



Regional Workshops on Electricity
and Development in

Africa, Asia and Latin America

Consolidated Report



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List of Acronyms and Abbreviations

ADB	Agricultural Development Bank of Nepal
AFREPREN	African Energy Policy Research Network
AIT	Asian Institute of Technology
ANEEL	National Electricity Regulatory Agency (Brazil)
APAEB	Association for the Sustainable Development of the Sisal Region
ARE	Accelerated Rural Electrification (Thailand)
CDM	Clean Development Mechanisms
CENBIO	National Reference Centre on Biomass
COELBA	Electrical Energy Concessionaire of the State of Bahia
CREDP	Caribbean Renewable Energy Development Programme
ECER	Rural Electrification Community Enterprises
ECG	Electricity Company of Ghana
EGAT	Electricity Generating Authority of Thailand
ESCO	Energy Service Company
GNESD	Global Network on Energy for Sustainable Development
GW	Gigawatt
HDI	Human Development Index
HT	High Transmission
IEA	International Energy Agency
ISP	Internet Service Provider
kVA	Kilo Volt-Ampere
kW	Kilowatt
LAC	Latin America and the Caribbean
LPG	Liquid Petroleum Gas
LT	Low Transmission
MDGs	Millennium Development Goals
MNES	Ministry of Non-Conventional Energy Sources (India)
NGO	Non-Governmental Organisations
NR	Nepalese Rupees
PEA	Provincial Electricity Agency (Thailand)
PPP	Public Private Partnership
PRSPs	Poverty Reduction Strategy Papers
RE	Rural Electrification
REA	Rural Electricity Agency
REDP	Rural Energy Development Programme (Nepal)
REF	Rural Electrification Fund
RERED	Renewable Energy for Rural Economic Development (Sri Lanka)
RETs	Renewable Energy Technologies
RPS	Renewable Portfolio Standard
SHP	Small Hydro Power
SMEs	Small and Medium Scale Enterprises
UNF	United Nations Foundation
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
URC	UNEP Risoe Centre

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1. Introduction

1.1 Background and objectives of the workshop series

An estimated 57 per cent of the world's poor—around 1.6 billion people or approximately a quarter of the world's population—do not have access to electricity or other clean and modern fuels such as kerosene, LPG and natural gas. An estimated 2.4 billion people meet their cooking needs through traditional use of biomass. It is projected that, without major policy action and increase in

350 GW in Latin America (excluding Brazil); and some 300 GW in both Africa and India. The additional capacity requirement would require a cumulative investment of US\$5.2 trillion by 2030. However, even if such investments are made, the total population without access to electricity will, according to the IEA still exceed 1.5 billion people in 2015. Another US\$ 202 billion USD would be necessary to bring this figure below 1 billion people.

Various studies have reported the linkages between economic growth and energy consumption and between development (measured by the Human Development Index (HDI)) and energy/electricity consumption. However, the link between energy and poverty is far from being fully understood.

In order to discuss the linkages between electricity and development and to debate innovative ideas to address issues related to financing, governance and sustainable development, the Global Network on Energy for Sustainable Development (GNESD), in collaboration with the United Nations Environment Programme (UNEP), UNEP Risoe Centre (URC), the United Nations Development Programme (UNDP) and the International Energy Agency (IEA) organised a series of three regional workshops (in Africa, Asia and Latin America) in 2005. These events followed the 'Electricity & Development' global workshop organised in Paris by the IEA, in January 2005, and which formed a solid foundation for the series of regional workshops.

The aim of the workshops was to bring together the best minds, from developed and developing countries, in the areas of economic development, energy infrastructure and technology, finance, and public



Figure 1: Participants in the African Workshop

investment in the power sector, 1.4 billion people will still lack electricity in 2030.

A massive growth in global energy demand is expected in the coming decades. According to the International Energy Agency (IEA), additional generating capacity of 2,437 GW will have to be installed by 2030 only to meet increasing demands in developing countries.

This consists of almost 900 GW in China alone; around 500 GW in Asia excluding China, India and Indonesia;

policy, to forge new and cost effective approaches that can lead to a sustainable energy future. The role of increased electricity access in national development and the challenge of providing increased access to the poor were the key themes of the workshops.

The work carried out by GNESD on energy access and renewable energy technologies (RETs) was also an important focus of the workshops. Specifically, the regional workshops aimed to bring to the attention of policy makers the impacts (both positive and negative) of power sector reforms on the poor, and the role that RETs can play in poverty alleviation.

The objective of the present report is to summarise the key ideas presented during the three regional workshops under four main themes: Electricity and Development Linkages, Financing, Governance, and Sustainable Development of the Power Sector. The main recommendations and suggested actions are given in the concluding section.

1.2 The three regional workshops

The African regional workshop was held at the UNEP Headquarters Complex, in Gigiri, Nairobi, on 13–14 July 2005. It was coordinated by the African Energy Research Network (AFREPREN). The two-day workshop was divided broadly into two parts: presentations and working groups.

About 150 participants from 20 countries attended the workshop. The participants included the Executive Director of UNEP; the Executive Director of the IEA; the Permanent Secretary, Ministry of Energy, Kenya; directors of national power utilities; regulators; representatives of key bilateral and multilateral funding



Figure 4: Inauguration of the Asian workshop



Figure 6: Participants in the Latin American workshop

agencies and banking institutions; experts in energy, electricity, environment, engineering, technology, finance and economics; regulatory agencies; members of the private sector; universities and research centres; and members of civil society. The full workshop presentations and background information can be accessed through the GNESD and AFREPREN websites using the following links: http://gnesd.org/regional_workshop.htm and <http://www.afrepren.org/gnesdworkshop.htm>. They are also available on a CD.

The Asian regional workshop on Electricity and Development, held on 28–29 April 2005, was coordinated by the Asian Institute of Technology

(AIT), one of the GNESD centres of excellence, located in Thailand. Fifty eight participants from 13 countries and six international organisations and donor agencies attended the workshop. The workshop programme, list of participants, presentations and workshop papers are available on a CD.

The Latin American regional workshop was organised by Centro Clima and CENBIO, which jointly constitute the GNESD node in Brazil. The workshop was held on 13–14 April 2005. Participants included experts in energy, electricity, environment, engineering, technology, finance and economics; policy makers from governments, international institutions



'Electricity is not only light, it is enlightenment.'

and the private sector; experts from universities and national laboratories; and representatives of multilateral and bilateral development cooperation agencies and NGOs. Forty-five participants from 10 countries and four international organisations and donor agencies attended the workshop. A detailed workshop programme as well as the list of participants and presentations is available on the Centro Clima's website (www.centroclima.org.br).

More details on the three workshops are available in the three summary workshop reports prepared by the organising centres. These reports are available on <http://www.gnesd.org/>.

2. Electricity and development linkages

Participants in the three regional workshops recognised the importance of energy in general and of electricity in particular for the development of the world's poor nations. Although

the provision of improved energy services is not mentioned specifically in the formal Millennium Development Goals (MDGs) framework, it was agreed that it is a vital factor for achievement of the Goals. Without access to electricity, it is almost impossible to carry out productive economic activities or improve health and education. As a result, poverty becomes inescapable. As highlighted by the UN Secretary General's report on progress towards the MDGs, if current trends persist, the Goals will not be achieved by 2015. This is especially true in countries where the majority of people rely on traditional biomass for the bulk of their energy needs (sub-Saharan Africa, South Asia, etc.).

Many presentations in the three regional workshops showed clear linkages between lack of access to electricity and low development indicators. In Brazil, low electricity access is concentrated in rural areas that mostly have low HDI (as compared with the urban areas in Latin America). In addition, a paper from Bangladesh illustrated the better socio-economic indices (including wealth, rich-poor divide in income, education, health, life expectancy at birth, gender equality, etc.) of electrified households in relation to non-electrified households. As observed by one participant: *'Electricity is not only light, it is enlightenment.'*

The participants highlighted the fact that lack of access to electricity remains the clearest indicator of energy poverty, and indeed, of poverty in general. It was also recognised that, in the absence of strong policy changes, the future picture could remain the same, i.e. stifled economic development resulting in a lower quality of life, condemning billions of people to continued poverty. Yet policy makers in developing countries often appear to follow conventional approaches that do not allow room for change (see Section 4, 'Governance'). This was well illustrated during the African regional workshop where all Poverty Reduction Strategy Papers (PRSPs) from sub-Saharan African countries recognised energy issues

as an important development topic, and almost all of them emphasised increased investment in large-scale energy supply infrastructure as a priority. Very few, if any, however, gave priority to increasing access to energy services for the poor.

It was acknowledged that in spite of its unquestionable positive impact on human development, electricity alone may not be a sufficient condition to improve development of the poorest countries in the world. Improving electricity access for the poor should be accompanied by other measures to promote use of electricity for development. It was emphasised that electricity should be seen as a vehicle to provide services, rather than an end in itself. As pointed out by a participant in the Asian workshop: *'The main issue is electricity for what?'*

It is, therefore, not enough to provide access to electricity. More importantly, people should be able to use it, meaning that electricity supply should be affordable and reliable. Appliances transforming electricity into a useful service should be readily available, reliable and affordable. Electricity users should also know how to use these appliances, maintain them and remedy problems associated with their use. The affordability factor is difficult to address in countries where populations have uneven purchasing power (e.g. Brazil). An Indian participant emphasised the fact that rural electrification programmes are often not directed specifically at the poor: *'In India, a village is considered electrified if all public structures (schools, health centres, community houses, etc.) and 10 per cent of the households are electrified. That 10 per cent of the population often does not include the poor.'*

The causal relationship between electricity and development also needs to be better understood. Socio-economic data on electrified and non-electrified villages can be compared within countries, but it is too simplistic to say that the higher development indexes measured in electrified villages are due solely to electricity access. A better way to assess the impact of

electricity would be to analyse the development indices of a village before and after electrification. Unfortunately, such data are scarce. It also has to be remembered that electricity can make rich people richer, hence increasing macroeconomic indices, while the effect on the poor remains marginal.

Electricity and poverty linkages are also difficult to study because segregated data are not always available. Specifically, the electricity consumption pattern of the poor is often not recorded at national level. Proxies therefore have to be used, either geographical (e.g. rural vs. urban) or in terms of electricity consumption (e.g. users below a certain consumption level are considered poor). These proxies may in turn affect the findings of research in the field of electricity and development. It could, therefore, be recommended that data on electricity and poverty be gathered simultaneously by relevant agencies. Moreover, governments may often be tempted to present data in a way that makes the situation look better than reality. For instance, in India, although 90 per cent of villages are officially electrified, for the reasons mentioned above, only 46 per cent of the Indian population actually have access to electricity.

The strong political focus on poverty reduction and the use of the rural population as a proxy for the poor may have contributed to some confusion over concepts at the workshops, with some participants seeing rural electrification as electricity access for the poor and others emphasising that rural electrification was mainly benefiting the richest strata of the rural population. The present reporting of discussions reflects this confusion. It may be advisable to distinguish between rural electrification and electricity access for the poor in subsequent discussions and analyses.

The role of electricity in gender development also requires further study. In developing countries, women are important household electricity consumers as they often stay at home

to look after the children and cook, yet disaggregated data on electricity consumption by gender are not readily available and gender does not usually appear as a separate issue in electricity development programmes. Electricity could play a crucial role for gender development, although provision of electricity will not, of itself, empower women. Electrification programmes should include a gender dimension and be linked with other development issues.

3. Financing

Presentations and discussions during the three regional workshops highlighted the necessity to enhance electricity access for all levels of population. However, providing greater access to electricity for those living in developing countries is a task facing many challenges. One of these is how to finance power sector development. As highlighted by a Brazilian participant, the current situation can be summarised as follows: *'Energy distribution goes hand in hand with income distribution. The greater the purchasing power of a region, the greater its access to electricity.'*

The difficulties related to servicing the low-income groups, either urban or rural, are intrinsic to the characteristics of these groups. They include limited financial resources for upfront investment, low access to capital, cyclical income flows (for rural areas), remoteness (for certain communities) and low electricity consumption. The challenge of increasing electricity access in a sustainable manner is therefore a problem of balancing the need to set prices at levels that cover cost but that remain low enough to be affordable to the poor. These are not easy objectives to achieve because they are inherently contradictory—achievement of one objective is often at the expense of the other. The situation is worsened by the fact that low electricity consumption significantly increases the recovery time for initial investments, further aggravated in the case of rural markets by high dispersion which requires higher initial investments. As a result, en-



hancing electricity access among the low-income groups often jeopardises the financial performance of electricity utilities in developing countries. Without incentives, it may therefore not be financially attractive to electrify the poor, who, as a consequence, are often excluded. As mentioned at the Latin American Workshop, concessionaires do not have an obligation to implement rural electrification and to improve supply to low-income consumers. In reality, competition has not reduced rates, and governments have not been able to withdraw from investment in the energy sector.

It was recognised that measures need to be considered to address both the technical and non-technical aspects of these financing issues.

3.1 Technical options to reduce electrification costs

Many technical solutions are available to reduce electrification costs. For grid extensions, measures include use of longer distances between transformers; single wire earth return; shorter, smaller poles; smaller conductors; pre-fabricated wiring systems (e.g. ready boards); high-mast community-lighting systems; load limiters; equipment standardisation; etc.

RETs are often perceived as a costly option, not worth considering by

utilities. However, they can be a cheaper alternative for rural electrification, especially in remote areas. As one participant pointed out: in Nepal, solar PV and micro-hydro cost around one fourth as much as grid extension in some parts of the country. A utility in Brazil reached the same conclusion for Bahia, one of the country's north-eastern states (see Box 1). A careful assessment of each situation is therefore required before selecting an option for rural electrification. Latin American participants even emphasised the need for utilities to use '*technical creativity*' in order to meet electricity demand in remote locations.

Box 1: RETs and rural electrification in North-Eastern Brazil

The Electrical Energy Concessionaire of the State of Bahia has undertaken studies to meet the universal access targets established by the government under the 'Light for All' programme. Data from a socioeconomic survey of the region indicated that the number of new connections required would be about 261,000. The target population's current monthly expenditure on batteries (for radios) and other lighting products is US\$1.6–4.8 on average, an amount which the rural consumers could afford to pay for their electricity bill.

The cost of new electrical connections was determined with respect to distance from the local electricity grid. It was concluded that photovoltaic panels were feasible, and were the best option for new connections at a distance greater than 3 km.

If universal electrification was to be achieved, the average tariff paid by all customers in Bahia would have to be 11.3 per cent higher than at present to recover the investment costs.

3.2 Non-technical options to help in financing power sector expansion

Non-technical options to reduce electrification costs include 'ring-fencing' (i.e. reserving) funds meant for the electrification of the poor; flat-rate tariffs; financial incentives (subsidies, credit schemes); community electricity service points; review of costing of rural electrification projects; and others.

The question of subsidies to make electricity affordable for the poorest was raised several times during the workshops. For some participants, subsidies are necessary to enhance electricity access for all, whereas for other participants they should not be used because they create a market distortion. Thailand provides an example where cross-subsidies in electricity tariffs have had a beneficial effect on enhancing electricity access for the poor. Brazil also provided interesting input on this theme. Currently, all Brazilian electricity users consuming less than 80 kWh per month benefit from a subsidised rate. However, most Brazilian participants at the workshop pointed out that many of the beneficiaries of the subsidy are not actually poor and do not require subsidy. Electricity tariff regulations should therefore be revised in order to better serve those who really need subsidy. The majority of participants at the Latin American workshop nevertheless agreed that if universal access to electricity is to be achieved, the utilities should have the economic capacity for the required investment. This is not the case for every utility in Brazil, especially in the northern areas. It was therefore suggested that the utilities should receive subsidy from the government to cover the costs of enhancing electricity access.

In many developing countries utilities alone cannot meet the challenge of rural electrification and have to seek financial assistance from donor agencies through grants or loans. These agencies could play a major role in influencing the choice of technologies used to enhance electricity access or the policies (tariffs, infrastructure, etc.) to put in place.

To reduce dependency on donor agencies, the issue of financing can be addressed by government policies that are conducive to the private sector entering into private-public partnerships (See Section 4 for more details). However, as pointed out by some of the participants, electricity access should remain a public service and the state should play a dominant role. The African workshop proposed the following innovative options that have been implemented in some countries to enable increased access to electricity by the poor:

Policies to enhance electricity access:

- Provision of electricity at commercial and community load centres (e.g. Zimbabwe).
- Social tariffs (e.g. Mozambique).
- Promotion of mini-grids based on local resources (e.g. Tanzania).
- Provision of electricity at district centres (e.g. Tanzania).
- Creation of Rural Electricity Agency (REA) mainly to extend subsidies to ESCO (e.g. Tanzania).

Policies to strengthen financial viability of utilities:

- Cost-recovery based tariffs, surplus ploughed back into Rural Electrification Fund, set by competitive bidding (e.g. Uganda).
- Generation levy (i.e. rural electrification levy) to fund Rural Electrification Programme (e.g. Uganda and Kenya).
- Locally developed and aggressively marketed low-cost electrical appliances, to facilitate demand
- creation (e.g. Zimbabwe).
- Parallel lines (HT, LT) for the same village, HT for agriculture and LT for domestic, small enterprises (e.g. India).
- Franchise, for billing and revenue collection as well as bulk purchase, and hence participation in upgrading of distribu-

tion network (e.g. India).

- Flat rate tariffs (e.g. India).
- Financing (or subsidising) of internal wiring to ensure recovery of otherwise dead investment.
- Credit to consumers to pay connection fee in instalments.

Regulatory measures:

- Auditing/monitoring of activities of distribution companies by regulators.
- Ensuring ring fencing of RE funds.
- Mechanisms for cross-border sale of electricity with tariff harmonisation.
- Encouraging small scale generation/distribution entities.

Box 2 gives details from Zimbabwe and shows how the country succeeded in enhancing electricity access while ensuring financial viability.

Micro-financing institutions can provide a good solution to overcoming the investment barriers for small scale, decentralised power generation. Unfortunately, these financial intermediaries often have a different culture from that of technology vendors. Successful examples were nonetheless cited at the Asian workshop: e.g. Grameen Shakti providing Solar Home Systems combined with micro-credit schemes in Bangladesh. In Nepal, Winrock International is working with several microfinance institutes to finance RETs.

Another possible way to attract funding for electrification initiatives is through international mechanisms such as the Clean Development Mechanisms (CDM). These could play a significant role in promoting cleaner power plants (See Section 5 for more details on clean electricity generation options). However, some participants pointed out that the CDM process is lengthy and that sometimes the capacity to implement such processes is lacking in least developed countries.



As mentioned in Section 2, electricity alone is often not enough to impact human development positively. Electrification initiatives should therefore be linked to other policies (see Section 5 for further details). One option to attract financing opportunities and improve financial viability of projects would be to mix productive and consumptive uses.

Box 2: How Zimbabwe's utility increased electricity access while ensuring financial viability

Increased political interest in the rural population of Zimbabwe resulted in three key events:

- Increase of the rural electrification levy from 1 per cent to 6 per cent.
- Enactment of the Rural Electrification Fund Act.
- Establishment of a dedicated Rural Electrification Agency (REA) in 2002.

An expanded electrification programme was launched in which a total of 9,906 rural institutions, irrigation and village schemes were identified for electrification by the end of 2005. A unique feature of the expanded programme was the financing of both electricity and end-use infrastructure, mainly irrigation equipment, by the REA. Although the 2005 target is unlikely to be achieved, the rate of connection of rural institutions has increased dramatically. A total of 3,992 institutions had been electrified by the end of June 2005.

There has been a steady growth in access, from 20 per cent in 1991, to 41 per cent in 2004. During the same period the financial performance was mixed, depending on the electrification phase. With the exception of one year, the utility had positive operating profits until 2002.

The rural electrification experience in Zimbabwe shows that electrification access is, ultimately, a pricing and financing problem. Successful balancing of electricity access and financial viability during the master plan phase was achieved due to the following factors:

- Successful marketing of the project selection based on economic and financial criteria.
- Efficient revenue collection, ensuring that funds were available for rural electrification.
- Increased use of private contractors—this helped in reducing the cost of grid extension.
- Explicit capital subsidies for rural electrification, supplemented by the mobilisation of community contributions, removed the burden of financing from the utility.
- Cross-subsidies to support lifeline tariffs for the poor helped to encourage use of electricity as an energy source for poor households.

4. Governance

Financing is not the only challenge faced by electrification initiatives in developing countries. Other issues need to be considered in order to ensure that every stratum of the population benefits from electricity supply. To address these different issues effectively, the electricity sector often needs to be reformed and innovative policies favourable to enhancement of electricity access need to be developed. Lessons can be learned from past experiences and best practices adopted.

4.1 Power sector reforms

In recent decades, many developing countries have undergone reforms partially targeting restructuring of their electricity sectors to improve performance (increased access to electricity, reduced technical and financial losses, etc.) and attract private sector investment. The changes have mainly been two-pronged, involving structural changes and changes of ownership.

Structural changes include functional unbundling of the utilities, enhancement of transparency (through establishment of regulation agencies), tariff reforms, etc. On the other hand, ownership change usually means increase of private sector investment and involvement.

Several presentations at the three workshops aimed at analysing the impact of power sector reforms on the poor. Of particular concern is the deterioration in some countries in quality and reliability of energy services available to the poor, in spite of numerous energy reform initiatives. Reliance on traditional bio-fuels is increasing and the proportion of unelectrified people continues to grow¹. A careful analysis of reform is therefore needed to ensure that the poor benefit from reforms rather than suffer from them.

1) In other words, although the absolute number of people with electricity is increasing, the rate of electrification is outpaced by population growth (Radka, 2002). Electrification rates are below population growth rates in many sub-Saharan African countries.

Results of the analysis of power sector reforms on three continents were presented at the workshops, illustrated by examples from different countries. The reforms identified as having a positive impact on the poor included: 'ring-fencing' of funds for the electrification of the poor; sequencing of reforms to prioritise the needs of the poor (first enhancement of electricity access, then privatisation); explicit focus on the poor in the reform process (establishment of funds or institutions dedicated

to enhancing electrification access of the poor); participation of poor/local communities in electrification initiatives (through community run cooperatives, encouraging in-kind contributions from communities); and measures that support low-cost technology options that lower the cost of electrifying the poor. Examples of reforms and impacts on the poor in South and South-east Asia and in Latin America are presented in Boxes 3 and 4.

Box 3: Examples of power sector reforms and their impact on the poor in Thailand and Bangladesh

In the early 1970s, only 7 per cent of poor households in Thailand had access to electricity. By 2000 this had increased to 98 per cent.

Thailand's achievements were the result of an Accelerated Rural Electrification (ARE) programme based on a master plan for rural electrification drawn up by the country's Provincial Electricity Authority (PEA). Initiated in 1974, the master plan placed emphasis on expansion of rural electrification via the grid and on institutional restructuring.

In 1992, an Act reforming the country's Electricity Generating Authority (EGAT) was passed. Known as the EGAT Act, this allowed independent power producers and small power producers to generate power in the country and allowed EGAT to engage in energy-related business activities. This major structural reform was followed, in 1990–2000, by a series of tariff adjustments that resulted in a steady increase of tariffs. Neither the EGAT Act nor the tariff reforms seem to have adversely influenced the already very high electrification level. However, the growth rate of electricity consumption by poor users seems to have slowed somewhat in recent years.

Bangladesh's reform effort began in 1977. In 1976, only 3 per cent of its total population had access to electricity, with supply being controlled by a single vertically-integrated, public utility. In 1977, the government created a Rural Electrification Board to expand electrification through the institution of Palli Biddut Samity (cooperatives).

In 1982, only around 26,000 poor households (0.2%) had access to electricity. By 2000, that figure had risen to over 4 million, bringing the proportion of poor households with access to electricity to 19 per cent. This represents considerable progress, even though the percentage with access remains rather low. One of the reasons for this may be the relatively high upfront cost of joining a Palli Biddut Samity: around US\$15–23, which was beyond the reach of many poor people.



Box 4: Examples of power sector reforms and their impact on the poor in selected Latin American countries

Although Brazil, Costa Rica, Ecuador and Venezuela allowed private and mixed companies restricted participation in their electrical system, most of the large companies in this sector continued to be state owned, especially where generating was concerned. Argentina, Bolivia and Mexico opened their natural gas markets, while Argentina privatised the sector. Brazil, Chile, Colombia, Tobago, Trinidad and Venezuela have private, mixed and state companies regulated under state jurisdiction.

This private investment, resulting from reforms introduced, has participated greatly in regional integration projects. The best known are in the MERCOSUL area, but there are other examples in Latin America and the Caribbean.

In Argentina, Brazil, El Salvador and Peru, restructuring of the power sector has led to a general increase in the level of electrification. In most cases, however, this relates to a higher electrification level in urban areas resulting from investments in grid extension. The question of enhancing electricity access in rural areas has been left aside to a large extent, especially in Brazil. In Argentina, El Salvador and Peru the annual rate of electrification decreased after the reforms and, furthermore, the cost of electricity to the poor increased significantly after power industry restructuring. These observations are illustrated in Table 1.

Table 1: Cost of energy for poor people (US\$/month) and rate of electrification (%)

	<i>Pre-reform</i>		<i>Post-reform</i>	
	<i>Cost of electricity</i>	<i>Rate of electrification</i>	<i>Cost of electricity</i>	<i>Rate of electrification</i>
<i>Argentina</i>	<i>4.35</i>	<i>2.04</i>	<i>11.77</i>	<i>1.03</i>
<i>El Salvador</i>	<i>4.8</i>	<i>6.6</i>	<i>16.8</i>	<i>4.1</i>
<i>Peru</i>	<i>6.8</i>	<i>7.8</i>	<i>17.2</i>	<i>5.8</i>

Brazil began to change the regulatory framework of its energy industry in 1995, initially opening up and privatising the industry. In 2003, a new government was elected and new changes were introduced, mainly increasing the government's share in the power sector and launching the 'Light for All' programme to ensure universal access to electricity (Box 5).

The participants in the African workshops went one step further and suggested the following policy options and regulatory measures to enhance rural electrification levels:

- Legislation to create a master plan for rural electrification. This should be made public to prevent it being 'hijacked' by politicians.
- Opening of generation, transmission and distribution sectors, accompanied by institutional and legal frameworks. Countries are at various stages with this. For example, Kenya is still to implement privatisation of distribution and sale of power.
- Establishment of strict time lines to be monitored or evaluated.
- Setting of clear targets for use of rural electrification, to spur economic activity or enhance that already in place.
- Ensuring that rural electrification targets economic activities—not focusing on households at first.

Regulatory measures proposed that can be implemented to enhance rural electrification levels include:

- Regulations that recognise the low economic power of the rural population, hence the need for flexibility regarding licence fees and quality of service/supply. Minimum safety standards must nevertheless be maintained.
- Need for regulators to delegate some of the regulatory duties to agents near the communities, to be able to assess energy situations on a case by case basis.

Box 5: Brazil's 'Light for All' programme

Universal access to electrical energy in Brazil was established by Law No. 10,438/02. This defines low-income consumers and frees consumers from the financial burden of financing expansion of the energy grid. Concessionaires are now responsible for the costs of meeting demands for supply or load increase

The Law established an 'energy development account' to promote universal access and use of renewables. Implementing legislation was enacted by ANEEL (National Electricity Regulatory Agency) imposing targets on concession and permit holders for full coverage (by 2015).

The 'Light for All' programme was launched with the aim of bringing universal access forward to 2008. Due to initial delays in the programme, the target for 2004 (400,000 new connections) was not attained. However, Workshop participants pointed out that the problems related mostly to equipment availability and initial programme adjustments. The participants agreed that initial difficulties only related to logistical issues most likely to be overcome during the first year of the programme.

The 'Light for All' programme also encourages the use of energy for productive purposes. One of the issues raised during the workshop was the fact that the role of energy concessionaires does not include identification of opportunities for the productive use of energy in the communities they supply. It is therefore important to promote integration of the 'Light for All' programme with other federal or state government development programmes to ensure focus on energy use.

4.2 Involvement of SMEs in the power sector

Participants in the African workshop argued that although local private investors—particularly small and medium sized enterprises^{2,3} (SMEs)—could be effective in improving electricity access for the poor, most reforms in sub-Saharan African countries have not attempted to involve local SMEs. One of the options for involving local private investors is to outsource some of the activities/services of the power utility to SMEs.

African policy makers emphasised the fact that the involvement of SMEs could strengthen local support for power sector reforms. In Africa, as in most developing countries, the private economy is almost entirely comprised of SMEs which are frequently the only realistic employment opportunity for the majority of the poor. Involvement of local SMEs in reforms was therefore seen as having the potential to not only expand access in a cost-effective manner but also to provide the possibility of substantial job generation and poverty reduction benefits.

To involve SMEs successfully in the power sector, lessons can be learned from the telecommunication sectors, as illustrated by Ghana (See Box 6).

2) Generally, 'an enterprise' refers to any income-generating activity. 'Micro-enterprises' usually have up to 10 employees, 'small enterprises' have 11–50 employees, while 'medium enterprises' have 51–100 employees.

3) World Bank's SME department defines enterprises as follows: micro-enterprises—up to 10 employees, total assets of up to US\$100,000 and total annual sales of up to US\$100,000; small enterprises—up to 50 employees, total assets of up to US\$3 million and total sales of up to US\$3 million; and medium enterprises—up to 300 employees, total assets of up to US\$15 million and total annual sales of up to US\$15 million.



Box 6: Lessons from Africa's telecoms sector—the case of Ghana

Africa has the fastest growth rate of telecom penetration in the world—over 100 per cent since 2001. In Ghana, the telecom industry has twice as many subscribers as the electricity industry and its growth rate is 89 per cent, against 13 per cent for the electricity sector. The experiences of telecoms in the region may give inspiration to the power sector.

Nature of interventions

The following interventions aided market penetration by Ghana's telecom industry:

- Reduced state control by deregulating, divesting and liberalising.
- Placing of policy functions in government ministries, and regulatory functions in independent bodies.
- Majority state ownership retained for basic infrastructure (pipes and cables).
- Introduction of competition.
- Promotion of universal access.

The telecom sector has also been successful in utilising SMEs, as evidenced by the list of services they provide, given below. The power sector has not been successful in this. For example, the Electricity Company of Ghana's prepayment meter system has failed because centralisation means that credit has to be purchased at company branches that are only open during working hours. In contrast, in Tanzania, where use has been made of SMEs, the use of prepayment meters is successful.

Role of SMEs in Telecom

Small and micro-enterprises in the telecom industry are providing the following services:

- communication centres (call shops),
- fixed wireless resellers,
- ISPs,
- voice over IP and SIP providers (telephoning over internet),
- equipment dealers, installers and repairers,
- prepaid card distributors and retailers.

A thriving industry was also generated for carpenters, sign writers, and umbrella dealers.

An example of an SME that is producing, transmitting and distributing electricity was presented by a Nepalese participant at the Asian workshop. It is summarised in Box 7.

Participants in the African workshop saw involvement of the private sector, especially local SMEs, as vital to the enhancement of electricity access for the poor. It was concluded that to facilitate the involvement of SMEs, the following is needed: a one stop-shop for licensing; creation of a local dispute resolution mechanism; and enforcement of regulations and empowerment (e.g. possibility of cutting off defaulters and of developing skills). The African workshop accordingly proposed the following measures to ensure involvement of SMEs in electrification of the poor:

- Provision of model contracts/agreements specifying minimum performance criteria, penalties etc.
- Use of alternative delivery mechanisms e.g. electricity co-ops, community projects, local companies.
- Development of flexible technical and environmental standards, without compromising safety.
- Encouragement of SME entrepreneurial and other relevant capacity building.
- Promotion of pre-payment options.
- Facilitating vending of electricity and sub-retailing.
- Introduction of flat-rate tariffs (e.g. India).
- Bundling of electricity supply and other commercial services for viability (e.g. Kenya [micro-hydro]).
- Exploring of alternative funding arrangements for non-conventional electrification.

The African workshop also proposed the following policy options to ensure involvement of SMEs in electrification of the poor:

Box 7: SME selling electricity in Nepal

A 500 kW micro-hydro power plant was installed in 1990 by an entrepreneur in the remote village of Barpak, located in an off-grid area of Nepal. The entrepreneur received financial help from the Agricultural Development Bank of Nepal (ADBN) through subsidies and soft loans. He also benefited from Nepalese policies which allow small independent power producers (up to 100 kW) to transmit and distribute power locally and to set their own electricity tariffs.

568 households are connected to the power plant. Domestic electricity use is mainly for light bulbs and radios. Domestic customers have a meter in their house and pay an electricity tariff of NR 5.5 per unit, cheaper than the national grid (7 NR/unit).

Realising that his business was not profitable with domestic customers alone, the entrepreneur encouraged the villagers to start income generating activities with the newly available electricity. He introduced a different tariff for cottage industries including a cheaper off-peak rate. The tariff structure encouraged local entrepreneurs to use electricity at night, therefore increasing the average load of the turbine and, in turn, improving the profitability of the micro-hydro power plant. The cottage industries established in the village include agro-processing mills, bakery, furniture mill, hand-made paper factory and a rope way.

The electricity allows annual savings of more than 1,000 litres of kerosene, 72,000 kg of firewood and 4,400 pairs of batteries. It is also responsible for the direct creation of more than 50 jobs at the village level.

- a) Encouraging large investors and SMEs to invest in electrification of the poor privately or through public private partnerships (PPP) (this has been attempted in India, Mauritius, South Africa and Tanzania):
 - co-generation projects which maximise the use of indigenous energy resources;
 - merger of small projects that bring economies of scale;
 - co-operative arrangement.
- b) Creation of an enabling environment for private investment by providing:
 - legal framework,
 - institutional framework,
 - access to adequate and accurate information,
 - security.

The above policy options have been implemented successfully in Ghana, Mauritius, Senegal, South Africa and Uganda.

- c) Introduction of incentives for investors (local & foreign) in the form of fiscal, legal (e.g. information status), infrastructural and other incentives (these have been tried in India, Kenya, Mauritius and Uganda).
- d) Promotion of electrification of special (difficult rural) areas through:
 - smart subsidies,
 - ring fencing of electrification funds,
 - differential tariffs.

4.3 Interconnectivity and other governance related issues

As pointed out during the Asian and Latin American workshops, the current trend in power sector development is towards interconnectivity of grids between different countries. Peak consumption times may differ from country to country, offering scope to reduce peak loads if grids are interconnected. Interconnectivity is seen by some as an ideal solution to reduce generating costs and peak generating needs. In South-East Asia, four interconnected grids will be in



operation by the end of 2005; ten more are planned in the near future. In northern Latin America, grid interconnectivity is seen as a priority by policy makers whereas in southern South America, a natural gas supply network will be implemented. Latin American participants saw grid interconnectivity as essential and standing above political issues. Integration between Colombia and Ecuador was quoted as an example. Connecting the grids of these two countries will require investment of US\$30 million, much less than building a new plant. Furthermore, Colombia will benefit from selling electricity to Ecuador.

On the other hand, as pointed out during the Asian workshop, large scale power generation and grid transmission will not necessarily enhance electricity access for the poor, especially those in the most remote areas that are inaccessible by grid. Furthermore, grid interconnectivity requires large investment and implies the need to standardise grid regulations in all the interconnected countries. Studies have proved that if grids are interconnected between different countries, there is a need for

a strong and independent regulatory agency. This fact was also emphasised during the Latin American Workshop: *'Interconnectivity is a gradual process that will be made easier by the elimination of barriers and the dovetailing of regulatory rules'*. These regulatory aspects are not always considered when interconnection agreements are signed. Some participants saw interconnectivity as a solution that is too risky and not effective in enhancing electricity access by the poor. It was suggested that the role of communities in electricity generation and distribution should be enhanced, instead of planning interconnected grids.

Another issue, raised by Asian participants, is that some poor households do not have the necessary legal documents (property rights, etc) to obtain connection and this can be a major barrier to the enhancement of electricity access for the poor. To address this issue, either the procedure to secure an electricity connection should be simplified or legal documents should be provided to the whole population. The latter measure is probably the most effective, but is not usually the responsibility of the power sector.

Finally, an important point to consider when extending electricity access to remote areas is capacity building. As pointed out by a Latin American participant, *'a universal electricity access programme must not only be concerned with access, it must also consider energy use and sustainable development, which cannot be added on to the rate as it is not the responsibility of the concessionaires. The idea is to encourage new agents to act in this geographical area.'* The policy framework should enable conditions for the creation of the infrastructure necessary to ensure effective use of electricity. This was summarised by a Brazilian participant when discussing biodiesel: *'Brazil needs a development policy that includes energy that takes into account the problem of income distribution. Biodiesel alone will not solve the issue of income distribution. There are human resources and technology access issues that need to be considered.'*

5. Sustainable development of the power sector

In developing countries, the challenge of increasing electricity access in a sustainable manner involves two main problems. As described in Section 3, there is the issue of balancing the need to set prices that cover costs while keeping prices sufficiently low to be affordable to the poor majority. Some innovative policies and measures to finance the expansion of the electricity sector were presented earlier in this report. However, another option is to promote the use of electricity for productive purposes or to generate income. This strategy, in turn, increases users' budgets to pay for electricity. The other major issue faced by the expansion of the power sector relates to the environment: development of the sector can only be sustainable if its impact on the environment is neutral.

5.1 Productive uses of electricity

Workshop participants highlighted the need to ensure mechanisms through which the poor can gain access to electricity (see Section 2 for more details). These mechanisms must also create the necessary conditions for the electricity users to generate income, as the productive use of electricity allows users to pay for their electricity. Electricity should provide populations with increased access to social services such as health and education, but it should also provide opportunities for developing income generating activities. However, enhancing income generation for the poor in rural communities is a big challenge not easily solved by project intervention and access to electricity. In particular, the linkage between electricity access and enhanced income generation needs to be further explored. This work is underway and several examples of electrification initiatives linked to promotion of income generating activities were quoted during the workshops.

Examples from Nepal showed how decentralised power plants became viable when users began to use the electricity to pursue income generat-

ing activities. For example, the Rural Energy Development Programme (REDP)⁴ developed a holistic package under which each household gaining access to electricity must undertake a commercial activity to generate additional income. The additional income must correspond to, at least, the minimum payment for electricity (25 NR). The income generated by electricity covers the operation and maintenance of the decentralised RETs based generating systems (mainly micro-hydro) as well as reimbursement of the loan contracted for the purchase of the system. Each project is therefore self-sustaining. REDP is currently working in 25 districts in Nepal.

The Association for the Sustainable Development of the Sisal Region (APAEB) has been working in the Brazilian state of Bahia since 1985. APAEB aims to make the necessary resources (credit) available to provide technical assistance and enable access to more profitable and fair markets as well as to develop and disseminate technologies suitable to the region's climate. A rotating fund is available for the local communities, allowing them to finance photovoltaic panels for lighting, water pumping and for electric fences for herds. Results in local development are visible: in 1990, the per capita income was US\$28.16 compared to US\$43.4 in 2000: a 54 per cent increase over 10 years.

B-REED is another noteworthy programme in Brazil. Sponsored by the United Nations Foundation (UNF) and UNEP with the collaboration of E+Co., it is implementing rural electrification programmes with emphasis on generating sustainable incomes. Projects assess the requirements and opportunities for using RETs, energy efficiency, and treatment of solid wastes and dirty agro-industrial effluents. As of April 2005, US\$450,000 had been invested resulting in the direct creation of 100 jobs affecting the lives of 825 people. In addition, the use of 300,000 litres of diesel was avoided, corresponding to a saving of about 23,000 tonnes of CO₂.

4) A UNDP/WB funded project promoting RETs in remote areas.

Productive community projects have been set up by micro-enterprises, associations and cooperatives in Ecuador. For example, the SILAE model (rural electrification community enterprises—ECERs) for decentralised rural electrification is seeking ways to contribute to increasing the coverage of basic energy services in the rural equatorial parts of the Amazon region. The aim is to encourage access to new information and communication technologies as a means of strengthening local administration and supporting local productive organisations.

Finally, the role of Thailand's governmental agency responsible for rural electrification (Provincial Electricity Authority [PEA]) in promoting productive uses of electricity was pointed out. During the 1970s and 1980s, when the grid was widely extended in Thailand (See Box 5), PEA tried to encourage villagers to use electricity in rice mills, to irrigate their fields and for other productive activities. Staff showed them that they could save/earn more money by using electricity and some financial institutions were brought in to provide funds at local level.

5.2 Environmental impact of the power sector and renewable energy technologies

The workshop participants recognised the paradox of power sector development and conservation and protection of the environment. Electricity is essential for development but its generation, transmission and use affects the environment. It will only be possible to reconcile power sector development and the needs of the environment if electrification initiatives are coupled with promotion of energy efficiency and RETs. However, in reality, the general policy framework for enhancement of electricity access is usually not favourable to RETs or energy efficiency.

As noted by a Latin American participant: *'The issue of efficiency is usually bypassed in the context of expanding energy access to poor people of Latin America. It has to be said that these*

populations often have access to old and obsolete technologies.'

It was recognised that in most developing countries, there are abundant and largely untapped natural resources that could power RETs.

Renewable energies are perceived as being more expensive than conventional sources. As shown in Section 3, this is not necessarily true, especially for remote areas. As pointed out by some participants, cost factors are slowing transition to greater use of RETs in South-East Asia, but these technologies may be the subject of greater attention after 2010.

It appears that power sector policies are often biased in favour of centralised generation. Grid electricity is often heavily subsidised and renewable options cannot compete if not equally subsidised. The ultimate possibility to level the playing field would be to allow competitive bidding for electrification subsidies. This would allow propagation of systems that provide the best quality and coverage for the same level of subsidy. In many countries, however, the present institutional power sector structure does not allow this approach.

Furthermore, the external costs of polluting energy sources are not internalised in the majority of developing countries, meaning that society and

not the users pay for the consequences of using polluting sources (e.g. coal power plants). One participant noted that in Thailand the least cost option for power generation is currently coal but if electricity users had

Box 8: Key initiatives to promote the use of RETs in Latin America and Asia

- Brazil: PROINFA programme that will result in 3.3 GW of grid connected renewable energy supply contracts by 2006.
- Guatemala: Renewable Energy Law offering substantial incentives for investing in renewables, including generous tax exemptions.
- The Caribbean islands: Caribbean Renewable Energy Development Programme (CREDP), designed to stimulate a regional transition to renewable energy generation.
- Bolivia, Brazil, Honduras and Peru: innovative rural electrification finance projects.
- Argentina, Brazil, Chile, Mexico (and elsewhere): national energy efficiency programmes and standards.
- India (in 1992): Ministry of Non-Conventional Energy Sources.
- Nepal: subsidies, facilitated access to soft loans, freedom to set tariffs and tax incentives for small (<1MW) decentralised RETs power producers.
- Bangladesh: Grameen Shakti promoting RETs and providing micro-finance services.
- Thailand: Renewable Portfolio Standard (RPS) requiring 5 per cent of additional new power generating capacity to be based on RETs.
- Sri Lanka: Renewable Energy for Rural Economic Development (RERED) project catalysing the private sector to develop the solar PV and micro hydro market until 2007.



to pay for the real cost of coal-based electricity generation, it could open a window for wider utilisation of RETs. It was also pointed out, especially by Thai participants, that there has been increasing opposition from local communities to coal and large hydro projects in recent years. Popular protests in favour of using cleaner technologies could push policy makers to design favourable policies for clean technologies, RETs in particular.

Another issue which hampers the development of RETs is the lack of capacity available in this field. More emphasis should be placed on training and capacity building for RETs. The need for good coordination between institutions dealing with these issues at the national level was mentioned as an important point for successful development of RETs. India's Ministry of Non-Conventional Energy Sources (MNES) was cited as a good example of a strong national institution coordinating RETs related activities at the country level. Such a body can establish a favourable policy framework for RETs, such as subsidy schemes, certification of RETs agencies, etc. Unfortunately, this type of powerful government agency dedicated to RETs does not exist in most developing countries.

Several developing countries have implemented programmes to promote RETs; examples from Latin America and Asia are given in Box 8. In Asia, Thailand aims to achieve a share of 8 per cent of RETs in its total commercial energy consumption by 2011. However, it was recognised that, while setting objectives is a first positive step, enforcing policies to make sure that targets are reached is altogether another issue. Policies are often not enforced in developing countries.

A final barrier to the development of RETs, mentioned by Brazilian and Thai participants, is the mismanagement of projects by implementing agencies. In the past RETs projects have been implemented based on a top-down approach. As a result, technology did not always match needs and users lacked training for operation and

maintenance. This approach led to rapid failures and gave RETs a bad name. Communities should therefore be the centre of new RETs projects.

6. Conclusion

Provision of modern energy services is crucial to overall social and economic development. As such it serves as a platform without which the Millennium Development Goals cannot be attained.

Lack of access to electricity remains the clearest indicator of energy poverty—indeed, of poverty in general. However, electricity itself is not enough to ensure the sustainable development of the world's poorest areas. New and innovative policies must be implemented, together with rural electrification programmes, to ensure that electricity has a positive effect on the lives of the poorest people who still lack access to modern forms of energy.

Innovative policies must also be introduced to prevent adverse impacts on the financial performance of the electricity industry and to promote clean technologies. Governments must design and approve policies to finance and implement electrification programmes in a holistic way. As one workshop participant pointed out: *'Our education is traditional, governments are traditional and traditional paths are usually followed. There is a need to get away from this and think of new ways of integrating electricity into development.'* Innovative ways of using subsidies that stimulate markets to invest and make changes must be found. This will require close international cooperation among stakeholders.

Electricity supply must be affordable and reliable and must promote development of income generating activities if it is to have a significant positive impact on development. Electricity expansion programmes will not positively impact development of the poor if electricity is not a clean, affordable and reliable vehicle to provide services that benefit everyone.

Electricity can also have a positive impact on gender development, provided the social dimension is addressed in electrification programmes.

Policy makers and other stakeholders in the power sector should introduce innovative measures to ensure the involvement of SMEs in the electrification process. Involvement of the local private sector (especially SMEs) has the potential to not only expand access in a cost-effective manner but also to generate substantial numbers of jobs and poverty reduction benefits.

Electrification initiatives should target income generation if they are to be economically sustainable. Electricity must be seen as a way to provide services and not as an end in itself. The traditional top-down approaches to reform of the power sector—motivated by macroeconomic factors and not aimed at improving access for the poor—should be replaced by bottom-up ones with communities at the centre of the decision making process. It is important that electricity supply should lead the development of income generating activities, making electricity users able to pay for their electricity.

RETs must have a much bigger share in the energy mix of developing countries if environmental degradation is to be limited. For this to happen, the playing field between conventional power generation and RETs must be levelled. Furthermore, policy makers must re-examine the widely held notion that RETs are more expensive than conventional sources of energy, as in many cases this is not true. The general trend is that the cost of RETs is decreasing over time.

In conclusion, the blame for a quarter of the world's population being deprived of energy cannot be laid at the door of nature or of technology. Nature provides an abundance of energy, and the technology exists to exploit it. It is the lack of appropriate policies and actions that is creating islands of deprivation.

