# The Products Catalogue

## Introductory document

Produced as output of the e-MFP Microfinance and Environment Action Group.

Elaborated by Microenergy International (MEI), with the collaboration of Davide Forcella (CERMi-ULB).

EUROPEAN MICROFINANCE PLATFORM
NETWORKING WITH THE SOUTH

Poor households are among the most vulnerable to environmental risks and climate change. The energy they use for their productive activities and for their daily needs is expensive, unreliable, polluting, and sometimes dangerous for their health and assets. Energy companies and financial institutions have the opportunity to participate to off-set this situation and support reliable, cheaper and environmentally friendly energy access to poor households and micro entrepreneurs thanks to the provision of renewable energy (RE) and energy efficiency (EE) devices. Indeed the up-front cost of such technologies, the lack of well suited providers and low awareness, undermine the diffusion and use of RE and EE devices. The proximity of micro finance institutions (MFIs) to their clients and their expertise in credit provision could give them a comparative advantage. Other financial institution and energy companies could also decide to target poor families or micro enterprises. RE and EE devices for poor households are moreover an occasion for products and portfolio diversification, and the development of a new market for financial and energy institutions. This set of catalogues aims to contribute to support an enabling environment for RE and EE access for poor households and micro entrepreneurs and overcome some of the main barriers related to lack of adapted technical understanding, financial mechanisms, and distribution channels.

## WHY THIS PRODUCTS CATALOGUE?

The project to write a catalogue for RE and EE devices for poor households or micro entrepreneurs is one of the main outputs of the e-MFP Microfinance and Environment Action Group. Its main objectives are to:

- provide a list of RE and EE devices for poor households or micro entrepreneurs which fill common energy gaps in non- or poorly electrified area or developing countries;
- provide a useful tool to guide interested MFIs along existing technologies that could fit with their operations, clients, and capacities in general;
- support partnerships among energy suppliers, manufactures, retailers and financial institutions to boost energy related projects;
- provide a list of options for social and green investors;
- promote environmental awareness raising for financial institutions, MFIs, NGOs, networks, investors and energy companies.

## TO WHOM IS IT ADDRESSED?

The catalogue is addressed to all the actors that aim to support energy access, current systems upgrading and available resources optimisation for poor households or micro entrepreneurs: financial institutions, MFIs, networks, DFIs, social investors, MIVs, public authorities, academics, energy companies, etc.

## WHY THESE SPECIFIC TECHNOLOGIES?

The devices presented in the catalogue are among the most commonly financed to poor households or micro entrepreneurs. Moreover they have been selected for their potentiality to improve standard of living and support positive environmental outcomes. However the catalogue is aimed to be a dynamic tool and to evolve together with the financing, technology, and distribution industry for RE and EE devices and thanks to external feedback.

## HOW IS THE CATALOGUE SUPPOSED TO BE USED?

The catalogue is meant to provide a first snapshot of RE and EE technologies for poor households and micro entrepreneurs to interested actors to help them select priorities and strategies. However actors aiming to engage in such initiatives should then undergo a detailed evaluation of their actual possibilities and of their local market.

## CHARACTERISTICS OF THE ENERGY PRODUCTS IN THE CATALOGUE

The products presented in the catalogues are addressed to energy provision and energy use for poor households or micro entrepreneurs. They are subdivided into two main categories: EE to RE devices. Both aim to reduce the cost of energy for clients (the actual money spent to access energy, but also in terms of time spent in obtaining the required energy, and contribute to risk reduction for their health and assets) or to start using resources previously ignored due to lack of human, financial or physical capital. These devices can generate savings, improve the reliability of the energy used, assure an efficient use of resources and moreover reduce the environmental impacts of clients' activities. The products described in the catalogue could support two different uses of energy: productive use: energy to support the development of incoming generating activities for poor households or micro entrepreneurs; consumptive use: to meet the energy needs for households daily activities.

## WHY FINANCIAL INSTITUTIONS AND MFIS SHOULD ENGAGE IN GREEN ENERGY MARKETS?

There are various reasons why MFIs (or other financial institutions or energy companies) should be interested in engaging in green energy for poor households or micro entrepreneurs:

- there exists an important energy gap, especially in rural areas in developing countries, and centralised energy provision does not seem to be a viable possibility to fill this gap in the short and medium term;
- it is a strategy to diversify their products in a competitive market;
- it could improve the public image of the institutions and help to collect new funds.

## VARIOUS FINANCING POSSIBILITIES

RE and EE products aim at generating economic savings for households or micro entrepreneurs in the medium and long term. However, their upfront cost is often one of the main obstacles that undermines their uptake by the clients. Developing adapted financing strategies that match the ability and willingness of clients to pay for RE and EE devices is of major importance. As a general rule, the installment paid by the clients should be comparable or lower than the money she/he would spend accessing traditional energy sources, and it moreover should match with clients' cash flow.

Various main strategies exist to finance RE or EE devices - just to cite some of the most common: integrate the financing of the energy devices in the portfolio of an MFI in partnership with an energy company that provides the devices; develop a lending structure directly for the payment of the devices for energy providers; or employ one of the pay as you go models in which the clients pay for the energy they use.

## VALUE CHAINS

The provision of RE or EE products often implies the development of partnerships (for example between energy companies and MFIs) and alignments of objectives, capacity building for staff, awareness raising for clients, and installation, distribution, after-sales and disposal services. All this implies that financing a RE or EE devices to a poor household or micro entrepreneur is not simply a matter of credit, but a value chain analysis should be performed. The absence of well performing distribution channels (in particular for the last-miles) or expertise for substitution or repairing part of the device could undermine an otherwise perfect credit. In the products catalogue we tried to underline some of the important points in the value chains that should receive particular attention.

## ENVIRONMENTAL PERFORMANCE OF MFIs AND SOCIAL AUDITS

The environmental performance of MFIs is attracting a growing interest and various rating agencies, social audit tools, and investors have introduced environmental assessment as one of the dimensions of their social audit or social rating. In particular the subgroup of the e-MFP Environment and Microfinance Action Group has recently developed the "Green Index": a specific tool that is currently being tested as one of the dimensions of the SPI4 of CERISE. It groups the previous environmental assessment tools and understanding of the sector. Developing green credits for RE and EE devices will help to MFIs to score higher in social performance and in particular to distinguish themselves as environmentally friendly institutions in a competitive and expanding market.

## PAYBACK TIME, LIFE TIME AND DISPOSAL

To be a convenient investment the payback time of the RE and EE device should be reasonable for the clients, the financing institutions and the energy companies to keep the credit risk under control. Payback time is then explicitly given in the catalogue for each device. The life time of the RE and EE devices should be compared to the one for less efficient and more polluting devices available to the local population. To offset the potential pollution generated by the device after its use, some care should be given to the material disposal and the existence of possibilities for recycling its components.

## ENVIRONMENT AND CLIMATE CHANGE MITIGATION AND ADAPTATION

The products discussed in the catalogue, if correctly distributed with an adapted credit methodology, have the potential to support win-win strategies for households and micro entrepreneurs, and financing and energy institutions in term of economic and environmental outcomes. Possible positive environmental outcomes are: reduction of waste, particulate emissions, or water and air pollution in general; offset or reduction of the amount of greenhouse gas emissions supporting in such a way climate change mitigation strategies. Some of the products in the catalogue, such as rice husk gasifiers, or biodigesters, have the potential to support circular economic strategies transforming (polluting) wastes in economic and energy resources. In some cases, RE and EE technologies can contribute to reduce the vulnerability of households and micro entrepreneurs to climate change or extreme weather events supporting climate change adaptation strategies such as: avoiding environmental degradation, reducing vulnerability to price volatility for energy and foods commodities and income sources diversification, etc.

## PRODUCTS CATALOGUE

The products catalogues are available at http://www.e-mfp.eu/actions-groups/microfinance-environment.

We welcome feedback on the products catalogue and are happy to receive your comments, please send them to: contact@e-mfp.eu

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# PICO PV

## Product Catalogue - 2015

**Prepared by MicroEnergy International GmbH**
**with the collaboration of Davide Forcella (CERMi-ULB)**

EUROPEAN MICROFINANCE PLATFORM
NETWORKING WITH THE SOUTH

e-MFP ACTION GROUP
ON MICROFINANCE
AND ENVIRONMENT

## Description and Working Principle

Pico Photovoltaic (PV) systems are very small solar systems, but large enough to run very basic electricity needs of one household, ranging from 1 – 10 Watts of PV capacity. The systems focus on lighting, but can often also run other small electrical appliances such as mobile phone charging stations, radios, mp3 players, etc. and have the ability to extend the systems in parallel. Use of Pico PV systems allows for the substitution of traditional light sources such as kerosene or battery lamps. The equipment is versatile in regard to sales since it can be either sold over-the-counter, leased or used to sell or provide a service. Appliances, solar panels, connection boxes, cabling and battery are included with the equipment. Some systems include portable lamps with integrated batteries, such as the solar lanterns pictured here. Other systems are meant for stationary use.

## Technical Characteristics

| | |
|---|---|
| PV module | 1 - 5 Watt, 5 - 12 Volt |
| Light output | 10 – 800 lumens[1] |
| Runtime | 4 – 13 hours depending on battery and intensity setting |
| Battery capacity | 1000 – 5000 mAh (multiple hours to about one day of autonomy) |
| Battery type | Nickel-Metal-Hydride, Lithium Iron, Lithium Ion |
| Battery lifecycle | 500 – 2000 cycles (1.5 – 5+ years) |
| Battery charging time | 3 - 5 hours |

## Ease of Distribution, Installation and Maintenance

Products are typically complete systems including all necessary components, and are sold without or with very little need for installation. Compact packaging reduces complexity of distribution, and components that meet basic quality standards, such as those certified by Lighting Africa[2] (also coming Lighting Asia) have a proofed damage resistance.

The installation of the equipment varies depending on the type of technology. Compact Pico PV systems, with the solar module integrated, are 'plug-and-play' technology, not requiring installation. However installation is required when the panel needs to be fixed in order to adequately mount the panel frame, properly oriented and away from possible shadows.

Typical maintenance work on a regular weekly basis:

- Cleaning of the solar panel with soft cloth
- Ensuring full charging of the battery

## Technology Options

Pico PV systems are offered as portable solar lanterns with integrated batteries or as fixed household systems. Options can include multiple lamps with up to five meters of cabling, mobile phone charging adapter kit, and in some cases, larger appliances such as small radios or televisions.

## Price Range

Cost of a complete set-up is typically in the range of USD $5 - $50. Target market segments include households, farmers, fishermen, sundry shops and other small business owners.


*Source: courtesy MEI; (top to bottom) Photos - Pico Lamp; Green Light Planet- SunKing Pro*

*Source: Kellie Jo Brown, Lighting Africa, 2012*

## Type of Financing

Microfinance loans for Pico PV systems are some of the most common microenergy loans. Pico PV systems carry small loan principles, and loan periods typically range from six months to one year.

## Economic and Social Impacts for End-users

Solar lighting provides a clean way to reduce expenditures on other sources of inefficient lighting, providing savings effects and improved quality of life through increased lighting services and other basic electricity needs. Reduction of indoor air smoke due to offsetting kerosene has significant positive effects on the health and safety of the end-users and their families. In some cases, Pico PV systems have been shown to lead to income generation, such as offering minimal mobile phone charging services and enabling increased working hours with light.

Example: The break-even time depends on the price of fuel replacement and income generating activities of the size of the Pico PV. For example, SolarAid empowered a number of Tanzanian households with PV lamps, most of them without electricity access. Households reduced their expenses for lighting by 71 percent, by switching from kerosene to Pico PV lamps. At this level of savings, "the cost of a small study lamp is recovered in less than two months" (SolarAid, Africa).

## Benefits for the MFI

MFIs can open and/or stimulate the market of Pico PV products by providing loans at different levels, depending on the electrification rate of targeted end-users. The substitution of other, more expensive, household lighting technologies can help customers to save money, improve their living standards, and increase the will to scale-up to larger, more powerful products. Also, a market for Pico PV products can be established in different sectors, such as education or agriculture.

## Environmental Benefits

Environment: Pico PV can contribute to reduce waste production (such as dry cell batteries), particulate matter emissions (for example from kerosene), fire hazards and their impact on forests.
Climate change mitigation: Pico PV reduces greenhouse gas (GHG) emission: if it replaces one kerosene lamp it reduces 112 kg $CO_2$ emissions per year.
Climate change adaptation: Pico PV could reduce households' vulnerability to volatility and price increase of non-renewable fuels.
Potential positive synergies with: Childhood education awareness raising and programs[3].

1 800 lumens corresponds to a 60W incandescent bulb.
2 Lighting Africa minimum quality standards (http://www.lightingglobal.org/activities/qa/standards/)
3 For further information on potential synergies check the other product catalogues for EE and RE technologies.

## European Microfinance Platform

The European Microfinance Platform [e-MFP] was founded formally in 2006. e-MFP is a growing network of 120 organisations and individuals active in the area of microfinance. Its principal objective is to promote co-operation amongst European microfinance bodies working in developing countries, by facilitating communication and the exchange of information. It is a multi-stakeholder organisation representative of the European microfinance community. e-MFP members include banks, financial institutions, government agencies, NGOs, consultancy firms, researchers and universities.

e-MFP's vision is to become the microfinance focal point in Europe linking with the South through its members.

## e-MFP Microfinance and Environment Action Group

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# RICE HUSK GASIFIER STOVE

## Product Catalogue - 2015

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**with the collaboration of Davide Forcella (CERMi-ULB)**

EUROPEAN MICROFINANCE PLATFORM
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## Description and Working Principle

### "From waste to fuel - turning rice husk into cheap, clean energy for cooking"

This low-cost and clean-burning stove utilizes rice husk as fuel to cater to domestic rural households and small cottage industries where abundance of rice husk is accessible. It is estimated that a ton of rice husk has a direct energy conversion of about 23 tanks of 11 kg LPG fuel thereby significantly reducing expenditure on conventional fuel sources. The production of combustible gases, primarily carbon monoxide and hydrogen, takes place by oxidizing the biomass fuel with a limited amount of air. Gasification of rice husks is achieved by controlling the air supply with a small fan.

## Technical Characteristics

| | |
|---|---|
| Reactor diameter and height | 16 cm ø x 60 cm |
| Fuel consumption rate | 2.6 kg/hr |
| Fan | 120 mm x 120 mm, 16 watts 12 V DC |
| Boiling time test | 14 to 20 min for 1.5 liters of water |
| Temperature beneath the cooking pot | 420°C |
| Thermal efficiency | 26% |
| Product lifetime | 2 - 3 years |

## Ease of Distribution, Installation and Maintenance

Fabricated rice husk stoves are available in regions where rice growing is the major economic activity such as India, Indonesia and Philippines. This simple stove requires no installation and is ready for use by end-users with basic instruction. Operation of the stove is best performed outdoors where proper air ventilation exists and fuel loading and char unloading processes are eased. Regular maintenance is carried out annually by users based on the usage frequency.

Typical maintenance work:

- Removal of char from the reactor (can be used as fertilizer due to its property to retain high water capacity)
- Cleaning and drying of the stove
- Replacement of fan after lifecycle

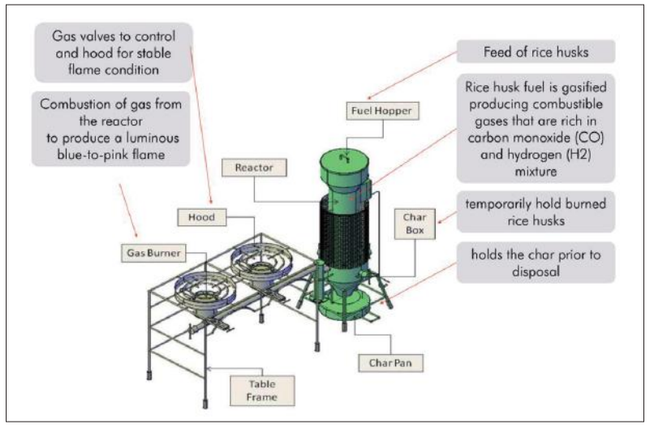
## Technology Options

Two types of gasifier stoves are commercially available at present, namely continuous and batch type. The main difference between these types is continuous operation without entirely discharging and reloading the stove. Also, the number of burners and material quality (e.g. stainless steel) can be selected according to clients' needs and capacity. Commonly, one and two-burner models are viable options, and these stoves are adaptable for AC or DC electrical inputs using a grid connection or a solar panel and battery.

## Price Range

A simplest and complete one-burner batch type gasifier set costs around USD $70.

| Type of target group | Price range |
|---|---|
| Domestic households | Between USD $70 - $100 |
| Small cottage industries, restaurants | USD $160 upwards |




*Source: Engr. Alexis T. Belonio*

*Source: Bioenergylists Stoves*

*Source: Bioenergylists*

## Type of Financing

Microfinancing as well as financial and operational microleasing can be provided to households and restaurants. Depending on the required size of the stove; home improvement, fixed-asset, or leasing-to-own loans can suit both, MFI and end-user.

## Economic and Social Impacts for End-users

This stove appeals to end-users as it reduces operation cost by 80 - 90 percent compared to LPG fuel. Depending on rice husk availability, it also reduces time intensity contrary to traditional biomass stoves. Its low-emission clean burning minimizes health hazards and is safer compared to traditional wood stoves. Moreover, the rice husk ash can be reused as soil fertilizer as an added value.

Example: The breakeven period of a one-burner batch type rice husk gasifier substituting an LPG gas stove is between 4 - 5 months for a medium consumption of 3 hours of cooking daily in the Philippines. This benefit will become more apparent as the cost of LPG continues to rise.

## Benefits for the MFI

Savings on cooking fuel expenses ensure reliable loan repayments for MFIs financing gasifier stoves. As this technology caters to a wide range of users and clients in rice-growing regions, MFIs can reach out their loan products to new clients.

## Environmental Benefits

Environment: Rice husk gasifier stoves reduce accumulation of rice husk in rivers banks and along roadsides. Rice husk ash can be used as organic fertilizer, pest/insect repellent, or for eco-friendly constructions. It can offset deforestation and pressure on natural resources: Every 1 ton of rice husk (average rice husk fuel needed annually per household) avoids burning 848 kg of wood and 510 kg of wood charcoal. It can offset the use of cow dung for heating, which can instead be used as organic fertilizer.

Climate change mitigation: It reduces the production of greenhouse gas (GHG): for example offsetting the use of LPG (replace 11 kg LPG tank monthly reduces a total of 86 kg $CO_2$ emissions annually), but also avoids change of land use and deforestation.

Climate change adaptation: It reduces the households' vulnerability to cost volatility of non-renewable fuels, and vulnerability to weather shocks due to environmental degradation (if the use of husk gasifier offsets trees cut).

Potential positive synergies with: Increase in environmental awareness, income diversification strategies or use of weather adapted calendar, certifications and TA for organic production with natural fertilizers[1].

## References


Alexis T. Belonio, Rice Husk Gas Stove Handbook, 2005
Altenphil, $CO_2$ Emission Factor for LPG, 2008
Stoves Bioenergylists http://stoves.bioenergylists.org/beloniolowcostrhstove


1 For further information on potential synergies check the other product catalogues for EE and RE technologies.

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Source : EnDev/GIZ Perú

# SOLAR TUNNEL DRYER

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EUROPEAN MICROFINANCE PLATFORM
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## Description and Working Principle

Solar tunnel dryers utilize the energy of the sun and wind to dry agricultural products, preparing them for proper storage, processing and export. The crop is spread in an even layer on tables or drying racks inside the tunnel. The air below the semi-transparent collector is heated by the sun and spreads throughout the tunnel. The increased temperature decreases the relative humidity of the air, thereby allowing the air to more efficiently dry the crop.

## Technical Characteristics

| | |
|---|---|
| Size | 4m x 8m x 1.7m |
| Usual weight | 120 – 200 kg |
| Fuel type needed | Solar insulation |
| Usual temperature range | Up to 60 $^{0}$C |
| Product life time | 10 years |
| Capacity | 250 kg |

## Ease of Distribution, Installation and Maintenance

Considering the volume of the system, transportation vehicles are usually needed. However, the modularity of the system allows it to be packed in batches and transported with smaller vehicles. A solar tunnel dryer is usually characterized as maximizing drying capacity while minimizing physical footprint, and they are relatively easy to install and disassemble so that the land remains usable. Drying racks can be built by the users themselves. However, usually, locally trained craftsmen build the drying racks and conduct the installation of the solar tunnel dryers. A solar tunnel dryer will work without any major supervision and requires only a small amount of maintenance, which can generally be conducted by the end-user.

### Typical maintenance work:

- Proper storage of semi-transparent collector
- Digging of canals to prevent water ingress
- Periodic replacement of collector
- Cleaning of collector

## Technology Options

The product is easily adaptable to the local environment and locally produced crops, such as varying the dimensions of the dryer, particularly height, and adding different types of plastic foils to simulate multiple drying effects when the product requires it. It is also possible to use a fan to induce forced convection when required.

## Price Range

These systems require semi-transparent collectors, and metallic and wooden structures. A complete set-up cost starts from around USD $700. However, according to the type of crop drying and the scale of the project, it can vary regarding to the specifications required, reaching a cost around USD $1500.

Source: Humana Spain

Source : EnDev/GIZ Perú

## Type of Financing

Microfinance loans and financial microleasing can be provided to both individual farmers and to farmer cooperatives depending on the magnitude of the project. The collateral for the loan can vary from the equipment itself to the land of the farmers.

## Economic and Social Impacts for End-users

Solar tunnel dryers offer an improved drying method for small and medium holder farmers. A typical solar tunnel dryer reduces the time required to dry the products from 1 to 5 days depending on the crop, can increase the productivity of the harvest by reducing the amount of product lost to moisture and reduces the amount of labor involved in drying products. Moreover, during the high season where the productivity level is high and the probability of decomposition is higher in which the farmers will have to sell their products at low price. The solar food dryer will decrease the financial losses as the crops could be stored without any decomposition for a longer time after the drying process.

Example: Solar tunnel dryers considerably change the process of drying crops compared to the traditional open-air method. High economic benefits of the dryers are incurred due to the improved efficiency and the decrease in required labor. As a technology aimed at productive uses, the payback period is related to the seasonability of the product harvested which can vary from 1.5 to 5 years.

## Benefits for the MFI

By increasing the income and reducing the labor force which affects mainly the operational costs of the drying process, the farmers will be more reliable when it comes to loan payments. In addition to that, the farmers will act as a passive marketing channel where they can attract new clients by sharing their practice. Furthermore, the MFIs could provide loans through other channels by collaborating directly with agriculture syndicates, organization or cooperatives.

## Environmental Benefits

Environment: Solar tunnel dryers could reduce pressure on forest and biodiversity due to the smaller area required to dry crops; they reduce waste, thanks to a more efficient drying, and they reduce pollution if they offset the use of mechanical dryers.
Climate change mitigation: Reduction of greenhouse gas (GHG) emission if they replace mechanical dryers.
Climate change adaptation: The possibility to dry foods can help households to adapt to change in weather seasonality due to climate change. Storing food can protect against weather extreme events and food price volatility, and it can be used to establish climatic insurance in kind. It can also help households to access better markets improving their position in value chains.
Potential positive synergies with: Training in agroforestry, certifications for organic production[1].

## References


- HUMANA Spain, http://www.humana-spain.org/quienes-somos/comunicacion/noticias/300-pequenos-agricultores-de-cabo-delgado-incorporan-tuneles-solares-de-secado-de-alimentos/en
- EBR Energy, http://ebr-energy.com/pakistan/


1 For further information on potential synergies check the other product catalogues for EE and RE technologies.

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# IMPROVED COOKING OVEN

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## Description and Working Principle

Improved Cooking Ovens (ICO) provide households and small and medium sized enterprises (SMEs) with opportunities to reduce fuel consumption and increase cooking efficiency. The improved cooking oven directs smoke around the center of the oven and out of a chimney, thereby achieving more evenly distributed temperatures throughout the oven. With the use of this portable metal ICO, end-users save money, protect the environment by off-setting non-renewable fuels, and improve indoor air quality.

## Technical Characteristics

| | |
|---|---|
| Target group | SMEs, restaurants, households |
| Approx. size | 1.00 m height (excluding chimney), 0.85 m width, 0.65 m diameter. |
| Approx. weight | 100 kg |
| Fuel type needed | Firewood / dense biomass |
| Fuel consumption | ca. 2.0 kg/hr |
| Burning chamber capacity | 0.6 – 0.7 kg of firewood |
| Cooking temperature | 170 – 250 °C |
| Product lifetime | Up to 3 years |

## Ease of Distribution, Installation and Maintenance

ICOs can be manufactured and distributed by local country producers. Considering the weight of each unit, transportation vehicles are usually needed. It is easy to install once delivered to an end-user, requiring no technical expertise unless additional adjustments to the installation site are required. An ICO requires some practice to operate skillfully, but only requires minimal operator training for normal use and minimal low-skill maintenance throughout the equipment lifecycle. Generally, the end-user can conduct regular maintenance without the need for technicians. Typical maintenance work includes regular cleaning of the inside of the oven, the combustion chamber and of the smoke-routing canals to assure optimal airflow and performance.

## Technology Options

The ICO can be built in various dimensions in order to serve different uses. There are a few possibilities to adapt the product to local circumstances, such as increasing chimney length to direct smoke away from specific building interiors, or the addition of ventilators to increase combustion temperature. In addition, in colder regions, the ICO may be able to be adapted to utilize the waste heat from the escaping smoke gases to feed other heating systems, such as water heating or indoor space heating.

## Price Range

ICO prices vary depending on the manufacturing materials, capacity and additional adjustments. The price of a small ICO made from galvanized steel starts from USD $360.

| Type of target group | Price range |
|---|---|
| Households | USD $360 - $540 |
| SMEs (restaurants, hotels, etc) | USD $410 - $750 |

*Source: MicroEnergy International*

*Source: The Ashden Awards for Sustainable Energy*

*Source: A.C.R.E.S.T Improved Stoves*

## Type of Financing

Microfinance loans can be provided mostly to individuals, for example microenterprise energy loans or home improvement loans.

## Economic and Social Impacts for End-users

A typical ICO reduces the time required to bake food by producing concentrated heat in a shorter period of time; it also reduces the amount of firewood required to cook. In addition, it reduces indoor pollution by routing smoke and particulate matter out of the building, thus contributing to protection of end-user health. Furthermore, due to the increased insulation, the external surfaces of the oven do not overheat, and thus the occurrence of accidental burns is mitigated.

The use of ICO results in a considerable reduction in consumption of firewood for households and SMEs. As a technology that can be used for both productive and private uses, the payback period is related to usage patterns and cost of firewood, and typically ranges from three months to three years.

## Benefits for the MFI

Savings on fuel expenses and increased productivity due to the efficiency features of the oven enable reliable loan repayments to MFIs financing ICOs. Furthermore, through the inclusion of clean technology products, an MFI can enhance its social and environmental performance, improving its reputation towards clients, funders and donors. Also, the ICO can attract new customer segments for MFIs such as SMEs engaged in the food, restaurant and hospitality industries. The portability of the ICO provides possibilities for increased visibility, as end-users can utilize the oven for special events in public spaces.

## Environmental Benefits

Environment: ICO reduces pressure on natural resources: firewood consumption is reduced by approximately 50 percent, while emission of particulate matter is reduced by an average 63 percent. Part of the heat produced can be reused.

Climate change mitigation: ICO reduces greenhouse gas (GHG) emission thanks to more efficient processes ($CO_2$ emission reduction by an average of 96 percent), and offset of local deforestation (if it offsets use of non-renewable biomass).

Climate change adaptation: ICO could contribute to reduce vulnerability against weather shocks due to environmental degradation (if it offsets local deforestation), and to reduce vulnerability to price increase and volatility for natural resources.

Synergies with: Increase in environmental awareness[1].

## References

A.C.R.E.S.T Improved Stoves http://www.acrest.org/domaines-d-interets/foyer-ameliore/?synSiteLang=2

Ashden Awards for Sustainable Energy http://www.ashden.org/ashden_awards

1 For further information on potential synergies check the other product catalogues for EE and RE technologies.

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# HOUSING THERMAL INSULATION

## Product Catalogue - 2015

**Prepared by MicroEnergy International GmbH**
**with the collaboration of Davide Forcella (CERMi-ULB)**

EUROPEAN MICROFINANCE PLATFORM
NETWORKING WITH THE SOUTH

e-MFP ACTION GROUP
ON MICROFINANCE
AND ENVIRONMENT

## Description and Working Principle

Thermal insulation prevents temperature exchange between the outside and inside of a house. It consists of several elements such as insulation of floor, ceiling, and walls, as well as windows and doors with high insulation properties. The insulation can be performed with various techniques adapted to local conditions and materials available on the market such as industrially manufactured materials as well as natural materials.

## Technical Characteristics

| | |
|---|---|
| **Heat loss reduction** | Up to 40% - 50% |
| **Examples of possible insulation materials** | • Straw or wood shavings<br>• Glass wool; sheep wool<br>• Styrofoam<br>• Gypsum |
| **Types of insulation measures** | • Walls, ceiling and floor insulation<br>• Window replacement<br>• Door replacement |
| **Product lifetime** | Up to the lifetime of the building |

## Ease of Distribution, Installation and Maintenance

Housing insulation consists of several elements that require technical expertise and installation work. Windows and doors must be precisely installed and generally easily maintained. In the case of improper installation or external stresses on the buildings, qualified technicians are required for repair. End-users require very little capacity building for regular maintenance activities.

Insulation of walls, ceiling and floors is more complex, calling for individual approaches and a detailed evaluation for the specific building. Craftsmen must be able to select appropriate materials, calculate price estimates and perform the installation. Once it is completed, good quality work will require a small amount of regular maintenance, such as cleaning and repainting, done by the end-user.

Industrially produced construction materials are readily available in most markets, while availability of local materials differs from region to region. Typical maintenance work is limited to cleaning and repainting coated surfaces every 2 - 3 years in order to prevent corrosion.

## Technology Options

A variety of options can be chosen to adapt insulation to local circumstances, such as the possibility to use locally available organic materials such as straw, wool, sawdust, locally available insulating biomass or more modern materials. In addition, one can select between plastic or wooden windows and doors depending on local preferences and availability supply chains.

## Price Range

An advantage of thermal insulation is that it can be installed gradually, thus offering affordability to clients with different income levels: from wealthier clients who can afford the whole range of measures to low-income clients who would rather insulate piece-by-piece. Therefore, the price can range from USD $100 - $1000.

| Type of insulation | Price range USD |
|---|---|
| Wooden/plastic window | USD $100 – $150 |
| Wooden/plastic door | USD $200 – $300 |
| Full insulation of 1 room with industrially manufactured materials | USD $600 – $800 |

*Source: Ecohouse Agent*

*Source: Hometone, EcoFriendly Wool Home Decoration*

## Type of Financing

Microfinance loans can be provided to individual borrowers for housing or building improvement.

## Economic and Social Impacts for End-users

Thermal insulation has many advantages for both cold and warm climates. First, it creates more comfortable living conditions by leveling the temperature inside the building. Second, in rural areas where people heat houses with firewood, local vegetation, manure and coal, a better insulated house will cut fuel consumption, potentially reducing expenses by up to 50 percent. In areas with high temperatures, insulation can help to reduce electricity bills for air conditioning. Finally, time spent collecting firewood or any other fuel stock can be spent on other activities.

The payback time of a USD $500 investment in insulation of ceiling, floor and window is 2 years with an average fuel expense of USD $200 - $300 per winter in the case of Tajikistan. Taking into consideration that the expected lifecycle of a window is 20 - 30 years and that of insulation is even higher, the investment will pay for itself at least 15 times over, saving the client USD $2250 on average.

## Benefits for the MFI

By providing thermal insulation loans, microfinance institutions can attract new clients interested in improving their living conditions and reducing costs. Savings on fuel expenses provide clients with increased means to repay loans. Additionally, innovative microloans for thermal insulation can attract attention from donors who are particularly interested in climate change mitigation and adaptation tools. Thus, such a financial product will not only diversify the portfolio of microfinance institutions and reduce risk of non-payment, but may also attract new funding opportunities.

## Environmental Benefits

Environment: Thermal insulation contributes to reduce polluting emissions, local deforestation and pressure on natural resources. It can support green jobs if environmentally friendly materials are used for insulation.

Climate change mitigation: Thermal insulation contributes to reduce the emission of greenhouse gases (GHG) thanks to reduction in electricity consumption, reduction in deforestation (if traditional heating is firewood), and use of environmentally friendly materials.

Climate change adaptation: Thermal insulation protects against hotter or colder weather and change in temperature in general. It could reduce the vulnerability to weather shocks due to environmental degradation and deforestation (if it offsets use of firewood for heating), and to energy price volatility.

Synergies with: Efficient Air Conditioners, increase in environmental awareness for energy use[1].

## References


HomeTone Ecofriendly Houses http://www.hometone.com/eco-friendly-home-decorating-tips.html

Ecohouse Agent Straw Insulation http://www.ecohouseagent.com/north-kesteven-straw-houses.html


1 For further information on potential synergies check the other product catalogues for EE and RE technologies.

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# EFFICIENT AIR CONDITIONERS

## Product Catalogue - 2015

**Prepared by MicroEnergy International GmbH**
**with the collaboration of Davide Forcella (CERMi-ULB)**

EUROPEAN MICROFINANCE PLATFORM
NETWORKING WITH THE SOUTH

e-MFP ACTION GROUP
ON MICROFINANCE
AND ENVIRONMENT

## Description and Working Principle

Air conditioning (AC) is the process of altering the properties (temperature and humidity) of the air towards more favorable conditions for humans; eventually providing comfort through cooling or heating. Efficient air cooling is satisfying the cooling needs of a certain space while consuming less energy than is usually needed with inefficient appliances. The medium used to transfer energy from the inside to the environment (outside) is the coolant or refrigerant.

## Technical Characteristics

| | |
|---|---|
| Size | 1,00 m * 0,25 m * 0,3 m |
| Usual weight | 7-8 kg |
| Fuel type needed | Electricity |
| Capacity (kW) | 2.5-7.5 |
| Product life time | 10 - 20 years |
| Seasonal energy efficiency ratio | 10 - 18 |
| Coefficient of performance | 2-4 |
| Energy consumed per year (new vs old) | 350 vs 1400 kWh/year |
| Reduction in costs (energy) | 75% |

## Ease of Distribution, Installation and Maintenance

Installation must be performed by a qualified technician. The system is mounted inside the space to be conditioned and the condenser is mounted on the roof or a designated space outside.

Regarding the maintenance, the AC system is usually well sealed; both the inner evaporator unit and the outer condenser unit should not be opened. However, a number of simple maintenance tasks are periodically necessary to ensure high performance:

- Clean dust off the evaporator
- Remove obstacles from condenser's fan air inflow
- Air conditioners can lose refrigerant with time. The refrigerant must be re-filled by a technician
- Filters need regular maintenance –can be done by the user– washing them with water at the beginning of the cooling season, and regularly during the rest of the year
- Clean the coils of the condenser and evaporator if not sealed.

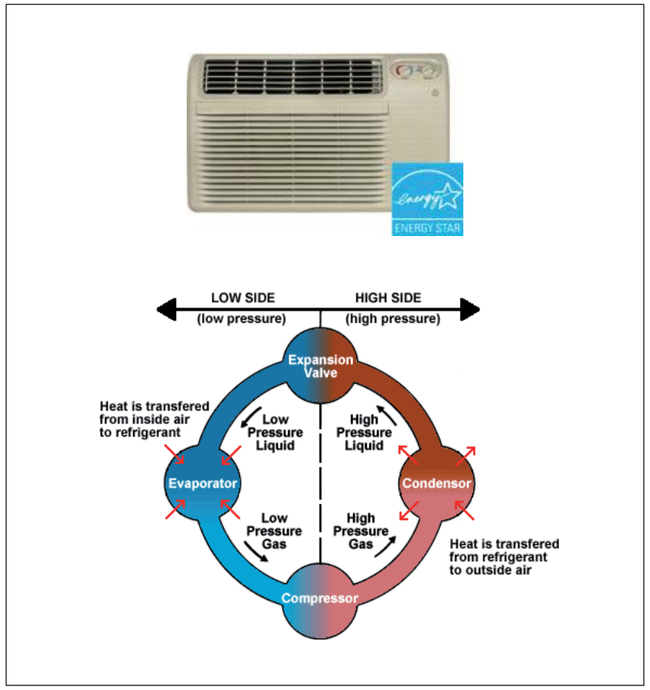
## Technology Options

Energy efficient systems are commercially available in a wide range of sizes. In addition, air conditioning concepts outside conventional vapor compression are gaining more and more interest, such as evaporative cooling or absorption cooling (using heat, e.g. from the sun). However, these are not as readily available and are more expensive.

## Price Range

The two main price drivers are the intial costs of buying and installing the system (major companies provide the service for free, or with a professional technician for an agreed price depending on the location) and the running costs.

| Type of target group | Price range |
|---|---|
| Individuals (houses) | USD $250 - $700 |
| Offices - companies - factories | USD $250 - $1250 |
| Operating costs (usage dependent) | USD $350 - $1250 per year |




*Sources: Geappliances / Southwest*

*Source: The New York Times*

## Type of Financing

Energy Efficient AC systems are best suited for both individual loans and commercial or industrial loans, either for replacing current non-efficient systems or installing new systems.

## Economic and Social Impacts for End-users

Energy efficient AC systems strongly reduce energy consumption for the purpose of cooling compared to old AC systems. This fact results in a meaningful reduction on electricity bills, at the same time it provides an improvement in life quality – especially in warm locations – playing also a role in productivity and comfort of beneficiaries.

If outdated air conditioners (with low seasonal energy efficiency ratings) are replaced with newer models, users would gain a considerable annual cost saving, depending on the geographical area and types of systems. For example a 15 year old AC replaced with a new efficient system could save up to USD $1850 over a 5 year period, with annual operating costs of around USD $370. This results in a payback period of 1 - 2 years.

## Benefits for the MFI

MFIs may contribute to providing efficient systems to end-users. Consumer demand is increasing, as the market is in great need of efficient technologies. Greater distribution of efficient technology helps improve communities' quality of life, reduces environmental harm and electricity expenditures.

## Environmental Benefits

Environment: Energy Efficient Air Conditioners reduce polluting emissions. They use new refrigerants, such as R410a instead of R12, that are approved by environmental protection authorities, and do not damage the ozone layer.

Climate change mitigation: Energy Efficient AC reduces greenhouse gas (GHG) emission if it replaces old devices or it offsets part of the GHG emission for a first air conditioner.

Climate change adaptation: Energy Efficient AC could contribute to adapt to higher temperature both for households and businesses. If it replaces old devices it could reduce the vulnerability to increase in energy demand and reduction in supply. Potential positive synergies with: housing thermal insulation[4]; increase in environmental awareness to moderate cooling temperature.

## References


The New York Times, http://www.nytimes.com/roomfordebate/2012/06/21/should-air-conditioning-go-global-or-be-rationed-away

Geappliances, http://www.geappliances.com/

Southwest Tech, https://www.swtc.edu/


1 COP is the measure for the efficiency of an aircon and is calculated as the ratio of heating or cooling provided to electrical energy consumed
2 Depends on the replaced device and its energy efficient ratio(EER).
3 EER is the ratio between the cooling capacity and the power input of the air conditioners. For example, if a 1 TR (3500 W) AC consumes 1000 watts, then the EER of the air conditioners is 3.5 W/W.
4 For further information on potential synergies check the other product catalogues for EE and RE technologies.

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# SOLAR WATER PUMPS

## Product Catalogue - 2015

**Prepared by MicroEnergy International GmbH**
**with the collaboration of Davide Forcella (CERMi-ULB)**

EUROPEAN MICROFINANCE PLATFORM
NETWORKING WITH THE SOUTH

e-MFP ACTION GROUP
ON MICROFINANCE
AND ENVIRONMENT

## Description and Working Principle

Solar water pumps (SWP) use electricity generated by photovoltaic (PV) panels to pump water from bore holes, wells or reservoirs directly onto fields or into a storage tank for gravity based irrigation. With no fuel inputs and simple operation, SWP are cheaper, cleaner and more reliable than diesel pumps. They offer the potential to increase smallholder incomes through reduced operating costs and improved crop yields. Once installed, SWP are low maintenance and have a long life if maintained properly. Water supplied can be used to irrigate crops, water livestock or, in some cases, provide drinking water.

## Technical Characteristics

| | |
|---|---|
| Target group | Community-scale irrigation, smallholders, diesel pump replacement |
| Components | Pump, controller, solar panels, wiring, piping, water tank |
| System size | Depends heavily on site and pumping requirements |
| Fuel type needed | High levels of sunlight |
| Fuel replaced | Diesel |
| Solar array size | 6 – 10 $m^2$/kW for silicon PV panels |
| System power | 1.1 kW – 8 kW |
| Typical lift range | 5 – 200 m |
| Typical flow rates | 10 – 400 $m^3$/day |
| Lifetime | Pump: 5 – 10 years, Panel: 20 years |
| Operation | Unattended, during daylight hours |

*Source: MicroEnergy International*

## Ease of Distribution, Installation and Maintenance

Detailed site and resource assessment, including soil type, crop type, water availability, and meteorology, are required to determine water flow requirements and system sizing. In cases where new wells or bore holes are constructed, careful consideration of the local hydrology is needed. Installation of the solar panel array, wiring and piping requires extensive technical know-how to optimize the system and avoid faults. Solar panels, electronics and pumps are sensitive preassembled components, and damage during transit must be avoided.

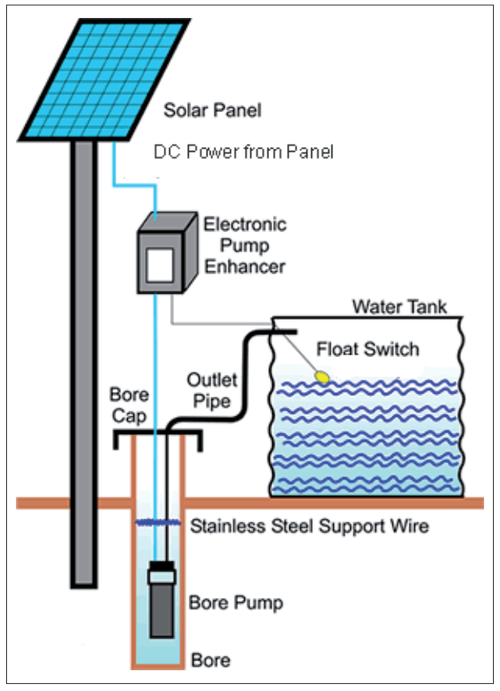
Pumps operate without supervision and require very little maintenance compared to diesel set-ups, however, routine maintenance is necessary to ensure a long lifecycle. This could include checking for faults, the cleaning of panels and pump filters, and the maintenance of the site around the SWP.

## Technology Options

Efficiency improvements can be made by combining SWP with drip irrigation or using automatic electric sun tracking arrays. A variety of pump systems and sizes are available from manufacturers worldwide, ranging from surface pumps to submersible pumps. Water tanks are optional, but enable storage of water for gravity pumping on demand. It is also possible to make small systems mobile.

## Price Range

System price depends on the sizing of the system, i.e. the volume and distance of pumping required. Prices range from around USD $2,400 to $10,000 for 1.1 – 4 kW pump systems. For a max pump head of 100 m and max flow rate of 3.9 m3/h, the cost of the pump-panel-controller system is approx. USD $4,500 (based on cost of Lorentz 1.8kW SWP and assumption of USD $1.2 per Watt of solar panels).




*Source: ClimateTech Wiki*

## Type of Financing

At this price range, an SWP could be offered through microenterprise loans, fixed-asset loans or a financial leasing contract. In Bangladesh, for example, equipment loans are provided to a cooperative and paid for by many members. The land of the individual farmers is used as collateral, a soft loan for the SWP system is provided directly to the cooperative, and the loan is paid back through fees for water.

## Economic and Social Impacts for End-users

SWP can reduce irrigation costs for farmers by 10 – 40 percent and provide a more reliable water supply than diesel pumps. Their simple operation and minimal maintenance requirements also save substantial time and effort irrigating fields and travelling to purchase diesel. Reduced exposure to pollution and lower possibility of diesel leaks onto crop fields protects the health of users.

Example: The breakeven time of a solar pump against the cost of diesel pumping is typically between 1.5 – 4 years. For instance a pump operating with 50 m lift and flow rates of 20 m3/day will breakeven after 20 months when compared to a diesel pump running for 5 hours a day with diesel costs of USD $1.30 per litre*. As diesel costs continue to increase, and solar pump systems become more affordable, this breakeven point will be reached sooner and savings will be higher.

*Based on 2008 retail price of Lorentz pump system from Lorentz Namibia Brochure

## Benefits for the MFI

The MFIs will be able to broaden their loan portfolio options available to agricultural clients, while sustainably reducing environmental impacts. Savings on diesel expenses and increased crop income will facilitate successful loan repayments, and demand for this technology can attract new clients to the MFI.

## Environmental Benefits

Environment: Solar water pumps avoid the emission of particulate matter (if it offsets diesel pumps), diesel leakages into cultivations and water, noise pollution, and travel to collect fuels. It could also contribute to a more efficient use of water.

Climate change mitigation: They reduce greenhouse gas (GHG) emission by replacing use of non-renewable energy, emission of $CO_2$ is reduced by 2.64 kg per liter of diesel; or by improving the use of the soil if agroforestry practices are implemented, or if cultivation is implemented on previously spoiled soils.

Climate change adaptation: Access to water helps increase resilience of rural households to climate shocks (such as droughts) and reduces the vulnerability of cultivation to higher temperature trends. It helps diversify income generating activities. It could help to decrease households' vulnerability on fuel price volatility.

Potential positive synergies with: Solar tunnel drier, rice husk gasifier, biodigesters (due to need of water), agroforestry, diversification strategies[1].

## References

Climatetech Wiki, http://www.climatetechwiki.org/technology/jiqweb-swp

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# SOLAR HOME SYSTEMS

## Product Catalogue - 2014

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**with the collaboration of Davide Forcella (CERMi-ULB)**

EUROPEAN MICROFINANCE PLATFORM
NETWORKING WITH THE SOUTH

e-MFP ACTION GROUP
ON MICROFINANCE
AND ENVIRONMENT

## Description and Working Principle

A Solar Home System (SHS) is a small-scale, autonomous electricity supply for households that are off-grid or have unreliable access to energy. It generates electricity from sunshine and stores the electricity in a battery for consumption during the night or cloudy days. SHSs generate direct current (DC) that can be used for a range of electrical appliances, from lighting and mobile phone charging to small televisions, radios, fans or other appliances. By replacing fossil energy sources such as kerosene, candles and dry batteries, SHSs have the potential to reduce indoor air pollution and substitute energy expenditures.

## Technical Characteristics

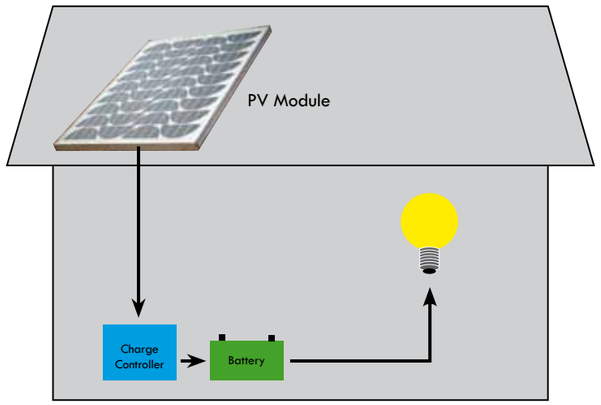
| | |
|---|---|
| Target group | Private households, small and micro enterprises (SMEs) |
| Components | Solar panel, charge controller, battery, wiring and mounting structure |
| System sizes | 20 W, 30 W, 50 W, 100 W up to kW range |
| Battery capacity | 10 Ah – 130 Ah depending on size |
| Typical output | 12 V DC most common<br>100 – 240 V AC possible with inverter |
| DC appliances | LED lighting, mobile phone charging, small ICTs (radio, TV, DVD player, etc.), fan, fridges ( in bigger systems only) |
| Operating time | 3 – 5 hours daily with full load |
| Sunshine required | 4 – 5 hours of full sunshine hours |
| Warranty | Battery: 3 – 5 years<br>Panel: 20 years |
| System cost | e.g. USD $150 – $800 / (20 W – 120 W) |
| Substitution potential | Kerosene, candles, dry cell batteries |

## Ease of Distribution, Installation and Maintenance

The initial sizing of the technology packages on offer should be carefully considered and calculated by engineers. Hands-on training provided by local technical or government institutions can enable low skilled people to properly install the SHS. Solar panels must be installed on poles or rooftops with a particular angle towards the sun and away from shade caused by trees or other objects. Batteries should be connected close by in a secure, cool, dry and ventilated location, and electrical cabling must be safely installed. Properly designed and installed SHSs operate without supervision and require only minor routine maintenance by end-users. End-user training on use and load management is essential and should be repeated multiple times during a loan period. SHSs present some distribution challenges, as they require multiple components in separate packages and tools for installation. Batteries are heavy (10 kg or more depending on size), and cushioned packaging must be used to prevent damage to solar cells in transit.

## Technology Options

| System capacity | Example appliances | Price range (USD) |
|---|---|---|
| 30 W | 3 × 3 W LED lights, a 16″ LCD/LED TV, mobile phone charging | USD $250 (price varies with local equipment cost, tax, etc.) |
| 50 W | 5 × 3 W LED lights, a 16″ LCD/LED TV, mobile phone charging | USD $410 (price varies with local equipment cost, tax, etc.) |




Source: MicroEngergy International

## Price Range

Each SHS requires a solar panel, battery, charge controller, cabling, switches, and appliances. A complete setup of 20 W panel capacity starts at around USD $150.

| Type of target group | Price range (USD) |
|---|---|
| Households | Between USD $150 – $800 |
| Community-scale projects | More than USD $800 |

## Type of Financing

SHSs are suitable for microfinancing and financial as well as operational microleasing. For community-scale projects microleasing can be more suitable. Depending on the down payment and size of the SHS, the loan or lease period can vary from two to three years. Higher down payment allows shorter repayment period and more attractive conditions for end-users. During this time MFIs also can offer after-sales service, including installation, maintenance and training.

## Economic and Social Impact for End-users

SHSs can reduce the health impacts of indoor air pollution and fire hazards caused by kerosene and candles, whilst reducing expenditures needed for these fuels and improving the quality of lighting. Time spent purchasing fuels can also be reduced, and increased lighting availability may enhance the productivity of shops and studying opportunities for school children.

Breakeven example: A kerosene lamp producing 37 lumens for 4 hours a day will consume about three liters of kerosene per month. If a 30 W SHS substitutes the use of 3 kerosene lamps with brighter LED lighting, it has the potential to save nine liters of kerosene a month – or USD $7.83 a month[1]. If the SHS system costs USD $250, a simple calculation shows that the system can breakeven in about 32 months.

## Benefits for the MFI

MFIs have the chance to expand their product portfolio with this technology and once implemented, the technology quickly gains interest from new potential clients such as neighbors, friends and family who see the benefits of clean, efficient and high quality products. SHSs offer an attractive opportunity to MFI clients wishing to gain access to basic electricity services. Substituted costs for conventional fuels and low operational costs help to ensure an ability to repay, however a focus on supporting productive use activities provides even more assurance. Due to their green characteristics, the inclusion of SHSs into an MFI's portfolio will promote the MFI to rank better in the Microfinance Environmental Performance Indicator.

## Environmental Benefits

Environment: it reduces particulate emissions and pressure on natural resources used to produce electricity. It reuses wasteland and it reduces waste coming from dry batteries and leakages from kerosene of diesel.

Climate change mitigation: it reduces greenhouse gas emission.

Climate change adaptation: it reduces the vulnerability to electricity and fuel price volatility, and it reduces the vulnerability to volatility in energy provision.

Potential positive synergies with: efficient air conditioner, energy efficient refrigerator.[2]

[1] Based on Bangladesh kerosene price of 0.88 US$/liter in September 2014

[2] For further information on potential synergies check the other product catalogues for EE and RE technologies.

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# SMALL-SCALE MINI-GRIDS

## Product Catalogue - 2014

**Prepared by MicroEnergy International GmbH**
**with the collaboration of Davide Forcella (CERMi-ULB)**

EUROPEAN MICROFINANCE PLATFORM
NETWORKING WITH THE SOUTH

e-MFP ACTION GROUP
ON MICROFINANCE
AND ENVIRONMENT

## Description and Working Principle

Small-scale Mini-Grids (MGs), also referred to as Nano-Grids or Micro-Grids, are micro-utilities that generate, store, and distribute electricity locally. These grids serve a wide range of market segments including off-grid rural areas and islands but also serve as backup systems in urban areas with frequent load shedding. These small scale grids usually work with direct current (DC) and range from approximately 4 to 24 hours of operation time per day. The structure of the system depends on the specific business model – which also defines the owner and operator. Electricity and/or electricity services are sold, leased, rented (or a combination of them) by the operator to end-users. Small-scale Mini-Grids cover two tiers of electrification, which indicate the energy access rate of the connected end-users. The first tier includes the basic household's needs, such as lighting or phone charging. The second tier refers to the situation when users are able to use electricity for small information and entertainment technology uses such as energy efficient TVs.[1]

## Technical Characteristics

| | |
|---|---|
| Target group | Islands, rural off-grid villages |
| System gize | Approx. 1 kW to 10 kW |
| Fuel type needed | Solar/wind/hydro/diesel |
| Fuel replaced | Kerosene, dry cell batteries, diesel |
| Preparatory work | Site assessment, load and demand forecast, commercial viability, tariff calculation, design and costing, environmental impact, and implementation plan |
| Product lifetime | ~20 years, influenced by O&M. Batteries need replacement approx. every 8 years. |
| Electricity cost | 0.4-0.9 USD$/kWh |

## Ease of Distribution, Installation and Maintenance

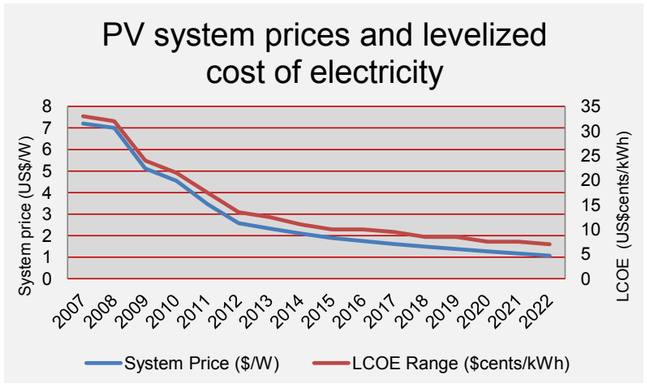
Small-scale Mini-Grids require accurate design in order to ensure sustainable long-term performance. The type of generation and storage technology, capacity of the system, paying method, and other technical aspects depend on the environmental resources, end-users' ability and willingness to pay, nature and volume of demand, and potential long-term load growth. Distribution and installation is normally performed by suppliers or local technicians. In some cases, the same supplier offers generation, distribution, and metering technology, easing the installation. In regard to maintenance, it is critical to ensure that the operator can carry out both the operation and maintenance tasks. Since a certain technical knowledge is required to operate and maintain the system, the installation period can be used to provide the necessary training to the future operator.

## Technology Options

A variety of technologies exist at different scales and requirements for the grid infrastructure (respective type and scale of components to be integrated into small-scale Mini-Grids). Local requirements and available resources should be considered at the design stage of the grid structure, as well as the components (battery system, type of meters, etc.). On the generation side, different technologies can be employed, preferably Renewable Energy Technologies (RETs), such as solar photovoltaic (PV), small wind turbines, biomass, but also diesel gensets, which can be flexibly integrated into the grid. These technologies can be installed separately or in combination of two or more, creating a hybrid system, resulting in a more flexible and robust grid infrastructure. Storage technologies can also be integrated on the generation side, as they can be installed next to each other. However, batteries can also be distributed on a decentralized level per household and used independently for each end-user.

[1] Bardouille, P. & Muench, D. (2014). "How a new Breed of Distributed Energy Services Companies can reach 500mm energy-poor customers within a decade".

**Figure 1:** Global average and forecast of PV system prices and LCOE.




*Source: Observer Research Foundation Mumbai. 2007 to 2012 are actual figures and 2013 to 2022 are estimate.*

Source: MicroEngergy International

Metering technologies depend on the business model and power consumed per connection. In small-scale Mini-Grids, pre-payment meters are commonly used allowing users to pay per power, energy, service, or "air-time"[2] consumed. Nonetheless, post-paid technology can also be utilized. The respective model is supported by smart metering technology.

## Price Range

The price of the system depends very much on environmental and accessibility conditions, as well as the scale and respective efficiency at which the system operates. RETs require a larger upfront expenditure than diesel generators. However, diesel powered Mini-Grids' maintenance and fuel costs pose a risk due to market volatility and diesel availability. RETs usually result in significant cost savings on a long-term basis.

## Type of Financing

Microfinance Institutions (MFIs) can participate in financing of Mini-Grids in a variety of ways. On the one hand, loans can be targeted either to a community or to an individual that wants to acquire the whole system in order to become the operator. On the other hand, once the system is installed, users may want to connect or enhance their connection with new loads. Loans can be directly provided to the end-users to address any issues of affordability.

## Economic and Social Impact for End-users

Access to electricity and energy services can have a huge impact on the development of off-grid rural communities. Economically speaking, small-scale Mini-Grids reduce household costs by providing energy to meet basic needs, such as efficient lighting and cellphone chargers. End-users are able to enjoy an increase in comfort as well as the possibility to access information instantly through appliances such as radios, TVs, and laptops.

## Benefits for the MFI

By financing small-scale MGs, MFIs will benefit from the fact that they will be able to widen the portfolio, not only by connecting their customers to a reliable energy supply but also, due to the rebound effect, the opportunity to finance other appliances that end-users would be willing to buy. Furthermore, due to the environmentally sound approach of MGs, i.e. generating and distributing electricity from Renewable Energy Technologies (RETs), MFIs will get a better ranking in the Microfinance Environmental Performance Index (MEPI).

## Environmental Benefits

Environment: it reduces particulate emissions and pressure on natural resources used to produce electricity. It reuses wasteland and it reduces waste coming from dry batteries and leakages from kerosene or diesel.

Climate change mitigation: it reduces greenhouse gas emission.

Climate change adaptation: it reduces the vulnerability to electricity and fuel price volatility, and it reduces the vulnerability to volatility in energy provision.

Potential positive synergies with: efficient air conditioner, energy efficient refrigerator.[3]

[2] "air-time" tariff is based on the amount of time the energy service is provided to the end-user, usually per minutes or hours.

[3] For further information on potential positive synergies please check the named product catalogs

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# LARGE-SCALE MINI-GRIDS

## Product Catalogue - 2014

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**with the collaboration of Davide Forcella (CERMi-ULB)**

EUROPEAN MICROFINANCE PLATFORM
NETWORKING WITH THE SOUTH

e-MFP ACTION GROUP
ON MICROFINANCE
AND ENVIRONMENT

## Description and Working Principle

Large-scale mini-grids are power infrastructures that provide energy services in rural and peri-urban areas where the main grid has not yet reached and is unlikely to do so in the near future. Relying on available local resources, energy can be generated from different renewable energy technologies (RETs), such as solar, wind, hydro or biomass. Depending on how fluctuating the electricity generation from this resource is, battery storage systems and diesel generators can be included in the mini-grid. The system's design and implementation nature and their integration into the existing infrastructure divide mini-grids into greenfield and brownfield types. Furthermore, mini-grids can potentially be interconnected to the main grid. Large-scale mini-grids usually operate as an AC system. This allows the usage of a wide range of domestic appliances, such as light bulbs, mobile chargers and information and entertainment technology, as well as powerful productive appliances with motors for agricultural and semi-industrial activities such as fridges, freezers, power tools and pumps.

## Technical Characteristics

| | |
|---|---|
| Target group | Rural off-grid villages/towns, islands |
| System size | 10 kW to 5 MW |
| Fuel type needed | Normally hybrid between diesel / solar irradiation / water flow / wind / biomass |
| Fuel replaced | Diesel |
| Preparatory work | Current and forecasted load profiles, commercial scheme including power or energy tariff calculation, detailed design, costing, environmental impact, social impact, implementation, operation and management |
| Role of user | Smart usage - demand side management training necessary |
| Lifetime | Approx. 20 years if well sized, operated and maintained.<br>Replacement of battery will be necessary at least every 8 years. |
| Electricity price | Approx. 0.6 -1.3US$/kWh, depending on location and technology |

## Ease of Distribution, Installation and Maintenance

Large-scale mini-grids are robust systems, usually providing a considerable amount of power and requiring a significant level of knowledge on different fields. As a consequence, a strategically defined business model, including operation and maintenance (O&M) services, is a key factor for guarantying the sustainable long-term development of the system, optimizing its lifetime.

Depending on the system's configuration as well as the geographical area in which it is implemented, different technical, economic, legal, social and environmental factors will apply, which shall determine the operational model of the mini-grid. This can be from a community-based model, to private- or utility-based as well as combination models. The installation, operation and maintenance contracts will be defined based on these structures and should ensure enough financial resources and high technical capabilities to implement and manage the project. A close relationship with the community should be established to avoid risky issues arising and the inclusion of training and capacity building is recommended in order to optimize the system's lifespan. This should particularly focus on future technicians who will be in charge of the operation and maintenance services of the mini-grid infrastructure and should also integrate the community from the beginning of the project development.

## Technology Options

Several clean energy generation and storage technologies can be used. These hybrid systems are commonly selected thanks to the synergistic connection between different renewable and conventional fuels. Smart metering technologies at the end of the distribution network ease the implementation of the desired billing and tariff system, which will depend on the established business model. Furthermore, demand side management strategies can be implemented by using smart meters.

## Price Range

The price range associated with a large-scale mini-grid varies according to the following factors:

- Local natural resources – most adequate technology or technologies.
- Required system size (number of connections, energy demand, and peak power demand).
- System configuration (use of batteries and/or hybrid mini-grid).
- Fuel price dependence.
- Associated O&M costs.
- Desired hours of operation.

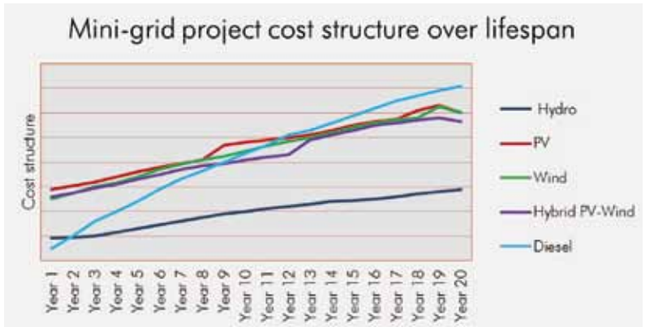
In order to provide a reference for the size of the up-front capital expenditure of a large-scale Mini-Grid, a case scenario is presented below including the type and amount of resources available. According to those resources, an approximate cost per technology is also presented. This only refers to the capital expenditure required to install the equipment. However, due to the weight or proportion of operation and maintenance costs, as well as fuel costs (in the case of a diesel based Mini-Grid), also presented is the cost structure of a mini-grid over its lifespan. For this, different sources (see Figure 1) are considered to run the Mini-Grid.

A financial institution can be interested in providing loans for devices directly targeting end-users. Examples for this segment are:

- Metering technology: Pre-paid and remotely controlled meters (will depend on the business model) ranging in price from USD $100 to USD $250.
- Load limiters and securing electrical installations: This part includes fuses, miniature circuit breakers, PTCs thermistors, and electronic circuit breakers. These devices range in price from USD $5 to USD $30.

Connection fee: Connection fees are usually applied to end-users willing to connect to a Mini-Grid. The price of such a connection varies according to the location. For instance, the connection fee for a mini-grid in Bangladesh is 5,000BDT (~USD $65).

**Figure 1**: Costs associated to a mini-grid over its lifespan.




*Source: Alliance for Rural Electrification.*

**Table 1**: Case scenario conditions.

| Local natural conditions and mini-grid service characteristics | |
|---|---|
| Hours of service | 24 |
| Energy demand | 270 kWh/day |
| Peak power demand | 26 kW |
| Solar insolation | 6 kWh/m2/day |
| Average wind speed | 5 m/s |
| Hydro resources | 80 L/s |
| Oil price | USD $0.70/L |

*Source: Alliance for Rural Electrification.*

**Table 2**: Component's price based on conditions.

| Estimated cost of components | |
|---|---|
| Genset | USD $400/kW |
| Small wind turbine | USD $2,120/kW |
| PV | USD $2,800/kW |
| Small hydro | USD $1,790/kW |
| Battery | USD $225/kW |
| Converter | USD $1,445/kW |

*Source: Alliance for Rural Electrification.*

## Type of Financing

Considering the high costs of components for large-scale mini-grids, microfinance instruments are viable only in the case of syndicated loans, i.e. when several microfinance institutions (MFIs) jointly participate in financing the system. In this case, risk-sharing and combined resources and competencies of MFIs may facilitate project implementation. For financing system components, financial microleasing is the most suitable option.

## Economic and Social Impact for End-users

Large-scale mini-grids can support the socioeconomic development in under- or non-electrified communities, not only to satisfy the basic needs of the households, but also to use more powerful appliances that have an impact on the quality of service and comfort. On the one hand, learning and working during night time become possible, while information and entertainment technologies improve the level of social connectivity. On the other hand, a more reliable energy access brings the possibility of using bigger agricultural and industrial appliances for productive use, supporting the creation of jobs within the community. Furthermore, a reduction of the every-day physical work of the population could be achieved through devices such as water pumps requiring a reliable electricity supply.

## Benefits for the MFI

Financing of large-scale mini-grids by MFIs will bring these institutions to a brand new level of their product portfolio management and technical as well as financial expertise. Cooperation with other MFIs to make this product available to communities will also involve knowledge sharing, risk sharing as well as more favorable after-sales service. Moreover, it also provides an individual institution an opportunity to extend their product offering to financing metering devices and connection fees.

## Environmental Benefits

Environment: it reduces particulate emissions and pressure on natural resources used to produce electricity. It reuses wasteland and it reduces waste coming from dry batteries and leakages from kerosene or diesel.

Climate change mitigation: it reduces greenhouse gas emission.

Climate change adaptation : it reduces the vulnerability to electricity and fuel price volatility, and it reduces the vulnerability to volatility in energy provision.

Potential positive synergies with: efficient air conditioner, and energy efficient refrigerator.[1]

[1] For further information on potential synergies check the other product catalogues for EE and RE technologies.

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Source: Thisoldhouse

# ENERGY EFFICENT REFRIGERATORS

## Product Catalogue - 2014

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**with the collaboration of Davide Forcella (CERMi-ULB)**

EUROPEAN MICROFINANCE PLATFORM
NETWORKING WITH THE SOUTH

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AND ENVIRONMENT

## Description and Working Principle

Energy efficient refrigerators provide cold storage services to users with a large reduction of energy consumption – over 50% compared to "non-efficient" refrigerators. Energy efficient refrigerators use a high performance electric compressor and are provided with enhanced insulation measures. The use of adequate insulation materials keeps the inside of the refrigerator cold for several hours, even when the electricity supply is interrupted. Refrigerating appliances can serve both the domestic and commercial sectors – including grocery shops, supermarkets, restaurants, hospitals or health institutions – with a range of sizes and cooling power to satisfy end-users needs.

## Technical Characteristics

| | |
|---|---|
| Capacity | 150 – 350 litres |
| Fuel type needed | AC Electricity |
| Yearly energy consumption | 60 - 220 kWh |
| Product life time | 12 years |
| Coefficient of performance | ~ 0.7 |

## Ease of Distribution, Installation and Maintenance

Fridges are easy to install; usually only plugging it into the electricity socket is required. However, adequate spacing behind the fridge should be available for heat to dissipate. Energy efficient fridges have been successfully marketed and distributed, particularly in the past two decades due to legally enforced high energy efficiency standards and requirements in many countries.

New energy-efficent fridges represent a low maintenance technology. The required maintenance activities include ensuring the fridge is not overloaded (the inlets and outlets for airflow inside the fridge are not blocked) and making sure that the fridge doors are always maintained tightly closed. Frequent cleaning is recommended.

## Technology Options

Cold appliances come in varying sizes and designs regarding the target sector and the application they are made for. On the one hand, domestic refrigerators can be divided in three categories;

- refrigerators, which are intended for food preservation and operate between 2-6 °C
- freezers, operating under -18 °C for storing frozen food, preserving fish and ice-making
- refrigerator-freezers which include both options

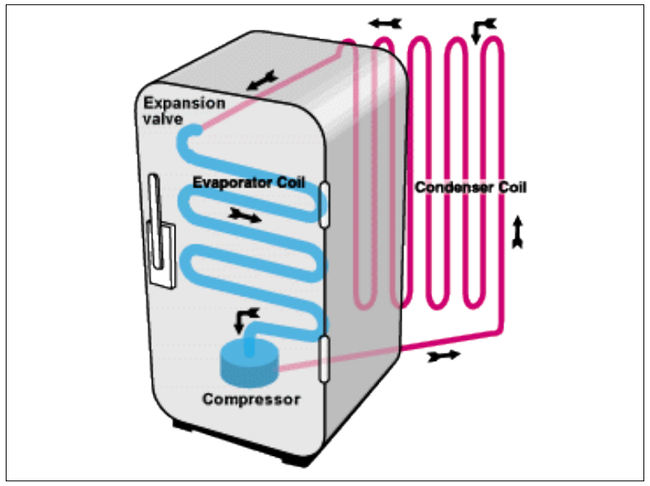
On the other hand, a wider range of models exist for commercial purposes. These can be vertical or horizontal, with or without doors, and with different opening systems to ease their use.

Source: EMT India

## Price Range

The cost drivers of this type of technology are the initial investment and the operating costs. Operating costs vary largely, depending on the size of the fridge purchased, starting from USD $ 0.15 per kWh for an A-rating refrigerator.

| Type of target group | Price range (USD) |
|---|---|
| Individual | USD $400 - $1500 |
| Commercial | USD $1000 - $3000 |




## Type of Financing

Energy-efficient refrigerators are suited for microfinancing as well as for financial microleasing. The products offer solutions for institutions or industries that want to replace their current non-efficient appliances or want to install a new refrigerator.

## Economic and Social Impact for End-users

The main benefits of energy efficient refrigerators are improved energy efficiency and the improvement in users' quality of life. The needs for preserving food are satisfied and with that, health hazards at the household or commercial level are reduced. Fridges represent a value chain intervention for commodities that require cooling such as fish, meat and dairy products. Selling cold drinks is a business model worldwide.

Replacing an old fridge with an EnergyStar-rated appliance could result in energy savings of up to 70% (aprox. 700 kWh per year). For example, for a medium size household in Bangladesh, where the electricity price is around 6.5 US cents/kwh, replacing an old fridge with an energy efficient appliance results in an annual average saving of USD $45.

## Benefits for the MFI

At the household level, MFIs may contribute to the acquisition of refrigerators that are desirable by the end-users for their price competitiveness, high performance and low long-term operating costs. Also, MFIs can drive financing for the commercial sector with loans for purchasing energy efficient and environmentally friendly refrigerators.

## Environmental Benefits

Environment: Energy Efficient Refrigerators reduce polluting emissions. They use new refrigerants that are more environmentally friendly. They can also contribute to reduce food waste.

Climate change mitigation: If substituting an old device, it reduces greenhouse gas (GHG) emissions, or it offsets part of the GHG emission for a first refrigerator.

Climate change adaptation: Energy Efficient Refrigerators can help preserve fresh food for longer periods, and prevent the spread of diseases by creating a bacteria isolated environment.

Potential positive synergies with: mini-grids.[1]

## References


- EMT India, http://www.emt-india.net/equipment_tips/HVAC_refrigeration/Heat%20Pump.htm
- Thisoldhouse, http://www.thisoldhouse.com/toh/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# COMMUNITY PV

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NETWORKING WITH THE SOUTH

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AND ENVIRONMENT

## Description and Working Principle

Community PV (Photovoltaic) is a solar power system that provides energy to the community, requiring either an individual investment or a community investment. An optimized site should be chosen and qualified skills and commitment are necessary to install and maintain the system. Community PV provides improved economies of scale and local job generation and also offers the potential to expand the participation to renters. After installation, relative low maintenance and a long lifetime is expected. Community PV is also good for the utilities because it aids power balancing. And during the agreed time period, there is no concern about increase in electricity price.

## Technical Characteristics

| | |
|---|---|
| Target group | Community in islands, rural areas without grid connection or with unstable grid connection |
| Components | PV Panel, charge controller, inverters, battery, wiring, measuring and monitoring devices, data storage |
| Fuel type needed | Solar irradiation |
| PV Array size | 500W – 2kW |
| Battery capacity | 210Ah – 850Ah |
| Battery type | Lead acid, Li-Lon, Ni-MH |
| Battery lifecycle | 200-1500 at 80% Depth-of-Discharge (DOD) for lead acid*<br>1000 cycles at 80% & 3000 cycles at 20% for Li-Lon and Ni-MH** |
| Battery charging time<br>Autonomous Days | Within 5 hours<br>3 days (depending on design) |
| Life time | PV Panel: 20 years, battery (see battery lifecycle above), Power Electronics 5-10 years. |
| Operation | Unattended, during daylight hours |

source: *: IEEE 1562-07(1) /IEEE 1361-03 (2) **: NEPQA-2013

## Ease of Distribution, Installation and Maintenance

Detailed research must be carried out to determine the requirement and system sizing. Site selection and resource evaluation are required. Damage to all the components must be avoided during the distribution process.

Installation at this scale requires skilled technicians. Multiple panels in an array must be connected in series, parallel, or a combination of series-parallel to meet both the voltage and amperage requirements of the power electronic inverter/controller. Typical maintenance work includes:

- Failure check
- Data measurement
- Remote monitoring
- Data collection
- Cleaning the solar panel surface

## Technology Options

The available technology option is Grid-Connected and Off-Grid Community PV. Grid-Model Community PV indicates that the utility is involved and the Community PV is connected to the grid. Off-Grid-Model Community PV is a stand-alone model, in which the Community PV is not connected to the grid. These two models will result in different business models. In both cases, Virtual Net Metering Technology will result in different business models. In both cases, Virtual Net Metering Technology will be implemented to monitor the energy generated by the Community PV and the energy delivered to each end-user. In case of Grid-Connected, the energy delivered to the utility will also be monitored.


Source: MicroEnergy International

## Price Range

The system price depends largely on the size of the system and the battery is the main determinant of the price. The price range varies from USD $2400 - $7800 for a size of 600W – 2KW. (Data based on Solar Mosaic 2012).

## Type of Financing

Community PV of this scale could be offered through microfinance loans direct to the individual investors. The electric energy allocated to each participant is proportional to his investment and based on consumption. The loan will be paid back through electricity sales. (e.g.: selling to utility, cell phone charging fees).

## Economic and Social Impact for End-users

Community PV provides reliable on-site electric energy access for the whole community thus improving the quality of community life and the possibility of local job generation as technicians are needed to install the whole system and carry out routine maintenance as well as monitoring.

The payback time depends largely on the parameter of the electricity tariff. Example: Solar Mosaic has a project for a Youth Employment Center in Oakland since 2012 and the loan period is 5 years. In other words, USD $200 investment will turn into USD $272 at the end of the 5-year period.

## Benefits for the MFI

Compared to normal Solar Home System (SHS), Community PV provides a better economy of scale. The repayment of the loan can be ensured at this scale and MFIs can extend the participation of people who are not the legal owners of a house to install the PV Panel and help to improve the quality of community life.

## Environmental Benefits

Environment: it reduces particulate emissions and pressure on natural resources used to produce electricity. It reuses wasteland and it reduces waste coming from dry batteries and leakages from kerosene or diesel.

Climate change mitigation: it reduces greenhouse gas emission.

Climate change adaptation: it reduces the vulnerability to electricity and fuel price volatility, and it reduces the vulnerability to volatility in energy provision.

Potential positive synergies with: efficient air conditioner, energy efficient refrigerator.[1]

[1] For further information on potential synergies check the other product catalogues for EE and RE technologies

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Source : http://www.bluenews-blueenergy.blogspot.com

# DOMESTIC BIODIGESTER

## Product Catalogue - 2014

**Prepared by MicroEnergy International GmbH**
**with the collaboration of Davide Forcella (CERMi-ULB)**

EUROPEAN MICROFINANCE PLATFORM
NETWORKING WITH THE SOUTH

e-MFP ACTION GROUP
ON MICROFINANCE
AND ENVIRONMENT

## Description and Working Principle

Domestic biodigesters convert biomass from different sources (cattle or pig manure, agricultural residue) into combustible biogas and bio-slurry, which can be used as organic fertilizer. The biogas is a mixture of methane and carbon dioxide and can be effectively used in gas stoves for cooking and gas lamps for lighting. Recent developments also allow the application of productive use appliances such as milk chillers. The use of clean biogas not only reduces customer expenses on conventional energy, but also results in improved health conditions due to less harmful emissions from cooking and lighting appliances. As a by-product of fermentation, bio-slurry can be used as fertilizer, closing the nutrient cycle and reducing the user's expenses on conventional fertilizer. While there are different types of biodigesters, all of them require a minimum of continuous, daily supply of biomass and water to keep the digestion process stable.

## Technical Characteristics[1]

| | |
|---|---|
| Target group | Farmers, remote rural communities |
| Components | Inlet, biodigester, gas holder, outlet, gas conveyance system, slurry compost pit (Fixed Dome Biodigester); |
| System size | Starting from approx. 4 m³ biodigester size; refer to table below |
| Time of construction | 3 days (polyethylene biogas digester) and several days for fixed dome digester |
| Fuel type needed | Animal manure (cattle, pigs, etc.) and animal droppings (chicken), agricultural residues, depends on type |
| Fuel replaced | Firewood, natural gas, diesel |
| Other resources replaced | Chemical fertilizer (at least partly) |
| Minimum feed | 20 kg of manure per day |

**Table 1: Scale of Fixed Dome biodigesters and respective estimated output.[2,3]**

| Biodigester size [m³] | Total cost [USD $] | Daily dung feeding [kg] | Water to mix with dung [litre] | Use of biogas stove [hours] | Use of biogas lamp [hours] |
|---|---|---|---|---|---|
| 4 | USD $ 550 | 20-40 | 20-40 | 2-4 | 8-16 |
| 6 | USD $ 620 | 40-60 | 40-60 | 4-6 | 16-24 |
| 8 | USD $ 720 | 60-80 | 60-80 | 6-8 | 24-32 |
| 10 | USD $ 800 | 80-100 | 80-100 | 8-10 | 32-40 |
| 15 | USD $ 1100 | 100-150 | 100-150 | 10 to 15 | 40-60 |

## Ease of Distribution, Installation, and Maintenance

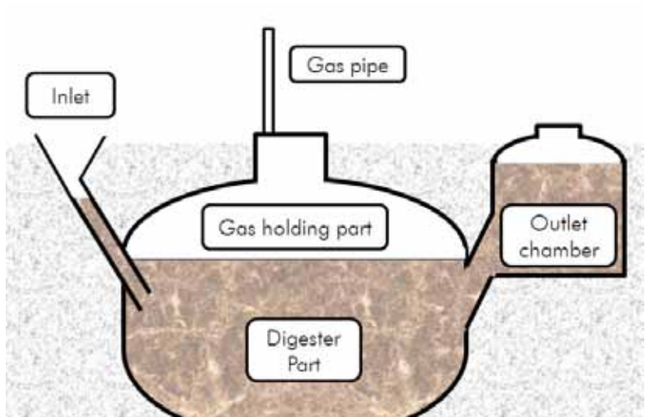
There are different types of small scale biodigesters, such as fixed dome, floating drum and polyethylene tube digesters. Distribution, installation and maintenance measures depend on the type of biodigester employed, the different space requirements, materials used and labour input for each type.

In the case of the low-cost polyethylene tube digester, construction and installation only needs half a day, assuming that the trench is already excavated and materials are available. The setup of the biogas supply line to the kitchen needs some more hours, depending on distance and specific requirements.

The installation and bricklaying of a fixed dome biogas digester is more labour-intensive, creating local employment whilst using only local materials. The different steps consist of surface preparation, excavation of holes, supply of building materials (brick, sand, cement, and stone), the actual mason works, installation of pipeline, fittings and appliances, and testing for leakages.

## Technology Options

There are a variety of different types of small-scale biodigesters using different materials and various dimensions, two of which have been proven in the field in several countries: the low-cost polyethylene tube digester and the fixed dome biogas digester. The first is an easy-to-implement and low-cost type of biodigester, the main fermentation chamber consisting of a tubular polyethylene film at each end bended and fixed around a 6 inch PVC drainpipe, one pipe of which serves as inlet, the other one as outlet of the slurry. A more robust but at the same time more elaborate type of small-scale biodigester, is the fixed dome biogas digester, mostly consisting of underground masonry structures with inlet, main digester, gas chamber and slurry outlet.[4,5]

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## Price Range

System price depends on the type of digester as well as the size of the system, i.e. the volume of digester, location of construction, model and country. While the low-cost polyethylene tube digester is cheaper and available in a price range from USD $120 – $500,[6,7] the price for a fixed dome biogas digester is higher, ranging from approximately USD $500 to over $1000 (see above).[8]

## Type of Financing

Low-cost polyethylene tube digesters and fixed dome biogas digesters are suitable for microfinancing as well as for financial microleasing. Financial microleasing offered by microfinance institutions (MFIs) for fixed dome biogas digesters may imply longer payment periods due to stronger legal position of MFIs in this financial instrument. Both financing types are suitable for households as well as for SMEs.

## Economic and Social Impacts for End-Users

Biodigesters produce valuable biogas that can be used as fuel for lighting and cooking, reducing costs on conventional energy or time needed to collect firewood. In particular, health standards in lighting and cooking devices are improved due to avoided indoor pollution, such as emissions of smoke, soot and other harmful substances. With the use of biodigesters, value can be generated from animal manure, human excrements and agricultural residues, increasing income and providing incentives to improved hygiene. As a by-product of the fermentative process, odourless bio-slurry can be used as fertilizer, closing the nutrient cycle and reducing the need for conventional fertilizer. For larger scale applications, the biogas can be used to run a power unit, generating carbon-neutral electricity.

With at least two cattle or six pigs, an average household can meet their daily lighting and cooking needs. Associated investment costs of a good quality biogas digester vary between USD $260 - $1100, depending on digester size, location of construction, model and country.[9]

## Benefits for the MFI

Savings on fuel expenses as well as conventional fertilizers will enable customers to pay back their loan, with an estimated amortization time of approximately 2.5 - 3 years only.[10] Additionally, the organic fertilizer produced will provide further savings and/or increase household income. As a result, microfinance institutions will get a high repayment rate of both loan principal and interest. Since the technology brings not only economical, but also social benefits, an increase in demand for microfinancing instruments is expected.

## Environmental Benefits

Environment: it reduces the pressure on natural resources: deforestation and use of chemical fertilizers. It promotes the use of organic fertilizers that can restore poor infertile soils and improve yields. It reduces the emission of particulates. It reduces the use of kerosene and dry batteries, and it reduces fire hazards and their impact on forests.

Climate change mitigation: reduction in greenhouse gas emission from firewood and dung.

Climate change adaptation: it reduces vulnerability due to environmental degradation and energy and fuel price volatility.

Potential positive synergies with: livestock and gardening financing, technical assistance (TA) and certifications for organic production or agro forestry, solar water pump.[11]

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10 SNV: http://www.snvworld.org/en/node/1489/, AshdenAwards – Sustainable solutions, better lives: http://www.ashden.org/biogas
11 For further information on potential synergies check the other product catalogues for EE and RE technologies.

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Source: MicroEngergy International

# SOLAR WATER HEATER – THERMOSYPHON TYPE

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EUROPEAN MICROFINANCE PLATFORM
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## Description and Working Principle

A solar water heating (SWH) system is an autonomous system designed to provide hot water to individual households or small businesses. Installed on a rooftop, the system's collector absorbs sunlight, and the heat energy is transferred to water. The heated water flows automatically by the thermosyphon principle to a storage tank where it can be accessed for consumption through piping when it is needed. Denser cooler water is displaced back into the collector, and the process repeats.

## Technical Characteristics

| | |
|---|---|
| Average size (for a 150 liter system) | 1630m * 1650m * 1250m |
| Average system capacity | 100 – 700 liters |
| Average weight (for an empty 150 liter system) | 95 kg |
| Fuel type needed | Solar irradiation |
| Temperature range for water | 40 °C – 80 °C |
| Product lifetime | 15 – 20 years |
| Storage time without sun | 24 – 48 hours |

## Ease of Distribution, Installation and Maintenance

Considering the weight and size of the system's components, transportation vehicles are needed for distribution. If the system is packed in separate boxes, last-mile transportation can be done in batches and with smaller vehicles. Assessment of the location is necessary to: avoid shading, design hot water distribution for optimal performance, as well as to evaluate the suitability of the roof structure to support the weight. Hence, installation requires suppliers or local plumbers with appropriate technical skills. SWHs of good quality will work without supervision and require only low end-user maintenance.

Typical maintenance work:

- Cleaning of the solar collector
- Visual inspection for leaks and intact insulation of pipes and tank
- In case of painted surfaces: redo painting every 2-3 years to prevent corrosion
- Periodic tank draining to clear sediment
- Occasional leaks in the plumbing can be repaired by ordinary plumbers

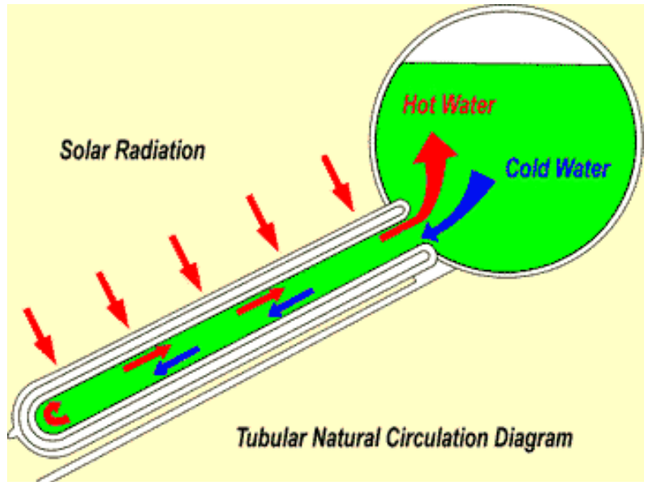
## Technology Options

The product can be adapted to the local context in many ways, such as adding electronic controllers and heat exchangers in order to provide constant hot water at a precise temperature or to use the system for space heating in zones with low ambient temperatures. Hot water pipes can also be insulated with various qualities of insulation to prevent heat loss.

## Price Range

A complete setup for a small house starts at around USD $460. According to the type of usage and scale of the project, costs can vary in respect to the specifications required.

| Type of target group | Price range (USD) |
|---|---|
| Households (ca. 30 liters per person per day) | USD $460 - $1050 |
| Small businesses with larger demand | USD $600 - $7000 |




Source: Porta Energy


Source: Jeff Morgan, Alamy

## Type of Financing

Microfinance loans are provided mostly on an individual basis, for example microenterprise energy loans or home improvement loans. Financial or operational microleasing is more suitable for SMEs, but can also be provided to households. Among the businesses that can be targeted with this technology are small family owned hotels and restaurants, laundry services, and farmers using hot water in their production processes or for disinfection of equipment.

## Economic and Social Impact for End-users

A SWH can offer a long term hot water solution for households and small enterprises. It presents the opportunity to replace solid and fossil fuels, such as firewood, coal, electricity or gas used for heating water. The replacement of such fuels reduces the expenses of households and small enterprises. Hot water is used for health, hygiene and comfort purposes to improve life quality standards.

For example, for an average household in a rural area that consumes 65 liters of water per day, an SWH with a capacity of 100 liters can bring savings of USD $65 per year by substituting the use of charcoal. In this case, the payback period of this technology is up to 4 years. However, such break-even points vary largely due to the equipment's size, type of fuel replaced and consumption patterns.

## Benefits for the MFI

SWH can significantly reduce business-related hot water costs and improve the quality and range of services offered increasing the end-user's ability to repay loans. Furthermore, through the inclusion of SWH in a loan portfolio, an MFI can attract new customer segments such as SMEs engaged in the food, restaurant and hospitality industries.

## Environmental Benefits

Environment: it reduces pressure on natural resources, or the cutting of trees when firewood is used for heating purposes. It reduces particulates emissions, fire hazards and their impact on forests.

Climate change mitigation: reduction in greenhouse gas emissions: A typical SWH can save up to 400 kg of $CO_2$ per system per year, by reducing the use of firewood, natural gas and other fossil fuels, as well as electricity from the grid.

Climate change adaptation: it can reduce the vulnerability due to degradation of local environment (if it offsets local deforestation), and the vulnerability to fossil fuels and electricity cost and distribution.

Potential positive synergies with: improved cooking oven, micro-enterprises dealing with food preparation or ecotourism.[1]

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- Porta Energy, http://www.porta-energy.com/TRX_Solar_Water_Heater.htm


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