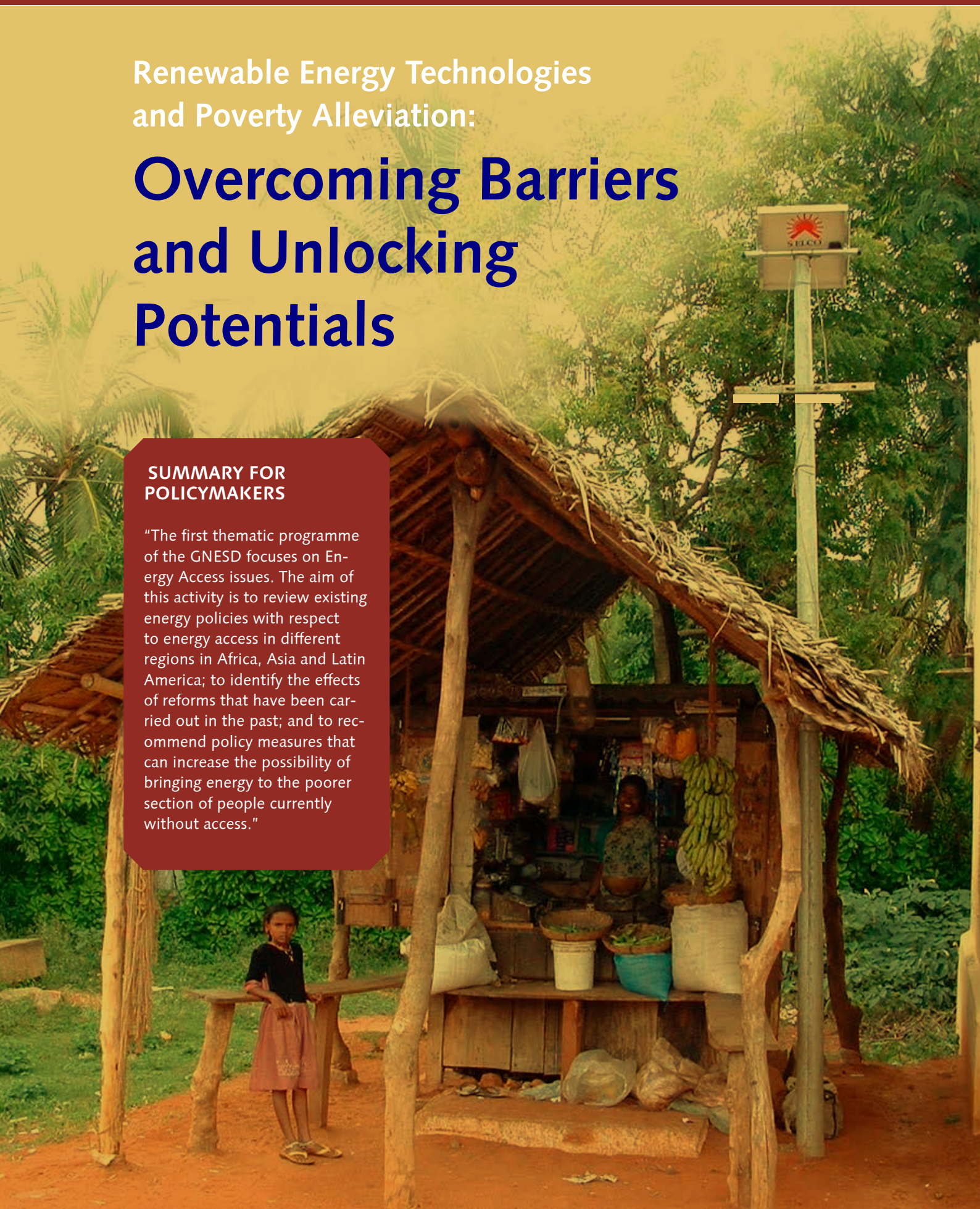
2007

GNESD

GLOBAL NETWORK ON ENERGY FOR SUSTAINABLE DEVELOPMENT

Renewable Energy Technologies and Poverty Alleviation:

Overcoming Barriers and Unlocking Potentials



SUMMARY FOR POLICYMAKERS

"The first thematic programme of the GNESD focuses on Energy Access issues. The aim of this activity is to review existing energy policies with respect to energy access in different regions in Africa, Asia and Latin America; to identify the effects of reforms that have been carried out in the past; and to recommend policy measures that can increase the possibility of bringing energy to the poorer section of people currently without access."

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This publication and other publications from GNESD can be downloaded from www.gnesd.org

ISBN 978-87-550-3601-7

GNESD

The Global Network on Energy for Sustainable Development (GNESD) is UNEP facilitated knowledge network of Centres of Excellence and Network Partners, renowned for their work on energy, development, and environment issues. The main objective of GNESD is to work for reaching the Millennium Development Goals (MDG) by:

- Strengthening the Members Centres' ability to acquire, assimilate, and apply existing knowledge and experiences.
- Working for a better understanding of the links between sustainable energy and other development and environment priorities, and technology and policy options, leading to better articulation of practical policies that can be adopted so as to promote and highlight the crucial role of energy for sustainable development.
- Working to provide research findings to the Governments to be considered in formulating their policies and programmes, and the private sector to attract investments in the energy sector, so that these favour energy sector growth for sustainable development, especially for the poor in the developing countries.
- Promoting a communication infrastructure that provides a means for Members to share experiences and draw on each other's strengths, expertise, and skills, and
- Strengthened South-South and North-South exchange of knowledge and collaboration on energy issues of common interest.

GNESD is one of several Type II partnerships in the field of Energy that were launched at the World Summit on Sustainable Development (WSSD) in Johannesburg, September, 2002.

Contents

Summary

Ten GNESD Developing Country Centres have completed the second phase (RETs II) of their investigations into the contribution that renewable energy technologies (RETs) could make to alleviating poverty in the developing world.

In the first phase (RETS I), the participating Centres made a general assessment of the renewable energy sector in different regions/countries. They then identified particular situations for which there seemed to be a favourable combination of energy requirements, resources, technologies and capacities with a high potential for poverty alleviation and that could be implemented in the short and mid term. Such a situation is referred to as a 'niche'; it is a situation in which certain identified RETs could make a significant contribution towards poverty alleviation.

RETs II goes a step further in terms of the assessment of selected niches, with each Centre focusing on: identifying the benefits that selected RETs could bring; the main barriers to their widespread dissemination; and the formulation of policy outlines and instruments to overcome the barriers.

The 'niches'
The selected niches are: treadle and wind pumps, solar pumps and improved stoves, biodiesel, vegetable oil as a fuel, solar water heaters, wind turbines, biomass gasification, and PV systems.

A first observation is that virtually all of the technologies selected are either non-electrical or provide off-grid electricity, contrasting with the conventional wisdom that 'modern energy' means centralised grid-based systems. A second observation is that they cover a very wide range of technologies, extending from simple mechanical devices—such as a lid for a traditional bread baking stove that will reduce use of firewood (Tunisia) or treadle pumps used to improve irrigation and crop yields for small farmers (East Africa)—to national-scale projects for the launch of a new industry (biodiesel, in South Africa).

Barriers
In spite of the extent of the range of technologies examined, common barriers are identified. The most fundamental of these stems from the 'conventional wisdom' referred to above. Countries have energy development patterns based almost exclusively on conventional energy sources, resulting in a lack of adequate institutional frameworks and weak or inexistent policies to support dissemination of RETs. In particular, the mechanical or thermal energy which RETs can provide has been almost entirely overlooked by the traditional energy sector and by policymakers and planners.

The barriers the reporting Centres have identified fall, globally, into five categories:

- lack of policy attention and institutional framework,
- financial barriers,
- lack of quality and consistency in the RETs made available, extending from the equipment itself right through to installation, operation and maintenance.
- missing capacity, and
- low awareness.

Policy outlines
Once barriers have been identified and analysed, policy instruments can be developed. The policies and instruments proposed by the GNESD Centres are oriented towards overcoming the main barriers mentioned above. Overall, they are aimed at:

- Implementation of incentives to improve affordability.
- Development of an adequate institutional framework.
- Development of capacity at all levels.
- Improving awareness.
- Integration of RETs into development policies and strategies aimed at poor populations.

Although the barriers identified have common aspects, the way in which countries go about addressing them depends, of course, on the unique economic, political and cultural situation of each country. Two Centres may therefore identify the same barrier but will not necessarily suggest the same policies to tackle it. The GNESD Centres' reports provide a wide panoply of solutions to create the enabling environment required to overcome barriers and unlock the opportunities that RETS can provide to improve people's livelihoods and help lift them out of poverty. The detailed policy outlines and recommendations can be found in each of the regional reports.

Background: local and global aspects of renewables in developing countries

It has been recognised for some years now that developing countries urgently need modern and sustainable forms of energy if they are to be able to satisfy the needs of their growing populations and expanding economic activities. For the millions of poorer inhabitants of these countries, energy is both an indispensable tool for the satisfaction of their basic human needs and the key to the creation and development of productive activities that will enable them to escape from poverty.

Developing countries have attempted to address this issue over the past three decades and many of them have introduced power sector reforms intended to streamline their energy sectors to make them economically viable service providers for all. In doing so they have generally attempted to replicate the model most common in the industrialised countries—centralised generating systems, complex distribution grids, conventional energy sources and a focus on electricity—and this has in many countries failed to meet the needs of the poor, both in terms of access to basic services and opportunities to improve their incomes. Box 1 describes the situation in rural East Africa, but it also reflects the pattern of low access and reliance on traditional biomass that is found in many developing countries throughout the world.

Box 1: Access to modern energy in East Africa

Rural electrification levels in East Africa are woefully low. In cases where electricity is provided in rural areas, it is often unaffordable to the poor, who therefore cannot access it. With the bulk of the region's poor living in dispersed rural settlements, conventional grid electrification is, in the near term, considered too costly. As a result, the use of modern and improved energy options is very limited in rural areas. Traditional biomass energy dominates major consumption sectors, namely, household, agriculture and small enterprises. This state of affairs contributes significantly to the high poverty levels in rural areas of the region.

Renewable energy technologies (RETs)—given their environmental advantages over conventional energy sources, their suitability for use in rural areas and their potential for local development of income-generating activities—seem to present a unique opportunity to break with the conventional patterns of energy development which have failed to meet the needs of the poor so far.

Previous GNESD studies and other work indicate that there is a huge potential for development of renewable resources of every type in developing countries, but that RETs have a somewhat chequered history1. Although many developing countries have considerable experience with some of the technologies, projects have typically been fragmented efforts with a research focus and have been carried out in isolation from other development challenges such as health, poverty, education or regional development. Above all, they have been implemented without the guidance of integrated programmes and policies. Where energy development is concerned, the low level of prior-

1 A general assessment of renewable resources in different regions/countries is presented in GNESD's RETs I reports and in the Summary for Policymakers entitled *Poverty: Can Renewable Energy Make a Real Contribution?* Available at http://www.gnesd.org

ity that has historically been assigned to RETs contrasts sharply with their apparent potential.

However, recent developments have combined to re-focus attention on RETs. First, increases and fluctuations in oil prices have served as a sharp reminder of the dangers of continued over-dependency on fossil fuels, leading to rekindled interest in the possibilities of developing hitherto untapped local resources to contribute to energy independence and security. The second influence is a growing awareness of the globally unsustainable nature of current patterns of energy production and use, and of the need to address the increasingly pressing issue of predicted climate change, in terms of both mitigation and adaptation. The position of Latin American countries, expressed in the quotation below from the GNESD report from Argentina, neatly encapsulates the local and global dimensions of developing countries' approaches to RETs. Box 2 lends further support to this view.

'The energy basis of modern development patterns in our countries has evolved, as elsewhere, based on the intensive use of coal, oil and natural gas resources. As alarm signals arise at international and local level forewarning about the environmental impacts of this development pattern, Latin America still relies heavily on fossil fuels but is beginning to look [...]into the integration of modern renewable energies into the energy matrix. However, in contrast with many industrialised nations, environmental issues are not the only motivation for this search, since there is also an urgent need for more and better energy to satisfy basic requirements and for productive activities which are a necessary tool for bringing millions of people out of the poverty trap.'

It is against this background of a new or reviving dynamic to mainstream renewable energy as part of a process to ensure access to sustainable energy services, that the Global Network on Energy and Sustainable Development (GNESD) undertook its thematic programme in which 10 participating Centres of Excellence focused on investigations of RETs and on the contribution they could make to alleviating poverty in developing countries.

Box 2: rationale and motivation for RETs development

• **Africa**

'*Recent interest in renewable energy in Africa has been driven by [...] important developments:*

- *the key driver is the recurrent increase in oil prices;*
- *second is the recurrent drought-related crises faced by power utilities; **
- *global environment initiatives have also stimulated greater interest in renewables in Africa.*'

• **Cambodia**

'*RETs can be an appropriate vehicle to provide modern energy services without increasing dependency on imported fossil fuels.*'

• **China**

'*China is one of the few countries whose energy depends heavily on coal. There is a great need to diversify its energy resources and increase clean and sustainable energy supply.*'

• **South Africa**

'*The provision of hot water using solar water heaters has the benefit of [..] saving households money over the long term and mitigating GHG emissions associated with fossil fuel usage.*'

• **Lebanon**

'*Energy in Lebanon is derived mainly from imported petroleum products and coal (98%) [...]. RETs can play a major role in meeting basic energy needs in Lebanon, especially in the light of the continuous increase in global energy demand and the unpredictability of international crude oil prices.*'

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* About 70% of electricity generation in eastern and southern Africa is from hydropower which is dependent on rainfall and is thus vulnerable to drought.

GNESD RETS I and RETS II

RETs is the second theme which the GNESD has addressed, the first being 'Energy Access'. Activities on the RETs theme were divided into two phases.

In Phase I (RETS I) the Developing Country Centres participating in GNESD made a general assessment of the renewable energy sector in different regions/countries. This helped identify potential 'niches' where renewable energies could make a significant contribution towards poverty alleviation by not only improving quality of life but also through the development of productive activities that would generate employment and extra income for poor populations.

An important result of RETs I was the identification of barriers limiting the use of renewable technologies and resources in developing countries. RETs I provided interesting insights, but being a broad study of the renewable energy sector, did not go into sufficient detail to allow concrete actions to be taken. In the policy area, RETs I only dealt with the formulation of policy outlines, but did not indicate instruments and strategies to be used to reach proposed objectives.

RETs II aims at filling these voids and goes a step further in terms of the assessment of selected 'niches' (defined as a favourable combination of energy requirements, resources, technologies, and capacities that have high potential for poverty alleviation and that could be implemented in the short and mid term). Each GNESD Centre focused its assessment on one or two renewable energy niches, identified major barriers to their widespread dissemination, and then formulated policy outlines and instruments to overcome the barriers, making recommendations which could guide policy makers towards this aim.

One of the key strengths of the GNESD is its ability to carry out research into a given subject in different parts of the world using a common approach. This makes its possible to extract useful lessons of global relevance from the comparison of experiences in different regions. This summary sketches an overview of the potential for poverty alleviation of the chosen niches, outlines the barriers identified and then presents selected policy solutions specific to the niches. Although the findings presented relate to the specific niches chosen by the Centres, very similar barriers can be identified for other RETs within the countries covered by the GNESD's investigations and elsewhere, and similar policies could be employed to overcome them. The scope of RETS II's findings extends beyond the framework of the selected technologies. The complete set of regional studies and a technical summary are available at www.gnesd.org

The niches: a focus on appropriate non-electrical technologies to improve incomes

The niches selected by the different Centres provide an interesting insight into the types of technologies that appear appropriate when working 'from the ground up', that is to say when looking at people's actual conditions and way of life, their actual needs for energy and their ability to access it. The niches selected were: treadle and wind pumps, solar pumps, improved stoves and kilns, solar water heaters, wind turbines, biodiesel and vegetable oil, photovoltaic systems, and biomass gasification. These are summarised in Table 1, showing which countries chose which options.

One thing that stands out from the table is the predominance of non-electrical technologies, contrasting clearly with the previously-mentioned prevailing assumption that 'modern energy' means grid electricity, and reinforcing the point that energy solutions must be suited to the actual needs of the potential users and to their ability to access them.

For example, the countries selecting pumping technologies, such as those in North and East Africa, have poor populations that are highly reliant on agriculture, making the improvements these technologies can bring to irrigation highly and directly relevant to their situation.

In a similar vein, improved cooking stoves were selected by Tunisia, Senegal and Cambodia all of which have significant numbers of people relying on biomass, with the well-known problems for health and for the environment which that entails.

The choice of wind energy systems by Argentina reflects the country's exceptional wind resources. Only one country chose PV and concluded that, in this case, low installed capacity precludes the development of economic activities.

Table 1: selected niches by region and country

Main RETs Niches identified	Africa				Middle East	Latin America		Asia		
	East Africa	Tunisia	Senegal	South Africa	Lebanon	Argentina	Brazil	China	Cambodia	India
Treadle pump, Wind pump	•									
Wind pump, PV pump		•								
Improved biomass stove		•	•						•	
Biodiesel				•						
Solar Water Heaters				•	•	•				
Wind Energy Systems						•				
Vegetable Oil							•			
PV							•			
Biomass Gasification								•	•	•

Energy for productive uses

Box 3: animate and wind power in East Africa

The treadle pump is a relatively simple and inexpensive device that uses animate (human) power to raise water for irrigation. The reported impacts of treadle pumps on farming have been substantial and include:

- increased land under irrigation;
- reduced work time compared with bucket irrigation;
- improved crop quality;
- less strenuous irrigation work;
- additional and new crops grown each season.

Figures for just one model also indicate a dynamic nascent industry: 45 000 pumps in use by poor farmers, generating some US$37 million per year in profits and wages; 29 000 new jobs created; more than half the pumps managed by women entrepreneurs...

Over 300 wind pumps have been installed in Kenya, mainly through initiatives of donors, churches, etc. Numerous benefits are reported from these with schools, farms and settlement schemes obtaining a stable water supply

Previous GNESD reports and findings from elsewhere have stressed the importance of providing energy in forms that people can use to generate income if the poverty cycle is to be broken. Energy for productive uses was therefore an important criterion for the Centres in selecting the niches. How effective the RETs selected can be is illustrated by the examples below, chosen to illustrate the breadth of possibilities offered by technologies that range from those usable at household level to far larger scale projects.

Improved use of biomass

Improvements to domestic cooking stoves are the simplest technologies proposed (one country, Tunisia, proposed simply the addition of a lid to a traditional bread baking stove). In addition to benefits for health and for the environment, already referred to above, results from Cambodia, Senegal and Tunisia indicate that there are potential domestic markets for manufacture and sales of such devices, once barriers to their penetration are overcome. This would open up considerable opportunities for local manufacture, and thus for employment.

In Cambodia, there are about 20 000 producers of palm sugar who could improve their livelihoods by using better stoves to produce higher quality sugar with a market value 30–60 per cent higher than that from traditional stoves. Payback time for the new stoves is just over one month. Improved charcoal kilns are also being made available commercially, although their payback period is 2 years.

Pumping for small scale irrigation

In spite of it being one of the driest continents and suffering from unstable rainfall regimes, irrigation is an embryonic practice in much of Africa. Here low-cost, water-efficient irrigation technologies have the potential to significantly improve food security and family incomes. Treadle and wind pumps are being used successfully in East Africa, as illustrated by Box 3.

In Tunisia, wind and PV powered pumping is suggested as a way of helping small vegetable farmers to protect their livelihoods. Vegetable farming in Tunisia may be at risk in coming years because of competition from produce from southern Europe and the introduction of free exchange agreements with the EU. In this context, pumping powered by a renewable energy source would be a reliable alternative that is more competitive than technologies currently used, especially diesel power.

Solar water heating
South Africa, Lebanon and Argentina foresee energy savings, reduced greenhouse gas (GHG) emissions and creation of jobs from wider dissemination of domestic solar water heaters (DSWH). In Lebanon, even at the current rate of installation the production/importation rate will have to triple to meet market demand. Jobs will also be created in installation, sales and maintenance. South Africa already has a mature DSWH industry and the knowledge, in both industry and academia, to support further development and industry regulation. It is estimated that expanding the SWH industry could add nearly 1.4 billion rand (≈US$195 million) to GDP and 176 million rand (≈US$25 million) to the income of South Africa's poor households.

Biomass gasification
Cambodia, China and India have examined the use of gas derived from biomass in both domestic and industrial applications.

Cambodia and China considered gasification a promising option for addressing the challenge of rural electrification, in addition to providing a gas supply. The gasification process allows production of electricity using local biomass, thereby avoiding dependence on a centralised grid, or imported or 'dirtier' fossil fuels such as coal (on which China is heavily dependent).

The suggested fuel in the China study is crop stalks abandoned in fields after harvesting—a fuel that would be in plentiful supply if its collection was organised. Box 4 provides an example of the advantages of an existing project. With utilities required to buy electricity from renewable sources at an advantageous 'feed-in-tariff' there is a great potential to create a market environment where biomass-sourced energy will compete with conventional forms.
In Cambodia, stakeholders have considered the option of plantations to provide a sustainable supply of biomass for gasification. If managed properly these could regenerate depleted soils and provide an additional source of income for farmers.

Initiatives are under way in India on applications of biomass gasification in small and micro enterprises (SMiEs) that make intensive use of thermal energy. SMiEs form the backbone of India's manufacturing sector. They account for over half of the country's entire industrial production in terms of value added and for one-third of export revenues. SMiEs are also major providers of jobs and employ many poor people. The introduction of energy efficient renewable technologies in SMiEs would contribute to reductions in fuel consumption (and therefore in cost), which would have direct beneficial and sustainable impacts for the environment and on income generation and poverty reduction. The fact that such industries tend to occur in clusters further increases potential for widespread penetration.

Box 4: advantages of a village level gasification plant

In the village of QiDian, in the west of China, a gasification unit using crop stalks has been designed to provide 320 households with a gas supply and is also used to generate electricity.
Lack of rain in recent years has led to a shortage of surface water resources and the village's main activity is now dependent on irrigation water pumped from wells using electricity from the combined gas and power plant.
Advantages from the plant are estimated as follows:

- increased income for households from sales of crop stalks (currently left in the fields);
- gas supply that provides a cheaper alternative to coal or LPG;
- electricity supply to ensure supply of irrigation water;
- employment opportunities at the gasifier plant.

Given the potential crop stalk resource around ZhangYe city (to which the plant belongs), a total of 250 similar plants could be established.

The technology has been used successfully in India's rubber processing and metallurgy sectors. In the late 1990s many rubber processing units had to close as a result of rising electricity costs in a context of increased competition. Use of gasifier technology has reduced fuel costs thereby increasing profitability of units and helping them to ensure their continued existence. In the metallurgy sector, use of gasifiers has reduced the cost of annealing operations by over 50 per cent.

Biofuels
In natura (i.e. 'straight') vegetable oil is being used successfully in isolated Brazilian villages as a substitute for the often prohibitively expensive diesel fuel used to power generators. Benefits observed include starting of night classes, well attended by the community and made possible by the provision of electricity for lighting.

Box 5: biofuels a promising outlook but a need for caution

Africa's vast arable land has the potential to rival top agricultural nations like the United States in supplying biofuels to a world seeking clean energy sources. But using land reserved for food production to supply biofuel demand could squeeze food supplies in regions vulnerable to shortages. It could also hurt poor consumers if the biofuel boom pushes food prices higher.

In spite of the infrastructural weaknesses in countries in Africa and some parts of Asia, there is a clear tendency of the energy movement to spread as the major agricultural powers in the developed world find limits to their output of energy crops and are forced to turn especially to Africa, and may be willing to invest in building their infrastructures.

However, for all its economic promise, some analysts feel that the current commercial momentum threatens food security, especially if it excludes Africa's many poor peasants. The best way to help people and secure food supplies is to teach them about more productive farming technologies and ensure that they become more than mere subsistence farmers by making them part of the biofuel boom for which many African countries are hoping. One way to achieve this would be to make the biofuel industry labour intensive i.e. involving small scale farmers producing food as well as biofuel crops.

Governments in developing countries, especially in Africa, must ensure that the expected boom does not transform their natural resources to a mono-culture adding no diversification to the national economy. A strong and transparent regulatory regime must also be put in place, with a focus on pricing of the product and food security for the poorer section of the population.

Increased incomes have also accrued from use of electrical devices to process and freeze locally grown fruits .

The South African government has plans for a larger scale biofuel initiative, aiming to make biofuels account for about 40 per cent of the country's renewable energies. Government support has gathered momentum and plans are being proposed to promote crops to be used specifically for production of bioethanol and biodiesel feedstock for the liquid fuels industry. Opportunities for job creation are expected to be high in both the agricultural and production sectors. Plans include industrial scale production—with the oil company Sasol considering production of biodiesel at a centralised location—and small scale production expected to produce benefits for poor rural communities. The biofuels sector is one that is attracting a deal of interest in many places and some general comments on its development, as well as some potential drawbacks, are presented in Box 5.

PV systems

PV systems can provide low power electricity supply which can greatly improve convenience and comfort by, for example, providing lighting, access to media, etc. For countries like Brazil with areas of widely dispersed and isolated populations where grid extension is both difficult to achieve and maintain, stand-alone PV systems can provide at least some reliable power, a solution which may be preferable to an unreliable grid. This is, of course, dependent on the ability to provide and maintain robust and reliable PV systems, especially in remote and inaccessible places.

Common barriers to dissemination

The case studies described above clearly indicate that appropriately selected RETs can have significant impacts on improving poorer people's lives and providing them with means to augment their income. RETs, in addition to their undisputed ecological advantages are often the most economical option for supplying energy to remote and thinly populated areas, and decentralised renewable energy systems that use local energy sources can be easily adapted in size and capacity to meet a modest demand. They are therefore especially suitable for overcoming energy poverty in rural areas.

It is also clear that many of the technologies have become mature in recent years and have moved from being a passion for the dedicated few to showing real business, and therefore employment, potential in developing countries and elsewhere. In some parts of the world, major global companies are entering the markets for wind, solar and biomass technologies. The drivers of increasing energy insecurity for oil-dependent countries and of impending climate change have already been mentioned.

Yet, in spite of their obvious capacity to provide attainable solutions in a variety of situations, dissemination of RETs in most countries has still not reached a satisfactory momentum. Significant barriers still remain to their uptake and these need to be clearly identified and understood if they are to be addressed and overcome. GNESD's common approach has provided insights into these barriers and allowed some common issues to be identified. Barriers fall, broadly, into the five categories discussed below.

- **Low level of policy attention and lack of institutional framework**
  A lack of coherent long-term policies, including those defining a specific role for RETs, has been identified as a major barrier to their dissemination. Even in countries that have framework legislation, this is often considered 'too general', resulting in a lack of policy instruments and, above all, a lack of institutions specifically designed and responsible for accompanying RETs through to implementation. In many cases, this situation is attributed to a somewhat blinkered view on the part of the conventional energy sector and other sectors which have not recognised the potential of RETs, especially that of the mechanical or thermal energy that can be obtained from renewable sources. The sample finding from East Africa given in Box 6 sums up the situation

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Box 6: contrasting attitudes to wind power for pumping and for electricity, East Africa

Wind pumps were considered old and inappropriate technology by government and other developers, in contrast with efforts to promote wind energy for generating electricity. Wind generators have been installed at several sites.

This is a result of lack of understanding of the role wind pumps can play in supporting water supply and irrigation initiatives where wind regimes are reliable and there is no feasible future for introduction of grid electricity.

A comprehensive policy on irrigation taking into consideration the role of small-scale technologies in agricultural development needs to be developed

- **Financial barriers**
  This category includes both issues of affordability for users and of entrenched attitudes in some financial institutions. Affordability is a compound problem of low income, high upfront investment cost to obtain RETs, and no adequate financing mechanisms. It is encountered right across the range of RETs examined in the Centres' studies. Even some of the simplest technologies proposed remain, at present, beyond the financial reach of many poor people. In the case of the very simplest solution of all, Tunisia's lid for the traditional bread baking stove, the 'competition' between this device and the 'free' firewood gathered traditionally is invoked as a barrier. Cheap electricity generated from coal in South Africa 'competing' with the initial investment required for domestic solar water heaters is also cited.
  The problem where financial institutions are concerned is one of a perceived lack of reliability and long-term viability where RETs are involved. RETs have a rather unfavourable reputation, largely due to their 'chequered history' with earlier attempts at development characterised by isolated donor-backed projects that very quickly fell into disuse once initial backing was withdrawn. This perception does not make RETs an attractive investment option.

Box 7: SolarSure – action on standards

In 2003, the Sustainable Energy Society for Southern Africa formed an association, SolarSure, to represent the interests of all stakeholders in the delivery of excellent services in the DSWH sector.

SolarSure has initiated task groups on standards and testing facilities; quality control and training; marketing; interaction with the national utility; and R&D.

- **low quality – low confidence**
  A lack of quality concerning RETs, resulting from the absence of any form of standards or certification, was mentioned as a barrier by almost all of the 10 reporting Centres. This point relates closely to the one mentioned above. RETs have a tarnished reputation not only amongst possible financiers but also amongst potential users. Failed projects in the past have left a legacy of doubt as to the real potential of RETs to replace conventional forms of energy satisfactorily. One country (Lebanon) also points out that systems can fail because of unsatisfactory installation, and suggests licensing requirements for contractors to ensure that they have the necessary experience and knowledge to install systems properly, in addition to local testing and certification for equipment. Box 7 provides an example, from South Africa, of effective action to encourage standards.

- **Missing capacity**
  Very closely related to the above barrier is a general lack of technical and marketing capability for the manufacture and selling of RETs. This is mentioned by all of the reporting Centres. Furthermore, there appears to be a general low level of research interest and little coordination between research institutes and the manufacturers who could, ultimately, bring the innovative solutions they develop to market.

  A shortage of local people with the skills to maintain and repair systems is also identified as an element that is hindering the emergence of coherent and stable markets, both restricting the effective contribution that RETs can make to poverty alleviation and further contributing to the negative perception of the technologies.

  Overall, the absence of the skills to develop and maintain innovative solutions and of routes to bring them to market, combined with an absence of standards, is preventing reductions in the cost of RETs and allowing the introduction of low quality technologies.

  Capacity is also low in other areas such as policy formulation and RETs financing

- **A knowledge gap**
  A low level of awareness of RETs, especially of their characteristics and advantages, underlies and reinforces virtually all of the barriers discussed here. There is clearly a need for more and better information for planners, developers, professionals and technicians and for actual and potential users, without forgetting the finance community which, although it is gradually mainstreaming some RETs into lending portfolios, still lacks knowledge of, and therefore confidence in, technologies such as those covered by most Centre's reports.

Objectives, policies and instruments

The barriers identified above clearly indicate that tapping developing countries' considerable renewable energy potential is not, for the most part, a problem of solving technological issues. It is, more fundamentally, one of putting in place an adequate institutional framework for the creation and implementation of policies that promote the use of truly accessible cleaner energy sources. There is no doubt that successful introduction and dissemination of RETs is, to a large extent, dependent on the existence of policies that create an enabling environment for their dissemination, and mobilise resources as well as encouraging private sector investment. From this point of view, advancing the process of policy formulation constitutes a key activity for adequate dissemination of renewable energies in developing countries.

Some of the policy options identified by the GNESD reporting centres are presented below for each of the niches selected. Overall, the policies and instruments proposed are aimed at:

- Implementing incentives to improve affordability.
- Developing an adequate institutional framework.
- Developing capacity at all levels.
- Improving awareness.

However, it must be borne in mind that, since the framework and conditions of each country are unique, the process of policy development must be tailored to the specific needs of each country and to the renewable energy niche being promoted. Two centres may therefore identify the same barriers for a given RET, but will not necessarily select the same policies to tackle those barriers, nor use the same instruments to make policy operative. A summary such as this can only hope to give an outline of the richness of the full range of policy instruments that could be developed.

RE pumping (East Africa and Tunisia)

The policies and instruments proposed for the dissemination of these niches in East Africa and Tunisia include:

- **Providing access to adequate financing mechanisms**. The East Africa study indicates tax rebates and subsidies as instruments to achieve this. It also notes that establishing a rural energy agency fund and development of policies specifically aimed at facilitating access to credit to small farmers would be necessary. In Tunisia, loans and subsidies are suggested to promote wind and solar pumps.

- **Research and technology adaptation** is also recommended in East Africa through the creation of an R&D fund from the existing electricity fuel levy. Establishing a rural energy agency is also proposed. Tunisia suggests communication campaigns targeting the ministry of agriculture, NGOs, farmers, experts on water resources, and RETs installers and operators.

- **Coordinated actions in order to promote the technologies**. This would require convincing the different stakeholders through, for example, communication campaigns and improved access to information. Cultural issues may also need to be addressed, as demonstrated by the case of East Africa (see Box 8).

- **Developing capacity** for pump operation and maintenance is recommended, through technical training, education and communication campaigns. Training of local end-users and communities on pump installation, repair and maintenance

Box 8: introducing RETs, a cultural dimension

When new technologies arrive, social and personal values are sometimes challenged. Successful integration of technologies into any cultural context requires sensitivity to people's attitudes if some barriers that are not immediately evident are to be identified and overcome.

For instance, around 70 per cent of treadle pump users in East Africa are women and, although the benefits from improved irrigation are known, some women do not feel comfortable standing for a long time in the elevated position needed to operate the pump. They feel exposed and consider the position undignified.

Such issues could be addressed by, for example, interviewing women so as to identify cultural barriers to pump use and/or by organising awareness raising campaigns to sensitise manufacturers to specific problems faced by women users. Better targeting of women will go a long way to making this technology contribute to poverty reduction efforts.

is proposed in the case of East Africa. Tunisia recommends training consulting firms, installers and operators.

Solar water heaters (South Africa, Lebanon and Argentina)

- **Implementing of standards and certification** is proposed by the three Centres as a way to increase customer confidence in SWHs and reduce the negative perception arising from low equipment quality, unsatisfactory installation and incorrect operation and maintenance procedures. Lebanon proposes the creation of national testing protocols and identification or creation of centres that could carry out testing activities. The Centre also stresses the usefulness of learning from the experience of others, either in the region or elsewhere. Where standards are concerned, it recommends the adoption of European standards, seen as expressing the consent of all of the stakeholders active in the solar thermal market. Argentina proposes linking certification of manufacturing procedures, equipment and installation to provision of incentives and mass purchase agreements. Argentina and Lebanon complement product certification with performance labelling systems, to bolster consumer confidence.

- **Providing financial and other incentives** is recommended by the three Centres, including: investment subsidies for poor households (South Africa), tax credits, grants, soft loans and government procurement commitments (Lebanon), mass purchase agreements, tax reduction, loans under preferential conditions, and reduction of hidden costs (Argentina). In the case of South Africa, agreements between SWH companies and banks will also offer financing based on electricity savings.

  Incentives also include the implementation of legal instruments requiring the installation of SWHs in public buildings (Argentina) and under new housing programmes (Argentina, South Africa).

- **Raising awareness and developing capacity**: lack of knowledge about the potential and characteristics of RETs systems amongst the general public and other stakeholders is a common problem. The Centres propose information and education campaigns to overcome the general lack of knowledge. Capacity development involves training for manufacturers and installers as well as provision of financial incentives for technology development and industrial upgrading. The study from Lebanon spells out stakeholders that should be targeted: planning sector personnel, energy experts, utility personnel, industrial sector staff, the finance sector, and academics. It further suggests that capacity building must also extend to the political level, targeting government officials. The Centre proposes a full 'organisational chart' for education and training, reproduced in Figure 1. Argentina includes government bodies, public institutions and officials responsible for updating building codes and regulations as targets for awareness raising.

Biomass gasification (China, Cambodia and India)

- **Financing:** for India, which focused on its SMiE's, improving access to finance for RETs would involve the use of community based financing mechanisms, financial assistance policies aimed specifically at the sector and sensitisation of financing organisations. In the case of Cambodia targeted subsidies for projects, soft loans and promotion of microfinancing through training and a supportive legal framework are proposed. China stresses the need for projects to become financially viable where possible, moving from a 'welfare' approach relying on government subsidies towards a more commercial approach and development of a true market. This would be achieved through tax and subsidy incentives for RESCOs and associated companies that initiate projects, and by encouraging the injection of private financing.

- **Supporting and developing capacity of local manufacturers**. For all three reporting countries, this should involve training courses for manufacturers. In China technology transfer from university research institutions and increased collaboration is proposed as a way to decrease costs. India also proposes fostering partnerships, in order to develop technology and improve commercialisation. Cambodia suggests cooperation in order to benefit from knowledge in places where the industry is more developed

Figure 1: suggested organisational chart for education and training (Lebanon)

Education and training needs

1. Identify relevant stakeholders and ministries involved (Ministry of Environment, Agriculture, Industry and Energy in the public sector). For the private sector, the parties involved are syndicates of Engineers and Industries.

2. Formulate education and training needs of relevant parties to be able to perform their functions within the available resources, with dependence on local expertise to develop and deliver the training.

Education and training capacities

1. Survey of training and education capacities and expertise in the region.

2. Formation of clusters of countries using the criteria of similarity of education and training needs. Lessons can be learnt from Jordan, Cyprus and Turkey.

3. Design of activities to meet educational and training needs including awareness, maintenance, universities.

4. Design a certification programme and introduce labeling for all products imported and manufactured locally.

Establishment of partnerships for programme implementation with

1. Ongoing regional projects that include activities related to education and training.
2. Universities and NGOs.
3. Professionals such as engineers, etc.
4. Regional and sub regional organisations and industrialists.
5. Professional associations involved in RETs and banks that will be providing loans.
6. National and international energy agencies such as the UNDP, ESCWA, UNEP.

Improved stoves (Tunisia and Senegal)

- **Finance and improved coordination:** the actors involved in the manufacture and supply of improved stoves have very limited financial capabilities. In Senegal, this situation forces artisans to operate informally, especially when it comes to sourcing raw materials. Coordination of material purchasing is suggested to help overcome this problem, allied with support for rural production facilities and points of sale. An integrated strategy for the dissemination of the technology is proposed, defining a guiding institution and the role of each of the stakeholders. The Cambodian study suggests that, in some cases, improved stoves could be given to people in return for work that is of benefit to the community as a whole.

- **Raising awareness:** the three country studies highlight the need for all stakeholders to be better informed about the advantages of improved stoves. In Tunisia, households need to be convinced of the financial value of the stoves, while in Senegal the benefits in terms of reduced energy bills can be demonstrated.

Wind energy systems (Argentina)

- **Finance:** strong financial incentives are proposed to support investment to stimulate the use of wind energy systems in rural isolated applications, including partial subsidies and soft loans linked to local economic activities.

- **Standards and certification** for manufacturing, installation and maintenance are needed to improve system quality and performance. Incentives, it is suggested, should be tied to certification compliance, capacity development programmes and training. Improving post sales services through local capacity development and use of existing infrastructure is also required.

- **Research** on wind-power grid interaction, improved forecasting, transmission infrastructure requirements and uncertainty management methods is required for large Wind energy systems

Biodiesel/vegetable oil (South Africa and Brazil)

- In South Africa, finalisation of a biofuel strategy is perceived as instrumental in facilitating cooperation between different ministries in order to support the implementation of biodiesel and increase awareness. Training and technical assistance are also needed to transfer knowledge to farmers on growing oil crops and use of associated by-products.

  Changing from a system in which blending of biodiesel with conventional fuel is voluntary to one making blending mandatory is also identified as an important step in attracting capital investment.

- In Brazil, the dissemination of vegetable oil technology as a substitute for diesel fuel for rural electrification will require the extension of existing subsidies to renewable fuels in general. The existing legal framework should also be reviewed and amended in order to benefit these niches. Tax incentives are also proposed for local technology development.

PV for rural electrification (Brazil)

- The reporting Centre concludes that, in order to encourage dissemination of RETs, there is a need for the government to introduce subsidies, lower interest rates and set firm targets for energy generated from renewable sources. Coordination between stakeholders, from government through to energy dealers, is also necessary.

Concluding remarks

At a first glance, the picture that emerges from GNESD's investigations of RETs and of their potential for poverty alleviation is one of vast untapped potential held back by a set of barriers that seem to be damming the way to progress. However, further examination, made possible by analysis of the barriers, reveals that, while these may be entrenched, they are perhaps not so formidable.

For example, the high initial cost of RET systems is often cited as a, if not 'the', major barrier to their uptake. But examples such as those cited in this summary show time and again that energy provided in appropriate forms augments income, meaning that people are able to afford to pay for access if this can be proposed under favourable conditions. Facilitating access to clean and efficient sources of energy (either by soft loans or other suitable means) is presumably a more sustainable solution than continued welfare transfers that can do no more than guarantee existence at subsistence level, and where there is no hope of 'payback' of any kind. Moreover, communities that are economically buoyant and that have a wider range of options will be better able to adapt to changing conditions in the future. In a context in which the brunt of the effects of potential climate change is likely to be borne by developing nations, this may become an important factor in avoiding rural exodus and large numbers of 'environmental refugees' converging on already overloaded urban areas.

Similarly, other barriers may be overcome by introducing fairly modest changes, such as creating institutions that will help to build capacity by establishing links and creating networks that open access to knowledge and allow it to be shared. Many developing countries have considerable experience with RETs as well as research capacity, and burgeoning commercial sectors eager to exploit new ideas. All that is needed is a framework that will allow knowledge to flow and synergies to flourish.

The fundamental barrier to dissemination of RETs is the lack of an adequate institutional framework resulting in weak or inexistent policies, and an energy development pattern based almost exclusively on conventional energy sources. This has led to a failure to recognise the potential contribution that a whole range of technologies could make to breaking the poverty cycle for very large numbers of people.

However, that there has been a recent and fundamental change in attitude towards RETs is in no doubt, and this summary has pointed to some of the reasons for that change (fluctuating oil prices, GHG reductions, etc.). A number of governments are introducing general framework legislation to encourage RETs and the overall situation is now fairly favourable to their development: technologies are mature and, as pointed out above, barriers to their dissemination are, for the most part, far from insurmountable and would not require commitment of huge resources to be eradicated.

However, the reaction of a number of governments that have either taken action or are planning to do so has been to set renewable energy targets for their national energy 'mix' and to proceed in a manner which, in some ways, mirrors the conventional energy development patterns of the past where the poor are concerned. Investing heavily in the development of biofuels (projected in South Africa) is one example, building of large-scale wind generators feeding into national grids (mooted in Argentina and elsewhere) is another. The potential dangers for poorer farmers in Africa of an extensive drive towards biofuels have been pointed out above (Box 5) and similar observations apply elsewhere and to other technologies. The risk here is that a conventional 'top-down' view of energy development will continue to prevail where RETs are concerned and that the specific needs of the poor will once again be overlooked or that the results of such developments may even be detrimental to their interests.

This summary has made it clear that RETs are particularly well suited to providing sustainable solutions to a whole range of poor people's energy needs and have great potential for improving livelihoods. However, they will only be able to fulfil that potential if they form part of an integrated approach to poverty alleviation that takes account of all aspects of the problem (including the rise in the numbers of urban poor who are also deprived of energy sources) and if the pitfalls of former approaches are avoided.

The detailed regulations and policy instruments needed to underpin dissemination of RETs in a way that will help to alleviate poverty effectively are missing in most countries. If they are to be developed, the policy focus will need to bridge the gap between development of RETs under the impetus of target-setting framework legislation and the more detailed instruments that lead to forms of development and dissemination that address the specific needs of the poor. Widening that focus to integrate smaller scale, non-electrical RETs into development policies and strategies aimed at poorer populations—as demonstrated by the case studies summarised above—is one step. There are certainly many other possibilities for imaginative and creative policy de-

sign if people's actual needs and capacities are taken as the starting point. At the end of the day, unlocking the opportunities that RETs can provide will be more about changing attitudes than anything else.

ISBN 978-87-550-3601-7