Renewable energy:

Does it promote both climate protection and rural development?

The main goal in promoting renewable energy (RE) in rural areas should not be its relatively minor contribution towards global climate protection, but rather its contribution to local development and the fight against poverty. Therefore, the most promising approach is one that aims to increase productivity and improve quality of life, and in which RE technologies are combined with income-raising activities. In this way, the problem of how to finance RE technologies can also be overcome in the long term.

Photo: Krause

For many, owning a television is still a dream. And yet, a simple photovoltaic system would provide enough energy.

The organizers of the international conference for renewable energies – Renewables 2004 – saw the global expansion of renewable energy (RE) use as a key way of eradicating poverty and slowing global warming. In particular, RE is believed to have great potential for energy supply in rural areas of developing nations, where most of the roughly 2 billion people worldwide live who lack access to modern energy services (Brook/Besant-Jones 2000, in *World Bank, Energy Services for the World's Poor*). In sparsely populated areas, off-grid energy systems based on micro hydropower, wind or solar energy not only represent a way to stabilize the climate, but are also a cost-effective alternative to conventional energy systems.

However, caution is advised when RE is promoted within policies for rural areas in developing nations. We do RE technologies no favour when we sell them as a panacea to overcome poverty and reduce global warming. We would be ill advised to concentrate development cooperation activities solely on RE as a source of energy for rural areas. Let us look at three aspects in detail.

First, priorities in energy policy should be defined for each specific region of the world. In most rural areas in developing countries, the focus should be on overcoming the energy-supply gap, not on slowing global warming, because energy deprivation is a severe obstacle to development. After all, such areas account for a minute part of energy-related global CO_2 emissions. Consequently, any reductions there would be negligible and would hardly contribute to climate protection.

Second, projects should be designed in such a way that, on the one hand, (renewable) energy technologies can be operated and serviced using local expertise and, on the other, productivity can be increased. This contribution to local development and income generation can be further enhanced when it is linked to other policies such as the promotion of the local economies and decentralization.

Third, the financing of most (renewable) energy technologies depends mainly upon whether the relatively large initial

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Improved stoves, fired e.g. with biomass, help protect the climate and improve human health.

investment barriers can at all be taken. If we want to reach the broad masses of the rural poor, considerable subsidies become indispensable.

Overcoming the energy supply gap

Activities to promote RE within development cooperation should be embedded in a coherent energy policy approach whose focus is not on finding appropriate projects for preconceived packages of (renewable) energy technologies, but on identifying and tackling the partner countries' most urgent development problems in terms of energy and aiming to solve them. From a global perspective, there are at least three types of problems in developing countries, which can be categorized broadly by the type of country and region. Each requires a different energy policy strategy (Krause/Scholz, *DIE, Briefing Paper 2 /2004*):

❶ The problem of insufficient energy supply, which is most often the case in least developed and low-income countries or in rural areas of low to middle-income countries (we will return to this in detail later).

❷ The problem of low energy efficiency, which is especially common in the countries of the former Soviet Union. Improvements here can help slow global warming substantially.

❸ The problem of rising CO_2 emissions, especially in the major developing and newly industrializing countries (China, India, Indonesia, Mexico, and Brazil). Here, expanding RE is especially important in order to avoid further acceleration of global warming.

The main problem in rural areas is insufficient energy supply; people who live there do not have access to affordable modern energy services and thus suffer from low productivity, low quality of life, and great health risks. This lack of access to modern energy services leads to an unsustainable use of biomass, which degrades local natural resources.

For poor rural households to be able to afford RE technologies, suitable means of finance have to be provided, for RE requires large initial investment.

Small, predominantly rural nations, most of them in sub-Saharan Africa, but also marginalized rural areas of large developing and newly industrializing countries with growing economies, are especially affected by this problem. Energy policy cooperation with these countries and regions should focus on eliminating energy supply deficits in order to improve quality of life and productivity, and on promoting the sustainable use of biomass. Preventing global warming should not be the focus as these countries and regions only make up a very small share of global CO_2 emissions, so that the potential reductions are minuscule.

RE's contribution for rural development

The key strategy to eliminate energy deprivation in rural areas is to engage in programmes that focus on the provision of affordable energy for lighting, cooking, irrigation, the processing of agricultural products, entertainment, education ser-

vices, and health services. The primary goals in this process must be to improve quality of life and raise productivity. RE technologies can play an important role here. These activities should include the sustainable management of biomass (such as afforestation to produce firewood), as biomass will probably remain an important source of energy in the medium term. It is important that energy policy be linked to a strategy for rural development; modern energy services alone are not likely to notably improve the quality of life and the income situation in rural areas (Ramani/Heijndermans 2003, *Energy, Poverty, and Gender*).

Selection of suitable energy technologies should be based on criteria relating to both least-cost provision of the energy service – given the system capacity needed – and the reliability of the technology. Local know-how and locally available spare parts should provide maintenance, which often is an obstacle. Depending on the local conditions, these requirements may be best met using RE technologies (such as micro-hydropower units, photovoltaic systems, or improved stoves fired with sustainably managed biomass) or by using conventional technologies (for example as by expanding the grid or using diesel generators). Special attention should be paid to the energy needs for cooking.

Photovoltaic systems generally do not provide enough power to support production processes (for processing of crop harvests or for irrigation), much less to provide energy for cooking. However, photovoltaics can greatly improve the quality of life by providing better and non-polluting light and by enabling people to use radios, televisions and telephones.

Access to modern energy services is prerequisite to better quality of life and higher income, but it does not suffice on its own. Therefore, energy policies must dovetail with other policies at local level (such as education, health services, economic development, administrative reform, and decentralization) in order to maximize the positive effects on local development. For instance, electric lighting has a potentially positive effect on education (by allowing classes to take place or homework to be done in the evening), but only if there are enough teachers in rural areas. Higher productivity and positive effects on income are also generally only achieved when energy services are combined with entrepreneurial expertise and when access to markets is combined with long-term financing (see box on page 60). If additional income is generated, the problem of financing, which is often a constraint to the spread of (renewable) energy technologies in rural areas, is not as severe.

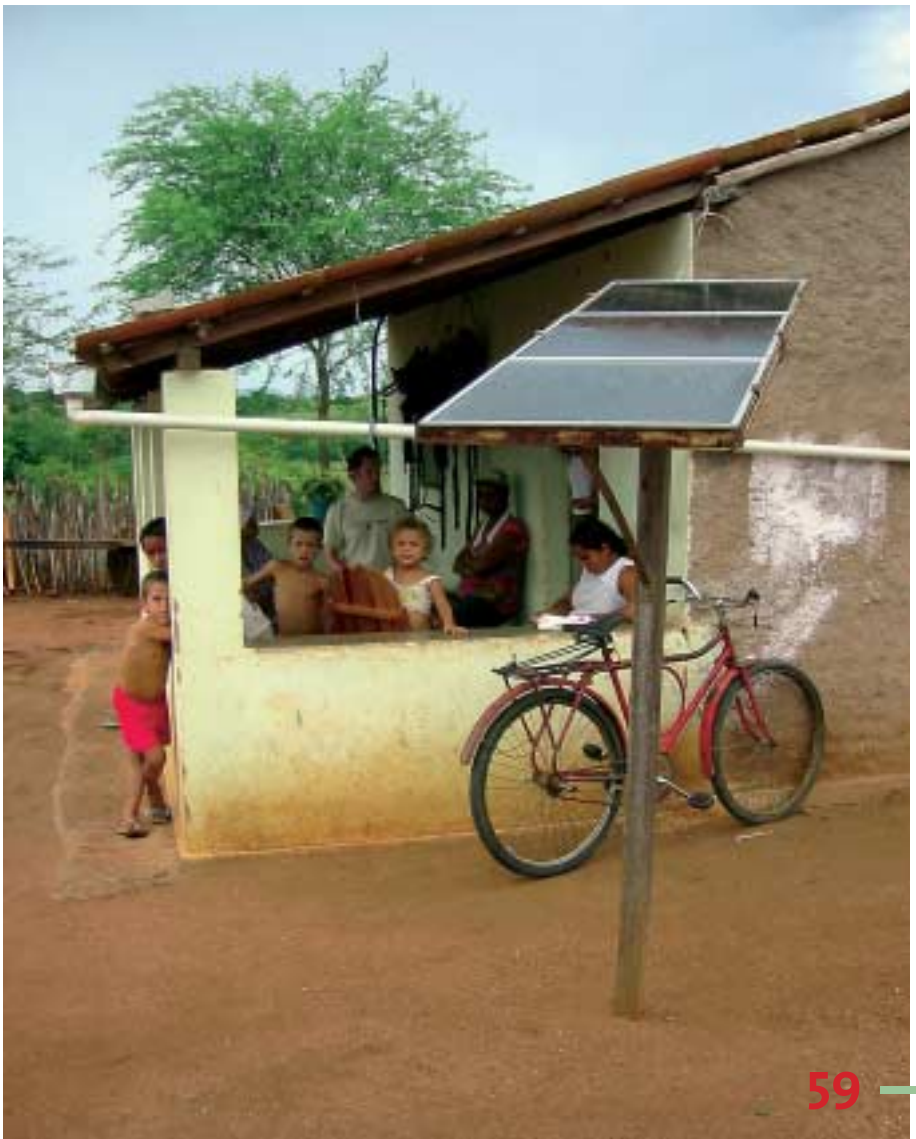
Financing RE technologies

Rural areas in developing countries are often at an inherent disadvantage compared to urban regions, and this also affects the financing of RE (though many of the points listed below also apply to conventional energy technologies). On the one hand, the low density of demand for energy rules out any economies of scale in the provision of energy and drives up the cost per unit of energy; this is also why off-grid technologies can be provided at competitive cost compared to grid expansion. On the other hand, because of the large share of poor families in rural areas, the purchasing power of the people who require energy is low (Krause et al., 2003, *Sustainable Provision of RET for Rural Electrification in Brazil*). The following factors largely determine whether poor rural families will be able to cover the costs:

- The cost structures of the technologies to be used (such as micro-hydropower, biogas, photovoltaics, and improved stoves);
- the availability of long-term financing instruments and the extent to which subsidies make up these funds; and
- the level of income of the families.

RE technologies generally require high initial investments but then involve relatively low costs for operation and maintenance. This does not apply to improved stoves, however, which generally cost less than 15 US dollars (USD) (Turkenburg 2000; Goldemberg 2000, in: *World Energy Assessment*). The amount invested can vary greatly depending on the installed capacity: 120,000 to 300,000 USD for a micro-hydropower unit with a capacity of 100 kW (1 200 to 3 000 USD per kW) that can supply power to a village or 500 to 1 000 USD for a photovoltaic system with a capacity of 0.1 kW (5 000 to 10,000 USD

Photo: Krause



The most important goal in promoting affordable RE in rural areas should be to improve quality of life. Climate protection is secondary here.

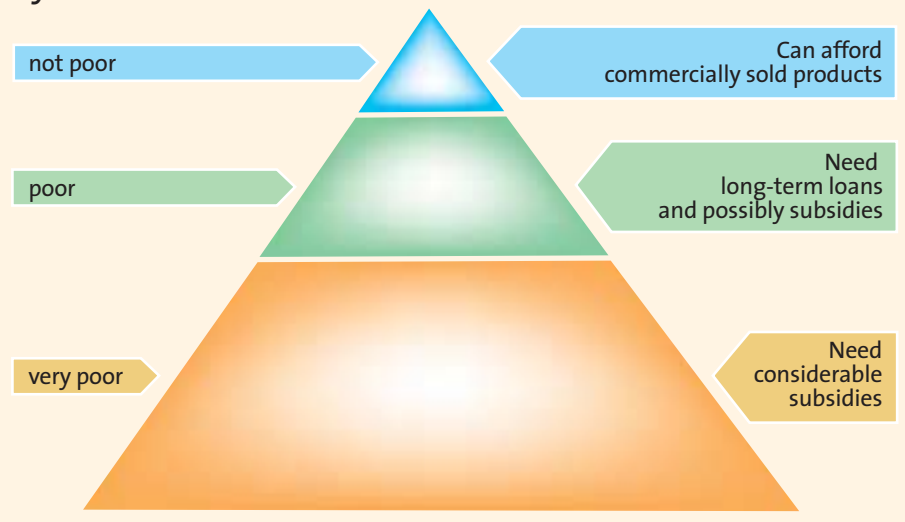
per kW) that can provide power to a single home. To remove the barrier presented by the initial cost, it is decisive to identify suitable means of finance. Moreover, for systems to be technologically sustainable users must be in a position to meet the cost of operation and maintenance.

For less wealthy rural families to be able to afford energy systems – the following discussion mainly concerns single photovoltaic systems – the relatively high investments (compared to the family income) have to be spread across time through a loan instrument, and/or reduced through subsidies. Among other things, the type of financing depends on the business model with which the energy will be supplied to households (Krause/Nordström, (ed.) 2004, *Solar Photovoltaics in Africa*). Are the systems to be sold to individual households? In this case, consumer loans are practical, though they are rarely available in the target areas with weak infrastructures. Therefore, successful models often cooperate with micro-financing institutes or loan cooperatives. Another business model is the service model, in which the systems belong to an energy service provider and are provided to users for a fee. In this case, the service provider has to cover the initial investments, thus shifting the question of financing to the provider.

A decisive question is how much rural households can afford to pay for energy. One measuring stick is to assess expenses for conventional substitutes such as candles, liquefied gas, and batteries, on which 3 to 15 USD is generally spent per month. The full monthly costs of a service model (capital costs, spare parts, operation and maintenance) may, as in the case of Argentina, be closer to 26 USD for a 0.1 kilowatt photovoltaic system or around 17 USD for a 0.05 kW system (Reiche/Covarrubias/Martinot 2000, in: *WorldPower 2000, Vol. 1*).

These examples are specific and do not allow us to draw any general conclusions. But they do show that there are clear limits to the financing of energy systems on a commercial basis. The income of rural households and their ability to pay varies considerably from region to region, country to country, and even within a given area. Commercial approaches will generally only reach the top segment of the income pyramid (see figure). If the poor are to receive energy services, considerable subsidies will be required, and they will have to be channelled in such a way that they reach the target group without simultaneously damaging the efficiency of energy supply.

Financing solutions for photovoltaic systems by income levels of rural households



Source: Reiche/Covarrubias/Martinot 2000, in: *WorldPower 2000*, Vol. 1, p. 59

Generally, initial investments for RE technologies are high; improved stoves, however, cost less than 15 US dollars.

Photo: GTZ/Uganda

How electricity effects incomes

A study recently published by the World Bank with a focus on Asia drew the following conclusions:

- The use of electricity in agricultural work (irrigation and processing of agricultural products) boosts productivity. This applies mainly to grid supplies where the quantity of electricity is sufficient, however. While the resulting increases in income are modest, they are nonetheless a noticeable improvement for poor people.
- Only a small number of households use electricity for work in the home (such as small crafts). This is especially true of poor families who lack the means to purchase productive use appliances (such as electric sewing machines).
- The income of small village enterprises depends on how much electricity is available, the span of time since electricity was provided, the funds available for investments, and access to markets. On average, the income of small businesses connected to an electricity supply is twice that of those without.

Source: Ramani / Heijndermans 2003, Energy, Poverty, and Gender, p. 4f