Productive Use of Thermal Energy

An Overview of Technology Options and Approaches for Promotion

euei pdf
energy for development

giz Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH

Productive Use of Thermal Energy
An Overview of Technology Options and Approaches for Promotion

This publication is part of the Productive Use of Energy (PRODUSE) Initiative. PRODUSE is a joint initiative of Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH, the European Union Energy Initiative Partnership Dialogue Facility (EUEI PDF), the Energy Sector Management Assistance Programme (ESMAP) and the Africa Electrification Initiative (AEI). It aims to disseminate knowledge about the relevance and the promotion of productive use of energy.

Further information are accessible at *www.produse.org*

Published by:
Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH - Programme - Poverty-oriented Basic Energy Services (HERA) and European Union Energy Initiative Partnership Dialogue Facility (EUEI PDF)

Authors:
Anna Brüderle, Katja Diembeck, Johanna Hartmann, Monika Rammelt and Heike Volkmer

Editors:
Heike Volkmer and Lucius Mayer-Tasch

English editing:
Andrew Morris

Place and date of publication:
Eschborn, 2014

Layout, diagrams and illustrations:
© creative republic //
Thomas Maxeiner Visual Communications, Germany
www.creativerepublic.net

Photos:
© GIZ/ Michael Netzhammer, M. Guiwa, Konjit Negussu, Christa Roth, Isaac Salima, Natalie Pereyra, Luz Maria Calvo, Maria Chipana Cuéllar, Omar Chuquimia, Eris Sawadogo, Julia Sievert
© EnDev/Peru, Carlos Bertello, MicroEnergy International
© Helmut Viertel, Hartmut Fiebig, shutterstock

Productive Use of Thermal Energy

An Overview of Technology Options and Approaches for Promotion

euei pdf
energy for development

giz
Deutsche Gesellschaft
für Internationale
Zusammenarbeit (GIZ) GmbH

Contents

1. Introduction 9

2. Value chains and production processes based on thermal energy 14

2.1 Thermal Energy in agricultural, industrial and commercial value chains 14

2.2 Productive processes based on thermal energy and suitable technology options 18

2.2.1 Cooking 18
2.2.2 Drying 20
2.2.3 Baking 22
2.2.4 Other productive processes with thermal energy input 24

3. Promoting productive use of thermal energy 30

3.1 Opportunities and challenges 30

3.2 Promotion of businesses using thermal energy for productive use 34

3.2.1 Promoting the adoption of energy efficient technologies by MSMEs 36
3.2.2 Promotion of the supply of energy efficient technologies 42
3.2.3 Creating an enabling environment for productive use 44

3.3 Overview of possible activities to promote thermal energy for productive uses 44

4. Bibliography 50

List of Figures

Figure 1: Value chain of coffee beans 15

Figure 2: Value chain of small-scale shea butter production...................... 16

Figure 3: Value chain of a restaurant with thermal energy 17

Figure 4: Results chain for productive use of thermal energy 31

Figure 5: Project context with proposed interventions.... 35

List of Tables

Table 1: Improved thermal technologies for different productive processes.........................26

Table 2: Possible interventions to promote productive use of thermal energy..........................45

Introduction

1

needs
king
view
economic
commercial
practitioners
Small-scale Electricity Generation
productive purposes
heat
sun
market regulation
electrification practitioners
publications
estimate
solar
business environment
International Energy Agency
traditional
technologies
economic development
potential benefits
future
developing countries
small enterprises
smoking
cooling
modern energy services
efficient thermal energy
agriculture
solar
baking
solutions
cooling
agriculture
heating
promoting
heat
sun
informal sector
Africa
energy
distribution
practical guidance
cooling
commercial
drying
sun
heat
precondition
rural areas
thermal energy
heating
practitioners
Biomass
remote areas
cooking
energy source
Africa
commercial
heat
sun
sun

1. Introduction

According to the estimates of the International Energy Agency (IEA), 2.6 billion people around the world currently rely on traditional uses of energy to cover their basic energy needs. This figure is expected to rise to 2.7 billion by 2030 (IEA, 2011). Over 80 % of these people live in rural areas in developing countries.

The important role played by modern energy services in welfare and economic growth is widely recognised by governments and international donors. Access to energy services is a precondition for economic development. However, access to modern energy services does not necessarily result in economic development, owing to many other factors that influence economic growth. Therefore, energy projects around the world are increasingly looking into promoting productive uses of energy in order to spur economic development.

The potential benefits of promoting efficient thermal energy technologies in the productive sector, notably amongst micro and small enterprises, are frequently overlooked by policy makers and international donors. Biomass, as the most common source of thermal energy, often suffers from an unfavourable reputation as a *dirty* energy source (Kees and Feldmann 2011, Owen et al. 2012). These enterprises often work in the informal sector and are frequently situated in remote areas.

Productive use of thermal energy involves a range of activities, such as cooking, drying, heating, smoking, baking, cooling and manufacturing. Biomass burning and use of solar thermal energy are already embedded in many conventional manufacturing processes in developing countries, but mainly with comparatively inefficient technologies.

This overview focuses on technology options and approaches for the promotion of businesses supplying and utilizing efficient thermal energy appliances. Detailed guidelines on how to plan, design and implement projects to foster productive use of electricity are laid out in the manual *Productive Use of Energy – PRODUSE: A Manual for Electrification Practitioners* (Brüderle et al., 2011). The conversion of biomass into electricity is outside the scope of this booklet and is treated in detail in the publication *Small-scale Electricity Generation from Biomass* (Dimpl, 2011).

This booklet sheds light on improved thermal energy technologies for productive purposes and approaches for promoting these technologies with a focus on micro, small and medium enterprises (MSME) in the agricultural, industrial and commercial sectors. It also provides practical guidance on how to promote effectively the distribution of efficient biomass and solar thermal appliances for productive uses for energy and private sector development practitioners. Though, it does not offer ready-made *one size fits all* solutions, particularly as energy needs and supply, market regulation and business environments vary greatly from country to country.

Each chapter offers a further reading section highlighting recent publications on the topic. Short profiles of Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) energy programme experiences from countries in Africa and Latin America are also included to illustrate opportunities for promoting productive use of thermal energy. Each profile features how a new efficient energy device augmented the profits of a small enterprise.

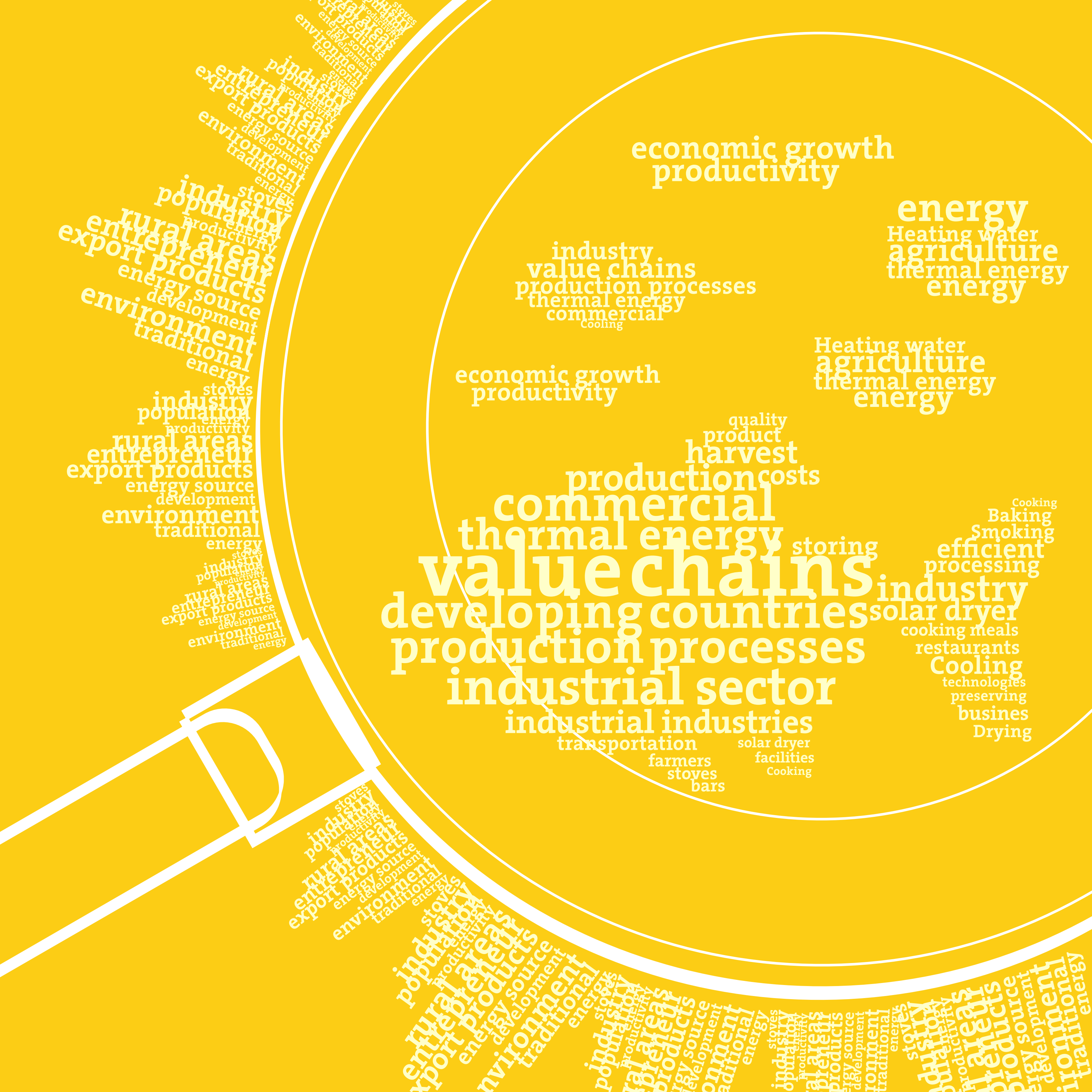
The reader's feedback is welcomed, in order to gain a better understanding of the topic for future successful support of productive use of thermal energy. Please do not hesitate to contact the GIZ programme *Poverty-oriented Basic Energy Services (HERA)* with your comments at *hera@giz.de*.

FURTHER READING

Brüderle, A., Attigah, B., and M. Bodenbender, (2011): Productive Use of Energy – PRODUSE: A Manual for Electrification Practitioners. GIZ and EUEI PDF, Eschborn, *http://www.produse.org/manual*

Value chains and production processes based on thermal energy

2


economic growth
productivity
energy
Heating water
agriculture
thermal energy
energy
industry
value chains
production processes
thermal energy
commercial
Cooling
Heating water
agriculture
thermal energy
energy
economic growth
productivity
quality
product
harvest
production costs
commercial
thermal energy
storing
value chains
developing countries
production processes
industrial sector
industrial industries
transportation
farmers
stoves
bars
solar dryer
facilities
Cooking
Cooking
Baking
Smoking
efficient
processing
industry
solar dryer
cooking meals
restaurants
Cooling
technologies
preserving
busines
Drying
industry
population
productivity
rural areas
entrepreneur
export products
energy source
development
environment
traditional
energy
stoves

2. Value chains and production processes based on thermal energy

Productive use of energy, thus thermal energy, can be a significant driver of economic growth and social progress in developing countries. The use of modern forms of energy can underpin the creation and upgrading of value chains, facilitate diversification of economic structures and livelihoods. Productive uses of energy are those that increase income or productivity (White, 2002). In rural contexts in developing countries, typical productive uses can be found in agro-processing (e.g. drying of agricultural products like coffee, tea, tobacco, or fruits), various industrial industries such as brick making, bread baking, and in the service sector, e.g. in bars and restaurants that use stoves for cooking meals. However, access to energy does not automatically create opportunities for economic growth.

The *Poor People's Energy Outlook* (Practical Action, 2012) has identified three mechanisms in which energy access can contribute to economic development:

- new energy services may enable completely new types of profitable productive activities
- new or improved energy services enhance existing earning activities in terms of returns by increasing productivity, lowering costs, and improving the quality of goods and services
- new or improved energy services reduce opportunity costs, reducing drudgery, and releasing time to enable new earning activities.

Although thermal energy is mainly associated with value adding processes in the agricultural sector, there are numerous examples of small-scale industrial and commercial businesses that also require thermal energy as an input, as will be illustrated in the following chapters. This chapter looks at value chains and identifies activities that typically involve thermal energy use.

2.1 Thermal Energy in agricultural, industrial and commercial value chains

Small-scale farmers often lack the appropriate facilities and technologies for preserving, storing and processing their harvest. Profit margins for unprocessed agricultural yields are limited and seasonal (Flavin and Hull Aeck, 2005). The return on unprocessed raw crops is only a small proportion of the price at which the final packaged product is sold to end-customers, as prices are low when markets are flooded with supply of the produce in season. Furthermore, if there is no diversification of produce, farmers typically depend on a single wholesale trader as their buyer which further decreases the profit margin.

For these reasons, efficient processing technologies can offer an important lever for increasing the profits of small-scale farmers.

Thermal energy is an important input to many processing stages in **agricultural value chains** (Utz, 2011) as *Figure 1* shows. Reduced production costs can be achieved with the use of efficient technologies. In Peru, Victoria Esteban Fuentes, a coffee farmer, increased her output by eight per

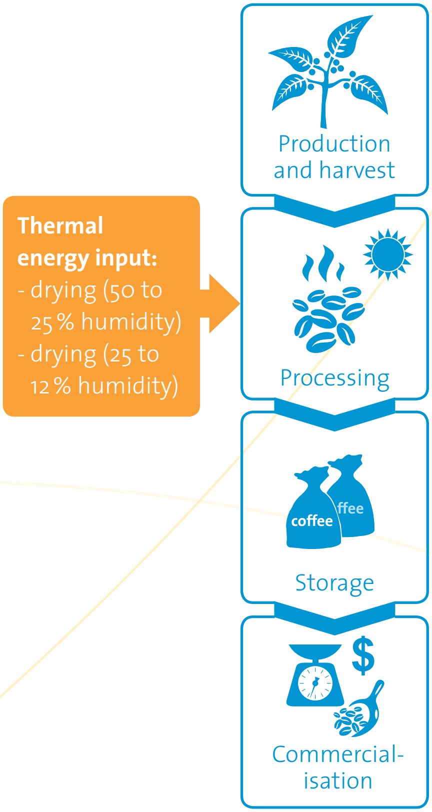
cent with a newly installed solar dryer. The duration of the drying process has been halved, and her income augmented by 30 per cent, owing to the higher price she can now charge for her improved quality coffee beans.

Hence, certain technologies enable the processing of agricultural residues and by-products, which can then be sold, further adding to the farmers' incomes. Drying appliances such as solar dryers allow farmers to preserve fruit for storage and transportation, thus increasing the price they can achieve off-season. The introduction of more efficient processing technologies may also allow to produce higher quality products which can be sold at a higher price. For example, tobacco leaves that are dried at constant temperature and ventilation in improved biomass fuelled barns yield higher profits by achieving high quality standards.

In the **industrial sector**, small-scale production is relatively common in developing countries, owing to small, geographically dispersed markets for simple consumer goods. The industrial sector is characterised by high energy input into the production of goods, with thermal energy playing an important role in many industries. In Zimbabwe, for example, brick making, beer brewing and bread baking are the three most common rural industries. The brick making industry accounts for around 284,000 tonnes of fuelwood consumption per year. The 50,000 breweries and 1,200 bakeries are estimated to consume around 163,000 tonnes and 218,000 tonnes, respectively, of fuelwood per year (Nyabeze, 1995).

Figure 2 illustrates the role of thermal energy during the processing of shea nuts into shea butter in Benin: to ease

Figure 1 Value chain of coffee beans



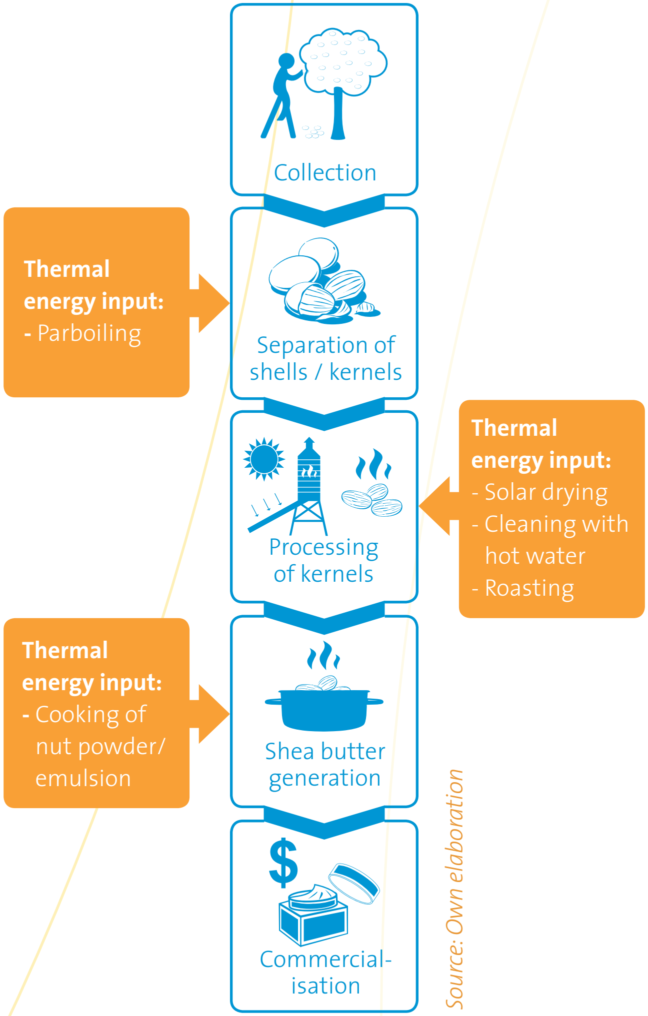
Source: Own elaboration

the separation of shells and kernels, the gathered nuts need to be parboiled soon after collection.

After being dried in the sun, the actual processing starts with cleaning the shea kernels with hot water. Before they can be roasted in a pot over a fire, the kernels are dried and crushed. Next, they are ground and the resultant powder is cooked in hot water to separate the white butter. The emulsion needs to be cooked for approximately 1.5 hours to evaporate the surplus water. Normally, all these thermal processes are realised on traditional cookstoves and fires. Fuelwood savings of up to 50 per cent are possible, when efficient cookstoves are used.

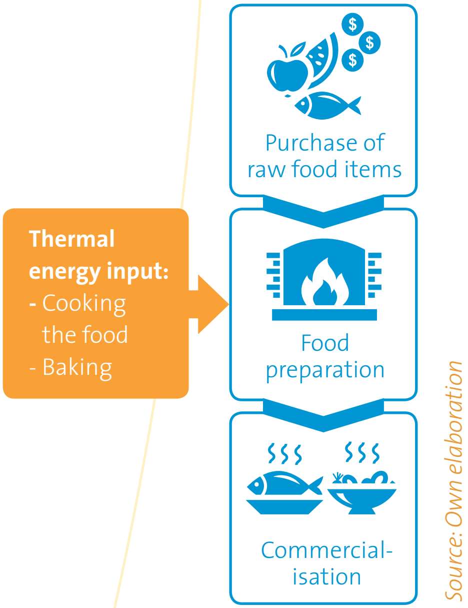
In the **commercial sector**, some services are characterised by relatively low requirements for skills and start-up capital, therefore offering important income opportunities to poor people, using thermal energy. For example, restaurants and street food vending enterprises are often run as informal businesses and exist in large numbers in rural and urban areas in developing countries (Draper, 1996), offering considerable employment generation potential, especially for women (Tinker, 1997). Investment in efficient stoves to enhance fuel efficiency for cooking can help these businesses reduce running costs and increase profits in the long term. For example, restaurants in Kenya use thermal energy to cook meals, mostly using wood as fuel. With an efficient stove, they can enhance their fuel efficiency, reducing fuel costs by 50 per cent. In the long term, these savings increase the income of the restaurants, while also improving the atmosphere and hygiene in the restaurant due to reduced smoke.

Figure 2 Value chain of small-scale shea butter production



Source: Own elaboration

Figure 3 Value chain of a restaurant with thermal energy



FURTHER READING

Energy For Development - The Potential Role of Renewable Energy in Meeting the Millennium Development Goals by C. Flavin and M. Hull Aeck.
http://www.worldwatch.org/system/files/ren21-1.pdf

Poor People´s Energy Outlook 2012: Energy for Earning a Living by Practical Action.
http://practicalaction.org/ppeo2012

ValueLinks Manual - The Methodology of Value Chain Promotion by A. Springer-Heinze.
The manual offers 12 modules on how to promote value chains for specific agri-businesses, handicraft and manufacturing sub-sectors.
http://www.valuelinks.org/images/stories/pdf/manual/valuelinks_manual_en.pdf

Modern Energy Services for Modern Agriculture, A Review of Small-holder Farming in Developing Countries by Veronika Utz (GIZ), 2011.
https://energypedia.info/images/f/fd/Energy_Services_for_Modern_Agriculture.pdf

The Integration of micro-enterprises into Local Value Chains by B.Tschinkel (Vienna University of Economics and Business), 2011.
http://epub.wu.ac.at/3095

2.2 Productive processes based on thermal energy and suitable technology options

Many of the entrepreneurs that require thermal energy for their different productive uses run MSME. Though there is no internationally accepted definition of MSME, they range from micro-enterprises with fewer than 10 employees, to small and medium enterprises with up to 250 workers. Micro-enterprises often operating in the informal sector in rural areas produce important export products in several countries. In Malawi, for example, over 30,000 small-holder farmers throughout the whole country constitute the main contributors to the tobacco industry.

In Sub-Saharan African countries, approximately two-thirds of the population work in the informal sector (Grimm, 2012). Enterprises operating in the informal sector often face difficulties in overcoming market barriers, gaining access to modern energy services and managing their way out of poverty towards profitability (Miehlbradt and McVay, 2003).

As these enterprises are often located in rural areas, access to the national grid or other energy services is very limited. It is therefore evident that micro-enterprises are highly dependent on biomass as their main energy source. Process and product upgrading through access to modern energy seems to be an important precondition for micro-enterprises to perform in an efficient way. This in turn is important for business development (Tschinkel, 2011).

2.2.1. Cooking

The high consumption of biomass for cooking with inefficient technologies is a serious environmental, social and economic concern in many countries. In general, traditional cooking causes 4 million premature deaths annually, with women and children most affected, due to smoke exposure. Hence, inefficient cooking worsens global warming due to the emission of greenhouse gases like carbon dioxide and black carbon. Cutting down natural forests causes erosion and desertification of entire regions. When fuel becomes scarce, energy expenditure rises. For business, using traditional cooking methods for producing goods and offering services, fuel purchase is a high operational cost factor.

When analysing the cost-effectiveness of various cooking technologies and fuel types in restaurants or food vending businesses, it is important to consider that these businesses also base their technological decisions on parameters such as cooking time, flexibility and cleanliness of the fuel, as well as the taste of the food.

Efficient biomass cookstoves vary in size, material, design and usage. However, they all aim at making the combustion process more efficient and improving the heat transfer from the fire to the pot, such reducing the amount of required fuel and harmful emissions. Institutional cookstoves for use in commercial kitchens or canteens require in average less than a quarter of the amount of firewood that would be consumed on an open fire to cook an equivalent amount of food. Special stove models have been developed in several countries to prepare local traditional dishes, such as the Mirt stove for baking *injera* bread in Ethiopia. For choosing the most appropriate cookstove model it is essential to consider the available fuel, the fuel manage-

ment and the cooking behaviour. Any expected fuel saving are impossible to gain, when the cookstove is not used and maintained properly. Efficient stoves are not only used in the food processing businesses, but also in certain other industries for manufacturing purposes or in the commercial sector for heating water.

FURTHER READING

Cooking Energy Compendium by GIZ HERA.
A compilation of comprehensive information on clean and efficient cooking energy is available at:
https://energypedia.info/index.php/GIZ_HERA_Cooking_Energy_Compendium

2.2.2. Drying

Drying is an important form of food preservation that is often carried out at farm level right after harvest, or especially with highly perishable crops, at peak harvest time when local markets are saturated. Drying vegetables, fruits and meat with thermal energy enables longer storage times and easier transportation. Without preservation, large shares of harvest can be lost. Up to 70 per cent of agricultural products spoil during the traditional process of open-air drying, especially in tropical and subtropical regions (INNOTECH, 2012).

Agricultural products can be dried open-air or unimproved, directly in the sun, with biomass or in solar dryers. Open-air or unimproved drying takes place when food is exposed to the sun and wind by placing it in trays, on racks, or on the ground. The advantage of drying products directly open-air is that almost no costs for fuel and appliances have to be spent by the farmer. However, the dried products are often of lower quality due to varying temperature levels and contamination of the products with dust, vermin's and leafs. Solar dryers require a certain investment for the set-up of the appliance, but no expenditures for the fuel. The basic function of a solar dryer is to heat air to a constant temperature with solar energy, which facilitates extraction of humidity from crops inside a drying chamber. Ventilation is enabled at a constant rate through defined air inlets and outlets, small ventilators or temperature difference, either due to exposition or vertical height. In direct sun driers the food is put in boxes with a transparent lid. The temperature in the drier is raised due to the greenhouse effect and the air exchange is regulated by vents. The food is not exposed to direct sunlight in indirect sun driers as the fresh air is heated separately from the food chamber. This method is preferable for drying foods which lose nutritional value when exposed to direct sunlight. Hybrid driers combine solar energy with a fossil fuel or biomass fuel (Green and Schwarz, 2001a). Biomass dryer require fuel input which especailly in bigger appliances such as tobacco dryer can be labour and monetary intensive.

A first step when considering solar drying is to compare the different drying options available. Solar drying will only be successful, when it shows tangible benefits in comparison to existing drying methods. In comparison to the traditional way of drying outside in an open field, solar dryers prevent contamination of produce by dust, insects, etc., thereby ensuring quality. They allow small-scale farmers to transform their harvest into storable and tradable goods, which they can sell off-season at higher prices. The constant temperature and ventilation allows a consistent drying process which results in better product quality and higher prices. However, the investments costs of solar dryers vary highly depending on the size of the solar dryer, locally available materials and environmental conditions, such as slope and exposition of the side, rainy seasons.

Project case 1: Coffee processing with solar dryers in Peru

Energising Development Peru promotes solar dryers among individual smallholder coffee farmers for the first drying period, during which the humidity of the beans is reduced to around 25 per cent. The solar dryer improves the drying process by filtering UV radiation, concentrating heat, reducing the relative humidity of the air and thus drying the beans with constant and natural ventilation. However, coffee can only be stored and exported at a lower level of humidity.

A second drying phase is therefore required, that reduces the humidity of the beans to around 12 per cent; this phase takes place in a bigger solar dryer with a capacity for up to 2 tonnes of coffee, which is managed by farmers' associations. Victoria Esteban Fuentes has a farm of two hectares in Santa Anita, Satipo, Peru. Before the adoption of the new solar dryer, approximately 70 per cent of Victoria's coffee harvest met export standards. The solar dryer has increased this rate by eight per cent. Victoria's income has therefore increased by PEN 2,400 (USD 885) or 30 per cent per annum. The investment in an efficient solar dryer certainly paid off for her.

FURTHER READING

Solar Drying Technology for Food Preservation by Matthew G. Green and Dishna Schwarz.
This publication presents possibilities of solar drying with a focus on technical needs, classification of driers and selection criterias. Moreover the publication provides information on moisture content of foods, drier components, the drying process, and the capabilities of solar driers.
http://www.gate-international.org/documents/techbriefs/webdocs/pdfs/e014e_2002.pdf

Solar Drying Equipment: Notes on Three Driers by Matthew G. Green and Dishna Schwarz.
http://www.gate-international.org/documents/techbriefs/webdocs/pdfs/e015e_2002.pdf

Solar Drying, Technical Brief by Barrie Axtell and Tony Swetman.
This manual by Practical Action discusses three basic designs: the solar cabinet dryer, tent-dryer, and solar tunnel.
http://practicalaction.org/solar-drying-2

Solar Drying by Werner Weiss and Josef Buchinger.
Trainings course on the production and sale of solar thermal plants in Zimbabwe.
http://www.aee-intec.at/ouploads/dateien553.pdf

Solar Drying in Morocco by Markus Häuser and Omar Ankila.
http://www.gate-international.org/documents/publications/webdocs/pdfs/g58s0e.pdf

2.2.3. Baking

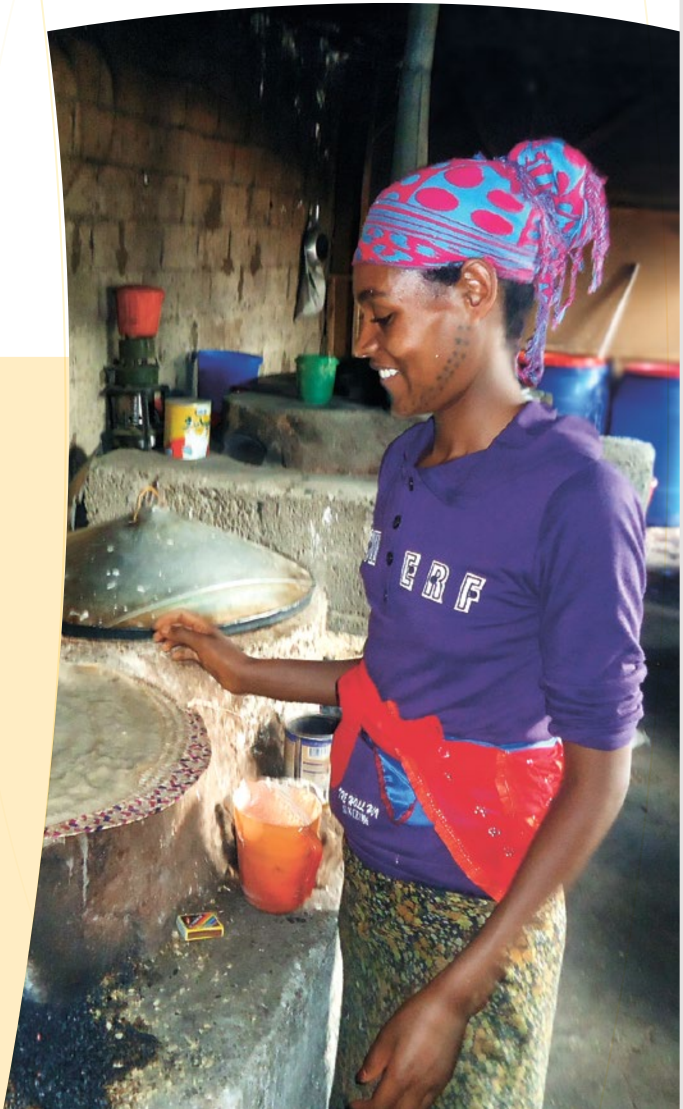
Baking is another essential way of preparing food from raw staple crops. Many different varieties of bread and pastry have emerged from regional traditions around the world. Baking involves very high temperatures (around 250°C) and therefore requires a larger amount of thermal energy input than is required for cooking. The availability and price of fuel is therefore crucial for bakeries, as it constitutes their largest operating cost (Fellows, 2012; Lawson, Joseph, 1989). A biomass fuelled baking oven is a major investment, which can easily exceed the available investment capital of small entrepreneurs, which for example in Mozambique ranges from USD 400 to USD 800. Local oven builders with technical support from GIZ managed to bring the initial cost of investment in a baking oven down by 30 per cent, thus enabling new business opportunities for women's groups interested in starting a bakery.

There are two types of ovens: direct heating ovens heated by fuels in the baking chamber, and indirect heating ovens that have a separate heater or firebox. Both types are constructed from materials such as steel that withstand high temperatures. Insulation of the chamber is very important for increased efficiency. Directly heated solid fuel ovens are typically used by potters, small-scale bakeries and restaurants. This type of oven is relatively low cost, but involves the risk of product contamination by smoke and ash. Fuel is burnt on the stone hearth for 6-12 hours, often overnight. The heat retained inside the oven and in the oven walls is then used for baking, while the oven temperature gradually drops through the course of the day.

Indirect heating ovens can be operated continuously at constant temperatures because the fire can be maintained without interrupting production. The simplest oven designs have a separate firebox with brick or tile-lined flues surrounding the baking chamber. Both types of ovens come in various sizes and with varying capacities. A portable oven model, the BEST bread oven developed in Papua New Guinea, can be brought to a temperature of 240°C within as little as 20 minutes, with a baking time for bread of 20 to 25 minutes (Fellow, 2012).

Project case 2: Efficient stoves for backeries in Ethiopia

Bakers in Ethiopia face various challenges: The *injera* baking process is labour and time intensive. An *injera* baker can only bake on two stoves at a time and each stove only bakes one *injera* at a time. According to data collected by GIZ, baking one *injera* takes on average about four minutes with an hourly rate of 16 *injeras* per stove. The Habesha Tikus Injera Share Company that is located in Addis Ababa and owned by the young entrepreneur Issac Wudu and his two partners is engaged in mass production and distribution of fresh injera. They own eight Mirt stoves and employ four women and two men, providing about 300 quality injeras every day for supermarkets, hotels and households. *Baking with Institutional Mirt stoves has many benefits* said Issac Wudu, *our fuel consumption has reduced by almost 50 per cent: from USD 1,900 to USD 970 per year as compared to the open fire method, and our income has risen from USD 2,020 to USD 2,750; four per cent per year.* After the amortisation of their investment in the Mirt stoves within approximately 15 months, they are now about to expand their business.



FURTHER READING

Energy for Domestic Brewing & Bread Baking. by W. Nyabeze. Boiling Point Issue 37 - Household energy in emergency situations.
http://www.hedon.info/BP37_EnergyForDomesticBrewingAndBreadBaking?bl=y#Bread_baking

Rocket Bread Oven Construction Manual, developed by Peter Scott.
The manual is a flexible tool that describes how to build efficient bakery scale wood burning rocket bread ovens.
https://energypedia.info/index.php/File:GIZ-2012_bread_baking_oven_burn_lab_design_en.pdf

Baking. Technical Brief of Practical Action, developed by Peter Fellows.
This is a technical brief about the baking process. March 2012.
http://practicalaction.org/baking

2.2.4. Other productive processes with thermal energy input

Smoking is another method of preserving food using thermal energy. Foods such as fish, meat, vegetables and cheese are cured through extended exposure to the smoke of wood fires. The smoking process reduces the water content of the food by about 10 to 40 per cent. In addition to increasing the durability of the food, smoking changes typical characteristics such as colour, smell, flavour and texture.

The simplest smoking unit comprises four wood stakes surmounted by a metal grate, which can be placed outside or inside the house. The produce is put in boxes and preserved by the smoke. Improved furnaces are brick-built constructions with metal roofs and doors that can be closed for an improved smoking process. Improved smokers consume less fuel and reduce the respiratory health risks of smoke exposure. In Senegal, the investment in improved smoking ovens has reduced the running costs of fish smoking businesses by two-thirds: fuel costs with an improved oven amount to only FCFA 1,000 (USD 1.90) per 100 kg of smoked fish compared to about FCFA 3,000 (USD 5.50) with a conventional smoker (Enda Energia 2007). The Ministry of Environment in Senegal has distributed an efficient smoker that allows for a 100 per cent increase in the amount of smoked fish output at a 58 per cent reduction in fuelwood input compared to the traditional smoker. Practical Action has issued a fish smoker construction manual in Sri Lanka with a detailed description of materials and budget for training (Practical Action, 2010).

Cooling plays an important role in tropical countries, primarily in the preservation of food and medicine and in air conditioning. In the absence of electricity, passive cooling methods such as shade, water evaporation or traditional mud jars can bring temperatures down to 10°C in some cases, but only 25°C in other cases (Holland, 2010). This is often not cool enough for the long-term storage of perishable food items. Heat-driven coolers can be fuelled by solar energy or biomass and transform heat, cooling to minus 10°C.

Heating water is a small but essential element of a wide range of production processes in agricultural, industrial and service sectors. Hot water is needed, for example, in restaurants for cooking and cleaning, in industrial processes for dissolving substances or cleaning equipment, in hotels for hot showers, etc. There are various techniques available for heating water, most of which are based on fuel combustion or the use of solar power.

Solar thermal water heaters enable water heating by using solar energy. The simple idea is that a black surface absorbs the heat from the sun and this heat is then transferred to a liquid, often water or antifreeze in cold regions.

Specially designed collectors and tanks capture and store heat from the sun. Productive use applications of solar water heaters arise in various industries, notably in the food service and hotel industries. Reliable and sufficient availability of hot water usually implies higher and cleaner service quality, which allows restaurants and hotels to attract more clients or increase prices.

The easiest models of solar water heaters can be constructed with simple materials and do not need any pumps or other electric devices. Effective solar collectors can even be used in winter due to the use of antifreeze.

Locally produced solar water heaters are of low costs for construction and the devices are simple to maintain and to repair. In comparison, the investments for industrial produced solar water heaters are often higher, but these show often good efficiency values. However, the quality of industrial solar water heaters vary greatly and services for maintenance, replacement and repair are required. GIZ experience from Tajikistan showed that the import of glass vacuum solar water heaters from China was not feasible due to a high percentage of glass pipes break during the transport, difficulties to order spare pipes and installation problems of solar water heaters in rural settings.

Table 1 provides an overview of the most important business activities involving thermal energy technologies based on biomass combustion and solar energy for distinct purposes. Each activity is described with its traditional techniques and energy carrier, as well as possible efficiency improvements involving the use of efficient cookstoves, solar dryers, ovens, smokers and water heaters. For GIZ examples, further information can be found in the factsheets or by contacting the projects listed in the final column.

Project case 3: Rocket stoves used for soil sterilisation in Kenya

One energy-intensive farming practice found in various countries in Africa is sterilisation of the soil with hot water in order to kill weeds and harmful germs before seeding. Traditionally, farmers boil water on a three-stone fire for sterilising the soil. This consumes enormous amounts of biomass. With an efficient **rocket stove steriliser**, as promoted in Kenya, water is boiled on a rocket stove, with a water tank built half-way into the combustion chamber. The steam rising from the tank is passed through a pipe into another tank, which holds the soil to be sterilised. It takes 30 minutes to sterilise one load of soil, with only 30 % of the firewood compared to the traditional sterilisation method. To sterilise 10,000 seedlings, a farmer using the improved steriliser spends KES 2,400 (USD 28) on firewood as opposed to KES 8,000 (USD 93) when applying the traditional method.

Table 1 Improved thermal technologies for different productive processes

Type of business	Baseline technology	Improved technologies	Project examples
COOKING			
Restaurants, food vendors, hotels	Traditional stoves, three-stone fires	Efficient biomass stove	**Kenya:** Restaurants with Efficient Cookstoves*
Beer brewing			**Burkina Faso:** Brewing Beer with Efficient Cookstoves*
Shea butter production			**Benin:** Efficient Stoves for Producing Shea Butter*
Soil sterilisation		Rocket stove steriliser with water boiler and vapour pipe	**Kenya:** Rocket stoves used for soil sterilisation *(see project case 3)**
Distilleries of traditional liquors		Efficient stoves and distillers	
DRYING			
Coffee, tea, fruit and cacao processing	Drying on open fields	Solar thermal dryers	**Malawi:** Efficient Barns to Cure Tobacco* **Peru:** Coffee Processing with Solar Dryers* **Bolivia:** Drying Peaches with Solar Dryers*
BAKING			
Bakeries, restaurant, food vendors	Inefficient baking ovens	Efficient biomass ovens	**Uganda:** Bakeries with Efficient Ovens* **Ethiopia:** Efficient Ovens for Bakeries*
SMOKING			
Farms, smokehouses	Inefficient smokers	Efficient smokers, efficient furnaces, biomass, solar thermal, geothermal	
COOLING			
Cooling	Shade, evaporating water or traditional mud jars	Efficient heat-driven coolers, Solar Vaccine Refrigerator	

Source: Own elaboration

** The respective project description are available as seperate factsheets*

FURTHER READING

Fish Smoker – Technical Brief developed by Practical Action .
This construction manual includes pictures and a description of how to build an efficient smoker.
http://practicalanswers.lk/PDFs/fish_smoker.pdf

Refrigerators in Developing Countries developed by Practical Action.
More information on cooling and refrigerators is available at:
http://practicalaction.org/refrigeration-in-developing-countries-1

Solar Vaccine Refrigerator is a robust, easy to maintain technology that can be made in most countries as materials such as steel, charcoal and ethanol can be found in most places.
http://contest.techbriefs.com/component/content/article/448

Technical Brief: Solar Water Heating by Amy Punter.
This publication by Practical Action explains how solar energy may be used to heat water and how the technology works.
http://practicalaction.org/solar-water-heating

Construction of Solar Collectors for Warm Water – Practical guide by Regina Drexel and Rostom Gamisonia.
This brochure by Women in Europe for a Common Future shows how to use the energy from the sun for heating water, how to construct a solar water heater and gives an overview of other solar collector models.
http://www.wecf.eu/download/2010/WECF_Construction_of_solar_collectors.pdf

Solar Water Heater with Thermosyphon Circulation by Bernd Sitzmann.
This publication describes briefly the advantages and engineering aspects of solar water heaters with thermasyphon circulation.
http://www.gate-international.org/documents/techbriefs/webdocs/pdfs/e021e_2003.pd

Promoting productive use of thermal energy

3

ent skills
communication strategy
Technological transformations
efficient thermal energy
government and private sector
information campaigns
advanced management skills
improved solutions
business development
target groups
new energy equipment
enterprise
efficient technologies
finance institutes
agricultural produc
remote area
developing countr
energy programm
thermal energ
donor programme
business capacitie
vocational schools
energy use

3. Promoting productive use of thermal energy

Energy programmes can encourage and support the adoption of more efficient technologies by MSMEs in many different ways. This chapter suggests a range of options for programme interventions. Entry points for energy programmes can be at various levels: working directly with entrepreneurs, supporting the development of a local market for thermal energy appliances, working with the government and private sector to improve business development services available to local MSMEs, and advocating for a more conducive regulatory framework for efficient productive energy use.

A distinction is made between activities that are directly addressed at energy use within MSMEs, and those interventions that strengthen business capacities of MSMEs in a broader sense. For the latter, it generally makes sense for energy programmes to consider joining forces with programmes and institutions that specialise in MSME development. Government agencies and donor programmes for private sector support are potential partners that command valuable expertise in designing and implementing business development services. In addition, (micro-) finance institutes, both commercial and non-commercial, typically have indepth knowledge of the MSME landscape at their disposal, given that the success of their finance operations crucially depends on information about their target clients. Local business associations, vocational schools and other educational institutions can also play facilitating roles in the design and implementation of targeted services to strengthen MSME performance.

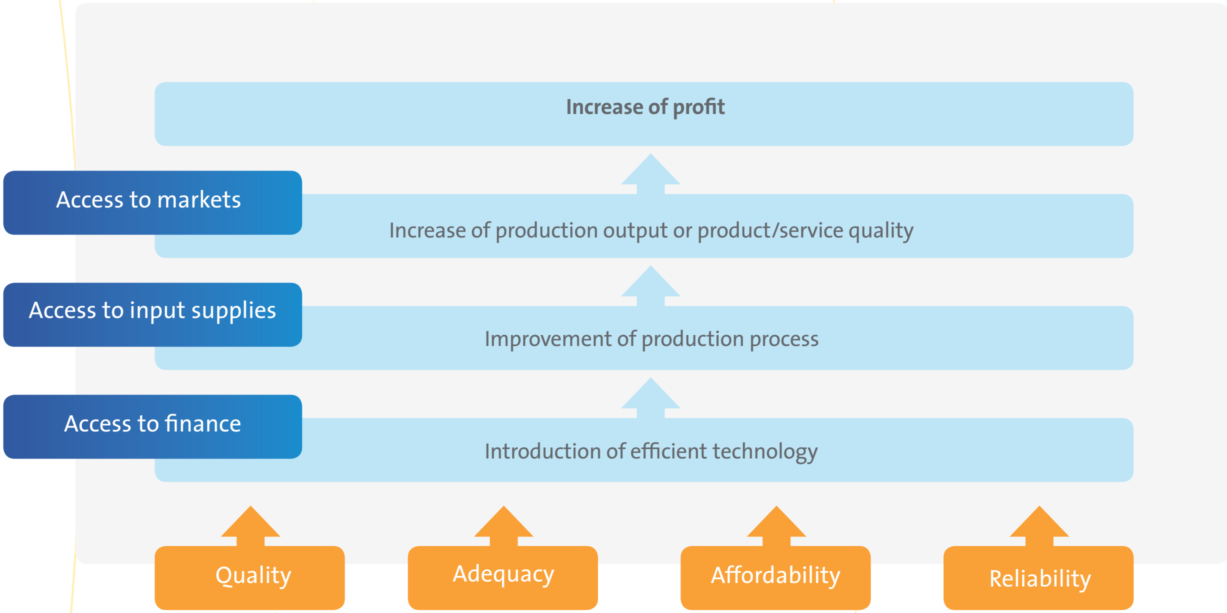
3.1 Opportunities and challenges

As the previous chapter has shown, various technological options for more sustainable and efficient use of thermal energy by MSMEs are available.

There are, of course, many factors other than energy that influence the performance of MSMEs. Technological transformations within an enterprise can sometimes engender new management challenges that require special attention to guarantee continued business success. The adoption of new technologies can result in altered demand for input supplies, e.g. increased demand for agricultural products for processing. Access to markets to sell increased output volumes or higher quality products is often a key constraint for the growth of MSMEs in remote areas. Altered flow of inputs and outputs may also call for advanced management skills on the part of the entrepreneur.

In addition, access to finance at favourable conditions is a precondition for MSMEs that invest in new energy equipment. This is another limiting factor for MSME growth in many developing countries.

Figure 4 Results chain for productive use of thermal energy



Source: Own elaboration

Before deciding to promote a certain productive use of thermal energy, programme planners should conduct a preliminary analysis of the local economic context and market situation (Brüderle, A. et al., 2011). In order to support sustainable economic development, programme interventions need to be targeted at business models that fit within the local economic structures, with a particular focus on the following factors:

- the availability of input products
- the qualifications of the local work force
- infrastructure conditions
- and notably, accessible markets for the sale of the final products.

After the analysis of the viability of a business idea and the respective thermal energy application the main bottlenecks that the targeted MSMEs face need to be identified. Based on this analysis the complementary services of energy and private sector programmes need to be defined for the support of MSMEs. According to their core areas of expertise, energy programmes will focus on issues related to the adoption of more efficient energy technologies by MSMEs and may neglect other factors that are key for improving business performance. For example, they may not have experience in improving access to finance to enable MSME to invest in energy efficient technologies. Hence for non-energy-related issues energy programmes should establish linkages with other actors such as private sector development programmes.

After the identification of viable business models, the availability of efficient thermal energy appliances in local markets and the low awareness of these technologies among MSMEs may be a constraint. In addition, entrepreneurs may hesitate to adopt new technologies, if this involves major changes in people's work practice and daily life. From the perspective of an individual entrepreneur who considers adopting a new energy technology, the key criteria that the appliance and energy supply must fulfil are **reliability, quality, affordability and adequacy** (Practical Action, 2012). All of the elements above are equally necessary for an entrepreneur to translate thermal energy supply into profits. Appliances need to be operational and the supply of energy needs to be guaranteed on a continuous basis to allow for production of goods and provision of services as the market demands. For example efficient solar driers might cause a high investment at the beginning, but they may allow drying of products even by low sunshine rates.

Total energy related costs to be considered in a business plan include investment in the energy technology or appliance, including costs for installation, maintenance and repairs, as well as running costs for fuel, if applicable. Technologies can be considered adequate for a given economic and social context only if they match the level of technical skills of the business owner, and if technical expertise for installation, maintenance and repair is locally available. In the case of certain technologies, entrepreneurs need special training to realise the technical potential of the device. Good cooking practices and techniques are essential for the efficient performance of a stove. Correct fuel preparation (e.g. dry firewood, small pieces of firewood with large surface area)


and fuel saving cooking habits (e.g. preparing ingredients before heating the fire, using a lid) can enhance fuel savings substantially.

However, production processes often have strong traditional and cultural elements, especially in rural areas. For example, encouraging farmers to replace traditional techniques for drying fruits with solar dryers can mean asking them to abandon the knowledge and experience of many generations of ancestors. It can also mean interfering with the calendar of festivities that may be tied to the annual agricultural production cycle. Energy programmes that promote the adoption of new technologies in traditional production sectors therefore need to exhibit sensitivity to local culture when designing their intervention strategies.

In order to facilitate successful technology adoption for productive use, projects need to identify main bottlenecks regarding the MSME itself, the energy efficient appliance market, and the regulatory framework.

Restrictions on the side of the commercial technology users:

- missing or low awareness on available energy efficient technologies
- limited working capital for investment
- insufficient business skills, e.g. in terms of business planning, price calculation
- lack of technical skills to operate the equipment
- lack of capacities and information enabling access to regional, national and/or export markets
- lack of information on governmental business regulations, e.g. tax payments.

Restrictions in the supply of energy efficient appliances:

- insufficient supply and marketing of energy efficient appliances
- lack of finances to investment into energy efficient technologies
- lack of technical skills of technology suppliers, which results in low quality offers, insufficient guarantees and after-sales services (e.g. installations, repair, spare parts).

Bottlenecks at the regulatory framework level:

- many of the MSME work in the informal sector and have therefore no access to certain forms of support from government and other actors
- unfavourable governmental business regulations and services, e.g. rights and obligation of different business forms, tax regulation
- lack of awareness of the multiple benefits of efficient energy technologies on the side of policy makers, local decision makers
- insufficient standards for quality assurance and/or enforcement of standards, e.g. financial institutions are unable to evaluate potential technical performance, durability and thus, the viability of loans.

FURTHER READING

Productive Use of Energy – PRODUSE: A Manual for Electrification Practitioners by A. Brüderle et al.
Module 3 of the manual offers analytical steps for identifying viable productive use opportunities, which need to be adapted partly when applied to businesses based on thermal energy use.
http://www.produse.org/manual

Local Economic Development (LED).
Participatory approach for analyzing local economic structures and getting an overview of commercial activities in an area in consulatation with private and public stakeholders. Online platform for sharing experiences and resources of people and organizations supporting LED processes at the local level.
www.ledknowledge.org

ValueLinks is a tool developed by GIZ to promote value chains for MSME to foster economic growth. It is oriented towards business opportunities, and consciously builds on the existing or emerging economic potential of the poor.
www.valuelinks.org

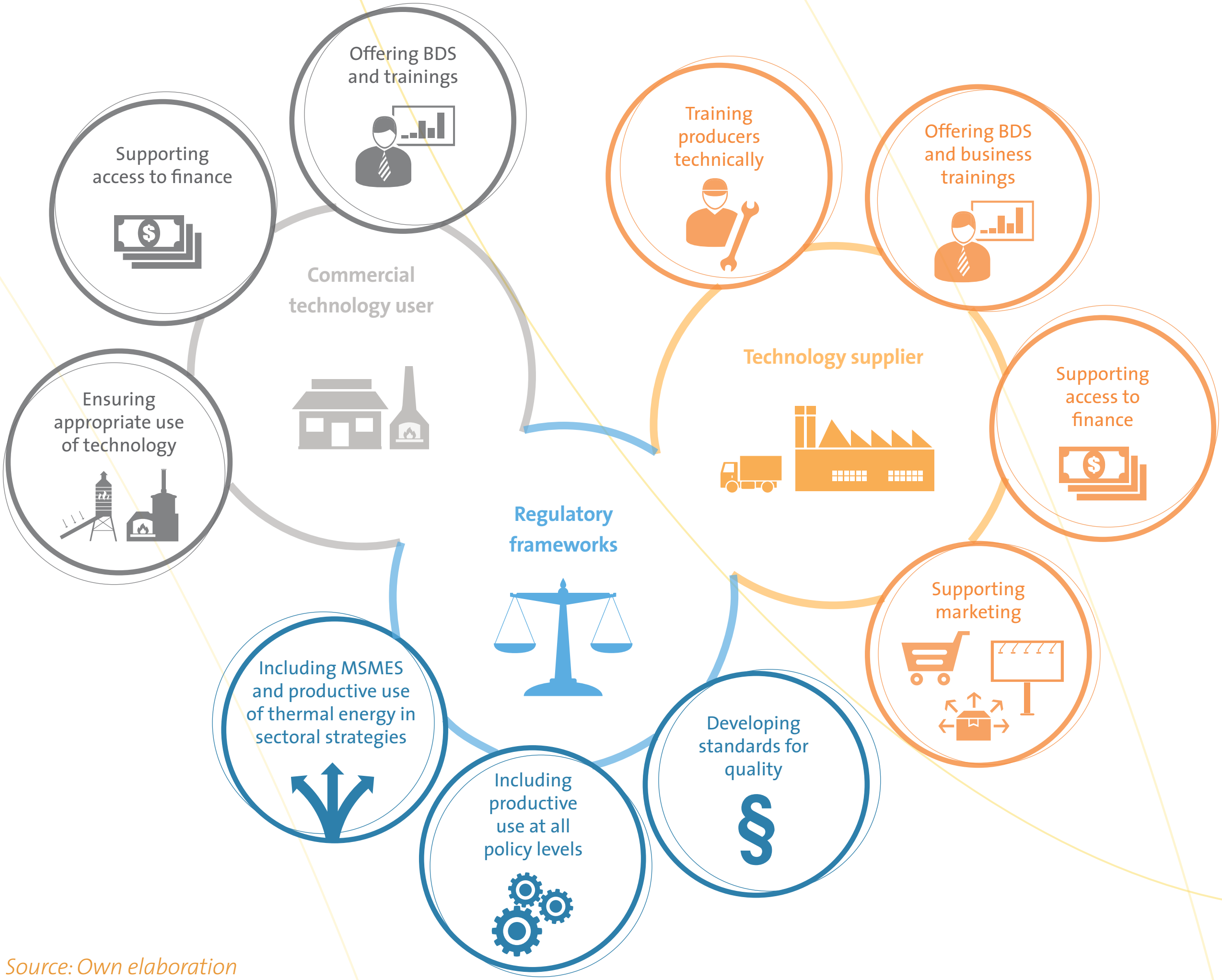
A Practical Primer for Productive Applications by J. Weingart and D. Giovannucci.
ESMAP Department World Bank.
http://www.dgiovannucci.net/docs/Rural_Energy-A_Practical_Primer_for_Productive_Applications_Weingart-Giovannucci.pdf

3.2 Promotion of businesses using thermal energy for productive use

Business promotion for the productive use of thermal energy has two dimensions: those businesses using an energy efficient technology commercially (bakeries, breweries, farmers etc.) and those locally producing these improved technologies. Both need support, business trainings, advice on how to establish links with financing institutions, marketing etc. Furthermore, for both business types on either side of the value chain, enabling regulatory and institutional framework conditions are key to successful business development.

In the following, the three dimensions of business promotion for productive use of thermal energy – businesses adopting of energy efficient technologies, businesses producing energy efficient technologies and the regulatory framework conditions will be briefly discussed. A detailed description of the project cycle and the specific interventions to support business development, business creation etc. can be found in in the manual *Productive Use of Energy – PRODUSE: A Manual for Electrification Practitioners* (Brüderle et al., 2011).

Figure 5 Project context with proposed interventions



Source: Own elaboration

3.2.1. Promoting the adoption of energy efficient technologies by MSMEs

Creating awareness

Without well targeted information campaigns highlighting the various problems associated with traditional energy use, and describing improved solutions, the promotion of energy efficient thermal energy technologies for productive use is likely to fail.

Projects need to interact with different groups to provide them with information regarding the relevance of thermal energy issues, the work of the project and the different products that are being promoted. Based on the objective a communication strategy helps to clarify messages, target groups and needs for making this communication process target-oriented and effective. It should answer the following key questions:

- Who is the target group?
- Why are they important?
- Which messages and information should reach the respective target group?
- How will the messages be transferred?

The first step for developing a communication strategy is to identify and analyse the target group(s) and to understand what needs to be achieved. To ensure sustainability of the interventions beyond the end of a project, the involvement of different stakeholders is required including governmental and non-governmental institutions as well as organizations specific to the area such as associations.

Only if they recognise the relevance of the topic and if they are willing to carry on different activities once the project has come to an end the probability of continued supply and demand for efficient thermal energy appliances for productive use will be much higher. The next step is to analyse the different information needs of the target groups. Therefore the following information might be helpful to answer:

- What kind of information would interest them?
- What information is needed to convince them of the importance of the issue?
- Which other convincing arguments besides increased profit exist?
- Do the target groups have basic background information about the benefits of improved technologies?

It is also important to consider possible barriers to reach target audiences: bad internet connections, access to mass media, harvest seasons, opening hours of shops and restaurants, hierarchies in ministries and associations, etc. Based on the defined messages and information the information materials need to be elaborated.

The information will be spread via different communication channels such as leaflets, radio or TV spots, street theatre or press releases need to be selected. If mass media are used, they should be selected on the basis of information on the numbers and geographic location of their users.

Business Development Services and trainings

Encouraging the creation of new businesses that use thermal energy requires an inclusive strategy. Such a strategy should be based on market analysis, target group selection, identification of entrepreneurship training and coaching needs to enable individuals for their new role as business people, and coaching support for the newly created businesses along the way. Supporting people with little or no business experience in becoming entrepreneurs requires a long-term strategy. Energy programmes need to be aware that when promoting business ideas that are new to a region or a target community, there may be many hidden challenges. It is therefore advisable to collaborate with other development programmes specialised in local economic development, value chain promotion, or MSME development.

Alternatively, programmes can be targeted at businesses that already use thermal energy as an input, and support technological change within these businesses. Particular attention has to be paid for micro enterprises operating in the informal sector to benefit from Business Development Services (BDS). Many entrepreneurs have very limited (or no) knowledge of the design and function of business plans. Many find it difficult to make realistic price/profit calculations. Others do not know how to calculate the price for their products or services. For some, the difference between profit and turnover may be unclear.

Knowing how to develop a business plan is extremely helpful for any entrepreneur, be it the owner of a small workshop, or the manager of a medium-size stove factory.

The business plan is the most essential document for launching, expanding and managing any successful business. It describes what the business is expected to do, how and where it will be done, and how the business will be financed and managed.

For producers who require access to (bank) credit, a sound business plan is imperative for raising capital and capturing the interest of investors. Lenders and investors require a business plan to evaluate their risks, and to assure them that they will get a fair return on their investment.

A good business plan accomplishes the following:

- draws a clear picture of the business objectives and goals
- provides a thorough overview of the business
- presents the strategy and the financial data supporting it
- shows the potential strengths and weaknesses of the business
- gives a timeline of events and financial milestones against which actual results can be compared
- gives prospective partners and investors a means of determining whether the business warrants their interest — and their money.

Business plans can be very detailed and elaborated, or contain only basic information. The very minimum that needs to go into a simple business plan should include:

- price for products/services to be sold
- basic sales strategies
- availability and costs of raw materials
- cost of labour
- other costs such as taxes, debt service etc.
- strategies to mitigate possible challenges
- monthly sales target.

Additional areas where micro enterprises often need support are bookkeeping and marketing. To meet these needs, GIZ developed the CEFE concept, *Competency based Economies through Formation of Enterprise*. CEFE aims to reinforce enterprise skills using participatory and active learning approaches *(www.cefe.net)*. CEFE courses offer comprehensive training modules that use an action-oriented approach and learning through experience. This develops and enhances business management skills and personal competence. It is a highly adaptable concept designed as much for academics as for people with low educational backgrounds (as experiences working with street children have shown). The course's overall objective is to improve entrepreneurial performance through guided self-analysis, by stimulating a business mentality, and through building up business competence.

CEFE courses offer solid instruction complemented by clear methodological guidelines that can be adapted to each participant's needs and requirements.

Alternatively, the Business Development Services (BDS) Forum offers a free-to-use *7 Training Modules for Entrepreneurs* (BDS, 2008). BDS comprise a wide range of services for MSMEs in order to help them operate more efficiently and growing their businesses. BDS concentrate on providing training, consultation and market information to address weaknesses such as low business and technical capacity of enterprises, focusing on (Miehlbradt and MacVay, 2003):

- market access (e.g. marketing, packaging, advertising)
- infrastructure (e.g. storage, transport, access to communication and information)
- governmental business regulations and service providers
- input supply (e.g. linking enterprises to input suppliers, facilitating the establishment of bulk purchasing groups)
- business management (e.g. finance, bookkeeping)
- technical skills and product development (e.g. technology transfer, equipment leasing)
- alternative financing mechanisms (e.g. supplier credit).

Access to finance

In relation to the working capital flows of MSME, the amounts required for purchasing efficient thermal energy equipment can be prohibitively high. Even if such investments reduce production costs tremendously and have relatively short amortisation periods, small businesses may not have the cash available to cover the high up-front cost. Savings and informal loans from friends or family are the most typical modes of finance for investment in MSMEs, but are often highly restricted. Formal financial institutions often hesitate to provide loans for efficient energy equipment in MSMEs if they do not have reliable information about the performance of the technology and guarantees for the appliance.

Designing specific loan products for MSME is beyond the scope and expertise of most energy programmes. Nevertheless, there are a number of activities for improving access to finance for energy-related investments that can be integrated into energy programmes:

- supporting financial institutions in designing specific loan or leasing products for thermal energy equipment
- facilitating linkages between financial institutions, thermal energy equipment retailers, and MSME, farmers and cooperatives, business associations, etc., to overcome information asymmetries and scepticism on both sides
- offering training and coaching in business plan development and accountancy for (informal) MSMEs to help them improve their creditworthiness.

As an alternative to loan products of financing institutions, other payment and loan schemes can be considered. Micro enterprises with low-income levels can often only pay material suppliers, wholesalers and service providers on an assignment-by-assignment basis.

As a solution, wholesalers and suppliers could agree on commission based payments. In the agricultural sector, some other forms of financing can be observed: exporting enterprises contract farmers and train them in quality and management skills in their own interest. Producer cooperatives train their members being paid with crops. MFIs and other commercial service providers also have an interest in well-educated customers and could provide, next to their main services financing options, other BDS as well (Eiligmann 2005).

Project case 5: The Energy Inclusion Initiative - a financing scheme for energy products in Peru

In 2011, the Energy Inclusion Initiative was launched in Peru to promote financing and servicing of certain energy products for rural MSMEs. Initially, the programme covered three products (solar thermal water heaters, solar dryers, improved cooking ovens) and worked through two established MFI partners. The first of these, FONDESURCO, is an NGO with about 11,511 clients, mainly farmers in rural areas in the south of Peru. It has had previous experience with loans and micro-leasing for energy products. The second, Caja Municipal de Ahorro y Crédito (CMAC) Huancayo, has 124,074 clients.

It was selected as a partner of the programme due to its experience with loans for hardware products such as home electrical appliances, laptops and cars, as well as its cooperation with suppliers. CMAC offers its clients favourable loan conditions and after sales services for technical products. Loans to a farmer who wants to purchase a solar dryer vary between USD 100 for a UV plastic sheet and USD 1,100 for the total solar dryer construction. The MFI even provides installation instructions and advice on usage and maintenance. A supervision visit is made one month after the technology has been installed to assure its functionality. The payback period for the loan is up to 2 years.

Plans for 2012 and 2013 foresee an expansion of the programme to a wider base of MFI agencies. The initiative aspires to enable 10,000 Peruvian microentrepreneurs to obtain green energy solutions by 2015 (Appui au développement autonome and Micro-Energy International 2011).

Ensuring appropriate use of technologies

Regardless of the technology, enterprises need to be familiar with the correct installation, maintenance and usage of the device. Whether the entrepreneur is able to construct and install the appliance himself or if a service provider has to do the **installation** makes a difference in costs. After the installation all employees **using the appliance** need to be trained to realize the technical potential, and thus the expected energy savings, higher production output and improved product quality. In regard to improved cookstoves, fuelwood and cooking practices are essential for efficient performance of a stove. Hence, correct fuel and cooking preparation can increase fuel savings substantially. Entrepreneurs need to have this information and be able to use their device in the most efficient way.

Furthermore it is important that users of an efficient appliance are aware of **maintenance** requirements in order to guarantee performance of the appliance. Whether this involves additional costs (e.g. support from specialized technicians) or just additional work (e.g. cleaning of solar collector) depends on the technology.

Business owners need to be aware, that lack of maintenance can result in malfunctioning of the appliance and considerable profit losses. Many appliances require the **replacement** of worn out parts or of the entire appliance after a certain period of time. Cost savings and higher profits due to the energy efficient appliance shall enable the business owner to invest into spare parts or to replace worn out appliance. However, often it is observed that appliances are repaired or replaced too late.

3.2.2. Promotion of the supply of energy efficient technologies

Training of producers

A large-scale, successful and sustainable market in efficient thermal energy appliances can only function where there are sufficient qualified entrepreneurs and premises to serve and develop the market without relying on subsidies. The principle that promotion and scaling up of efficient thermal energy technologies should follow an essentially commercial approach is one of the main lessons learnt from numerous stove projects.

Therefore suppliers of these technologies need to be skilled entrepreneurs with access to resources, supplies, finance and markets. Consequently, in order to promote the supply of energy efficient technologies, producers need to be trained in business skills similarly to the methods and approaches described above (BDS and business trainings, access to finance).

Supporting the marketing of energy efficient technologies

Marketing is defined as getting the right product of the right quality to the target users in the right quantity, and at the right price in the right place at the right time and with each business person in the marketing chain making a fair profit.

As a general rule, marketing includes all the activities that lead to increased profitable sales. Producers and suppliers of efficient thermal energy appliances should either adapt their products to the specific needs of their customers or chose their target groups wisely in order to suit their products. Changing habits, i. e. the usage of a particular appliance for a certain activity is a very long-term process. User motives are often unconscious and implicit. The users' motives for switching to a more efficient technology may vary considerably from what the producer assumes (saving time, money, other resources; being modern and hence attracting more customers). Therefore, to determine these factors, quantitative and qualitative marketing research is an indispensable tool to develop the right product and marketing strategy.

The classic marketing approach involves the so called 4 Ps: product, price, place, and promotion. These 4 Ps form the four main pillars of the marketing mix. These include the identification and development of new products, at an appropriate price, through distribution channels and selling in the right places, supported by promotion.

Recently this number has been increased (up to 10 Ps) to include among others people, processes, packaging and so on.

FURTHER READING

CEFE is a comprehensive set of training instruments using an action-oriented approach and experiential learning methods to develop and enhance the business management and personal competencies of a wide range of entrepreneurs.
www.cefe.net

Business Development Services.
Seven training modules for entrepreneurs.
http://www.bds-forum.net/training-modules

Implementing Sustainable Private Sector Development: Striving for Tangible Results for The Poor by A. O. Miehlbradt et al.
This reader focuses on private sector programs that open and stimulate markets to generate significant and expanding benefits for the poor.
http://www.ilo.org/wcmsp5/groups/public/---ed_emp/---emp_ent/---ifp_seed/documents/publication/wcms_143173.pdf

Developing Commercial Markets for Business Development Services by A. O. Miehlbradt and M. McVay
This publication provides information for tracking pioneering activities, engaging in significant debates, and finding innovative ideas and new approaches to delivering market-based BDS. It is more relevant for experts on business development services.
http://www.ilo.org/empent/Publications/WCMS_143127/lang--en/index.htm

The Rural Energy Enterprise Development Handbook for Energy Entrepreneurs by UNEP and UNF.
This Toolkit covers the topics that must be addressed in a business plan for any energy business. The topics covered range from defining objectives, elaborating financial analyses and determining distribution strategies.
http://www.ilo.org/empent/Publications/WCMS_143127/lang--en/index.htm

Cooking Energy Compendium by GIZ HERA.
Correct fuel use: Firewood management techniques.
https://energypedia.info/wiki/Firewood_Management_Techniques

Cooking Energy Compendium by GIZ HERA.
Correct cooking preparation: General Kitchen Management Practices.
https://energypedia.info/wiki/General_Kitchen_Management_Practices

FURTHER READING

Effective Policies for Small Business by A. Gibb.
This publication provides practical guidelines on policy development and strategic planning for micro, small and medium enterprise development for policy makers.
http://www.unido.org/fileadmin/media/documents/pdf/Ammended_pdfs/33163_EffectivePoliciesforSmall-Business.pdf

Making Business Development Services, Markets Work for the Poor by A. Eiligmann.
http://www.value-chains.org/dyn/bds/docs/433/MakingBDSMarketsWorkforthePoor_0505.pdf

3.2.3. Creating an enabling environment for productive use

Politicians and other decision makers often overlook the important role of biomass as a renewable, modern source of energy for the productive sector and neglect the benefits of efficient technologies for small-scale industry.

The political and regulatory framework can either facilitate or inhibit the productive use of thermal energy.

Raising awareness of available efficient thermal energy options and associated business models among decision makers, including energy aspects in sectoral development strategies and developing quality standards for energy appliances are vital for the success of any intervention to support productive use of thermal energy.

3.3. Overview of possible activities to promote thermal energy for productive uses

As we have shown in the previous chapters, interventions for the promotion of productive use of thermal energy should target on commercial thermal energy appliances users, producers and/or suppliers of these appliances, and decision and policy makers. *Table 2* provides an overview of suitable interventions, and gives examples of where these measures have been applied successfully.

The enclosed factsheets *at the end of the publication* provide further details and contact information.

Table 2 Possible interventions to promote productive use of thermal energy

Interventions addressed directly at entrepreneurs		
Bottleneck to overcome	**Possible activities**	**Example**
Adoption of new technologies: Risk aversion, lack of information on technology alternatives	➤ Organise exposure visits ➤ Organise meetings of business people to discuss risk factors and opportunities ➤ Organise fairs to present appliances ➤ Assist individual businesses and associations with selecting the most appropriate technology	**Kenya:** sensitisation forums on efficient stoves for restaurant owners*
		Peru: technology is directly introduced to farmers' associations* **Bolivia:** farmers' associations receive support for the acquisition, construction or installation of solar dryers.*
Investment capital: On the side of business owners: limited working capital, lack of awareness about credit facilities On the side of MFI: Lack of awareness of energy efficient technologies	➤ Organise workshops to bring together business owners, equipment retailers and MFI representatives ➤ Support the design of specific financing options for energy equipment for MSME	**Malawi:** facilitation of cooperation between microfinance institutions and farmers* **Peru:** cooperation with micro finance institution* **Kenya:** facilitation of cooperation between MFI and farmers* **Bolivia:** facilitation of agreements between farmers and three MFI*
	➤ Develop standardised loan products	**Peru:** development of standardised loan product for solar dryers*
	➤ Subsidies for energy efficient equipment	**Bolivia:** farmers receive financial support to cover input costs for agricultural production* **Peru:** subsidies of up to 20 per cent of the investment costs for associations*

Table continues on page 46

Interventions addressed directly at entrepreneurs		
Bottleneck to overcome	**Possible activities**	**Example**
Production process: Lack of technical skills to operate the equipment	➤ Technical training delivered through local NGOs or training institutes	**Benin:** training for producers of shea butter to improve product quality* **Malawi:** technical training for use of improved barns for tobacco curing*
Business management: Lack of business administration skills	➤ Business management training, radio programmes on business management, counselling services	**Bolivia:** provision of technical assistance, capacity building measures through on-the-job training for small farmers*
Marketing: Lack of skills, capacities and/or information for accessing to regional, national and/or export markets	➤ Facilitate linkages with dealers / traders on a regional, national or export level	**Benin:** support for marketing of shea butter products*

Intervention addressed at the regulatory framework level		
Bottleneck to be overcome	**Possible activities**	**Example**
Neglect productive use in environment, business development and energy strategies at national and subnational level	➤ Support formation of and lobbying by associations of stove producers etc.	**Bolivia:** the project interventions in Bolivia integrate all stakeholders, including those at the municipalities and local authorities. *
Poor knowledge of productive use of thermal energy among policy makers	➤ Raise awareness of productive use of thermal energy among decision makers (e.g. specific workshops and information material for policy makers) ➤ Facilitate interaction between ministries and agencies responsible for environment, energy as well as local and rural economic development	
Lack of awareness of thermal energy use in the productive sector, lack of knowledge of efficient technologies among decision makers at national and local level		

Interventions to support the provision of thermal energy appliances		
Bottleneck to be overcome	**Possible activities**	**Example**
Technological capacities: Lack of skilled personnel for the production of efficient technologies	➤ Training in thermal energy equipment manufacturing	**Uganda:** training of local producers of efficient stoves (various sizes) and baking ovens*
Financing for equipment manufacturers: No linkages between MFI and equipment manufacturers	➤ Facilitate linkages between MFI and stove producers ➤ Invite MFI representatives to trade fairs for energy equipment	**Kenya:** facilitation of linkages between stove dealers and banks*
Technology: Producers are not familiar with efficient thermal energy technologies Materials for improved equipment are not available Technologies do not always meet quality standards	➤ Support design of efficient equipment ➤ Assist manufacturers in sourcing material (e.g. UV plastic foil)	**Malawi:** development of the *rocket barn** **Bolivia:** training for local installers and promoters of solar dryers * **Uganda:** technology development and testing, quality control* **Benin:** implementation of a quality system and optimisation of appropriate technology*
Business management: Lack of business administration skills, training opportunities not available	➤ Offer business management training and coaching tailored to local energy equipment manufacturers	**Kenya:** training on basic business skills for stove suppliers*
Marketing: Lack of marketing skills and insufficient understanding of the market	➤ Offer specific marketing training for energy equipment ➤ Develop marketing strategies jointly with retailers, e.g. calculations of fuel savings for clients, demonstrations, etc.	**Peru:** capacity development of the providers in market expansion, business training* **Burkina Faso:** organising of debates on radio, TV and theatres*

Source: Own elaboration.

** The respective project descriptons are available as seperate factsheets at the end of this publication.*

4 Bibliography

economic development energy potential benefits solar thermal

et regulation business environment heat baking promoting

Productive use industry cooling economic growth interna

prises electricity developing countries modern energy services heat rural areas future

energy opportunities manufacturing

agriculture practitioners remote areas solutions successful efficient opportunities

practical guidance drying International Energy Agency heat heating

4. Bibliography

Appui au Développement Autonome and MicroEnergy International (2011): The Energy Inclusion Initiative,
http://www.ada-microfinance.org/download/485/affiche-microenergy-en-2012.pdf

Art, L. (2004): *Productive Use of Renewable Energy by Rural Enterprise: A Key to Reaching Millennium Development Goals, presentation on Sustainable Energy Practitioner's Workshop Community Power Corporation,* May 29-31, 2004,
http://siteresources.worldbank.org/EXTRENENERGYTK/Resources/5138246-1237906527727/5950705-1239294026748/Keyoto-0Reachin1ty0Power0Corporation.pdf

Axtell, B. and Swetman, T. (2008): *Solar Drying, Technical Brief by Practical Action,*
http://practicalaction.org/solar-drying-2

Brüderle, A., Attigah, B. and M. Bodenbender (2011): *Productive Use of Energy (PRODUSE) - A Manual for Electrification Practitioners*. EUEI PDF and GIZ, Eschborn,
http://www.euei-pdf.org/sites/default/files/files/field_pblctn_file/EUEI%20PDF_Productive%20Use%20Manual_2011_EN.pdf

Business Development Services Forum (2008): *7 Training Modules for Entrepreneurs,* Heidelberg,
http://www.bds-forum.net/training-modules

Dimpl, E. (2011): *Small-scale Electricity Generation from Biomass.*

Part I: Biomass Gasification. GIZ Eschborn, 2nd edition, 2011,
http://tinyurl.com/elec-generation-gasification

Part II: Biogas. GTZ Eschborn 2010,
http://tinyurl.com/elec-generation-biogas

Part III: Vegetable Oil. GIZ Eschborn, 2011,
http://tinyurl.com/electricty-generation-veg-oil

Draper, A. (1996): *Street Foods in Developing Countries: the Potential for Micronutrient Fortification,* London,
http://pdf.usaid.gov/pdf_docs/pnacj872.pdf

Drexel, R. and Gamisonia, R. (2010): *Construction of Solar Collectors for Warm Water – Practical Guide, Women in Europe for a Common Future,*
http://www.wecf.eu/download/2010/WECF_Construction_of_solar_collectors.pdf

Eiligmann, A. (2005): *Making Business Development Services, Markets Work for the Poor, Elaborated for the OECD-PovNet Task Team on Private, Sector Development and Pro-poor Growth,* Eschborn, GIZ,
http://www.value-chains.org/dyn/bds/docs/433/MakingBDSMarketsWorkforthePoor_0505.pdf

Enda Energia (2007): *Mise en place de fours parpaings pour le fumage de poissons: la condition pour obtenir un meilleur rendement, Senegal,*
http://www.bioenergie-promotion.fr/wp-content/uploads/2012/01/Fiche-ENEFIBIO-S%C3%A9n%C3%A9gal-Fumage-poisson.pdf

Fellows, P. (2012): *Baking. Technical Brief of Practical Action,* March 2012,
http://practicalaction.org/baking

Flavin, C. and M. Hull Aeck (2005): *Energy For Development, The Potential Role of Renew-able Energy in Meeting the Millennium Development Goals.* REN21 Renewable Energy Policy Network, Washington DC, USA,
http://www.worldwatch.org/system/files/ren21-1.pdf

Gibb, A. (2004): *Effective Policies for Small Business.* A Joint OECD-UNIDO Publication,
http://www.unido.org/fileadmin/media/documents/pdf/Ammended_pdfs/33163_EffectivePoliciesforSmallBusiness.pdf

Green, M. G. and Schwarz, D. (2001a): *Solar Drying Technology for Food Preservation,* Deutsche Gesellschaft für Technische Zusammenarbeit (GTZ), Eschborn, Germany,
http://www.gate-international.org/documents/techbriefs/webdocs/pdfs/e014e_2002.pdf

Green, M. G. and Schwarz, D. (2001b): *Solar Drying Equipment: Notes on Three Driers,* Deutsche Gesellschaft für Technische Zusammenarbeit (GTZ), Eschborn, Germany,
http://www.gate-international.org/documents/techbriefs/webdocs/pdfs/e015e_2002.pdf

Grimm, M. (2012): *Informelle Kleinstunternehmen in Sub-Sahara Afrika, Potentiale für die Entwicklung und Ansatzpunkte für die EZ, Institute of Social Studies, Erasmus University Rotterdam,* presentation in Eschborn 19th March 2012.

Häuser, M. and Ankila, O. (not stated): *Solar Drying in Morocco,*
Deutsche Gesellschaft für Technische Zusammenarbeit (GTZ), Eschborn, Germany,
http://www.gate-international.org/documents/publications/webdocs/pdfs/g58soe.pdf

Practical Action (2012): *Refrigerators in Developing Countries,*
http://practicalaction.org/refrigeration-in-developing-countries-1

INNOTECH Ingenieursgesellschaft (2012): *Solar Tunnel Drier, Elaborate Technique for Tropical and Subtropical Countries,*
www.innotech-ing.de/Innotech/Prospekte/TT.pdf

International Energy Agency (2011): *Energy for All – Financing Access for the Poor. Special early excerpt of the World Energy Outlook 2011.* Updated estimates of the OECD/IEA 2010,
http://www.iea.org/media/weowebsite/energydevelopment/presentation_oslo_oct11.pdf

Kees, M. and Feldmann, L., (2011): *The Role of Donor Organization in Promoting Energy Efficient Cook Stoves.* Energy Policy.

Lawson, W. and Joseph, S. (1989): *Lost Cost, Efficient, Wood Fired, Bread Ovens for Small Industry. Hedon Bolled Boint Issue 18: Stove Programmes in the 90's,*
http://www.hedon.info/BP18_BetterBreadOvens

Miehlbradt, A.O., et al. (2006): *The 2006 Reader - Implementing Sustainable Private Sector Development: Striving for Tangible Results for The Poor, Seventh Annual BDS Seminar - Chiang Mai,* Thailand, ILO September 2006,
http://www.ilo.org/wcmsp5/groups/public/---ed_emp/---emp_ent/---ifp_seed/documents/publication/wcms_143173.pdf

Miehlbradt, A.O. and McVay, M. (2003): *Seminar Reader - Developing Commercial Markets for BDS Update, Fourth Annual BDS Seminar* - Turin, Italy, ILO, Small Enterprise Development Programme of the International Labour Organisation,
http://www.ilo.org/empent/Publications/WCMS_143127/lang--en/index.htm

Nyabeze, W. (1995): *Energy for Domestic Brewing & Bread Baking, in Boiling Point Issue 37: Household Energy in Emergency Situations,*
http://www.hedon.info/BP37_EnergyForDomesticBrewingAndBreadBaking?bl=y#Bread_baking

Owen, M., van der Plas, R. and Steve, S. (2012): *Can there be Energy Policy in Sub-Saharan Africa without Biomass? Energy for Sustainable Development*,
http://dx.doi.org/10.1016/j.esd.2012.10.005

Practical Action (2012): *Poor People's Energy Outlook 2012: Energy for Earning a Living*. Rugby, UK,
http://practicalaction.org/ppeo2012

Practical Action (2010): *Fish Smoker – Technical Brief,* Sri Lanka,
http://practicalanswers.lk/PDFs/fish_smoker.pdf

GIZ (2011): *GIZ HERA Cooking Energy Compendium,*
Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH, Eschborn, Germany,
https://energypedia.info/index.php/GIZ_HERA_Cooking_Energy_Compendium

Punter, A. (2002): T*echnical Brief: Solar Water Heating, Practical Action,*
http://practicalaction.org/solar-water-heating

Sitzmann, B. (2003): *Solar Water Heater with Thermosyphon Circulation,*
Deutsche Gesellschaft für Technische Zusammenarbeit (GTZ) GmbH, Eschborn Germany,
http://www.gate-international.org/documents/techbriefs/webdocs/pdfs/e021e_2003.pdf

Scott, P. (2012): *Rocket Bread Oven Construction Manual,*
https://energypedia.info/index.php/File:GIZ-2012_bread_baking_oven_burn_lab_design_en.pdf

Springer-Heinze, A. (2008): *ValueLinks Manual, The Methodology of Value Chain Promotion,* GIZ, Eschborn,
Reprint of First Revised Edition, January 2008,
http://www.valuelinks.org/images/stories/pdf/manual/valuelinks_manual_en.pdf

Tinker, I. (1997): Street Foods: *Urban Food and Employment in Developing Countries,* Oxford University Press, New York.

Tschinkel, B. (2011): *The Integration of Micro-Enterprises into Local Value Chains. Doctoral Thesis, WU Vienna University of Economics and Business,*
http://epub.wu.ac.at/3095

United Nations Environment Programme and United Nations Foundation (2004): *Rural Energy Enterprise Development (REED) Toolkit, A handbook for Energy Entrepreneurs,*
https://energypedia.info/images/1/11/Reed-handbookenergyentrepreneurs1.pdf

White, R. (2002), *GEF-FAO Workshop on Productive Uses of Renewable Energy: Experience, Strategies, and Project Development, June 18–20, Workshop. Food and Agriculture Organisation of the United Nations (FAO),* Rome, Italy
http://www.martinot.info/GEF-FAO_productive_uses_workshop.pdf

Utz, V. (2011): *Modern Energy Services for Modern Agriculture, A Review of Smallholder Farming in Developing Countries.* GIZ, Eschborn,
https://energypedia.info/images/f/fd/Energy_Services_for_Modern_Agriculture.pdf

Weingart, J and Giovannucci, D. (2004): *Rural (Renewable) Energy: A Practical Primer for Productive Applications. ESMAP Department World Bank,*
http://www.dgiovannucci.net/docs/Rural_Energy-A_Practical_Primer_for_Productive_Applications_Weingart-Giovannucci.pdf

Weiss, W. and Buchinger, J. (not stated): *Solar Drying, Arbeitsgemeinschaft Erneuerbare Energien (AEE INTEC)*
http://www.aee-intec.at/ouploads/dateien553.pdf

For more information, please contact:

EU Energy Initiative
Partnership Dialogue Facility (EUEI PDF)

c/o Deutsche Gesellschaft für
Internationale Zusammenarbeit (GIZ) GmbH
P.O. Box 5180
65726 Eschborn, Germany

T +49 (0) 61 96-79 63 12
E info@euei-pdf.org
I www.euei-pdf.org

Deutsche Gesellschaft für
Internationale Zusammenarbeit (GIZ) GmbH

Sector programme "Poverty-oriented
Basic Energy Services" (HERA)

Dag-Hammarskjöld-Weg 1-5
65760 Eschborn, Germany
T +49 6196 79-6179
E hera@giz.de
I www.giz.de/hera

EUEI PDF is an instrument of the

euei
EUROPEAN UNION ENERGY INITIATIVE

Restaurants with Efficient Cookstoves

KENYA

Project name	Energising Development (EnDev) Kenya
Project region	Kenya
Lead executing agency	Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH
Duration	10/2005 – 12/2014

Productive use of thermal energy

Alongside electricity and mechanical energy, thermal energy plays a key role in processing goods and offering services, particularly in remote areas where biomass and solar radiation are often the only source of energy available. Thermal energy – used for cooking, heating, drying and smoking – is an essential input for production processes in agricultural businesses, small industries and commercial services.

Restaurants in Kenya

Most restaurants in the rural areas of Kenya use firewood for cooking, mainly on a traditional three-stone fire. Normally these businesses have to buy expensive firewood on a daily basis due to their small-scale operations. One 10kg head load of fuelwood costs about KES 120-200 (USD 2–3), varying between regions. Fuel costs therefore comprise a substantial part of the running costs of these businesses.

Owners of small restaurants are often unaware of more efficient cooking technologies, such as an improved cookstove that could help them increase their profits.

At Lake Victoria, a variety of small restaurants offer traditional meals. The use of improved cookstoves can help these businesses to save substantial amounts of firewood, which translates directly into increased profits.

Employees benefit from the technology due to fewer smoke emissions and therefore healthier work environments. Less smoke also means more comfort for the guests, which can also enhance income for the business owner.

Enhancing the energy efficiency of restaurants

Energising Development in Kenya enables the adoption of efficient energy technologies by individual enterprises, institutions or groups who engage in food and agricultural processing. Support is provided in the form of awareness raising about the new technology among energy users, as well as training in basic business skills for stove producers.

A core activity of the project is to identify restaurants that use three-stone fires, organise forums to raise awareness of the benefits of improved cookstoves, and inform people on how to access the technology. Technicians trained in the construction of improved cookstoves are also introduced to potential clients during these forums. Once a business owner has decided to acquire an improved cookstove, he or she can directly approach one of these technicians to place an order.

The project has also established a loan facility with two banks, specifically tailored for the acquisition of improved cookstoves by small restaurant owners. However, due to the small size of investment required, very few people actually need to take a loan to finance a stove.

Providing efficient cooking technologies

To provide restaurants with efficient cooking technologies, the Institutional Brick Rocket Stove is distributed. This fixed stove is built with durable fired bricks and no moving parts. A side inlet allows more air into the chamber for an optimal combustion process. When used correctly, the rocket stove uses up to 60 per cent less firewood than a three-stone fireplace. A chimney made from sheet metal can also be added. The technology is user-friendly and very easy to operate. Depending on the size and type of material used in stove construction, the cost can vary between USD 10 and USD 75. The combustion chamber is the most important part of the stove, considering the frequency and intensity of use in restaurants. It is recommended that fired clay bricks are used, to ensure longer life spans. With other materials the fire chamber would grow larger over time due to wear and tear, thus diminishing the stove's efficiency. Correct usage and maintenance procedures are also important to retain high efficiency. Removing the ash on a daily basis before starting the fire allows proper airflow into the combustion chamber. The biggest challenge for small restaurants is the maintenance of the stove: owners are very focused on making money, often omitting to carry out necessary repairs. Consequently, continuous awareness raising and follow-up visits are very important, especially at the beginning.

Okelo's stoves save money and attract more customers

Joyce Apondi Okelo owns a small restaurant in a fishing community on Lake Victoria. She sells traditional tilapia fish with ugali (maize porridge), to approximately 100-150 customers

per day. Before Mrs. Okelo invested in a brick rocket stove, she had to cook on a three-stone fireplace, which created a lot of smoke and a high demand for firewood. Today, she only needs half the firewood that was previously used. Thus, Okelo saves about KES 600 (USD 7) per day – a considerable amount given that most people's daily income barely exceeds KES 200. For comparison, a portion of fish and ugali costs KES 150 (USD 2). Okelo has invested around KES 14,000 (USD 165) in two stoves. 'The stoves have long since paid for themselves,' Okelo reports. The amortisation period was only 25 days. Additionally, the stoves cook much faster, raising the quality of service and helping to generate more income. Motivated by increased customers due to reduced smoke, some restaurants decided to attract even more customers by renovating their eating areas with new chairs, tables and tiled flooring.

Published by:
Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH
T +49 6196 79-0
F +49 6196 79-80 1115
E info@giz.de
I www.giz.de

Programme - Poverty-oriented Basic Energy Services (HERA) and European Union Energy Initiative Partnership Dialogue Facility (EUEI PDF)

Contact:
Energising Development
endev@giz.de

Place and date of publication:
Eschborn, 2013

Design & Layout:
creative republic Thomas Maxeiner Visual Communications
Frankfurt, Germany
www.creativerepublic.net

Photos:
© GIZ / Michael Netzhammer

Printed on 100 % recycled paper

euei pdf
energy for development

giz Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH

Efficient Stoves for Producing Shea Butter

BENIN

Project name	Energising Development (EnDev) Benin Programme of Conservation and Management of Natural resources (ProCGRN)
Project region	Benin, Atacora and Donga
Lead executing agency	Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH
Duration	10/2009 – 12/2014

Productive use of thermal energy

Alongside electricity and mechanical energy, thermal energy plays a key role in processing goods and offering services, particularly in remote areas where biomass and solar radiation are often the only source of energy available. Thermal energy – used for cooking, heating, drying and smoking – is an essential input for production processes in agricultural businesses, small industries and commercial services.

The shea sector in Benin

Shea is a forest tree that grows only in Africa. Depending on the annual precipitation, a full-grown shea tree produces between 12 and 14 kg of dry nuts per year. These can be processed to shea butter, which is in strong demand by the international cosmetics, food and pharmaceutical industries. In 2009, shea was Benin's third largest agricultural export product, after cotton and cashew nuts.

In Benin, about 35,000 tonnes of dry shea nuts are harvested annually, with women constituting the major part of the work force. Most shea nut collectors have no legal employment status and earn low salaries. In the departements of Atacora and Donga in the Northwest of Benin, 28 per cent of all women engage in shea nut collection.

On average a woman harvests between 300 and 1200 kg of shea nuts annually, which generates between 100 and 400 kg of shea butter. In some areas, revenue from shea collection makes up around 55 per cent of the total income of rural women.

Of the total processed shea butter, roughly one quarter is set apart for local use, with three quarters being sold to professional processing units and exporters. On the local market, the price of shea butter varies between CFA 800 and 1200 (USD 1,60 - 2,40) per kg depending on the quality and season.

Enhancing the energy efficiency of the processing procedure

The district of Atacora, is suffering from severe deforestation due to the rapid increase of its population and their energy needs. The Programme of Conservation and Management of Natural Resources (ProCGRN) under the Energising Development programme therefore engaged in the promotion of improved cookstoves in order to help reduce the amount of wood needed to produce shea butter.

As a co-benefit for shea butter producers, improved cookstoves generate fewer smoke emissions than traditional woodstoves, due to more efficient combustion. In order to spur the development of the local market for improved cookstoves, the project offered technical and business management training to stove producers and retailers. In order to improve the production process, 5,812 people invested in improved cookstoves between 2005 and 2009.

Additionally, the programme supported the producers of shea butter and soap to improve the quality of their products. It offered advice on the purchase of improved equipment for shea processing, as well as customer relations and marketing training.

Providing efficient cooking technologies

The 'fixed rocket mud stove' is an improved stove for households and productive uses. It has one pothole where the pot sits within the stove body. It is built of a clay mixture, comprising mud and organic material such as chopped grass, sawdust or chopped dry banana leaves, which have an insulating effect to maintain the high temperature of the fire. The combustion chamber and the opening for the firewood are L-shaped; the distance between the bottom of the pot and the fire is clearly specified to guarantee complete combustion of the firewood and to avoid toxic fumes. An extra air inlet on the side creates an undercurrent of air for optimal combustion. If used correctly, the stove saves over 50 per cent firewood compared to a three stone fire. Investment costs for the purchase of the fixed rocket mud stove are around CFA 5000 and 7000 (USD 10 - 14). Assuming that the stove is used for three cooking cycles per day, the daily savings in firewood are equal to CFA 1,050 (USD 2.10). Thus, the amortisation period for an efficient stove is less than 7 days. Maintenance costs total between CFA 500 and 1500 (USD 1–3) per stove and year, depending on the materials used.

At Soukatignina women earn more money and produce better quality

The enterprise SOUKATIGNINA is run by a group of 28 businesswomen and is located in Kouandé, a community in Atacora in Northern Benin.

Since the acquisition of an efficient stove, they have saved up to 50 per cent on fuel, which increases each woman's daily profit by CFA 350 (USD 0.70). The women have also extended their working hours: previously, there was one team of five maintaining just one three-stone fire.

Steps of the preparation and processing of sheabutter and the thermal energy inputs in form of firewood (yellow).

Ms Rebeka Boni, who is the president of the group, said: "We always had to be numerous women around the fire, as we always had to run the fire and to take care of our children to avoid burns."

Today, three teams of three people monitor three stoves. Thus, with the fixed rocket stoves, they have tripled their production. This has approximately doubled the revenue of the company. They produce about 1,024 kg of shea butter per month.

The quality of the shea butter also improves by using a rocket stove, since it avoids the spread of ash on the butter in the last stage of processing, thus rendering a pure, white final product, which attracts higher sales prices.

Published by:
Deutsche Gesellschaft für
Internationale Zusammenarbeit
(GIZ) GmbH
T +49 6196 79-0
F +49 6196 79-80 1115
E info@giz.de
I www.giz.de

Programme - Poverty-oriented
Basic Energy Services (HERA) and
European Union Energy Initiative
Partnership Dialogue Facility
(EUEI PDF)

Contact:
Energising Development
endev@giz.de

Place and date of publication:
Eschborn, 2013

Design & Layout:
creative republic Thomas
Maxeiner Visual Communications
Frankfurt, Germany
www.creativerepublic.net

Photos:
© GIZ / M. Guiwa

Printed on 100 % recycled paper

euei pdf
energy for development

giz Deutsche Gesellschaft
für Internationale
Zusammenarbeit (GIZ) GmbH

Project name	Energising Development (EnDev) Ethiopia
Project region	Ethiopia: Oromia, Amhara, Tigray, Addis Ababa, Harar, Dire Dawa, Southern Nations, Nationalities and People's Regional State
Lead executing agency	Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH
Duration	01/2010 – 12/2013

Productive use of thermal energy

Alongside electricity and mechanical energy, thermal energy plays a key role in processing goods and offering services, particularly in remote areas where biomass and solar radiation are often the only source of energy available. Thermal energy – used for cooking, heating, drying and smoking – is an essential input for production processes in agricultural businesses, small industries and commercial services.

Injera baking in Ethiopia

Thermal energy applications in Ethiopia are the most important ones with respect to final energy use. The cooking and baking applications of thermal energy in Ethiopia are not limited to households, however. The baking of injera, a thin pancake-like bread about 60 cm in diameter, alone accounts for 50 per cent of primary energy consumption. Traditionally, the baking of injera takes place on a hot metal plate, which is placed on a fire.

Besides restaurants and commercial bakeries, public institutions such as colleges, universities, hospitals, prisons and detention centres are some of the most notable users of thermal energy applications for meal preparation. Although this segment of energy users represents a smaller percentage than households, the actual energy demand is substantial. Biomass is often the only energy source available.

Dissemination of improved stoves

EnDev Ethiopia focuses on institutional strengthening and capacity building for the public as well as the private sector. In order to assure long-term sustainability, the project actively supports strong participation from the private sector and focuses on commercial dissemination of improved stoves and ovens. Raising awareness on fuel efficiency, indoor air quality and general environmental consciousness are also part of the project that aims at improving up-take of efficient stoves by commercial users and by the general public. The Mirt stove allows to cook food while baking injera with no additional fuel. The nearly 600 small-scale producers of energy efficient cookstoves, who have been supported in 310 districts of seven regions of Ethiopia, disseminated more than 505,000 stoves from January 2010 to June

2012. Institutions and small enterprises adopted 2,722 of those stoves.

Mirt stoves: a sound investment that pays off

The Mirt stove is primarily designed for baking injera. The stove is produced from locally available raw materials, mainly red ash (or in its absence, pumice or river sand) mixed with cement. The stove comprises six parts. Four of these make a cylindrically shaped enclosure that is about 66cm in diameter and 24cm high, where the firewood is burned under a baking plate. The remaining two parts sit behind the cylindrical enclosure and facilitate smoke removal and cooking on a pot.

Small holding injera bakers use a single stove for their daily baking. Others, such as cooperative micro-enterprises use different versions of modified Mirt stoves, which cluster two or more stoves so that they use a single chimney, with additional parts for collecting the smoke from the individual stoves.

The stove reduces fuel consumption by up to 50 per cent compared to the traditional three stone open fire and is optimised to burn a range of biomass fuels including firewood, agro-residues and dung.

The current average market price for a single stove is USD 11 and USD 126 for the modified stove with four individual stoves. Thanks to the resultant reduced fuel costs, the stove has a payback period of approximately two months. All components can be replaced if damaged. One of the concrete costs only USD 2, whereas, a new chimney costs around USD 63. Due to the high costs of the spare parts, unfortunately users are often reluctant to repair them immediately.

Injera baking women´s association

'Achem, Zewude & their friends share company' is a women's association engaged in mass production and distribution of fresh injera, located in Bahir Dar, northern Ethiopia. They own 76 Mirt stoves and supply about 25,000 injeras every day to the Bahir Dar University Canteen. The association has 80 members and 16 additional employees working in two shifts around the clock.

‘Baking with Institutional Mirt stove has many benefits,’ said Atsede Sintayehu, manager of the association. ‘Considering only the supply of 12,000 injera per day for one campus out of the four, our fuel consumption has reduced by 40 per cent i.e. from USD 150,000 to USD 90,000 per year as compared to an open fire. Besides the financial strength, the health benefits we are getting by avoiding indoor air pollution while using the improved stove are very significant.’

Now the association has paid off a USD 20,500 bank loan that was used for financing the initial investment. Atsede added: “At this rate, no doubt we will be able to ensure the timely delivery of the entire demand for the university in the near future”.

Published by:
Deutsche Gesellschaft für
Internationale Zusammenarbeit
(GIZ) GmbH
T +49 6196 79-0
F +49 6196 79-80 1115
E info@giz.de
I www.giz.de

Programme - Poverty-oriented
Basic Energy Services (HERA) and
European Union Energy Initiative
Partnership Dialogue Facility
(EUEI PDF)

Contact:
Energising Development
endev@giz.de

Place and date of publication:
Eschborn, 2013

Design & Layout:
creative republic Thomas
Maxeiner Visual Communications
Frankfurt, Germany
www.creativerepublic.net

Photos:
© GIZ / Konjit Negussu,
Andrea Görtler, Berhanu Negasy,
Endalkachew T. Gebresilassie
Printed on 100 % recycled paper

euei pdf
energy for development

giz Deutsche Gesellschaft
für Internationale
Zusammenarbeit (GIZ) GmbH

Efficient Barns to Cure Tobacco

MALAWI

Project name	Programme for Basic Energy and Conservation (ProBEC)
Project region	Malawi, Zambia, Tanzania
Lead executing agency	Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH
Duration	01/2005 – 05/2008

Productive use of thermal energy

Alongside electricity and mechanical energy, thermal energy plays a key role in processing goods and offering services, particularly in remote areas where biomass and solar radiation are often the only source of energy available. Thermal energy – used for cooking, heating, drying and smoking – is an essential input for production processes in agricultural businesses, small industries and commercial services.

Tobacco production in Malawi

Tobacco is Malawi's largest cash crop. Over 30,000 smallholder farmers own approximately one hectare of land each. Flue cured tobacco is a high quality product. It requires curing for 48 hours at constant low heat and several days of drying to turn the green tobacco leaves that come from the field into the yellow-brown dry leaves sold on the auction floors.

The traditional curing process entails high firewood consumption. Smallholder farmers have to invest 10-20 kg of firewood to obtain 1 kg of cured tobacco.

Farmers can be contracted by tobacco buying companies to grow tobacco according to demand. With the help of extension workers from these companies, the farmers form groups in order to receive advice on good farming practices and to access finance for farm inputs from the banks. Independent farmers sell their tobacco on Malawi's four main government-controlled auction floors.

The tobacco season starts in September. Reaping begins in January; the bottom leaves are hung on sticks before loading them into barns for curing. Depending on the weather conditions and the skills of the operator to control the temperature, curing takes between 5 and 14 days with conventional barns. Once graded, pressed into bales and properly labelled, the tobacco is ready for sale to the tobacco factories, which process the dried leaves and sell them on the international market.

Technological improvements by the project

GIZ's Programme for Basic Energy and Conservation (ProBEC), together with the tobacco industry in Malawi and consultant Peter Scott, developed the 'rocket barn', an efficient technology for smallholder farmers to cure tobacco. ProBEC also assisted the local non-profit organisation Hestian Rural Innovation Development in the rollout of the technology and the technical training, which help farmers achieve a fuel reduction of 75 per cent. Since then, approximately 1,500 rocket barns have been built and are currently in use.

The 'rocket barn' pays off!

The 'rocket barn' reduces firewood consumption considerably, from up to 20 kg to as little as 2-3 kg to obtain 1 kg of cured tobacco. The cost of converting an existing traditional barn into a 'rocket barn' is approximately USD 1,300 plus the farmer's contribution of some labour and materials such as bricks and thatch. The barn is built from burnt bricks and has an iron-sheet roof to increase durability.

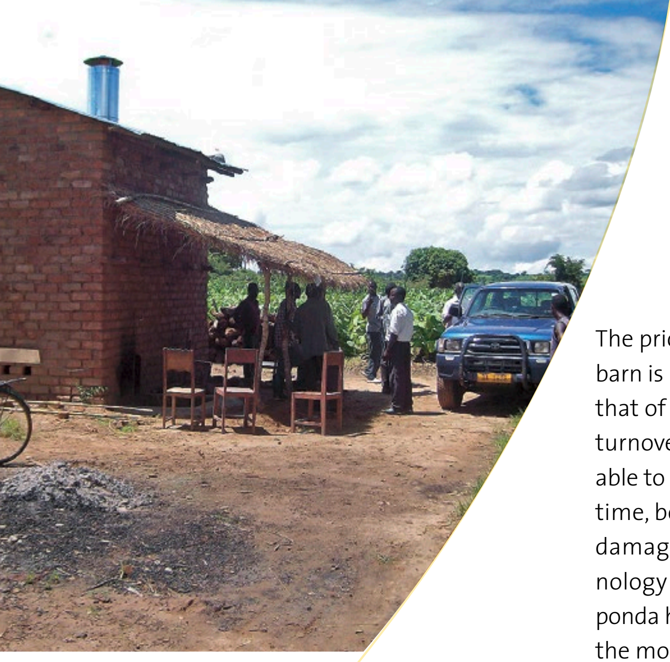
Two new features contribute to more efficient fuel use: the improved flue pipe transfers the heat more efficiently into the barn. The double chimney induces an effective airflow system, which draws pre-heated air horizontally through the barn, curing and drying the leaves efficiently. This ensures equal heat distribution with improved airflow minimising the risk of barn fires. It also enhances the quality of the tobacco through a controllable curing process. Curing times are shortened, leading to an approximately 10 per cent increase in quantity of sellable product as the tobacco suffers less degeneration. By selling more and at a better price because of improved quality, farmers increase their income. Shorter curing times also require less hired labour to stoke the barns. Maintenance costs for the smallholder farmers are also reduced, as their curing barn is now more durable.

Using rocket barns successfully

Mr. Kamponda is an enterprising farmer in Kasungu district, in the Central Region of Malawi. He grows 6 hectares of tobacco. That is more than the average smallholder tobacco farmer. In the conventional barns, Mr. Kamponda used 15 cords of firewood for curing one hectare of tobacco. With the mediocre prices for conventionally cured tobacco he was sometimes paid only USD 8,000 for the entire crop, not even recovering his input costs (e.g. fertiliser) of ca. USD 3,300 per hectare. Life looks much brighter now: since 2009, when he started using rocket barns, he has not made a loss. On the contrary: in 2012, he was paid USD 36,000 for his tobacco, which meant a net profit of USD 16,000 for the season. To date he has more than ten rocket barns which he has already managed to pay off.

With the rocket barns he uses only four cords of firewood to cure the produce of one hectare – a fuel saving of 73 per cent. At a cost of USD 20 per cord, he can save up to USD 1,320 on firewood alone, plus a similar amount of savings on transport of the firewood to the barn.

His yield of dried tobacco per kilogramme of fresh leaf has increased by 10 per cent. In conventional barns the tobacco was often spoiled when it overstayed in the barn, could not be cured at all or was lost in a barn fire.



The price for quality tobacco cured in a rocket barn is up to 30 per cent higher compared to that of conventionally cured tobacco. Since the turnover of tobacco in the barn is faster, he is able to reap the tobacco leaves just at the right time, before the leaves grow too big or are damaged by the weather. Since the new technology requires training for users, Mr. Kamponda has joined forces with Mr. Isaac Salima, the most experienced rocket barn builder in Malawi, and the extension worker of his group Salota to train other farmers.

Published by:
Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH
T +49 6196 79-0
F +49 6196 79-80 1115
E info@giz.de
I www.giz.de

Programme - Poverty-oriented Basic Energy Services (HERA) and European Union Energy Initiative Partnership Dialogue Facility (EUEI PDF)

Contact:
Energising Development
endev@giz.de

Place and date of publication:
Eschborn, 2013

Design & Layout:
creative republic Thomas Maxeiner Visual Communications
Frankfurt, Germany
www.creativerepublic.net

Photos:
© GIZ / Christa Roth, Isaac Salima
Printed on 100 % recycled paper

euei pdf
energy for development

giz Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH

Project name	Energising Development (EnDev) Bolivia
Project region	Bolivia: La Paz, Norte Potosí, Beni, Cochabamba
Lead executing agency	Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH
Duration	10/2009 – 12/2014

Productive use of thermal energy

Alongside electricity and mechanical energy, thermal energy plays a key role in processing goods and offering services, particularly in remote areas where biomass and solar radiation are often the only source of energy available. Thermal energy – used for cooking, heating, drying and smoking – is an essential input for production processes in agricultural businesses, small industries and commercial services.

Drying local food in Bolivia

One third of the population in rural Bolivia relies on agriculture for their main livelihood. The mountainous topography of the country combined with poor road infrastructure in rural areas, however, restrains small-scale farmers' access to national and international markets. Large shares of the agricultural produce of small farmers are therefore wasted, notably during peak times of harvest.

Food preservation with thermal energy technologies such as solar dryers, can help improve the income and food security of small farmers in remote areas. Instead of merely drying the products without protection from other environmental influences or weather risks, using a solar dryer allows for a faster and more hygienic drying process. The result is a product with a higher economic value in the market. Dried fruits are also a successful export product for Bolivia: 67.5 tonnes of dried fruits (banana, peaches, mango, pineapple, green tea and anise) were exported in 2011.

Enhancing the energy efficiency of food processing technologies

Since Energising Development (EnDev) was launched in Bolivia, 7,616 families have been supported with access to energy and technologies to improve their productive activities. EnDev promotes food processing technologies such as solar dryers among small and medium enterprises (SME) and farmers. The demand is increasing. Throughout the different regions of the Altiplano (Andean dry highlands), at least 40 solar dryers have been constructed and installed for the production of Andean products such as sweet potato, oca, maca, medicinal plants and meat; in the more humid valleys, peanuts, peaches and chillies are grown; and in the tropical region, cocoa, coffee, stevia and jatata leaves are produced. All project activities are carried out in close cooperation with local actors from the public and private sector, and rural associations. EnDev offers technical assistance and capacity building measures on the usage of solar dryers through on-the-job trainings and seminars. In addition, it provides monetary incentives for micro and small producers of agricultural products: Organised groups of farmers can receive financial support of up to USD 25 per family or 60 per cent of the total material costs from the project. EnDev also facilitates links between producers and microfinance institutions. After the completion of monetary transactions and technical training, EnDev maintains close contact with the programme beneficiaries for monitoring and evaluation of the interventions.

Promoted solar dryers

The basic function of a solar dryer is to heat air to a constant temperature with solar energy and extract the humidity from agricultural products. Even under adverse weather conditions the operation of the promoted solar dryer is reliable. This method improves the efficiency of the drying process and the quality of products, thereby increasing the selling power of local farmers.

EnDev supports two kinds of solar dryers: one is completely constructed and delivered by the manufacturer. The cost depends on the size of the solar dryer and the materials used, but is at least USD 150. The other solar dryer model has a simpler design and can be constructed by the farmer using local materials such as wood and bamboo. Farmers thereby develop a good technical understanding and working knowledge of the solar dryer, which keeps maintenance costs low.

EnDev supports either the entire construction of a solar dryer, or the mere acquisition of an UV-resistant plastic foil or a self-made construction. The UV-resistant plastic foil covers the solar dryer and costs approximately USD 260 per roll (4m x 50m). One roll is sufficient to cover two self-built solar dryers for coffee. The foil needs to be replaced or adjusted after 2 years. The project facilitates contacts between retailers of this special material and farmers.

Some of the solar dryers are mobile, or can be disassembled completely to store the parts until the next year. This feature is useful to extend the lifetime of the solar dryers when they are not in use after the harvest season.

Drying peaches: associations increase income substantially through solar dryers

In the North of Bolivia, in the Indigenous Municipal District of Uma Uma, a label for primary and transformed food has been created: 'Uma Uma Products'. Four associations produce and sell their products under this label. Established in 2006, the associations now have 195 families as members. Thanks to the use of solar dryers, they have secured a firm position in the local and regional market, because of the quality and constant availability of their products. They are now in a position to acquire more solar dryers, and also buy more machinery to increase production.

One association is called 'Asociación de fruticultores del Rio Chayanta' (AFRUCH). They dry fruits to make them more durable. Peaches, for example, are dried for conservation and preparation of the traditional soft drink "mocochinchi", which consists of dried peaches boiled with cinnamon and clove.

In 2011, the association produced half a tonne of dried peaches. Previously they sold dried peaches for approximately BOB 8/kg. After the acquisition of the solar dryer, they have taken a more entrepreneurial approach: after packing the peaches in boxes of 250 or 500 g, they command a sales price of BOB 24/kg. Despite the additional cost of the boxes, 80 per cent of the sales price goes to the producers. All associations were able to increase their income; AFRUCH, for example, increased its income by over 60 per cent over the last three years.

Solar dryers have proven to be a perfectly appropriate technology for Bolivian small-scale farmers, which along with other promotional activities of the association, boost the productivity of the dried fruit sector.

Published by:
Deutsche Gesellschaft für
Internationale Zusammenarbeit
(GIZ) GmbH
T +49 6196 79-0
F +49 6196 79-80 1115
E info@giz.de
I www.giz.de

Programme - Poverty-oriented
Basic Energy Services (HERA) and
European Union Energy Initiative
Partnership Dialogue Facility
(EUEI PDF)

Contact:
Energising Development
endev@giz.de

Place and date of publication:
Eschborn, 2013

Design & Layout:
creative republic Thomas
Maxeiner Visual Communications
Frankfurt, Germany
www.creativerepublic.net

Photos:
© GIZ / Natalie Pereyra,
Luz Maria Calvo, Maria Chipana
Cuéllar, Omar Chuquimia
Printed on 100 % recycled paper

euei pdf
energy for development

giz Deutsche Gesellschaft
für Internationale
Zusammenarbeit (GIZ) GmbH

Coffee Processing with Solar Dryers

PERU

Project name	Energising Development (EnDev) Peru
Project region	Peru: Junin
Lead executing agency	Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH
Duration	06/2009 - 12/2014

Productive use of thermal energy

Alongside electricity and mechanical energy, thermal energy plays a key role in processing goods and offering services, particularly in remote areas where biomass and solar radiation are often the only source of energy available. Thermal energy – used for cooking, heating, drying and smoking – is an essential input for production processes in agricultural businesses, small industries and commercial services.

Coffee Farmers in Peru

Peru massively exports coffee and earns significant revenue through its coffee exports. Coffee is the country's most important agricultural sector. The country has a large number of small-sized coffee plantations, meaning that coffee growers are often small farmers with an average plot size of 2.5 hectares. In remote areas, each hectare produces an average of 900 kg of coffee beans per year.

Coffee is harvested during the rainy seasons. As a first processing step, coffee beans are sun-dried, traditionally by spreading them out on the ground without further protection. Due to frequent interruptions by rain, the traditional drying process takes up to 12 days.

Small farmers usually have no access to national and international markets and sell their coffee beans on the local market at prices far below export price levels. To overcome the difficulties in market access, many small farmers are organised in associations. Evidence shows that farmers in associations generate higher production, and benefit from greater negotiating power and better sales prices. Farmers organised in associations can also afford commonly used solar dryers to produce a higher quality product.

Promoting credits for solar dryers

EnDev Peru supports these farmers' associations and their members to gain access to thermal energy for coffee drying. The approach is two-fold along the value chain of coffee: EnDev Peru promotes the use of solar dryers in the first drying period, during which the humidity of the beans is reduced to ca. 25 per cent. The solar dryer prevents the coffee

beans from getting wet from rain. It improves the drying process by filtering the UV radiation, concentrating heat, reducing the relative humidity of the air and thus drying the beans with constant and natural ventilation. The drying time is reduced to 2-3 days. To be able to afford these solar dryers, farmers need access to micro loans, which are often provided by the associations. In Satipo, in the region of Junín, the micro finance institution (MFI) 'Caja Huancayo' offers a specialised loan for the purchase of solar dryers to its clients. This has already enabled 77 farmers in Satipo to buy individual solar dryers.

However, coffee can only be stored and exported at a lower level of humidity. A second drying phase is therefore needed that reduces the humidity of the beans towards 12 per cent; this phase takes place in a bigger solar dryer with a capacity of up to 2 tonnes of coffee.

EnDev has so far supported six farmers' associations to acquire this technology. In addition, EnDev supports these associations in applying for public subsidies to improve their competitiveness. Within 20 months, 1,748 farmers have increased their productivity through the use of this improved thermal energy technology by their associations.

Micro loans enabling the investment into solar dryers

The investment costs for a solar dryer depend on the chosen configuration of the kit. The MFI offers a modular concept, which allows variations of the technology depending on the needs of the farmer. The investment costs vary between USD 100 if the farmer only needs to purchase the UV-resistant plastic foil and USD 1,100 if he acquires a complete solar dryer with a standardised metal structure and wooden modules for holding the beans. Because coffee farms are highly dispersed in remote areas, installation is usually done by the users.

The farmer receives precise instructions for the installation, usage and maintenance of the technology when he decides to take the loan. A supervision visit is conducted one month after the technology has been installed to ensure its functionality. Besides this, there is frequent interaction between the MFI and the farmer because of the monthly payments. This allows addressing usage or maintenance problems, if they occur. The functionality of the solar dryer relies on the possibility to dry the coffee beans under the UV-resistant plastic foil. After 2 years of usage the foil should be replaced with a new one. Accordingly, the term of the loan should be fixed to a maximum of 2 years. All other components can be repaired with local materials.

Farmer Victoria's solar dryer increases her income

Victoria Esteban Fuentes has a farm of 2 hectares in Santa Anita, Satipo. She produces approximately 1,800 kg of coffee per year. The coffee beans usually have a moisture content of 50 per cent. To enable transportation and storage and to reach the export market quality standard, coffee beans need to be dried to an optimal moisture content of 12 per cent. Before the adoption of the new solar dryer, only approximately 70 per cent of Victoria's coffee harvest met the export requirements. The solar dryer has increased this rate by 8 per cent. Since the kilo price of export coffee is approximately PEN 8 (USD 3), Victoria's revenue increased to PEN 0.20 for each extra per cent of exportable coffee. Victoria's income has therefore increased by PEN 2,400 (USD 885) per year – a 30 per cent increase.

Published by:
Deutsche Gesellschaft für
Internationale Zusammenarbeit
(GIZ) GmbH
T +49 6196 79-0
F +49 6196 79-80 1115
E info@giz.de
I www.giz.de

Programme - Poverty-oriented
Basic Energy Services (HERA) and
European Union Energy Initiative
Partnership Dialogue Facility
(EUEI PDF)

Contact:
Energising Development
endev@giz.de

Place and date of publication:
Eschborn, 2013

Design & Layout:
creative republic Thomas
Maxeiner Visual Communications
Frankfurt, Germany
www.creativerepublic.net

Photos:
© EnDev/Peru, Carlos Bertello,
MicroEnergy International

Printed on 100 % recycled paper

euei pdf
energy for development

giz Deutsche Gesellschaft
für Internationale
Zusammenarbeit (GIZ) GmbH

Project name	Energising Development (EnDev) Burkina Faso Reducing poverty in the Sahel through energy efficiency and renewable energies (FAFASO)
Project region	Burkina Faso: Centre, South-West, East, Hauts-Bassins, East-Centre
Lead executing agency	Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH
Duration	01/2010 – 12/2014

Productive use of thermal energy

Alongside electricity and mechanical energy, thermal energy plays a key role in processing goods and offering services, particularly in remote areas where biomass and solar radiation are often the only source of energy available. Thermal energy – used for cooking, heating, drying and smoking – is an essential input for production processes in agricultural businesses, small industries and commercial services.

Beer brewing in Burkina Faso

In Burkina Faso, beer brewing is the third most important livelihood, after farming and wage labour. In the country's two major cities, Ouagadougou and Bobo-Dioulasso, there are around 2,380 and 1,144 breweries, respectively, which produce the local dolo beer. Across the country, it is estimated that more than 25,000 people work in the beer brewing industry, with production being concentrated in the south-western regions, where beer is an important traditional and ceremonial drink.

Beer brewing is mostly the domain of women in rural areas. The entire beer making process, which takes up to 10 days, involves three stages: malting, brewing and fermentation. The business involves a major risk since the beer can easily be spoiled during the final production stage, fermentation. Beer making involves high thermal energy input; breweries account for more than 50 per cent of total wood consumption in Ouagadougou. For that reason, the breweries of Burkina Faso constitute an important target group for the dissemination of improved stoves. With an improved stove, local brewers can reduce their firewood consumption by up to 60 per cent, thereby increasing their profits significantly.

Enhancing the energy efficiency of breweries

The project FAFASO (Foyers Améliorés au Burkina Faso) supports the dissemination of efficient stoves in order to reduce poverty in the Sahel through energy efficiency and renewable energy. Apart from promoting metallic stoves for households, the project also engages in the introduction of large stoves to millet beer brewers, particularly in the big cities. Other large-scale consumers of wood, for example shea butter producers in the south of the country and the rice processors on the river plains, are also targeted. The goal of FAFASO was to install 2,000 mud stoves for beer production over a two-year period by December 2012. To reach this goal, the project trained around 285 masons in stove construction. These masons have already constructed over 2,200 stoves by the end of 2012. FAFASO also engages in raising awareness of improved stoves, through organising radio and TV-debates for urban areas and public debates at theatres in rural areas.

Providing efficient cookstoves

The improved mud stove Foyer dolo Roumdé for local beer production, disseminated by FAFASO, saves more than 60 per cent on fuel in comparison to older stove models and even more than 80 per cent in comparison to the traditional three-stone fires which are still often used in rural areas, even for beer brewing. To produce 472 litres of dolo using four medium-sized pots, entrepreneurs spend around CFA 20,000 (USD 38) on malt and CFA 7,500 (USD 15) on firewood when working with a traditional stove. With an improved stove, the firewood cost is reduced to CFA 2,500 (USD 5). Amortisation of an improved stove that costs CFA 15,000 (USD 28) is achieved after only three cooking cycles for an average brewery. Since the lifespan of the stoves is more than three years, reduced firewood costs result in a direct increase in profits. Maintenance of the stove can be done by the women themselves.

Reduced fuel costs increase incomes for beer brewer Compaoré

Evelyne Compaoré owns a brewery located in Ouagadougou with two improved stoves with four big pots and another stove with two smaller pots. Her four female employees are responsible for brewing the beer. She also has one male employee who collects water

and maintains the equipment. With the old traditional stove, she bought firewood for CFA 22,500 (USD 43) for each brewing process. Brewing eight times a month, she had fuel costs of CFA 180,000 (USD 340) per month. With the improved stoves, she needs less firewood and pays only CFA 12,500 (USD 24) for each brewing cycle, saving CFA 80,000 (USD 151) per month. Her total production costs have fallen by eight per cent. Mrs. Compaoré's profit now amounts to over CFA 240,000 (USD 455) per month. In addition to the firewood savings of CFA 10,000 (USD 19) per month, she produces more and better quality dolo. The quantity of the final product is higher and the taste turns out to be better if the brewing process is shortened and evaporation reduced. Mrs Compaoré now plans to expand her business and to invest in another improved stove. She also intends to increase her employees' salaries and their social security status by subscribing them to the National Social Security Fund.

Published by:
Deutsche Gesellschaft für
Internationale Zusammenarbeit
(GIZ) GmbH
T +49 6196 79-0
F +49 6196 79-80 1115
E info@giz.de
I www.giz.de

Programme - Poverty-oriented
Basic Energy Services (HERA) and
European Union Energy Initiative
Partnership Dialogue Facility
(EUEI PDF)

Contact:
Energising Development
endev@giz.de

Place and date of publication:
Eschborn, 2013

Design & Layout:
creative republic Thomas
Maxeiner Visual Communications
Frankfurt, Germany
www.creativerepublic.net

Photos:
© GIZ / Eris Sawadogo

Printed on 100 % recycled paper

euei pdf
energy for development

giz Deutsche Gesellschaft
für Internationale
Zusammenarbeit (GIZ) GmbH

Bakeries with Efficient Ovens

UGANDA

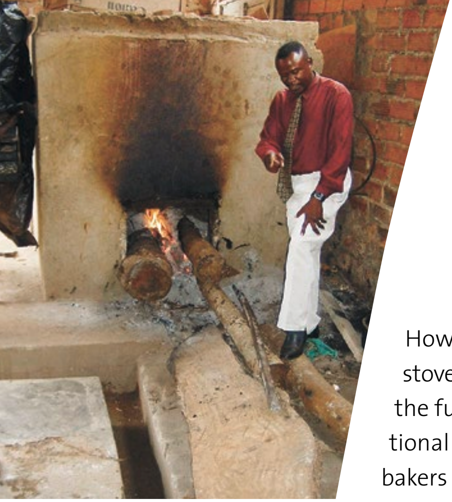
Project name	Energising Development (EnDev) Uganda Promotion of Renewable Energy and Energy Efficiency Programme (PREEEP)
Project region	Uganda, north-western and south-western regions
Lead executing agency	Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH Ministry of Energy and Mineral Development (MEMD)
Duration	04/2009 – 12/2014

Productive use of thermal energy

Alongside electricity and mechanical energy, thermal energy plays a key role in processing goods and offering services, particularly in remote areas where biomass and solar radiation are often the only source of energy available. Thermal energy – used for cooking, heating, drying and smoking – is an essential input for production processes in agricultural businesses, small industries and commercial services.

Baking bread in Uganda

Bread is becoming an increasingly popular snack with many Ugandans, as are bakery products ranging from small buns to large wedding cakes. The bakeries are generally small-scale. The total number of bakeries and ovens in the country is difficult to estimate as most of them operate informally and no government statistical information is available.



However, the introduction of improved stoves means a great potential for reducing the fuel consumption and thus the operational costs in these backeries. Families of bakers have a source of income which enables their children to go to school and to have the necessary scholastic materials, and also to meet the basic necessities of life for all family members. This income increases when less firewood needs to be purchased. The most important source of energy for those rural small and medium-sized enterprises is biomass. Firewood, charcoal or crop residues fuel the high energy consumption in bakeries.

Promoting energy efficient baking ovens

The Promotion of Renewable Energy and Energy Efficiency Programme (GIZ PREEEP) has been promoting efficient biomass energy technologies. Using a purely commercialised approach, GIZ has been disseminating the rocket baking ovens to bridge the energy gap, especially for the development of small and medium enterprises in the baking sector. Ovens are produced and sold by private companies without any subsidy. GIZ supported the technology development and the testing process between 2003 and 2005.

Technical training has enabled oven builders to construct and market efficient rocket baking ovens by themselves.

The project also supervises the performance of the installed ovens. So far, 68 improved ovens have been distributed. The project evaluates whether the ovens meet the quality criteria regarding firewood consumption, product quality, smoke emission, and oven construction material choice, etc.

The project promotes efficient baking ovens at various fairs and events throughout the year; e.g. the World Food Day and the annual Energy Efficiency Week organised by the Ministry of Energy. At these events, the technologies attract many people, especially small entrepreneurs.

Rocket ovens decrease production costs enormously

The firewood rocket baking oven comes in three different sizes: the single deck rocket oven, the double deck rocket oven, and the large-scale commercial rocket oven which is the equivalent of four double deck ovens constructed in modular format. Baking capacity per oven varies between 32 and 256 kg

of bread in one cycle, or 100 to 800 buns. A baker can save time and money compared to using a traditional baking oven. Preheating time is reduced by at least two-thirds. Firewood consumption is reduced to one-tenth of previous consumption. The rocket oven increases efficiency by 70 per cent because of improved heat transfer. It evenly distributes heat around the baking chamber, thereby producing better quality products. Proper sealing of the baking chamber ensures that the bread is not contaminated by smoke or ash.

Depending on the size of the oven, the entrepreneurs need to invest between UGX 4 and 18 million (USD 1500 and 7000) to purchase an improved baking oven. Big ovens bake 760 loaves of bread at once, small ovens 12-24 loaves. These investments can be financed by future savings because of considerably reduced firewood consumption. One cubic metre of fuel wood costs UGX 20,000 (USD 8).

Malaika Bakery plans to expand business

Mr Patel operates a bakery business in Arua Town, West Nile Uganda, called 'Malaika Bakery'. He owns a large-scale commercial rocket baking oven with eight baking shelves. Four women and nine men work in his bakery. Malaika bakery produces 1,000 kg of bread daily. Mr Patel learnt about the rocket oven two and half years ago after observing a demonstration oven that GIZ PREEEP had constructed in Arua Town. He then contacted the GIZ office, 700 km away, in Kampala for more information.

He obtained technical details of the design and performance as well as a list of trained artisans located in the region who could build the oven for him. The entrepreneur invested USD 7,100 in acquiring the oven. Since then, he has profited from the benefits of the rocket baking oven. The reduced fuelwood consumption leads to less expenditure on wood, resulting in lower production costs and ensuring competitiveness. He states that his income has increased by 20 per cent and expects further increases after completing the process of replacing all his remaining traditional ovens.

Although maintenance and cleaning of the oven entails production downtime and additional costs, the entrepreneur realises that the new oven has been a catalyst for his business development. In the future, Malaika Bakery plans to shift to bigger premises and to construct two new commercial rocket baking ovens. His only concern is the fact that smaller pieces of wood are more expensive.

Published by:
Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH
T +49 6196 79-0
F +49 6196 79-80 1115
E info@giz.de
I www.giz.de

Programme - Poverty-oriented Basic Energy Services (HERA) and European Union Energy Initiative Partnership Dialogue Facility (EUEI PDF)

Contact:
Energising Development
endev@giz.de

Place and date of publication:
Eschborn, 2013

Design & Layout:
creative republic Thomas Maxeiner Visual Communications
Frankfurt, Germany
www.creativerepublic.net

Photos:
© GIZ / Julia Sievert
Printed on 100 % recycled paper

euei pdf
energy for development

giz Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH