capacities to supply the necessary goods and services. These goods and services include site selection; system design; technology selection and acquisition; construction and installation of civil, mechanical, and electrical components; operation; maintenance; troubleshooting; overhaul; and refurbishment.

Organizational intermediation consists not only of the initiation and implementation of programs, but also of lobbying for policy changes required to construct an "environment" of regulation and support in which energy services and the various players can thrive. It involves putting in place the necessary infrastructure and getting the incentives right to encourage owners, contractors, and financiers. Organizational intermediation must include the development of regulatory support and incentive structures that can specifically address the energy needs of the poor and women, particularly in rural areas.

Social intermediation could be usefully distinguished from organizational intermediation, although the two are interrelated. It involves the identification (by socioeconomic status and gender) of owners and beneficiaries of projects and the "community development" necessary to enable a group of people to acquire the capabilities to take on and run each individual investment project. It includes measures for enabling poor people, specifically women, to obtain a voice in project identification, design, and management.

Training and Capacity-Building

Many training and capacity-building initiatives have been in place in relation to energy, ranging from policy analysis to technical skills development. From an energy-poverty-gender viewpoint, it is important to assess training needs and institutional capabilities in those areas that are critical to lend a poverty and gender focus. Such an assessment should be as comprehensive as possible, and it should include the training and capacity-building needs of the following:

- Energy development financing and technical assistance agencies, such as ASTAE and World Bank, and other bilateral and multilateral institutions.
- National planning bodies, especially rural development and local government organizations, and electricity utilities.
- National financing institutions, including microcredit and specialized energy financing agencies.
- Sectoral agencies in charge of various aspects of rural infrastructure development (education, health, agriculture, animal husbandry, forestry, poverty reduction, social welfare, and so on).
- Private entrepreneurs dealing with energy and other service delivery in the rural areas.
- NGOs and community-based organizations, especially women's organizations, that have capabilities of assisting with decentralized energy project identification and implementation, including the facilitation of micro loan programs.
- Research and training institutions dealing with rural development, poverty reduction, gender, and energy issues.
- Rural communities and poor women, especially in the form of skills development to operate and maintain decentralized energy systems, and to establish and manage micro and small-scale enterprises at the household and community levels.

Refining Methodological Tools and Techniques

Energy, Poverty, and Gender Assessment

The EnPoGen outcomes suggest the need for an energy, poverty, and gender assessment (EPGA), to be carried out within the framework of designing new rural energy and electrification programs. The EPGA could have a national scope and be sized in a larger way whenever important decisions are to be taken in relation to energy-power sector reform. It should be used scaled down, however, to evaluate existing programs and to prepare new ones. An EPGA should serve the following objectives:

- Analyze the real conditions of access of the poor in past rural energy-electrification programs and alert national decisionmakers on necessary changes.

- Have a better understanding of the social parameters of unelectrified populations and populations without access to other modern energy services, and of their financial capacity to participate in energy-electrification schemes.
- Improve the identification, quantification, and comparison of the socioeconomic benefits of different rural energy-electrification options—beyond the mere avoided cost and environmental analysis currently used in project assessments—in order to compare and evaluate public interest in supporting rural energy-electrification programs, and to establish a set of "reference" benefits (to be adapted according local contexts) for specific fuel or technology options.
- Determine subsidy levels and mechanisms, as well as other public support schemes necessary, to (a) open financial cost-effectiveness "zones" that will define ranges of projects that are attractive to stakeholders, provide equitable access, and offer acceptable tariffs; and (b) reflect public priorities, such as the building of institutional and social interconnections, and awareness of the costs and benefits of alternative energy solutions.
- Evaluate the sociopolitical context of local communities in order to define mechanisms that ensure both effective community decision processes and project ownership so that access can be maximized without endangering the financial viability of the project.

Poverty and Gender Impact Assessment Tools

The social benefits of rural energy-electrification programs and projects on health, education, safety, or housework are not easy to quantify because they deal with qualitative aspects and estimates for several parameters. A simple impact assessment tools is needed to guide public financing for rural energy-electrification (criteria of eligibility, type and level of financial support).

Further work in this area may be concentrated on four main socioeconomic impacts:

- Reduction of consumption of and expenditure on kerosene and candles for lighting, battery-charging to operate TVs and, to a lesser extent, dry cell batteries for radio-cassettes or flashlights.
- Gender-disaggregated time savings because of different energy options, and the allocation of these savings to various productive and reproductive tasks.
- Extent of household income growth from home-based microenterprises and community-scale enterprises.
- The rate of penetration of common appliances and devices according to income, type of energy, and duration of access.

What Comes Next?

The majority of the recommendations contained in the preceding parts of this chapter will involve substantial resource commitments by national governments and donors, and they will take time to be set in motion. Although ASTAE and the World Bank will have a major role to play in following up these recommendations, subject to their acceptance, some immediate actions can be thought of in order to keep up the momentum generated by EnPoGen. These actions fall into two categories: a set of pilot projects or initiatives that seek to implement on a small scale the more critical of the EnPoGen recommendations in order to test and validate, and the dissemination of EnPoGen's findings and conclusions to a larger audience.

Pilot Projects

- Case studies and/or briefs on promising approaches and strategies, and suggestions on how they could be replicated and scaled up.
- An ASTAE pilot project or projects to operationalize poverty-gender approaches from the outset.
- Pilot "integrated" projects combining energy-electricity with complementary resources.
- Application of the proposed monitoring and evaluation framework to design and evaluate one or more integrated projects.
- A study similar to EnPoGen to review urban energy, poverty, and gender linkages.
- A study of financing, especially microcredit, for decentralized energy systems.

Dissemination of Project Outcomes

- Presentation of the key findings of EnPoGen in a form that is attractive to nonenergy people.
- Posting of all EnPoGen reports and material on the Internet, including an exploration of the possibility of creating an EnPoGen home page on the ASTAE–World Bank website.
- Local language translations of the main findings of EnPoGen for audience in different countries, possibly in the form of a brief booklet.
- Internal dissemination of the EnPoGen outcomes within the World Bank group, particularly among task managers.
- Preparation of a viewpoint note by the World Bank.

9 Conclusion

The outcomes of the EnPoGen studies leave two distinct sets of impressions. First, there are the facts and realities of the effectiveness with which modern energy services, particularly electricity, address poverty and gender concerns. By and large, they indicate that not enough is being done for reasons ranging from lack of awareness and conceptual clarity to insensitivity and disregard for the needs of the poor and women. Second, arising from these, there are the first-hand reflections of those who carried out the studies as to where the major gaps lie and what can be done to bridge them in future efforts. They echo the hopes and aspirations of people in distant villages who might not get another such opportunity to present their case to an international audience.

Although the calls for action by the authors of the EnPoGen studies are backed by a wealth of evidence to satisfy all but the obdurate, what is remarkable is the ardor with which they are argued. Their transition from analytical discourse to impassioned pleas for change capture the essence of a new urgency that has not been felt before among energy professionals. It is not as if the central problems of poverty or gender were unknown until now, nor was the energy community entirely ignorant of its role in resolving them. However, even those who considered themselves alive to these issues were moved by the vast gaps that exist between those who enjoy the benefits of modern energy and those who do not. Close encounters with poverty are not the same as clinical observations over cold statistics around conference tables.

The EnPoGen studies in Indonesia and Sri Lanka, in fact, argue at the end that it might be unrealistic to expect energy, at least electricity, to play a direct role in poverty reduction on its own. By contrast, the China study argues for a more explicit role for energy in relation to poverty through greater attention to its income-generating and asset-building potential, but it also stresses the importance of accompanying inputs other than energy-electricity. In fact, these seemingly divergent views are saying the same things.

EnPoGen as a whole offers several crucial insights that explicitly relate to the energy sector in general and to rural energy systems in particular:

- The poverty-reducing impacts of energy inputs are significantly affected by the existence or absence of complementary inputs, ranging from energy end-use equipment to the existence of roads to take increased production to markets.
- The financial sustainability of energy interventions is often determined by the existence of income-generating end uses, but most energy interventions have so far been unable or unwilling to support the development of these end uses.
- The size and distribution of poverty impacts of energy interventions will be significantly determined by the choice of end uses to which energy is put.

- The viability of local resource-based alternative energy technologies is highly dependent on the "load factor," that is, the extent to which the potential energy output is actually used.
- The energy needs of women are often significantly different from those of men. The poorer the people are, the more their energy requirements are related to domestic or reproductive tasks of cooking, lighting, and space heating where are the most important actors both in energy supply and use. Therefore, women and their energy needs will have to be addressed specifically if poverty is to be reduced through energy.
- Women's energy needs will not be met until they have a "voice" in determining their options and priorities.

These insights are related mainly to a *perspective* rather than some finite set of energy-poverty-gender linkages. There is unlikely to be a set of rules or fixed input-output relationships that provide a "magic bullet" to solve poverty through energy interventions. There is now a new situation in which poverty reduction is seen as the main objective of development. The key to this is the need to increase awareness across the development community that energy interventions have an important role in removing potentially binding constraints on poverty reduction strategies. The primary concern must be that, at present, energy issues are often not even considered when policy is being formulated.

Opportunities for addressing poverty through energy interventions have increased substantially over recent years:

- Both medium- and small-scale energy conversion technologies have increased in efficiency, reduced in cost, and increased in convenience, thereby offering a wide range of potential options for profitable small-scale, decentralized energy supply.
- Energy sector restructuring and regulation has removed some of the monopoly powers of energy utilities, and there are now fresh opportunities for private sector initiatives.
- Even relatively poor people are willing to make significant cash payments for improved energy services.
- Energy-using microenterprises, made possible by appropriate financing and credit tailored to the needs and repayment capacities of the poor, could bring about economic transformations that are also conducive to social transformations.

This suggests that a broad market-based approach, combined with carefully targeted support for the poorest, could play a major role in meeting the needs of poor people. Even so, it is likely that some forms of subsidy will remain important. However, little of this potential will be realized in the absence of an effective institutional and regulatory environment.

EnPoGen might not be the last word in energy, poverty, and gender analysis because it raises just as many questions as it offers answers, but to the extent that it serves to

initiate a new line of development thought, it hopefully marks the end of a beginning. Those who would pursue the lines of inquiry it prompts are clearly headed toward *business unusual*.

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