# Energising Sustainable Development

## Concepts and Projects

gtz Partner for the Future. Worldwide.

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**Cornelia Richter**

**Director General, Planning and Development Department**

## Dear Reader,

A sustainable energy supply is a precondition for economic and social development and achievement of the Millennium Development Goals. This became clearer than ever in 2002 at the World Summit on Sustainable Development in Johannesburg and at the recent session of the UN Commission on Sustainable Development in New York.

In many parts of the world, a large share of the population have no access to modern energy services. At best, towns and industries are supplied with antiquated and unsustainable energy facilities. Worldwide, two billion people with no access to modern energy supplies are forced to use traditional forms of biomass such as wood, coal or dung to cover their basic energy needs. This practice is putting enormous pressure on ecosystems and seriously damaging the health of women and children who are exposed to the smoke of traditional fireplaces. According to WHO estimates, some 4,000 people die every day from indoor air pollution. More developed countries are struggling with the ecological consequences of the massive use of fossil fuels. These range from local air pollution to global climate change. The recent rise in oil and gas prices has demonstrated the negative economic and social effects of most countries' dependency on imported fossil fuels.

In light of this situation, there is an urgent need for developing countries to adopt sustainable and forward-looking energy policies. GTZ offers a wide range of capacity-building services to assist in the transition to a sustainable energy future. In this process, GTZ can draw on its long-standing experience with a current 65 energy projects all over the world.

Access to modern energy services, the promotion of renewable energy, and greater energy efficiency are the three key elements of any strategy for a sustainable energy supply. The transformation of the global energy system is one of the greatest challenges facing humankind in the 21st century. The contributions to this volume discuss the energy challenges in different parts of the world, illustrate some conceptual approaches to address these challenges, and provide some concrete examples how we, at GTZ, work with our partners to find solutions that work.

Yours truly,
Cornelia Richter

# Energy in Africa – facing a double challenge

Mike Enskat and Holger Liptow, text | Getty Images/Brand X; agenda fototext; GTZ archive, photos

Energy security in sub-Saharan Africa requires a two-pronged approach addressing investments and capacity development. Years of insufficient support have rendered power supply notoriously inefficient in the region. The authors argue that there is much scope both for renewables and for private sector initiative.

On the 4th November 2006, trouble with power transmission in Northern Germany left people as far afield as Southern Spain and Italy in the dark for about an hour. How could something like this happen in Europe? So far, so bad: somebody must have goofed. But in sub-Saharan Africa (SSA), even consumers in the big cities count themselves lucky to get just a few hours of electricity a day, while blackouts tend to be frequent and prolonged. Lack of appropriate action – not once, but over decades – has created monumental shortcomings.

There is a strong link between a reliable, cost-effective energy supply and development. For instance, economic development is seriously constrained if there is no dependable energy supply. The World Bank notes with concern that levels of electrification in SSA are much lower than those in other regions with similar income levels. This is due to the absence of investment programmes in the past. In Ethiopia, bottom of the scale in terms of electrification levels, a mere three percent of households are electrified. And across the entire region, more than 80 percent of the population rely on biomass energy, such as wood, charcoal, agricultural residues or dung.

The low electrification and the high biomass energy rate is not only a development and energy challenge, but has tremendous health implications as well. The World Health Organization estimates that about 1.5 million people die each year from indoor air pollution caused by cooking with traditional biomass energy, with the proportion heaviest in SSA – a state of affairs that politicians and energy-planners ought to be far more aware of. Moreover, the lack of efficient energy sources also impacts health systems in the region. In Kenya, for example, only about five percent of dispensaries have access to electricity, while power is supplied to 50 percent of the health centres. Schools in the region are similarly affected, with children's education being additionally impaired by low-quality lighting in poor households.

## Energy inefficiency – an economic constraint

Of course, on top of the social implications of an insufficient, unreliable and costly power supply, there are massive constraints to productivity and competitiveness. In Kenya, an estimated eight percent of power sales is lost to power outages. Is this down to insufficient investments or to a lack of the necessary know-how to run the system?

While economic growth rates in SSA have averaged at around four percent in recent years, current levels of increase in power supply are less than 1,000 megawatts a year, with 4,000 required to keep up the economic growth rate. To put things into perspective, China is constructing 1,000 megawatts at least every two weeks. Projections of energy access figures for the region present a gloomy picture. Already, twice as many households are formed each year as those getting new power connections. Are large-scale investments in power systems the best remedy to improve the energy situation for the majority of the people?

True, power for economic growth is required in bulk quantities. And here, major improvements are indeed on the horizon. International donors are sending clear signals that after years of very little interest in Africa's infrastructure, energy is back on the international development finance agenda for the continent. The World Bank has launched a related Action Plan for Energy in SSA, and the EU has committed itself to substantially increase spending on infrastructure there. The Africa Infrastructure Consortium, started as an initiative under the UK Government's 2005 G8 Presidency, brings together senior-level representatives from the G8, the African Union (AU), the New Partnership for Africa's Development (NEPAD), the African Development Bank, the Economic Community of West Afri-

The African challenge requires a differentiated response: ranging from large-scale infrastructure to decentralised energy systems and improved household energy.

can States (ECOWAS), the World Bank and the European Commission. Africa has to build the capacities to absorb these new investments which, hopefully, are going to come.

## The problem of rural supply

Nevertheless, rural supply remains the biggest challenge. Private sector enthusiasm about expanding access to energy to rural consumers will stay limited as long as the profit margin is too low. But however fragmented, the local private sector can engage in an interesting business segment when it comes to decentralised energy solutions of smaller scale. This could include more efficient and healthier stoves for wood and charcoal, in households and institutions, solar systems for the better-offs, or small hydro or wind units for communities, where appropriate. Shifting the balance in favour of such decentralised solutions could prove a much more viable approach than opting for costly and complicated grid extension. Capacity development and investment will help, provided the right marketing strategy is found.

The predominance of biomass in SSA warrants a closer look at this area in particular. Africa is the world's largest consumer of biomass energy. In many African countries, biomass energy accounts for more than 70 percent of primary energy supply, and its consumption is expected to rise. Households consume 80 percent of total biomass energy, with the remainder being used as process heat by industry and services, including small and medium sized enterprises and the informal sector.

Among the chief benefits of biomass compared to grid electricity and modern fuels are its low cost and its accessibility, especially in rural areas. And unlike other renewable energy sources such as wind or solar, biomass can be stored. Another important aspect is that sustained biomass energy utilisation emits little or no greenhouse gasses since the atmosphere will reabsorb carbon dioxide released during combustion as biomass regrows.

But while biomass does have the potential to contribute to sustainable development and rural livelihoods, its present widespread inefficient use is damaging to health and the environment. Moreover, the use of solid biomass is prone to considerable heat losses through incomplete combustion, inefficient equipment or inefficient conversion technologies. Finally, sustainable supply of biomass is threatened by poor resource management, logging activities and agricultural expansion.

## The potential of biomass

Here, a closer look reveals a very heterogeneous situation. While some areas still have a surplus of wood, plant cover is rapidly decreasing in others, forcing people to buy fuel for cooking even in rural areas. Damage to the environment has prompted governments to impose restrictions on the production of charcoal. But the resulting price increases are putting a strain on many urban consumers. Nowhere in Africa has a ban on charcoal worked. More clever solutions are required. Capacity development could be one of them. Investments in efficient charcoal production could be a tremendous relief for the standing stock of woody biomass.

Improvements in end-use efficiency for cooking and heating could lead to biomass energy savings of up to 80 percent. Clearly, strategies addressing its sustainable supply and efficient use are called for. While biomass has certainly not been given due attention at national or regional level so far, a number of steps do go in the right direction. The Program for Biomass Energy Conservation (ProBEC), led by the Southern African Development Community and executed by GTZ, concentrates on the design and implementation

Capacities cannot simply be injected, but have to be developed over time.

of comprehensive biomass interventions. Also, GTZ and the EU are assisting the Sahelian countries in organising the sustainable supply and rational use of domestic energy via the PREDAS programme. Countries like Ethiopia, Senegal, Tanzania and Uganda have adopted national policies addressing the biomass sector.

Biomass energy is believed to have a big potential when it comes to biofuels and biomass for power generation. Co-generation in sugar industry is still hardly tapped, while biomass generation from excess agricultural residues or energy plantation has not been fully screened. And finally, hopes are high regarding biofuels to be blended with petrol or diesel, or even to produce for export. However, one must not forget that biofuels production should not replace food production, and that it took Brazil decades to reach the level of biofuels utilisation it has today, involving huge investments and massive capacity development.

### Capacity development key to progress

Summing up, what such initiatives highlight is the importance of developing human and institutional capacities. Regardless of the choice of energy resources and of whether energy is generated for business or for households, Capacity Development remains the lynchpin of progress in this sector. First of all, most governments and government authorities in the region lack the basic human resources and institutional capacities to analyse problems, formulate policies and implement solutions. Such capacities cannot simply be injected, nor can they be purchased as a service on the international market. They can only be achieved, literally developed, through a complex and integrated process of behavioural change. While some ad hoc diagnostic work in terms of problem analysis and the development of policy options merely appears to be a technical challenge that could be addressed with a short-term perspective, a sustainable policy environment cannot be "prescribed" by others. Therefore, any approach to capacity development in this area requires a long-term approach that should not be sacrificed to short-term measures and hectic responses to latent crises. In turn, the international donor community would thus have to face the fact that simply mobilising large funds for material infrastructure investment in Africa is far from sufficient and can even lead to negative development outcomes. In addition to the policy level, the actual establishment, operation and maintenance of energy service systems – whether it be centralised or decentralised, fossil-based or renewable, public or private – calls for a vast amount of all sorts of technical, managerial and commercial skills. Any solutions that the international community proposes to Africa have to recognise that such capacities are dramatically scarce. At this level too, any new initiative would have to start with a systematic stocktaking of available capacities and resources.

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# Energy is politics

Jens Drillisch and Stefan Opitz | text

Developing and emerging countries need a sustainable energy policy framework to fuel their economy, create income and reduce poverty. The triangle of energy security, ecology and economy must be readjusted.

One thing that not only national economies of emerging and developing countries especially need is energy: Biomass serves for cooking; wood, coal, gas and dung for heating. In these countries, mostly coal, hydropower or diesel fuel are transformed into electricity to power machines, make computers work, give light. Energy is indispensable to raising the gross national product and fuel the engine that will take the population out of the poverty trap.

As numerous recent world events have shown, energy is a political issue. Last year's oil price developments showed that the energy sector has a strong impact on the economy. Growing knowledge on the effect of the generation and use of energy on climate put environmental policy into the spotlight and the latest IPCC report speaks a clear language. The international conference "Renewables 2004" in Bonn particularly emphasised the relevance of renewable energies to climate and the environment.

The reform efforts of emerging and developing countries with respect to the energy, and especially the electricity, sectors, also demonstrate that energy policy has a central role to play. A certain amount of regulation will remain necessary as long as most of the energy supply continues to be tied to the grid and bear the characteristics of natural monopolies. Government interventions are justified by market failures, whether

real or perceived, with energy policy challengingly set between economics, energy security and ecology.

## Social and economic factors

The priority as regards grid-connected energy, especially in the electricity sector, is to establish a legal framework and settle issues such as network access and tariff regulation. Complete cost recovery is indispensable to the development of a sustainable energy sector. But the poor must have access to modern energy too. The challenge of energy policy consists of creating a tariff system that sets efficient incentives both for investors and consumers while taking affordability into account.

Providing access to modern sources of energy for people in rural and remote areas also requires the targeted support of energy policy. Up to now, most access concepts based entirely either on the market or on the state have failed. Obviously, the focus must shift to the productive use of energy if investments are to be recovered, incomes created and poverty reduced. This approach is at the heart of GTZ's technical cooperation, be it in Mongolia, Indonesia or Tibet.

But countries that have important domestic energy resources and enjoy high export revenues can also profit from consultancy. The GTZ consultants seek to prevent national economies from relying solely on one sector and highlight that the redistribution of state incomes from energy exports should be used to benefit pro-poor growth.

## Securing energy supply

Adjusted for inflation, the present oil price is only slightly higher than it was during the first oil crisis in 1973-74. Yet the fact remains that in nominal terms, the price of the world economy's main fuel is 30 times what it was prior to the crisis. Price history reflects all the aspects of a real global market economy that doesn't always fit the theory: Demand increases, supply hardly does, cartels develop, speculators appear, and political influence grows.

Emerging and developing countries often largely depend on energy imports and are thus hit disproportionately hard by price increases on energy markets. Take Morocco for instance. This North African country depends on imports to meet more than 90 percent of its energy needs. State expenditures for energy tripled to around 2 billion € between 2003 and 2005. And this is due in part to high state subsidies of consumer prices, a situation found in many other countries. Consumers do not pay the full costs, leaving the state to cover the highest share of the energy bill.

If oil supplies were to really become short, developing countries would be the first to be cut off from supplies, as tankers would cruise on to the ports of industrialised countries. Thus a prime task for government policy is to reduce dependency on oil imports by increasing the use of renewable energy or more efficiently exploiting energy potentials. Further, subsidies should only be used in a targeted, selective manner.

Jens Drillisch und Stefan Opitz

## Protecting the environment

The use of conventional energy sources comes at a high environmental cost on a local, regional and global scale. China, for instance, estimates in its June 2006 environmental report that environmental damages amount to some US$ 200 billion per year. The resulting costs usually do not bother the polluters; it is society as a whole that pays. Strong environmental policy is necessary to introduce the polluter-pays principle without preventing sustainable economic development. At national level, this requires interventions that are regulated by administrative rules in most emerging and developing countries. The Clean Development Mechanism is one of the instruments available at international level.

The war in Iraq, the dispute over nuclear energy in Iran, gas supplies between Russia and its neighbours, the construction of gas pipelines in the Baltic Sea or the nationalisation of the gas industry in Bolivia have all shown that the energy sector is an eminently political economic sector, and that energy markets are extremely sensitive to political changes. The energy issue thus covers much more than simple technical aspects. Energy is politics! In developing countries, politics should contribute to the development of sustainable energy supply in urban and rural areas as it is one prerequisite for alleviating poverty and promoting sustainable development.

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# Energy efficiency

Marian Rzepka, text | Marian Rzepka; GTZ archive, photos

Energy demand is growing in developing and emerging countries as industrialisation progresses and populations grow. These countries bear a huge potential to raise energy efficiency – an issue where technical cooperation can have a huge impact.

It's high time that something is done. After years of debating the pros and cons of using conventional and renewable energy, the issue of energy efficiency is becoming increasingly important. The European Commission has estimated that the inefficient use of energy is going to cause additional annual costs of up to 100 billion € for the EU alone up to 2020.

But in emerging and developing countries too, pressure is growing to enhance energy efficiency levels both on the producer and consumer side. High dependence on fossil fuels that are expensive to obtain is aggravating the socio-economic situation in many of these countries. Also, the inefficient use of fossil fuels is taking a heavy toll on the environment. As economic growth and production capacities increase in several countries, the strain on the ecosystems is growing, with the negative impacts of accelerated industrialisation threatening to jeopardise economic success and ruin prospects for further development.

## Efficiency means more than saving

Energy efficiency is often equated with saving energy. Actually, the term refers to the energy utilisation ratio – the more of the energy fed into a system is really used for the purpose it has been designed for, the higher the energy utilisation degree will be. So energy efficiency is a lot more than mere energy saving. For example, it encompasses retrofitting power stations so that more electricity can be generated with every ton of hard coal, or electrical modernising of transmission lines or reducing losses in district heating systems. Energy efficiency also means providing energy services that require a minimum of energy. Good heat insulation will reduce the specific thermal energy demand of a house. Energy saving lamps require just a fifth of the energy that conventional bulbs consume but have the same luminous power, and even among the fluorescent tubes that are widely used in offices and public buildings, efficiency will range from 15 to 60 percent depending on the technology employed.

In Germany, energy efficiency has already been introduced in several areas. This has been supported by corresponding new laws and guidelines such as the regulations on energy saving or the Energy Consumption Labelling Directive (ECLD). Also in response to increasing international competitive pressure, industry has successfully implemented energy efficiency programmes. Households are offered qualified advice and can acquire a wide range of energy-optimised products such as refrigerators, television, telecommunications equipment and other electrically-powered appliances. Low-interest loans are available for energy-relevant investment. While initial steps have been taken, Germany is still far from having exhausted all options to raise energy efficiency. Much still remains to be done in the transport and construction

sector as well as in energy generating and transmission.

Finally, the European Commission has responded, too, by recently presenting an extensive Energy Efficiency Action Plan. The implementation of the measures it provides for is hoped to result in a 20 percent reduction in energy demand in the EU by 2020. Energy efficiency is also going to be a focal topic of Germany's Presidency of the EU and G8 Presidency in 2007.

## Laws alone are not enough

However, the situation is different in the emerging and developing countries. Steadily growing populations and the need to catch up in terms of development are causing higher rates of growth in energy consumption than in most of the OECD countries, bearing in mind that total energy consumption is still lower than that of developed countries. Industrialisation correlates with changes in consumer behaviour and greater traffic volumes. The growing price of gas and oil on the world market is severely exacerbating the socio-economic situation in those countries without sufficient natural resources of their own. It has been estimated that energy consumption worldwide is going to increase by around 50 percent by 2030, compared to 2005, if drastic political action is not taken. The developing countries account for two thirds of this increase. According to the Federal Ministry for Economic Cooperation and Development (BMZ), additional expenditure for developing countries importing mineral oil today is already almost as high as the total of international finance provided for Official Development Aid. However, energy efficiency is still not high on the agenda in many countries, although enormous potentials exist. The reason for such a state of affairs is often that the wrong incentive systems are in place. For instance, the price of energy may be highly subsidised, while production plants are operating with obsolescent equipment and there is only little know-how regarding the efficient use of energy in all fields of society. In rapidly growing economies such as India and China, it is not rare for efficiency measures to founder on the fast pace of growth. But even the existing political determination to take action is not necessarily enough. Monitoring of compliance with laws, which is deficient in several countries, as well as corruption quite often impede the implementation of effective efficiency measures in spite of progressive legislation.

Commissioned by the BMZ, GTZ is working together with its partners in various emerging and developing countries in Asia, Latin America and Africa to arrive at solutions to enhance energy efficiency. The thematic foci here are raising the efficiency of thermal power plants, energy efficiency in buildings, eco-efficiency in industry and energy in households. Often enough, small measures can result in big impacts. Implementing measures to improve efficiency, such as the introduction of an energy-optimised cooker in an African household or the energy optimisation of a technical process in a production plant, is usually only the last and simplest step within a long impact chain. Before this level is reached, processes of change taking years are required to create the necessary framework conditions in politics and society.

## Development requires time and skills

This can be illustrated by the example of thermal retrofitting of residential buildings in Romania, where around 85,000 buildings were constructed with prefabricated slabs between 1950 and 1985. These buildings have hardly any insulation and are usually fitted with single-glazed windows, while the radiators cannot be adjusted. As a result, many occupants sit in the cold during the winter, behind icy windows and mouldy walls even though the heating is turned on. This is energetic, ecological and social madness that has only been brought about by gas prices that used to be subsidised in the past. In spite of energy prices that are gradually adapting to world market level, the situation is changing only slowly. There are a multitude of reasons for this. Establishing and implementing government funding programmes requires specialist know-how and transparent processes and procedures in the authorities. For a long time, no legal provisions existed to take out a mortgage. Legally independent homeowners' associations had to be founded, which required amendments to existing legislation. The homeowners had to be convinced that the renovation measures made sense. Renovation standards had to be developed, and specialists had to be trained who could then comply with them or monitor compliance with them. This shows the wide range of demanding activities that the GTZ advisers are engaged in at local level, with the renovation measure proper at the end of a long impact chain the simplest of problems to be solved. Today, Romania has to import around 40 percent of its mineral oil requirements – thermal renovation of all prefab slab buildings in the country would suffice to render these imports virtually superfluous.

Consistent tapping of potentials to raise energy efficiency not only cuts costs. It also represents a valuable contribution to combating global warming, reduces the strain on the environment caused by air pollutants, enhances industry's competitiveness and thus creates incentives to invest. That this is only making sluggish progress is due to what are often conflicting interests among the actors involved, unsuitable structures in authorities and public administration, poorly trained specialist staff, an insufficiently sensitised population, restricted access to information, a lack of technology transfer, obstacles to accessing funding sources, corruption or simply the hurdle of changing well-worn habits. Technical cooperation can contribute to the devlopment of effective practical solutions to these complex problems through joint programmes between the partner countries.

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The range of energy efficiency measures is broad, from retrofitting power stations to introducing energy-saving light bulbs.

Albrecht Kaupp

Decoupling economic growth from energy demand in India requires determined steps towards energy efficiency and energy modesty. Mike Gardner talked to Albrecht Kaupp about the country's problems and priorities in the energy sector and the role that the Indo-German Energy Programme (IGEN) plays in this context.

# What colour is your energy?

## Reflections on an emerging geopolitical issue.

Mike Gardner: What is the mandate of the Indo-German Energy Programme (IGEN)?

**Albrecht Kaupp:** IGEN's mandate can be summed up in one line, as printed on our stationary: "Energy modesty, efficiency and conservation are our mandate. Let us walk the talk!" It captures the mandate in this order of priority best. We need to reflect that a society may use the most energy efficient state-of-the-art technology but still be a large energy waster if no energy modesty is practised.

Where do you see a difference of opinion between Germany and India?

The major differences emerge at three different levels. There are not so much differences in opinion but different perceptions. The first issue deals with the belief that there may not be enough affordable energy, renewable and fossil, in the mid-term future for all countries to grow at their own pace.

The official opinion as reflected in a speech by the honourable Indian Prime Minister is best captured by stating that "India has a long way to go in catching up with levels of consumption of even middle-income countries. So when we talk of energy conservation in India, we are referring to this aspect at a relatively low per capita level of consumption. India is under no illusion that it can approximate the consumption levels that the affluent western societies enjoy. Indeed, in the interest of humanity and the sustainability of our life support system on this planet, it is the West that must bring its energy consumption level closer to India's rather than the other way round."

One of the most widely used indicators for quality of life is the UN Human Development Index, which is very closely correlated with per capita electricity consumption. Germany hovers around 7,220 kWh, the USA is at 14,000 kWh, and India stands at 616 kWh in terms of supply, since about 45 percent of the Indian population do not have access to electricity. India's expectations that the West should do a little bit more at home in terms of energy modesty and energy efficiency before preaching it in India are therefore high.

The second issue deals with our German preoccupation of renewable energy as THE solution to India's energy supply problems. In my opinion, India has never left the renewable energy age because 80 percent of the energy supply in rural areas where 75 percent of Indians live comes from renewable energy. When we talk about modern fuels in Germany we usually mean renewable energy. When India talks about modern fuels programmes it means increased supply of kerosene and liquefied petroleum gas (LPG) for rural areas to replace renewable energy such as cow dung, agricultural waste and biomass as a sign of poverty.

In India, the view prevails that the colour of electricity shouldn't matter. Black from coal, grey from gas, green from renewable energy, blue from hydro power and yellow from nuclear power plants. India's policy-makers feel that they do not have the luxury to be selective in their choice of energy supply in supporting an annual eight percent of economic growth.

The third difference is on the future of nuclear energy. In India the nuclear power development programme is regarded as an integral part of a policy for diversifying the power mix. We move out – India moves in.

Energy modesty and energy efficiency require behavioural changes at all levels and segments of energy consumers.

### What is the acceptance of technical cooperation in the energy sector like?

India has a very lively and strongly argumentative federal democracy with an extremely analytical and critical media coverage of what is happening at all levels of society. Official partners can certainly cope with a few foreigners having their own views about energy topics that occasionally contradict the official opinion. The question is: "Is anybody in India listening to our views?" The country readily accepts "intellectual sparring partners" because it is a tradition to discuss long and hard. I feel that any honest broker who does not have a hidden agenda and adds value to the Indian opinion and agenda is highly welcomed and accepted. The status of GTZ, viewed in India as a German public service unit, helps in this respect.

### In your opinion, what are the priorities and real problems in the Indian energy sector?

Lobbyists for particular energy technologies usually ignore the fact that a very swift decoupling of economic growth from growth in energy consumption, particularly electricity demand, is THE key issue for India. It is not so much to what extent India accelerates utilisation of renewable energy sources or removes excessive cross subsidies. In this federal democracy, the poor win every election because they represent 72 percent of the vote bank. Consequently, access to affordable modern liquid fuels and electricity in adequate quantities can be decisive in state elections. India is further facing the problem that replacing imported energy with locally grown biofuel from large commercialised energy plantations will compete with the food chain for land, water and fertiliser.

### What role can technical cooperation play?

Extensive surveys have clearly shown that the market potential for very attractive investment in energy-efficient technologies is conservatively estimated at 1.5 billion € per year, while only about 400 million € is invested annually. Consequently, the market for energy-efficient technologies and measures is insufficiently tapped. The issue of how the Indian Energy Conservation Act, which our partner, the Bureau of Energy Efficiency (BEE) is implementing, should be enforced is more an issue of how to market it. It may sound strange to market a law, but the Act is a rare piece of legislation that forces highly energy-intensive industries to increase their profit. Unlike most environmental pollution control regulations, the act does not make expensive end-of-pipe solutions mandatory. On the other hand, Government intervention under the Act helps. The role of technical cooperation is firstly to help expand and diversify the supply of energy-efficient technologies and appliances in the market and secondly to step up human resource development and marketing so that everybody knows that efficient technology is available and the pay-back period in such investments is from one day to five years. Therefore, campaigns, campaigns and more campaigns combined with lots of training are effective modes of delivery. Our joint efforts in the IGEN programme focus on training and certification of at least ten thousand energy managers and energy auditors up to the end of 2008 who, as shown in the last three years, trigger investments in energy efficient technologies. Furthermore, our efforts concentrate on labelling of household appliances as well as energy intensive industrial equipment.

### What about conflicts of interest or conflicting opinions?

The more time you have spent on the subject in India, the more they will increase. It is more a conflict of loyalty between principles and beliefs in what should be done worldwide under the broad heading "integrated sustainable energy policy". The problem is that up to 2000, energy security was not so much in the limelight. All of a sudden, in the last five years, politicians and the market have jointly started to debate how we may manage future energy supply deficits. India could have an edge there because energy deficits are managed here on a daily basis and of an order of magnitude unknown in Germany. What India is trying to achieve to bring modern liquid fuels to all of the population and provide electricity to all at affordable prices and in adequate quantities is a monumental task. India still has to provide electricity and with it electrical appliances and liquid household fuels to 45 percent of its population.

# Energy modesty, efficiency and conservation for inclusive growth

Together with GTZ, India's Bureau of Energy Efficiency (BEE) and Central Electricity Authority (CEA) have been commissioned to implement IGEN – the Indo-German Energy Programme – by the German Federal Ministry for Economic Cooperation and Development (BMZ) and the Government of India's Ministry of Power (MoP). Financial support is provided by the KfW Development Bank. The European Commission and InWEnt are assisting in capacity building measures at state levels. Activities focus on support for a nation-wide implementation of the Indian Conservation Act of 2001 as an effective, market-oriented growth instrument to improve energy conservation and contribute to de-coupling economic growth from that of energy consumption. Setting out from the Act's provisions, and involving local and international professionals, IGEN supports:

- training and certifying energy managers and energy auditors,
- labelling household appliances as well as energy-intensive industrial equipment with respect to energy efficiency,
- research work and exchange of opinion about rules and regulations in support of the Act and associated policies,
- setting norms and standards for energy-intensive industries,
- the transfer and promotion of cutting-edge technology to reduce energy consumption,
- private-public partnerships to promote awareness of the need to save energy,
- capacity building and development of high-quality Clean Development Mechanism (CDM) projects in cooperation with the Ministry of Environment and Forests and the local CDM authority, and
- design and maintenance of the webpage portals www.energymanagertraining.com, www.cdmindia.com, and http://cdmindia.nic.in

So far, cooperation has impacted on about 60 accredited larger energy auditor firms, 6,000 trained and 4,000 certified energy managers and auditors, 600 firms in the unorganised sectors and 120 firms in the organised sectors with a workforce of half a million that manufacture industrial equipment as well as 23,000 firms in the unorganised and 110 firms in the organised sectors with a million workforce that produce electrical household appliances. Furthermore, the programme incorporates 30 agencies at state level and targets around 2,000 large, energy-intensive industries with an energy consumption of more than 30,000 tonnes of oil equivalent (TOE) a year. An estimated 20 million households, or 150 million people, at an annual income level of more than 80 € per month, benefit from the programme as well.

To a large extent, poverty alleviation in India means infrastructure projects in the energy sector and not only the usual measures and strategies that we think will alleviate poverty. I am afraid the issue of convergence and contraction of energy consumption among OECD countries and the other emerging economies such as India and China is one that will not get away in particular because it is closely linked to a global problem without a passport: climate change. Pushing accelerated state-of-the-art technology transfer by industrialised countries will not do the trick. Our work clearly shows that 50 percent of the energy conservation potential in India is run-of-the-mill technology and another 30 percent is plain better housekeeping measures. Consequently, energy modesty and energy efficiency starts in people's minds and is a state of attitude requiring behavioural changes at all levels and segments of energy consumers. Only this combination will do the trick.

**What about renewable energy as the solution to sustainable energy management?**

As pointed out, India has been, is and will be deeply entrenched in the renewable energy age. India is also going to move deeper into the coal age for the next 50 years or even longer due to increasing demand by heavy industry and the power sector. There is no contradiction in this statement. For instance, I am not worried that we will find gasoline stations or oil depots with a sign: "Sorry, we are out of energy. Please come back in 20 years." The fossil fuel business is run by trading houses that will never go out of business just because they have run out of fossil fuels such as oil, gas, and coal. They will all switch to renewable energy sources in a timely manner and trade those instead of fossil fuels at their terms and conditions. It is wishful thinking to believe that under such a scenario renewable energy resources will become cheap or cheaper. Prices will most likely follow the price trend of fossil fuels if trading houses are involved. Instead of an OPEC, we may be facing a REPEC. However, energy modesty combined with decentralised renewable energy supply strategies is a manageable localised solution that could emerge as an affordable alternative within the command and control area of villages and townships. There is neither a natural nor an economic law saying we need large monopolies comprising just a few power and energy supply utilities. There could just as well be a hundred thousand town or village based and controlled energy utilities in the future.

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# Enhancing energy security

Photo | Axel Schmidt

Shimon Awerbuch

Shimon Awerbuch, text and figures | Axel Schmidt; Getty Images/Brand X, photos

Our guest author Shimon Awerbuch presents convincing economic reasons for increasing the use of renewable energies all over the world. As the proportion of such energies rises, overall economic costs and risks fall. Greater energy security benefits developing countries most of all.

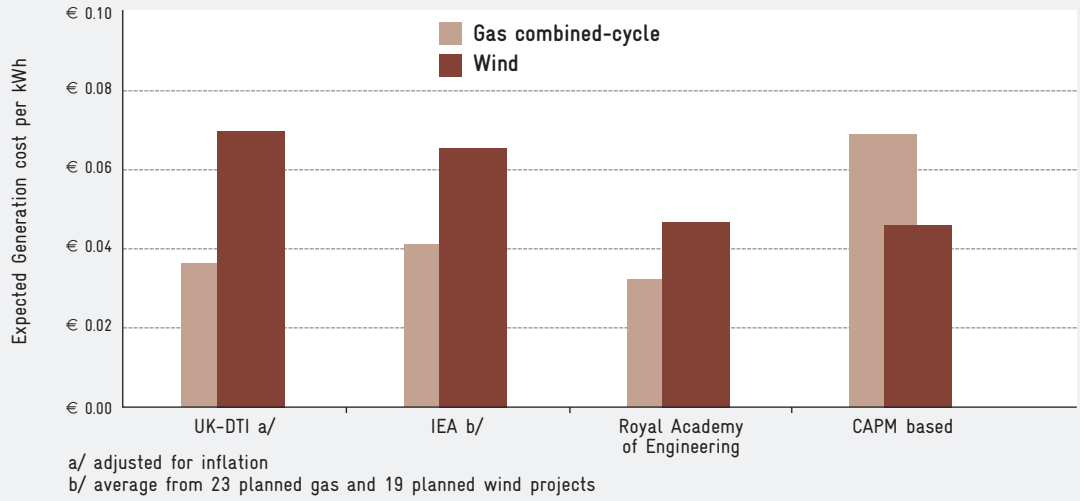
Recently, I had the privilege of addressing a meeting in Washington D.C. sponsored by the German Federal Ministry for Economic Cooperation and Development and the World Bank. This article summarises that presentation, in which I argued that, when valued using portfolio theory and other contemporary finance-based approaches, renewables are considerably more cost-effective than is widely believed. This is especially true in the case of developing countries, which spend significantly higher proportions of their GDP on fossil imports. Also, because these countries often do not have fully developed power grids, conventional central generation technology investments require expensive grid extensions. In such settings, renewables become especially attractive.

The first important point of my talk was to stress that we must shift the grounds for debate on renewables. Dr. Jorge Huacuz of Mexico's Institute for Electricity Research was the first to suggest this idea. To me, it implies that we must abandon century-old engineering-based electricity cost measures and in their place incorporate modern finance theory, which focuses on the cost and risk contributions various technologies make to a portfolio of generating assets. Finance theory provides a better basis for evaluating energy investment strategies in today's highly uncertain environment.

Intelligent energy planning decisions require reliable assessments of uncertain future energy prices. How much does it cost to make a kilowatt-hour (kWh) of electricity from gas or wind? Widely cited engineering cost estimates produced by national and multi-national agencies such as the UK's Department of Trade and Industry, the International Energy Agency, and the Royal Academy of Engineering give the impression that gas-fired generation is "cheapest". However, these estimates, as I have been arguing since the early 1990s, tell us little about the true, risk-adjusted cost of generating with gas relative to wind and other renewables. Setting energy policy targets on the basis of such poor cost information is like driving a car that has no speedometer.

## Electricity generating cost estimates

Finance theory tells us how to value investments – and also how not to do it. By incorporating the cost of market risk, it represents a major improvement over previous engineering techniques that have been around since the beginning of the 20th century. The principal underpinnings of modern finance theory include the Sharpe-Lintner Capital Asset Pricing Model (CAPM) and Markowitz's Mean-Variance Portfolio Theory, both developed 50 years ago. These




Current estimate of future cost of energy generation according to the author (Figure 1)

Nobel-winning contributions, which fundamentally affect all aspects of investment analysis, present a new, and to many, a surprising picture of the relative cost-effectiveness of conventional and renewable generating alternatives.

My own kWh cost estimates, which have remained quite constant over the last decade, use a standard risk-adjusted approach based on the CAPM. Through periods of both low and high fossil prices, these estimates have consistently suggested that gas generation costs more than wind and other renewables, in stark contrast to the results produced by national and multinational agencies. CAPM-based models tell us that over the next 25 years the expected cost of gas-fired generation will be at least 75 percent higher than widely cited engineering-based estimates and well in excess of the CAPM-based cost of wind (Figure 1). The CAPM kWh cost estimates use the same set of projected fuel and other input costs, but have a precise economic interpretation: they provide a conservative proxy of the firm, 25-30 year fixed-price offers investors would submit for producing electricity in efficient markets.

Though gas prices have risen sharply and fluctuated wildly, energy analysts seem to have difficulty shaking their traditional beliefs that gas is "cheapest." Their engineering cost models tell them that gas costs less because it will produce more kilowatt-hours for a given projected level of capital, operating and fuel costs. But gas-fired generation is not cheaper; it is simply riskier. Financial investors understand this idea. They routinely analyse, for example, investments in low-risk government bonds as compared to high-risk, high-yield corporate bonds (usually called "junk bonds"). These promise a higher return for a given level of investment but also carry a higher risk that the promised return may not materialise. These risk differences explain why a low-grade corporate bond with an expected annual yield of around 8 percent, (80 per 1,000 € invested) trades at the same market price as a US government bond with an expected yield of only 40 € per year, per 1,000 € invested. Although the junk bond promises twice the payout, investors recognise its speculative nature and hence will not pay more for it than they would for a 'safe' government bond that pays only half as much each year.

Investors in gas generation do not worry as much about the risk of fluctuating gas prices since these are more readily passed on to customers, potentially leading to more investment in gas generation than may be optimal from a societal perspective. This is where policy-makers need to step in. I suspect few policy-makers anywhere invest large portions of their personal assets in risky energy commodity markets. They need to apply this same sensibility to their policy making and recognise that today's fossil generation investments create risk by way of long-term consumer obligations to purchase electricity generated with highly speculative fossil commodities. Traditional cost estimates for gas- (and coal ) fired electricity do not reflect the speculative nature of these fuels.

## Long-term energy policy: focus on portfolios and strategies

CAPM models reflect investor behaviour and produce more reliable generating cost estimates. Yet these estimates are still not fully satisfactory for planning future electricity capacity. Suppose we assume for the moment that gas generation installed today will really be cheaper than wind over the next 25 years. Should we then invest only in gas to the exclusion of wind and other renew-

ables? This is equivalent to a financial investor placing all of his assets in yesterday's best performing stock. This is more or less how electricity capacity expansion has been conceived over the last 50 years.

Investors take a more sophisticated approach to managing risk. They hold balanced, diversified and efficient portfolios; these produce the best results under a variety of possible economic outcomes. Policy-makers must take their cue from these risk professionals. Instead of focusing on the 'stand-alone' cost of energy technologies, they need to consider the cost and risk of alternative generating portfolios and investment strategies.

And this brings me to the second major point of my presentation in Washington: when added to a fossil generating portfolio, renewables actually reduce overall generating cost at any given level of risk – even if they are assumed to cost more. This direct result of textbook theory derives from the so-called portfolio-effect identified by Markowitz, who in essence showed investors that adding low-yielding government obligations to a stock portfolio serves to raise expected portfolio return. This outcome seems counter-intuitive, since government bonds might return only 4 percent per annum, as compared to 8 percent for stocks. Applied to generating assets, the portfolio effect suggests that renewables, which mimic the financial properties of government bonds, will diversify the portfolio thereby reducing overall generating cost.

I have applied portfolio optimisation to evaluate generating mixes in several developing (and developed) countries, using engineering cost estimates – which show that gas is cheapest. The results consistently indicate that increased renewables shares improve the generating portfolio. For example, in an analysis of Mexico's electricity mix, I found that adding more wind and geothermal reduces the cost and risk of the 2010 mix projected by SENER, the Mexican Energy Ministry. This, in spite of the fact that wind and geothermal are assumed to cost 5.1 and 4.5 US-cents/kWh, compared to 3.2 US-cents/kWh for gas.

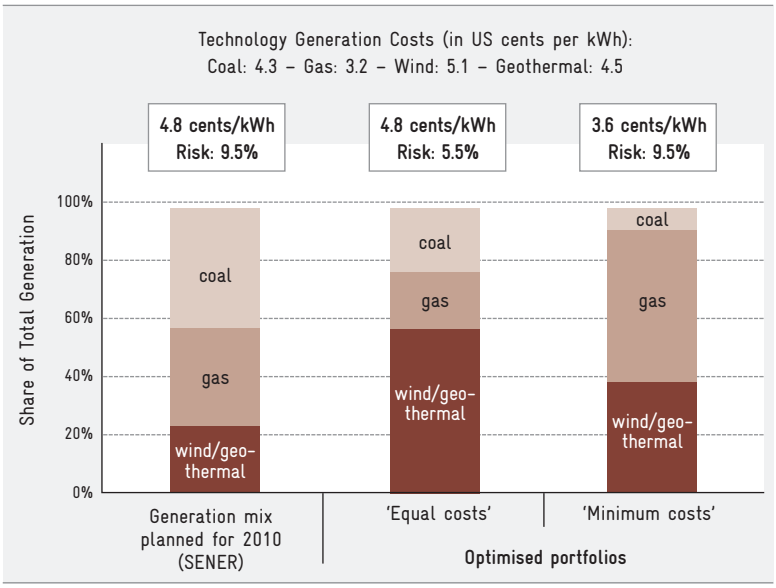
The 2010 SENER mix has an expected cost of 4.8 US-cents/kWh, with an expected risk of 9.5 percent (Figure 2). Risk reflects the magnitude of expected year-to-year generating cost fluctuations. Figure 2 also shows two optimised 2010 portfolios. The equal-cost mix leaves generating cost unchanged at 4.8 cents, but nearly halves the expected year-to-year volatility, from 9.5 percent to 5.5 percent. The equal-risk mix reduces expected generating cost by 25 percent, from 4.8 cents to 3.6 cents, while leaving risk unchanged at 9.5 percent. These portfolio cost-risk reductions are obtained as the renewables share rises dramatically, from 22 percent in the SENER mix, to 58 percent and 39 percent in the equal-cost and equal-risk mixes. The portfolio results are clear: investments in fixed-cost renewables reduce overall generating cost even when they are assumed to be more expensive than conventional generation. Optimised portfolios reduce generating costs without sacrificing decarbonisation goals*.

## Enhancing energy security: the Oil-GPD effect

Another key aspect of energy security is the so-called Oil-GDP effect. Energy security is often conceived in terms of the geopolitical risks of supply interruptions. But the Oil-GDP effect represents a more powerful market-based aspect of energy security. Exposure to fossil price volatility imposes massive macroeconomic consequences in energy consuming (and producing) nations. These include lower GDP growth and higher inflation. J.D. Hamilton is usually credited for the first long-term empirical analysis of the Oil-GDP effect in 1983, although two years earlier the US Congressional Budget Office estimated that the 1973 oil embargo cut US$ 350 billion from the US economy.

Though the idea is not new, energy policy-makers have widely ignored the powerful implications of Oil-GDP and Gas-GDP effects on renewables policy, even as oil prices surged 300 percent in 1999-2001 and again by 200 percent in subsequent years. The link between effective energy policy and sustained economic growth is obvious, though widely misunderstood. The US administration, for example, maintains that

Mexico-2010 Projected & optimised generating portfolios (Figure 2)



meeting Kyoto targets is too costly. One wonders whether this conclusion reflects the findings of its own Oak Ridge National Laboratory, which in 2000 found that oil price volatility cost the US economy at least US$ 7 trillion USD over the previous 30 years, not including "military, strategic or political costs".

Costly as oil price volatility is to the economies of developed nations, it hits developing countries even harder, as shown by a World Bank analysis in 2004. These countries devote larger shares of their GDP and household incomes to importing oil and gas. This, combined with the pressure that energy imports place on developing country currencies, has significantly slowed growth rates. The report found that a US$ 10 per barrel oil price increase (in 2003) reduced the GDP of OECD members by 0.3 percent while the effect on low-income countries was 1.4 percent, nearly five times as great.

The Oil-GDP 'elasticity'– the magnitude of GDP reduction for a 100 percent oil price increase– is generally estimated at about 5 percent. In rough terms, this means that every 10 percent oil price increase cuts 160 billion € off global GDP. This has powerful implications for renewables. In a recent paper, Raphael Sauter and I estimate the extent to which wind and other renewables might mitigate such Oil-GDP losses. We find that by displacing gas and, in turn oil, a 10-percentage point increase in the share of renewable electricity generation could eradicate 75 – 140 billion € in global GDP losses. The effects would no doubt be larger in developing nations, to the extent that renewables might directly displace oil usage. Our analysis further suggests that avoided GDP losses offset 250 € of each kW investment in wind and solar, and 800 € per kW for geothermal and biomass investments. This GDP offset presents a powerful economic rationale for increasing the worldwide deployment of renewables. The societal valuation of renewables must reflect avoided GDP losses, whose benefit is not fully captured by private investors. Energy security is enhanced when nations hold optimised generating portfolios that minimise exposure to fossil volatility.

## Conclusions

The economic case for increased global deployment of renewables is strong. Finance-oriented cost models suggest that at currently projected gas prices, wind and other fixed cost renewables are likely to provide electricity at lower cost. Moreover, even if their generating costs are assumed to be higher, renewables reduce overall cost and risk when added to fossil-dominated generating mixes. Renewables enhance energy security by offsetting costly Oil-GDP losses. This is particularly important for developing country economies. In the US and other OECD countries, where renewables displace gas generation, every kW investment in wind or solar offsets 250 € in oil-induced GDP losses. This offset is likely to be larger in developing nations where renewables deployment may directly displace oil.

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*The full report for this project, sponsored by REEEP, UNEP and BASE, is available at http://www.awerbuch.com/shimonpages/shimondocs/REEEP-UNEP-report.doc.

# Cooperation matters

The Netherlands and Germany have developed an innovative joint approach for providing access to modern energy services

Arno D. Tomowski and Florian Ziegler, text
agenda fototext, photo

In recent years it has become increasingly obvious that coordinating and harmonising development efforts is an important contribution to achieving sustainable development. Partnerships between development institutions offer the possibility of significantly increasing assistance effectiveness, a fact highlighted in the Paris Declaration on Aid Effectiveness adopted in March 2005. GTZ regards partnerships and cooperation as critical in promoting sustainable development.

Experience has shown that there is no "one-size-fits-all" approach to effective development cooperation. In parallel with the implementation of technical assistance projects and programmes, GTZ has actively sought dialogue and cooperation with other development actors. Thus, GTZ has been able to constantly learn from others, and has also provided expert knowledge from its twenty-five years of experience in implementing energy projects.

## Energising Development

In some cases, other bilateral donors have co-financed existing German Technical Cooperation activities, thus providing the possibility to scale up successful approaches. One outstanding example is the "Energising Development" (EnDev) programme launched in December 2004 by the Netherlands Ministry for Development Cooperation (DGIS) and the German Federal Ministry for Economic Co-operation and Development (BMZ). The Netherlands and Germany have agreed on implementation-oriented cooperation to increase access to modern energy services, including renewable energy and energy efficiency.

In the framework of EnDev, DGIS will offer grant funding over a period of four years. The objective of EnDev is to provide five million people in developing countries with sustainable access to modern forms of energy in an accountable, technology neutral and demand-driven way in the following four service categories: lighting, cooking, social infra-

structure and, for productive purposes, especially in small and medium-sized enterprises.

It is a core element of the Dutch Government's strategy to attain the target of providing modern and sustainable energy services to ten million people by 2015. With this cooperation scheme, both partners intend to translate the principles and objectives of the UN Millennium Declaration and the Johannesburg Plan of Implementation into concrete action. GTZ is acting on behalf of Germany as the principal agency for the general execution of the partnership.

The core criteria for projects to be supported under the EnDev partnership relate to both quantitative output (in terms of the number of people provided with access to modern energy) and long-term sustainability. This means that activities are guided by the objective of achieving long-term development impacts in a cost-efficient way. The economic sustainability of support to energy service providers is enhanced by a number of criteria that apply to all projects, including the requirement to create self-sustaining markets within a maximum of five years. Subsidies can only be granted for investment costs, and a substantial contribution from the beneficiaries is consistently sought. Affordability of energy services is improved through targeted interventions to promote the use of energy for income-generating activities/productive use. EnDev is building local capacity, for example by training stove producers not only in technical skills but business, marketing and sales skills as well. It is also creating adequate maintenance structures for different kinds of energy services. Sustainability and progress are constantly monitored.

EnDev is taking an "outcome-oriented" approach with a strong focus on quantifying the results. With the support of EnDev, on-going bilateral activities are being scaled up, and new activities are being established. In order to reach a maximum of people with the available funding, projects with a favourable cost-per beneficiary ratio are selected for co-financing under the EnDev programme. This is rendered possible by the fact that GTZ is granted full flexibility in the allocation of programme funds to the most successful projects in different countries. Thus, the programme is providing an opportunity to apply mature and proven concepts for delivering quantifiable development impact at comparatively low transaction costs. Transparent monitoring and evaluation tools have also been developed to assure an effective and efficient design and implementation of projects.

## A wide range of partners

Cooperation between donors and implementing agencies is effective because it combines the comparative advantages of each development instrument. "Energising Development" is a good example of how cooperation and delegated implementation can increase the overall impact of interventions through synergies and economies of scale.

Beyond the EnDev programme, GTZ works with a wide range of partners such as the UN, regional organisations, and international financial institutions including development banks such as the World Bank. Today, a number of international energy partnerships are actively advancing the "energy for development" agenda. GTZ has managed to build strong relationships with many of these initiatives, including the EU Energy Initiative for Poverty Eradication and Sustainable Development (EUEI), the Renewable Energy Policy Network for the 21st Century (REN21), the Renewable Energy and Energy Efficiency Partnership (REEEP) and the Global Network on Energy for Sustainable Development (GNESD).

Cooperation between institutions that are involved in the field of energy and development benefits everyone. The pooling of resources promotes diffusion and a scaling up of successful approaches. The exchange of information and experiences reduces project transaction costs and improves quality. It also helps avoid duplication and bridge gaps between the efforts of different institutions. Partnerships are therefore essential in order to increase the impact that energy projects and programmes have on developing countries.

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## EnDev – A Dutch-German partnership

| | |
|---|---|
| **Concept** | EnDev focuses on the scaling up of ongoing energy projects, using GTZ's long-standing experience in the field and the benefits of an established infrastructure for implementation. It aims at improving energy access in the following four areas: Energy for cooking, Energy for lighting/ household applications, Energy for social infrastructure, Energy for productive use |
| **Actors involved** | The Dutch department for development cooperation within the Ministry of Foreign Affairs, the German Ministry for Economic Cooperation and Development, Deutsche Gesellschaft für Technische Zusammenarbeit (GTZ), Senter Novem as well as ministries of energy business associations and NGOs in numerous of partner countries. |
| **Countries involved** | EnDev runs activities in Africa (Benin, Burkina Faso, Ethiopia, Ghana, Kenya, Mali, Mozambique, Rwanda, Senegal, Tanzania, Uganda and two supra-regional projects), Asia (Bangladesh, Mongolia, Indonesia) and Latin America (Bolivia, Nicaragua, Honduras). |
| **Costs** | The overall amount of the Partnership amounts to 60 million € for the budget allocation period of 2005-2008. |


Village receiving electricity from microhydro power plant in East Africa.

# Regional approaches to energy access in Africa

Ray Holland and Lucius Mayer-Tasch, text | GTZ archive, photos

In the 90 percent of rural sub-Saharan Africa that depends on traditional biomass energy for energy supplies, even modest improvements in access to modern energy services can have a big impact. The major question is: how can access to modern energy services be improved on the huge scale needed to attain the Millennium Development Goals by 2015? Action to promote access to energy at national level is key but must be complemented by regional activities.

After a long period of neglect, energy is finally back on the agenda of governments, international organisations and the development scene in Africa. With more and more donors willing to provide resources for energy infrastructure and energy access in sub-Saharan Africa, there is a need to integrate access to modern energy services into national plans such as Poverty Reduction Strategies, to develop policies and strategies and identify good projects. This wave has also prompted regional organisations to reach agreement on ways to improve energy access. But what role can regional organisations play here?

In 2002, the New Partnership for Africa's Development (NEPAD) proposed that regional organisations, such as the Economic Community of West African States (ECOWAS), the


ECOWAS: Economic Community of West African States

CEMAC: Communauté Economique et Monétaire de l'Afrique Centrale

EAC: East African Community

Communauté Economique et Monétaire de l'Afrique Centrale (CEMAC) or the East African Community (EAC), play a key role in increasing access to modern energy services. NEPAD set a target for providing access to electricity for 35 percent of the population of Africa by 2015 and modern energy for cooking such as improved stoves or fuels like Liquid Petroleum Gas (LPG) to half the population. Since then, all of these regional organisations have developed strategies or action plans, such as the ECOWAS/UEMOA White Paper on Energy Access, the EAC Energy Access Strategy and the CEMAC Action Plan for Promotion of Energy Access (all adopted in 2006). These regional strategies are aimed at addressing the following four targets: 1. Providing modern energy for cooking to at least half the population; 2. Energy for urban and peri-urban areas; 3. Energy for social services like energy for lighting, refrigeration and water pumping; 4. Energy for productive use, particularly motive power for milling and other crop processing.

## The role of regional organisations

These targets have been adopted by all the member states of the regional organisations concerned, and it is primarily up to their governments to take action to achieve them. However, by acting together as regional organisations, the countries are able to provide solidarity and mutual support.

At present, none of the regional organisations has much capacity in energy access at Secretariat/Commission level, but in response to demand from their member states they have now all succeeded in putting energy access on the agenda and gaining political commitment. The regional organisations are now building their capacity to address common energy-related development concerns of their member states, harmonise policies and strategies and share experience.

## Creating a regional market

The first step in regional integration is usually economic integration, and the regional organisations of sub-Saharan Africa share the objective of developing common regional markets. This process needs to be led by regional organisations and can make a significant contribution to increased access to energy. Creating an enabling environment for intra-regional trade in energy-related products and services as well as imports from outside the region is clearly something that requires regional agreement. Reduced import duties and uniform standards for products such as solar panels and the creation of a common, bigger market for fuels, equipment and energy services can help bring about price reductions for consumers and improved services. Furthermore, regional markets allow local enterprises such as stove producers to benefit from economies of scale and facilitate trade of wood and charcoal between deficit and surplus areas. This may be complemented by harmonised subsidy schemes for rural electrification and by the transfer of successful business models to provide modern energy services to the poor (the energy access strategy for EAC puts particular emphasis on proven business models).

## Ensuring regional power supply

Many parts of Africa currently suffer from a lack of generating capacity, which poses a threat to their energy security and restricts energy access. The current power shortage in East Africa, due among other things to historically low water levels of Lake Victoria, is a case in point. The power crisis has led to load shedding as well as costly investments in private gensets and expensive diesel generation for the grid. These problems can be mitigated by joint development of energy resources and increased cross-border trade in electricity. The regional power pools that have gradually been established in all regions of Africa are playing a crucial role in laying the basis for cost-effective regional electricity supply

and successful grid extension programmes in rural and peri-urban areas. The large investment programmes needed are supported by the international financial institutions and the EU. However, investment in major regional generation projects, interconnections and transmission lines alone will mainly benefit large industrial consumers and those already connected to the grid (e.g. urban elites). Such investments therefore need to be complemented by local investments in grid extension and off-grid access to energy.


Participants of a regional workshop on the EAC Energy Access Strategy in Arusha

## Exchange of experience and planning

Another important area for regional cooperation is the exchange of experience with energy access interventions, including best practices and lessons learnt. The regional organisations are therefore planning to provide a platform for exchange and joint learning for government officials, staff of rural energy agencies, NGOs, etc. This cooperation can help identify successful and cost-effective approaches for scaling up access to energy including successful business models, or public-private partnerships. The regional organisations will work closely with existing specialist national research and training institutions in this area, to provide regional services.

Collection of data across a region will facilitate regional energy planning and enable monitoring of energy access indicators and targets. For instance, CEMAC is planning to establish a regional *Observatoire de l'Accès à l'Energie* and wants to engage in coordinated regional hydropower planning. The latter has been identified as a priority action by CEMAC, and since adoption of the strategy, the CEMAC secretariat and the member states have reviewed the existing data and defined the next steps with support from the EU Energy Initiative Partnership Dialogue Facility (EUEI PDF).

## Advocacy and fund mobilisation

The existence of a regional strategy provides a further argument for making more resources available for access programmes and for important but neglected issues such as the household energy sector. In addition, it may facilitate the mobilisation of funds from bilateral and multilateral donors. This has the positive side-effect of making external support more coordinated and reducing transaction costs. These are all areas where the regional activities can clearly complement and help improve action at national level. However, the issue of subsidiarity deserves serious attention. In this respect, the EAC's access strategy is a positive example: while the Secretariat is expected to play a critical role in coordinating and monitoring the implementation of the strategy, the actual implementation is the responsibility of national governments and the private sector.

## Conclusion

The regional organisations have suddenly become new players in the game, and it remains to be seen how much of the good intentions will be put into practice. The fact that each of the three regional strategies has been taken up by the heads of state of the member states concerned is encouraging. In addition, there is some evidence of follow-up action. For instance, the CEMAC Secretariat, along with the ministries of energy and the utilities and the Central African Development Bank, has submitted a proposal to the recent EU Energy Facility for countries from Africa, the Caribbean and the Pacific (ACP) for co-funding of a peri-urban electrification programme that would connect 62,500 households to the grid. ECOWAS has developed a concept for a new Regional Agency for Energy Access (RAEA), and the EAC member states have drawn up action plans to kick-start their strategy. As these strategies get underway, there is an opportunity for the regional organisations to learn from each other in order to be more effective in jointly working for the achievement of the ambitious continental access targets as envisioned by NEPAD. New initiatives, such as the World Bank's Africa Energy Access Action Plan under the Clean Energy and Development Investment Framework, demonstrate that the issue of access to energy is now receiving serious attention from both donors and African decision-makers.

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EUEI PDF has supported the development of the CEMAC energy access action plan, the EAC access strategy as well as a study on Regional Agency for Energy Access (RAEA) that is foreseen in the ECOWAS white paper.

# Boosting renewables with the right policies

Paul H. Suding and Philippe Lempp, text | GTZ archive; agenda fototext, photos

2005 was another record year for investment in renewable energy. The REN21 Global Status Report 2006 update brims with accounts of high growth in almost every technology and market in this sector. However, growth tends to be strongest where policy has established favourable conditions, underscoring that setting an appropriate policy framework is crucial to promoting renewable energy.

Sustained promotion policy has made Germany the leader in wind as well as photovoltaic solar energy. Spain has effectively followed that path, and other European countries are joining in. In 2006, the US took the lead in wind capacity additions, fostered by a prolongation of the federal promotion policy and the renewable portfolio obligations set by a number of states. With the adoption of renewable energy promotion policies even in large developing countries like China and India, yet more momentum is created to bring renewables forward.

### The International Action Programme of renewables 2004

In June 2004, participants of the International Conference for Renewable Energies (renewables 2004), held in Bonn, Germany, assembled an "International Action Programme" consisting of 197 specific actions towards developing renewable energies. The actions were put forward by a large number of governments, international organisations and stakeholders from civil society, the private sector and other stakeholder groups. They all contributed with voluntary commitments to goals, targets and actions within their own spheres of responsibility, demonstrating the dynamics of renewable energy in a very concrete manner.

Lately, rising fossil energy prices have led more investors to look into renewable energy options in particular biofuels. Even in such cases, policy is critical to ensure access to energy markets. In many countries modern renewable energy technologies are new players in the markets for electricity generation, transport and household energy. As such, these technologies have to overcome entry barriers where strong existing competitors occupy dominant market positions that they have bolstered with formal and informal arrangements over the decades. Rules and regulations geared to yesterday's market place continue to favour the established market actors. New policies are required to level the playing field. Fair competition often requires removing subsidies for traditional energy sources or granting equitable support for new energy technologies.

## Renewable energy in the global energy supply

According to the REN21 Global Status Report, renewable energy provides some 17 percent of the world's primary energy with 9 percent still being delivered by traditional biomass (i.e. agricultural residues, fuel wood and charcoal). Large hydropower (i.e. from plants above 10 MW) and the so-called "new renewables" (small hydro, modern biomass, wind, solar, geothermal and biofuels) supply the remaining 8 percent.

Despite their small share in global primary energy, the "new renewables" are advancing fast and are gaining significance in their respective markets. Wind energy has experienced an average annual growth rate as high as 25 percent for 15 years now. Solar photovoltaic generation capacity has made leaps of 50 percent in recent years. Since 2004, biodiesel production has doubled each year. Technologies like hydropower, ethanol, and solar hot water are growing strongly but with rates below 10 percent per year.

As ever more countries join the renewable energy policy trend, technological progress is bringing down costs. With fossil fuel prices remaining high,

the growth of renewable energy is set to continue. Biofuels are expected to see a boom in the short term. Long-term projections foresee a sustained high growth of renewables (except for the traditional fuels), even under business-as-usual assumptions.

However, these business-as-usual projections of world energy supply are considered unsustainable due to climate change and increasing scarcity of fossil resources. Global concern requires an even higher share and therefore more growth of renewables. It is not only global concerns but also local rationale that leads countries to accelerate the development of renewables: protection of the local environment, security of energy supply, protection against price volatility, industrial policy.

In summary, there is broad consensus that renewable energy technologies (RET) should play a much larger role in world energy supply. All the global scenarios developed to explore a low carbon future consider RET at least a highly significant part of the solution, and some even a panacea. The International Energy Agency (IEA) believes to be realistic when it estimates that by 2050 renewables could contribute 35 percent of global electricity production (up from 18 percent today) and that biofuels could reach a 20-percent share of the transport market, but it stresses that even this can only be achieved if the existing technologies are determinedly and consistently applied.

This draws our attention back to policy again. Market forces as predicted under business-as-usual conditions will not be sufficient for the development that is needed. Policy is critical to shape the markets that create favourable conditions for people and organisations to use and invest in renewables.

## Renewable energy policies in existing and emerging markets

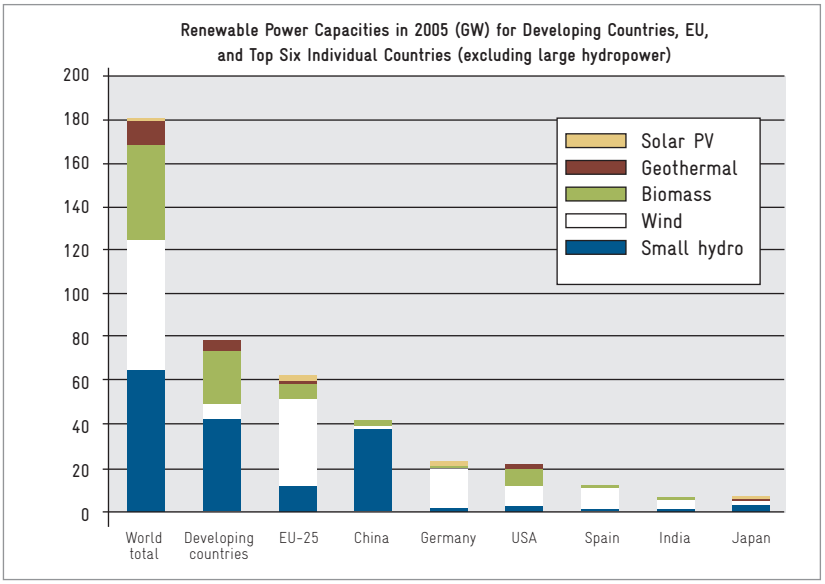
In industrialised countries and in modern areas of the developing economies, renewables have great prospects in electricity production, as transport fuels, and for low-temperature energy used for heating and cooling in buildings.

Years of experience in the promotion of renewable energy for electricity generation have shown that the most effective way to rapidly increase market shares and create thriving renewable energy industries is the establishment of feed-in regulations, including obligations for the electricity network and trading companies to connect, take up and remunerate - at a guaranteed preferential price - the electricity delivered from renewables. It is this policy that has made Germany and Spain the forerunners in wind power. Nonetheless, renewable energy quotas and portfolio standards (for electricity generators or distributors) have also proven quite successful if the electricity market framework is appropriate. Public bidding for renewable energy (RE) resource concessions and a power purchase contract will also work in an initial exploratory stage but become cumbersome when rapid expansion is the goal, as each project requires public bidding. China has decided to stay with this instrument for wind energy development, though it is combined with an unofficial quota that forces the electricity generators to participate in bids. Other proven instruments are fiscal incentives (e.g. tax breaks) to correct market signals. Like public bidding, tax incentives are often temporary measures and do not transform markets in a sustained long-term way, which feed-in tariffs and quotas do.

## Securing market access

In all cases, securing long-term market access and levelling the playing field for renewables is indispensable, and must be ensured through rule of law and powerful regulators. Interestingly, reforms in the electricity sector have generally enhanced the opportunities for renewable electricity generators where they have created an accessible generation market and reduced the dominant and politically influential position of integrated electricity companies.

Creating appropriate conditions for RE also includes a range of technical and procedural standards for connecting renewable electricity to the grid, land use regulation, etc. These standards reduce the time and cost of approval, thus facilitating access for non-traditional generators like farmers and private households. Indeed, specific rules and standards for decentralised electricity generated by the consumers is one of the secrets of Germany's renewable energy boom.




Secure market access and quota as well as tax exemptions are also the preferred policies for increasing the share of biofuels and biodiesel in the transport sector. As bioenergy production requires land resources and may compete with the production of food and even with nature conservation areas, a need emerges for coordination between energy, agriculture and forestry as well as nature conservation, which bears new opportunities but also dangers. In collaboration with the Worldwatch Institute, GTZ recently presented a comprehensive in-depth study showing that further breakthroughs in technology would be highly desirable to increase productivity and permit a sustained growth of bioenergy. Thus, related research and development (R&D) and a balanced promotion policy is needed.

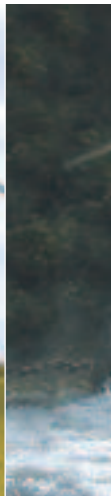
In the building sector, renewable energy obviously has enormous importance in terms of gains from solar radiation, which is, however, not accounted for in the statistics. More intelligent use of solar radiation by building technology (passive solar) and the reduction of losses can significantly contribute to a low carbon economy. RET like solar water heaters have attained wide application, most notably in China. They are still used in a hybrid manner, though, in combination with other hot water or heating technology. Energy efficiency policy can change this and define low or zero energy standards for buildings so that renewables can entirely cover the need for low-temperature energy services (for hot water, heating, and – why not? – cooling). The economics of solar thermal systems improve decisively when these technologies are not only an auxiliary but actually become the main system.

## Renewable energy in developing countries

Only few developing countries have ventured into policies focused on bringing RET into energy markets on a significant scale. Some large middle-income countries have advanced considerably, like China, India, or Brazil, followed by South Africa, Mexico and others which are still struggling internally to enact the policies.

Some developing countries have initiated specific renewable energy programmes that combine awareness raising, capacity building and research & development with the deployment of renewable energies in individual projects on the ground (e.g. Egypt, Tunisia, Uganda, Madagascar, Pakistan). Most developing countries do not promote renewable energies with special programmes but rather incorporate RE in programmes for rural energy, electricity sector expansion, etc.

Low-income developing countries are confronted with a complex challenge. In the modern energy



sector, they face a supply crisis, while in the rural and peri-urban area, access to modern forms of energy is urgent in order to reduce poverty. In such a situation, some consider the complex introduction of RET an additional burden. However, this need not necessarily apply. In many instances, renewable energies are actually the most cost-efficient solution. Where this is not the case, international co-operation and finance may be willing to help overcome the cost barrier. Special instruments like the Global Environment Fund (GEF) have been created to take care of such incremental costs.

In many developing countries, urban and productive electricity demand is rising but existing generation and grid infrastructure has become increasingly unreliable because of old age, extreme climate and inappropriate maintenance. Rehabilitation of existing hydropower plants has top priority, alongside improved water resources management, to realise the urgently needed expansion of electricity generation and gain capacity margins. In order to avoid that the worst-hit countries slip back to electricity production based on imported fossil fuels, all opportunities to establish renewable energy generating capacity must be seized: hydropower, biomass, and wind and geothermal energy where available. This requires clear government policies, enterprise involvement, and support from the international community via instruments such as the Clean Development Mechanism.

In off-grid areas, a variety of low-tech energies are used. The low quality of the energy services goes hand in hand with the lower quality of other technical, as well as social infrastructure, and – consequently – poverty. Modern forms of energy, like electricity and gas, can significantly improve the quality and opportunities of life in these areas. At the same time, traditional fuel use has to be rendered ecologically sustainable and also benign vis-à-vis people's health. Solar, small wind, small hydro, as well as biogas, are the preferred technologies where grid extension is uneconomical. Rural energy policies need to consider the rural energy needs in an integrated manner. Here too, government policy is required and international support is available to follow a low-carbon growth path. The establishment of institutions for financing, operation, and maintenance is crucial to securing sustainability.

Development and environment need not clash. Indeed, the two can be complementary. RET provide means to attain local development without damaging the local environment while contributing to the protection of global environmental goods.

Without doubt, achieving sustainable energy is one of the major challenges of our time. Its local and international aspects cannot be separated, nor can its impacts on development and environment. Therefore, REN21 works as a global policy network to connect different stakeholders from all parts of the world, with the goal to improve understanding of the value of renewables in contributing to sustainable development in a holistic way. While further research and technological development remain important, the time is already ripe to benefit from more renewable energy. Tapping these benefits now is above all a question of political will and very practical policy measures.

REN21 Renewable Energy Policy Network for the 21st Century

**About REN21**

REN21 is a global multi-stakeholder initiative that emerged from the renewables 2004 conference. It keeps the international momentum of renewables 2004 active and follows up on the conference outcomes. REN21 has many participants from all types of organisations from the development, environment and energy communities. GTZ and UNEP are the implementing partners of the REN21 Secretariat in Paris. So far, the principal financing partners have been the German Ministries for Development (BMZ) and Environment (BMU). The IEA is an additional partner in the Secretariat, and more than 30 distinguished individuals from a large variety of organisations are members of the network's Steering Committee.
GTZ is executing partner in the REN21 Secretariat.
www.ren21.net

Paul H. Suding is head of the REN21 Secretariat, and Philippe Lempp is policy advisor in the Secretariat.

# Stand-alone energy

Bernward Janzing, text | GTZ, photos

Electricity for 23 million people. That is the goal of the Brightness Programme in the People's Republic of China. With the aid of small local renewable energy systems, poor people in remote rural areas will soon be able to generate power for their own use.

Today in the People's Republic of China, only two percent of the population are still without access to electricity. That doesn't sound much. But two percent of China is thirty million people – the same as half the population of Britain. More than 20 million of these will see a change in the next four years. Such is the goal of the Brightness Programme in the western provinces, which plans to use stand-alone photovoltaic systems, small wind turbines or small hydropower units to secure a decentralised supply of electricity for these areas.

How come a booming economy like that of China still needs development assistance? The average per capita consumption of 1,450 kilowatt-hours is one quarter of that in Germany, but hides huge inequalities in the country. In the West and North of the People's Republic, people are cut off from development. Both the economic boom and targeted rural development are creating an explosion in the consumption of natural resources and energy. China is laying claim to its share of the world energy market and to its population's right to emit greenhouse gases along with everyone else. It is in Europe's own interests to aid China in scaling back its $CO_2$ emissions.

Development cooperation in China involves a long-term relationship with Germany, which in turn creates markets for German technology. It also provides an opportunity to adapt a proven legal framework such as the German Renewable Energy Act into China's legislation. This can make a significant contribution to combating global warming.

Fossil fuels such as coal, natural gas and oil are still the main energy sources in China, providing about 80 percent of total power generation. The share of hydroelectric power is steady at nearly 20 percent. Despite massive construction of hydroelectric facilities, such as the Three Gorges scheme, the simultaneous increase in energy consumption has meant that the share of hydropower has hardly changed. The contribution of nuclear energy is just one percent of the total, and wind power considerably less than that.

China has the greatest wind energy generation potential in the world, also thanks to its huge size. The usable potential of onshore sites is estimated to be 250 gigawatts. Windy locations are found mainly in the steppes and deserts in North and West China and in coastal regions. And according to the Chinese Wind Energy Association, potential for off-shore sites is around 750 gigawatts. At the end of 2005, the installed total capacity was about 1.26 gigawatts. The Chinese government is pursuing the ambitious objective of installing a total of 30 gigawatts of wind power capacity by 2020.

In terms of hydropower, too, no country on Earth has resources as great as China's. At the end of 2004, the total installed capacity of all hydropower units in the People's Republic was 116 gigawatts. The technically exploitable hydropower potential is reckoned to be around 680 gigawatts. By 2020, China wants to boost its installed hydropower capacity to 290 gigawatts. To achieve this, an array of large-scale projects is being launched in addition to the many small ones. When the gigantic Three Gorges power plant on the Yangtze is completed in 2009, it alone will have a generating capacity of 18 gigawatts, and China plans five more mega hydropower plants with a total capacity of 50 gigawatts.

## Small-scale systems

Small-scale systems driven by wind, water or solar energy are the subject of great interest from technical cooperation assistance. Around 500,000 small-scale renewable units are currently connected in mini-grids supplying power to over one million people in remote communities. The systems are equally divided between solar photovoltaics, small wind and mini-hydropower generation.

Like wind and hydropower, solar energy has great potential. China has a good average solar energy (insolation) level of four kWh per square metre. The West of the country has more than 3,000 hours of sunshine annually. The rural Township Electrification Programme, the first stage of the Brightness Programme, installed a total of 15.6 megawatts of photovoltaic power from 2002 to 2004. Two years ago, the nation's lar-

Long-term goals. The Brightness Programme is not only about installing small photovoltaic arrays and wind turbines. GTZ experts are supporting the establishment of an entire technical and economic system.

gest photovoltaic plant, with a capacity of one megawatt, went on the grid in Shenzhen. By the end of 2005, the total capacity was more than 70 megawatts. Increasingly, the technology is coming from China itself. The production capacity for photovoltaic panels, which tops 1,500 megawatts per year, supplies German firms as well as the domestic market.

GTZ has been working in the field of rural electrification with renewable energy on behalf of the German Federal Ministry for Economic Cooperation and Development (BMZ) since the beginning of the 1990s. Since 2005, GTZ has also supported the rapid development of on-grid electricity generation from wind power and is preparing a project for the use of bioenergy. Cooperation on policy development complements the project-based activities. From the start, technical cooperation supported locally produced renewable energy technologies, helping to adapt them technically and to disseminate them. Today, micro wind turbines, village-scale photovoltaic plants and solar hot water systems are all elements of decentralised supply. Micro wind turbines are now being integrated into local power supply systems together with photovoltaic units. With 22 manufacturers, China is the world's largest producer of off-grid wind turbines with capacities of less than three kilowatts – and also their largest user. The current total capacity of the 250,000 small systems installed is about 42 megawatts.

### Small systems, major impacts

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| **Context** | In rural areas of the PR China, 30 million people still have no access to electric power. |
| **Goal** | Rural electrification and promotion of the local economy through decentralised renewable energy technologies. |
| **Concept** | Support for the establishment of a market for renewable energy technologies, advising institutions, training of local staff and improvement of technical quality. |
| **Partners** | Local operators, rural energy utilities and governmental organisations. |
| **Costs** | BMZ promotes technical cooperation for the use of renewable energy in rural areas of the PR China with 7.1 million €. |

### An all-around package

The Brightness Programme involves considerably more than simply installing small photovoltaic arrays and wind turbines, however. GTZ experts, acting on behalf of BMZ, are supporting the establishment of an entire technical and economic system. Designed with a view to the long term, the programme includes not only equipment maintenance and power transmission but sales of power and training of instructors to train local operators as well. Both the Township Electrification Programme and the follow-up programme for smaller villages are intended to improve living conditions and point the way towards better economic prospects for the people in China's rural regions.

Besides distributed power generation in off-grid regions, GTZ is also promoting grid-connected wind generation, particularly in China. And because China's ambitious wind energy expansion plans cannot be achieved without sufficient trained staff, GTZ and its Chinese partners founded a Research and Training Centre. At the end of the 1990s, as part of the TERNA wind energy programme (see the article "The Cradle of the Winds", page 34), wind measurements had already been made in Hubei Province, and national energy policy advisory services had begun.

### Advisory services on energy policy

The early expansion of wind power faced a number of obstacles. The government of China was not prepared to factor the external costs of producing power from coal into economic calculations, which would have made wind power competitive in favourable sites. Wind power was only developed in a few provinces with the support of the

## Project portfolio in China

In addition to the project "Renewable Energies in Rural Areas", the Federal Ministry for Economic Development and Cooperation (BMZ) has commissioned GTZ with three further projects in the fields of energy efficiency and renewable energies in China. GTZ's activities in these projects include providing advice to the clients, counterparts and the private sector, and deploying short-term and long-term experts.

In order to increase wind-generated electrical power, substantial changes have to be made to political framework conditions, and training facilities need to be created for qualified staff to operate the new wind power plants. GTZ's Wind Power Research & Training Project aims to improve the technical capacities for a nation-wide expansion of grid-connected wind energy use. Project inputs consist of a wide range of training courses for technicians, planners and developers, practice-oriented studies of the technical aspects of using wind energy, monitoring existing power plants, supporting certification of wind energy plants, testing grid connections and providing services. The implementing organisations are the China Long Yuan Electric Power Group (CLYEPG) and the China Electric Power Research Institute (CEPRI).

Energy consumption for heating, cooling and other services in buildings creates vast amounts of carbon dioxide. Improving urban air quality as well as housing conditions benefits lower income groups in particular, while simultaneously, pressure on water supply is lowered and greenhouse gas emissions are reduced. The project Energy Efficiency in Existing Buildings (EEEB) aims to disseminate proven standards and procedures for energy-efficient retrofitting of existing residential buildings by the Ministry of Construction for Northern China. EEEB is working together with the Ministry as well as, among others, construction sector R&D institutes, local governments and heating supply companies. Based on experience from Europe, the project supports efforts to develop and improve technical concepts and programmes in retrofitting existing buildings. The new measures have resulted in energy savings of 30 percent.

China is the world's largest coal producer, and 68 percent of its electricity is generated in coal-fired plants. On average, however, these plants consume around 15 percent more coal and 50 percent more water than power plants in Germany. And each year, China loses around 20 million tonnes of coal a year through spontaneous coal-seam fires. The project Environmental Protection in the Energy Industry (EPEI) aims to promote the environmentally friendly use of coal and water in the power plants that are being examined as well as the protection of coal in its natural deposits. GTZ is cooperating with the Energy Bureau of the National Development and Reform Commission (NDRC), the China Electricity Council (CEC), a non-governmental association of power sector companies, the State Administration of Coal Mine Safety, service providers in the power sector, power plant operators and fire-extinguishing departments dealing with coal-seam fires. Several power plants have already been optimised, and environmental and resource protection in the Chinese power sector has become a political priority.

provincial government, mostly with bilateral financial cooperation with Denmark or the German KfW development bank.

Satisfactory long-term contracts with acceptable prices were rarely obtainable. Foreign wind power developers failed to negotiate their way through Chinese approval procedures. High import duties were imposed. The Chinese government has stipulated that a high percentage of components, e.g. 70 percent of wind turbine parts, must be locally manufactured. Foreign manufacturers were very wary of setting up the local production facilities desired by the Chinese side, fearing to lose their head start in know-how. A few have therefore granted licences, but it was not until last year that foreign manufacturers started to invest heavily in plant construction.

New ground was broken in Chinese energy policy when, in 2003/2004, the first tenders were solicited for two concessions for wind farms with a capacity of 100 megawatts each. Concurrently, work began on a comprehensive law on the promotion of renewable energy. The GTZ energy adviser supported government representatives in this process. The Chinese law on promoting renewable energy, which came into force on 1st January 2006, includes elements of Germany's successful Renewable Energy Act. Whether and to what extent it will also be a success – especially in the case of wind energy, where China still holds fast to the concession model – remains to be seen.

Bernward Janzing is a freelance journalist based in Freiburg.

Solar energy. Increasingly, photovoltaic technology is coming from China itself.

# Biomass on a low flame

Frank Räther | text and photos

The three-stone hearth, symbol of African cooking, is slowly but surely being replaced with a new alternative – in Malawi, too. Starting in Mulanje, clay and metal stoves are moving in a triumphal march across the country, and saving firewood and money.

The "Mbaula", the clay stove that Christina Manlana cooks on, looks a bit like a flower pot. It is about 20 cm high, 28 cm in diameter and costs just 150 kwacha – less than one €. Christina puts a few sticks into the semicircular opening on the side of the stove towards the bottom. There the firewood burns protected from but fed by the wind. The pot rests on the three clay prongs formed on the stove's upper rim. Christina loves using her Mbaula. It may look simple enough, but it is revolutionary for Africa's villagers.

Until now, the women usually cooked on logs hemmed in by the three stones. But this method puts the pot too close to the flame. The heat dissipates. The wind blows the flame sideways. "I have thrown my cooking stones away. I'll never cook that way again," vows Christina. Not only does the new clay stove cook quicker, with the pot set optimally right above the flame, but it also uses only half the firewood for the same amount of cooking. This makes it worth a lot in Malawi, where vast stretches of the country have been deforested.

In other African countries firewood is just as scarce. With the population growing, the demand for firewood is soaring as well, creating a crisis for sub-Saharan Africa's ecology, as the Food and Agriculture Organisation (FAO) warns. In sultry Niger, wood is already more expensive than water. In the Tanzanian capital Dar es Salaam, the forestry ministry recently banned the use of charcoal – without suggesting any alternative. "What are we to cook with?" asked the signs angry women carried as they marched through the streets.

Save money! Above his shop on the main street of Mulanje, Ken Chilewe has his slogan painted for all to see: "Rocket Stoves: Cook Quickly, Save Energy, Save Money!"

"Electricity, gas, kerosene, solar and other kinds of energy are either not available or are too expensive for the poor," says Christoph Messinger, regional coordinator of the Programme for Biomass Energy Conservation in Southern Africa (ProBEC). He adds, "Charcoal is getting more and more expensive, too, and besides, it's inefficient because so much energy is used to produce it." The stoves he advocates are "cheap to buy and operate and well adapted to the way people cook here".

The programme is being implemented throughout the Southern African Development Community (SADC). It is jointly financed by the German Federal Ministry for Economic Cooperation and Development (BMZ) and its Dutch counterpart, the Directorate-General for International Cooperation (DGIS). By May 2008, 4.5 million € will have been spent on the programme, which GTZ is supporting on behalf of BMZ with three international advisers and some 20 local experts for ProBEC North in Malawi, Zambia und Tanzania.

## A stove makes a hit

In the 1980s, GTZ employees in Kenya helped develop the firewood-saving clay stove, a similar version of which has traditionally been used in Asia. The stove spread from Kenya throughout East Africa and was introduced in Malawi in 1999 through the GTZ-supported food security programme. "In talking back then with Malawians who were suffering from hunger, we came to see that the insecurity of their food situation was partly due to the scarcity of fuel," recalls Christoph Messinger. For example, people had stopped eating beans – a good source of protein – because they had to be cooked for four hours, and firewood is expensive. Since people had to be selective about what they cooked, malnutrition increased.

Thanks to GTZ's work in southern Malawi, the clay stoves have become widespread. Agnes Mbawa from Ligomba village, who now manufactures this kind of stove, says, "I've made 28 clay stoves in the past two days. They have to be baked in the kiln here until this afternoon. Then they need a day to cool." Afterwards, she delivers the stoves to her customers. Four other women have another 36 stoves in the kiln and are helping to fire it. They built the kiln two years ago, covering its cost with their very first round of production.

The ten women who joined together in the project have been turning a profit ever since. Of the 9,000 kwacha (60 €) proceeds for one firing, only 850 go for fuel. The clay is free. The women scoop it up from the riverbank, about an hour away on foot. "Two-thirds of the households in the area now have clay stoves," says Agnes. The stoves only last two to three years, so she and the other women will have plenty to do in the future as well. They could easily fill their kiln ten times a month, but they limit themselves to two firings. They do not want to make anybody jealous. If the women were suddenly richer than the village chief, they would have a regular "hell on earth" to live with, as they put it. So they make just enough to pay the school fees for their children, or to buy corrugated iron and bricks for a better house and a little furniture.

## The steel version

The ProBEC programme for a secure energy supply began two years ago. It seeks not only to distribute the clay stoves more widely but also to develop and test new technologies. The present frontrunner is the "rocket stove", which "operates on a principle developed by a former NASA engineer at the Aprovecho Institute in Oregon – hence its somewhat misleading name," explains GTZ's Andreas Michel, who works at ProBEC along with Christoph Messinger and their colleague Christa Roth in Mulanje, Malawi. He adds, "Peter Scott of the Aprovecho Institute showed us the rocket stove technology and helped adapt it to Malawian conditions." The rocket stove is larger and even more efficient than the clay stove, but it is also much more expensive. So it is manufactured primarily for institutions and urban households. There are already various models of rocket stove, each adapted to the needs of the respective user.

Protestant vicar Karl Dietrich Opitz, Director of the Emmanuel Teacher Training College in Blantyre, was the first to have a rocket stove installed, in October 2004. Although the steel stove cost 27,000 kwacha, about 170 €, the college had recouped the amount in firewood savings within nine months. Harry Madalizo, head cook of the teacher training institute, raves about the stove. "It is simple, cooks quickly and uses only half the firewood. And above all, it doesn't smoke. I used to spend my life rubbing my eyes. We three cooks were always coughing and our eyes were running – we had to relieve each other every ten minutes. Now all that is past."

The rocket stove principle is based on two factors: complete combustion of the firewood and better distribution of the heat over a large surface. The wood

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New era. More effective stoves made of steel and clay are slowly but surely making the traditional three-stone hearth obsolete.

## Efficient use of biomass

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| **Context** | In Africa, the use of wood for cooking is accelerating desertification and reducing the food budget of poor families. Fumes from wood fires injure human health. |
| **Goal** | Sustainable and socially equitable use of biomass energy. |
| **Concept** | Tested strategies for the mass commercial distribution of improved stoves in selected SADC member states. |
| **Partners** | Players in the regional development plan of the SADC states, government institutions, private companies and local small-scale manufacturers. |
| **Costs** | The German Federal Ministry for Economic Cooperation and Development (BMZ) finances Technical Cooperation for the Programme for Biomass Energy Conservation (ProBEC) to the tune of 5.8 million €. Dutch co-financing of 1.7 million € enables Tanzania and Zambia to be added to the programme as well as an intensification of ProBEC activities in Malawi. |

is split relatively thinly and then fed bit by bit into the flame through a 15 x 15 cm hole. The flames are contained in a cylinder clad with insulation material and touch the pot at their hottest point. The pot itself is embedded in skirting that is only a finger away from its sides. Since the pot fits the stove precisely, it rests right within the flames. The pots are provided along with the stoves.

The neighbouring Evangelical Bible College Berea was quick to follow Vicar Opitz's lead. "When I told the director at Berea that we had a smoke-free kitchen and were spending much less on wood, he came right over, took a look for himself, was thoroughly convinced and bought a rocket stove himself." Vicar Opitz now has his future teachers take a two-week course on energy efficiency and the new types of stoves, taught by a Malawian GTZ expert. The course participants build a clay stove themselves, so that they take their knowledge with them from then on and can teach their pupils what they know. Then the pupils tell their parents. "This word-of-mouth propaganda is sure to have a major impact," Vicar Opitz is convinced.

### A hot tip and mass production

Ken Chilewe is already manufacturing a standard line of the large rocket stoves. The small-scale producer has just added on to his shop in Mulanje and is now building a new, larger plant. "An orphanage has ordered 15 of the stoves from me, and the World Food Programme wants 60 stoves and 190 stainless steel pots," he says with obvious satisfaction. The World Food Programme (WFP) runs a programme for school meals in Malawi. Employees noticed that the surroundings of the schools were slowly but surely turning into wasteland as the traditional cooking methods used up the wood. Every tree and bush simply disappeared into the oven. The stove promoted by GTZ is to put the brakes on this fuel consumption.

Twelve workers cut, weld, shape and polish the pots. It is a form of mass production, carried out by up to 28 workers for major contracts. Above his shop on the main street of Mulanje, Ken Chilewe has his slogan painted in plain sight for all to see: "Rocket Stoves: Cook Quickly, Save Energy, Save Money!" In addition to the large stoves, he also manufactures cheaper, smaller stoves for urban households on the same principle. Many passers-by stop and have Ken and his people explain what the advantages of the stoves are. Several have placed orders right on the spot. On top of this, a salesman drives around in a pick-up truck and demonstrates the stove to institutions. Ken has sold around 1,300 stoves in 18 months, 40 percent through his own advertising.

The rocket stove is also creating a sensation at the country's largest tea producer, Eastern Produce Malawi. The Lauderdale tea factory already has four. "We prepare meals every day for several thousand employees. With the new stoves, we save up to 90 percent of the firewood we need," says Brian Mailosi, the assistant manager. To show just how much wood is saved, one of the cooks gathers up an armful – the amount four rocket stoves need for two days' cooking. They used to burn up a full cubic metre. Now anyone can see it is much less. Here in Lauderdale, the built-in model is in operation. Andreas Michel points out: "We are constantly working on developing the stove technology to meet the various needs of institutions and private households."

Over the next three years, a small-scale version will be installed at a cost of around 15 € per stove in the kitchens of 5,600 employees of Eastern Produce Malawi. Anne Taulo is already testing the prototype. "No smoke, quick cooking – and one little piece of wood is all I need." She has already named the new stove changu – "quick". Meanwhile, in the yard of the GTZ office in Mulanje, long-term testing is carried out on a portable version of the rocket stove. This one, which looks like an elongated tin bucket, will also cost just a little over 15 €.

GTZ's Christa Roth is already dreaming of a kit that includes the main components and can be bought at any market and put together at home. "The next step is to advertise the various models in Zambia and Tanzania and manufacture them there," says Roth. Her team in the Programme for Biomass Energy Conservation wants to persuade yet more women to plant bamboo. This way they could use the fast-growing stalks for fuel. They could do the same with palm fronds, which just rot otherwise, or the stalks of the dwarf pea. All these little extras help reduce dependence on wood.

And the future goals of the ProBEC programme? "We are now busy looking for new ways to provide fuel for tobacco drying sheds, or for drying fish, or other purposes. Too much firewood is consumed too inefficiently in Malawi and elsewhere," says Roth. Her colleague Christoph Messinger is confident: "With firewood-saving stoves and drying systems, deforestation can be slowed and the smoke that takes such a toll on people's health can be reduced. With the money that is saved on wood, people have more left over for food and other essentials."

Frank Räther lives in South Africa and writes for the news magazine Focus, among other publications.

# Household energy

Electricity is often too expensive for poor families – if indeed they have access to it in the first place. Half of the world's population still cook on open fires or on the stoves their parents and grandparents used. They burn wood, manure or charcoal. The inefficiency of using biomass in this way is taking a severe toll on forests, while people waste time and money gathering or buying firewood. Moreover, the health problems caused by kitchen smoke cost the lives of 4,000 people a day throughout the world.

GTZ's household energy programme HERA seeks to supply more people in developing countries with modern forms of energy for cooking, baking and heating. Better technology and alternative fuels are needed. HERA develops concepts and strategies to enhance basic energy supply. Policy advising in partner countries plays a major role in this context. HERA highlights the issue's importance at national and international levels and urges that it be integrated into development cooperation programmes and projects. HERA cooperates with other organisations such as the World Health Organisation (WHO). Knowledge and information exchange is very important in the search for the best solutions. Regular meetings of GTZ team workers in the household energy projects help them to network with one another and with project management and pass on their experience.

Technical Cooperation joins with local partners to promote the distribution of improved stoves and to ensure that the resource supply is sustainable. The focus is on sub-Saharan Africa, where more than 90 percent of the population use biomass for cooking. The production of efficient and clean-cooking stoves is backed by measures to train producers in management, production and marketing of the new technologies. The household energy projects also support information and marketing campaigns to ensure that the public are well informed. HERA's portfolio includes afforestation and forest management.

GTZ has been working in the household energy sector on behalf of BMZ for more than 20 years. During this time, some 20 projects have been implemented with various partners. These projects have developed, manufactured and distributed about a million of the improved stoves. Still, much remains to be done. There is more information about HERA at: www.gtz.de/hera

# The cradle of the winds

Peter Korneffel | text and photos

Colombia's first wind farm has been supplying electricity to the national grid for two years now – with the GTZ wind energy programme TERNA playing a major role. The first wind power plants in Colombia are setting an example for other countries.

The pioneers were a couple of meteorologists working in the Colombian desert at the beginning of the 1990s. "At that time, wind energy production was just a shadow of what it is today," reminisces Bernhard Bösl, GTZ's Country Director in Mexico. "No one could imagine the spectacular developments that the next 15 years were to bring." Back then, Bösl was the planner responsible for the South American component of GTZ's wind energy programme TERNA (Technical Expertise for Renewable Energy Application). Right from the start, the studies from the Guajira Desert in northern Colombia threw up data on wind and weather that made people sit up and take notice.

"Even at a height of ten metres, we had impressive average wind speeds of seven metres per second," says Bösl. When the national programme for the promotion of renewable energy in Colombia ended, the data was stored away and forgotten. But the country's growing energy consumption and an over-dependence on hydroelectric power plants prompted a re-examination. The utility company Empresas Publicas de Medellín (EPM), one of the country's largest electricity utilities, came across the neglected wind data while looking for new energy resources. It asked TERNA for further support to set up a Colombian wind energy programme.

Soon more and more wind measurement masts sprouted in the Guajira Desert. The technical data at 50 metres height was even more encouraging than those of the early measurements nearer ground level. Average wind speeds of more than ten metres per second were recorded, with top speeds of 20 m/s maximum, hardly any lulls, and little turbulence. In the hot, dry semi-desert of Guajira such conditions are the norm – and have been so for time out of mind. The indigenous Caribbean people, the Wayúu, call their country the "cradle of the winds".

## Rotors over the ranchería

The Wayúu people have lived on their sparsely populated stretch of coastline for 1,400 years, defying the blasting northeast wind as best they can in villages of huts often blown about by the wind. By Colombian law, their land, the upper Guajira, is a reserve and may be neither sold nor leased. But would the Wayúu be prepared to allow the soaring large-bladed rotors to swoop over their desert gardens and grazing goats?

The Medellín utility company EPM contacted tribal leaders of the Media Luna and Kasushi communities in 1999. However, the negotiations turned out to be far more complex than taking measurements had been. The desert dwellers simply could not imagine what impact the turbines might have on their lives. And they demanded guaranteed compensation in return for their agreement. They knew all about the grand promises of greedy investors. To this day, the giant ramps of the coal loading harbour of Puerto Bolívar reach up to the skies within plain view of their rancherías. When the wind is from the east, the harbour sends out its reminder: a cloud of fine black dust. And during the long months of drought, the drinking water promised by the coal company dries to a mere trickle. The Wayúu stand like beggars, their empty canisters and buckets in their hands, before the heavily guarded gates to the harbour.

"Our families are divided on the subject of the wind project," said 36-year-old Laura Pushaina from the nearby Ranchería Casiguarín at the time, "but one thing is clear: there won't be any windmills in the Guajira until there is drinking water." In the event, it was the other way around: without the windmills there could be no drinking water in the Guajira. Thus wind became the basis for communication between EPM, which was seeking to rid itself

Support all the way. To develop the Jepírachi wind farm in Colombia, GTZ provided a range of support services such as training and energy policy advice.

of its dependence on water for electric power, and the Wayúu, who wanted drinking water guaranteed.

The negotiations went on until June 2002 when the Wayúu communities finally agreed to allow the wind turbines in return for schools, a health centre, eight boats and a new dock. But the key was that they were to get a modern seawater desalination plant that EPM's wind energy would provide the electricity for.

During the long negotiations between the EPM and the Wayúu, TERNA continued to churn out reports which became the first feasibility study for a wind farm in northern South America. The programme also invited utility company managers to Germany for courses and visits to trade fairs. Bösl rates this aspect particularly highly. "The visits were crucial to implementation later on. It meant that high-ranking decision-makers of EPM could see for themselves that this was a technology to be taken seriously, as Germany was going all out to develop its wind energy."

## TERNA: soaring on an updraft

GTZ's wind energy programme TERNA was launched in 1988 at the behest of the German Federal Ministry for Economic Cooperation and Development (BMZ). Since the mid-1990s, wind farms conected to the electricity grid have been at the heart of the programme, although smaller hybrid wind-diesel systems are also given support. "A key point is that our advisory services on energy policy are becoming more and more important for partner countries," says Jens Drillisch, who heads the programme. At the highest political levels, GTZ employees in the bilateral projects work on formulating enabling legislation for implementing energy policy on wind energy. The partners on the ground are energy utility companies and governments. So far, wind measurements and feasibility studies have led to the creation of wind power projects in Bangladesh, Brazil and Morocco, and a programme is being developed for Ethiopia.

In the case of the Jepírachi wind farm in Colombia, TERNA was on site right up to project completion. It supplied energy policy advice, train-

Having a share. The indigenous Wayúu people, above whose reserve the rotors now turn, were a key negotiating partner when developing the wind park.

ing and skills upgrading. In addition, country analyses and seminars for specialists disseminated information on the subject.

With the signing of the agreement for construction of the first wind farm in Colombia, the involvement of the GTZ programme came to an end. A number of producers of wind energy plants showed a commercial interest in the project at first, but in the end only the Spanish company GAMESA and Germany's NORDEX actually submitted bids. The Colombians decided in favour of NORDEX, which delivered and installed 15 wind turbines of the 1.3 MW class. At the end of 2003, the Jepírachi scheme was inaugurated and became Colombia's first wind farm supplying electricity to the national power grid.

The pioneering wind farm in Colombia serves as an example to other countries. TERNA, which has remained in contact with the Medellín utility company EPM, occasionally invites Colombians to present their experience at seminars. In November 2004, representatives of a number of Caribbean countries visited the site to learn about the potential for wind power – and surely also to learn more about how the Jepírachi wind farm became one of the first to receive funding from carbon trading via the World Bank's Prototype Carbon Fund.

The Jepírachi story thus provides an inspiration for investors interested in wind power development.

Peter Korneffel spent several years writing from Colombia for Die Zeit, Geo and Mare and now he works as Spanish correspondent among others for the magazine Neue Energie.

## Energy from the wind

| | |
|---|---|
| **Context** | Imported fossil fuels are a drag on the economy and pollute the environment. |
| **Goal** | Exploitation of the potential for wind energy; sustainability as an integral element of energy policy |
| **Concept** | Know-how transfer for wind measurements, feasibility studies, and a conducive energy policy framework |
| **Partners** | Governments and utility companies like Medellín's EPM or independent power producers |
| **Costs** | BMZ has allotted 187,000 € for technical cooperation for the exploitation of wind energy potential in Colombia and 3.5 million € for the TERNA wind energy programme overall. |

# High-power seeds

Klaus Sieg, text | Jörg Böthling, photos

The world's first factory for the production of biodiesel from the Jatropha plant is located in Hyderabad in the Indian state of Andhra Pradesh. A development partnership between GTZ and the private sector made it possible. The easy-to-grow, oil-producing plant could help rural regions develop – all over the world.

When dried, the Jatropha fruit looks like a walnut. It contains three black, very oily, bean-like seeds. And on these seeds rest the hopes of millions of smallholders everywhere. No wonder: they can yield high-quality biodiesel fuel as well as plant-seed oil for vehicles and heaters. "In developing countries, Jatropha is the most eagerly discussed of the energy crops right now," says Dirk Assmann, a GTZ energy planning specialist based in Eschborn, Germany.

The Jatropha plant is a shrub of the wolf's-milk family. Originating from Central and South America, it grows all over the world in subtropical and tropical regions today. The shrub thrives in a very dry climate with only 250 mm of rain a year, but it also grows in regions with as much as 2,500 mm of rainfall and will even survive on stony soil that is poor in nutrients. So growing Jatropha does not necessarily reduce the space for food crops, and even helps reduce or avoid soil erosion.

## A pioneering factory in India

There are 170 million hectares of wasteland in India alone. Especially smallholders, whose land is often inferior, have lost large sections of arable farmland to erosion and climate change. Jatropha could be planted on a good 30 percent of this land. In Hyderabad, in the Indian state of Andhra Pradesh, the first factory

Replenishable resource: Young Jatropha plants grow in the arid steppes of the Indian state of Gujarat. The plants promise to become an additional source of income for villagers.

for the production of biodiesel from the Jatropha plant opened its doors in July 2006. The factory is the result of a development partnership between GTZ and two private companies: the Frankfurt systems engineering company Lurgi AG and the Indian company Chemical Construction International. The Indian firm Southern Online Bio Technologies Ltd. runs the factory, which has the capacity to produce 10,000 tonnes of biofuel per year. "A bus company in Hyderabad takes the lot," explains GTZ India's Michael-Peter Glück. "Other public bus operators and the Indian railway company have shown considerable interest, too", he adds.

India is obliged to import most of its oil, for which it pays dearly. In 2005, it used 40 million tonnes of conventional diesel fuel, and this year it expects to consume 52 million tonnes. So even a substitution of five percent would mean a demand for more than 2.5 million tonnes of biodiesel. This is a market option that is worth more than just thinking about! The biodiesel factory entered into agreements with farmers from around 60 villages in the area in order to promote the systematic growing of Jatropha and Pongamia Pinnata, a domestic Indian oilseed-producing tree. Bank loans are to give a boost to the establishment of small, decentrally located oil mills. In this way, sustainable sources of income are being created throughout the area around Hyderabad. The development project in the Indian state of Andhra Pradesh could well serve as a model for others elsewhere. Despite the fact that India's economy is growing by leaps and bounds (eight percent per annum), a quarter of all Indians have to manage on less than a dollar a day.

## A source of income in a dry land

The creation of new sources of income is also the primary objective of another German-supported Jatropha project in India. "We can hardly do anything with this land," says Vallhaba Bhai, head of the 1,200-inhabitant village of Chorvadla in the Indian state of Gujarat. He points to the parched steppe, where a gaunt cow is nibbling at the blades of dried grass. "But in future, we may be able to use it after all. Some 500 hectares of the wasteland around our village could be used for planting Jatropha," the village leader continues, and the men around him nod. They are taking a break from their work on a test planting of Jatropha plants. Ten hectares bear long rows of mostly small plants, whose green shoots stand out brightly against the arid landscape. "We are testing to find the best conditions for high yields from the Jatropha," explains Jinabhai Sambhubhai Patolia, a scientist from the Central Salt and Marine Chemicals Research Institute (CSMCRI).

The German Investment and Development Company (DEG), Hohenheim University and DaimlerChrysler are participating in the development partnership in the barren stretch of land in the state of Gujarat. The three organisations, all based in the Stuttgart area, have invested 750,000 € in research and supplied three Mercedes C-class vehicles to test the fuel. The three models, manufactured in the DaimlerChrysler plant in Pune, India, started out in Jatropha and then drove 10,000 km all over India on the biodiesel fuel.

## Intensive research

Without any doubt, the farmers of Chorvadla in the arid state of Gujarat could well use an easy-to-grow, energy-producing plant. However, before they start planting Jatropha in a big way, the characteristics of the wild plant must be carefully researched. "This plant has great potential, but there is hardly any experience with seed improvement so far," says Klaus Becker of Hohenheim University. Becker has been working with Jatropha for 15 years now, often with GTZ, in Nicaragua and Mali, for instance. "We have yet to come up with a standard seed variety, predictable yields, or well-researched farming methods," warns Becker. "Still," he continues, "nowhere are these matters being so intensively pursued as in our project in Gujarat." The Indian research partner CSMCRI has been gathering various species of the plant for years, selecting several elite specimens that produce three to four times the yield of the average varieties.

These optimal specimens are now being subjected to further testing on the Chorvadla planting and on another planting in the state of Orissa. How much water do the plants need? How much space? With what amount of manure do they produce the highest yields? The subsoil around Chorvadla is stony, the humus layer only 20 cm deep. "Even here, the plant can survive without manure or irrigation, but we want to optimise our yields," says Jinabhai Sambhubhai Patolia. He removes a few seeds from one of the plastic bags hanging on each bush for documentation purposes and spreads them out on his palm. At first sight, they look like dried black beans. "If we want good yields, we have to allow about 100 litres of water for each plant over the four-month dry season," says the researcher. In the beginning, the plantings have to be weeded as well, and the plants pruned. Every part of the plant is poisonous. Fortu-

nately, goats and cows will not eat them, so there is no need for fencing around the plantings. But the initial investment is still high for the farmers. It takes five years for crop yields to make sense in economic terms – but then they do so for 30 years. The soil at Chorvadla is expected to yield about two tonnes per hectare, which can be converted into around 500 litres of biodiesel.

## Seeking a wider range of products

"If we are to optimise the economic benefits to the farmer, we must find uses for every part of the plant," says Pushpito Ghosh, Director of CSMCRI in Bhavnaghar.

Thus in addition to the production of biodiesel, the team, which is composed of scientists and engineers, researches the potential applications of spin-off products. They want to use the seed-oil cake that remains after the fruit has been pressed as animal feed, but first the plant's poison would have to be neutralised. Then there is the glycerine produced in large amounts during the process of converting the plant-seed oil into biodiesel. The institute makes soap out of it, but it is also attempting to employ bacteria to extract biopolymers from the mixture – to be used, for instance, in the manufacture of car seats.

Over the past year, the project's pilot facility produced 8,000 litres of biodiesel that conformed to the specifications of EU DIN Standard 14214. Emissions are comparable to those of biodiesel derived from rapeseed. The facility was built to produce 250 litres a day and costs around 30,000 €, so that operation by farmers' cooperatives would be possible. Moreover, British Petroleum (BP) and the Indian giant Reliance, among others, are also said to be interested in the research going on in Bhavnagar. But there are still no plans for commercial production in Gujarat. "We were talking with DaimlerChrysler, but the project's facility isn't large enough to be economical – marketing wouldn't pay," says GTZ energy planner Assmann.

## Testing models all over the world

In a few countries, Jatropha can already compete with diesel derived from petroleum. "With a reasonable bit of conversion, tractors and buses can run on plant oil without any problem," says Assmann. In Peru, GTZ is participating in a project with the German Development Service (DED) and the German company United Workshops for Vegetable Oil Technology (VWP). In the capital, Lima, some 40,000 buses provide the public with local transport services. Directly tied to oil prices, ticket fares are soaring. Exhaust from the diesel-powered buses pollutes the city's air. VWP trains local specialists to convert and maintain California company buses running on vegetable oil. Other bus companies are showing a keen interest in the pilot testing, which in the end should have California company's entire fleet running on plant oil. DED takes care of the cultivation of Jatropha and the construction of oil mills to be operated by farmers' cooperatives. A project, just starting up in Tanzania, is to use Jatropha oil to fuel a power station that is presently diesel-fired. Here, too, a private company is handing overall operations.


Fuel for engines, fuel for heat. Biodiesel and vegetable oil can be extracted from the bean-like black seeds of the Jatropha fruit.

GTZ acts as general consultant on all aspects of bioenergy in other countries as well. One example is Brazil, where the Socialist president Lula is trying to reduce the bitter poverty in the northeast of the country through the growing of oil crops like the castor oil plant. He is opposed by the powerful big landowners, who would rather grow soy beans for their own profit.

"Our development partnership approach with the private sector is unique and very important, because in spite of the intense interest in Jatropha, not enough practical projects are available that meet market conditions." This is how Dirk Assmann summarises global developments in the particular world of the oil-producing tree. One can only hope that the future of the sector generally proves to be as fruitful as this useful tree!

Klaus Sieg and Jörg Böthling write and take photos for agenda. photographers & journalists in Hamburg.

# High-voltage policy

Daniela Spies, text
Harald Struckmann, photo

Electricity meets just one percent of Uganda's energy needs. With Kampala, the capital, also running low on power these days, the yawning gap between energy demand and supply has become everyone's problem – and not just the rural population's. The Ugandan Government has declared electricity supply a top priority.

The electricity crisis is nothing new in Uganda," notes Philippe Simonis, head of the Ugandan-German Energy Advisory Project. But now, unlike in the past, it is also being felt in the capital. "And that is why everyone is suddenly in such a state," he adds. As GTZ policy advisor to the Ugandan Ministry of Energy and Mineral Development, Simonis hopes this subtle difference might tip the scales. The power shortage could be an opportunity for the East African country to make an urgently needed change in its energy policy. The government has declared national power supply a top priority for its new term in office, and is focusing energy policy on saving electricity and decentralised energy supply.

Up to now, the energy crisis in Uganda affected people living in rural areas – albeit the majority of the population – but decision-makers have always been based somewhere else, namely in the city. Rural areas are not linked up to the power grid. Energy needs are met chiefly through firewood and charcoal, with a diesel generator here and there and nowadays the occasional solar panel. The country's energy mix throws the dimensions of the power problem into sharp relief: biomass, mostly wood, covers 93 percent of the country's demand for energy, imported oil six percent and electricity from the central power grid only one percent. Uganda has the lowest per capita consumption of commercially-produced electricity in sub-Saharan Africa.

The lack of electricity is detrimental to the economy, the environment and people. Electricity generated with diesel fuel or batteries is expensive and burdens villagers' household budgets, which are already strained as it is. The burning of firewood in the traditional three-stone hearth is not only cumbersome but causes burns and eye and respiratory diseases from the smoke. Women

and children carry firewood over long distances – exhausting and dangerous work. The environment suffers because forests are denuded and are not adequately reafforested. Great stretches of formerly forested land are succumbing to erosion. Rural economic development also suffers from the lack of electricity. Without it, small and medium-sized enterprises that could potentially create employment and income for rural people do not have the infrastructure they need.

### Alternatives to hydropower

In the capital city Kampala and the centre of the country in general, the situation looks altogether different. Since the mid-1980s, this area has experienced considerable economic growth, levelling out at about 5.5 percent since 2000. In this respect, Uganda has outperformed other sub-Saharan African countries, whose economic growth is at around 2.2 percent. But successful economic growth is worsening the energy crisis because the country's outdated power plants and decrepit grid are no match for the extra demand. Power supply is constantly failing, usually between seven and eleven in the evening, when demand for electricity peaks.

Electricity from the central region of Uganda is for the most part generated in a hydroelectric plant at Owen Falls in Jinja on the Victoria Nile. The plant, which started operations in 1954, cannot cope with today's demand, even though it has been extended a number of times. The construction of a second power plant at the Bujagali Falls further downstream is meant to relieve the situation. The World Bank provided a loan of US$ 215 million, but a corruption scandal brought delays. A new investor has now been found. The Ugandan government has signed the building contract together with the World Bank and the Industrial Promotion Services of the Aga Khan Foundation.

Although the construction of the new hydroelectric power station is an important step towards a better power supply in Uganda, it is no solution in itself. Water in the region is in short supply. Uganda has joined Kenya and Tanzania, the other riparians of Lake Victoria, in an agreement to limit water depletion of the lake, in order to restore normal levels.

In any case, since the new Bujagali hydroelectric plant will not be complete before 2011, other solutions must be found for the near future. Thus the core of energy policy is to increase energy efficiency. The obsolete national electricity grid was privatised at the beginning of 2005 and has undergone a series of renovations and expansions. Both private and commercial consumption of electricity must also become more efficient.

"Saving electricity is an unpopular subject, but people are now feeling the energy shortage firsthand and are aware that everyone has to do their part," says Simonis. The government has started an energy-saving campaign, using public events, brochures, schoolbooks and the educational film "Full of Energy" to show people how to save energy. The response to Energy Efficiency Week, which took place for the first time in 2005, was especially strong this year. The media report on the issue and publicise it widely. Sales of energy-saving and power-storage devices are on the rise.

### Stove-builders make house calls

Things are happening in rural areas as well. The Ugandan-German energy project in Bushenyi district is making energy-saving stoves on a pilot basis. The ministry is working closely with the Integrated Family Development Initiative, a local NGO. In the villages, stove manufacturers have been instructed on how to build an improved stove model – one that uses half the firewood of the traditional three-stone hearth – right in people's homes. Thanks to simple technology, construction is inexpensive, and the stoves seldom need repairs. The families only provide the materials (mainly clay and sand) and board and lodging for the stove-builder during construction, and they pay as much as they can for the stove. Some 120,000 households in Bushenyi have been provided with improved stoves in this way. Optimised combustion chambers in the new stoves make heat transmission so much more efficient that they perform nearly as well as gas. And it hardly produces any smoke. The greater efficiency of these stoves means considerably less work for the family. Women and children spend only half as much time on the time-consuming chore of gathering wood, and cooking on the improved stoves takes half as long as it used to.

An independent monitoring team checks all stoves for quality and safety. There are prizes for the best stoves and the most successful stove producers. Another positive side-effect is that stove manufacturing creates jobs and improves workers' skills.

Daniela Spies is employed in the GTZ Corporate Development unit.

Potential exploited to the full. The capital city of Kampala and the centre of the country generally get their electric energy from hydropower. Alternatives are urgently needed.

### Energy for households and industry

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|---|---|
| **Context** | The inefficient use of biomass, especially for cooking and for energy for small and medium-sized enterprises, contributes to the destruction of forests in many areas of the country. |
| **Goal** | Better access to modern and sustainable energy utility services for industry and poor population groups. |
| **Concept** | GTZ advisers are supporting the shaping of energy policy in Uganda. They develop strategies at district level, help private companies and NGOs to improve energy supplies and efficiency in rural areas, and sensitise the population to energy problems by bringing the issue into schools, professional life and the university. |
| **Partners** | Managers and experts of the Ministry of Energy and Mineral Development, government and non-governmental institutions at local, regional and national levels, schools and NGOs. |
| **Costs** | BMZ has allotted 6.1 million € up to 2008 for technical cooperation towards a sustainable energy supply in Uganda. |

# Project briefs

## New PPP Hydro Project between e7 and GTZ in Madagascar

The Lokoho Hydro Project is a public-private partnership (PPP) between GTZ, the private partners e7 (an institution set up by the world's largest electric utility companies) and Electricité de Madagascar (EDM). The project aims at integrating electricity generated by a newly constructed 4 MW hydropower plant into a comprehensive rural development approach. The electricity it provides enables productive economic processes and creates income for the rural population. The electrification of rural areas in north-eastern Madagascar, in combination with the promotion of productive use of energy, will contribute to the economic and social development of the project region. In addition, 16,000 households (approximately 80,000 people) in rural areas will gain first-time access to modern and affordable power supply. The Lokoho project has been developed in close cooperation with the Growing Sustainable Business (GSB) initiative, which is coordinated by the United Nations Development Programme (UNDP).

## GTZ Supports IDB on the Promotion of Renewable Energies and Energy Efficiency

In November 2006, the Inter-American Development Bank (IDB) launched the Sustainable Energy and Climate Change Initiative (SECCI). SECCI seeks to intensify the Bank's actions and capacity to play a leading role in facilitating a substantial increase in sustainable energy investments in Latin America and the Caribbean. GTZ's renewable energy expert, Pablo Rosenthal-Brendel, has been seconded to support the initiative. This secondment is part of a joint programme of the German Federal Ministry for Economic Cooperation and Development (BMZ) and IDB. The programme aims to advise the IDB and its borrower member countries on the promotion of renewable energies and energy efficiency, and to identify new projects.

## Facilitating Electrification of Households through a New Financing Scheme in Bolivia

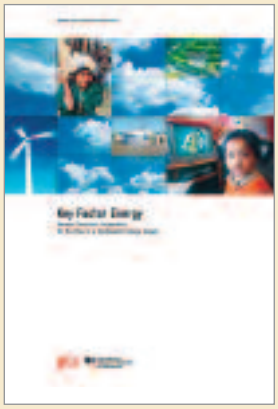
In Bolivia, 55 percent of all families still lack access to modern energy services. Since 2005, GTZ has been seeking to address this by implementing a new project known as "Access to Energy Services". A key intervention is the development of an internal financing mechanism and credit line that enable poor people to pay for a grid connection. The results have been stunning: within the first seven months, over 5,500 households had already been connected to the grid. The concept of grid densification, offering a financing scheme for household connections, has generated growing interest not only from the utilities but also among municipalities and regional governments. The project is financed by the Dutch-German partnership "Energising Development" (EnDev).

## Biomass Energy Strategy (BEST) Initiative for Africa

The Biomass Energy Strategy (BEST) initiative is a response to the urgent need in many African countries to address the dwindling supply of biomass (wood, charcoal etc.) for cooking and heat-using industries. It aims at building awareness and supporting policies that will ensure a sustainable supply of biomass energy and promote access to modern cooking fuels and efficient biomass combustion technologies by households and small enterprises. BEST supports governments to develop national biomass energy strategies. These strategies will address the supply of fuelwood and charcoal, the promotion of improved stoves and modern fuels such as LPG. In some cases the strategies may also be extended to cover the production of liquid biofuels and biomass-based power generation-subjects that have been attracting great interest since the recent oil price increases. BEST is a joint initiative of GTZ's Energising Africa programme, the Household Energy for Susainable Development (HERA) programme and the EUEI Partnership Dialogue Facility (EUEI PDF).

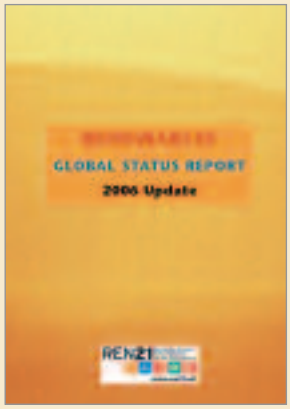
# Publications

GTZ's energy newsletter provides information on its work on energy and climate protection. If you wish to subscribe, please send an email to energy@gtz.de.



The brochure gives an overview of strategy, aims, and activity areas in the energy sector in technical cooperation. Available at www.gtz.de/energy.

This publication contains 21 country analyses of energy-policy framework conditions for electricity markets and renewable energies. Available at www.gtz.de/energy.




The Global Status Report (GSR) shows current trends in renewable investment and policies worldwide. Available at www.ren21.net.

## Tapping into Thailand's Biomass Energy Potential

Biomass residues from palm oil, sugar, rice, tapioca and other agro industries make up 70% of Thailand's renewable energy potential and could provide 3,000 MW electricity generating capacity, corresponding to 15% of the country's peak load. Energy production from biomass waste and energy efficiency improvements are the main objectives of the E3Agro Project, which is funded by BMZ and jointly implemented by GTZ and the Thai Department of Alternative Energy Development and Efficiency. The focus during the first two years has been on the palm oil industry, where energy efficiency improvements of 10% have been achieved. Meanwhile, five biogas plants are selling electricity to the grid, with five more under planning, while two biomass power plants are currently being constructed. In the next two years the project will expand to other agro-industry sectors, especially those related to Thailand's ambitious biodiesel and bioethanol targets (sugar, tapioca and palm oil).

## Cooperation between the World Bank and GTZ on Productive Use of Energy

The targeted promotion of productive use (PU) of electricity can significantly enhance the viability of energy investments and maximise the developmental impact of energy access interventions. On behalf of BMZ, GTZ has engaged in a partnership with the World Bank to review existing experience with targeted interventions for the promotion of PU, and to create additional knowledge about the impact of and approaches for PU promotion in Sub-Saharan Africa. Ghana, Nigeria, South Africa and Uganda have been chosen as possible locations for case studies, during which new empirical data will be generated. In addition, tools and recommendations for PU promotion in technical assistance and lending projects will be developed. A first report is planned to be published at a conference in summer 2007.

## A New PPP to Introduce Conversion Technology for Diesel Engines in Peru

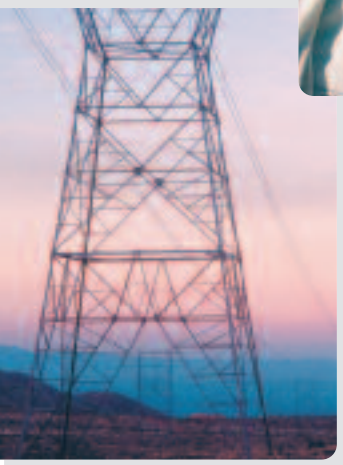
GTZ and VWP (Vereinigte Werkstätten für Pflanzenöltechnologie - a leading German developer of diesel engine-based vegetable oil technology) are cooperating to promote the introduction and adaptation of diesel conversion technologies utilising straight vegetable oil in public transport in Peru. Locally produced natural vegetable oil offers a sustainable substitute for fossil fuels, reducing carbon emissions and providing additional income options in the agricultural sector. The new Public-Private Partnership (PPP) between GTZ and VWP comprises not only the conversion of 15 buses as a pilot project, but also has a strong focus both on the training of local experts in oil seed cultivation and oil production, as well as of mechanics in conversion and maintenance requirements. Other essential contributions made by the project include training and awareness-raising programmes for governmental institutions, as well as the development of quality standards. The PPP is also closely linked to a programme operated by the German Development Service (DED) on the adaptation of straight vegetable oil by planting oil-bearing crops and extracting raw oils.

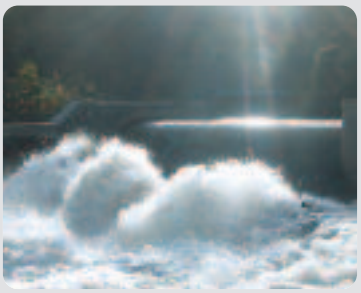
## Tapping the Huge Potential for Solar Water Heaters in Mexico

"It is absurd that a rainy country like Germany should have an area of solar water heaters (SWHs) installed (approx.7.2 million $m^2$) more than ten times higher than Mexico." That is how an employee from CONAE, Mexico's National Energy Conservation Commission, summarises the situation in Mexico, a country that has one of the highest levels of solar radiation of all countries. This helps explain why GTZ is supporting development of this market in Mexico. Since a previous study had identified financing as the main barrier to speeding up market development, current activities have focused on exploring ways of lowering this barrier without introducing subsidies. The results of a recently completed study commissioned by BMZ/GTZ in cooperation with CONAE and the Mexican Energy Ministry shows a promising opportunity: including SWHs in mortgages for house purchase considerably lowers both the interest rate and the repayment period compared to other alternatives. Encouraged by the results of this study, INFONAVIT, a public institution providing soft loans in the housing sector, is currently preparing a "green mortgage programme" that includes SWHs. In 2005 there were more than 400,000 newly built homes alone in the formal sector in Mexico, which underlines the potential of this approach in terms of tapping the market for SWHs in Mexico.

## Renewable Energies for Universal Energy Access in Brazil

Brazil's new Electric Energy Law, enacted in 2002, outlines an ambitious programme with the objective of providing electricity to all Brazilian citizens by 2015. The promotion of renewable energies plays an important part in it. Power distribution companies are therefore obliged to gradually extend energy access. In remote areas, renewable energy technologies (RETs) are often the most viable option for energy supply, yet only a few power distribution concessionaires have integrated them into their portfolio of rural energy supply options. To fill this gap, GTZ (on behalf on BMZ) and Eletrobrás, a state-owned holding group comprising several power generation and distribution companies, are jointly implementing the "Renewable Energy for Universal Energy Access" project. This project provides technical assistance to selected distribution companies via the development and evaluation of sustainable models for rural off-grid electrification using renewable energies. At the macro level, technical assistance will be provided to the power sector authorities in order to improve and then adapt the regulatory set-up for renewable energy in rural electrification. The first pilot project is currently being implemented in the state of Acre, and features a new service known as "Solar home systems power supply", operated by Eletroacre, a Brazilian company. This new service will be tested and monitored with 100 families who live spread out in a forest reserve that is difficult to access.





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