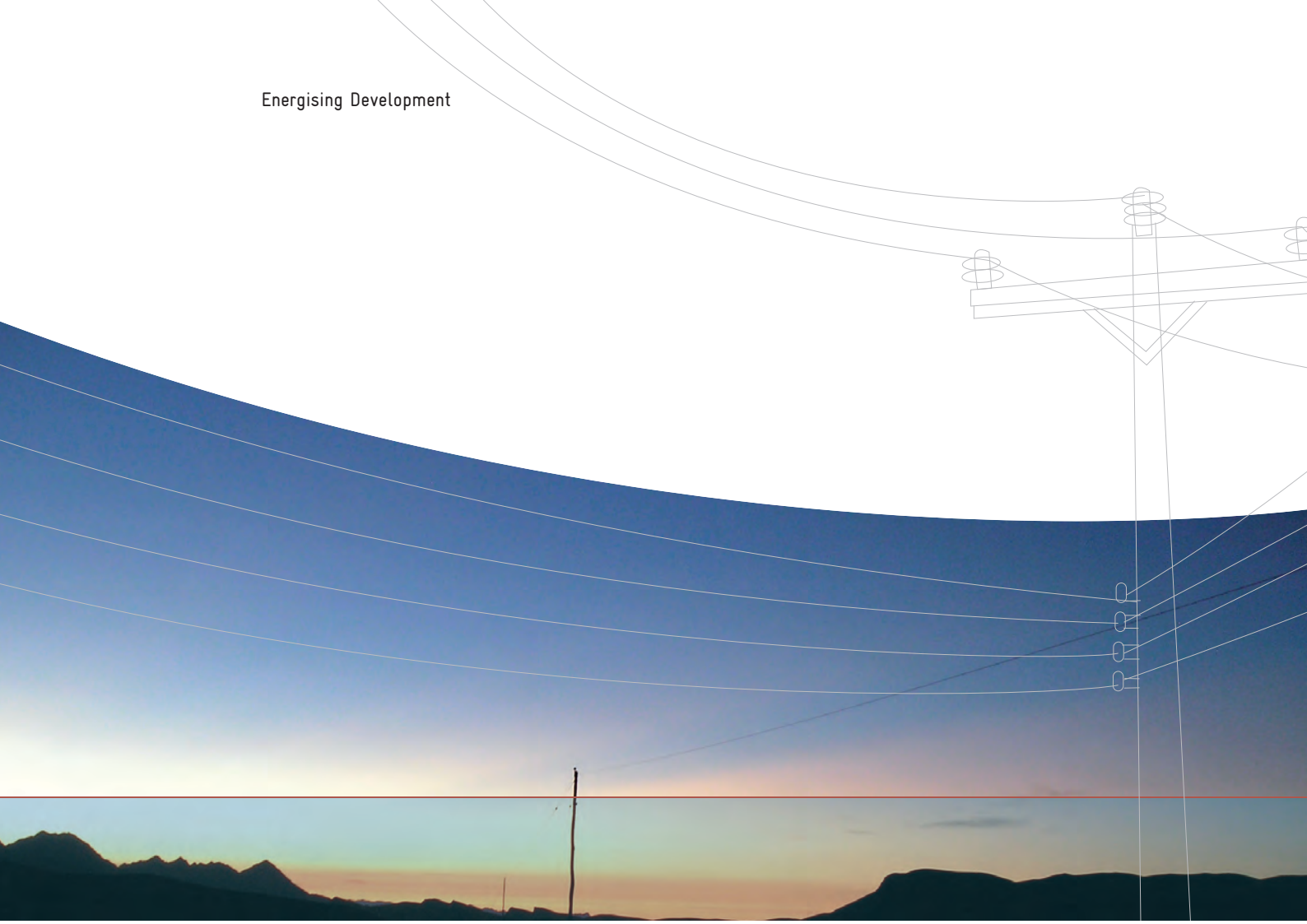


Energising Development
Report on Impacts

gtz

NL Agency
Ministry of Foreign Affairs

Content

2nd edition of the Report on Impacts with the final figures of the first phase of Energising Development

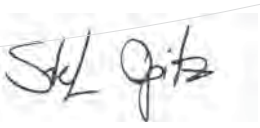
Editorial Note

Access to energy is a basic requirement for achieving the Millennium Development Goals. In developing countries, the vital role of modern[1] energy services is all too clear, especially for low-income groups. Access to energy for cooking and heating is essential to meet vital needs. Economic growth is inhibited, and many economic activities are simply not possible if energy is unavailable. Energy also makes mechanised agricultural production possible, which results in higher crop yields. Electricity and modern fuels enable poor households to engage in income generating activities. Electric light enables households to work during the evening hours or pursue social activities and other activities, such as studying. Electricity powers machines that increase productive outputs, and it is essential for telecommunications, ICT services and healthcare.
The Dutch-German partnership to implement the Energising Development programme reflects the strong will of both the Dutch and German governments to successfully promote access to energy, which is seen as crucial for development. Its goal is to achieve sustainable access to modern energy services for five million people in developing countries. The relationship between energy and development was already acknowledged by the international development community at the 2000 World Summit on Sustainable Development (WSSD) in Johannesburg. As a follow-up to the WSSD, international conferences on the subject were hosted by both the Netherlands (Energy for Development 2007) and Germany (Bonn Renewables 2004).

Energising Development combines Dutch and German expertise in the field of energy. It is contributing to the Dutch target of providing 10 million people with access by 2015, the year in which the international community has pledged to achieve the Millennium Development Goals. As a partnership between the Dutch and German governments, Energising Development is being implemented by the Deutsche Gesellschaft für Technische Zusammenarbeit (GTZ) GmbH in cooperation with the Dutch agency for sustainability and innovation, NL Agency.

In this report GTZ and SenterNovem summarise the impacts of projects implemented in the first phase of Energising Development. The report is aimed at the general public. It describes the successes achieved by the various measures, as well as the problems encountered and the challenges which persist.

We wish you an interesting read and look forward to hearing your reactions.



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[1] Modern energy in this context means access to electricity, energy efficient cooking stoves.

Executive summary

From 2005 to 2009, the Dutch-German partnership, Energising Development (EnDev), undertook 24 activities in 21 different countries. By connecting households to either a central grid or a mini grid, and by promoting technologies such as improved stoves or solar home systems (SHS), in December 2009, 5.01 million people had gained access to electricity or been provided with improved cooking technologies. And all this has been achieved at a cost efficiency of around nine Euros per person.

Energy is a key factor for sustainable development and poverty reduction. It is now generally accepted that access to energy and the achievement of the Millennium Development Goals (MDGs) are linked. Around 2.5 billion people worldwide still rely on the traditional use of biomass energy for cooking, baking and heating[I]. Cooking usually involves a 3-stone-fire, a method that wastes around 90% of the biomass energy generated. At the same time, the open fires emit a lot of smoke, which is hazardous to health. Indoor air pollution is estimated to be responsible for about 1.5 million deaths every year[II].

At the household level, electrification has contributed to improved living standards, while at the level of small businesses, it has significantly boosted economic growth and poverty reduction. The provision of electricity to more than 1000 schools has enabled teachers to use overhead projectors, computers, televisions, and audio and video cassette recorders, and has thus enhanced the quality of the education system. EnDev has also provided power to around 245 health centres using grid-connections or solar energy systems. This has improved the quality of medical treatment, with such benefits as vaccine refrigeration, improved lighting for treatment, operation rooms and better availability of hot water to sterilise instruments.

At the household level, EnDev has contributed to the MDGs by disseminating the technology for more than 870,000 well-designed energy-efficient stoves in 15 different countries. Use of the improved cooking stoves reduces household fuel consumption by 40–80%, with most assessments showing a saving of around 50%. This leads to both time savings when firewood is collected and money savings where fuel has to be bought. Almost all beneficiaries of improved wood cooking stoves reported a significant reduction in the time they spend collecting firewood. The stoves emit very little smoke and have therefore raised the quality of air indoors. At the same time, safety and hygiene in kitchens have also improved. Furthermore, children in the beneficiary households have been relieved of some of their time-consuming housework (cooking, fuel collection), so the dispersal of energy-efficient stoves means children have more time to attend school and to study after school. More than 5,200 stoves have also been bought by schools and other social institutions that cater for the persons they take care of.

Introduction

Happy users make energy interventions successful.

The aim of the Dutch-German partnership, Energising Development (EnDev), is to provide five million people in developing countries with sustainable access to modern energy services by 2015. During the first phase of Energising Development (2005–2009) the target was to reach 3.1 million people. The activities of EnDev focus on providing access to modern and clean energy services to poor households, small enterprises and social institutions in rural areas. The energy services include:

1. Energy for lighting and household appliances

Worldwide, especially in rural areas, more than two billion people have no access to electricity[III]. This means they have inadequate lighting, few labour-saving devices, and limited use of telecommunications. Artificial lighting is perhaps the most immediately beneficial form of modern energy use. Energising Development is working to establish economically sustainable electricity generation and distribution schemes for rural communities. It is doing this by extending power grids, installing micro-hydropower plants and distributing solar home systems.

2. Energy for cooking

Particularly in rural areas, around 2.5 billion people around the world still rely on the traditional use of biomass energy for cooking, baking and heating. Most cooking is usually done on a 3-stone-fire, a method that wastes around 90 % of the biomass energy. The open fire also causes high smoke emissions, which are hazardous to health. Indoor air pollution is esti-

mated to be responsible for the death of about 1.5 million people every year. Energising Development is cooperating with GTZ's HERA-– programme for poverty-oriented basic energy services to establish self-sustaining markets for the production and sale of more efficient (improved) cooking stoves. These efficient and less smoke emitting stoves are adapted to suit purchasing power of the targeted households.

3. Energy for social infrastructure

Electricity supplies are being established for schools, clinics, hospitals and community centres. This is used, for example, to provide lighting in schools or operating theatres, for refrigeration of medicines, and, where appropriate, to harness thermal energy for cooking school meals.

Regional Distribution of the EnDev Projects

4. Energy for production and income generation

Many productive activities require some form of energy, whether it is for driving motors, or for drying and packaging agricultural products. By generating additional income for a community, productive use is probably the most important contributor to poverty alleviation.

> In 2009, the EnDev partnership was running 22 activities in 21 different countries. These projects are carried out in close collaboration with partner ministries in the respective countries, local non-governmental organisations and the private sector. By connecting households to either a central grid or a mini grid, and by promoting technologies such as improved stoves or solar home systems (SHS), by December 2009 4.19 million people had gained access to electricity or been provided with improved cooking technologies
> In social infrastructure institutions (e.g. schools, hospitals, community centres etc.), 510,000 people had benefited from improved uses of energy for cooking, and
> 880,000 had benefited from electricity-services or other modern energy sources.
> 240,000 people had been provided with a modern form of energy for productive use (e.g. bakeries, restaurants).

Data collection and surveys are necessary for counting achievements and to assess impacts.

All this has been achieved at a cost efficiency of around nine Euros (EUR) per person.

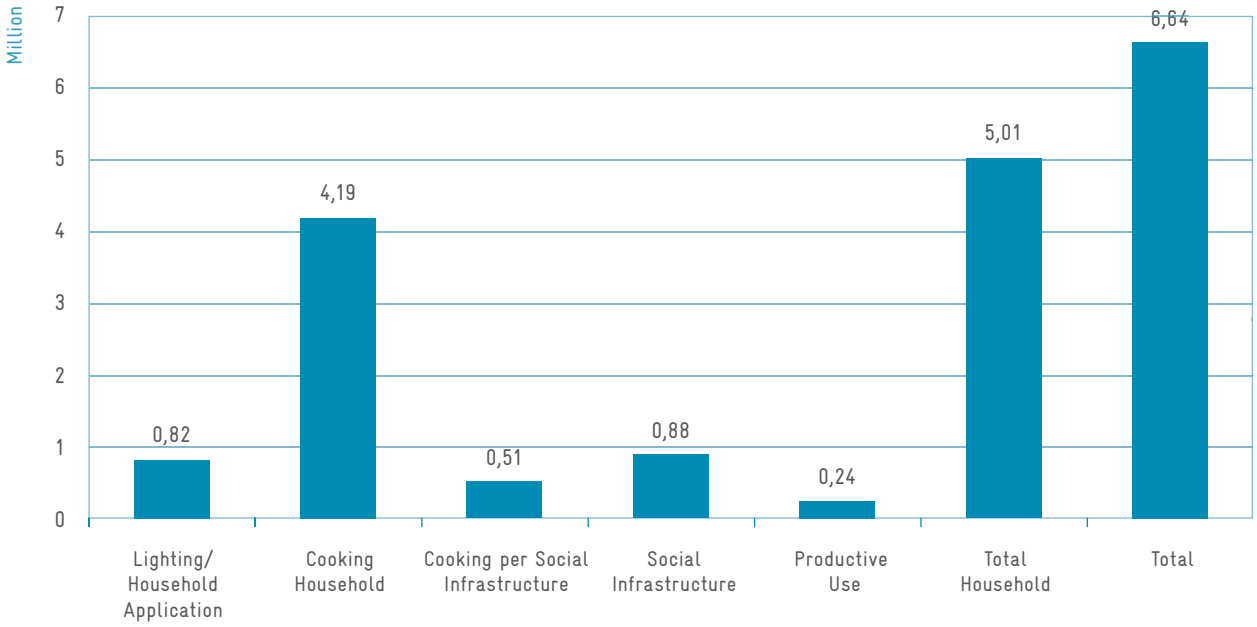
To improve energy use in cooking, EnDev cooperates closely with GTZ's programme for poverty-oriented basic energy services, HERA, thereby benefiting from GTZ's 25 years of experience in household energy. All impact studies on energy for cooking were developed and carried out with substantial input from HERA.

Energy is a key factor for sustainable development and poverty reduction. It is now generally accepted that there is a link between access to energy and the achievement of the Millennium Development Goals (MDGs)[IV]. This report is intended to summarise the results of impact studies and field observations from ongoing EnDev country projects. It will compare general theoretical assumptions about the links between energy and poverty with actual project experiences. The aim is to paint a picture of the benefits of providing modern energy services to households, social institutions, and small enterprises.

As this first review was conducted at an early project stage, the number of quantitative impact studies is so far limited to eight studies in seven countries. Many impacts are expected to occur in the longer term and could therefore not yet be included. Besides the existing studies, this report draws on information from field observations and non-systematic qualitative interviews with partner organisations and EnDev project staff members. While it therefore does not claim to be universally representative, it does provide an overview of general tendencies in the projects' contribution to the MDGs. A systematic approach to measuring the impacts of energy projects has been developed for use in the second phase of Energising Development, starting in 2010.

In the following chapter on impacts we try to demonstrate how access to energy in general, and the EnDev activities in particular, are contributing to the achievement of the MDGs. Although access to energy is not, in itself, one of these goals, it is recognised that access to energy is a precondition for achieving them. Using the impact studies implemented as part of the EnDev projects, we explain the relationship between energy and the first seven MDGs.

Number of households member and people in Social Institutions provided with modern energy services in a sustainable manner



Impacts
Poverty and economic development

MDG 1:
ERADICATE EXTREME POVERTY & HUNGER

According to World Bank measurements, 1.4 billion people live below the poverty line of US-Dollars (USD) 1.25 per day[V]. The first UN Millennium Development Goal (MDG) is to halve this number and "achieve full and productive employment and decent work for all". Energy services may contribute to poverty reduction by increasing production capacities and creating jobs. Electricity enables the poor to engage in new fields of productive activity and provides the basis for them to benefit from (tele)communication services. Artificial light allows people to work in the evening and rest for certain periods during the day when temperatures are high, thus making work more productive. On another level, modern energy services can decrease energy expenditures. Most of energy expenses for poor people go on cooking. They pay a much higher price for cooking fuels, such as charcoal (or firewood), than do higher income groups who use more efficient fuels such as gas or electricity. Similarly, in the long-run kerosene and batteries cost more than electricity supply. Moreover, the poor not only face the financial burden of paying for energy resources, they also spend a significant amount of their time collecting firewood – time that could otherwise be used for productive purposes.

Access to adequate, efficient energy services contributes to food security and therefore helps to eradicate global hunger. MDG 1 is to halve, by 2015, the number of people worldwide who do not have enough to eat (currently 963 million)[VI]. 95 % of all meals must be processed, conserved and cooked, which requires heat from various fuels. If fuel is unavailable or only available at a high cost, foods that need longer cooking times may sometimes be improperly cooked or even abandoned. Therefore, efficient cooking stoves and modern fuels contribute to eradicating hunger.

Improved cooking stoves bring savings of 40–80 % in household fuel consumption

EnDev has been promoting the achievement of the MDG 1 targets by disseminating the technology for improved cooking stoves and supporting rural electrification measures. The various programmes have had impacts on households and individual beneficiaries as well as at the producer level. Improved cooking stoves bring savings of 40–80 % in household fuel consumption. Most assessments put the savings at around 50 %. Although almost all the beneficiaries of the improved stoves reported a significant reduction in the time they spend collecting firewood, there is too little information to assess how they use the extra time they have gained. Time savings can result in increased agricultural productivity and thereby contribute to a more secure food supply and income generation. However, figures are so far only available for Malawi. There, in Mulanje District, 34.3 % of the beneficiaries spend their additional time on farming activities, and 8.4% on small-scale businesses. EnDev projects have observed that – depending on fuel resources – savings in fuel consumption also reduce households' financial outlays. Households with an efficient cooking stove spend less on firewood than those without. Numbers vary from EUR 4 per month in Uganda to EUR 6 per week in Peru, depending on living standards and the proportion of people who buy their firewood (instead of collecting it for themselves). Data from Mulanje District in Malawi indicate that most of this money is then used for household items or food.

In line with EnDev's and HERA's strong market-oriented approach, the producers, installers and marketers of the stoves are all trained locally to serve the growing demand. This contributes to job creation and income generation for the local population. Although in some places the trainees had already previously been involved in stove production, these producers nevertheless indicated that they would hire additional labour and thus also contribute to job creation. Overall, stove building can be said to be a good business. Some producers have become highly successful and can now support themselves with their income from selling stoves. In Kenya, stove producers earn EUR 100–300 per month. However, in most cases stove building remains just one of various sources of income that contribute to the producers' household budgets.

Four out of five electrified households have switched completely from traditional to modern, electric lighting sources

Electricity from solar home systems and micro-hydro plants is usually cheaper than batteries and kerosene in the long run. An ex-ante impact assessment was carried out in Rwanda, in which the target region of a micro-hydro project was surveyed at an early stage, alongside a group of four comparable villages that had already been electrified. This allowed a cross-sectional comparison. The greatest improvement observed at the household level was in lighting. Four out of five electrified households had switched completely from traditional to modern, electric lighting sources. They benefit from (i) greater convenience, (ii) better quality of light (electrified households consume 350 times more lumens than non electrified ones), (iii) less indoor smoke and (iv) lower costs (e.g. 40 % savings if kerosene is substituted by incandescent light bulbs and even 85 % if substituted by compact fluorescent bulbs).

High-tech made of clay and grass: Rocket Lorena stoves have a specially designed combustion chamber and save up to 60 percent of firewood compared to the traditional 3-stone-fire. The "Promotion of Renewable Energies and Energy Efficiency Programme" (PREEEP) in Uganda supports local NGOs and the Ugandan Energy Ministry in training of stove builders. Close to 650,000 improved cooking stoves have been built so far. Also, 37 health centers, 2 schools and 62 small and medium enterprises have been provided with electricity through grid connection and PV technologies.

Put briefly, at the household level the main contribution of electrification is to improve living standards, although it does not necessarily decrease poverty in economic terms. For small businesses, electrification makes a significant contribution to economic growth and poverty reduction. It is very rare for new income generating activities to arise as a consequence of a new electricity supply. Exceptions to this have been seen in Indonesia, for example, where some of the households that gained new connections through EnDev activities occasionally started offering services to their neighbours. For instance, one woman owns a battery charger and offers a charging service, while others can offer electric coconut rasping if greater quantities of food have to be prepared. The study in Rwanda shows that, without explicit interventions from outside, no substantial productive uses of electricity emerge. Among the electrified households in the control villages, only 7 % actually started to practise new activities that depended on their electricity supply, such as trading or welding.

Solar home systems help to attract new and possibly better off customers in rural markets and workshops. With access to electricity, businesses can diversify the service they offer and extend their working hours into the evening.

Uganda – A stove rockets Uganda

The stove component in Uganda's Promotion of Renewable Energies and Energy Efficiency Programme is one of EnDev's most successful stove programmes in terms of numbers built. Using the efficient Rocket Lorena stove, a family can save 3.1 kilogrammes of firewood each day, which adds up to 1.13 tonnes annually. A micro-economic analysis carried out among individual households confirmed the financial impact that this has at the household level. The table below presents the main results.

In non-financial terms, each family cooking on a Rocket Lorena stove spends seven hours less each week collecting firewood and cooking. Women and children in particular benefit from the saved time.

In Kabale, a district of Uganda that suffers severe wood scarcity, 77.5 % of people interviewed reported that prior to the use of the efficient stove they had eaten half-cooked meals, while 70 % said

Economic criteria	Household purchasing firewood
Payback period in months	1
Net benefit during stove's life (sum of the total saving in fuel wood costs during this period minus the costs incurred for the stove during the same time period)	185 EUR
Rate of return (factor: indicates by what factor this net benefit exceeds the expenses for the stove)	46
Annual avoided fuel costs	47 EUR

they had also skipped meals as a result of firewood shortages. Due to the positive impact they have on firewood consumption, improved stoves significantly reduce the limitations on the variety and frequency of food intake, which arise from firewood shortages.

Honduras – Solar home systems for coffee farmers

The EnDev component in the project Promotion of Sustainable Use of Natural Resources and Local Economic Development in Honduras has used a dual approach of stove dissemination and rural electrification. The rural electrification activities using solar home systems have brought significant financial savings. In the past, monthly expenditure on lighting (kerosene and candles) was about USD 5. With access to electricity, this has fallen to USD 1.3 per month, which covers the contribution to a communal fund for repairs and replacements. The majority (71 %) of households paid for their solar home system directly after the coffee harvest, and have thus avoided the need to pay monthly instalments. Considerable savings were also reported by the beneficiaries of a micro-hydropower mini-grid, for example through the cheaper cost of charging mobile phones.

This picture shows a Rocket Lorena stove as disseminated by the "Promotion of Renewable Energies and Energy Efficiency Programme (PREEEP)" in Uganda. PREEEP supports local NGOs and the Uganda Energy Ministry with the dissemination of close to 650,000 improved cooking stoves on the basis of a strong market-oriented approach. Also, 37 health centers, 2 schools and 62 small and medium enterprises have been provided with electricity through grid connection and PV technologies.

Impacts Education

MDG 2: ACHIEVE UNIVERSAL PRIMARY EDUCATION

"Worldwide, 75 million children fail to complete primary school, either because they drop out in the early grades or because they never get the chance to attend school at all."[VII] Children in rural areas, especially girls, often spend a great deal of time on basic subsistence activities, such as collecting firewood. Providing households with more efficient cooking technologies means less wood needs to be collected. As a consequence, more time may be available for children to go to school. In remote rural areas, education levels are also affected by hunger and chronic malnutrition, which reduce children's learning capacities. School feeding programmes are "effective in encouraging enrolment, increasing attention spans, and improving attendance at school."[VIII] However, the relative success of such feeding programmes depends on their actual cost per meal. This, in turn, depends partly on the energy-efficiency of the cooking techniques used.

Although access to electricity does not have an immediate impact on educational levels, it can influence learning performances by providing adequate lighting for children to spend more time studying and reading later into the evening. In addition, it brings with it the possibility of gathering information through radio or television. Electricity also helps schools provide efficient teaching and improves the quality of their education programmes, as it enables them to use media such as overhead projectors. Moreover, access to modern energy services could have an impact on the availability of qualified teachers: by improving rural living standards, it can help to attract teachers to remote communities.

Parents involved in the installation or marketing of stoves have more money to spend on their children's education

More than 870,000 household stoves have been distributed by EnDev, each of them bringing a saving in firewood consumption of 40–80 %. As a consequence, children in these households are relieved of some of their time consuming housework (cooking, fuel collection). Promoting the use of energy-efficient stoves has therefore helped to create free time for children to attend school and to study after school. At the same time, the economic benefits accruing from stove production allow those involved in the business to spend more money on their children's education. This has been demonstrated, for example, in Uganda and Malawi, where 76 % of the stove producers interviewed stated that they were better able to pay their children's school fees and related expenses. Moreover, more than 5,200 stoves have also been distributed to schools themselves.

The electrification of more than 1000 schools now means that teachers can use overhead projectors, computers, televisions, tape recorders and video machines: a significant contribution to the quality of the education system. As reported by the projects in Peru, Honduras and Indonesia, electricity has also improved people's ability to access information.

Malawi – less firewood, better food

In Malawi, EnDev has provided 1,500 schools, orphanages, and nurseries with efficient stoves, thus reducing their firewood costs. As a result, individual institutions have experienced savings in their catering budgets of 12–38 %. Depending on their size, the energy-efficient stoves save 60–80 % of the firewood needed for a traditional open fire. An orphanage that prepares two meals a day in a 100-litre pot saves USD 680 a year on the cost of its firewood. If a 200-litre stove is used twice a day throughout the year, the net benefit over the stove's four-year lifespan is USD 4,235. Depending on the cooking frequency and stove size, the investment pays off within three to nine months. In this way, school feeding programmes have become more affordable. The money saved can be spent on better food for the students, which provides an additional incentive for parents to send their children to school.

Institutional Rocket stoves have contributed remarkably to an improvement in school feeding like at this school in Blantyre, Malawi. Since 1998, the "Programme for Basic Energy and Conservation in Southern Africa "(ProBEC) disseminates improved cooking technologies by forming and training producers to professionally produce improved clay and metal stoves.

A technician from Grameen Shakti installing a solar home system on the roof of a rural household. EnDev is supporting the market-oriented dispersal of solar home systems in off-grid areas of rural Bangladesh. Customers purchase their solar energy system with a micro-credit from a local NGO. The NGO provides maintenance and after-sales service to guarantee its long-term operation. So far, more than 77,000 solar home systems have been sold with the support of the EnDev programme.

Solar home systems enhance studying

In an impact survey of households involved in a Bangladeshi project to distribute solar home systems (SHS), about one quarter of the 178 households interviewed described the lack of electricity as a major problem of daily life. 40 % of the SHS households cited the improved availability of information as an important change, followed by improved lighting conditions (34 %). 26 % of the respondents with SHS stated that the main benefit of the electric light was their children's ability to learn, and 94 % agreed with the statement, "it is easy to read in the evening." Of the non-electrified households, however, only 3 % agreed with the statement. Children from SHS homes remained awake longer each day and used 38 % of their additional time for studying and reading. Interviewees confirmed that children working by the light of kerosene lamps were not tempted to prolong their education-related activities. The average studying time in the evening was 21 minutes longer in SHS households compared to the households without solar electricity. Overall, the prevalence of solar home systems in rural schools still seemed to be quite low. This is apparently due to a low perceived need for electric power: as classes are predominantly held during daytime, lighting is not deemed an urgent necessity.

Indonesia – electrification enhances access to information

One year after a micro-hydropower system began operating in Indonesia an impact monitoring survey conducted in two villages showed that the inhabitants are aware of the possible benefits of electrification, and that they are using electricity in a very efficient way (e.g. about 85 % of the inhabitants have bought energy-saving bulbs). Asked to list the benefits of the electricity supply, 47 % of the respondents said that children can study in the evening. 57 % of the men and 60 % of the women mentioned lighting as a great benefit. The use of free time for studying and reading after 6pm increased to 22 %, as compared to 8 % before electrification. Moreover, 21 % of the interviewees stated that television is "opening children's minds." Some also mentioned their intention to invest more money, especially in their children's education. This development might reflect a growing awareness of the importance of education that arises from the access to information through television. People also depend on radio and television as sources of information because newspapers are not available. Access to television is regarded as a particularly important source of information and is therefore viewed as a significant change arising from electrification.

Institutional Rocket Lorena stoves have contributed remarkably to an improvement in school feeding like at this school in Blantyre, Malawi. Since 1998, the 'Programme for Basic Energy and Conservation in Southern Africa' (ProBEC) disseminates improved cooking technologies. In 2003 the Malawi based ProBEC-branch "Integrated Food Security Programme" adopted a commercial approach by forming and training producer groups to professionally produce improved stoves.

This picture shows the turbine house of a micro hydro power facility in Indonesia. EnDev activities in Indonesia concentrate on "Micro Hydro Power for Sustainable Economic Development" for institutional, domestic and productive use. The Mini Hydro Power Project (MHPP) in Indonesia follows a commercial approach ensuring a continuous sustainable growth of the MHP market.

Impacts
Gender

MDG 3:
PROMOTE GENDER EQUALITY AND EMPOWER WOMEN

According to the United Nations Population Fund's report, State of World Population 2008, there is still a strong link between poverty and gender. 60 % of the people suffering from poverty are women. Poverty among women is strongly linked to the dependence on the cheapest energy sources, such as biomass, for everyday living. In the traditional gender-specific division of labour, household activities are predominantly the duty of women. It is therefore women and their children who face the related discomforts. They are subject to the various health risks connected with cooking, such as the chronic respiratory diseases, pneumonia or eye infections that are caused by indoor air pollution from traditional cooking devices and 3-stone-fire. Acrid smoke and deposits of soot in the lungs are responsible for more than 500,000 deaths among women around the world every year.

Providing access to modern energy helps women to escape poverty.

Burdened by their household activities, women can spend less time than men in education. Two thirds of the 960 million illiterate adults worldwide are women, and around 70 % of the children who do not attend school are girls trapped in poverty[IX]. At the same time, their workload also reduces women's options for participating in productive activities, which condemns them to economic dependence. Promoting the potential of women to act as producers, for example as builders of energy-efficient stoves, would not only help them to gain an income, it would also to change their position in the community, reduce their vulnerability and increase their security. Providing access to modern energy services is therefore important for establishing equal opportunities for women and can help them to escape poverty. Electricity is an important factor in overcoming gender-specific disadvantages. It makes possible the use of innovative, timesaving electrical appliances, it opens up access to new sources of information, and it can help to create additional income.

Women are trained to work as producers and promoters; they gain self-confidence and pride by doing the same work as men

Although gender aspects have not been central to EnDev projects, gender-specific benefits could be observed in many of the projects in different continents. In most project regions women and children, particularly girls, are still the main persons responsible for firewood collection. For example, in a project in Kenya 83 % of the women said this was their responsibility, and that they always fulfilled the task. The projects in Malawi, Mali, Kenya and Uganda have shown that the use of energy-efficient stoves leads to savings of 40–80 % in firewood consumption. Women must therefore invest less money and effort in collecting or purchasing fuel and can use the saved time and/or money for other activities. As mentioned above, in the chapter on MDG 1, 34.3 % of the beneficiaries in Malawi spend their additional time on farming activities, and 8.4 % on small-scale businesses. Low-emission stoves have also contributed to improvements in the health of women and girls, as stated by beneficiaries in Peru, Uganda, Malawi and others. Interviewees living in stove-owning households in Uganda, Ethiopia and Kenya, as well as those in Honduras and Bangladesh whose houses have been provided with solar home systems, all claimed to have noticed an improvement in indoor air quality in the kitchens, which has led to reduced health hazards. In Uganda, for example, one in two users reported suffering less from respiratory diseases and eye infections after installing the cleaner stoves.

The empowerment of women through job creation was not a primary objective of EnDev projects. Nevertheless, from case to case between 36–85 % of those who earned their livelihoods as stove producers were women (e.g. Ethiopia: 36 % of 339 producers, Uganda: 70 % of around 4,000, Malawi: 85 % of 59). In Peru it was also reported that women had been trained as installers and promoters, and had gained self-confidence and pride by doing the same work as men. Similar statements were recorded in Malawi where the respondents also said that, by becoming entrepreneurs, women are improving their social position, and enhancing their roles within families and villages.

Stored parts of Mirt stoves, which later will be joined together. Half of the producers trained in Ethiopia are women. By becoming entrepreneurs, woman are improving their social position, and enhancing their roles within families and villages

A weaver in Bangladesh is working under artificial light

Cooking is usually done by women in Bolivia.
However, Hermino Acaya likes to cook on the new stove, too.

Before, many time-consuming activities, like rasping coconuts and chopping chillies, had to be done manually

Electrification also supports income generation. As was recorded in Honduras, it has made it possible for women to do some of their housework after dark, so they have time to do productive work during the day. Likewise, most of the households interviewed in Peru also agreed that women have benefited most from the improved lighting conditions. The same was true for Bangladesh, where 88 % of women in households with new solar home systems said they had benefited because they spend most of their time at home: the improved lighting helps them in their household work, and they can avoid the hassle of kerosene lamps.

In the Indonesian EnDev project, access to electricity has been increased by using micro-hydropower systems. Here, the women claimed that many time-consuming activities, such as rasping coconuts and chopping chillies, which before were done manually, can now be completed easily using electrical appliances. (For example, in Pancung Taba, where people have had access to electricity since 2000, 90 % of the women use electric coconut rasping machines, at least 30 % use a rice cooker, 50 % a blender, 50 % a mixer, 40 % a cold and hot water dispenser and 15 % a fridge). In some few cases they are even selling these services to neighbours. The women also reported improved hygiene, because they can now boil water to sterilise it before putting it into the dispenser. In some villages, households now use electric pumps to pump water from a nearby river

or from a well. This also reduces the workload for the women and children, as it was usually they who had to fetch the water before. Before having electricity they used kerosene for their lamps and to light the fire in the cooking stove. The women also stressed that saving on kerosene was also a reduced expense. They estimated that their kerosene consumption had decreased from 20 litres a month to about eight. Not only does this correspond to a cost reduction of about 30 %, it also constitutes an improvement of the indoor air quality. Apart from the cost and health benefits from the reduced kerosene consumption, some women have started to generate additional income by offering electric coconut rasping as a service for others.

Improved cooking technologies such as the biogas cooker shown in the picture facilitate especially women´s household activities. The Bolivian "Agricultural Development Programme" (PROAGRO) has disseminated more than 250 biogas plants and 17,000 fuel wood burning cooking stoves for households and social institutions. Furthermore, it is promoting grid electricity, mini-grid electricity through hydropower, solar lanterns, and energy for productive use.

Impacts
Health

MDG 4: REDUCE CHILD MORTALITY
MDG 5: IMPROVE MATERNAL HEALTH
MDG 6: COMBAT HIV/AIDS, MALARIA AND OTHER DISEASES

Millions of people around the world do not have sufficient access to high quality medical treatment. One of several factors that can improve the efficiency of health care systems is the provision of affordable energy. Electric power is important for any well functioning health care system because it enables clinics to refrigerate vaccines, sterilise medical equipment, provide lighting in wards and operating theatres, and make use of communication equipment. Moreover, access to electricity can help attract and retain health workers. It also allows the use of modern mass communication tools to fight the spread of preventable diseases. Besides access to electricity, installing clean cooking stoves in clinics can strengthen health systems as they can be used to provide better nutrition (for patients as well as employees) as well as hot water for hygiene purposes.

At the household level the use of traditional forms of energy for cooking causes serious health problems. Biomass fuels such as firewood, dung, agricultural residues and charcoal are often the only energy sources available, and these are usually burned on inefficient open fires or stoves. The toxic smoke emitted by these fires is responsible for a significant high number of women and children suffering from respiratory diseases which even can lead to death, making traditional stoves a major killer in the kitchen. The World Health Organisation[II] has shown that every year around 1.5 million deaths are caused by indoor air pollution (from traditional cooking stoves. Most of these deaths are among women and small children). Furthermore, a high number of women and children suffer from respiratory diseases and a substantial number of people incur serious burns, or are injured while gathering firewood (due to accidents or rape). In areas where fuel is scarce, people may also be obliged to make unhealthy choices, such as drinking water that has not been boiled, eating half-cooked meals or skipping meals altogether.

The improved stoves emit very little smoke. They have therefore enhanced indoor air quality, safety and hygiene

At the household level, in rural areas, EnDev has contributed to improved health conditions by promoting the construction of more than 870,000 well-designed energy-efficient stoves in 15 different countries. The various projects report that the improved stoves emit very little smoke. They have therefore enhanced indoor air quality, as well as the safety and hygiene of kitchens in the households involved. Efficient stoves have also led to lower consumption of firewood, thereby reducing the health risks connected with gathering firewood. Furthermore, the extra income generated by the stove business has indirect effects on health. For instance, 75 % of the Ethiopian stove producers claimed that they are now better able to pay for medical and health care for themselves and their families.

At the institutional level, EnDev has provided 26 hospitals with energy-efficient stoves. This has led to better nutrition and hygiene, both for the patients and the cooks. EnDev has also provided access to electricity for approximately 245 health centres, using grid connections or solar energy systems. This access has improved the quality of medical treatment. Electrification of households does not bring immediate improvements to the health situation, although it does make a general contribution, for example, by reducing kerosene-related accidents. This point was made by the beneficiaries of solar electrification projects in Bangladesh and Honduras as well as those with new grid connections in Peru.

Peru – stoves and electricity for safety and health

In a self-evaluation by the EnDev project in Peru which provides access to an electricity grid, and promoted energy efficient stoves and solar ther-

mal water heaters, beneficiaries stated that the new stoves reduce smoke emissions inside the kitchen to about zero. They also said that the stoves improve hygiene in the kitchen, which prevents diseases such as diarrhoea, and they reduce incidences of accidental burns, especially among children. In 2009, a study held by the Universidad Peruana Cayetano Heredia showed that the symptoms of respiratory diseases in the high Andes declined significantly among families using the improved cooking stoves for even a short period of 4 to 12 month. At the same time, the respondents pointed to the reduced risk of accidental fires in the home due to the change from kerosene lamps and candles to electric lighting. This is seen as a great benefit of the access to grid electricity. Besides households, social institutions and small enterprises have also been supplied. In terms of access to energy, the situation in the institutional sector resembles that of the households, especially the need for hot water. The distribution of solar water heaters in communal institutions has increased the availability of hot water. This was an important improvement for 90 % of the health centres, where it is needed for hygienic purposes, such as cleaning instruments, patient care and handling materials.

Uganda - more stoves, fewer risks

Similar results have been observed in Uganda, where the dissemination of the stove technology was a key component. A household survey showed that people using the improved stoves suffer less from smoke-related diseases than those still using traditional methods (Only 23% of the new stove users complained of eye infections, compared to 43% of those cooking traditionally). Even households that do not use the stove exclusively (48%) benefited from a marked reduction in cooking times (an average of 45% time savings). Households also reported that gathering firewood is associated with certain risks (injuries: 57%, snake bites: 10%). They said that using the improved stove has reduced the amount of time spent gathering firewood by about 53%. Consequently the associated risks and problems are also becoming less common. Furthermore, the wood saved during the cooking process was used to boil water. By contrast, 15% of households cooking on a three-stone fire stated that they do not boil water for drinking, 46% mentioned eating half-cooked meals once or twice a week, and 70% also said they skip some meals due to the lack of firewood. None of the households using the efficient stove mentioned problems of restricted cooking capacity, despite the fact that the district in which the stoves are being used also suffers from extreme scarcity of firewood.

During the first phase of the EnDev Peru component "Risk Management Programme for Food Security in Arequipa, Peru" solar thermal water heaters similar to this one have been installed in 46 schools and health centres, 11small and medium enterprises as well as 34 households. Apart from solar thermal devices the EnDev Peru component aims at improving access in terms of grid extension and improved cooking stoves. For the new phase project activities shall be not only increased in Arequipa region but also extended on a national scale.

Impacts
Environment

MDG 7:
ENSURE ENVIRONMENTAL SUSTAINABILITY

Most sources of energy derive from our natural surroundings, including fossil fuels, biomass, or the sun, the wind and water. Without sound, sustainable management, the production, distribution and consumption of energy all have severe effects on the local and global environment. Deforestation, land degradation, desertification and air pollution from excessive greenhouse gas emissions affect the people of the southern hemisphere most severely. The majority of the population in these regions depend on biomass such as wood and agricultural residues as their primary energy source. This leads to the over-exploitation of biomass stock for cooking and heating, which in most cases intensifies natural risk scenarios. Due to their poverty, however, the people living in these regions have too few alternatives to be able to manage their resources sustainably, and they have little awareness for environmental issues.

Goal 7 of the UN Millennium Development Goals is to achieve environmental sustainability by various means, including reducing the loss of biodiversity. Modern and clean energy services, with improved energy efficiency and the use of clean energy resources, help to ensure environmental sustainability. They reduce the demand for biomass and therefore slow down the destruction of forests; they reduce greenhouse gas emissions and the acidification of land and water. Local adaptability and integration are essential preconditions for the successful promotion of alternative resources and technology options.

Compared to cooking on open fires, the improved stoves emit between one and one and half tonnes of CO2 less per stove annually

Energising Development has contributed to the reduction of environmental degradation through the distribution of energy-saving cooking stoves, mini hydropower applications, solar water heaters, grid extension and small photovoltaic systems for lighting and household electricity needs.

Improved stoves help reduce demand for firewood by 50 % on average. They therefore reduce deforestation, soil erosion, land degradation and desertification, and they improve water control. A further consequence of the more efficient burning and the lower demand for firewood is the reduced emission of greenhouse gases. Compared to cooking on open fires, the improved stoves emit between one and one and half tonnes of CO2 less per stove annually. The amount of the CO2 reduction depends (among other factors) on the efficiency of the stove, the quality of the firewood used and the proportion of the country's biomass stock that is non-renewable. It can therefore only be measured exactly for each individual case. However, with over 870,000 new stoves having been built since 2005, the EnDev projects have made a considerable contribution to the reduction of greenhouse gas emissions and hence to the fight against climate change. Furthermore, it is acknowledged that EnDev activities have raised environmental awareness among the participants of its cooking energy programmes.

Almost 165,000 households have gained access to electricity since the beginning of EnDev activities. Electrification through grid extension, mini hydropower plants or photovoltaic installations has helped to reduce soil acidification by decreasing the demand for small batteries. Used batteries are usually discarded in the local environment as toxic waste without further treatment. Mini hydropower plants also contribute to increased awareness of environmental issues due to the importance of proper watershed management and reforestation to secure a long-term water supply. Photovoltaic installations, such as solar home

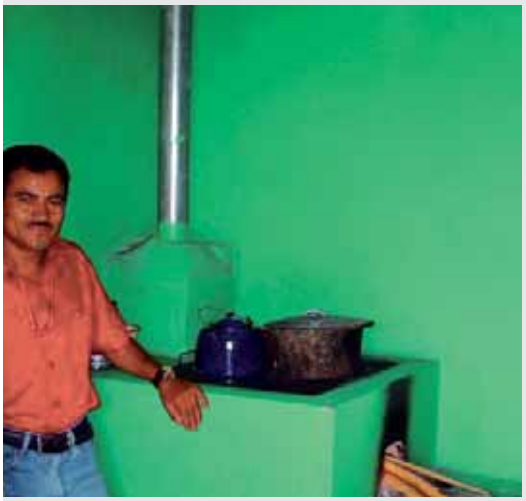
systems, do contribute to environmental sustainability by decreasing the demand for kerosene and gasoline. However, special attention must be paid to the proper disposal of the solar charged batteries, a process which is still in its infancy in many project regions.

Nicaragua – a tree for a stove

The stove component pursues a unique counter-conditioning approach to stove promotion and reforestation. The EnDev partner, Proyecto de Zonas Costeras (PZC), is using stoves as an incentive within their awareness campaign on deforestation. 1000 stoves have been subsidised by the project, but the beneficiaries had to commit themselves to plant and care for trees in the PZC reserve area. By undergoing training and nursing the trees, people become aware of the importance of tree planting and reforestation; they get directly involved in these activities in their home areas and thus develop a feeling of responsibility for their environment.

Mali – Forest protection in a commercial way

Stove producers received on-the-job training to build energy-saving stoves. Then training was also given in promotion and marketing strategies, business management and quality control mechanisms. Drawing on best practices taken from stove projects in other parts of Africa, the image of the project, with its focus on the environment and forest preservation, was changed to use marketing methods to emphasise the commercial benefits. In short: people don't buy improved stoves because they want to save the forest but because they will spend less on cooking fuels. The economic benefit is a very strong incentive for buying and using efficient cooking technologies.



Within the German-Nicaraguan project "Sustainable Management of Natural Resources and Strengthening of Entrepreneurship Competencies (MASRENACE)" EnDev follows a multi-facetted strategy of improved energy access for rural households by means of grid extension, mini-grid hydropower electricity, photovoltaic electricity and energy efficient stoves. The stove dissemination is coupled with reforestation efforts by the EnDev partner Proyecto de Zonas Costeras (PZC).

Impacts
Additional impacts and findings

Energy is central to nearly all aspects of human welfare. It has already been shown that energy services, such as lighting, heating, cooking, motive power, mechanical power and telecommunications, can contribute to achieving the Millenniums Development Goals (MDGs) – both directly, by raising incomes, and indirectly through their impacts on education, health, environment and gender issues. In addition to this, energy services, especially rural electrification, can contribute to other social aspects of human development.

In Bangladesh, 40 % of SHS households reported greater potential to access information and entertainment

For example, a study of a project in Bangladesh aimed at identifying the link between electricity and sustainable development found several additional benefits of electrification.

One way in which rural electrification can have a positive social impact is through improved media access. Radio and television may have an impact on various aspects of social life. Besides their use for entertainment, radio and television can be regarded as possible agents of change in the sense that they can contribute to education through educational programmes. They supply people with information on what is going on in their country (e.g. news bulletins or weather reports for farmers) and in the world, and they increase people's knowledge about health and gender-related topics.

In Bangladesh, 40 % of households with new solar home system reported that they now have greater potential to receive information and entertainment, thanks to radio and television. Similar effects were reported by the female beneficiaries of an electrification project in Indonesia. Women in Langai listed the advantages of having a television. They especially appreciated receiving information from abroad, which before they had not been able to hear to such an extent. It should be noted, however, that the impact of radio and television is multifaceted. Certain negative effects are sometimes also associated with radio and television usage, such as the loss of time for productive or social activities, or for studying. Electricity also makes charging of mobile phones possible. Other results from Bangladesh include the fact that 18 % of respondents were glad of the possibility to charge mobile phones.

There seems to be an increase in social activity as a result of gatherings taking place in electrified households

An additional positive social impact of energy for lighting was that it increases feelings of safety and security in rural households, as it discourages theft and robbery. In electrified villages, it not only increases the feeling of safety within homes, it can also make people feel safer moving around. This was the case for women in Pancung Taba, Indonesia, who reported that before they got access to electricity, they were often afraid to go out in darkness, and that electricity had increased their social activity. Even if this greater perception of safety might not be justified in terms of an actual decline in thefts and other incidents, the fact that lighting makes people feel more secure is an important psychological effect.

In Bangladesh, on the other hand, solar PV technology was not used for public lighting, and the improved feelings of safety only occurred within households that owned a solar home system. 34 % of people questioned cited their improved lighting conditions and 26 % claimed this made it easier to move around in their houses after dark. 12 % of respondents felt more secure due to household lighting. Despite the lack of artificial light in public spaces, there nevertheless seemed to be an increase in social activity due to social gatherings taking place in electrified households.

It is sometimes argued that energy services keep rural populations from migrating to urban areas. Advocates of this idea hold that access to modern energy services improves quality of life and removes the reasons to migrate. However, evidence for such a relationship is ambiguous. It may even be the case that access to modern energy services increases outward migration, because improved socioeconomic development raises people's expectations.

Additional findings were also obtained from a study in Malawi. Here, it was shown that involvement in the use or production of improved stoves has a positive effect on a person's social position in the village. Such people often acquired a reputation for being innovative and were thought to contribute to village development; thus they enjoy the appreciation of many families.

Typical transport of a solar panel to a rural customer in Bangladesh

Solar-powered TV in a village shop in rural Bangladesh

Making impacts sustainable

Sustainability and access to energy

The concept of sustainable development generally includes three elements: economic development, social equity and maintaining a healthy environment. This points to an explicit link between access to energy services and sustainable development. After all, access to modern energy services influences all aspects of development: economic, social, and environmental. It affects agricultural productivity, health, education, and gender issues. Moreover, sustainability inherently implies that projects should secure long-term results. In other words, projects should be implemented in a way that ensures activities persist, even after the project has ended.

Sustainability and Energising Development

For EnDev, planning, implementing and monitoring development interventions is guided by the objective to provide long-term sustainable access to modern energy services in developing countries. Activities should focus on energy services and resources that are reliable, affordable, economically viable, socially acceptable and environmentally sound. Subsidies, either direct or indirect, should be used only temporarily to overcome certain barriers to entry or market development. Moreover, ownership and participation of the target group needs to be guaranteed and the activities themselves must be efficient in terms of their costs and benefits. To ensure that activities continue after projects end, EnDev uses a commercial approach that involves establishing functioning markets for the energy products and services. These markets should include permanently available commercial services and productive capability, as well as constant demand for products.

Under EnDev the main criteria for sustainability are:

- demand-orientation in the partner country to guarantee project ownership and long-term sustainability
- coherent political, legal and regulatory frameworks for improving access to modern energy
- participation of national, regional and local authorities as well as civil society
- recognition of the central role of the private sector in creating markets for modern energy services
- consideration of social issues including gender
- consideration of environmental issues
- development of locally available human and institutional capacities for the long-term self-sustaining expansion of energy access.

Malawi – a success story for commercial stove production

For projects that promote the use of improved stoves, ensuring the continuation of activities after the end of the project implies that the users should appreciate the stoves. This can be measured in terms both of the take-up rate among new customers, and the replacement rate among existing users. At the same time, continuity of stove production should be guaranteed. The results of a study in the districts of Mulanje, Ntcheu and Thyolo show that, on the demand side, people have been happy to adopt the improved stove technology. In Mulanje, where the stoves were first introduced in a self-help project in 1999/2000, the user rate has risen by a factor of three since 2004. The rate has been accelerating since the commercialisation of the approach in 2003, which indicates that commercial stove production has been established successfully.

The study also indicates that the commercial approach seems to favour user acceptance and demand, as well as the stove supply, which means production of the improved stoves is a profitable business for the producers. The clay stoves have an average lifespan of two years. Thus, the replacement of old or broken stoves with new ones is a good indicator of the sustainability of their use, and of changing cooking patterns. The data indicates that the share of households that had used an improved stove, but did not replace it after it was damaged, is 8 %. These households returned to the exclusive use of a 3-stone-fire.

In Malawi, commercial stove production has been established successfully. Chitetezo Mbaula, the protecting stove as it was named by the women themselves, is mostly produced by rural women groups. They appreciate their business.

"Foyers améliorés au Burkina Faso (FAFASO)" concentrates on the dissemination of improved cooking stoves in the two urban centres of Ouagadougou and Bobo Dioulasso. The key characteristic of FAFASO is its strictly commercialized approach. By means of an intensive marketing campaign including posters and radio as well as TV spots and public theater performances, exhibitions, sponsoring of events and most importantly the introduction of a broadly recognizable quality label for the stoves, FAFASO reached a distribution rate of 2,000 stoves per month.

On the supply side, the prospect is similarly optimistic: most of the producer groups have established continuous production, albeit on a small scale. They have acquired suitable marketing and promotion skills, which suggests they are likely to continue their business without further support. Moreover, all the producers interviewed said they appreciate their business and are willing to continue with production and sales.

Ethiopia – an initial subsidy with a clear exit strategy

A similar study was conducted to assess the impacts of an improved stove commercialisation project in four regions of Ethiopia. The project took a market-oriented approach, but it tried to speed up the development market by providing a direct subsidy for the first 100,000 stoves. This was combined with a clear exit strategy. Despite a slow start, the growth of sales has proved to be steady. In terms of consumer acceptance, potential for income generation and market development, the 'Mirt' stove business in the Oromia and Amhara regions now seems to be approaching a sustainable level of commercialisation.

Consumers' perception of the Mirt stoves is very positive. The users appreciate the benefits associated with improved stoves that were described in earlier chapters, such as fuel savings, improved health and the cleaner cooking environment. Moreover, the stove owners use their stoves on a regular, daily basis.

From the producers' point of view, the high value they place on the technical and business skills they have acquired through their involvement in the stove business is a promising indication of its sustainability. EnDev Ethiopia has trained 370 producers in 230 towns. Of this group, 306 are still actively producing and selling improved stoves. About half of these are women.

Injera bread is the staple food in Ethiopia. Therefore EnDev Ethiopia component GTZ SUN-Energy has adopted a commercial approach to disseminate injera baking Mirt stoves by setting up 370 Mirt stove production units in 230 towns in the four project regions Amhara, Oromia, Southern Nations, Nationalities and Peoples (SNNP) and Tigray Regional States. Up to date over 200,000 Mirt stoves have been sold.

Lessons learnt

Several lessons can be learnt from the impact studies considered in this report. The impact assessment of the first phase of the Energising Development programme has also shown where there is scope for improvements to be considered in the second phase, starting in 2009.

Cooperation with national governments

The EnDev country activity in Rwanda, known as the PSP Hydro Project, is a good example of a project whose impacts at the policy level were made possible by involving several stakeholders and by learning from the concrete experiences gained during the implementation of pilot hydropower projects together with the private sector and the national government.
As an innovative development measure, the PSP Hydro Project has had to overcome a number of institutional and regulatory challenges since its start in 2005. For example, at the outset of the project there were no nationally standardised power-purchase agreements (PPAs), and feed-in tariffs did not exist. Project developers need such agreements to reduce their risks and to convince banks to lend them money. As a result of negotiations between the responsible authorities, today a standard PPA contract exists. The latest of these agreements was concluded in just two weeks of negotiation, and introduced a standard tariff of FRW 60/kWh. Since the start of the PSP Hydro Project, a regular dialogue with all private sector electricity projects has been established, and a provisional independent power supplier approval process has been put in place. Approval of electricity projects currently takes 2–8 weeks.

Working together with the Department Arequipa, EnDev Peru managed to encourage the widespread use of the Inkawasi stove. The national government of Peru has recognised the problems of the high cost of cooking fuel and indoor air pollution that face thousands of families, and is now drawing on the successful experiences of Arequipa. Its national campaign, 'Half a Million Homes without Indoor Air Pollution', was launched in the summer of 2009. All governmental and state institutions now support the wider use of improved cooking stoves. Furthermore, a national technical norm for modernised traditional cooking appliances has been introduced. The norm uses the experiences of GTZ HERA in more than 20 countries and defines performance indicators such as energy saving potential, indoor air parameters and safety standards.
Another example is the case of EnDev Bolivia. Among other approaches, EnDev Bolivia supports the supply of grid electricity to households and social institutions, as well as to productive, locally-based, private or communal enterprises in rural and periurban areas close to the grid. It supports the densification of the existing grid, offering a partial subsidy for a connection. At the same time, a novel financial mechanism is used to facilitate and cover the costs of connection by the electricity distribution company in the area. The project selected communities that have a great need for electricity and a solid organisational structure, and which have the commitment of local authorities and beneficiaries. The concrete successes of the project implementation contributed to the passing of a new Law for Universal Access to Electricity (Ley de Acceso Universal). Guided by this law, a programme, Electricity for a Decent Living, was designed to improve both rural and urban electrification. This cooperation between the ministry and GTZ is responsible for 45% of the planned connections. The short-term goal (2006-2010) of the programme is to increase rural electrification to 53 % (connection of 210,000 new households) and urban electrification to 97 % (connection of 460,000 new households).

Reaching low-income groups

Although this report points to several impacts related to poverty alleviation, such as income generation and saving time, it cannot be proven satisfactorily in all cases that the activities EnDev implements to promote stoves and electrification actually target low-income groups in the specific regions and contribute to poverty eradication. In one project, for example, substantive doubts are voiced about whether the poor were reached on a large scale, because the project clientele mainly lived above the national poverty line of EUR 45 per month. In Bangladesh, recipients of solar home systems generally belong to "higher" income groups (average monthly income: 43 Euros compared to very poor households: less than 22 Euros), who prefer to use electricity for entertainment instead of income generating activities. Poor households that would benefit most from photovoltaic appliances cannot afford them, but this can be explained in terms of the market orientation of Energising Development. The Rwandan study shows that a significant community-wide wealth impact is not predetermined. According to a wealth indicator that combines 14 sub-indicators representing assets, expenditure and income, three of the four project villages attained a similar wealth level as comparable control villages. Inequality might even increase in the short term, as poor households are three times less likely to be connected to grids than wealthier households.

The second phase of the programme must place more emphasis on this issue.

Side effects

Several greater or lesser side effects – some of them undesirable – were observed in the course of the impact studies. For instance, there is little awareness among local populations about the issue of solar battery disposal. This results in high risks for the environment as well as health hazards for those who have been provided with solar home systems. In some regions, battery recycling capacities have been put in place.

One example of an unexpected side effect is that new access to electricity services can lead to increased energy consumption and higher expenditure. One of the micro-hydropower projects reported that total spending on energy has increased slightly since the connection to the micro-hydropower grid, although electricity is in fact less expensive than other energy sources. Sometimes it is also evident that solar home systems with a high capacity are financially less attractive than using kerosene and batteries to cover basic energy needs.

Finally, in some instances the programme has been seen to have a greater impact on men than on women. In one of the stove projects, for example, more male than female producers have diversified their stove business. This might be due to the greater mobility of men compared to women, who are generally more tied down by their household chores and child caring. Diversification (production, installation, and marketing) allows producers to increase their incomes. However, it has also been shown that women gain a better reputation in the village if they are entrepreneurs in the stove business.

Quality control and maintenance

All modern energy technologies that are disseminated by EnDev do need some kind of maintenance. In the case of improved stoves it turned out that beneficiaries' understanding of quality and thus the need of maintenance, repair or replacement differs significantly from projects' specifications. In this context it might be necessary to impose a rigorous quality control system for a certain time in order to establish a common sense for quality first among producers and secondly among clients. Moreover it is essential to establish after-sales services; to achieve a high customer satisfaction on the one hand and to increase the life-time of a product on the other hand.

Replacement is considered to be an ultimate criterion for sustainability. So far it is difficult to measure replacement numbers, because most disseminated technologies did not yet exceed their lifespan. However, first data suggests that there is a need to follow up on replacement figures and to include measures into the project planning. Several EnDev- projects reached impressive outcome numbers, the success is however challenging with regard to the monitoring activities. Studies indicated that there is a strong need to verify reported figures of partner organizations. It might be considered to increase the monitoring budget according to the outcome number to ensure a maximum level of reliability.

Impact assessment

During the start-up phase of Energising Development, impact assessment was not given high priority. Therefore an important lesson learnt is that proper impact-related baseline studies would not only have made it easier to measure the impacts achieved later, but would also have enhanced the impact itself. In the second phase of EnDev, impact evaluation is given a greater priority. An EnDev Monitoring Group has been formed, which possesses practical experience and theoretical knowledge of country impact monitoring. Therefore the Monitoring Group has developed a toolbox with recommendations for "proper" impact assessments. The group includes EnDev staff at both programme and project levels.

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Annexes

TABLE OF REPORTS AND STUDIES CONSIDERED

Country	Title of study	Technology	Research methods	Year
Bangladesh	Electricity and Sustainable Development: Impacts of Solar Home Systems in Rural Bangladesh	Solar Home systems	› quantitative and qualitative study to find empirical evidence of the impacts › data collection using a household survey (incl. non-electrified village as a control group) › interviews with owners of shops and small businesses › interviews with local experts	May 2007
Bangladesh	Impacts of Basic Rural Energy Services in Bangladesh	Solar Home System And Improved Cook Stove	› quantitative and qualitative study to find empirical evidence of the impacts › data collection using a household Survey › interviews with solar branch managers › interviews with SHS-owning households and MSE	2009
Ethiopia	Impact Assessment of Mirt Improved Biomass Injera Stoves Commercialization	Stoves	› literature review › development and testing of result chain › quantitative household and producer surveys › qualitative assessment: producers surveys and stakeholders assessment	2008
Honduras	Promotion of Sustainable Use of Natural Resources and Local Economic Development – Midterm review report	Stoves & Rural electrification (micro hydropower and solar home systems	› situation analysis (literature review, internet search and interviews) › analysis and assessment of EnDev activities (project site visits, interviews with beneficiaries, stakeholders and project staff, observations)	July 2007
Indonesia	Women's Benefit from Electricity - Quick note from a rapid survey in Sumatra	Rural electrification – hydro power	› individual interviews › group interviews	February 2008
Indonesia	How electricity changes life - Evaluation of a baseline survey and impact monitoring after electrification based on MHP systems	Rural electrification – hydro power	› baseline study before electrification › questionnaires and interviews after electrification	September 2008
Kenya	Improved Stoves Impact Survey Study	Stoves	› surveys with standardised questionnaires for households, schools, restaurants, stove producers/traders › observation › PRA tools for group discussions	2009
Mali	Dissemination of improved stoves FAMALI - Foyers Améliorés au Mali (Final Technical Report)	Stoves	› data from baseline study › stove tests › statistics	July 2007
Nicaragua	Sustainable Management of Natural Resources and Strengthening of Entrepreneurial Competencies – Midterm review report	Stoves & Rural electrification – grid connections, mini grids and solar energy	› situation analysis (literature review, internet search and interviews) › analysis and assessment of EnDev activities (project site visits, interviews with beneficiaries, stakeholders and project staff, observations)	May 2007

Country	Title of study	Technology	Research methods	Year
Peru	Katastrophenrisiko-management zur Ernährungssicherung im Departement Arequipa, Peru – EnDev component – Midterm review report	Stoves & Rural electri-fication (grid connections)	› situation analysis (literature review, internet search and interviews) › analysis and assessment of EnDev activities (project site visits, interviews with beneficiaries, stakeholders and project staff, observations)	May 2008
Peru	Evaluación del Cambio de Cocinas en el Centro de Población de Lliupapuquio, Andahuaylas	Improved Cooking Stoves	› survey	2009
Rwanda	Private Sector Participation in Micro-hydro Power Supply for Rural Development	Micro hydropower	› baseline study in target regions and comparable regions already electrified: household visits, interviews with enterpreneurs and social institutions	May 2008
SADC – Malawi	ProBEC – Programme for Biomass Energy Conserva-tion – Impact Assessment at Local Level Experiences from Malawi – Mulanje District	Stoves	› questionnaire › detailed assessment of changes of changes within the impact area of Mulanje district › follow-up visit	2005
SADC – Malawi	Impact Assessment of Chitetezo Mbaula Improved Household Firewood Stove in Rural Malawi	Stoves	› standardised household questionnaires › field observations › semi-standardised interviews with producers › intensive interviews with partner organisations › review of project documents	2008
Uganda	Impact Monitoring Study: The Rocket Lorena Stove Dissemination in Bushenyi District	Stoves	› household surveys with questionnaires › stove producers survey	2006
Uganda	Economic evaluation of the improved household cooking stove dissemination programme in Uganda	Stoves	› cost-benefit analysis › cost-effectiveness analysis › economic evaluation	2007
Uganda	Sustainability of Stove Disseminationn in Bushenyi and Mbale Districts, Uganda	Stoves	› surveys with standardised questionnaires for households and stove producers › interviews with local leaders › observation › review of project documents	2010

Annexes

TABLE OF ENDEV PROJECTS

Country	Activity	Name
Bangladesh	Rural Electrification	Programme Renewable Energy and Energy Efficiency
Benin	Rural Electrification	Programme for Decentralisation and Communal Development (PDCC)
Benin	Improved Cooking Technology	Programme – Conservation et gestion des ressources naturelles
Bolivia	Rural Electrification and Improved Cooking Technology	Agricultural Development Programme (PROAGRO)
Burkina Faso	Improved Cooking Technology	Programme Décentralisation et Développement Communal (PDDC) – FAFASO
Burkina Faso and Mali	Improved Cooking Technology	"Comité Permanent Inter-Etats de Lutte contre la Sécheresse dans le Sahel" (CILSS) German Mission for the Support of CILSS
Ethiopia	Improved Cooking Technology	Sustainable Utilization of Natural Resources for Improved Food Security (SUN) – SUN Energy
Ethiopia	Rural Electrification	Access to Modern Energy Services in Ethiopia (AMES-E)
Ghana	Rural Electrification	Energy for Productive Use Project (EPUP)
Honduras	Rural Electrification and Improved Cooking Technology	PRORENA Energy Advisory Project
Indonesia	Rural Electrification	Micro Hydro Power for Sustainable Economic Development Mini hydro Power Project (MHPP)
Kenya	Improved Cooking Technology	Promotion of Private Sector Development in Agriculture
Mali	Rural Electrification	Promotion of Local Government (Rural Electrification component)
Mongolia	Rural Electrification	Development of Renewable Energy Resources
Mozambique	Rural Electrification	Access to Modern Energy Services in Mozambique (AMES-M)
Nepal	Rural Electrification	Small Hydropower Promotion Project (SHPP)
Nicaragua	Rural Electrification and Improved Cooking Technology	Sustainable Management of Natural Resources and Strengthening of Entrepreneurial Competencies
Peru	Rural Electrification and Improved Cooking Technology	Disaster Risk Management for Food Security
Rwanda	Rural Electrification	Private Sector Participation in Micro-Hydro Power Supply for Rural Development (PSP Hydro)
Rwanda	Biogas	Support of the National Domestic Biogas Programme (NDBP)
SADC (e.g. Malawi)	Improved Cooking Technology	Programme for Biomass Energy Conservation (ProBEC) SADC – Southern African Development Community
Senegal	Rural Electrification and Improved Cooking Technology	Promotion of Electrification (PERACOD – ERSEN/FASEN)
Sub-Saharan Africa	Rural Electrification and Improved Cooking Technology	Promotion of Cooperation between African Nations in the Energy Sector (Component promoting energy businesses with E&Co)
Uganda	Rural Electrification and Improved Cooking Technology	Energy Advisory Project (EAP)

Imprint

Published by

GTZ and NL Agency

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Photos

All photos from GTZ,
except page 18 upper is from Grameen Shakti

Design

ansicht Kommunikationsagentur
www.ansicht.com, Wiesbaden, Germany

Printed by

Druckerei Lokay e.K., Reinheim, Germany

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Eschborn, May 2010

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