

ALTERNATIVE:

DC OPERATED EQUIPMENT FOR PRODUCTIVE USE

FOCUS ON OFF-GRID AREAS / PHOTOVOLTAIC POWER

SUPPLY

PHOTOVOLTAIC FOR PRODUCTIVE USE

– A CATALOGUE OF DC-APPLICATIONS –

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## Acronyms

<b>Acronym</b>	<b>Description</b>
AC	Alternate current
ARE	Alliance for rural electrification
CO2	Carbon dioxide
D	Day
DC	Direct current
DD	Direct drive
€	Euro
EE	Energy Efficiency
GIZ	Deutsche Gesellschaft für internationale Zusammenarbeit
GWP	Global warming potential
h	Hours
HERA	GIZ Sector Program Poverty-oriented basic energy services
IRENA	International Renewable Energy Agency
LED	Light-emitting diode
PC	Personal Computer
PCM	Phase Change Material
PUE	Productive uses of energy
PV	Photovoltaic
R	South African rand
RE	Renewable Energy
Rs	Indian Rupees
SME	Small and medium-sized enterprise
SWP	Solar Water Pumping
TV	Television
US\$	US Dollar
VAT	Value added tax
W	Watt

## 1. Introduction to the catalogue

About 1.1 billion people worldwide lack sustainable and reliable access to electricity (SE4All 2015). That is almost 15 % of the world's total population. The majority of this group lives in rural areas. With electricity being a key factor for productive activities, the range of potential economic growth in areas with unreliable or no power supply is severely hampered.

In many of the less developed nations, several hours a day are spent for acquiring energy, e.g. travelling to the next town/trading center where fuel can be obtained. This shows that what can be done by the flip of a switch in one part of the world might require a whole day of work in another (Svensson, Souza Farina 2010).

Energy for productive uses in rural areas is currently mostly provided through polluting sources such as petrol or Diesel, which, in addition, create dependency on fuel price volatility. The opportunity of using solar photovoltaic (PV) as decentralized energy systems is still rare in un-electrified areas.

Yet a review of existing manufacturers show that the technology development for off-grid PV-powered applications has been accelerating. Especially the development for DC household appliances has been pushed by technological progress achieved in the recreational vehicle industry. (Lasch & Groh, 2014).

### Background

With the publication of this catalogue, the BMZ-funded GIZ sector program 'Basic Energy Services (HERA)' aims to provide a market overview of PV-powered appliances, which can be used for business activities in rural areas. This first version does not aim to provide a conclusive picture but rather to provide overview of currently available appliances with technical details, distribution channels and, where possible, practical experience from the field. The catalogue is directed at practitioners as well as public and private sector actors promoting PV for productive use of energy.

Furthermore, the catalogue may assist manufacturers, distributors, governmental and non-governmental organizations and donors as a tool to identify applications adequate for specific commercial, regional and social settings.

This is the first edition of the catalogue and as such a first attempt to compile state of the art technology suitable for entrepreneurial activities in off-grid areas. We do not make any claims that this overview is complete.

Moreover, we would like to see this catalogue as a kick-off to a broader work on PV-powered



appliances for off-grid businesses. In order to do so, we would like to invite all interested to send us data and information about appliances that have not been covered in this catalogue. We are especially interested in gathering data on the status of technology development, if possible distribution chains, experiences from performance in field and potential business scenarios.

### The Technologies, featured in the Catalogue

The technologies featured in this catalogue range at different stages of technology development. Some of them are already tested and are proven in the field and have reached market maturity, whereas others are under development prior to piloting in field.

It is thus important to note that the product related data used in the catalogue are partly based on information provided by the manufacturers and partly -complemented by own research.

Price information are only indicative, as real end user prices vary widely from country to country depending on shipping costs and taxes. ).

We would like to note that, although we selected all the appliances carefully, and have verified their status of technology development in close collaboration with a pool of reviewers from academia, the private sector and project implementers, some technologies may face unforeseen hurdles when performing in the field.

To draw a comprehensive and complete picture of the economic viability of each product more factors will have to be taken into account, which requires further research.

Most appliances are characterized by a high capital-to-operational-cost ratio. Nevertheless they might be energy and cost efficient in a long time perspective compared to conventional products.

Such an in-depth analysis on product specific costs should include

- product life cycle costs,
- costs for service, maintenance and repair,
- fuel savings, considering oil price volatility,
- increase of income
- change of working patterns and
- decreasing product costs due to technological development and economies of scale.

Until now, only few long term field tests have been conducted providing such a range of information.

Currently ongoing studies on economic feasibility of PV appliances for PUE

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Generell: entscheiden, ob Preise auftauchen oder nicht.  
Vorschlag HO: manufacturer price as of: xyz

**Kommentiert [CP2]:** What's the purpose of this section?  
JM: auf Kommentar Rosenbusch: macht deutlich, dass diese DATen (life cycle costs, interest rates, etc,...) nicht verfügbar sind.

Powering Agriculture surveyed solar water pumps, existing irrigation systems and their energy supply. The study shall be published end of this year. Furthermore, a handbook and toolbox should be developed to evaluate PV for irrigation systems technically and economically. (<https://poweringag.org>, 2015-0820)

For cooling systems the University of Hohenheim has developed a tool for system calculation and dimensioning, based on climate data and energy measurements, allowing for an economic up-front analysis of a business idea (<https://www.uni-hohenheim.de/institution/fg-agrartechnik-in-den-tropen-und-subtropen>, 2015-08-20).

### **How to read this catalogue**

**Part 1** gives a brief insight into productive use and correlating aspects, such as users of PV appliances. Furthermore it describes related technical issues, e.g. direct and alternating current, gives a brief overview on the development of DC mini grids and closes with the description of challenges for introduction of PV-powered appliances for PUE.

**Part 2** comprises the actual catalogue factsheets – datasheets of the individual appliances, grouped in sections according to 7 categories of productive use.

. These factsheets contain technical specification and, where available, information on markets and distribution chains. All of the latter information are based on voluntarily provided input by project developers, manufacturers and distributors and self-conducted market research. We do acknowledge the need to further research on market potential of some of the products, in field performance and their business potential. This however, needs to be tackled in the next edition of this catalogue or a separate publication respectively.

**Part 3** of the catalogue elaborates on the potential for micro, small and medium sized enterprises in rural areas to use these appliances to establish viable businesses and create net profit. Reliable data for assessing the real business potential of the appliances is lacking. Henceforth, the respective chapter in this catalogue can only briefly touch upon the aspect of business opportunities. Field tests for selected applications are scheduled as a follow-up activity to this catalogue.

## **2. PV appliances for productive use**

### **Productive use of energy:**

In the international debate one can distinguish various different definitions for productive use of energy (PUE). Some say PUE are only those activities directly leading to monetary income. In a broader understanding of the term enhancements in welfare through improved

health or education are included. For this catalogue a fairly narrow definition for PUE is used: it is understood as “agricultural, commercial and industrial activities involving energy services as a direct input to the production of goods or provision of services.” PUE can be differentiated from ‘consumptive use’ (i.e., the use of energy services such as household lighting, cooking and private entertainment) and the use of energy for ‘community services’ (such as health and education). Furthermore this catalogue focusses on appliances for productive use powered by photovoltaic electricity. By using solar energy technologies new business opportunities can be created, already existing enterprises can be improved and income may increase or diversify. Hence creating additional options for income generation for rural population. (Attigah /Mayer-Tasch/Rammelt 2015)

**Definition of Productive Use of Energy (PUE):**

**PUE** is understood as “agricultural, commercial and industrial activities involving energy services as a direct input to the production of goods or provision of services.”

**PUE** targets promotion of socio economic development by enabling and/or increasing income generation.

**PUE** can be differentiated from ‘consumptive use’ (i.e., the use of energy services such as household lighting, cooking and private entertainment) and the use of energy for ‘community services’ (such as health and education).

**Users of PV applications for productive use of energy**

Opportunities for productive activities in remotely located, rural areas (not connected to the national grid, off-grid) can be manifold and may range from mobile phone charging to crop irrigation and cottage industries. A business opportunity may involve a number of different stakeholders, like financiers, institutions, entrepreneurs and customers. Furthermore the type of PV appliance for PUE depends on a number of individual factors, such as region and social setting. A PV powered refrigerator for a shop or restaurant, for example, will be a different one than the appliance adequate for a group of marketeers or a fishery cooperative.

People using an innovative DC-PV appliance for productive use are customer of and investors in a new technology at the same time. Simultaneously, business activities are created and the market entrance for new DC products is facilitated. To make both a success story trust and confidence in the new technology needs to be created. This involves technological maturity, robustness of the product as well as a good service and maintenance infrastructure. As some products are technological innovations especially the service and maintenance structures are not always given – and these are essential for a business approach, as the business fails if the technology does not work. We put a special focus on this aspect and information regarding

service and maintenance structure is integrated under technology and market development in the factsheets.

Also financing solutions should be tailored to the ability and needs of the customers. The importance of micro finance institutions and availability of appropriate credit lines and loan products is undisputed. However though, depending on the type of application, capacity of the micro finance institution and maturity of the technology, a bank may or may not be willing to integrate financing instruments for the respective technology into its portfolio. Awareness and capacity building with the financial institutions should hence be one of the areas of work for development projects that aim to push productive uses of energy.

### **Direct Current versus Alternating Current**

Since the late 19<sup>th</sup> century, due to advantages in generation and transmission, electricity is provided as alternating current (AC). Especially for solar based isolated grids or stand-alone systems, direct current has some advantages. It is the form of current generated by solar PV systems and stored in a battery bank. Using DC power directly from the PV generator or the battery avoids the transformation to AC via an inverter. This reduces costs as well as electricity losses.

Whereas the majority of electrical appliances used, run on AC, especially entertainment and media equipment mostly require direct current (DC) and use an AC adapter when connected to the grid. Furthermore, many DC appliances, while being high efficient, are available in a robust and simple design, what makes them easy to use and repair.

“Off grid areas do not have access to grid electricity and thus they are not familiar with the common AC gadgets. High efficient DC gadgets can be introduced easily in this area, no question of changing AC eco systems.” (Chowdhury, 2015).

In a comparison of AC and DC systems Lasch and Groh identified some key advantages of DC:

- All modern appliances such as LED lights, televisions, mobile phones, laptops etc. that run on AC are also fully functional on DC in the same voltage range.
- On a DC grid no frequency synchronization is necessary which results in:
  - Easier adding up or scaling up of DC system (energy sources) in parallel.
  - Good grid reliability.
  - Modular growth of DC generators and storage devices is possible, improving the ability to meet a changing demand.
  - Unscheduled outages should not occur.
- Power factor is not a concern in DC systems. A DC system can even operate at very low

loads, e.g. a single light, for several hours without significant losses. In AC systems a relatively low power consumption is associated with relatively high losses in generators and inverters.

- DC systems are less expensive as no conversion from DC to AC is needed.
- DC system has no inductive or capacitive losses.
- Management of harmonics distortion is much easier in DC than AC.
- DC motors (cooling fans, irrigation pumps etc.) are more efficient than conventional AC motors.
- DC requires a simple two wire distribution network.
- DC floating systems are less prone to shocking hazards (neutral grounding is necessary in AC)

### **DC mini grids**

Due to the above mentioned advantages of DC current and the technological development of high efficient DC appliances, more and more DC mini grids are implemented. In fact, small solar DC grids can be a cost effective electrification solution for off grid areas.

Nevertheless some requirements of DC grids should be taken into account to allow a consumer friendly and functioning DC electricity supply. These factors should be considered at planning stage and for purchase of new devices and appliances:

- For voltage equalization a DC/DC converter is required.
  - While planning the DC-grid it should be specified that all electrical applications have a lower voltage level than the overall grid.
  - The consideration of the correct voltage level is important for all electronic devices. Standardized plugs make sure that an appliance is connected to the right voltage level (e.g. a 5 V mobile phone receptacle only fits into a 5 V port; all USB ports run on 5 V).
- Type and quality of the battery is very important for battery based appliances.

### **Challenges and barriers for PV appliances for productive use**

As shown before, PV appliances have strong advantages and may be supportive for entrepreneurs in business opportunities in off-grid areas.

Nevertheless they are not yet broadly implemented and face some challenges especially for the successful implementation in rural areas. Possible solutions for these barriers strongly depend on different and very individual factors like region and target group.

Below mentioned are the main barriers for PV powered appliances. We have attempted to provide some general recommendations to overcome these.

#### **Energy Efficiency**

Appliances powered by PV, no matter if they are running on DC or AC power, should be of high energy efficiency. The capacity of an installed PV system has to correspond to the energy required by the user. Inefficient appliances consume more energy and the size of a PV system could make the investment economically not feasible. Efficient appliances allow for proper dimensioning of the PV system, reduce costs and enable the realization of the estimated outcome. Higher investment costs for energy efficient products can be overcompensated in the long run, as the operational costs are reduced.

Consumers can look for energy labels like the Energy Star or the European Energy Label that qualify the product as energy efficient.

#### **High investment costs**

High investment costs are a barrier for many high quality PV powered products and especially for DC appliances. Buying decisions are often made upon short term cost comparison, e.g. comparing the investment costs of two products. This barrier remains, even if there are no or only marginal operation and maintenance costs connected with the more expensive product. A costs analysis over a long time period can demonstrate the long-term advantages and shift the criteria for a purchase decision. Furthermore innovative lending schemes may help to overcome the initial barrier of high up-front costs.

#### **Service and maintenance infrastructure**

The service and maintenance infrastructure involves the technical know-how to repair appliances as well as the availability of spare and wear parts. Especially in rural areas a functioning service and maintenance infrastructure often is not existent which may lead to a reduced product life time and in a loss of trust and confidence in the technology.

At this point manufacturers are challenged: the products should be of high quality, robust and with low maintenance effort. If necessary it should be easy to repair – best with locally available spare parts.

References to quality control procedures can help to identify high quality products.

Furthermore high quality producers are listed on the website of lighting Africa (<http://www.lightingafrica.org>).

### **Non-availability of new and energy efficient products on local markets**

Local markets often lack a diversified product range and new technologies are not yet established.

In many cases high energy efficient DC appliances have to be purchased with international retailers which is a high barrier for people in rural areas.

### **Low awareness among consumers**

People may hesitate to invest in a new and so far unknown technology.

Information and awareness raising campaigns as well as high quality products will help to create knowledge, good experiences with products and therefore trust in the technology.

The main factors for success of modern high efficient PV Appliances are the local availability through a wide distribution network, consumer trust in the technological solution and technical knowledge for maintenance and repair.

- Tickliste für User → Entwurf allgemein Hints für Projektumsetzer ...

### 3. Factsheets

The following section contains the heart of the catalogue – the data factsheets for the individual appliances. The focus lies on products that can directly be connected to a DC power source, e.g. a photovoltaic system. By leafing through the factsheets, you will realize that we included appliances running on AC where we saw fit.

The market of DC appliances is still evolving and although, DC appliances have some clear benefits over AC products, many manufacturers still are reluctant to modify their products. Some very interesting and innovative products applicable for PUE run on AC power. In other cases appliances are equipped with a brushless DC motor, but their connection for power supply is configured for AC plugs and the manuals and guarantee only refer to AC. Therefore you may find a selection of AC-current products in this catalogue.

The technological development of the products you may find in this section vary. Some are already tested in the field. Others are first of its kind and innovative and still have to undergo the field test. We have tried to figure out their individual development status by questioning the manufacturer and do own review and research. The outcomes are indicated on the factsheets.

Product related information are obtained from the manufacturers, distributors, reference organizations, and by own research.

Although we have chosen all the appliances carefully, and have verified the technological development status through expert and practitioners review, some technologies may face unforeseen hurdles when implemented in the field.

#### Categories of productive use of energy in the catalogue

- **Food production and storage:** (pumping systems, cooling appliances)
- **Food processing** (grain mills, husker, polisher, milk cooling, food for sale)
- **Livestock breeding** (poultry incubators, milking machines)
- **“Other” services** (washing machines, hair trimmer, hair straightener, etc.)
- **Handcraft and artisanry** (sewing machines, cordless power tools)
- **Media and entertainment** (IT, secretarial services, cinema, etc.)
- **Energy services** (Charging mobile phones and battery, DC/DC inverter, DC-kWh-meter, etc.)



## 3.1 Food Production and Storage

(Hier eventuell das detaillierte Inhaltsverzeichnis für diese Factsheets einfügen)

### 3.1.1 - Solar Water Pumping

A – Surface Pumps

B – Submersible Pumps

C – Pump Inverter

### 3.1.2 - Cold Chain

A – Freezers

B – Refrigerators

C – Walk-In Cold Rooms

**Kommentiert [CP3]:** Fände ich gut. Kann der Designer dann auch gut farblich etc. zuordnen.

### 3.1.1 Solar Water Pumping

#### **Description:**

Restricted Water Supply affects people's day to day life as well as options for productive activities. Solar Water Pumping (SWP) systems pump water from bore holes, wells or reservoirs and can be an attractive option for remote areas with high sunshine hours but without access to reliable electricity.

Regular irrigation, e.g. by using solar power, can have a positive effect on farming activities. It may lead to a higher output, save costs in daily operation due to reduced consumption of fossil fuels and can create additional income through increased harvest.

SWP can be used for:

- Village water supply
- Irrigation in agriculture
- Livestock watering
- Tourism sector, e.g. restaurants, hotels and lodges (pool management)
- Washing
- Fisheries (pond management)

#### **Technology Status and Development during the last years**

A variety of DC powered pump systems in different sizes are available from manufacturers worldwide. These range from surface pumps to submersible pumps. Water tanks are optional, but allow water supply during cloudy periods or in early morning and late evening hours.

SWP is an established and reliable technology with experiences in economic viability. Good distribution networks do exist. Retailers in Developing Countries make local purchase of pumps and spare parts possible.

Daily operation or maintenance of pumps requires no specially trained personnel. The operation and maintenance costs are low and cost reductions compared to diesel pumps can be achieved. It is important to focus on efficiency of the pump to as the difference in cost between the poor pump and a very efficient pump is much less than the additional cost required for a larger PV panel. Accurate sizing of the array is important in keeping costs down (practical action).

By replacing a diesel system with a SWP, CO<sub>2</sub> emissions can be reduced and farmers are less exposed to pollution. Diesel leaks onto crop fields are avoided and pumped water is prevented from contamination of diesel and lubrication oil. In addition noise pollution and the emission of fine particulates are reduced.

During recent years technological development led to further improvements of SWP:

- Easier planning, installation and maintenance
- Screw type pumps with higher efficiency to achieve higher pumping head.
- New generator concepts with better starting characteristics and variable voltage
- Efficiency of SWP has increased significantly during the last years.

→ While rehabilitating an old pumping system with photovoltaic, it should be considered to replace the old pump by a new, more efficient one. This can lead to significant reductions in power consumption.

### Equipment

A SWP System usually consists of the following elements:

- **Solar components:** Solar modules, Solar Inverter, optional batteries
- **Pump components:** Pump inverter, motor, pump
- **Water storage or distribution system:** Tank, Reservoir, distribution system

#### Decision for a SWP System:

When choosing a new SWP System proper planning and correct assessment of the individual requirements are important.

- Proper sizing of pump with regard to
  - water demand/patterns of use
  - water availability including well yield and expected drawdown
  - flow range and pumping head→ Some SWP pump as low as 0.5 gallon per minute which allows to implement them in wells of very low yield.
- Planning tools should be provided by manufacturer.

### Types of SWP products in this catalogue:

#### A – Surface pumps

This section includes pressure, delivery, and booster pumps.

#### B – Submersible pumps

Primarily submersible well pumps.

#### C – Pump inverters

A pump inverter monitors and controls the system operation. Moreover it converts the DC power produced by the PV plant into AC power, which is required for some pumps of high load.

##### Attention:

Check the efficiency of the pumping system. Pump efficiencies have improved significantly over the last years. The inverter should not be used to connect an inefficient, existing pumping system to a solar system, as it would require too much power.

## A Surface Pumps

### FS1 Surface Irrigation system ONergy

SwitchON/ONergy, 1A, D. L. Khan Road, Kolkata – 70002, India

#### Product Description:

SwitchON-ONergy has developed a solar irrigation system with

- Remote monitoring capability, allowing farmers to control their own water supply via GSM.
- Reliable irrigation and pumping system that replaces diesel and irregular grid pumps, farmers have access to safe and secure irrigation facilities.

#### Target group:

- Regional Focus: India: Kokatta, West Bengal
- Target Group: Smallholder Farmers

Product Specification	
Type of pump (surface, submersible, other)	Surface Pump
DC or AC coupled	AC
Pumping range (m)	6 – 25 m
Water output (LPD)	10 K – 600 K
Water pressure ()	N/A
Hydraulic energy required (kWh/day or 0.002725 m <sup>3</sup> /day x head (m))	N/A
Load of pumping motor (kW)	0.45 kW – 22 kW
Electrical to hydraulic efficiency	N/A
Solar energy to hydraulic efficiency	N/A
Capacity of PV modules required (kWp)	0.75 – 36 kWp
Battery	No
Product life time (y)	Panels: 25 y
Size	N/A
Weight	



Price	Customer price Germany
Investment	N/A

#### Market development and distribution chains

- Implementation of 3 solar irrigation systems in West Bengal charging farmers on a pay-as-you-go basis. The project is jointly funded by NABARD.
- Successful microfinance scheme

#### Links

[http://www.onergy.in/product\\_details.php?id=18](http://www.onergy.in/product_details.php?id=18)

<http://switchon.org.in/India/projects-2/agriculture/solar-irrigation/>

## FS2 Surface Irrigation Pump Sunflower

**Futurepump**, Nairobi, Kenya

### Product Description:

A photovoltaic powered piston pump

- Portable design; manual back-up
- Robust hardware design, all components can be replaced and maintained with basic mechanical skills
- Versatile, can be adapted as suction pump or deep lift pump, Applicable to bore holes as small as 2"

### Target group:

- Seasonal vegetable farmers; Smallholder plots of one-acre with access to surface water or a well of maximum 24 feet of head



Product Specification	
Type of pump (surface, submersible, other)	Surface pump (piston pump)
AC or DC coupled	DC coupled
Pumping range (m)	N/A
Water output (l/d)	12,000 l /24h
Water pressure	N/A
Hydraulic energy required (kWh/day or 0.002725 m <sup>3</sup> /day x head (m))	900l /h @ 6m, 2000l/h @ 1m
Load of pumping motor (kW)	75W max
Electrical to hydraulic efficiency	60-70%
Solar energy to hydraulic efficiency	70%
Capacity of PV modules required (kWp)	80Wp
Product life time	10 years
Size	Pump: 60 x 23,5 x 64 cm Module: 67 x 40 x 92 cm
Weight	Pump 28.5 kg PV Module 8 kg

Price	Customer price Kenya
Investment for pump and PV module	400 US\$
Installation costs	0 – 50 US\$
Repair	0-10 US\$

### Market development and distribution chains

- The pump is currently available in Kenya, expansion into the region is planned.
- Distribution is undertaken by Futurepump with clustered groups of farmers; relationships with responsible distributors are build up.
- All farmer feedback is incorporated into R&D for further development and troubleshooting.
- Payment plans are offered by Futurepump

### Links:

<http://www.futurepump.com/>

### FS3 Surface Pumps Lorentz PS-CS-F

**Lorentz**, Siebenstücken 24, 24558 Henstedt-Ulzburg, Germany

**Product Description:**

TZ PS centrifugal pumps are high quality products designed for water transfer, livestock watering, drinking water, pond management and irrigation applications where a surface pump is required.

- A controller provides inputs for monitoring storage tank levels, controlling the pump speed and uses maximum power point tracking technology to optimize the water volume.

**Target group:**

- N/A



<b>Product Specification:</b> centrifugal pump series	
Type of pump (surface, submersible, other)	Surface, centrifugal pumps: PS600 CS-F, PS1800 CS-F, PS4000 CS-F
AC or DC coupled	DC coupled
Pumping range (m)	40, 50, 70 m
Water output (m3/h)	8.3, 8.5, 59 (m3/h)
Water pressure ()	N/A
Hydraulic energy required (kWh/day or 0.002725 m <sup>3</sup> /day x head (m))	N/A
Load of pumping motor (kW)	N/A
Electrical to hydraulic efficiency	N/A
Solar energy to hydraulic efficiency	90 %
Capacity of PV modules required (kWp)	N/A
Product life time	Long life expectancy
Size	N/A
Weight	N/A

Price	Customer price Germany
Investment	N/A

**Market development and distribution chains**

- Proven in service record
- Fast and simple installation
- Designed for use in remote and harsh conditions
- Smart modular design for simple and cost effective servicing and repair
- Cost effective spare parts philosophy

**Links**

[https://www.lorentz.de/pdf/lorentz\\_ps\\_surface\\_general\\_en-en.pdf](https://www.lorentz.de/pdf/lorentz_ps_surface_general_en-en.pdf)

## FS4 Surface Centrifugal Pumps Lorentz PSk2-CS

**Lorentz**, Siebenstücken 24, 24558 Henstedt-Ulzburg, Germany

### Product Description:

PSk2 centrifugal pumps are designed for larger scale water projects.

### Target group:

- N/A



Product Specification	
Type of pump (surface, submersible, other)	Surface, centrifugal pumps PS 7k2, PS 9k2, PS 15k2, PS 21k2, PS 25k2, PS 40k2
AC or DC coupled	DC coupled
Open circuit voltage (V DC)	max. 850 V DC
Pumping range (m)	90, 80, 80, 80, 40, 90 m
Max. flow rate (m3/h)	114, 120, 279, 306, 457, 499 (m3/h)
Water pressure ()	N/A
Hydraulic energy required (kWh/day or 0.002725 m <sup>3</sup> /day x head (m))	N/A
Load of pumping motor (kW)	N/A
Electrical to hydraulic efficiency	N/A
Solar energy to hydraulic efficiency	90 %
Capacity of PV modules required (kWp)	N/A
Product life time	Long life expectancy
Size	N/A
Weight	N/A

Price and costs	Customer price Germany
Investment	N/A

### Market development and distribution chains

- Although technically advanced, PSk2 is simple to specify, install and maintain
- Include a wide range of sensor inputs and inbuilt monitoring and management
- Remote monitoring and management is possible.
- Smart modular product design for simple and cost effective product repair

### Links

[https://www.lorentz.de/pdf/lorentz\\_psk2\\_surface\\_en-en.pdf](https://www.lorentz.de/pdf/lorentz_psk2_surface_en-en.pdf)

## FS5 Solar Surface Slow Pump Dankoff

**Dankoff Solar Pumps**, 1730 Camino Carlos Rey, Suite 106 Santa Fe, NM 87507, USA

### Product description

This slow pump is one of the first slow pumps and was developed for the first time in 1983.

It is used to draw water from shallow wells, springs, cisterns, tanks, ponds, rivers and streams and push it up to 137 vertical meter and through miles of pipeline.

It is approved for drinking water

### Target group:

- N/A

Product Specification: Models 1300, 1400, 2500, 2600	
Type of pump (surface, submersible, other)	Surface, positive displacement pump
AC or DC coupled	DC coupled 12, 24, 48 VDC
Pumping range (m)	137
Suction capacity	(6 m) at sea level. Subtract 1ft. for every 1000ft. altitude (1 m for every 1000 m)
Water output	0.75 – 23 LPM
Load of pumping motor	40 – 675 W
Electrical to hydraulic efficiency	N/A
Solar energy to hydraulic efficiency	90 %
Capacity of PV modules required	N/A
Product life time	15 – 20 y, Wearing parts last 5 - 10 years
Size	N/A
Weight	5-13kg



Price	Customer price Germany
Investment	N/A

### Market development and distribution chains

- First developed in 1983

### Risks and Barriers:

- Pump does not tolerate dirt - MUST be filtered clean

### Links

<http://www.dankoffsolarpumps.com/pumps/>



## FS6 Surface Pump Dankoff SunCentric

**Dankoff Solar Pumps**, 1730 Camino Carlos Rey, Suite 106 Santa Fe, NM 87507, USA

### Product description

Does not require filtration – tolerant of dirt.

Applicable for irrigation, livestock watering, domestic water, pond management,

Easy to repair, no special skills necessary, detailed instruction manual is available.

It is approved for drinking water

### Target group:

- N/A

<b>Product Specification: Models 1300, 1400, 2500, 2600</b>	
Type of pump (surface, submersible, other)	Surface, positive displacement pump
AC or DC coupled	DC coupled 12 – 36 VDC
Suction capacity	3m at sea level. Subtract 1 m for every 1000 m altitude
Water output	19-265 LPM 200 m3/d
Load of pumping motor	40 – 675 W
Capacity of PV modules required	117 – 1112 W
Product life time	15 – 20 y, Wearing parts last 5 - 10 years
Size	N/A
Weight	5-13kg



Price and costs	Customer price Germany
Investment	N/A

### Market development and distribution chains

- On the market since 1989
- A pump controller is not required
- no routine maintenance required

### Risks and Barriers:

- NOT for pressurized applications;
- Pump must be sheltered from rain and direct sunlight

### Links

<http://www.dankoffsolarpumps.com/pumps/>

## FS7 Surface Pump Dankhoff Solar Force Piston Pump

**Dankhoff Solar Pumps**, 1730 Camino Carlos Rey, Suite 106 Santa Fe, NM 87507, USA

### Product description

This piston pump draws water from a shallow well, spring, pond, river or tank. It can push water up hill and over long distances for home, village, irrigation or livestock uses. It uses less power than other pumps of this range and requires only low light conditions.

The pump does not require filtration – tolerant of dirt.

Easy to repair, no special skills necessary, detailed instruction manual is available.

It is approved for drinking water

### Target group:

- N/A

<b>Product Specification:</b> Models 1300, 1400, 2500, 2600	
Type of pump (surface, submersible, other)	Surface, Piston pump
AC or DC coupled	DC coupled 12, 24, 48 VDC
Suction capacity	7.6 m at sea level. Subtract 1 m for every 1000 m altitude
Water output	19 – 34 LPM
Load of pumping motor	70 - 403 W
Product life time	20-year life expectancy
Size	N/A
Weight	53 kg



Price	Retail price Germany
Investment	N/A

### Market development and distribution chains

Proven design, easy to repair with ordinary tools.

- Maintenance intervals: 5-10 years
- Tolerant of dirt and dry run
- Includes mechanical drive as back-up

### Risks and Barriers:

- NOT for pressurized applications;
- Pump must be sheltered from rain and direct sunlight

### Links

<http://www.dankoffsolarpumps.com/pumps/>

## FS8 Surface Pump Dankhoff Solaram

**Dankhoff Solar Pumps**, 1730 Camino Carlos Rey, Suite 106 Santa Fe, NM 87507, USA

### Product description

A very efficient solar pump, applicable for high-lift conditions. It starts pumping at very low light conditions.

### Target group:

- Village water supply, irrigation, livestock watering
- High lift and high flow

<b>Product Specification:</b> Models 1300, 1400, 2500, 2600	
Type of pump (surface, submersible, other)	Surface pump Neoprene diaphragm backed by piston
AC or DC coupled	DC coupled VDC
Suction capacity	7.8 m at sea level. Subtract 1 m for every 1000 m altitude
Water output	11 – 34 LPM LPM
Load of pumping motor	W
PV capacity required	170 – 1815 W
Product life time	20 y
Size	710 x 420 x 410 mm
Weight	68 kg



Price	Retail Price Germany
Investment	N/A

### Market development and distribution chains

- Simple to maintain and easy to install.
- Tolerant of dirt and dry run.
- Linear current booster (pump controller) is required to facilitate starting and prevent stalling in low light conditions

### Links

<http://www.dankoffsolarpumps.com/pumps/>

## FS9 Pressure and Delivery Pumps SHURflo 2088

**SHURflo**, 3545 Harbor Gateway South Suite 103, Costa Mesa, CA 92626, USA

### Product description

The Shurflo 2088 series pumps are considered the workhorse of the small diaphragm pumps. They are used in a variety of transfer and dispense-on-demand applications. These pumps are not designed for continuous heavy duty use. The 2088 is one of the most popular line of small delivery pumps.

### Target group:

- applications where flow up to 13,5 liter per minute is required
- RVs, remote homes, cabins and marine

Product Specification:	
Type of pump (surface, submersible, other)	Surface pump
AC or DC coupled	DC coupled 12 or 24 VDC
Suction capacity	N/A
Water output	6 – 13.5 lpm
Load of pumping motor	W
PV capacity required	N/A
Product life time	N/A
Size	Max. 300 x 150 x 130 mm
Weight	2.5 – 6.5 kg



Price	Retail Price Germany
Investment	N/A

### Market development and distribution chains

- N/A

### Links

[http://legacy.shurflo.com/pages/new\\_industrial/Industrial/solar/solar\\_home.html](http://legacy.shurflo.com/pages/new_industrial/Industrial/solar/solar_home.html)

## B Submersible Pumps

### FS10 Submersible Irrigation Systems ONergy

SwitchON/ONergy, 1A, D. L. Khan Road, Kolkata – 70002, India

#### Product Description:

SwitchON-ONergy has developed a solar irrigation system with

- Remote monitoring capability, allowing farmers to control their own water supply via GSM.
- Reliable irrigation and pumping system that replaces diesel and irregular grid pumps.

#### Target group:

- Smallholder farmers
- Regional Focus: India: Kokatta, West Bengal

Product Specification	
Type of pump (surface/submersible)	Submersible
DC or AC connected	AC and DC
Max. pumping head (m)	30 m – 310 m
Water output (m <sup>3</sup> /24h)	Up to 10 Lacs
Water pressure ()	N/A
Load of pumping motor	0.45 - 22 kW
Pump capacity (kW)	
Electrical to hydraulic efficiency	N/A
Solar energy to hydraulic efficiency	N/A
Capacity of PV modules required (kWp)	0.9 – 64 kWp
Battery	No
Product life time	Panels: 25 y
Size	N/A
Weight	N/A



Price	Retail Price
Investment	N/A

#### Market development and distribution chains

- Implementation of 2 solar irrigation systems in West Bengal charging farmers on a pay-as-you-go basis. The project is jointly funded by NABARD.
- Successful microfinance scheme

#### Links

[http://www.onergy.in/product\\_details.php?id=18](http://www.onergy.in/product_details.php?id=18)

<http://switchon.org.in/India/projects-2/agriculture/solar-irrigation/>

## FS11 submersible and surface pump 3” Grundfos SQFlex

Grundfos, Schlüterstr. 33, 40699 Erkrath

### Product Description:

Being designed for continuous as well as intermittent operation, the SQFlex system is especially suitable for water supply applications in remote location. Eleven different pump models cover a wide range of heads and flows.

- Can pump water at very low light levels
- Low weight, installation in 3", 4" or larger boreholes, only an on/off switch is needed.
- Horizontally or vertical installation.
- Protection against dry running, over-voltage and under-voltage, overload and over-temperature.
- Built-in MPP-Tracking for DC application
- High motor reliability through carbon/ceramic bearings, excellent starting capabilities.

### Target group:

Applicable for village water supply, watering of cattle, irrigation of fields and greenhouses, game parks and game farms, conservation areas, surface water pumping, floating pump installations for pumping of water from ponds and lakes.

Product Specification	
Type of pump (surface/submersible)	Submersible Helical rotor pump
DC or AC connected	Optional DC- or AC connected <ul style="list-style-type: none"> <li>• 30-300 VDC, PE</li> <li>• 1 x 90-240 V -10%/+6%, 50/60 Hz, PE</li> </ul>
Max. pumping head (m)	N/A
Water output (m3/24h)	N/A
Water pressure ()	N/A
Load of pumping motor Pump capacity (kW)	MSF 3 permanent-magnet motor 900 W, Max. speed: 3600 min <sup>-1</sup>
Electrical to hydraulic efficiency	N/A
Solar energy to hydraulic	N/A

efficiency	
Capacity of PV modules required (kWp)	N/A
Battery	Optional (30-300 VDC, maximum current 8.4)
Product life time	N/A
Size	N/A
Weight	9,4 – 12,4



Price	Retail Price Germany
Investment	N/A

### Technological and market development

- Easy to install, maintenance confined to periodic cleaning of solar panels, few and simple components

### Risks and Barriers

- SQF pumps are applicable in thin, clean, non-aggressive, non-explosive liquids, not containing solid or long-fibred particles larger than sand grain
- Maximum sand content: 50 g/m<sup>3</sup>

### Links

[http://africanenergy.com/new/wp-content/uploads/2012/08/grundfos\\_sq\\_flex\\_literature-1569\\_eng.pdf](http://africanenergy.com/new/wp-content/uploads/2012/08/grundfos_sq_flex_literature-1569_eng.pdf)  
<http://de.grundfos.com/products/find-product/sqflex.html>

## FS12 Submersible Centrifugal Pump Grundfos SQFlex 4”

Grundfos, Schlüterstr. 33, 40699 Erkrath

### Product Description:

Being designed for continuous as well as intermittent operation, the SQFlex system is especially suitable for water supply applications in remote location. Eleven different pump models cover a wide range of heads and flows.

The SQFlex 4” is a centrifugal pump for low heads and large flows.

### Target group:

N/A



Product Specification	
Type of pump (surface/submersible)	Submersible Centrifugal pump
DC or AC connected	Optional AC or DC coupled <ul style="list-style-type: none"> <li>30-300 VDC, PE</li> <li>1 x 90-240 V -10%/+6%, 50/60 Hz, PE</li> </ul>
Max. pumping head (m)	N/A
Water output (m3/24h)	N/A
Water pressure ()	N/A
Load of pumping motor Pump capacity (kW)	Permanent magnet motor 1400 W; max. speed: 3600 min <sup>-1</sup>
Electrical to hydraulic efficiency	N/A
Solar energy to hydraulic efficiency	N/A
Capacity of PV modules required (kWp)	N/A
Battery	Optional
Product life time	N/A
Size	N/A
Weight	N/A

Price	Retail Price Germany
Investment	N/A

### Technological and market development

**SQFlex System components:** SQF submersible pump,

- CU 200 SQFlex control unit, IO 100 SQFlex switch box, IO 101 SQFlex switch box, IO 102 SQFlex breaker box, charge controller.
- Easy to install, maintenance confined to periodic cleaning of solar panels, few and simple components

### Links

<http://de.grundfos.com/products/find-product/sqflex.html>

## FS13 Submersible Pumps SunPumps SDS (Series D, Q, T)

**SunPumps**, 325 East Main Street, Safford, Arizona 85546, USA

### Product Description:

The SunPumps Solar Diaphragm Submersible Pumps are low cost, high efficiency, positive displacement submersibles designed to be an economical solution for “solar water pumping”.

### Target group:

N/A



Product Specification	
Type of pump (surface/submersible)	Diaphragm submersible
DC or AC connected	12 – 30 V DC
Max. pumping head (m)	230 – 80 feet
Water output (m3/24h)	N/A
Flow rate	1.1 – 18 l per minute
Well diameter	4-5”
Depth range	24 – 70 m
Load of pumping motor	N/A
Pump capacity (kW)	N/A
Electrical to hydraulic efficiency	N/A
Solar energy to hydraulic efficiency	N/A
Capacity of PV modules required (kWp)	N/A
Battery	N/A
Product life time	N/A
Size	N/A
Weight	N/A

Price	Retail Price Germany
Investment	N/A

### Technological and market development

- Repair Kits are available

### Links

<https://www.sunpumps.com/>



## FS14 Submersible Pump SunPumps SCS

**SunPumps**, 325 East Main Street, Safford, Arizona 85546, USA

### Product Description:

Sun Pumps SCS series submersibles are high quality, maintenance-free, DC powered pumps specifically made for water delivery in remote locations.

### Target group:

N/A



Product Specification (several models of the SCS series)	
Type of pump (surface/submersible)	Submersible
DC or AC connected	DC (30 – 180 V)
Depth range	4 – 189 m
Well diameter	4 – 6 ″
Flow range	15 – 870 l per minute
Water output (m3/24h)	N/A
Water pressure ()	N/A
Load of pumping motor	N/A
Pump capacity (kW)	N/A
Electrical to hydraulic efficiency	N/A
Solar energy to hydraulic efficiency	N/A
Capacity of PV modules required (kWp)	N/A
Battery	N/A
Product life time	N/A
Size	N/A
Weight	N/A

Price	Retail Price Germany
Investment	N/A

### Technological and market development

- The PCA series controller provides pump protection for over-voltage and over-current as well as current boosting in low sunlight conditions.

### Links

<https://www.sunpumps.com/>

## FS15 Submersible Pump Lorentz PS Helical Rotor

**Lorentz**, Siebenstücken 24, 24558 Henstedt-Ulzburg, Germany

### Product description

The PS helical rotor pump systems are submersible pumps for 4” and 6” wells. It deliver water economically, cleanly and reliably, anywhere.

It is designed for drinking water supply, livestock watering and smaller irrigation applications.

### Target group:

N/A

Product Specification:	
Type of pump (surface, submersible, other)	Submersible helical rotor pump PS200HR, PS600HR, PS1200 HR, PS1800 HR, PS4000 HR
AC or DC coupled	DC coupled
Pumping range (m)	50, 180, 240, 250, 450 m
Max. flow rate (m <sup>3</sup> /h)	2.6, 2.6, 2.5, 3.9, 2.5 m <sup>3</sup> /h
Solar energy to hydraulic efficiency	90 %
Capacity of PV modules required (kWp)	N/A
Product life time	Long life expectancy
Size	N/A
Weight	N/A



Price	Retail Price Germany
Investment	N/A

### Market development and distribution chains

- Simple, efficient and reliable
- Modular system consisting of a pump, pump motor and controller.
- Smart modular design for simple and cost effective servicing and repair
- All electronics are kept above ground providing, simple servicing, ease of access and a low cost of ownership.
- Designed for use in remote and harsh conditions
- Cost effective spare parts philosophy

### Links

[https://www.lorentz.de/pdf/lorentz\\_ps\\_hr\\_general\\_en-en.pdf](https://www.lorentz.de/pdf/lorentz_ps_hr_general_en-en.pdf)

## FS16 Submersible Centrifugal Pump Lorentz PS

**Lorentz**, Siebenstücken 24, 24558 Henstedt-Ulzburg, Germany

### Product description

The LORENTZ PS range of DC powered submersible centrifugal pumps have been designed specifically to pump larger volumes of water efficiently using solar power. It is designed for drinking water supply, livestock watering and smaller irrigation applications.

### Target group:

N/A



Product Specification:	
Type of pump (surface, submersible, other)	Submersible centrifugal pumps PS150 C, PS600 C, PS1200 C, PS1800 C, PS4000 C
AC or DC coupled	DC coupled
Pumping range (m)	20, 30, 40, 100, 160 m
Max. flow rate (m <sup>3</sup> /h)	4.0, 12, 21, 53, 79 m <sup>3</sup> /h
Solar energy to hydraulic efficiency	90 %
Capacity of PV modules required (kWp)	N/A
Product life time	Long life expectancy
Size	N/A
Weight	N/A

Price	Retail Price Germany
Investment	N/A

### Market development and distribution chains

- Designed for use in remote and harsh conditions
- Simple, efficient and reliable
- High efficient pumps can achieve flow rates of 79 m<sup>3</sup>/hour and are applicable for 4" and 6" wells.
- Smart modular design for simple and cost effective servicing and repair
- Modular system consisting of a pump, pump motor and a controller.
- All electronics are kept above ground providing, simple servicing, ease of access and a low cost of ownership.
- Cost effective spare parts philosophy

### Links

[https://www.lorentz.de/pdf/lorentz\\_ps\\_hr\\_general\\_en-en.pdf](https://www.lorentz.de/pdf/lorentz_ps_hr_general_en-en.pdf)

## FS17 Submersible Pump SHURflo 9300

**SHURflo**, 3545 Harbor Gateway South Suite 103, Costa Mesa, CA 92626, USA

### Product description

The SHURflo solution for remote water pumping needs. This pump is rugged, durable and built to last. It is designed to be strong and lightweight. For shallow wells a pump controller should be used.

- Water blocked electrical connector
- Corrosion proof housing with stainless-steel fasteners
- Internal bypass feature for pump protection
- For 4" wells or larger

### Target group:

Drip irrigation, stock and wildlife watering, remote homes and cabins



Product Specification:	
Type of pump (surface, submersible, other)	Positive displacement 3 chamber diaphragm pump
AC or DC coupled	DC coupled, 24 V, 4.1A
Pumping range	70m
Max. flow rate	230-320 l/h
Outlet port	N/A
Solar energy to hydraulic efficiency	N/A
Capacity of PV modules required (kWp)	N/A
Product life time	Long life expectancy
Size	Ø 95 x 305 mm
Weight	2.7 kg

Price	Retail Price Germany
Investment	N/A

### Market development and distribution chains

- Long -life 24 VDC operation
- Dry running capability without pump damage

### Links

[http://legacy.shurflo.com/pages/new\\_industrial/Industrial/solar/solar\\_home.html](http://legacy.shurflo.com/pages/new_industrial/Industrial/solar/solar_home.html)

## C Pump Inverter

### FS18 Pump Inverter MPP ILK

**ILK Dresden**, Institute for Air Handling and Refrigeration, Bertolt-Brecht-Allee 20, 01309 Dresden

#### Product Description:

The solar pump inverter is directly connected to the dc-voltage of the solar generator and supplies e.g. pumps or compressors which formerly were supplied by diesel generators.

- Standard variable frequency drive with MPP-control
- Input voltage range adapted to solar generator
- In order to earn max. power from the solar generator, the load is adjusted for matching the maximum power point (MPP) of the generator by varying the input resistance.
- Frequency drive controls load power consumption according to output voltage.

#### Target group:

- N/A

Product Specification	
Type	Solar pump inverter
AC- or DC coupled	Converts DC to AC (320Vdc)
Load of pumping motor (kW)	N/A
Capacity of PV modules required (kWp)	2 – 15 kWp
Product life time	N/A
Size	N/A
Weight	N/A

FOTO of Product

Price	Retail Price Germany
Investment	N/A

#### Market development and distribution chains

- Allows the adaptation of formerly diesel powered pumps to a solar system
- Aiming at being a technically mature and cost efficient solution, which can be produced in large quantity.

#### Links

<http://www.ilkdresden.de/en/service/research-and-development-rd/applied-materials-engineering/detail/mpp-inverter-for-autonomous-solar-systems/>

## FS19 Pump Inverter JUWI solar Variable Speed Drive (sVSD)

**Juwi Solar**, Energie-Allee 1, 55286 Wörrstadt, Germany

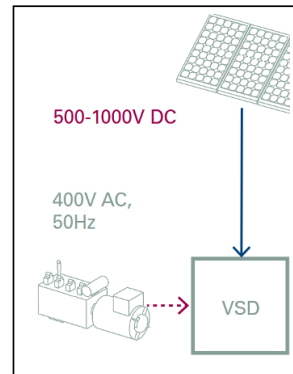
### Product Description:

- Battery free water pumping, power supply of asynchronous standard pumps
- Maximum Power Point Tracking (MPPT)
- Protections: over voltage protection, recognizes minimum water flow, integrated soft starter and current limiter

### Target group:

Large scale: The agricultural sector and industrial customers.

Product Specification	
Type	Pump inverter
Ac- or DC coupled	Converts DC to AC 55 – 1000 V DC 400 V AC
Pump power supply	Starting from 30 kW
Frequency adaptation	20 - 55 Hz



Price	Retail Price Germany
Investment	N/A

### Market development and distribution chains

N/A

### Links

[http://www.juwi.com/fileadmin/user\\_upload/.com/Off-Grid/BB\\_Solar\\_Pumping\\_FINAL\\_Web.pdf](http://www.juwi.com/fileadmin/user_upload/.com/Off-Grid/BB_Solar_Pumping_FINAL_Web.pdf)

## FS20 Pump Inverter EMPO-NI Solar Direct Drive SDD5.5-850-M

EMPO-NI Wernigeroder Str 102 D-40595 Düsseldorf Germany

### Product Description:

The Solar Direct Drive "SDD" has been developed to operate standard industrial 3 phase electrical motors from a few hundred Watts up to several horse powers (hp) where mains grid is not available.

Its robust case structure is designed to meet a protection degree of IP54 (IP65) permitting to install the device outside. Since flexibility has been a crucial design objective, the EMPO-NI Solar Direct Drive is capable to operate with almost every manufacturer's PV panels and driving any standard industrial 3 phase motor in typical applications like pumping and ventilation.

### Target group:

Large scale: The agricultural sector and industrial customers.

Product Specification	
Type	Pump inverter
Voltage range:	300V...850V (input) 300V...750V (MPPT range)
Power range	550W - 5.5kW



Price and costs	Retail Price Germany
Investment	N/A

### Market development and distribution chains

- N/A

### Links

<http://www.empo-ni.de/SolarDirektAntrieb.html>

### 3.1.2 Cold Chain

#### General Description

Cooling is on increasing demand in rural areas. It concerns storage of fresh or frozen food as well as medicines and vaccinations. In both areas cooling can have significant influence on health as well as income generation.

A challenge for cold chain in rural areas of many developing countries is the high outside temperature combined with unreliable electricity supply. As most 240 AC powered refrigerators rely on relatively constant energy supply, DC appliances can be a good alternative for rural areas. They should contain a good insulated cooling cabinet and have the ability to cover a certain time period without electricity supply.

High efficient 12 V DC fridges, which can easily be powered by simple PV systems, are available in a number of sizes, but are still high priced niche products. They are mainly produced in Europe and North America and distribution chains are slowly expanding to Africa and Asia.

Most appliances have to be combined with a battery, a few, innovative ones use a direct drive technology that can be directly connected to the PV system. For battery free appliances, an ice bank around the cabinet ensures the cooling temperature during non-availability of power (e.g. night time).

#### Refrigerants used in DC cooling appliances:

- R-134a is a halo alkane refrigerant with a low ozone depleting potential and a global warming potential (GWP) of 1430.
- R-600a, Isobutene, has a GWP of 3 and is the most common refrigerant in Europe.
- Some appliances' cooling cycle work on the basis of hydrocarbon, which is non-toxic.
- Freezers are only available using HFC-refrigerants.

#### Energy Efficiency

Energy efficiency is crucial for choosing the right refrigerator to be connected to a PV power system. One indicator of the efficiency is the European Energy Label.

The label contains information of:

- Annual power consumption relative to a reference consumption that is based on the storage volume and the type of appliance (refrigerator or freezer)
- Annual energy consumption in kWh
- Capacity of fresh foods in liters for refrigerators and combined appliances
- Capacity of frozen foods in liters for freezers and combined appliances
- Noise in db.

To date the most efficient conventional refrigerators are rated A+++ and can realize energy savings of about 60% compared to the efficiency class A. DC

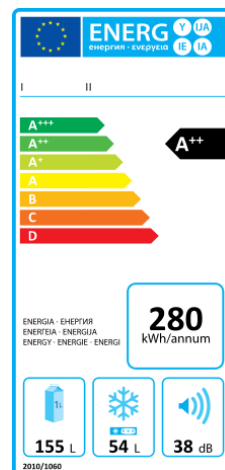


Figure 1: Example of EU Energy label for a refrigerator



appliances are mostly classified as A++ which is due to the fast developments of AC-refrigerating system over the last years and that their DC counterparts still lag behind. In most cases DC appliance use commonly available refrigerating compartments as basis and then integrate the DC technology. They now have to undergo the switch to A+++.

### Climate Class

The capacity of a cooling appliance to achieve the estimated cooling temperature at the indicated electricity consumption depends on the ambient temperature: A refrigerator situated in a high temperature environment requires more power to achieve and hold the cooling temperature inside. Climate classes indicate the ambient temperature range for which the appliance is constructed and will achieve the targeted cooling temperature.

The four climate classes are shown in table 2.

Climate class	Ambient temperature	Remark
<b>SN (Sub-normal)</b>	+10 °C to +32 °C	
<b>N (Normal)</b>	+16 °C to +32 °C	
<b>ST (Sub tropical)</b>	+16 °C to +38 °C	this category allows a 10% higher energy consumption compared to an appliance of climate class normal to achieve the same energy label (e.g. A++)
<b>T (Tropical)</b>	+16 °C to +43 °C	For regions with very high temperatures; this category allows a 20% higher energy consumption compared to an appliance of climate class normal to achieve the same energy label (e.g. A++)

Figure 2: Definition of Climate Classes for Refrigerators and Freezers

**Consumer hints to check the quality of a refrigerator**

While choosing a refrigerator, a quality check should be conducted at a minimum according to the following points:

- **Size:** The size of a refrigerator effects its energy consumption and its price. Therefore a consumer should ask himself what quantity of products should be cooled in the refrigerator and procure the appropriate size.
- **Energy Label:** the label indicates the efficiency of an appliance. Does the manufacturer present an internationally accepted energy label?
- **Energy consumption:** This information should be provided by the manufacturer. The data sheet should include information with regard to
  - Energy consumption (kWh/24h)
  - Standby time (time the cooling temperature can be held without electricity supply)

**Types of SWP products in this catalogue:****A Freezers**

Freezers offer the opportunity of freezing goods at temperatures of – 10°C to – 20°C with a cooling volume of up to 300l.

**B Refrigerators**

Refrigerators are of the same size as freezers and offer the opportunity of cooling goods to temperatures of 2 to 8°C. Fridge- freezer-combinations combine both functions, cooling and freezing, by a separate freezing compartment.

**C Walk-in cold rooms**

A special sort of cooling appliances are reefers or walk-in cold rooms. They consist of an insulated container, often equipped with a PV-system powering the cooling technology. These large scale cooling solutions are suited for large quantities of goods. They may be applicable for market places, in the agricultural sector or for fisheries.

## A – Freezers

### FS21 Freezer - Steca PF 166/240

**Steca Elektronik GmbH**, Mammostraße 1, 87700 Memmingen, Germany

#### Product Description:

The Steca PF is available with a cooling volume of 166l or 240l. It can be used as refrigerator or freezer, its function is adjustable and the temperature is fully programmable.

- Automatic detection of voltage
- Suitable for all DC applications
- Low maintenance, easy to clean, lock with two keys
- Also suitable for mobile use
- Auto-dimming for reduction of own consumption
- Reverse polarity protection
- Deep discharge protection
- Power breakdown display
- Temperature alarm

#### Target group:

Small enterprises, clinics and hospitals.

Product Specification PF 166	
Cooling volume	166l
Freezer temperatures	-20 – -10 °C
Kg ice / 24 h	N/A
Nominal power	40 – 100 W
Energy efficiency class	A++
AC- or DC coupled	DC 10, 24 V
Energy consumption (Wh/24 h) (@25°C, 32°C, 45°C)	166 l; Inside temperature: -10°C: 259 Wh/d @ 25°C 346 Wh/d @ 30°C 589 Wh/d @ 40°C
Ambient Temperature (Climate class)	10 – 43 °C
Capacity of PV modules required	70 W
Autonomous days/ stand by	N/A
Type of refrigerant	190 g R134a
Battery	Not included

Product life time (y)	N/A
Size	917 x 872 x 709 mm 1,288 x 919 x 760 mm
Weight	47 kg, 62 kg



Price	Retail Price Germany
Investment (including solar panels)	N/A €

#### Technological and market development

- Compliant with European Standards (CE)
- Abstinance of ozone destroying materials according EC 1005/2009 (CFC-free)
- Developed in Germany
- Manufactured according to ISO 9001 and ISO 14001

#### Links

<http://www.steca.com/index.php?Steca-PF-166---Steca-PF-240-en>

## FS22 Freezer - Phocos FR Series

Phocos AG | Magirus-Deutz Str. 12 | 89077 Ulm, Germany

### Product Description:

The Phocos FR series are available at a cooling volume of 50 l, 165l and 225l.

- Shutoff at low voltage
- Top-quality craftsmanship guarantees a long useful life
- 11 cm thick insulation layer made of polyurethane ensures minimal thermal losses
- Scratch-proof steel-panel housing
- The refrigeration system is equipped with a maintenance-free, brushless DC compressor
- The patented low-frost system reduces the formation of condensation water and ice
- Easy-to-clean aluminum lining, lockable lid (except for the model FR 50 R)
- Interior lighting
- Adjustable interior temperature

### Target group:

N/A

Product Specification – Phocos FR165	
Cooling volume	165 l
Cooling temperatures	N/A
Nominal power	40W
AC- or DC coupled	DC, 12 V or 24 V
Energy consumption (Wh/24 h) (@25°C, 32°C, 45°C)	@ 21°C: 300Wh/24 h @32°C: 444 Wh/24 h
Energy efficiency class	N/A
Ambient temperature (Climate class)	-10 to +43 °C
Capacity of PV modules required	N/A
Autonomous days/ stand by	N/A
Type of refrigerant	R-134a
Battery	N/A
Produkt life time (y)	N/A
Size	98 x 76 x 98 cm
Weight	51 kg



Price	Retail Price Germany
Investment (including solar panels)	N/A

### Technological and market development

- Delivery: 114 units/40 ft container (50 l), 72 units/40 ft container (165 l), 56 units/40 ft container (225 l)

### Links

<http://www.phocos.com/products/fr-50-165-225l>

[www.phocos.com/sites/default/files/document/Phocos\\_datashet\\_FR\\_e\\_web\\_o.pdf](http://www.phocos.com/sites/default/files/document/Phocos_datashet_FR_e_web_o.pdf)

## FS23 Freezer - Dulas solar VC series

**Dulas International** | Unit 1 Dyfi Eco Park | Machynlleth, Powys | Wales, SY20 8AX, UK |

### Product Description:

Stand-alone solar refrigerators and combined refrigerators with freezers for vaccines and blood for use in health centers. The Dulas solar is available with cooling volume of 65 l, 150 l and 200 l.

- High efficiency, low carbon footprint, long lasting
- Flexible, reliable vaccine storage solutions
- Ice pack freezing
- Robust, high quality materials
- Rapid, even cooling
- LED display for fridge and freezer temperature
- Low maintenance

### Target group:

Small enterprises, clinics and hospitals.

Product Specification VC 150-2	
Cooling volume	Gross volume: 33.1 L Waterpack freezing capacity: 2.4kg/24h Waterpack storage capacity: 26 x 0.6 L
Cooling temperatures	N/A
Nominal power	N/A
AC- or DC coupled	DC, 12V
Energy consumption (Wh/24 h)	during freezing: 1.06 kWh/24h +32°C = 380 Wh / 24 hrs +27°C = 270 Wh / 24 hrs
Energy efficiency class	N/A
Ambient temperature (Climate class)	N/A
Capacity of PV modules required	N/A
Autonomous days/ stand by	@ 43°C: 3 hours 22 min
Type of refrigerant	CFC free
Battery	N/A
Product life time	N/A
Size	92.9 x 128.5 x 78.1 cm
Weight	N/A



Price including solar panels	Retail Price (incl. solar system; excl. shipping, taxes and installation work)
VC65-2	as off 3,550.00 €
VC150-2	As off €4,600.00 €
VC200-1	As off 3,350.00 €

### Technological and market development

- WHO/UNICEF certified
- Supplied with: Locking door, external temperature indicator, air circulation basket, instruction manuals
- Appliance can be supplied as a complete kit including solar panels, batteries, charge controller and accessories
- Dulas offers on-site training for installation and maintenance to ensure the ongoing success of the cold chain program and technical support via email and telephone - See more at: <http://www.dulas.org.uk/pns/international-solar-solutions/solar-refrigeration#sthash.Ooz6KiuH.dpuf>

### Links

[http://www.nccvmtc.org/PDF2/2\\_028.pdf](http://www.nccvmtc.org/PDF2/2_028.pdf)

[http://www.nccvmtc.org/PDF2/2\\_029.pdf](http://www.nccvmtc.org/PDF2/2_029.pdf)

<http://www.dulas.org.uk/products/vc150-solar-medical-refrigerator.cfm>

<http://www.dulas.org.uk/pns/international-solar-solutions/solar-refrigeration>

## FS24 Freezer - SunDanzer DCF

SunDanzer | 11135 Dyer Suite C | El Paso, Texas 79934 USA

### Product Description:

The SunDanzer DCF is available with a cooling volume of 165l, 225l, 390l or as commercial reefers in 10', 20' or 40'-containers. The SunDanzer is applicable for remote areas, off-grid and intermittent grid. The low energy consumption requires smaller PV system.

- Thick insulation and optimized refrigeration system
- Rugged scratch resistant galvanized steel exterior, easy to clean aluminum interior
- With lockable lid and interior light
- Low cost refrigerator or freezer for rural areas
- Patented low-frost system, automatic control with adjustable thermostat

### Target group:

N/A

Product Specification (DCR165)	
Cooling volume household units	165l
Cooling temperature	N/A
AC- or DC coupled	N/A
Energy consumption (Wh/24 h) (@25°C, 32°C, 45°C)	@ 32°C: 441 Wh/24h
Energy efficiency class	N/A
Ambient temperature (Climate class)	N/A
Capacity of PV modules required	75 W
Autonomous days/ stand by	N/A
Type of refrigerant	Using R-134a (halo alkane refrigerant) as refrigerant
Battery	N/A
Product life time	N/A
Size	102 x 76 x 94 cm
Weight	54,4 kg



Price and costs	Retail Price
Investment (household units)	As off 700 \$

### Technological and market development

- High technological standard, high energy efficiency.

### Links

[www.sundanzer.com/](http://www.sundanzer.com/)

## FS25 Freezer - Smart solar ice maker (Steca PF166)

**Steca Elektronik GmbH**, Electronics Services | Mammostraße 1  
87700 Memmingen, Germany

**Phaesun GmbH** | Brühlweg 9 | 87700 Memmingen, Germany

**University of Hohenheim**, Institute of Agriculture Engineering,  
Tropical & Subtropical Group | Garbenstr. 9 | 70599 Stuttgart

### Product Description

A direct current domestic refrigerator is operated by an additional control unit to produce ice only in solar radiation hours. The compressor speed and inner cabinet temperature are adjusted depending on actual solar radiation. The system can run with a small battery (10Ah) but achieves 35% more ice production with a 65Ah battery. The Ice production are between 8 and 14 kg/day depending on location and daily irradiation.

### Target group:

Small enterprises in agricultural sector

Product Specification	
Cooling volume	160 L
Cooling Temperatures	Depending on solar radiation between -3°C and -20°C
Nominal power	40-100 W
AC- or DC coupled	DC
Energy consumption (Wh/24 h) (@20°C, 30°C, 40°C)	700 , 1000, 1340 Wh/d
Energy efficiency class	A++
Ambient temperature (Climate class)	20°C-40°C
Capacity of PV modules required	400 Wp
Autonomous days/ stand by time	3
Type of refrigerant	R134a
Battery	Minimum: 10Ah Optimum: 65Ah (for a higher ice production)
Product life time	N/A
Size	917 x 872 x 709 mm (freezer)
Weight	47 kg(freezer)



Price for whole system	
Investment (whole system)	N/A

### Technological and market development

- Developed by Steca (Freezer) and the University of Hohenheim (additional control unit).
- Distributed by Phaesun (whole system)
- R&D phase until 2017; In-field test 2015 – 2017 in Tunisia

**Links:** <https://www.uni-hohenheim.de/einrichtung/fg-agrartechnik-in-den-tropen-und-subtropen>

## B - Refrigerators

### FS26 Refrigerator - Solar Chill

**SolarChill** (Project Coordinator) | 5106 Walden Street | Vancouver, B.C., Canada, V5W 2V7

**A/S Vestfrost** | Falkevej 12 | DK-6705 Esbjerg Ø

#### Product Description:

A stand alone refrigerator with DC compressor that runs the refrigerant cycle. An ice bank maintains the required temperature in the cabinet.

- Uses public domain technology – patent free
- Battery is substituted for an ice bank
- Instead of fluorocarbons, hydrocarbons are used as refrigerant.

#### Target Group:

- Food and vaccine refrigeration
- Off grid regions, instable grid area
- Small shops, restaurants, fisheries, dairy, etc.

Product Specification	
Cooling volume	50 l
Cooling temperatures	2 – 8 °C
Nominal power	N/A
AC- or DC coupled	DC
Energy consumption (Wh/24 h) (@25°C, 32°C, 45°C)	Ca. 500 Wh/d 15V
Energy efficiency class	N/A
Ambient temperature (Climate class)	N/A
Capacity of PV modules required	Min. 180 Wp (e.g. 3 x 60 Wp)
Autonomous days/ stand by	5 (depending on insulation) ?
Type of refrigerant	Hydrocarbon creates an ice bank as thermal energy storage
Battery	No
Product life time	N/A
Size	N/A

Weight	N/A
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Price and costs	Retail Price Germany
Investment (including solar panels)	1500 – 2000 \$

#### Technological and market development

- Solar Chill A is commercialized and implemented as vaccine cooler at health centers.
- ~1000 Solar Chills are installed world wide
- Manufacturer: Vestfrost (Denmark), Palfridge (Swaziland), Haier (China), True Energy (UK)
- Until now not many manufacturer use hydrocarbons as refrigerant, therefore a commercial production is difficult;
- no freezer available

#### Links

<http://www.solarchill.org/wp-content/uploads/2014/02/SolarChill-Technology-Brief.pdf>

[http://www.greenpeace.org/canada/Global/canada/report/2011/12/SolarChill%20Backgrounder%20Canada%2011\\_2011.pdf](http://www.greenpeace.org/canada/Global/canada/report/2011/12/SolarChill%20Backgrounder%20Canada%2011_2011.pdf)



## FS27 Refrigerator Steca PF 166/240

**Steca Elektronik GmbH**, Mammostraße 1, 87700 Memmingen, Germany

### Product Description:

The Steca PF is available with a coling volume of 166l or 240l. It can be used as refrigerator or freezer, its function is adjustable and the temperature is fully programmable.

- Automatic detection of voltage
- Suitable for all DC applications
- Low maintenance, easy to clean, lock with two keys
- Also suitable for mobile use
- Auto-dimming for reduction of own consumption
- Reverse polarity protection
- Deep discharge protection
- Power breakdown display
- Temperature alarm

### Target group:

Small enterprises, clinics and hospitals.

Product Specification PF 166	
Cooling volume	166l
Freezer temperatures	-20 – -10 °C
Kg ice / 24 h	N/A
Nominal power	40 – 100 W
Energy efficiency class	A++
AC- or DC coupled	DC 10, 24 V
Energy consumption (Wh/24 h) (@25°C, 32°C, 45°C)	166 l; Inside temperature: 8°C: 72 Wh/d @ 25°C 109 Wh/d @ 30°C 216 Wh/d @ 40°C
Ambient Temperature (Climate class)	10 – 43 °C
Capacity of PV modules required	70 W
Autonomous days/ stand by	N/A
Type of refrigerant	190 g R134a
Battery	Not included
Product life time (y)	N/A
Size	917 x 872 x 709 mm 1,288 x 919 x 760 mm

Weight	47 kg, 62 kg
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Price	Retail Price Germany
Investment (including solar panels)	N/A €

### Technological and market development

- Compliant with European Standards (CE)
- Abstinence of ozone destroying materials according EC 1005/2009 (CFC-free)
- Developed in Germany
- Manufactured according to ISO 9001 and ISO 14001

### Links

<http://www.steca.com/index.php?Steca-PF-166---Steca-PF-240-en>

## FS28 Refrigerator ONCool

### Company Contact Information

ONergy | Punam Energy Pvt. Ltd. 1A | D. L. Khan Road Jaju Bhawan  
| Kolkata – 700027 | Phone: +8420104760 | info@onergy.in

### Product Description:

Standalone solar DC Refrigerator for Milk, Vegetables, Vaccines etc available in sizes of 50 and 165 l. Applicable in urban and rural areas.

- Energy Efficient Brushless Dc Compressor
- Low maintenance
- Fast Cooling, Temperature Controller
- Portable & Reliable
- Long Life
- Ideal For Off-Grid Application

### Target group:

Applicable in urban and rural areas for milk, vegetables, vaccines, etc.

- Rural Medical Units/Stores
- Remote Health Centres

Product Specification	
Cooling volume	50 ltr & 165 ltr
Types	Refrigerator & Freezer
Nominal power	45W to 80W
AC- or DC coupled	DC, 12 V / 24 V
Energy consumption (Wh)	Very Low
Energy efficiency class	N/A
Ambient temperature (Climate class)	-10 to +40°C
Capacity of PV modules required	80Wp - 200Wp
Autonomous days/ stand by	3 days
Type of refrigerant	R-134a
Battery	Lead Acid
Product life time (y)	10 Years
Size	68x 77x 60 cm 100 x 75 x 100cm
Weight	34 kg, 51 kg, 59 kg

Price and costs	Retail Price
Investment (including solar panels)	N/A

### Technological and market development

- Low Maintenance requirements
- Low voltage application

### Links

<http://onergy.in>

## FS29 Refrigerator SunDanzer DCR

SunDanzer | 11135 Dyer Suite C | El Paso, Texas 79934 USA

### Product Description:

The SunDanzer DCR is available with a cooling volume of 165l, 225l, 390l or as commercial reefers in 10', 20' or 40'-containers. The SunDanzer is applicable for remote areas, off-grid and intermittent grid. The low energy consumption requires smaller PV system.

- Thick insulation and optimized refrigeration system
- Rugged scratch resistant galvanized steel exterior, easy to clean aluminum interior
- With lockable lid and interior light
- Low cost refrigerator or freezer for rural areas
- Patented low-frost system, automatic control with adjustable thermostat

### Target group:

N/A

Product Specification (DCR165)	
Cooling volume household units	165l
Cooling temperature	N/A
AC- or DC coupled	N/A
Energy consumption (Wh/24 h) (@25°C, 32°C, 45°C)	@ 32°C: 168 Wh/24h
Energy efficiency class	N/A
Ambient temperature (Climate class)	N/A
Capacity of PV modules required	75 W
Autonomous days/ stand by	N/A
Type of refrigerant	Using R-134a (halo alkane refrigerant) as refrigerant
Battery	N/A
Product life time	N/A
Size	102 x 76 x 94 cm
Weight	54,4 kg



Price and costs	Retail Price
Investment (household units)	As off 700 \$

### Technological and market development

- High technological standard, high energy efficiency.

### Links

[www.sundanzer.com/](http://www.sundanzer.com/)

## FS30 Refrigerator Dulas solar VC series (battery driven)

Dulas International | Unit 1 Dyfi Eco Park | Machynlleth, Powys | Wales, SY20 8AX, UK |

### Product Description:

The Dulas VC are stand-alone, battery driven solar refrigerators and combined refrigerators with freezers for vaccines and blood for use in health centers. The Dulas solar is available with cooling volume of 65 l, 150 l and 200 l.

- High efficiency, low carbon footprint, long lasting
- Flexible, reliable vaccine storage solutions
- Ice pack freezing
- Robust, high quality materials
- Rapid, even cooling
- LED display for fridge and freezer temperature
- Low maintenance, CFC free

### Target group:

Small enterprises, clinics and hospitals.

Product Specification VC 150-2	
Cooling volume	Vaccine storage capacity: 86 l Gross volume: 111.2 l
Cooling temperatures	N/A
Nominal power	N/A
AC- or DC coupled	DC, 12V
Energy consumption (Wh/24 h)	@ 43°C: 680 Wh/24 h
Energy efficiency class	N/A
Ambient temperature (Climate class)	T (43°C)
Capacity of PV modules required	N/A
Autonomous days/ stand by	@ 43°C: 3 hours 22 min
Type of refrigerant	CFC free
Battery	N/A
Product life time	N/A
Size	92.9 x 128.5 x 78.1 cm
Weight	N/A



Price	Retail Price (incl. solar system; excl. shipping, taxes and installation work)
VC65-2:	As of 3,600.00 €
VC150-2:	As of 4,600.00 €
VC200-1:	As of 3,350.00 €

### Technological and market development

- WHO/UNICEF certified
- CFC free solar refrigerators.
- Supplied with: Locking door, external temperature indicator, air circulation basket, instruction manuals
- Appliance can be supplied as a complete kit including solar panels, batteries, charge controller and accessories
- Dulas offers on-site training for installation and maintenance to ensure the ongoing success of the cold chain program and technical support via email and telephone - See more at: <http://www.dulas.org.uk/pns/international-solar-solutions/solar-refrigeration#sthash.Ooz6KiuH.dpuf>

### Links

[http://www.nccvmtc.org/PDF2/2\\_028.pdf](http://www.nccvmtc.org/PDF2/2_028.pdf)

[http://www.nccvmtc.org/PDF2/2\\_029.pdf](http://www.nccvmtc.org/PDF2/2_029.pdf)

<http://www.dulas.org.uk/products/vc150-solar-medical-refrigerator.cfm>

<http://www.dulas.org.uk/pns/international-solar-solutions/solar-refrigeration>

## FS31 Refrigerator - Dulas VC200SDD Solar Direct Drive

**Dulas International** | Unit 1 Dyfi Eco Park | Machynlleth, Powys | Wales, SY20 8AX, UK |

### Product Description:

Solar Direct Drive (SDD) is Dulas' latest innovation in solar refrigeration. This new technology uses a ground breaking phase change energy storage solution instead of traditional batteries. Inspired by over three decades of solar refrigerator manufacturing and feedback from the field the SDD is developed for challenging environments that vaccine refrigerators experience. The solar direct drive is as robust, easy to use and as reliable as the battery driven solar refrigerators.

- British made
- Freeze-free technology
- Widest range of solar operating conditions
- Designed for challenging environments
- Exceptional energy efficiency & reliability

### Target group:

Small enterprises, clinics and hospitals.

Product Specification VC200SDD	
Cooling volume	158.1 L refrigerator; 42.9 L freezer Net vaccine storage capacity: 102 L
Freezing capacity	@ 32°C. 2.4 kg; @43°C 2.04 kg
Nominal power	40 W
AC- or DC coupled	DC, 12V
Energy consumption (Wh/24 h)	N/A
Energy efficiency class	N/A
Ambient temperature (Climate class)	T (43°C) Min. rated ambient temperature: +5°C
Capacity of PV modules required	> 600 W 60 cell module, Vpmax > 24 Vdc; Voc < 45 Vdc
Autonomous days/ stand by	@ 43°C: 77.95 hours @ 32°C: 118.85 hours
Type of refrigerant	CFC free - R600a

Battery	Direct drive (PCM), no battery
Product life time	N/A
Size	73.5 x 128.3 x 99.2
Weight	170.4 kg



Price	Retail Price (incl. solar system; excl. shipping, taxes and installation work)
VC150SDD	As of 6,700.00 €
VC200SDD	As of 4,600.00 €

### Technological and market development

- WHO/UNICEF certified; exceeds WHO PQS standards.
- Supplied with: Locking door, external temperature indicator, air circulation basket, instruction manuals.
- Appliance can be supplied as a complete kit including solar panels, batteries, charge controller and accessories.
- Dulas offers on-site training for installation and maintenance to ensure the ongoing success of the cold chain program and technical support via email and telephone - See more at: <http://www.dulas.org.uk/pns/international-solar-solutions/solar-refrigeration#sthash.Ooz6KiuH.dpuf>

### Links

<http://www.dulas.org.uk/pns/international-solar-solutions/solar-refrigeration>

## FS32 Refrigerator Sure Chill GVR

**The Sure Chill Company Ltd**, Enterprise Park, Tywyn, Gwynedd, Wales, LL36 9LW, UK

**Godrej & Boyce Manufacturing Company Ltd**, Pirojshanagar, Vikhroli, Mumbai – 400 079, India

### Product Description:

Sure Chill solar refrigerators are available in two sizes: 46.5l and 99 l. They are direct driven and battery free. Water surrounds a Sure Chill refrigeration compartment. Using electric power the water forms an ice bank above the compartment, leaving only water at four degrees cooling the contents. When power is switched off, the 4°C water does the cooling until the ice compartment is melted.

- Surechill cooling technology doesn't rely on constant power.
- Part-time running (Silent running during office hours, or switch it off at night).
- Digital LED display,
- Self-sealing twin door gaskets and high levels of insulations
- Front opening for easy stock management
- Environmentally friendly - CFC, HFC and HCFC free
- Corrosion resistant: Outer cabinet is made of galvanized steel

### Target group:

Vaccine cooling, food and beverage, domestic and commercial refrigeration sectors.

Product Specification	
Cooling volume	46.5 l, 99 l
Cooling temperatures	4°C
Nominal power	N/A
AC- or DC coupled	DC, 24V
Energy consumption (Wh/24 h) (@25°C, 32°C, 45°C)	Stable running: 0.56 kWh/ 24 hours, 0.75 kWh/ 24 hours Cool down test: 0.64 kWh/ 24 hours, 1.90 kWh/ 24 hours
Energy efficiency class	N/A
Ambient temperature (Climate class)	T, +10°C to +43°C
Capacity of PV modules required	470 Wp, 24V

Autonomous days/ stand by	+5 (GVR50DC)/+11 (GVR100DC)
Type of refrigerant	R900a
Battery	No battery
Product life time	N/A
Size	1220 x 790 x 750 mm 1820 x 795 x 750 mm
Weight	125 kg, 160 kg



<b>Price</b>	Incl. solar array, mounting kit and cables. Excl. shipping, taxes, etc.
GVR50DC:	\$4,070
GVR100DC:	\$5,450

### Technological and market development

- WHO standard, Quality standard ISO 9001:2008
- Sure Chill technology is available worldwide and is in use as vaccine refrigerators in more than 38 countries.
- Currently tests and further development for food, beverages and domestic markets are conducted.
- Experiences from the field are integrated in product development.
- Designed for easy maintenance and repair
- Sure Chill medical refrigerators are available directly from The Sure Chill Company. Contact +44 (0) 1654 712 713 or at hello@surechill.com for further information.

### Links

www.surechill.com  
http://www.godrejappliances.com  
hello@surechill.com

## FS33 Absorption refrigerator Dometic RML 9430 / 9435

**Dometic GmbH** | In der Steinwiese 16 | 57074 Siegen

Refrigerator using absorption cooling technology. This type of fridge is absolutely silent. They allow you the freedom to use a wide variety of power sources – mains or battery powered, LPG or solar panels (AES models). Its outstanding characteristics include high performance, reliability and a completely silent operation, together with convenient features and a long service life.

### Target group:

Application where a silent refrigerator is preferred

Product Specification	
Cooling volume	without freezer compt.: 151 l with freezer compt.: 146 l, Freezer compt.: 12l
Cooling temperatures	7°C - 12°C
Nominal power	N/A
AC- or DC coupled	230 V AC/ 12 V DC
Energy consumption (Wh/24 h) (@25°C, 32°C, 45°C)	3200 Wh/24 h
Energy efficiency class	N.A.
Ambient temperature (Climate class)	SN
Capacity of PV modules required	N.A.
Autonomous days/ stand by	N.A.
Type of refrigerant	N/A
Battery	N/A
Product life time	N/A
Size	468 x 1293 x 555 mm
Weight	37 kg



Price and costs	Retail Price
Investment (including solar panels)	N/A

### Technological and market development

- Care must be taken to always ensure good ventilation

### Links

<http://www.dometic.co.za/product/dometic-rml-9430-9435/>

## FS34 Portable Cooling Box Dometic RCW42/RCW50

Dometic GmbH | In der Steinwiese 16 | 57074 Siegen

### Product Description

- Compressor technology
- CFC and HCFC free
- Big vaccine storage capacity
- Big pack storage capacity
- TCW 2000 SDD is a Solar Direct Drive unit
- Compression refrigerators, freezers and ice liners are made of rotomoulded polyethylene.
- These products are really robust for intensive use.
- 100 mm polyurethane foam and silicon gasket provide optimal insulation allowing an operating temperature range 0 – 43 °C.
- Separate compartments, each for refrigerating vaccines and freezing icepacks.

### Target group:

Vaccine cooling

Product Specification	
Cooling volume	vaccine 14 l & ice 2,4 l vaccine 24 l & ice 2,4 l
Cooling temperatures	N/A
Nominal power	DC, 12/24 V
AC- or DC coupled	N/A
Energy consumption (Wh/24 h) (@25°C, 32°C, 45°C)	610 Wh/24h 460 Wh/24h
Energy efficiency class	N/A
Ambient temperature (Climate class)	0 – 43 °C
Capacity of PV modules required	N/A
Autonomous days/ stand by	N/A
Type of refrigerant	R134a
Battery	Yes
Product life time	N/A
Size	500 x 550 x 920 mm 830 x 720 x 980 mm
Weight	43 kg

50

71 kg



RCW 42 DC



RCW 50 DC

Price and costs	Retail Price
Investment (including solar panels)	N/A

### Technological and market development

- Fully WHO immunization standard

### Links

[http://www.phaesun.com/fileadmin/user\\_upload/\\_o\\_PhaesunWebsite\\_2015/1\\_Portfolio/Downloads/Phaesun\\_Product\\_Catalogue\\_lrg.pdf](http://www.phaesun.com/fileadmin/user_upload/_o_PhaesunWebsite_2015/1_Portfolio/Downloads/Phaesun_Product_Catalogue_lrg.pdf)  
<http://www.dometic.de/>  
<http://order.phaesun.com/index.php/vaccine-refrigerator-dometic-rcw-42-dc.html>  
<http://order.phaesun.com/index.php/vaccine-refrigerator-dometic-rcw-50-dc.html>



## FS35 Portable Cooling Box Dometic TCW3000 DC/TCW2000 DC BL53 POS

Dometic GmbH | In der Steinwiese 16 | 57074 Siegen

### Product Description:

- Compressor technology
- CFC and HCFC free
- Big vaccine storage capacity
- Big pack storage capacity
- TCW 2000 SDD is a Solar Direct Drive unit
- Compression refrigerators, freezers and ice liners are made of rotomoulded polyethylene.
- These products are really robust for intensive use.
- 100 mm polyurethane foam and silicon gasket provide optimal insulation allowing an operating temperature range 0 – 43 °C.
- Separate compartments, each for refrigerating vaccines and freezing icepacks.
- TCW3000 exists as ice lined vaccine refrigerator. The same model is available as a vaccine freezer. A preset set point of – 20 °C can be changed by a technician.

### Target group:

Vaccine cooling

Product Specification	
Cooling volume	vaccine 110 l or ice 48 l   vaccine 76 l & ice 15,6 l
Cooling temperatures	N/A
Nominal power	N/A
AC- or DC coupled	DC 12/24 V
Energy consumption (Wh/24 h) (@25°C, 32°C, 45°C)	1,820 Wh/24h 990 Wh/24h
Energy efficiency class	N/A
Ambient temperature (Climate class)	0 – 43 °C
Capacity of PV modules required	N/A
Autonomous days/ stand by	N/A
Type of refrigerant	R134a
Battery	Yes
Product life tme	N/A

Size	1280 x 780 x 900 mm 1270 x 790 x 910 mm
Weight	115 kg 121 kg



Price and costs	Retail Price
Investment (including solar panels)	N/A

### Technological and market development

- Fully WHO immunization standard

### Links

[http://www.phaesun.com/fileadmin/user\\_upload/\\_o\\_PhaesunWebsite\\_2015/1\\_Portfolio/Downloads/Phaesun\\_Product\\_Catalogue\\_lrg.pdf](http://www.phaesun.com/fileadmin/user_upload/_o_PhaesunWebsite_2015/1_Portfolio/Downloads/Phaesun_Product_Catalogue_lrg.pdf)  
<http://www.dometic.de/>  
<http://order.phaesun.com/index.php/vaccine-refrigerator-dometic-tcw3000-dc.html>  
<http://order.phaesun.com/index.php/vaccine-refrigerator-dometic-tcw2000-dc-bl53-pos.html>

## FS36 Refrigerator Phocos FR50R/FR165R/FR225R

Phocos AG | Magirus-Deutz Str. 12 | 89077 Ulm, Germany

### Product Description:

- 11 cm thick insulation layer made of polyurethane ensures minimal thermal losses.
- Featuring shutoff at low voltage to protect battery from deep discharge.
- Scratch-proof steel-panel housing.
- The refrigeration system is equipped with a maintenance-free, brushless DC compressor.
- The patented low-frost system reduces the formation of condensation water and ice.
- Easy-to-clean aluminum lining.
- Lockable lid (except for the model FR 50 R), interior lighting
- Adjustable interior temperature.

### Target group:

N/A

Product Specification FR165R	
Cooling volume	165 l
Cooling temperatures	2 – 5°C
Nominal power	40 W
AC- or DC coupled	DC, 12 V or 24 V
Energy consumption (Wh/24 h) (@25°C, 32°C, 45°C)	@ 21 °C: 96 Wh/24 h @ 32 °C: 168 Wh/24 h
Energy efficiency class	N/A
Ambient temperature (Climate class)	ST; (<+38°C)
Capacity of PV modules required	N/A
Autonomous days/ stand by	N/A
Type of refrigerant	R-134a
Battery	N/A
Product life time	N/A
Size	98 x 76 x 98 cm
Weight	51 kg



Price	Retail Price
Investment (including solar panels)	N/A

### Technological and market development

- top-quality craftsmanship guarantees a long useful life
- Delivery: 54 units/20 ft container (50 l), 30 units/20 ft container (165 l), 26 units/20 ft container (225 l)

### Links

<http://www.phocos.com/products/fr-50-165-225l>  
[www.phocos.com/sites/default/files/document/Phocos\\_datasheet\\_FR\\_e\\_web\\_o.pdf](http://www.phocos.com/sites/default/files/document/Phocos_datasheet_FR_e_web_o.pdf)

## C – Walk-in cold rooms

### FS37 Walk-in Cold Storage Room

**ONergy** | Punam Energy Pvt. Ltd. 1A | D. L. Khan Road Jaju Bhawan | Kolkata – 700027, India

#### Product Description:

A grid connected, partial solar powered cold storage room for extending produces' shelf life. Target group consists of farmers.

#### Target group.

- Targeting Rural areas, NGOs, Farmer Groups, Small farmers, village markets, fishery,

Product Specification	
Cooling volume	9 Tonnes
Cooling temperature	3°C to 26°C
Nominal power	2Kw
AC- or DC coupled	AC
Energy consumption (Wh/24 h) (@25°C, 32°C, 45°C)	16 Units
Energy efficiency class	N/A
Ambient temperature (Climate class)	5°C - 45°C
Capacity of PV modules required	3.4KWp
Autonomous days/ stand by	2
Type of refrigerant	N/A
Battery	Solar Tubular Lead Acid 4500 lifecycles
Product life time	10 Yrs
Size	N/A
Weight	N/A

Price	
Investment	N/A

#### Technological and market development

- Hybrid Solar PCU with High Surge Capacity
- Low Cost Solution compare to conventional system

#### Links

<http://onergy.in/>

### FS38 Walk-in cold room FarmFresh

**Smallholder Foundation** | 1 Umuagwko Umuoba Road, Off MCC Uratte Road | P.O. Box 3508 | Owerri, Imo State, Nigeria | +23 48060292346 | info@smallholdersfoundation.org

#### Product Description:

A solar-powered walk-in cold room using the “CoolBot” technology to cool fruits and vegetables for women small famers in rural communities.

- Applicable for farms, at home, at the market or at social institutions (schools)
- Cooling unit: solar powered air conditioner (1 - 2 hp), controlled by Cool Bot
- Construction: 20 ft insulated Container equipped with shelves and crates for vegetables and fruits
- Social and environmental benefits: reduces fruits and vegetable losses and improves quality ; increases household income; reduces daily labor
- 7.5 KWA Inverter

#### Target group

N/A

Product Specification	
Cooling volume	N/A
Cooling Temperatures	N/A
Nominal power	N/A
AC- or DC coupled	DC, 12V
Energy consumption (Wh/24 h) (@25°C, 32°C, 45°C)	N/A
Energy efficiency class	N/A
Ambient temperature (Climate class)	N/A
Capacity of PV modules required	5 x 200 W solar panels, Solar Charge Controller 7.5 kVA Inverter, 10 x 12 V Batteries,
Autonomous days/ stand by time	N/A
Type of refrigerant	N/A
Product life time	N/A

Battery	N/A
Size	N/A
Weight	



Price and costs	Average price of construction
Investment (including solar panels)	25,000 € (5,481,300 Nigerian Naira)

#### Technological and market development

- CoolBot technology is applying for patent
- Risks and barriers: long cool down period; not applicable for regular door opening as system recovers slower; poor functionality below 2°C – no freezer

#### Links

<http://foodwaysblog.ch/our-common-food/participants/introducing-farm-fresh/>

## FS39 Large Scale Refrigeration - SunDanzer

SunDanzer | 11135 Dyer Suite C | El Paso, Texas 79934 USA

### Product Description:

The SunDanzer DCR is available with a cooling volume of 165l, 225l, 390l or as commercial reefers in 10', 20' or 40'-containers. The SunDanzer is applicable for remote areas, off-grid and intermittent grid. The low energy consumption requires smaller PV system.

- Thick insulation and optimized refrigeration system
- Rugged scratch resistant galvanized steel exterior, easy to clean aluminum interior
- With lockable lid and interior light
- Low cost refrigerator or freezer for rural areas
- Patented low-frost system, automatic control with adjustable thermostat

### Target group:

N/A

Product Specification (DCR165)	
Cooling volume household units	165l
Cooling temperature	N/A
AC- or DC coupled	N/A
Energy consumption (Wh/24 h) (@25°C, 32°C, 45°C)	@ 32°C: 168 Wh/24h
Energy efficiency class	N/A
Ambient temperature (Climate class)	N/A
Capacity of PV modules required	75 W
Autonomous days/ stand by	N/A
Type of refrigerant	Using R-134a (halo alkane refrigerant) as refrigerant
Battery	N/A
Product life time	N/A
Size	102 x 76 x 94 cm
Weight	54,4 kg



Price and costs	Retail Price
Investment (household units)	696 – 1174 \$

### Technological and market development

- High technological standard, high energy efficiency.

### Links

[www.sundanzer.com/](http://www.sundanzer.com/)

## FS40 Cooling Container ILK

**ILK Dresden – Institute for Air Handling and Refrigeration** | Bertolt-Brecht-Allee 20 | 01309 Dresden, Germany

### Product Description:

A stand alone solar reefer (20ft) with 23 m<sup>2</sup> cold storage room to cool e.g. medicine or food. The Solar Cooling Container is designed as a shelter with steel-made outer walls, and an inner double skin thermal insulation system with a low over-all heat transfer coefficient.

- Stand alone, optional grid interface
- Thermal energy storage for 3 days of autonomy, small battery
- Easy to move e.g. by lorry, ship or helicopter
- Can be adapted for use as solar power supply and cooling of supplied devices as well.
- Uncomplicated commissioning and operating, low level of maintenance
- Automatically operating system designed for high ambient temperatures up to 52 °C and for rough operation conditions in full-year operation;
- PV-inverter 230V/50Hz
- Type of charge controller: MPP

### Target group:

- Cold storage for medicines or vaccines in remote areas,
- Storage of perishable goods supporting the cold chain,
- Cooling of telecom equipment
- Mobile systems for disaster relief and humanitarian aid,
- Integration of the cold storage in existing houses and infrastructure

Product Specification	
Cooling volume	23 m <sup>2</sup>
Cooling Temperatures	0 °C to 10°C (adjustable, fan controlled)
Nominal power	5.1 kW
AC- or DC coupled	DC/AC
Energy consumption (Wh/24 h) (@25°C, 32°C, 45°C)	N/A

Energy efficiency class	N/A
Ambient temperature (Climate class)	up to 52 °C
Capacity of PV modules required	40 modules, 3.4 kWp
Autonomous days/ stand by time	3
Type of refrigerant	N/A
Battery	Gel
Product life time	< 10 years
Size	20 ft
Weight	5 t



Price and costs	
Investment (including solar panels?)	N/A

### Technological and market development

- ILK is a research and development enterprise in Germany, developing innovative prototype solutions.
- Adapted technologies according to special requirements and conditions can be developed.

### Links

<http://www.ilkdresden.de/en/service/research-and-development-rd/applied-materials-engineering/detail/solar-cooling-container/>

## FS41 Cooling Container ILK Milk Collection Center

**ILK Dresden – Institute for Air Handling and Refrigeration**  
| Bertolt-Brecht-Allee 20 | 01309 Dresden, Germany |

### Product Description:

System for cooling and storage of milk with a refrigeration capacity of 1000l targeting cooperatives.

- Stand alone, optional grid interface
- 20ft container with milk storage
- a large ice storage with 70kWh
- PV-inverter 230V/50Hz
- type of charge controller: MPP

### Target group:

Dairy farmers, milk collection centers

Product Specification	
Cooling volume	1000 l
Cooling Temperatures	4 °C
Nominal power	N/A
AC- or DC coupled	DC/AC
Energy consumption (Wh/24 h) (@25°C, 32°C, 45°C)	N/A
Energy efficiency class	N/A
Ambient temperature (Climate class)	Up to 52 °C
Capacity of PV modules required	40 modules, 3.4 kWp
Autonomous days/ stand by time	3
Type of refrigerant	N/A
Battery	Gel
Product life time	< 10 years
Size	20 ft
Weight	N/A



Price and costs	
Investment (including solar panels)	N/A

### Technological and market development

- ILK is a research and development enterprise in Germany, developing innovative prototype solutions.
- Adapted technologies according to special requirements and conditions can be developed.

### Links

<http://www.ilkdresden.de/en/service/consulting-expert-opinions/detail/solar-cooling/>

[http://www.ilkdresden.de/fileadmin/user\\_upload/img\\_projekte/03\\_Angewandte\\_neue\\_Technologien/PV\\_allgemein/PV\\_cooling.pdf](http://www.ilkdresden.de/fileadmin/user_upload/img_projekte/03_Angewandte_neue_Technologien/PV_allgemein/PV_cooling.pdf)

## FS42 Container ILK Solar Ice Maker

**ILK Dresden – Institute for Air Handling and Refrigeration**  
 | Bertolt-Brecht-Allee 20 | 01309 Dresden, Germany

### Product Description:

Specially developed ice machine with high efficiency for fisheries.

- Variable ice maker with small battery
- Stand alone, optional grid interface
- PV-inverter 3ph/230V/50Hz
- 250 kg crushed ice per day
- Water tank
- UV water disinfection
- Ice storage size for two daily outputs
- type of charge controller: MPP

### Target group

- Fisheries

Product Specification	
Cooling volume	N/A
Cooling Temperatures	N/A
Nominal power	5.9 kW (-10°C / 45°C)
AC- or DC coupled	DC/AC
Energy consumption (Wh/24 h) (@25°C, 32°C, 45°C)	N/A
Energy efficiency class	N/A
Ambient temperature (Climate class)	Up to 52 °C
Capacity of PV modules required	e.g. 60 modules, 5.1 kWp
Autonomous days/ stand by time	1
Type of refrigerant	N/A
Battery	Gel
Product life time	< 10 years
Size	20 ft
Weight	N/A



Price and costs	
Investment (including solar panels?)	N/A

### Technological and market development

- ILK is a research and development enterprise in Germany, developing innovative prototype solutions.
- Adapted technologies according to special requirements and conditions can be developed.

### Links

<http://www.ilkdresden.de/en/service/consulting-expert-opinions/detail/solar-cooling/>

[http://www.ilkdresden.de/fileadmin/user\\_upload/img\\_projekte/03\\_Angewandte\\_neue\\_Technologien/PV\\_allgemein/PV\\_cooling.pdf](http://www.ilkdresden.de/fileadmin/user_upload/img_projekte/03_Angewandte_neue_Technologien/PV_allgemein/PV_cooling.pdf)



## **3.2 Food Processing**

3.2.1- Milling, grinding, hulling

3.2.2- Oil Press

3.2.3- Milk Processing

3.2.4- Food for sale preparation

### 3.2.1 Milling, grinding, hulling

#### **Description:**

Graining cereal crops is a basic, traditional business necessary for alimentation and it will behold its importance in the upcoming years. In rural areas of developing countries it is very common to mill cereals by hand for daily food preparation. This takes a lot of time and is an arduous work mainly carried out by woman and children. Mechanized processing of crops and cereals saves time which can be spend on other income generating activities.

Larger quantities of grains are usually milled by electric and fuel driven mills. Often, crops have to be carried over long distances to electrically driven mills which are available in bigger towns only.

Main grains that are processed are: Maize, Barley, Wheat, Millet, Teff, and Sorghum. Typical diesel-driven mills have a capacity of 25 to 1,800 kg of grain per hour. For scattered rural settlements smaller mills are sufficient, since average daily consumption per family is about 2.5 kg.

Solar PV power can be used to drive an electrical AC or DC motor that powers a grain mill. With advancement in technology and rapidly falling prices of Solar PV, solar milling has become economically viable.

Factors that make solar milling attractive:

- Rural farming;
- Scattered but otherwise dense population, and remoteness of the area without connection to the electrical grid;
- Tropical high solar radiation with predictable sunshine hours over the year.

Several manufacturers offer AC grain mills that can be connected to a PV System via inverter. Until now, DC driven solar mills are under development only (University of Ulm).

Solar powered grain mills offer advantages compared to conventional crop processing:

- Time saving due to faster milling process and reduced transportation ways; Time can be used for additional work in the fields which leads to an increased harvest and more food security. Of course saved time can also be spent on non-agriculture income generating activities or education.
- Generation of additional income, e.g. if grain is milled for others on a fee for service basis.
- Costs reduction as crops do not have to be transported to nearest grid-connected mill

The main target groups for PV powered grain mills are smallholder farms, rural communities, cooperatives or projects in places where there is not electrical grid

### Equipment:

A PV powered grain mill consists of the following components:

1. The Mill (hammer, stone, roller mills, etc.)
2. Photovoltaic Array.
3. Control panel
4. Inverter, if an AC mill is used
5. Battery, if the mill is to be used without sunshine

### Challenges

- **High start-up current** is required or a start-up resistor is needed which is prone to breakage. A manual starter, a soft start device or a starting current limitation can prevent from problems with high starting current.
- In case the mill is directly connected to the battery, the battery is not protected against deep discharge. To prevent **deep discharge** recurring user training required.
- Service is needed for **battery maintenance** and the exchange of batteries should be included in the estimated service and maintenance costs.

The grain mill shall be dimensioned in correspondence of the amount of grain that is estimated to be milled on a daily basis. Furthermore the associated power system as to be dimensioned accordingly, taking into account the high start-up current.

Key factors to be defined for proper planning and sizing:

- Amount of grain that is to be milled per day on average, and in peak times? Can the system power the mill for a sufficient amount of time?
- Are there seasonal variations?
- Output of the mill (in kg/day)? Does the output vary in function of the type of grain?
- Does the mill offer the required grain refinement?
- What is the "catchment area" of the mill, i.e., from how far will people come to mill with their products?

## FS43 Grain Mill Solar Milling

**Solar Milling/Seine Tech**, Alemany, 58 (Poligon Industrial)  
08700 IGUALADA (BARCELONA) SPAIN

### Product Description:

This solar mill represents an affordable system to facilitate appropriate cereal/food processing technology.

- Complete milling equipment designed for grinding dry cereals.
- Simple to operate, incurs no running costs, only very low maintenance cost
- Direct drive system without conveyor belt and batteries,

### Target group:

- Smallholder farms, rural communities, cooperatives or projects in off-grid areas.

Product Specification	
Type of Product	Pure granite 500 mm stone mill
Motor	Standard 3-phase asynchronous motor 230/400V 50 Hz; Made in the EU, CE certified.
AC/DC	AC
Soft start device available? (yes/no)	N/A
Electricity consumption	4.4 kWh/d
Control Panel	Links PV array to the stone mill
Placement of above components	Indoor
Battery	Optional, "direct drive system", Batteries only upon request
Capacity of PV modules	750 W
Autonomous days	Zero
Product life time	Long lasting
Packaging	2 wooden boxes (suitable for sea or air freight)
Size	2,16 m <sup>3</sup>
Weight	475 kg



Indicative production capacity per hour (may vary depending on hardness of grain)	
Wheat	35 – 150 kg/hour
Maize	35 – 150 kg/hour
Barley	30 – 110 kg/hour
Millet	25 kg/hour
Teff	40 kg/hour
Sorghum	35 kg/hour

Price	Retail Price
Investment	3490 US \$

### Technological and market development

- Basic milling technology equipped with standard 3-phase motor that in case, can be adapted and found in any market.
- No maintenance costs estimated

### Links

<http://www.solarmilling.com>

## FS44 Grain Mill BOSS Pro Farina

Phaesun GmbH, Brühlweg 9, 87700 Memmingen, Germany

### Product Description:

Obtain flour from most common cereals like maize, wheat, barley, millet, teff and rice.

- Auto stop device for hopper empty with security switch

### Target group:

- Smallholder farms, rural communities, cooperatives or projects in off-grid areas.

Product Specification	
Type of Product	Pure granite 500 mm stone mill
Type of grain	Adjustable grinder for different sorts of grain
Hourly output	45 – 160 kg (depending on grain)
Motor	Standard 3-phase asynchronous motor 3x230/400V, 50Hz, 750 W
AC/DC	AC
Soft start device available? (yes/no)	N/A
Control Panel	Links PV array to the stone mill
Placement of above components	Indoor
Battery	Optional, “direct drive system”, Batteries only upon request
Capacity of PV modules	900 W
Product life time	N/A
Packaging	2 wooden boxes (suitable for sea or air freight)
Size	1000 x 670 x 230 mm
Weight	185 kg



### Indicative production capacity per hour (may vary depending on hardness of grain)

Wheat	55 – 260 kg/hour
Maize	40 – 110 kg/hour
Barley	40 – 110 kg/hour
Millet	45 kg/hour
Teff	45 kg/hour
Sorghum	45 kg/hour

Price and costs	Retail Price
Investment	6000 \$

### Technological and market development

- Phaesun maintains close and long-lasting relationships with local distributing partners in about 18 African countries.
- Phaesun partners provide the service and maintenance structure as well as spare parts and technological optimization for the enduser.
- Experiences from the field are integrated into product optimization.
- Phaesun supports the approach of developing tailor made systems for productive use for special business cases. Contact via <http://www.phaesun.com>

### Links

<http://order.phaesun.com/index.php/phaesun-boss-kit-pro-farina.html>

## FS45 Grain Mill PN-BOSS FMA

Phaesun GmbH, Brühlweg 9, 87700 Memmingen, Germany

### Product Description:

This stone mill can be used for all sorts of grain and corn. Adjustable grinder allow the production of different types of flour. Cereal supply can be manually regulated.

### Target group:

- Smallholder farms, rural communities, cooperatives or projects in off-grid areas.

Product Specification	
Type of Product	Naxo stone mill
Type of grain	Adjustable grinder for different sorts of grain
Production capacity per hour	Ca. 30 kg grain / h
Motor	Standard 3-phase asynchronous motor 3x230/400V, 50Hz, 750 W
AC/DC	AC
Soft start device available? (yes/no)	N/A
Control Panel	Links PV array to the stone mill
Placement of above components	Indoor
Battery	Optional, "direct drive system", Batteries only upon request
Capacity of PV modules	6.3 kW (7 x solar modules 900W)
Product life time	N/A
Packaging	2 wooden boxes (suitable for sea or air freight)
Size	950mm x 800mm x 1100mm
Weight	120 kg



Price and costs	Retail Price
Investment	N/A

### Technological and market development

- Phaesun maintains close and long-lasting relationships with local distributing partners in about 18 African countries.
- Phaesun partners provide the service and maintenance structure as well as spare parts and technological optimization for the enduser.
- Experiences from the field are integrated into product optimization.
- Phaesun supports the approach of developing tailor made systems for productive use for special business cases. Contact via <http://www.phaesun.com>

### Links

<http://order.phaesun.com/index.php/phaesun-boss-kit-pro-farina.html>

## FS46 Grain Mill AgriSol 750W

AgriSol, (project coordinator)

Project Support Services PNG, (manufacturer), PO Box 1912, Lae 411, Morobe Province , Papua New Guinea

### Product Description:

The AgriSol grain mill is applicable for different sorts of grain. AgriSol offers food processing equipment with add-on modules for household electrification, village lighting and income generation. The technology is robust, easy to use and competitively priced.

### Target group:

- Small scale farmers, cooperatives
- Regional Focus: Pacific, Africa

Product Specification	
Type of Product	Grain mill
Type of grain	maize, millet, sorghum etc.
Production capacity per hour	25-50kg/hr
Motor	750W
AC/DC	DC
Soft start device available? (yes/no)	N/A
Control Panel	N/A
Placement of above components	N/A
Battery	Lead-acid, AGM, Gel
Capacity of battery @C10 (Ah)	120 Ah+
Charge Controller	20-40A
Stand by time	1 -2 hours
Capacity of PV modules	4-8 x 125W 24V
Product life time	N/A
Packaging	N/A
Size	N/A
Weight	N/A

Price and costs	Retail Price
Investment	3250 USD

### Technological and market development

Regional Focus: Pacific, Africa

Replacement of components:

- Battery replacement 2+ years,
- DC brushes every 2-5 years

### Links

<http://www.agrisolenergy.com/>

<http://www.psspng.com/products.html>

## FS47 Rice Huller AgriSol RHT-1 AC, 250W

AgriSol, (project coordinator)

Project Support Services PNG, (manufacturer), PO Box 1912, Lae 411, Morobe Province , Papua New Guinea

### Product Description:

This rice huller is designed for brown rice production. AgriSol offers food processing equipment with add-on modules for household electrification, village lighting and income generation. The technology is robust, easy to use and competitively priced.



### Target group:

- Small scale farmers, cooperatives
- Regional Focus: Pacific, Africa

Price and costs	Retail Price
Investment	850 / 2500 US \$

Product Specification		Technological and market development
Type of Product	Rice Huller	
Type of grain	Rice	
Production capacity per hour	35 - 40kg/hr	<ul style="list-style-type: none"> <li>• Battery replacement: 2+ years,</li> <li>• rubber rollers: every 6 mth,</li> <li>• DC brushes every 2-5 years</li> </ul>
Motor	250W	
AC/DC	DC	
Soft start device available? (yes/no)	N/A	Links
Control Panel	N/A	
Placement of above components	N/A	<a href="http://www.agrisolenergy.com/">http://www.agrisolenergy.com/</a> <a href="http://www.psspng.com/products.html">http://www.psspng.com/products.html</a>
Battery	Lead-acid, AGM, Gel	
Capacity of battery @C10 (Ah)	80 Ah+	
Stand by time	1 -2 hours	
Charge Controller	10A	
Capacity of PV modules	240W (2 x 120 W) 24 V	
Product life time	N/A	
Size	25 x 55 x 83 cm	
Weight	33 kg	



## FS48 Rice Huller AgriSol 375W

AgriSol, (project coordinator)

Project Support Services PNG, (manufacturer), PO Box 1912, Lae  
411, Morobe Province , Papua New Guinea

### Product Description:

The AgriSol rice huller produces brown rice. AgriSol offers food processing equipment with add-on modules for household electrification, village lighting and income generation. The technology is robust, easy to use and competitively priced.

### Target group:

- Small scale farmers, cooperatives
- Regional Focus: Pacific, Africa

Price and costs	Retail Price
Investment	3000 US \$

### Technological and market development

Regional Focus: Pacific, Africa

Replacement of components:

- Battery replacement: 2+ years,
- rubber rollers: every 6 mth,
- DC brushes every 2-5 years

Product Specification		
Type of Product	Rice Huller	Links
Type of grain	Rice	<a href="http://www.agrisolenergy.com/">http://www.agrisolenergy.com/</a>
Production capacity per hour	70kg/hr	<a href="http://www.psspng.com/products.html">http://www.psspng.com/products.html</a>
Motor	375W	
AC/DC	DC	
Soft start device available? (yes/no)	N/A	
Control Panel	N/A	
Placement of above components	N/A	
Battery	Lead-acid, AGM, Gel	
Capacity of battery @C10 (Ah)	120 Ah+	
Stand by time	1 -2 hours	
Charge Controller	20A	
Capacity of PV modules	240W (2 x 120 W) 24 V	
Produkt life time	N/A	
Size	N/A	
Weight	N/A	

## FS49 Rice Polisher AgriSol 375W

**AgriSol**, (project coordinator)

**Project Support Services PNG**, (manufacturer), PO Box 1912, Lae 411, Morobe Province , Papua New Guinea

### Product Description:

The AgriSol Rice polisher produces white rice and bran and is normally part of the rice huller.

AgriSol offers food processing equipment with add-on modules for household electrification, village lighting and income generation. The technology is robust, easy to use and competitively priced.

### Target group:

- Small scale farmers, cooperatives
- Regional Focus: Pacific, Africa

Product Specification	
Type of Product	Rice Polisher
Type of grain	Rice
Production capacity per hour	60kg/hr
Motor	375W
AC/DC	DC
Soft start device available? (yes/no)	N/A
Control Panel	N/A
Placement of above components	N/A
Battery	Lead-acid, AGM, Gel
Capacity of battery @C10 (Ah)	N/A
Stand by time	1 -2 hours
Capacity of PV modules	Normally part of the rice huller
Produkt life time	N/A
Packaging	N/A
Size	N/A
Weight	N/A

Price and costs	Retail Price
Investment	1000 US \$

### Technological and market development

Regional Focus: Pacific, Africa

Replacement of components:

- Battery replacement 2+ years, DC brushes every 2-5 years

### Links

<http://www.agrisolenergy.com/>

<http://www.psspng.com/products.html>

## FS50 Maize Sheller/Thresher AgriSol 100W

AgriSol, (project coordinator)

Project Support Services PNG, (manufacturer), PO Box 1912, Lae 411, Morobe Province , Papua New Guinea

### Product Description:

The AgriSol maize sheller/thresher.

AgriSol offers food processing equipment with add-on modules for household electrification, village lighting and income generation. The technology is robust, easy to use and competitively priced.

### Target group:

- Small scale farmers, cooperatives
- Regional Focus: Pacific, Africa

Product Specification	
Type of Product	Maize sheller/thresher
Type of grain	Maize
Production capacity per hour	250kg/hr
Motor	100W
AC/DC	DC
Soft start device available? (yes/no)	N/A
Control Panel	N/A
Placement of above components	N/A
Battery	Lead-acid, AGM, Gel
Capacity of battery @C10 (Ah)	120 Ah+
Charge Controller	20-40A
Stand by time	1 -2 hours
Capacity of PV modules	Product is typically part of the grain mill
Produkt life time	N/A
Size	N/A
Weight	N/A

Price and costs	Retail Price
Investment	500 US \$

### Technological and market development

Maize sheller/thresher typically comes as part of maize milling package - i.e. with grain mill

Replacement of components:

- Battery replacement 2+ years,
- DC brushes every 2-5 years

### Links

<http://www.agrisolenergy.com/>

<http://www.psspng.com/products.html>

## FS51 Cassava grater AgriSol 250W

AgriSol, (project coordinator)

Project Support Services PNG, (manufacturer), PO Box 1912, Lae  
411, Morobe Province , Papua New Guinea

### Product Description:

AgriSol Cassava grater  
AgriSol offers food processing equipment with add-on modules for household electrification, village lighting and income generation

### Target group:

- Farmer, cooperatives
- Regional Focus: Pacific, Africa

Product Specification	
Type of Product	Cassava grater
Type of grain	Cassaava
Production capacity per hour	100kg/hr
Motor	250W
AC/DC	DC
Soft start device available? (yes/no)	N/A
Control Panel	N/A
Placement of above components	N/A
Battery	Lead-acid, AGM, Gel
Capacity of battery @C10 (Ah)	80 Ah+
Charge Controller	10A
Stand by time	1 -2 hours
Capacity of PV modules	2 x 125W 24V
Produkt life time	N/A
Size	N/A
Weight	N/A

Price and costs	
Investment	1750 US \$

### Technological and market development

Replacement of components:

- Battery replacement 2+ years,
- DC brushes every 2-5 years

### Links

<http://www.agrisolenergy.com/>

<http://www.psspng.com/products.html>

### 3.2.2 Oil-Press

#### FS52 Oil Press BOSS Kit Pro Press

Phaesun GmbH, Brühlweg 9, 87700 Memmingen, Germany

#### Product Description:

This solar oil press is ideal for the pressing of different crops. It contains speed regulation and achieves excellent pressing results due to the very efficient engine. The solar oil press is available as complete kit with high quality components for a reliable and professional usage day by day.

#### Target group:

- Smallholder farms, rural communities, cooperatives or projects in off-grid areas.

Product Specification	
Product	Oil press
Type of grain	Adjustable speed for different sorts of grain
Motor	1,5 kW/230 VAC oil press
AC/DC	AC
Inverter	3 kW inverter
Battery	System includes battery
Capacity of PV modules	2400 Wp
Produkt life time	N/A



Price and costs	Retail Price
Investment	

#### Technological and market development

- Phaesun maintains close and long-lasting relationships with local distributing partners in about 18 African countries.
- Phaesun partners provide the service and maintenance structure as well as spare parts and technological optimization for the enduser.
- Experiences from the field are integrated into product optimization.
- Phaesun supports the approach of developing tailor made systems for productive use for special business cases. Contact via <http://www.phaesun.com>

#### Links

### 3.2.3 Milk processing

#### FS53 On-farm milk cooling system

**Steca Elektronik GmbH**, Mammostraße 1, 87700 Memmingen, Germany

**Phaesun GmbH**, Brühlweg 9, 87700 Memmingen, Germany

**University of Hohenheim**, Institute of Agriculture Engineering, Tropical & Subtropical Group, Garbenstr. 9, 70599 Stuttgart, Germany |

#### Product Description:

Small-scale Solar milk cooling system based on the use of DC-Refrigerators and conventional milk cans.

- Use of 2 refrigerators for ice production and milk cooling.
- Ice is used as cooling medium for fast milk cooling.
- Adapted 20L milk cans assures milk quality for over 24h.
- The use of ice as energy storage reduces the need of batteries and increase system profitability

**Target group:** Farmers.



Product Specification	
Cooling volume	Up to 45 L milk / day
Cooling temperatures	4°C
Nominal power	40-200W
AC- or DC coupled	DC
Energy consumption (Wh/24 h) (@20°C, 30°C, 40°C)	1000, 1500, 2000 Wh
Energy efficiency class	A++
Ambient temperature (Climate class)	T
Capacity of PV modules required	1000 Wp
Autonomous days/ stand by	3
Type of refrigerant	R134a
Battery	Gel, 300Ah
Size	917 x 872 x 709 mm (freezer) 1,288 x 919 x 760 mm (chiller)
Weight	47 kg(freezer), 62 kg(chiller)

Price and costs	Retail Price Germany
Investment (whole system)	Ca. 3500€

#### Technological and market development

- Developed by Steca(domestic refrigerators) and the University of Hohenheim (additional components).
- Distributed by Phaesun (whole system)
- R&D Phase until 2017; In-field testing 2015 – 2017 in Tunisia

#### Links

<https://www.uni-hohenheim.de/project/field-testing-of-an-innovative-solar-powered-milk-cooling-solution-for-the-higher-efficiency-of-the-dairy-subsector-in-tunisia>

## FS54 Solar Milking Machine Lifeway Solar

**Lifeway solar devices**, 1st Floor, Central Arcade, Azad Road, Cochin - 682 017, Kaloor, Cochin, Kerala, India.

### Product Description:

Pollution Free Solar Milking Machines prevent air and noise pollution from diesel generators and also helps to avoid various diseases generated from unhygienic milking practices.

Includes a 10 watt LED light for early morning milking.

### Target group:

Cattle Farmers



Product Specification		Price and costs	Retail Price India
Load (W)	N/A	Investment (Indian Rupees)	70.000 Rs (1250 US\$ in 2012)
AC- or DC-coupled	DC		
Voltage of system (V)	24		
Capacity of solar panel (kWp)	230 Wp		
Motor and pump	24V/1Hp Dc motor & suction pump	<b>Technological and market development</b>	
Capacity of battery @C10 (Ah)	200 Ah, 12 V	N/A	
Battery type	N/A	<b>Links</b>	
Product life span (h)	N/A	<a href="http://www.lifewaysolar.com/products.htm">http://www.lifewaysolar.com/products.htm</a>	
Autonomy days	N/A		
Size	N/A		
Weight	N/A		

## FS55 Mobile Milking Machine Siddon Biotech

**Siddon Biotech & Equipments**, 23/2, 2nd Main, 40 Ft Road, P N S Layout, Subbaiahna Palaya, Bangalore, India.

### Product Description:

Solar powered mobile milking machine. This electrical milking machine reduces noise significantly which is a significant benefit for farmer and dairy.

### Target group:

Cattle Farmers

Product Specification	
Load (W)	N/A
AC- or DC-coupled	N/A
Voltage of system (V)	N/A
Capacity of solar panel (kWp)	N/A
Motor and pump	N/A
Capacity of battery @C10 (Ah)	N/A
Battery type	N/A
Product life span (h)	N/A
Autonomy days	N/A
Size	N/A
Weight	N/A

Price and costs	Retail Price India
Investment (Indian Rupees)	40.000 Rs

### Technological and market development

N/A

### Links

[http://www.siddon.in/cattle\\_products.html](http://www.siddon.in/cattle_products.html)



## FS56 Mobile Milking Machine Wenzhou Marice

Wenzhou Marice Animal Husbandry Machinery  
Technology, Zhejiang, China

### Product Description:

Portable Milking Machine for Cow or Buffalo. The mobility of Dairy Maid Milking machine is ideal for today's cattle farmers. Robust construction means easy maintenance. Easy to operate. Large and heavy duty wheels make easy to move around. Goat milking machine also available.

Single and Double buckets available.

### Target group:

Cattle farmers

Product Specification	
Motor	24V / 1 Hp DC motor
AC or DC coupled	DC
Voltage of system (V)	12 V
Capacity of solar panel (kWp)	230 Wp
Capacity of battery @C10 (Ah)	200 Ah
Battery type	N/A
Product life span (h)	N/A
Autonomy days	1
Size	N/A
Weight	N/A

Price and costs	Retail Price China without Tax and Shipping
Investment	800 – 1000 US\$

### Technological and market development

Made in China

### Links

[http://www.alibaba.com/product-detail/Solar-Energy-Milking-Machine-Mobile-](http://www.alibaba.com/product-detail/Solar-Energy-Milking-Machine-Mobile-Cow_852480837.html?spm=a2700.7724857.35.1.bnikEN)

[Cow\\_852480837.html?spm=a2700.7724857.35.1.bnikEN](http://www.alibaba.com/product-detail/Solar-Energy-Milking-Machine-Mobile-Cow_852480837.html?spm=a2700.7724857.35.1.bnikEN)

### 3.2.4 Food for sale preparation

#### FS57 PV-powered Buttermaker

##### Product Description:

The solar buttermaker is an adapted technology which reduces time and alleviates workload traditionally carried out by women. It enables women to produce butter and by-products like whey or curd for sale and therefore offers additional income generation for families.

##### Target Group:

Rural women

Product Specification	
Load (W)	N/A
Ac or DC coupled	N/A
Product life time	N/A
Capacity of solar panel (kWp) required	N/A
	N/A
Size	N/A
Weight	N/A



Price and costs	Retail Price Afghanistan
Investment	39 €

##### Technological and market development

Project supported by GLS Bank “Zukunftsstiftung Entwicklung”

##### Links

<http://www.entwicklungshilfe3.de/spenderinnen/projekte/weltweit/afghanistan/energiestationen/>

## FS58 Kettle RoadPro 12-Volt 20oz Hot Pot

RoadPro, 724 Lawn Road, Palmyra, PA 17078, USA

### Product Description:

- Plug for Cigarette Lighter Socket
- See Through Window for Viewing Contents
- Holds Up to 20 Ounces of Liquid (600ml)
- Outer Lid Can be Used as a Cup
- Safety Circuit Protection
- CE Certified

### Target Group:

Caravaning, RV, remote areas with DC electricity supply

- 



Product Specification	
Load (W)	• 85 Watts/ 7 Amps
Ac or DC coupled	DC, 12 V
Product life time	N/A
Capacity of solar panel (kWp) required	N/A
Size	N/A
Weight	N/A

Price and costs	Retail Price USA
Investment	17 US \$

### Technological and market development

#### Links

<http://www.roadproonthego.com/products/portable-electronics/12-volt-products/sp/12volt-20oz-hot-pot/>

## FS59 Coffee Maker RoadPro 12-Volt with 16oz. Metal Carafe

RoadPro, 724 Lawn Road, Palmyra, PA 17078, USA

### Product Description:

- Brews 16 Ounces of Coffee In Under 15 Minutes
- Brews Directly Into the Stainless Steel Travel Mug
- Easy to Clean Reusable Filter, Saves Money
- Illuminated On/Off Switch
- Includes Mounting Bracket to Mount In Your Vehicle
- Fused 15 Amp 12-Volt Plug
- Water Level Meter
- Stop-Drip Interrupt and Auto Shut Off Features
- 7' Cord Length
- 13 Amps/156W Current Draw

### Target Group:

Caravaning, RV, remote areas with DC electricity supply

- 

Product Specification	
Load (W)	156 W
Ac or DC coupled	DC, 12 V
Product life time	N/A
Capacity of solar panel (kWp) required	N/A
Size	N/A
Weight	N/A



Price and costs	Retail Price USA
Investment	30 US \$

### Technological and market development

#### Links

<http://www.roadproonthego.com/products/portable-electronics/12-volt-products/sp/12volt-coffee-maker-with-16oz-metal-carafe/>

## FS60 Vacuum cleaner RoadPro 12-Volt Wet/Dry Canister

RoadPro, 724 Lawn Road, Palmyra, PA 17078, USA

### Product Description:

DC Vacuum Cleaner

- Plug for cigarette lighter socket
- Heavy Duty 12,500 RPM Motor
- 36" Flexible Hose with Swivel Cuffs
- 17' Power Cord

### Target Group:

Caravaning, RV, remote areas with DC electricity supply

- 

Product Specification	
Load (W)	N/A
Ac or DC coupled	N/A
Product life time	N/A
Capacity of solar panel (kWp) required	N/A
Size	N/A
Weight	N/A



Price and costs	Retail Price USA
Investment	30 US\$

### Technological and market development

- Product Specifications have to be adapted to the specific technology

PV-System Specifications in case it is a PV-System solution, Specifications also may be adapted.

### Links

<http://www.roadproonthe-go.com/products/portable-electronics/12-volt-products/sp/12volt-wetdry-canister-vacuum/>

## FS61 DC Microwave WaveBox

**Power Hunt**, 12655 SW Center St, Suite 275 Beaverton OR 97005, USA

### Product Description:

- Large (25.4 x 17.8 x 15.3 cm) inside dimensions
- Cooks in minutes
- Permanent mount or portable use
- New space age interior improves performance by more than 10% and provides even heating without the need for a turntable.
- Includes FREE CoolBag Storage for food storage
- Requires PNP power outlet (sold separately)

### Target Group:

Caravaning, RV, remote areas with DC electricity supply

- 

Product Specification	
Load (W)	660 W
Ac or DC coupled	DC, 12 V
Product life time	N/A
Capacity of solar panel (kWp) required	N/A
Size	N/A
Weight	N/A



Price and costs	Retail Price USA
Investment	330 US \$

### Technological and market development

Main markets: North and South America, Australia and New Zealand

### Links

<http://www.power-hunt.com/12-volt-products.php>

## FS62 AC/DC Microwave WaveBox

Power Hunt, 12655 SW Center St, Suite 275 Beaverton OR 97005, USA

### Product Description:

- Large ( 25.4 x 17.8 x 15.3 cm) inside dimensions
- Cooks in minutes
- Permanent mount or portable use
- New space age interior improves performance by more than 10% and provides even heating without the need for a turntable.
- Includes FREE CoolBag Storage for food storage
- Included 120V AC power cord enables operation through any standard household power outlet
- Requires PNP power outlet for DC operation(sold separately)

### Target Group:

Caravanning, RV, remote areas with DC electricity supply

Product Specification	
Load (W)	660 W
Ac or DC coupled	Optional DC, 12 V or AC, 110V
Product life time	N/A
Capacity of solar panel (kWp) required	N/A
Size	N/A
Weight	N/A



Price and costs	Retail Price USA
Investment	N/A

### Technological and market development

Main markets: North and South America, Australia and New Zealand

### Links

<http://www.power-hunt.com/12-volt-products.php>

## FS63 Solar DC Kettle SE520

Ningbo Jiming Electric Appliance Co., Ltd., No.546 Qiye Road,  
Zhouxiang Town, Cixi, Zhejiang, China

### Product Description:

A DC operated plastic solar kettle

- Energy saving
- Water loading capacity: 0.8L
- Stainless steel heating element
- ON/OFF light indicator
- Easy open cover button
- Color: variable color printing options
- With water level indicator
- Automatic switch off
- Keep warm for more durable for a long time
- With locking lid, keep safe when you operate

### Target Group:

For solar home, car, travel, trip, camping, outdoor activity

Product Specification	
Load (W)	400 W
AC or DC coupled	DC, 12 / 24V
Product life time	N/A
Capacity of solar panel (kWp) required	N/A
Size	N/A
Weight	N/A



Price and costs	Retail Price China
Investment	N/A

### Technological and market development

Made in China

### Links

<http://www.solarappliance.com/solar-dc-kettle/solar-dc-kettle.html>



## FS64 Solar Kettle Stainless Steel 12V SE510

Ningbo Jiming Electric Appliance Co., Ltd., No.546 Qiye Road,  
Zhouxiang Town, Cixi, Zhejiang, China

### Product Description:

A DC operated solar kettle

- Energy saving
- Water loading capacity: 1.2L
- Stainless steel heating element
- ON/OFF light indicator
- Easy open cover button
- Color: variable color printing options
- With water level indicator
- Automatic switch off
- Keep warm for more durable for a long time
- With locking lid, keep safe when you operate

### Target Group:

For solar home, car, travel, trip, camping, outdoor activity

Product Specification	
Load (W)	350 W
AC or DC coupled	DC, 12 / 24V
Product life time	N/A
Capacity of solar panel (kWp) required	N/A
Size	N/A
Weight	N/A



Price and costs	Retail Price China
Investment	N/A

### Technological and market development

Made in China

### Links

<http://www.solardcappliance.com/solar-dc-kettle/dc-solar-kettle.html>

## FS65 Solar DC Kettle SE500

Ningbo Jiming Electric Appliance Co., Ltd., No.546 Qiye Road,  
Zhouxiang Town, Cixi, Zhejiang, China

### Product Description:

A DC operated plastic solar kettle

- Energy saving
- Water loading capacity: 1.2L
- Stainless steel heating element
- ON/OFF light indicator
- Easy open cover button
- Color: variable color printing options
- With water level indicator
- Automatic switch off
- Keep warm for more durable for a long time
- With locking lid, keep safe when you operate

### Target Group:

For solar home, car, travel, trip, camping, outdoor activity

Product Specification	
Load (W)	350 W
AC or DC coupled	DC, 12 / 24V
Product life time	N/A
Capacity of solar panel (kWp) required	N/A
Size	N/A
Weight	N/A



Price and costs	Retail Price
Investment	N/A

### Technological and market development

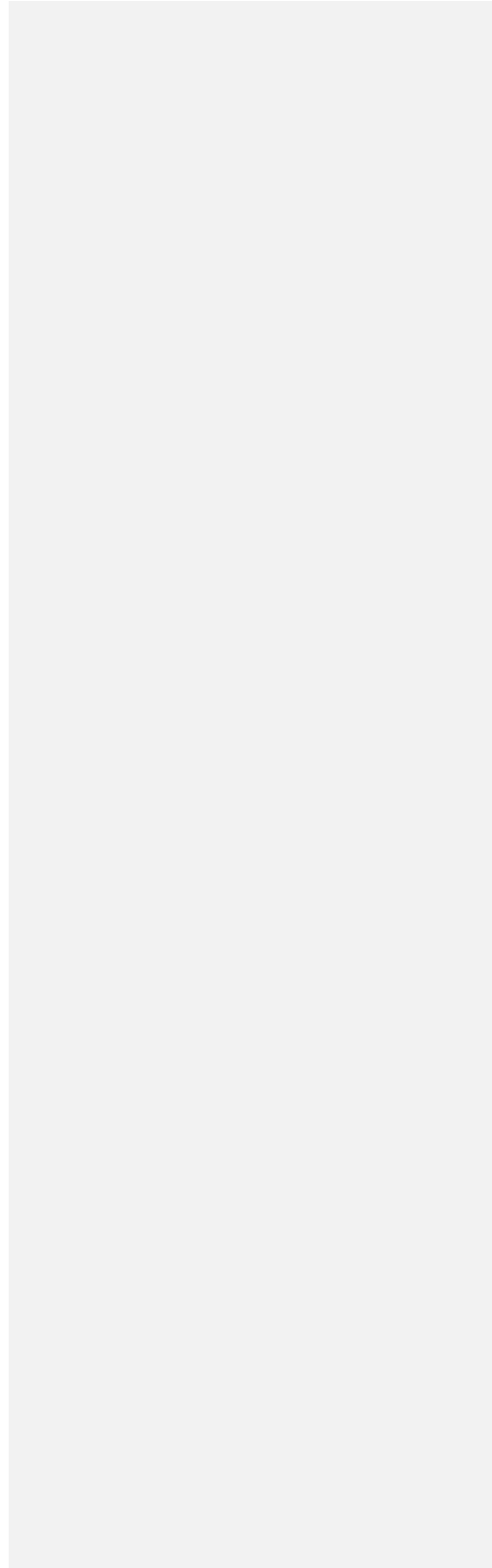
Made in China

### Links

<http://www.solarappliance.com/solar-dc-kettle/solar-dc-kettle.html>

### **3.3 Equipment for Livestock management**

- 3.3.1 - poultry farming
- 3.3.2 - Solar fences



### 3.3.1 Poultry farming

#### FS66 Semi-automatic Poultry Incubator (40 eggs capacity) Lifeway Solar

**Lifeway solar devices**, 1st Floor, Central Arcade, Azad Road, Cochin - 682 017, Kaloor, Cochin, Kerala, India.

##### Product Description:

This semi-Automatic unit is capable of hatching 100 Quail, 40 Chicks or 25 Goose eggs. It is supplied with fully automatic heat control and excellent thermal properties of the fiber glass cabinet.

Egg turning is done manually by turning each egg 4 or 5 times in a day. There are no internal Electrical moving mechanism associated with the egg turning. So nothing to trap or injure emerging chicks.

##### Target group:

This incubator is developed exclusively for unemployed woman living in rural India to find themselves a self employment venture to support their families.

Product Specification	
Load (W)	26 W
AC- or DC-coupled	DC
Voltage of system (V)	12
Capacity of solar panel (kWp)	40 Wp
Electricity supply	N/A
Capacity of battery @C10 (Ah)	26 Ah
Battery type	N/A
Product life span (h)	N/A
Autonomy days	N/A
Size	N/A
Weight	N/A



Price and costs	Retail Price India
Investment (Indian Rupees)	40,000.00 Rs

##### Technological and market development

- This project has been approved by IIT Madras, Chennai and financed by L-Ramp. Cooperation with NGOs is envisaged.
- Distribution is accompanied by training and support in cooperation with local institutions.
- Solar poultry incubators are distributed among villagers in Jhabua Dist. MP, Ananthapur and Ananthapur, India.
- Financing support is offered.

##### Links

[http://www.lifewaysolar.com/prdt\\_pincubator.htm](http://www.lifewaysolar.com/prdt_pincubator.htm)

## FS67 Fully automatic Poultry Incubator (200/500 eggs capacity) Lifeway Solar

**Lifeway solar devices**, 1st Floor, Central Arcade, Azad Road, Cochin - 682 017, Kaloor, Cochin, Kerala, India.

### Product Description:

Lifeway has developed poultry incubators with a capacity of 200 and 500 Eggs as fully automatic solar powered system.

The fiber glass double skinned box with puff insulation further improving temperature stability and operational efficiency.

### Target group:

This incubator is developed exclusively for unemployed woman living in rural India to find themselves a self employment venture to support their families.

Product Specification	
Load (W)	175 W
AC- or DC-coupled	DC
Voltage of system (V)	24
Capacity of solar panel (kWp)	200 Wp
Electricity supply	N/A
Capacity of battery @C10 (Ah)	26 Ah
Battery type	N/A
Product life span (h)	N/A
Autonomy days	N/A
Size	N/A
Weight	N/A

### Fully Automatic (200-500 eggs capacity)



Price and costs	Retail Price India
Investment (Indian Rupees)	40,000.00 Rs

### Technological and market development

- This project has been approved by IIT Madras, Chennai and financed by L-Ramp. Cooperation with NGOs is envisaged.
- Distribution is accompanied by training and support in cooperation with local institutions.
- Solar poultry incubators are distributed among villagers in Jhabua Dist. MP, Ananthapur and Ananthapur, India.
- Financing support is offered.
- We are also Renting out poultry incubators on monthly basis

### Links

[http://www.lifewaysolar.com/prdt\\_pincubator.htm](http://www.lifewaysolar.com/prdt_pincubator.htm)

## FS68 Egg Incubator NANS

**NANS/Thomas International**, Rajiveer Pinheiro (Partner), Old No. 169, New No. 306, Linghi Chetty Street, Chennai – 600001, Tamil Nadu, India

### Product Description:

A solar powered egg incubator with capacity of 264chicken eggs, 189duck eggs, 663quail eggs, 96 goose eggs, 6 ostrich eggs. The incubator has an automatic egg turner, turning eggs every 90 minutes allowing a hatching rate of 98 %.



### Target group:

N/A

Product Specification	
Load (W)	250 W
AC- or DC-coupled	AC
Voltage of system (V)	220 – 240V
Capacity of solar panel (kWp)	N/A
Electricity supply	N/A
Capacity of battery @C10 (Ah)	N/A
Battery type	N/A
Product life span (h)	N/A
Autonomy days	N/A
Size	N/A
Weight	N/A

Price and costs	Retail Price India
Investment (Indian Rupees)	N/A

### Technological and market development

- N/A

### Links

<http://www.thomaseximp.com/egg.html>

## FS69 Egg incubator WQ-42 Engokho

Engokho Kuku Farmers, Lazarous House / Inn Rm. 17,  
Nairobi.

### Product Description:

This egg incubator has a capacity for 42 chicken or 168 quail eggs. It also is applicable for duck, ostrich, turkey, goose, reptile, bird, emu.

It has an automatic temperature control,

### Target group:

Smallholder poultry farmers

Product Specification	
Load (W)	80 W
AC- or DC-coupled	DC
Voltage of system (V)	12V - 120V or 220V - 240V AC 50/60 HZ
Capacity of solar panel (kWp)	120W
Capacity of battery @C10 (Ah)	N/A
Battery type	N/A
Product life span (h)	10 – 15 years
Autonomy days	N/A
Size	N/A
Weight	N/A



Price and costs	Retail Price Kenya
Investment (Kenian Shilling)	30.000 Kshs

### Technological and market development

- 2 years warranty
- Offers project development, training and assists in identifying an appropriate financing scheme.
- Main market focus: East Africa

### Links

<http://www.kuku.co.ke/42-eggs-incubator.php#.VaPCivncKzU>

### 3.3.2 Solar Fences

#### FS70 Adjustable Solar Electric Fence Controller Thunderbold

Thunderbold Magnum Solar,.

##### Product Description:

This solar fencer can electrify 3 to 5 miles of single-strand fencing wire, and you can adjust its solar panel's angle to capture more solar power at your location. The solar fencer is designed to keep only animals confined to a specific area by emitting an electrical shock. A ground rod (not included) is required to properly ground this solar fence control.

- Over-discharge protection circuit
- Protected on/off flip switch
- Copper terminal posts marked red (positive) and black (negative) for quick and easy hook-up
- Impact resistant housing
- Rechargeable 4.5 amp hour, 6 volt lead-acid battery
- Fully charged in 8 hours of direct sunlight
- 2-1/4 in. keyhole mounting holes for easy installation

##### Target group:

Cattle Farmers

Product Specification	
Load (W)	1.3 W
AC- or DC-coupled	DC
Input Voltage	N/A
Output Voltage	8.7 V
Capacity of solar panel (kWp)	N/A
Capacity of battery @C10 (Ah)	N/A
Battery type	Lead Acid
Product life span (h)	N/A
Autonomy days	N/A
Size	N/A
Weight	3.50 lb



Price and costs	Retail Price USA
Investment	69.99 S\$

##### Technological and market development

Available via Harbor Freight

##### Links

<http://www.harborfreight.com/solar-fencer-47454.html>



## FS71 Solar Electric Fence Charger Zareba® (2 – 30 miles)

Zareba, <http://www.zarebasystems.com/>

### Product Description:

Patented mechanical heliotropic capability allows the energizer to turn to face the sun, regardless of the direction the T-post faces. Made in the USA, this charger can be used in conditions with no weeds or light weeds. The solar panel features compartmental damage-resistant construction.

- 360° rotation allows charger to rotate on T-Post to face the sun
- Can be used with steel, aluminum, poly wire, poly rope or poly tape
- Low-impedance technology allows for longer battery life
- One year limited warranty includes damage caused by lightning
- Service Experts Available To Answer Your Installation Questions

### Target group:

Livestock Farmers

Product Specification	
Load (W)	1.3 W
AC- or DC-coupled	DC
Output Voltage	6 V
Output Voltage	8.7 V
Capacity of solar panel (kWp)	N/A
Capacity of battery @C10 (Ah)	N/A
Battery type	Lead Acid
Product life span (h)	N/A
Autonomy days	N/A
Size	N/A
Weight	3.50 lb



Zareba® Systems Solar Charger Options						
Model Number	Range	Input Voltage Output Voltage	Animal Controlled	Weed Controlled	Battery Type (Included)	Number of Warranty Years, Includes Lightning Damage**
ESP2M-Z	2 miles	Input Voltage: 4 VDC, 0.2 A Output Voltage: 8 KV +/- 20% open circuit voltage	Small animals including rabbits, chickens, and pets	Light	4 volt battery	1-year limited warranty
ESP3M-Z	3 miles	Input Voltage: 6 VDC, 0.2 A Output Voltage: 7.2 KV +/- 20% open circuit voltage	Small livestock and nuisance animals	Light	6 volt battery	1-year limited warranty
ESP5M-Z	5 miles	Input Voltage: 6 VDC, 0.2 A Output Voltage: 8.2 KV +/- 20% open circuit voltage	Large and small livestock and nuisance animals	Up to Moderate	6 volt battery	1-year limited warranty
ESP10M-Z	10 miles	Input Voltage: 6 volt input Output Voltage: 7.5 KV +/- 20% open circuit voltage	All livestock and nuisance animals	Up to Heavy	6 volt battery	1-year limited warranty
ESP30M-Z	30 miles	Input Voltage: 6 VDC, 0.2 A Output Voltage: 7.8 KV +/- 20% open circuit voltage	Small, large and exotic livestock and predators. Not recommended for small animals.	Up to Heavy	12 volt battery (2 6-volt batteries in line)	2-year limited warranty

\* In ideal conditions  
\*\* Register your Zareba® Systems charger online at ZarebaSystems.com

Price and costs	Retail Price
Investment	136 - 350 S\$

### Technological and market development

All of Zarebas solar fence controllers use low impedance technology to maintain maximum energy levels. They can compensate for energy loss caused by vegetation or fence load, enabling them to power long fences with moderate weeds. Our solar energizers feature 4, 6, 9, or 12 volt batteries.

### Links

<http://www.zarebasystems.com/store/electric-fence-chargers/solar-powered>

## **3.4 Other Services**

3.4.1- Laundry

3.4.2- Barber shop and beauty salon

### **3.4.1 Laundry**

We will present some example appliances for DC washing machines, clothes dryers and irons, to demonstrate that first technological developments have been made in this direction. Information on field tests and experiences with these products are still pending.

## FS72 Washing Machine CERAD

CERAD, UET, Lahore, Pakistan

### Product Description:

An energy efficient washing machine has been designed by CERAD, using a 12 V DC motor and saving up to 80 percent of power. It is made by altering a conventional washing machine. It is power failure independent during sunny days. Its electric power consumption is reduced by 5 times. It has same washing capacity at equal speed and better working hours. It has 1.5 years payback period.

- A low mute design, single tube, full plastic cabinet, water proof and rust proof machine is available in just

### Target Group:

Product Specification	
Load (W)	70 W
Ac or DC coupled	DC
Voltage (V)	12V
Capacity of solar panel (kWp) required	N/A
Washing capacity	5 – 7 kg
Size	N/A
Weight	N/A



Price and costs	Retail Price Pakistan
Investment	2600 Rs

### Technological and market development

### Links

[http://cerad.uet.edu.pk/solutions/products\\_detail/1](http://cerad.uet.edu.pk/solutions/products_detail/1)

## FS73 Cloth Dryer CERAD

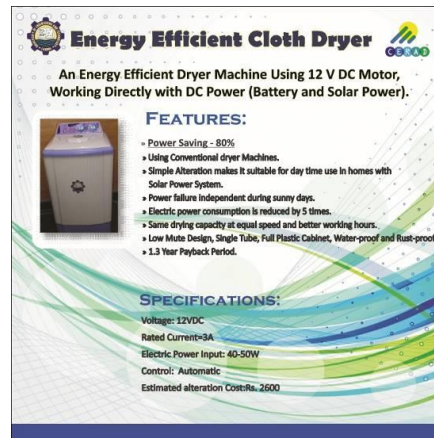
CERAD, UET, Lahore, Pakistan

### Product Description:

This energy efficient cloth dryer designed by CERAD saves up to 80 percent of energy. A simple dryer machine is converted into an energy efficient device by doing some alterations.

- Single tube ,
- full plastic cabinet,
- water proof and rust proof,
- moreover it has 1.3 years pay back guarantee.

### Target Group:



**Energy Efficient Cloth Dryer**

An Energy Efficient Dryer Machine Using 12 V DC Motor, Working Directly with DC Power (Battery and Solar Power).

**FEATURES:**

- Power Saving - 80%
- Using Conventional dryer Machines.
- Simple Alteration makes it suitable for day time use in homes with Solar Power System.
- Power failure Independent during sunny days.
- Electric power consumption is reduced by 5 times.
- Same drying capacity at equal speed and better working hours.
- Low Mute Design, Single Tube, Full Plastic Cabinet, Water-proof and Rust-proof.
- 1.3 Year Payback Period.

**SPECIFICATIONS:**

Voltage: 12VDC  
 Rated Current: 3A  
 Electric Power Input: 40-50W  
 Control: Automatic  
 Estimated alteration Cost: Rs. 2600

Product Specification	
Load (W)	40 – 50 W
Ac or DC coupled	DC
Voltage (V)	12V
Capacity of solar panel (kWp) required	N/A
Produkt life time	N/A

Price and costs	Retail Price Pakistan
Investment	2600 Rs

### Technological and market development

### Links

[http://cerad.uet.edu.pk/solutions/products\\_detail/1](http://cerad.uet.edu.pk/solutions/products_detail/1)

## FS74 Solar DC Power Iron Dry/ Spray style-12V SL100S

Ningbo Jiming Electric Appliance Co., Ltd., No.546 Qiye Road, Zhouxiang Town, Cixi, Zhejiang, China

### Product Description:

Electric Solar Energy 12Volt. DC Iron. Option for dry ironing or spray.

- 3M 2x1.5mm<sup>2</sup> Power wire with clamp, White and blue
- Max. current: 12.5A
- Max. temperature: 150°C
- Automatic temperature control system
- Energy saving: 1 minute hot for 60°C; 2 minutes hot for 150°C
- Can work with car battery
- Duration time: if work by 100Ah battery can use 7 hours
- Material: ABS body and aluminum baseplate
- With 3meters copper cable and clamps
- Red power indicating light

### Target Group:

For solar home, car, travel, trip, camping, outdoor activity

Product Specification	
Load (W)	150 W
AC or DC coupled	DC, 12
Product life time	N/A
Capacity of solar panel (kWp) required	N/A
Size	240x107x115mm
Weight	N/A



Price and costs	Retail Price
Investment	N/A
Price and costs	

### Technological and market development

Made in China

Warranty 2 years

### Links

<http://www.solardcappliance.com/solar-dc-iron/solar-dc-power-iron.html>

## FS75 DC Electric Dry Iron SL-100D

Ningbo Jiming Electric Appliance Co., Ltd., No.546 Qiye Road, Zhouxiang Town, Cixi, Zhejiang, China

### Product Description:

- Dry use only
- Max. temperature: 150°C
- Automatic temperature control system
- Energy saving: 1 minute hot for 60°C; 2 minutes hot for 150°C
- Can work with car battery
- Duration time: if work by 100Ah battery can use 7 hours
- Material: ABS body and aluminum baseplate
- Size: 240x107x115mm
- With 3meters copper cable and clamps
- Red power indicating light

### Target Group:

For solar home, car, travel, trip, camping, outdoor activity

Product Specification	
Load (W)	150 W
AC or DC coupled	DC, 12
Product life time	N/A
Capacity of solar panel (kWp) required	N/A
Size	N/A
Weight	N/A



Price and costs	Retail Price
Investment	N/A

### Technological and market development

Made in China

2 years warranty

### Links

<http://www.solardcappliance.com/solar-dc-iron/dc-solar-iron.html>

### 3.4.2 Barber Shop and Beauty Salons

Hair trimmer are the ideal appliances for short haircuts or to cultivate a beard. Several appliances run on battery, without power cable, which makes handling easier. Hair trimmer are easy to use and do not require much energy, so that they can easily be provided with PV power.

Several international brand offer hair trimmers in different sizes and with a variety of features. We cannot present all appliances in this catalogue, but rather want to provide a sample selection.

All models allow for adjustment of hair length, some with integrated telescope systems others with easy slip on adapters. Length adjustment ranges normally from 4 to 25 mm, some even allow for 43 mm.

Beard trimmer can be used for shaving, beard trimming and hair trimming.

The quality of these products relies on it knives which should be of stainless steel or ceramic. Knives of carbon-titanium or diamante laminated knives provide best and accurate cuts, but are costly.

Hairdryers, in contrast to trimmers, usually require lots of energy. Their power load normally ranges from 1000 – 2000 W. We have included two examples for DC hairdryers with only 500 W in this catalogue, being fully aware that drying long and thick hair with these appliances may take some time.

Other beauty appliances like shavers or hair straighteners, which can be connected to a battery via USB cable, are coming up on the market.

In case of an appliance with integrated battery, the customers should make sure, that the **battery is of high quality**.



## FS76 21-Piece Haircut Kit Custom Cut® with Case (model: HC200GB)

Conair-Store.com, 20 Constitution Blvd. South, Shelton, CT 06484, USA

### Product Description:

The look of professional hair care with this kit that comes complete with all the tools of the trade. Powerful clipper with 5-detent taper control, nine comb attachments and a powerful DC motor for 50% more cutting power to blade. Provides 50 precision height settings.

- For all lengths and hair styles
- Diamond-sharpened carbon steel blades
- Powerful clipper with 5-detent taper control
- 9 comb attachments: 1/8", 1/4", 3/8", 1/2", 5/8", 3/4", 7/8", left and right ear
- Provides 50 precision height settings
- Barber cape, barber comb, styling comb, 2 styling clips
- Hard case
- Scissors, cleaning brush, oil, blade guard
- Spanish/English instruction booklet
- UL listed

### Target Group:

- Barber shops

Product Specification	
Load (W)	N/A
AC or DC coupled	AC
Voltage (V)	N/A
Produkt life time	N/A
Size	N/A
Weight	N/A



Price and costs	Retail Price USA
Investment	23,99 US\$

### Technological and market development

- Limited five-year warranty
- Available via online shop

### Links

<http://www.conair.com/custom-cut-21-piece-haircut-kit-with-case-p-682.html>

**FS77 Clipper/Trimmer 2-in-1 Custom Styler  
model: HCT420RCSV**

**Conair-Store.com**, 20 Constitution Blvd. South, Shelton, CT 06484, USA

**Product Description:**

This uniquely styled 24-piece kit features a corded clipper, two blades, one for cutting hair and one for trimming facial hair. Includes 5-detent taper control, nine comb attachments, three jawline combs and a 5-position comb attachment for customized style on the go!

- 9 comb attachments: 1/8", 1/4", 3/8", 1/2", 5/8", 3/4", 7/8", left and right ear
- 3 jawline combs
- 5-position comb attachment
- Styling comb
- Mustache comb
- Scissors, oil, cleaning brush
- Storage pouch
- Barber cape
- Blade guard
- UL listed

**Target Group:**

- Barber shops

Product Specification	
Load (W)	N/A
Ac or DC coupled	AC
Voltage (V)	N/A
Produkt life time	N/A
Size	N/A
Weight	N/A



Price and costs	Retail Price
Investment	49,99 US\$

**Technological and market development**

- Limited five-year warranty
- Available via online shop

**Links**

<http://www.conair.com/2-in-1-custom-styler-clipper-trimmer-p-612.html>

**FS78 Professional 20-Piece Haircutting Kit  
Fast Cut Pro, model: HC1000**

**Conair-Store.com**, 20 Constitution Blvd. South, Shelton, CT  
06484, USA

**Product Description:**

The Fast Cut Pro Professional Home Haircutting Kit has twice the cutting force, with a powerful DC motor and professional blade technology.

- High-quality, self-sharpening stainless steel blades
- High-performance DC motor
- Taper control for customization
- 10 guide combs: 1/8", 1/4", 3/8", 1/2", 5/8", 3/4", 7/8", 1", left and right ear
- Includes: barber scissors, comb and cape, deluxe storage case, cleaning brush and oil, 2 styling clips and blade cover

**Target Group:**

- Barber shops

Product Specification	
Load (W)	N/A
Ac or DC coupled	AC
Voltage (V)	N/A
Produkt life time	N/A
Size	N/A
Weight	N/A



Price and costs	Retail Price
Investment	44,99 US\$

**Technological and market development**

- Limited five-year warranty
- Available via online shop

**Links**

<http://www.conair.com/2-in-1-custom-styler-clipper-trimmer-p-612.html>

## FS79 Philips Hairclipper series 9000

Philips, Lübeckertordamm 5, 20099 Hamburg, Germany

### Product Description:

HAIRCLIPPER Series 9000 gives you total precision and control of your haircut. With Digital Swipe, Motorized Combs, Memory function and a high performance cutting element, it's the only clipper that gives consistently the expected results.

Ultimate precision and control

- Digital Swipe interface
- Easy to select and lock-in 400 length settings: 0,5 to 42mm
- Adjustable hair combs for the best clipping results

Performance

- Self-sharpening titanium blades for extra durability
- Motorized Combs for easy length selection
- Auto Turbo to boost cutting speed
- Double-sharpened cutting element

Easy to use

- Remembers 3 cutting length settings per comb
- 120 minutes of cordless use after a 1-hour charge
- Easy charging and storage

### Target Group:

- Barber shops

Product Specification	
Load (W)	N/A
Ac or DC coupled	AC
Voltage (V)	N/A
Produkt life time	N/A
Size	N/A
Weight	N/A



Price and costs	Retail Price Germany
Investment	99,99 €

### Technological and market development

2 years guarantee worldwied

### Links

[http://www.philips-shop.de/store/catalog/haarschneider/haarschneiderserien/hairclipper-series-9000-haarschneider/productdetail/QC5770\\_80\\_DE\\_SHOPPUB/DE/de?active\\_tab=specifications#productDetailtabs](http://www.philips-shop.de/store/catalog/haarschneider/haarschneiderserien/hairclipper-series-9000-haarschneider/productdetail/QC5770_80_DE_SHOPPUB/DE/de?active_tab=specifications#productDetailtabs)

## FS80 Hairclipper series 7000

Philips, Lübeckertordamm 5, 20099 Hamburg, Germany

### Product Description:

HAIRCLIPPER Series 7000 gives you total precision and control of your haircut with just one click. With Motorized Combs and a high performance cutting element, it's the only clipper that gives consistently the expected results.

Ultimate precision and control

- Control buttons
- Easy to select and lock-in 60 length settings: 0,5 to 42mm
- Adjustable hair combs for the best clipping results

Performance

- Self-sharpening steel blades for long-lasting sharpness
- Motorized Combs for easy length selection
- Auto Turbo to boost cutting speed
- Double-sharpened cutting element cuts two times faster\*
- 2-year guarantee

Easy to use

- Remembers the last used length setting
- 120 minutes of cordless use after a 1-hour charge

### Target Group:

- Barber shops

Product Specification	
Load (W)	N/A
Ac or DC coupled	N/A
Voltage (V)	N/A
Capacity of solar panel (kWp) required	N/A
Produkt life time	N/A
Size	24.5 x 14.0 x 7.0 cm
Weight	0.46 kg



Price and costs	Retail Price
Investment	N/A

### Technological and market development

### Links

[http://www.philips.de/c-p/QC5380\\_32/hairclipper-series-7000-haarschneider/](http://www.philips.de/c-p/QC5380_32/hairclipper-series-7000-haarschneider/)

## FS81 Beardtrimmer Series 1000

Philips, Lübeckertordamm 5, 20099 Hamburg, Germany

### Product Description:



### Target Group:

- Barber shops

Product Specification		Price and costs	Retail Price
Load (W)	N/A	Investment	29,99
Ac or DC coupled	N/A		
Voltage (V)	N/A		
Capacity of solar panel (kWp) required	N/A		
Produkt life time	N/A		
Size	N/A		
Weight	N/A		

### Technological and market development

### Links

[http://www.philips.de/c-p/BT405\\_15/beardtrimmer-series-1000-bartschneider](http://www.philips.de/c-p/BT405_15/beardtrimmer-series-1000-bartschneider)

## FS82 Hair Dryer Solar DC SE310

Ningbo Jiming Electric Appliance Co., Ltd., No.546 Qiye Road,  
Zhouxiang Town, Cixi, Zhejiang, China

### Product Description:

- Solar Power Foldable Travel DC Hair Dryer
- Can work with solar panel or battery
- Safe operation
- High quality foldable hair dryer, durable motor, excellent power cord
- With Concentrator
- Material: ABS
- Over Heating Protection Device
- Function: 2 speed control (low-high)
- Color: variable color printing options
- Environmental protection
- Energy saving
- Long life time

### Target Group:

For solar home, car, travel, trip, camping, outdoor activity

Product Specification	
Load (W)	400 W
AC or DC coupled	DC, 12
Product life time	N/A
Capacity of solar panel (kWp) required	N/A
Size	N/A
Weight	N/A



Price and costs	Retail Price
Investment	N/A

### Technological and market development

Made in China

2 years warranty

### Links

<http://www.solardcappliance.com/solar-dc-hair-dryer/12v-solar-dc-hair-dryer.html>

### FS83 Hair Dryer Solar DC SE300B

Ningbo Jiming Electric Appliance Co., Ltd., No.546 Qiye Road, Zhouxiang Town, Cixi, Zhejiang, China

#### Product Description:

- Solar Power Foldable Travel DC Hair Dryer
- Can work with solar panel or battery
- Safe operation
- High quality foldable hair dryer, durable motor, excellent power cord
- With Concentrator
- Material: ABS
- Over Heating Protection Device
- Foldable handle
- Function: 2 speed control (low-high)
- Color: variable color printing options
- Environmental protection
- Energy saving

#### Target Group:

For solar home, car, travel, trip, camping, outdoor activity

Product Specification	
Load (W)	180 W
AC or DC coupled	DC, 12
Product life time	N/A
Capacity of solar panel (kWp) required	N/A
Size	N/A
Weight	N/A



Price and costs	Retail Price
Investment	N/A

#### Technological and market development

Made in China

#### Links

<http://www.solardcappliance.com/solar-dc-hair-dryer/solar-dc-hair-dryer.html>



## FS84 Hair Straightener Carmen Mini, Cordless, Rechargeable

Carmen Products, Link House,, Bute Street, Stoke-on-Trent, ST4 3PR, UK

### Product Description:

- Ultra Portable
- 3 Temperature Settings: 140 / 160 / 180 degrees C
- Locking function
- 2.5 hours charging time
- 25 minutes continual use from 1 charge
- Rechargeable lithium battery

### Target Group:

- Barber shop, mobile coiffeur



Product Specification	
Load (W)	N/A
Ac or DC coupled	N/A
Voltage (V)	N/A
Capacity of solar panel (kWp) required	N/A
Produkt life time	N/A
Size	N/A
Weight	N/A

### Price and costs

Investment	99.99 £
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### Technological and market development

N/A

### Links

<http://www.carmen-products.co.uk/carmen-ranges/carmen-cherish-2028/cordless-rechargeable-mini-hair-straighteners.html>

## FS85 Shaver Carmen USB C82002

Carmen Products, Link House,, Bute Street, Stoke-on-Trent, ST4 3PR, UK

### Product Description:

- Compact design -Super slim
- On/off switch
- Rechargeable by USB plug
- Charge time: 8 hours
- Run time: 40 minutes

### Target Group:

- Barber shops



Product Specification	
Load (W)	N/A
Ac or DC coupled	N/A
Voltage (V)	N/A
Capacity of solar panel (kWp) required	N/A
Produkt life time	N/A
Size	2.3 x 6.2 x 10.7 cm
Weight	0.229 kg

### Price and costs

Investment	25 £
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### Technological and market development

N/A

### Links

<http://www.carmen-products.co.uk/carmen-ranges/carmen-chrome/shaver-usb.html>

## FS86 Barber Kit Ecoboxx 160 DC Plus

**Ecoboxx/Sungrid Group (PTY) LTD South Africa** Unit Do6B  
Collingwood Building, Black River Park Observatory, Cape Town  
7925, Somerset West 7129

### Product Description:

Ecoboxx is a revolutionary portable solar generator. Whether for productive, recreational or emergency use, there are multiple Ecoboxx models available with varying power outputs to suit your needs.

The barber kit consists of:

- 2 x 3 W super bright LED lights with independent switches
- USB fan + clipper
- AC/DC adaptor
- 2 x USB charging ports
- 1 x Multi point phone charging cable
- 75 W modified sine wave inverter

### Target Group:

- Barber shop, mobile coiffeur

Product Specification	
Load (W)	N/A
Ac or DC coupled	Ac and DC
Voltage (V)	12 V
Capacity of solar panel (kWp) required	2 x 10 W
Type of battery	14 Ah Lead Crystal battery
	N/A
Produkt life time	Battery: 5 years; solar panels: 20 years.
Size	N/A
Weight	N/A



### Price and costs

Investment	4,499 R
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### Technological and market development

Retailers in Southafrica, Namibia, Lesotho, Swaziland

### Links

[http://www.ecoboxx.co.za/pages/products.php?prod\\_id=9](http://www.ecoboxx.co.za/pages/products.php?prod_id=9)

<http://energcare.co.za/solar-light-charger-combos/>

### **3.5 Handcraft and Artisanry**

Handcraft and artisanry is an important category for the productive use of PV appliances as it offers a wide range of activities. It comprises all sorts of cottage industries as well as mobile workshops. For all these activities it is important to use the most efficient appliance that is available. By using an energy efficient appliance, less electricity is needed and the PV system can be sized cost effectively.

Until now, this catalogue only presents appliances for tailoring. Others are yet to come.

- Tailoring
- Workshop Tools

### **3.5.1 Tailoring**

There are three main types of sewing machines used in the tailoring sector, depending on size and type of commercial tailoring units: Straight stitch sewing machine, industrial sewing machine, fashion stitch sewing machine.

#### Straight stitch sewing machines

In small commercial tailoring units the regular manual pedaled sewing machines is still commonly used. With manual pedaling only about 300 stitches per minute is achieved. (a industrial sewing machine achieves 1000 stitches per minute). To increase productivity, pedal sewing machines are often equipped with an additional motor mostly a conventional AC motors. Although this intervention increases productivity of the tailor compared to simple pedaling, fulltime working hours rarely can be achieved due to restricted power supply.

Through a case study in India undertaken by SELCO, it was found out, that a sewing machine equipped with a high efficient DC motor coupled with a PV system for constant electricity supply, allows the tailor to increase productivity and double his income. (SLECO, 2015)

By using an energy efficient DC motor 25 % increase in energy efficiency could be achieved. Furthermore, the reliable electricity supply from the solar system allows for longer working hours. Both factors, constant electricity and a motorized sewing machine, increased the productivity of the tailor.

#### Industrial sewing machines

Industrial sewing machines are used in industrial production spaces and are bigger in size and have a sturdier base than the traditional sewing machines. They achieve a speed of 1000 stitches per minute and have various needle variations to allow for stitching textiles of different texture.

Industrial sewing machines also can be equipped with an energy efficient DC motors. Combined with solar power, the intervention can lead to an increase in productivity through constant power supply.

Industrial sewing machines have a high starting current, which can be countered with a three phase DC motor with VFD (Variable frequency drive) controller.

To equip an industrial sewing center with PV powered sewing machines high investment costs have to be faced. Advantages that can be achieved become significant when compared to a diesel generator powering the machines. Then the main benefits are constant power supply covering eight hours a day, savings in diesel consumption and lower service and maintenance costs.

#### Fashion stitch sewing machines

Fashion stitch sewing machines usually are energy efficient multi-function machines with various stitching patterns and spacing options, which are very useful for fashionable stitching and design tailoring.

Powering these machines with a PV system leads to reductions in the electricity bill. Furthermore the PV-system offers constant electricity supply. As the tailors work is not interrupted by power cuts, he can increase his productivity.

## FS87 Sewing Machine ON Sewing

SwitchON/ONergy, 1A, D. L. Khan Road, Kolkata – 70002, India

### Product Description:

Sewing Machine, which can variably be connected to AC or DC.

### Target Group:

Small enterprises, cottage industry

Product Specification	
Load (W)	30 W
Ac or DC coupled	AC or DC
Voltage (V)	12V
Capacity of solar panel (kWp) required	75 Wp
Product life time	3 years
Size	N/A
Weight	N/A

FOTO of Product

Price and costs	Retail Price
Investment	N/A

### Technological and market development

N/A

### Links

[www.onergy.in](http://www.onergy.in)

## FS88 Sewing Machine retrofitted with DC motor - SELCO

**Selco Solar Light Pvt.ltd.**, 690, Ground Floor, 15th Cross, 2nd Phase, J P Nagar, Bangalore - 560078, India

### Product Description:

A regular manual pedaled sewing machines equipped with a high efficient DC motor.

- About 25 % increase in energy efficiency is possible
- Brushless DC motors (BLDC) and Permanent magnet DC motors (PMDC)

### Target Group:

- Small scale commercial tailoring units
- Karnataka, India

Product Specification	
Load (W)	60 W
Ac or Dc coupled	DC
Voltage (V)	12V
Motor rated speed	3000 rpm
Typical machine speed	1000 stitches per minute
Stitch types	Straight stitch only
Speed control	PWM pedal control
Working time	8 hours / day
Capacity of solar panel (kWp) required	60 Wp
Battery	Lead acid flooded, 40 Ah, 12 V
Product life time	N/A
Size	N/A
Weight	N/A



Price and costs	Price SELCO Foundation
Investment (sewing machine and solar power system)	RS 18,000

### Technological and market development

- SELCO maintains close cooperation with its partners and customers to provide tailor made system solutions.
- The provided technologies range from high efficient AC machines with multiple design aspects, retrofitted DC machines to complete solar powered sewing systems.
- Cooperation with financing institute
- Local service support through 30 service centers in South India
- Introduction of key maintenance measures to customers
- One year free service and maintenance support for solar sewing machines

### Links

[http://www.selco-india.com/contact\\_us.html](http://www.selco-india.com/contact_us.html)

<https://www.youtube.com/watch?v=HGTO2Nm5lng>

## FS89 Industrial Sewing Machine - SELCO

**Selco Solar Light Pvt.ltd.**, 690, Ground Floor, 15th Cross, 2nd Phase, J P Nagar, Bangalore - 560078, India

### Product Description:

Industrial sewing machines allow a variation of stitches at a high speed. They are mainly used in larger sewing centers or training centers.

Industrial sewing machines can be equipped with a more efficient DC motor or with a complete PV system to power the whole setup.

- VFD (Variable frequency drive) controller with a 250W 3 phase induction motor of 3 Phase (230V, 50Hz).
- High starting current suppressed by VFD.
- Solar PCU with MPPT (800VA, 24V)

### Target Group:

- Industrial production spaces, training centers
- Karnataka, India

Product Specification	
Load (W)	230 W
Ac or Dc coupled	AC induction motor (3 phase)
Voltage (V)	230V, 50Hz single phase
Motor rated speed	1440 rpm
Typical machine speed	2500 stitches per minute
Stitch types	Straight stitch only
Speed control	VFD speed control
Working time	8 hours / day
Capacity of solar panel (kWp) required	230 Wp
Battery	Lead acid flooded, 40 Ah, 12 V
Product life time	N/A
Size	N/A
Weight	N/A



Price and costs	Retail Price
Investment	N/A

### Technological and market development

- SELO maintains close cooperation with its partners and customers to provide tailor made system solutions.
- The provided technologies range from high efficient AC machines with multiple design aspects, retrofitted DC machines to complete solar powered sewing systems.
- Cooperation with financing institute
- Local service support through 30 service centers in South India  
Introduction of key maintenance measures to customers
- One year free service and maintenance support for solar sewing machines

### Links

[http://www.selco-india.com/contact\\_us.html](http://www.selco-india.com/contact_us.html)

<https://www.youtube.com/watch?v=HGTO2Nm5Ing>



## FS90 Faison Stitch Sewing Machine - SELCO

**Selco Solar Light Pvt.ltd.**, 690, Ground Floor, 15th Cross, 2nd Phase, J P Nagar, Bangalore - 560078, India

### Product Description:

Modern faison stitch sewing machines mostly are modern high efficient electric machines.

They offer a variation of stitches, as embroidery design, zig-zag stitching, button hole, etc.

### Target Group:

- Small enterprises, fashionable and design tailoring
- Karnataka, India



Product Specification	
Load (W)	100 W
Ac or De coupled	AC
Voltage (V)	230V, 50Hz single phase
Motor rated speed	N/A
Typical machine speed	1000 stitches per minute
Stitch types	Straight stitch, zig zag, embroidery
Speed control	N/A
Working time	8 hours / day
Capacity of solar panel (kWp) required	150 Wp
Battery	Lead acid flooded, 40 Ah, 12 V
Product life time	N/A
Size	N/A
Weight	N/A

Price and costs	Retail Price
Investment for sewing machine	Rs.6,000-Rs.8,000
Investment for PV-equipment	Rs. 35,000- 40,000

### Technological and market development

- SELO maintains close cooperation with its partners and customers to provide tailor made system solutions.
- The provided technologies range from high efficient AC machines with multiple design aspects, retrofitted DC machines to complete solar powered sewing systems.
- Cooperation with financing institute
- Local service support through 30 service centers in South India
- Introduction of key maintenance measures to customers
- One year free service and maintenance support for solar sewing machines

### Links

[http://www.selco-india.com/contact\\_us.html](http://www.selco-india.com/contact_us.html)

<https://www.youtube.com/watch?v=HGTO2Nm5lNg>

## FS91 Weaving Loom Solar-powered charkha, MIGRI

**Mahatma Gandhi Institute for Rural Industrialization (MGIRI)**, Maganwadi, Wardha, Maharashtra – 442 001, India.

### Product Description:

Application of solar energy in rural garment manufacturing. MIGRI has developed a 8 spindled solar-powered spinning wheel (charkha) with the aim of reducing the spinners' physical drudgery, increasing the quantity of cloth output and thereby positively influencing livelihoods in rural communities.

- Integration of DC motor increased the energy efficiency
- Output of woven fabric can be doubled in comparison to a traditional handloom.

### Target Group:

Rural communities, cottage industry, small textile entrepreneurs

- 

Product Specification	
Load (W)	30 - 40W
Ac or DC coupled	
Voltage (V)	12V
Capacity of solar panel (kWp) required	
Size	
Weight	



Price and costs	Retail Price
Investment	N/A

### Technological and market development

Textile entrepreneurs require a 24 spindled charkha, which still is to be prototyped by MIGRI.

### Links

[www.migri.org](http://www.migri.org)

## FS92 Sewing Machine CERAD

CERAD, UET, Lahore, Pakistan

### Product Description:

A solar powered sewing machine has been introduced by CERAD with the use of a highly efficient DC motor. It saves up to 80 percent of the power. To minimize the load a highly efficient DC motor has been introduced for sewing machines to operate on small solar systems.

### Target Group:

Product Specification	
Load (W)	40 W
Ac or DC coupled	DC
Voltage (V)	24V
Capacity of solar panel (kWp) required	70 – 100 W
Product life time	
<b>Back-up time</b>	2 h
Size	
Weight	

**SOLAR POWERED SEWING MACHINE**

To minimize the load, a highly efficient DC motor introduce for Sewing Machines to operate on Small Solar System.

**Features**

- Power Saving - 80%
- Power Saving up to 80%
- Using conventional sewing machines with better features and capacity
- Efficient and Continuous working without any power failure during day time and 3 hour backup.
- Less noise Produce.
- 1 year payback period, with 25 years solar PV warranty and 2 years for batteries.

**Technical Specifications**

- Input voltage: 24VDC
- Input Power: 40Watt
- Solar panel Requirement: 70-100 Watt
- Battery: 2 x (12V, 7A)
- Charge controller: 24V, 2A
- Backup: 2 hours
- Total cost of alteration with PV system Rs.12550/-

The graphic also includes a diagram of the solar system components (panel, controller, battery, and sewing machine) and a small table at the bottom with technical data.

Price and costs	Retail Price India
Investment	12,550 Rs

### Technological and market development

Developed by Center for energy research and development (CERAD), which aim is to evolve efficient, innovative and cost effective solutions of Punjab province.

### Links

[http://cerad.uet.edu.pk/solutions/products\\_detail/3](http://cerad.uet.edu.pk/solutions/products_detail/3)

### 3.5.2 Cordless Power Tools

“The future of power tools is cordless” is a statement of [popularmechanics.com](http://popularmechanics.com) after testing 20 V drills. In fact the range of powerful cordless tools encompasses multi tools, combi hammer drills, saws, grinder, multi cutter, palm sander and many more. Many are as powerful as their AC counterparts.

The product range of high quality cordless power tools is manifold. We would like to present some examples to give an idea of the variety of products. Besides examples for different cordless power tools, two complete sets of five to six tools are presented. These kits contain the essential tools a mobile workshop needs in a bag: a drill/driver, a circular saw and a reciprocating saw, and others, depending on the kit.

Some criteria are important, when opting for a cordless power tool:

#### **The current:**

- Cordless power tools are available with 12, 14.4, 18 or 20 V which has no effect on their working quality. In case the workshop should be powered by a PV-system, should support the respective current.

#### **The battery:**

- High quality battery with a low rate of self-discharge.
- Full charging is mostly achieved in one hour. A second battery allows for long working times.

#### **Impact drills:**

- The choice of appliance depends mainly on the material that should be processed. For wood an impact drill can be used, for metal and concrete a hammer drill would be the right choice.
- Two-mode drive allows users to switch between tightening screws and drilling. Some appliances have adjustable torque. For wide drill diameters or hard materials the first gear can also be used for better drilling.

#### **Rotary hammers:**

- Mostly rotary hammers are equipped with industrial SDS plus chucks, requiring SDS drill bits .
- Some special drill chucks require fitting drill bits, what may result in an expensive and hard to find accessory.

- Some models even have a hammer-only mode that allows to chip off hardened concrete or crack through a rock.
- High torque drillers have an intense reaction, if the driller tilts. A second handle and a stable stand avoid injuries.

### FS93 Drill – CIMCO 2 Gear Accumulator Impact Drill

**Cimco Werkzeugfabrik**, Hohenhagener Str. 1-5, 42855 Remscheid, Germany

#### Product Description:

This impact drill comes with a second accumulator pack.

- Two modes drive
- QuiXS quick-action chuck 13mm diameter,
- Quick charger CSL 30LI: only 15 minutes charging time
- Protection cap.

#### Target Group:

Mobile workshop, carpentry, etc.



Product Specification	
Load (W)	N/A
Ac or DC coupled	DC
Voltage (V)	14,4V
Capacity of solar panel (kWp) required	N/A
Battery	Li-Ion
Product life time	N/A
Size (LxWxH)	
Weight	1.6 kg

Price and costs	Retail Price
Investment	N/A

#### Technological and market development

N/A

#### Links

[http://pdf.cimco.de/Kapitel\\_2015/Handwerkzeuge/Bohrer,Lochsaegen,Diamantwerkzeuge.pdf](http://pdf.cimco.de/Kapitel_2015/Handwerkzeuge/Bohrer,Lochsaegen,Diamantwerkzeuge.pdf)  
[www.phaesun.org](http://www.phaesun.org)

## FS94 Rotary Hammer – Bosch RHS181

**Bosch**, Robert-Bosch-Platz 1, 70839 Gerlingen-Schillerhöhe, Germany

### Product Description:

Light and well balanced one handed tool featuring compact portability for drilling small diameter holes in overhead or tight spaces.

- Variable speed trigger enables speed regulation,
- Two-mode drive allows users to switch between drilling with hammer action and drilling only.
- LED light illuminates dark work spaces.
- 
- Drills over 100 ¼”x 2” – ½” holes per battery charge.

### Target Group:

Mobile workshop, carpentry, etc.

Product Specification	
Load (W)	
Ac or DC coupled	DC
Voltage (V)	18 V
Capacity of solar panel (kWp) required	N/A
Battery	Optional! Li-Ion
Product life time	N/A
Size (LxWxH)	N/A
Weight	2 kg



Price and costs	Retail Price
Investment (only tool)	200 €
Investment including one battery	295 €

### Technological and market development

Since 1886 Bosch is an expert in for high quality home appliances. Today Bosch has a worldwide production and retailer network.

- Best ranked rotary hammer in 2013
- Sometimes the battery is not included

### Links

<http://www.boschtools.com/Products/Tools/Pages/BoschProductDetail.aspx?pid=rhs181b#reviews>

## FS95 Rotary Hammer – Hilti TE 4-A18

Hilti Deutschland AG, Hiltistraße 2, 86916 Kaufering  
Germany

### Product Description:

- Easy handling through ergonomic design
- Drilling and hammer drill for concrete and stonework

### Target Group:

Mobile workshop, carpentry, etc.



Product Specification	
Load (W)	N/A
Ac or DC coupled	DC
Voltage (V)	21.6 V
Capacity of solar panel (kWp) required	N/A
Battery	Optional! Li-Ion
Product life time	N/A
Size (LxWxH)	324 x 94 x 201 mm
Weight	3.3 kg

Price and costs	Retail Price as off
Investment (only tool)	320 €
Investment including one battery	680 €

### Technological and market development

N/A

### Links

<https://www.hilti.de/akku-bohr--und-kombih%C3%A4mmer/akku-bohrh%C3%A4mmer/r4717>

#



## FS96 Chain Saw Makita X2 LXT

Makita, Germany

### Product Description:

A cordless electric chain saw for brushing and slashing, cutting up trees and branches under 6 inches in diameter.

- Quiet electric appliance

### Target Group:

Mobile workshop, carpentry, etc.



Product Specification	
Load (W)	N/A
Ac or DC coupled	DC
Voltage (V)	18 V
Capacity of solar panel (kWp) required	N/A
Battery	Optional! Li-Ion
Product life time	N/A
Size (LxWxH)	N/A
Weight	5 kg

Price and costs		Retail Price as off
Investment (only tool)		360 €
Investment including two batteries		650 €

### Technological and market development

- N/A

### Links

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## FS97 Oscillating multi tool- Bosch PS50

**Bosch, Robert-Bosch-Platz 1, 70839 Gerlingen-Schillerhöhe, Germany**

### Product Description:

An oscillating tools are really multifunction tools. They cut, grind, sand, with low vibrations and easy handling. A wide range of accessories is available.

- Oscillations per minute: 5,000 – 20,000
- Soft start feature
- Universal adapter plate, fitting for accessories of other manufacturers.

### Target Group:

Mobile workshop, carpentry, etc.

Product Specification	
Load (W)	N/A
Ac or DC coupled	DC
Voltage (V)	12 V
Capacity of solar panel (kWp) required	N/A
Battery	Optional! Li-Ion
Product life time	N/A
Size (LxWxH)	N/A
Weight	2.2 kg



Price and costs	Retail Price as off
Investment (only tool)	160 €

### Technological and market development

Since 1886 Bosch is an expert in for high quality home appliances. Today Bosch has a worldwide production and retailer network.

### Links

<http://www.boschmultix.com/ps50.html>

**FS98 DeWalt 18V Max Lithium Ion 6-Tool Kit (DCK691M3)**

**DEWALT Industrial Tool Co.**, 701 E. Joppa Road, Baltimore, MD 21286, USA

**Product Description:**

DeWalt's 18V Max Lithium-Ion kit.

- DCD785 Compact Hammer Drill: (350 W)
- DCF885 Impact Driver
- DCS391 Circular Saw (460W)
- DCG412 Grinder (405 W)
- DCS331 Jigsaw (400W)
- DCLo40 LED Pivot Light
- 3 x 4.0Ah Slide Pack Batteries
- Multi-voltage charger
- 2 x DS300 Tough System Kit Box
- 

**Target Group:**

Product Specification	
Load (W)	350 – 460 W (depending on tool)
AC or DC coupled	DC 18 V max
Type of battery	XR Li-Ion
Product life time	N/A
Capacity of solar panel (kWp) required	N/A
Size	
Weight	13.5 kg



Price and costs	Retail Price Germany
Investment	As of 1000 €

**Technological and market development**

- 3 Year Limited Warranty
- 1 Year Free Service Contract
- 90 Day Money Back Guarantee

**Links**

<http://www.dewalt.co.uk/powertools/productdetails/catno/DCK691M3/info/specifications/>

**FS99      Bosch 18V Lithium Ion 4-Tool Combo Kit (CLPK414-181)**

**Bosch GmbH**, Robert-Bosch-Platz 1, 70839 Gerlingen-Schillerhöhe, Germany

**Product Description:**

Bosch's lithium-ion line-up is confidence in a well-appointed bag. Every tool included in this kit is built without compromise to deliver true contractor-grade goods — except the work light. This kit includes the 4.0Ah battery pack option.

Combo kits are available at 12 or 18 V an vary between 2 and 8 tools.

- Brute Tough Hammer Drill Driver
- EC Brushless 1/4 In. and 1/2 In. Socket-Ready Impact Driver
- 1-1/8 In. Reciprocating Saw,
- Flashlight

**Target Group:**

Carpenter, mobile workshop, facility management, etc.

Product Specification	
Load (W)	N/A
AC or DC coupled	N/A
Type of battery	Lithium-Ion Battery 4.0 Ah FatPack Batteries
Product life time	N/A
Capacity of solar panel (kWp) required	N/A
Size	N/A
Weight	~ 1,5 kg



Price and costs	Retail Price Germany
Investment	As of 500 €

**Technological and market development**

Since 1886 Bosch is an expert in for high quality home appliances. Today Bosch has a worldwide production and retailer network.

**Links**

[www.bosh.com](http://www.bosh.com)

### **3.6 Media and Entertainment**

- Office equipment
- Computer technologies
- Portable Printers
- Television and Radio

### 3.6.1 Office equipment

#### FS100 Fan ONergy BOX FAN

SwitchON/ONergy, 1A, D. L. Khan Road, Kolkata – 70002, India

#### Product Description:

- 10" DC FAN
- five blades
- 3 modes speed control

#### Target Group:

Households



Product Specification	
Load (W)	6 – 8 W
Ac or DC coupled	DC
Capacity of solar panel (kWp) required	10W, 12 V
Product life time	3 years
Size	10"
Weight	N/A

Price and costs	Retail Price
Investment	N/A

#### Technological and market development

N/A

#### Links

[www.onergy.in](http://www.onergy.in)

## FS101 Fan ONergy PEDESTAL FAN

SwitchON/ONergy, 1A, D. L. Khan Road, Kolkata – 70002, India

### Product Description:

- 16" AC / DC FAN
- 3 blades
- 3 modes speed control
- High speed, High air delivery

### Target Groups:

Small rooms, individual work spaces



Product Specification	
Load (W)	15W
AC or DC coupled	AC and DC coupling possible
Voltage	12 V DC or 100 – 240 V AC
Product life time	N/A
Capacity of solar panel (kWp) required	20W, 12 V
Size	16 inch
Weight	5.5 kg

Price and costs	Retail Price
Investment	N/A

### Technological and market development

N/A

### Links

[www.onergy.in](http://www.onergy.in)

## FS102 Fan fosera Fan 50

Fosera, Beim Mühlbach 3, 89171 Illerkirchberg, Germany

### Product Description:

The fosera Fan 50 offers a pleasant indoor climate and improves significantly the living quality. The Fan 50 has a diameter of 42 cm, a very low energy consumption and a speed of 290 rpm.

### Target Group:

Domestic use, Media entertainment for restaurants, bars, multimedia theaters



Price and costs	Retail Price Germany
Investment	19,20

Product Specification	
Load (W)	4 W
AC or DC coupled	DC, 12- 14 V
Voltage (V)	13 V
Capacity of solar panel (kWp) required	0,01 kWp
Size	21x9.5x9 cm
Weight	0.41 kg

### Technological and market development

- Development and market entry: 2015
- Spare parts are supplied by foser and are available with the retailer.

### Links

<http://www.fosera.com/products/power-line/applications.html>



### FS103 Solar Air Conditioner GenPro DC48VFT-12 DC

GenPro Energy Solutions, 13261 Timberline Plaza, Suite B  
Piedmont SD 57769

#### Product Description:

Designed as efficient cooling choice for 48VDC (or -48VDC) as part of a telecom or off-grid solar application. DC48 air conditioners can substantially reduce power supply/generation costs and battery requirements. An all-DC system means you get the advantage of extreme high efficiency without the need for inverters.

#### Target Group:

- Households, offices, shops



Product Specification	
Load (W)	N/A
Ac or DC coupled	N/A
Product life time	N/A
Capacity of solar panel (kWp) required	N/A
Size	N/A
Weight	4.65 kg

Price and costs	Retail Price
Investment	N/A

#### Technological and market development

##### Links

<http://www.genproenergy.com/genpro-products-solutions/product-catalog/energy/solar-energy-pv/speciality-solar-powered-products/solar-air-conditioner.html>

### 3.6.2 Computer Technology

#### FS104 Computer station ONergy Solar Computer

SwitchON/ONergy, 1A, D. L. Khan Road, Kolkata – 70002, India

##### Product Description:

Solar powered lean computer station

- one Server
- 6 computer terminals each equipped with LED Monitor.

##### Target Group:

Schools, Rural Computer Training Centres, Offices, banks, internet café etc

Product Specification	
Load (W)	300 W
AC or DC coupled	Ac
Voltage (V)	12V
Capacity of solar panel (kWp) required	500Wp
Battery	Solar Tubular Lead Acid
Product life time	5yrs +
Size	NA
Weight	NA

FOTO of Product

Price and costs	Retail Price
Investment	N/A

##### Technological and market development

N/A

##### Links

[www.onergy.in](http://www.onergy.in)

## FS105 PC Aleutia T1 Fanless Eco PC

Aleutia Computers Ltd, 1st Floor London Heliport\*, Lombard Road, London

### Product Description:

A silent, fanless, solid state Mini PC with low power consumption and the reliability of 'no moving parts'.

Intel® Bay Trail technology with 4GB RAM, a Quad Core 2.0 GHz Celeron™ processor, a powerful integrated graphics allows you to watch full HD content and with a high speed SSD (30GB to 1TB), the T1 is the ideal PC for 90% of the world.

### Target Group:

Households, schools, secretarial service

•

Product Specification	
Load (W)	N/A
AC or DC coupled	DC
Voltage (V)	8 – 20 V
Capacity of solar panel (kWp) required	N/A
Battery	N/A
Product life time	N/A
Size	N/A
Weight	N/A



Price and costs	Retail Price
Investment	N/A

### Technological and market development

- The T1 is designed for solar and runs on DC directly, taking any voltage from 8-20V and does not require a regulator
- AC adapter included;
- The T1 has both a VGA and HDMI port and can power two independent displays (2560 x 1440 resolution each)

### Links

<http://www.aleutia.com/products/t1-fanless-eco-pc/>

## FS106 PC Asus EEE Box EB1007P

ASUSTeK COMPUTER INC., 15, Li-Te Rd., Taipei 112, Taiwan

### Product Description:

A flexible 1L-sized energy efficient commercial PC that is easy to use, low on power consumption and provides excellent connectivity.

Windows 7 professional is installed.

An excellent choice in power-constrained, moderately harsh environments.

### Target Group:

Small business, offices, rural health clinics.



Product Specification	
Load (W)	16W (27 W with monitor)
AC or DC coupled	N/A
Voltage (V)	V
Capacity of solar panel (kWp) required	N/A
Battery	N/A
Product life time	N/A
Size	N/A
Weight	0,7 kg

Price and costs	Retail Price
Investment	N/A

### Technological and market development

- The PC can power two independent displays at the same time.
- Worldwide distribution network
- not suited for processor-intensive applications (CAD/CAM, video editing, etc.)

### Links

[http://www.asus.com/de/EeeBox\\_PCs/EeeBox\\_PC\\_EB1033/](http://www.asus.com/de/EeeBox_PCs/EeeBox_PC_EB1033/)

## FS107 Router - EdgeRouter POE

Ubiquiti Networks, 2580 Orchard Parkway, San Jose, CA 95131, USA

### Product Description:

5-Port Router with Power over Ethernet. EdgeRouters combine carrier-class reliability with enterprise-level features in a compact and affordable unit.

### Target Group:

Office, schools, health clinics.

- 

Product Specification	
Load (W)	N/A
AC or DC coupled	DC
Voltage (V)	24/ 48 V
Capacity of solar panel (kWp) required	N/A
Battery	N/A
Product life time	N/A
Size	
Weight	



Price and costs	Retail Price
Investment	N/A

### Technological and market development

- Distribution via Simplifi Networks with offices in Nairobi, Kenya and Kampala, Uganda:

### Links

<https://www.ubnt.com/products/#all/routing>

[www.simplifinetworks.com](http://www.simplifinetworks.com)

### 3.6.3 Portable Printer

#### High functionality in miniature

Compact printers offer almost the whole range of functionality: black and white or coloured print, scans, copies. Their main advantage against normal printers is their mobility, targeting mainly at sales representatives and field staff and professions that require lots of travelling (Testberichte.de, 2015).

Main feature of a compact printer is its small size (about 20 cm width) and light weight (about 1.5 kg). The smallest printers weighs less than 500 g. Furthermore they should be equipped with a battery power option that allows for mobility and printing on the go without worrying about a power source.

Some compact printers use special paper, which may not be available in every local store or must be purchased via internet. In addition this may result in higher printing costs. To avoid this, a printer taking standard letter-size copy paper should be chosen.

Most printers can be connected via USB cable. If wireless printing is included it is important, that the printer can connect to the respective mobile device. Apple users should look for a printer with AirPrint; Android users should make sure that a compatible app is available. Bluetooth or Near Field Communication (NFC) technology offer direct printing from notebooks or smartphones. Additional options are card reader, USB plugs for external memory modules (sticks, hard drive) allow for computer independent prints.

Help and support should be offered by the manufacturer via email and phone, so that there are multiple ways for contacting. An active social media presence, like Twitter, is often helpful and may be the easiest way to get in contact with a company's support team. (TopTenReview, 2015):

#### Different printers

Inkjet, laser and thermal printers have different functionalities and performances. Below the performance of each printer is described briefly.

##### Thermal

Thermal printers are robust, reliable and require only minimum maintenance. They are reliable in a harsh climate. But normally prints are only done in black and white and printing quality is secondary (TopTenReviews (2013)). As thermal printers do not use ink to print there are no moving parts like cartridges and ribbons, which makes them insensitive against shocks. Thermal printers use a special paper, thermal paper, that is coated with chemicals to make the paper change colour when heated. This special paper may be more expensive than normal copy paper. Thermal printers can be extremely small and portable, the lightest models weighs below 500 g and size about 25 x 5 x 5 cm.

Some small scale photo printers also use a zero ink, special thermal technology and offer the right in time printing of photos of good quality. These photo printers are pocket sized and create small scale photos (max. 3 x 4 "). As a special paper is required for these printers, costs per print are relatively high. DNP offers a high quality thermal-dye photo printer for professional photo booths for weddings or corporate events, with minimal printing costs but investment costs ranging at around 1500 €. Due to the high investment or high printing costs, thermal-dye photo printers are not included in this catalogue.

##### Printers

### **Laser Printers**

Laser printers use the basic concept of static electricity to print efficient and great black and white quality prints.

Laser printers are the right choice if a robust and reliable appliance is needed and documents should be of good printing quality.

### **Inkjet Printers**

In case coloured printing or even photo printing is required, a mobile inkjet printer is the right choice. It achieves high coloured print quality at relatively low costs. Some contain up to five ink cartridges and therefore offer high quality photo prints.

An inkjet printer should at least have a print resolution of 1200 x 600 dots per inch (dpi). This gives clear, sharp-looking documents. Furthermore it should print at least eight black-and-white pages per minute. In case the printer is used by multiple people at one time, print speed should be reconsidered.

As inkjet printers are bigger in size, some manufacturers offer special printer cases for transportation.

## FS108 Inkjet photo printer HP Officejet Mobile 150

**Hewlett-Packard GmbH**, Herrenberger Str. 140, 71034 Böblingen, Germany

### Product Description:

The HP Officejet 150 Mobile is a compact printer that prints at a high quality and has all-in-one functionality. It's small and light, and incorporates wireless print technology.

- Print, scan and copy function
- Inkjet technology printing in colour or black and white
- Uses standard copy paper
- Supports manual duplexing (no automatic)
- Navigation via small LCD touchscreen
- Battery is rated for 500 printed pages of use which gives ample time of usage without charging.
- Supports USB, SD card slot, Bluetooth connectivity
- Does not have Wi-Fi, (Apple users can't send it print jobs from iPhones or iPads)

### Target Group:

Offices, field staff, sales representatives, business travelers

Product Specification	
Load (W)	22 W (active), 3.2 W (sleep), 6.4 W (standby), 0.4 W (manual-Off)
AC or DC coupled	AC, 90 – 132 V
Type of battery	Lithium-ion battery
Printing speed	5 b/w pages per minute 3.5 coloured pages per minute
Print resolution	4800 x 1200 dots per inch
Paper feeder capacity	50 pages
Product life time	N/A
Printing capacity	500 pages per month
Capacity of solar panel (kWp) required	N/A
Size	9 x 18 x 36 cm
Weight	2.9 kg (3.1 kg with battery)

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Price and costs	Retail Price Germany
Investment	436,85 €

### Technological and market development

- For its exceptional functionality and smart design, the HP Officejet 150 Mobile is the Top Ten Reviews Gold Award winner.
- HP does offer phone, email and social media support. It ships the Officejet Mobile 150 with a one-year warranty.
- Energy Star qualified model

### Links

<http://printers.toptenreviews.com/compact/hewlett-packard/hp-officejet-mobile-review.html>



## FS109 Inkjet photo printer Canon Pixma iP100

Canon Deutschland GmbH, Europark Fichtenhain A10, 47807 Krefeld, Germany

### Product Description:

The Canon PIXMA iP110 is an extra compact inkjet printer with excellent wireless capabilities. It is one of the smallest compact printers, lightweight and easy to use. Everywhere you travel it creates top-quality photo prints with excellent colour resolution. Settings are controlled via phone app or the included software. (Apps: for Apple: AirPrint; for Android: Google Cloud Print app or the Canon PIXMA)

- Print, scan and copy function
- Uses standard copy paper in a variety of sizes (A4, B5, A5, ID card, photo, envelopes, etc.)
- Manual duplexing (no automatic)
- Supports USB, IrDA, optional Bluetooth®-Adapter BU-30
- SD card slot

### Target Group:

Offices, field staff, sales representatives, professionals on the go

### Product Specification

Load (W)	9 W operational 1.5 W stand-by 0.4 W off
AC or DC coupled	100 – 240 V AC
Type of battery	Lithium-Ion-Akku
Printing speed	9 b/w pages per minute 5.8 color pages per minute 4 x 6 photo in 50 seconds
Print resolution	Colour: 9600 x 2400 dpi Black/white: 600 x 600 dpi
Paper feeder capacity	50 pages
Product life time	N/A
Capacity of solar panel (kWp) required	N/A
Size	6.3 x 19 x 32 cm
Weight	1.9 kg



Price and costs	Retail Price Germany
Investment (incl. battery)	265 €

### Technological and market development

- A detailed user manual is available online
- Canon offers excellent customer support via email, phone and social media
- Recyclin: Canon operates a recycling program for its products at a small fee. The company's Energy Green program helps reduce ink and paper consumption, avoids using hazardous materials and employs recycled plastic in its power supply castings
- Canon ships the PIXMA iP110 with a one-year warranty.j

### Links

<http://printers.toptenreviews.com/compact/hewlett-packard/hp-officejet-mobile-review.html>

<http://printers.toptenreviews.com/photo-only/canon/canon-1446b002-reviews-21505.htm>

[http://www.canon.de/printers/inkjet/pixma/pixma\\_ip100/](http://www.canon.de/printers/inkjet/pixma/pixma_ip100/)

## FS110 Inkjet photo printer Epson PictureMate Charm PM 225

**Epson America, Inc.**, MS: 3-13, 3840 Kilroy Airport Way, Long Beach, CA 90806-2469, USA

### Product Description:

The Epson PictureMate Charm PM 225 is a pure photo printer with its main feature in portability and quality. As a photo printer that looks more like a small cooler, the Charm is quite deceiving in what it can accomplish.

- Simple and straightforward in use
- Uses PictureMate photo paper
- Connections: USB connection between printer and PC, PictBridge and USB Direct Print-enabled digital cameras.
- Battery has to be purchased separately

### Target Group:

Offices, field staff, sales representatives, professionals on the go

Product Specification	
Load (W)	Operational mode: 11.5W Sleep mode: 3.0 W
AC or DC coupled	120 V AC
Type of battery	Optional lithium-ion battery
Printing speed	4 x 6 photo: around 40 to 60 sec
Print resolution	5760 x 1440 dpi
Paper feeder capacity	20 sheets of photo paper
Product life time	N/A
Capacity of solar panel (kWp) required	N/A
Size	17 x 23 x 14.5 cm
Weight	3.5 kg



Price and costs	Retail Price Germany
Investment	145 €
Li-Ion battery	~ 45 €

### Technological and market development

- ENERGY STAR® qualified
- Epson customer service offers email and phone support user manual and FAQs section.
- Standard one-year warranty.

### Links

<http://printers.toptenreviews.com/photo-only/epson/epson-picturemate-charm-pm-225-review.html>  
<http://www.mypicturemate.com>

## FS111 Laserprinter: Sharp AL-1035

Sharp, 22-22 Nagaike-cho, Abeno-ku, Osaka 545-8522, Japan

### Product Description:

Sharp's AL-1035 is a multi-function product (MFPs) for small bureaus and home offices. From scanning, integration in a network or saving scans on a USB stick, Sharp's home and small office solutions leave nothing to be desired. The portable AL-1035 provides its users with mobility and its extremely simple operation.

- Black and white prints and copies, colour scans
- Flexible use during customer meetings, at events or on business trips.
- Ideal for mobile use at different workplaces.
- Practical carrying handle and low weight make it easy to transport.
- Excels for occasional use on the store counter in small shops.
- Easy to be stored away nearly anywhere when it's not being used.
- ID card scanner allows to scan all cards in credit card format in colour from both sides and print them out on a page in a single step.
- Two USB 2.0 ports and 'scan to USB' function make it possible to save scanned documents or images directly onto a connected USB stick.

### Target Group:

Small shops, mobile workplaces, home offices

Product Specification	
Load (W)	660 W
AC or DC coupled	AC 220 – 240 V
Type of battery	No battery
Printing speed	10 b/w pages per minute
Print resolution	600 dpi
Paper capacity	40
Product life time	N/A
Printing feeder capacity	800 pages/month
Capacity of solar panel (kWp) required	N/A
Size	422 x 291 x 130 cm
Weight	7 kg



Price and costs	Retail Price Germany
Investment	270 - 299€

### Technological and market development

- The toner saving mode lowers toner density during the copying process, thus saving money by reducing toner consumption.
- Automatic power cut-off and preheating mode in order to reduce energy consumption.
- The Sharp AL models have been awarded the 'Energy Star' environmental label.
- 24 month warranty.

### Links

<http://printers.toptenreviews.com/compact/>

<http://www.sharp.eu/cps/rde/xchg/eu/hs.xsl/-/html/compact-and-high-performance-sharps-mfp-solutions-for-small-offices-.htm#downloads>

## FS112 Thermal printer: Possio Greta

**Possio AB**, P.O. Box 1236, SE-164 28 Kista, Sweden

### Product Description:

GRETA is designed to turn any computer into a small mobile office. Printing is available by simply connecting GRETA via an USB cable to the computer. And like in all offices the other typical All-in-One functions scanning, faxing and copying are neat to have available. But GRETA is also a phone which clearly makes her different to all other multi-function printers.

- Printer, Fax, Scanner, SMS-printer and Copier
- USB Connection
- Telephone, via SIM card reader
- **Cellular interface:** Quad band Cinterion, MC55i and/ or Triple band Siemens, MC56 (for US market)
- Comes with mounting kit and carrying case
- Adjustable print and scan density

### Target Group:

Professional vehicles, sales representatives, service engineers, mobile offices, travelling professionals

Product Specification	
Load (W)	N/A
AC or DC coupled	DC 12/24 V AC/DC adapter is included
Type of battery	Internal NIMH-battery (1300mA)
Printing speed	N/A
Print resolution	N/A
Paper feeder capacity	15 meter / 50ft. roll (Appr. 50 A4 pages)
Product life time	N/A
Capacity of solar panel (kWp) required	N/A
Size	29 x 15 x 5 cm
Weight	1087 g



Price and costs	Retail Price Germany
Investment	600 - 700 €

### Technological and market development

- User Manual available

### Links

<http://printers.toptenreviews.com/compact/>

<http://www.possio.com/products-and-services/greta-gsm-fax-a-printer/greta-specifications>

## FS113 Thermal printer Brother PocketJet6

**Brother International Corporation**, 100 Somerset Corporate Boulevard, Bridgewater, NJ 08807-0911, USA

### Product Description:

The PocketJet 6 series is a black, bar-shaped printer with a USB port and little else. It has a rechargeable battery that gives you 70 pages per charge.

- Prints: black and white prints at a resolution of 203 x 200 dots per inch, which is sufficient for professional-looking black-and-white documents.
- Connections: USB , IrDA and Bluetooth (PJ662)
- Paper has to be introduced manually
- Easy to handle

### Target Group:

Professional vehicles, sales representatives, service engineers, mobile offices, travelling professionals

Product Specification	
Load (W)	N/A
AC or DC coupled	AC-adapter is optional
Type of battery	Ni-MH 14,4V or Li-Ion 11,1V
Printing speed	6 pages per minute
Print resolution	300 dpi
Paper feeder capacity	0; manual paper feeding only
Product life time	N/A
Capacity of solar panel (kWp) required	N/A
Size	25,5 x 3 5,5 cm
Weight	473 g



Price and costs	Retail Price Germany
Investment	Ca. 500 €

### Technological and market development

- Special paper is needed (costs per print around 0.14 €)
- 3 years warranty

### Links

<http://printers.toptenreviews.com/compact/>

<http://www.testberichte.de/p/brother-tests/pj-622-testbericht.html>

### 3.6.4 Television

#### FS114 COLOR TV ONergy - 16

SwitchON/ONergy, 1A, D. L. Khan Road, Kolkata – 70002, India

**Product Description:**

A 15.6" coloured LED TV

**Target Group:**

Households, bars, kiosk, etc.

•

Product Specification	
Load (W)	20 W
AC or DC coupled	Optional AC and DC coupled
Voltage (V)	12V
Capacity of solar panel (kWp) required	40 W, 12 V
Battery	Solar Tubular Lead Acid
Product life time	N/A
Size	16"
Weight	N/A

FOTO of Product

Price and costs	Retail Price
Investment	N/A

**Technological and market development**

**Links**

[www.onergy.in](http://www.onergy.in)

## FS115 COLOR TV ONergy - 22

SwitchON/ONergy, 1A, D. L. Khan Road, Kolkata – 70002, India

### Product Description:

A 21.5" coloured LED TV

### Target Group:

Households, bars, kiosks, etc.

Product Specification	
Load (W)	25 W
AC or DC coupled	Optional AC and DC coupled
Voltage (V)	12V
Capacity of solar panel (kWp) required	75 W, 12 V
Battery	Solar Tubular Lead Acid
Product life time	N/A
Size	22 "
Weight	N/A

FOTO of Product

Price and costs	Retail Price
Investment	N/A

### Technological and market development

#### Links

[www. Onergy.in](http://www.Onergy.in)

## FS116 TV-Kit BOSS Kit Pro Fit

Phaesun, Brühlweg 9, 87700 Memmingen, Germany

### Product Description:

A complete TV-Audio kit for off-grid entertainment. It can be used for video shows, live broadcast of sports events or karaoke shows in restaurants and bars.

- A DC television of Alphantronics R-24eWDSB
- 24" LED screen,
- full HD
- DVD player
- USB connection
- independent Bluetooth sound system and
- DVB-T Antenna.

### Target Group:

Households

- 

Product Specification	
Load (W)	20 – 24 W
AC or DC coupled	DC
Voltage (V)	12V
Capacity of solar panel (kWp) required	85 W, 12 V
Battery	65Ah
Working hours per day	6 h/d
Produkt life time	
Size	
Weight	



Price and costs	Retail Price
Investment	N/A

### Technological and market development

- Phaesun maintains close and long-lasting relationships with local distributing partners in about 18 African countries.
- Phaesun partners provide the service and maintenance structure as well as spare parts and technological optimization for the enduser.
- Experiences from the field are integrated into product optimization.
- Phaesun supports the approach of developing tailor made systems for productive use for special business cases. Contact via <http://www.phaesun.com>

### Links

<http://order.phaesun.com/index.php/kits-40892/bosskits-40949/phaesunbosskitsprofit-41296.html>



## FS117 TV Alphatronics

alphatronics GmbH, Breitengraserstraße, 90482 Nürnberg

### Product Description:

Best technology solutions for mobile televisions

- Energy efficient
- Integrated media features (DVD, Bluetooth, USB, DVB-T)
- Several sizes

### Target Group:

Households

- 



Product Specification	
Load (W)	Starting with 10 W
AC or DC coupled	DC
Voltage (V)	12V
Screen diagonal	15 - 24", Widescreen
Capacity of solar panel (kWp) required	
Battery	
Produkt life time	
Size	
Weight	

Price and costs	Retail Price
Investment	N/A

### Technological and market development

- Reliable, state of the art multimedia technology

### Links

[www.alphatronics.de](http://www.alphatronics.de)

## FS118 LED TV Niwa 15,6"

Niwa, 15/F, Neich Tower, 128 Gloucester Road, Wan Chai, Hong Kong

### Product Description:

Niwa TVs combine very low power consumption with all features for latest generation. Integrated digital and analog tuner combined with HDMI, VGA and Video-In allows a very universal use for entertainment, education and presentation.

- 15.6"
- DVB-T, DVB-T2, HDMI, HDTV MPEG4, PC VGA

### Target Group:

Households, schools, restaurants, bars

- 

Product Specification	
Load (W)	8 W
AC or DC coupled	DC, 12V
Voltage (V)	12V
Capacity of solar panel (kWp) required	N/A
Size	375 x 130 x 288 mm
Weight	1.5 kg



Price and costs	Retail Price
Investment	N/A

### Technological and market development

N/A

### Links

<http://niwasolar.com/Modular-Solar-Systems-MSS/>  
[http://order.phaesun.com/index.php/solar-eled-tv-niwa-15-6.html?\\_\\_store=german&\\_\\_from\\_store=default](http://order.phaesun.com/index.php/solar-eled-tv-niwa-15-6.html?__store=german&__from_store=default)

## FS119 TV fosera DC 15.6" 12 V

Fosera, Beim Mühlbach 3, 89171 Illerkirchberg, Germany

### Product Description:

The fosera DC TV for high quality home entertainment consumes only 5.5 W and offers a number of inputs for modern entertainment. With highest energy-efficiency it is designed to work with the fosera POWER LINE LSHS and all other 12V solar systems.

Ports:

- HDMI 1.3,
- USB 2.0,
- SCART
- AV interfaces.

### Target Group:

Media entertainment for restaurants, bars, multimedia theaters

- 

Product Specification	
Load (W)	5.5 W
AC or DC coupled	DC, 13V
Voltage (V)	13V
Capacity of solar panel (kWp) required	0,02 Wp
Size	15.6 "
Weight	2,2 kg



Price and costs	Retail Price
Investment	134,85 €

### Technological and market development

- Winner of the Global Leap Award 2014, emerging technology - small TV.
- Spare parts are supplied by fosera and are available with the retailer.

### Links

<http://www.fosera.com/products/power-line/tv.html>

## FS120 Satellite Receiver foser DVB-S2

Fosera, Beim Mühlbach 3, 89171 Illerkirchberg, Germany

### Product Description:

To enjoy full entertainment, foser proudly presents the satellite receiver DVB-S2.

The Satellite Receiver DVB-S2 needs to be connected to a Satellite in order to successfully operate.

### Target Group:

Media entertainment for restaurants, bars, multimedia theaters

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Product Specification	
Load (W)	8.8 W
AC or DC coupled	DC, 13 V
Voltage (V)	13 V
Capacity of solar panel (kWp) required	0,02 Wp
Size	20.5x6x21.5 cm
Weight	0,9 kg



Price and costs	Retail Price
Investment	41,85 €

### Technological and market development

- Before purchase it is required to know how program signals can be received in the residential area, whether by antenna or satellite.
- Spare parts are supplied by foser and are available with the retailer.

### Links

<http://www.fosera.com/products/power-line/tv.html>

## FS121 Terrestrial Receiver foser DVB-T2

Fosera, Beim Mühlbach 3, 89171 Illerkirchberg, Germany

### Product Description:

The Terrestrial Receiver enables to enjoy programs received by antenna, which means that no satellite is necessary to successfully receive program signals.

### Target Group:

Media entertainment for restaurants, bars, multimedia theaters

Product Specification	
Load (W)	3.1 W
AC or DC coupled	DC, 13 V
Voltage (V)	13 V
Capacity of solar panel (kWp) required	0,02 kWp
Size	18.5x17.5x5.5 cm
Weight	0,7 kg



Price and costs	Retail Price
Investment	37,35 €

### Technological and market development

- Before purchase it is required to know how program signals can be received in the residential area, whether by antenna or satellite.
- Spare parts are supplied by foser and are available with the retailer.

### Links

<http://www.fosera.com/products/power-line/tv.html>

## FS122 Radio foser

Fosera, Beim Mühlbach 3, 89171 Illerkirchberg, Germany

### Product Description:

The foser radio includes, additional to FM, AM, SW, MW receiver also an AUX-IN-Outlet that allows connection to any cell phones or mp3 players to play own music.

The radio is ultra-efficient, combined with high quality components. Products from foser have a unique, modular design principle. The radio can be powered with the foser PSHS, LSHS, all foser lanterns or over USB.

### Target Group:

Media entertainment for restaurants, bars, multimedia theaters



Price and costs	Retail Price
Investment	10,35

Product Specification	
Load (W)	20 – 100 mA (depending on sound volume)
AC or DC coupled	DC, 12- 14 V
Voltage (V)	3,25V & 13V
Capacity of solar panel (kWp) required	0,01 kWp
Size	19.5 x 14.2 x 9 cm
Weight	0,52 kg

### Technological and market development

- To use the radio with the LSHS, a USB to 2.1 mm DC jack cable is required.
- Spare parts are supplied by foser and are available with the retailer.

### Links

<http://www.fosera.com/products/blue-line/applications.html>

### 3.7 Electricity services - Charging, Metering and Measuring

In the context of this catalogue energy services refer mainly to charging of Batteries, Lamps, mobile phones and other electronic devices.

Almost everywhere people are used to the utilization of electronic devices. Cell phones, batteries for illumination purposes and DVD players are in common use although the grid is far away. Therefore charging is a widely requested service in remote, off-grid areas and can easily be used for income generation. Charging services can either be provided in shops or as mobile solutions e.g. for services offered at markets etc.

In remote off-grid areas villagers often already have rechargeable batteries to provide light and some other services. Nevertheless they have to carry these batteries a long way - e.g. to the next town and back - in order to get them recharged.

Battery charging stations (BCS) installed at central points in rural areas have the potential to considerably reduce time and expenses for recharging such batteries. Hence, there seems to be a market for convenient and clean (e.g. PV powered) battery-charging systems.

Central battery charging stations have lower initial investment costs for households compared to individual PV solutions. A charging station can be further developed to an energy shop, providing energy services and additional other services such as selling refrigerants, snacks, offering secretarial services like printing, copying, provide entertainment like watching soccer games on TV.

Factors that influence the economic performance of a business activity positively may be the shop separation from home and larger distance from electricity grid. ()

In addition to charging systems we included DC/DC converter, as it allows electricity supply at required current level, and DC meter in this catalogue.

- PV powered charging systems
- DC/DC converter
- DC meter

#### **Apart from these benefits charging stations face some challenges:**

- Relatively high running and maintenance costs e.g. for blown fuse, charger, inverter and batteries  
→ only high quality equipment should be purchased and the operator should be trained in handling it appropriately.
- At cloudy days the system may not provide enough energy to respond to the demand  
→ Therefore, appropriate sizing of the system components is required (size of battery, number of power outlets and DC ports)
- Environmentally friendly discharge of used battery system

### 3.7.1 Charging

#### FS123 Charging Kit Azad Power Pack

SwitchON/ONergy, 1A, D. L. Khan Road, Kolkata – 70002, India

#### Product Description:

A plug and play - mini solar home electrification system with LED tube and charging capability for mobile phones

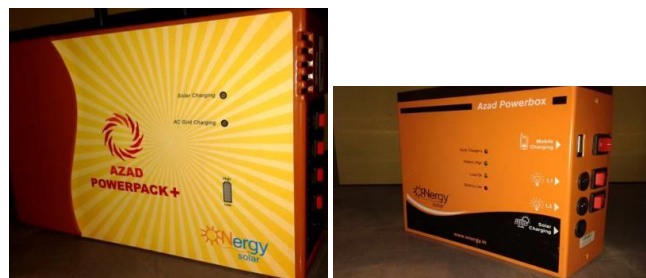
- Azad Powerbox: 1.5 W LED bulb and mobile phone
- Azad Powerpack: 2 x 3 W LED tube and mobile phones

Powerbox and Powerpack are consisting of solar panels, Micro Controller Based, PWM Charge Controllers, LED tube and charger.

#### Target group:

Urban and rural households, farmers, cooperatives, etc.

Product Specification	
Voltage of system (V)	
Capacity of solar panel (kWp)	5 W, 6 V (Powerbox) 10W, 12 V (Powerpack) 18 W
Electricity supply	4 hours of light
Possible loads (appliances)	1 – 2 lamps + mobile phones
Maximum number of loads that can be charged at a time	N/A
Capacity of battery @C10 (Ah)	4.5 – 7.2 Ah
Battery type	Gel
Product life span (h)	N/A
Autonomy days	2
Size	N/A
Weight	N/A



Price and costs	Retail Price
Investment	N/A

#### Technological and market development

- Partnership with individuals, NGOs, farmers' clubs, cooperatives, who are trained by ONergy
- ONergy supports business generation.
- Cooperation with MFIs is under development.

#### Links

<http://onergy.in/product.php>



## FS124 Solar Home System Griha On Shakti (75/ 100W)

SwitchON/ONergy, 1A, D. L. Khan Road, Kolkata – 70002, India

### Product Description:

A 75 W/ 100 W home solar power system that can supply DC appliances like Fans and TV and can be used for mobile charging. The system consists of solar panels, inverter, Micro Controller Based, PWM Charge Controllers. Furthermore it contains a number of LED bulbs and CFL lights.

### Target group:

Urban and rural households



Product Specification: ON Shakti 75/ 100		Price and costs	Retail Price
Voltage of system (V)	12 V	Investment	N/A
Capacity of solar panel (kWp)	20 – 200W	<b>Technological and market development</b>	
Electricity supply	4 hours light	<ul style="list-style-type: none"> <li>The system is robust and weather resistant.</li> <li>ONergy gives a 5 years warranty.</li> </ul>	
Possible loads (appliances)	N/A	<b>Links</b>	
Maximum number of loads that can be charged at a time	Varies with system capacity	<a href="http://onergy.in/product.php">http://onergy.in/product.php</a>	
Capacity of battery @C10 (Ah)	20 – 200		
Battery type	Lead Acid		
Autonomous days	3		
Product life span	Battery: 8 y Solar Panels: 25 y		
Size	N/A		
Weight	N/A		

## FS125 Inverter System Griha ON Shakti (200/ 400W)

SwitchON/ONergy, 1A, D. L. Khan Road, Kolkata – 70002,  
India

### Product Description:

Solar Smart Charger 20/ 40A , with hybrid charging feature with priority being given to Solar. This can be used to retrofit existing home inverters.

- For AC appliances
- Grid connected and off-grid system

### Target group:

- Urban and rural households
- Urban and rural offices



Price and costs	Retail Price
Investment	N/A

Product Specification	
Voltage of system (V)	N/A
Capacity of battery @C10 (Ah)	N/A
Capacity of solar panel	200 – 1000 W
Possible loads (appliances)	AC appliances (TV, Fans, etc.)
Maximum number of loads that can be charged at a time	Varies with system capacity
Battery type	Lead Acid
Product life span (h)	Battery: 8 y Panels; 25 y
Size	N/A
Weight	N/A

### Technological and market development

- ONergy gives 1 y Warranty.

### Links

<http://onergy.in/product.php>

## FS126 Solar Charging Station ONergy

SwitchON/ONergy, 1A, D. L. Khan Road, Kolkata – 70002, India

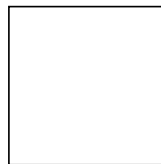
### Product Description:

A Lantern Charging Station for different types of solar lanterns and mobile phones.

### Target group:

- Small enterprises
- Urban and rural offices
- Urban and rural households

Product Specification	
Voltage of system (V)	48 V
Capacity of solar panel	2000 Wp
Possible loads (appliances)	Small Lights/ Lanterns/ mobile phones
Maximum number of loads that can be charged at a time	1500 W
Capacity of battery @C10 (Ah)	300 Ah
Battery type	Solar Tubular Lead Acid
Product life span (h)	8 years
Size	N/A
Weight	N/A



Price and costs	Retail Price
Investment	N/A

### Technological and market development

N/A

### Links

<http://onergy.in/product.php>

## FS127 Charging Sundaya Charging station

**Sundaya**, Indonesia, Sweden, China

Sundaya Nordic, Flöjelbergsgatan 12 431 37 Mölndal Sweden

### Product Description:

The Sundaya Ulitium and T-lite lamps are high efficient LED-lamps with integrated Li-Ion batteries. They can lighten entire rooms and are completely independent lighting solutions for Off-Grid households. The Sundaya Charging Station can charge 30 – 120 Ulitium or T-lite lamps at the same time.

### Target group:

- Households, small enterprises, schools, workshops

Product Specification Ulitium	
Output of Lantern	LED
Light output	Adjustable 25, 120 or 240 lumen
AC or DC coupled	DC, 12 V
Capacity of battery @C10 (Ah)	4500 mAh
Type of battery	integrated lithium cobalt battery
Product Specification T-lite	
Output of Lantern	LED
Light output	Adjustable 18 - 180 lumen
AC or DC coupled	DC, 12 V
Capacity of battery @C10 (Ah)	N/A
Type of battery	integrated lithium cobalt battery
Capacity of solar panel (kWp)	100 – 120 Wp
Working time	60h light
Days of autonomy	N/A
Possible loads (appliances)	T-Lite or Ulitium Lamps
Maximum number of loads that can be charged at a time	Plug-in for 30 - 120 T-lite or Ulitium Lamps
Product life span (h)	N/A
Size	N/A

Weight	N/A
--------	-----



Price and costs	Retail Price
Investment	N/A

### Technological and market development

- Broadly distributed by Phaesun.

### Links

<http://sundaya.com/>  
[www.phaesun.com](http://www.phaesun.com)

## FS128 Charging Boss Kit Pro Fee

Phaesun GmbH, Brühlweg 9, 87700 Memmingen, Germany

### Product Description:

The Pro Fee Phone Charging Station enables shop owners to recharge mobile phones for a fee in areas without grid power.

- Cell phones are charged via USB.
- Optionally an inverter can be integrated to supply an AC plug. This can even be extended with a multi plug socket to charge older phones via AC plug.
- PV-modules recharge a conventional system-battery to make business independent from weather or daytime.
- Plugs, electronics and battery are integrated into one enclosure.
- The system is mobile.

### Target group:

Mobile phone charging stations, kiosk, small shop

Product Specification	
AC or DC coupled	DC, 5 V
Capacity of battery @C10 (Ah)	N/A
Type of battery	Integrated
Capacity of solar panel (kWp) required	55 W (85W for AC plug)
Working time	N/A
Days of autonomy	N/A
Possible loads (appliances)	Mobile phones
Maximum number of loads that can be charged at a time	18
Product life span (h)	N/A
Size	N/A
Weight	N/A



Price and costs	Retail Price
Investment	N/A

### Technological and market development

- Phaesun maintains close and long-lasting relationships with local distributing partners in about 18 African countries.
- Phaesun partners provide the service and maintenance structure as well as spare parts and technological optimization for the enduser.
- Experiences from the field are integrated into product optimization.
- Phaesun supports the approach of developing tailor made systems for productive use for special business cases. Contact via <http://www.phaesun.com>

### Links

[www.phaesun.com](http://www.phaesun.com)

## FS129 Charging Ready Set Solar Charger

**Fenix**, 30 Cleveland Street, San Francisco, CA 94103, USA  
Plot 12 Makindu Lane, Kampala, Uganda

### Product Description:

ReadySet is a smart battery system engineered to thrive in the harshest conditions in Africa. Its microcontroller works in concert with patented firmware to protect itself from high-temperature, overloads, and short circuits. Intelligent electronics prevent deep discharge and preserve battery life.

ReadySet includes a solar panel and is expandable up to 75 watts as your needs grow.

### Target Group:

- Rural Areas

Product Specification	
AC or DC coupled	DC: 16 – 19- V
Capacity of battery @C10 (Ah)	9 Ah
Type of battery	Valve-Regulated Lead-Acid
Capacity of solar panel (kWp) required	5 - 75W
Working time	N/A
Days of autonjomy	N/A
Possible loads (appliances)	lights, mobile phones, tablets, LCD TVs
Maximum number of loads that can be charged at a time	Up to 4 devices with a 15 W solar panel
Product life span (h)	N/A
Size	N/A
Weight	N/A



Price and costs	Retail Price
Investment	N/A

### Technological and market development

- Smart, rugged and user-friendly design that makes it easy for anyone to use and maintain.
- Due the characteristics of the battery, the charge rate is limited to a max charge power of 30W regardless of available solar power. If energy is being drawn from the power ports while charging, the ReadySet can convert up to an additional 30W of solar energy and provide it directly to the outputs (bypassing the battery) for a total of 60W of solar energy conversion
- CLA and USB output
- Rental schemes available for Uganda and Tanzania
- 6 month limited warranty

### Links

<http://www.fenixintl.com/products/>

## FS130 Charging ECOBOXX Qube 50/ 90/ 160

**EcoBoxx/ Sungrid Group (PTY) LTD South Africa**, Unit Do6B Collingwood Building, Black River Park Observatory, Cape Town 7925, PO Box 3231, Somerset West 7129

### Product Description:

A solar powered package capable of providing up to 50 hours of power. It can be used for lighting, cell phone charging and the charging of other small electrical appliances (such as fans, radios and small TVs).

- Different sizes for different needs (50, 90, 160)
- 2 x 3 W super bright LED lights with independent switches
- 75 W modified sine wave inverter

### Target group:

- Rural offices, Village community

Product Specification	
AC or DC coupled	DC, optional with AC converter
Capacity of battery @C10 (Ah)	4 - 14 Ah
Type of battery	Lead Crystal
Capacity of solar panel (kWp) required	5 - 20 Wp
Working time	
Days of autonomy	1 - 4 days <sup>4</sup>
Possible loads (appliances)	LED lights, mobile phones, DC fans, tablet
Maximum number of loads that can be charged at a time	1 - 2 USB ports
Product life span (h)	
Size	170 x 75 x 65 cm
Weight	95 kg



Price and costs	Retail Price Southafrica
Investment	1499 – 2999 R

### Technological and market development

- Made in Southafrica
- Retailer in Southafrica, Lesotho, Swaziland
- Distributed via energcare

### Links

- [http://www.ecoboxx.co.za/pages/products.php?prod\\_id=1](http://www.ecoboxx.co.za/pages/products.php?prod_id=1)
- <http://energcare.co.za>

### 3.7.2 Portable charging stations

#### FS131 Portable charging station Boss Kit Port Able

Phaesun GmbH, Brühlweg 9, 87700 Memmingen, Germany

##### Product Description:

This system is the link between a portable Pico PV-System and a fixed installation. Constructed on a hand wagon or bicycle trailer on 20" wheels.

- Includes panel, charger, battery, inverter.
- Maintenance free, high quality components
- Plenty of storage space inside.

##### Target group:

- Small mobile business
- Village community

Product Specification	
AC or DC coupled	DC, optional with AC converter
Capacity of battery @C10 (Ah)	138 Ah
Type of battery	Integrated
Capacity of solar panel (kWp) required	130 Wp
Working time	
Days of autonomy	
Possible loads (appliances)	Mobile phones
Maximum number of loads that can be charged at a time	18
Product life span (h)	
Size	170 x 75 x 65 cm
Weight	95 kg



Price and costs	Retail Price Germany
Investment	2665 €

##### Technological and market development

- Phaesun maintains close and long-lasting relationships with local distributing partners in about 18 African countries.
- Phaesun partners provide the service and maintenance structure as well as spare parts and technological optimization for the enduser.
- Experiences from the field are integrated into product optimization.
- Phaesun supports the approach of developing tailor made systems for productive use for special business cases. Contact via <http://www.phaesun.com>
- Loads can be adapted to individual needs
- Examples for 24h/d use:
  - 3 cell phones, 2 laptops and 5 LED lamps .
  - 1 refrigeration box, 1 TV and 5 LED lamps
  - 1 broadcast station with 1 PC, 5 lamps, charging station for radio equipment
  - 1Surface water pump

##### Links

[www.phaesun.com](http://www.phaesun.com)



## FS132 Portable charging station ECOBOXX 300

**EcoBoxx/ Sungrid Group (PTY) LTD South Africa**, Unit Do6B Collingwood Building, Black River Park Observatory, Cape Town 7925, PO Box 3231, Somerset West 7129

### Product Description:

Portable solar charging equipment, ideal for heavier multiple charging, light and medium plus AC-power.

- LED indicator for battery level.
- Includes 1 x AC/DC wall charger for grid charging

### Target group:

- Small mobile business

Product Specification	
AC or DC coupled	5 – 12 V DC/ 300W AC
Capacity of battery @C10 (Ah)	24 Ah
Type of battery	AGM
Capacity of solar panel (kWp) required	30 Wp (3 x 10 W foldable solar panel)
Working time	
Days of autonomy	
Possible loads (appliances)	Mobile phones, tablet, USB-fan, AC-fan, TV p to 130 W, router, radio, camping fridge,
Maximum number of loads that can be charged at a time	4 DC outlets, 2 AC outlets
Product life span (h)	
Size	
Weight	



Price and costs	Retail Price Southafrica
Investment	8999 R

### Technological and market development

Made in Southafrica

Retailers in Southafrica, Namibia, Lesotho, Swaziland

### Links

[http://www.ecoboxx.co.za/pages/products.php?prod\\_id=7](http://www.ecoboxx.co.za/pages/products.php?prod_id=7)

## FS133 Portable charging station ECOBOXX 600

**EcoBoxx/ Sungrid Group (PTY) LTD South Africa**, Unit Do6B Collingwood Building, Black River Park Observatory, Cape Town 7925, PO Box 3231, Somerset West 7129

### Product Description:

The ultimate all-in-one power machine. High charging and greater AC power capacity.

- LED indicator for battery level.
- Travel trolley included
- Includes 1 x AC/DC wall charger for grid charging

### Target group:

- Small mobile business

Product Specification	
AC or DC coupled	5 – 12 V DC/ 600W AC
Capacity of battery @C10 (Ah)	42 Ah
Type of battery	AGM
Capacity of solar panel (kWp) required	40 Wp (4 x 10 W foldable solar panel)
Working time	
Days of autonomy	
Possible loads (appliances)	LED lights, mobile phones, tablet, USB-fan, AC-fan, TV p to 130 W, router, radio, camping fridge, 600 W tools, 800 W microwave
Maximum number of loads that can be charged at a time	4 DC outlets, 2 AC outlets
Product life span (h)	N/A
Size	N/A
Weight	N/A

164



Price and costs	Retail Price Southafrica
Investment	12,999 R

### Technological and market development

Made in Southafrica

Retailers in Southafrica, Namibia, Lesotho, Swaziland

### Links

[http://www.ecoboxx.co.za/pages/products.php?prod\\_id=7](http://www.ecoboxx.co.za/pages/products.php?prod_id=7)

## FS134 Portable Charging Station ECOBOXX 1500

**EcoBoxx/ Sungrid Group (PTY) LTD South Africa**, Unit Do6B Collingwood Building, Black River Park Observatory, Cape Town 7925, PO Box 3231, Somerset West 7129

### Product Description:

The ultimate all-in-one professional power machine for the ultimate power need.

- stand and carry bag
- 1m cable from the junction box with MC4 connector
- 4m Solar panel cable for multiple connections
- 5 Amp / 16 V DC AC/DC adaptors
- Big LCD display to monitor and control the parameters

### Target group:

- Small mobile business

Product Specification	
AC or DC coupled	5 – 12 V DC/ 1500W AC
Capacity of battery @C10 (Ah)	100 Ah
Type of battery	EcoTank
Capacity of solar panel (kWp) required	130 Wp (2 x 65 W foldable solar panel)
Days of autonomy	
Possible loads (appliances)	LED lights, mobile phones, tablet, USB-fan, AC-fan, TV p to 130 W, router, radio, camping fridge, 600 W tools, 800 W microwave
Maximum number of loads that can be charged at a time	3x 5 V DC USB charging ports 2 x 5.5mm DC jacks - 12 Vdc output 1 x 12 V DC cigarette light 4 DC outlets, 2 x 230 V AC sockets

Product life span (h)	
Size	
Weight	



Price and costs	Retail Price
Investment	19,995 R

### Technological and market development

- Made in Southafrica
- Retailers in Southafrica, Namibia, Lesotho, Swaziland

### Links

[http://www.ecoboxx.co.za/pages/products.php?prod\\_id=7](http://www.ecoboxx.co.za/pages/products.php?prod_id=7)

### 3.7.3 DC/DC Converter and Metering Equipment

#### FS135 DC/DC Converters Studer MDCI and MDC Series

Studer

##### Product Description:

The DC/DC converters type MDCI and MDC are used, depending on the model either to step up or to step down a DC voltage. The MDCI range converters are electrically isolated. High efficiency Low consumption Protection against short circuit, over heating overvoltage and reverse polarity Great stability of the output voltage for a more reliable system

##### Target Group:

- 

##### Product Specifications:

Article	Dimensions [l x w x h]	Weight	Article No.
DC/DC Converter MDCI 100 100 W   input: 9–18 VDC or 20–35 VDC or 30–60 VDC or 60–120 VDC   output 12,5 VDC/8 A or 24 VDC/4 A	49 x 88 x 152 mm	0,5 kg	104118
DC/DC Converter MDCI 200 200 W   input: 9–18 VDC or 20–35 VDC or 30–60 VDC or 60–120 VDC   output 12,5 VDC/16 A or 24 VDC/8 A	49 x 88 x 182 mm	0,6 kg	104119
DC/DC Converter MDCI 360 360 W   input: 9–18 VDC or 20-35 VDC or 30–60 VDC or 60–120 VDC   output 12,5 VDC/30 A or 24 VDC/15 A	64 x 163 x 160 mm	1,4 kg	104120
DC/DC Converter MDCI 360 charger 330 W   input: 9–18 VDC   output 27,6 VDC/12 A	64 x 163 x 160 mm	1,4 kg	321209
DC/DC Converter MDC 1224-7 170 W   input: 9–18 VDC   output 24 VDC/7 A	49 x 88 x 98 mm	0,3 kg	104121
DC/DC Converter MDC 2412-5 65 W   input: 18–35 VDC   output 13,2 VDC/5,5 A	49 x 88 x 68 mm	0,2 kg	104122
DC/DC Converter MDC 2412-8 105 W   input: 18–35 VDC   output 13,2 VDC/8 A	49 x 98 x 88 mm	0,3 kg	104123
DC/DC Converter MDC 2412-12 160 W   input: 18–35 VDC   output 13,2 VDC/12 A	49 x 98 x 88 mm	0,3 kg	104124
DC/DC Converter MDC 2412-20 275 W   input: 18–35 VDC   output 13,8 VDC/20 A	49 x 88 x 126 mm	0,5 kg	104125
DC/DC Converter MDC 2412-30 415 W   input: 18–35 VDC   output 13,8 VDC/30 A	49 x 88 x 151 mm	0,6 kg	104126



Price and costs	Retail Price
Investment	N/A

##### Technological and market development

- Distributed via Phaesun

##### Links

[www.phaesun.com](http://www.phaesun.com)

## FS136 DC/DC Converter Solaric Solar Optimizer

Solaric, House# 03, Roadd # 08, Baridhara, Dhaka 1212, Bangladesh

### Product Description:

Solar Optimizer is a highly efficient DC/DC converter that produces high voltage DC (125 VDC) from low voltage battery input (12 VDC). The very low conversion losses make it possible to implement it in the low power off-grid SOLAR applications such as Solar Home System (SHS).

- Reduced cable diameter allows standard wiring.
- Transmission losses are reduced.
- Costs are reduced.
- The distance from battery to load can be extended.
- Enables user to use LED tubes, mobile phone charger, Lantern charger etc from low voltage DC battery.
- The integrated Solar Charge Controller provides the necessary functions and protections to charge the battery from PV panels
- The high voltage enables the consumer to use standard appliances such as Laptop, Fan, color TV, standard LED lighting etc

### Target Group:

- Rural areas

Product Specification	
Load (W)	N/A
DC Input	12 V
DC output	125 V
Capacity of solar panel (kWp) required	N/A
Battery	N/A
Produkt life time	N/A
Size	N/A
Weight	N/A



Price and costs	Retail Price
Investment	N/A

### Technological and market development

- Available in Bangladesh, India, Nepal and Tanzania.
- Improved load capacity and lower end user cost are targeted.

### Links

<http://solar-ic.com/solaricdev/major-innovations/solar-optimizer/>

## FS137 DC/DC Converter Solaric Solar APS Micro

Solaric, House# 03, Roadd # 08, Baridhara, Dhaka 1212, Bangladesh

### Product Description:

The APS is a high efficient multipurpose device: Solar Charge Controller and DC/DC Converter and LED Driver. The DC/DC converter that produces high voltage DC from low voltage battery (12V) or PV input. Conversion losses are so low that it is possible to use it in low power off-grid solar applications as well as on grid establishments as secondary power source.

- Small static loss leads to reduced stand-by consumption.
- The innovative Eco-Power mode can be used to dim the driverless LED Lamp and thereby saves energy and increases backup time significantly.
- The solar APS allows the user to use any standard appliances such as SOLARIC driverless LED lamp, AC CFL Lamps, mobile phone charger, lantern charger etc. from low voltage DC battery.
- The output voltage level is high enough to be within the universal Voltage range (85-265 Volt) such that it can drive standard loads such as CFL, Mobile charger, Color TV etc.

### Target Group:

- Users with SHS in off grid and grid connected areas

Product Specification	
Load (W)	N/A
DC Input	12 V
DC output	85-265 V
Capacity of solar panel (kWp) required	N/A
Battery	N/A
Produkt life time	N/A
Size	N/A
Weight	N/A



Price and costs	Retail Price
Investment	N/A

### Technological and market development

- N/A

### Links

<http://solar-ic.com/solaricdev/products/solar-ips/>

## FS138 Digital DC Energy Meter

Solaric, House# 03, Roadd # 08, Baridhara, Dhaka 1212, Bangladesh

### Product Description:

The DC Pre paid Energy Meter measures energy consumption and counts down balance in TAKA as per tariff setting. The tariff setting is adjustable after commissioning if required. The meter shuts down load on low balance.

- Information display: connected load, operation voltage, balance, cumulative energy usage after each recharge, any fault conditions.
- Impressive electrical attributes: measurement accuracy > 99 %; very low static loss (3mA).
- The recharge code used is based on random numbers and is completely secure to user.
- Overload and short circuit protection
- Secure recharge code

### Target Group:

- Designed for solar grids where energy is expensive and has to be predictably distributed.

Product Specification	
Rated power (W)	60-100 W
Measurement accuracy	> 99 %
Self consumption	< 1 W
Capacity of solar panel (kWp) required	N/A
Battery	N/A
Produkt life time	N/A
Size	N/A
Weight	N/A



Price and costs	Retail Price
Investment	N/A

### Technological and market development

- N/A

### Links

<https://www.ubnt.com/products/#all/routing>

## 4. Business cases using PV appliances for PUE

Although investment costs often are higher, PV powered appliances are often cost competitive with conventional products on a life-cycle basis. Nevertheless the key barrier they face is the relatively high capital-to-operational cost ratio compared to conventional appliances. (IRENA, 2015)<sup>k</sup>

The economic situation of rural communities tends to push people towards technology choices made on a short-term basis referring mainly to lowest investment costs. For a household that buys a solar lamp to save money on kerosene or candles, investment takes several months to pay off. But these choices often are not the best option in the long term, especially in isolated communities where diesel fuel is an expensive resource that is difficult to obtain and distribute. (Wiemann & Li, 2014)

Identifying appropriate financing schemes, tailored to the consumers' income, cash flow and current expenditures on energy services (e.g. kerosene or candle lighting, mobile charging), facilitates overcoming these barriers. (IRENA, 2015)

### 4.1 Set-up of a viable business model

There are different approaches to set-up a business model. The best model will depend on the respective product and may vary from community to community. It should be best suited to the conditions of local stakeholders. (Wiemann & Li, 2014)

Typical types of business models are:

- Direct sale (cash sale)
- Microcredit
  - Dealer Credit (One hand model)
  - End-user Credit (Two hand model)
  - Lease / Hire purchase (either One hand model or Two hand model)
- Fee for Service
- Point-of-Sale
- Dealer based

Some of the key factors that should be taken into account when choosing the adequate financing scheme, are the product and framework conditions. Both are described below in more detail.

#### 1. The product

The product is an essential factor for the choice of a business model as the required investment costs and involved persons may vary significantly (e.g. solar irrigation pump vs. solar charging station). It is no show case technology that is adopted in the field. Each technology has to fit to the local communities and, if necessary, be adapted (ONergy).

Below important points for product choice are listed:

- **Local market conditions** that affect the cost-effectiveness of the product.  
Local markets may be very different and conditions such as costs for diesel or kerosene may vary from region to region. In Africa, for example, costs for kerosene are much higher than in India. Furthermore diesel and kerosene are still subsidized in several countries.

**Kommentiert [giz4]:** In dem Kapitel müsste deutlicher unterschieden werden zwischen dem Business Modell, das aus Perspektive des Vertreiber der Technologien geschrieben ist und den Business Case, der aus der Perspektive des Technolgiebenutzers geschrieben ist. Das geht durcheinander. Vielleicht finden sich in der GIZ Publikation „Energize the BOP“ noch gute Hinweise, wie dies Kapitel aufgebaut werden könnte.



→ A good network enables research on specific market conditions.

- **Training** requirements should be defined.
  - Training for the solar entrepreneur, to run a solar business.
  - Training for technicians (or entrepreneur/ consumer) in service and maintenance.
  - Training for consumer for correct handling.
  - Training should be adapted to local conditions and requirements.

## **2. Framework conditions for an appropriate business model**

To establish a reliable business model the local framework conditions should be analysed.  
Important points are listed below:

- **Regional and local financing structures**
  - What are the lending institutions in the country (banks, microcredit institutes, institutions that manage revolving funds, point-of-sale financing etc.).
  - What are the existing repayment structures? (Mobile banking, cash collection, pre-payment systems etc.)
  - What are customers used to pay for: product, service, energy, time?
  - Repayment structure should be adapted to financial capabilities of the consumers, taking into account for cash clients as well as poorer people.
  - Consider ability to pay as well as pay-back time.
  - In case of a community structure: can the responsibility of repayment be bared of the entire community?
- **Stakeholders involved**
  - Entrepreneur: invests in technology, should be linked to financial institution
  - Operator: operates the system, has to be trained and get paid
  - Financier: facilitates investment
  - Customer:
    - Number of consumers and financial capabilities
    - In case that the investment is very small, a group of consumers can enlarge the overall sum to attract the interest of financiers.
  - If one of the actors is the community: how is it organized?
- **In the agricultural sector it has to be adapted to farming costumes**
  - At what time is the energy needed? (Over the course of the day or only in morning and evening hours, 2-4 h per day, seasonal, etc.)
- **The business model should include a service and maintenance mechanism :**
  - To ensure sustainable implementation of the product.
  - To create trust in the technology (among both customers and financiers).
  - Promising payment only if the product works; buyback mechanisms.
    - In case of a battery based product battery replacement should be planned.

- **Successful operating business model foster new ones**
- **Functioning models grow trust in business and trust in technology.**
  - **More entrepreneurs are willing to invest in PV technologies.**
  - **New technologies can be introduced.**

**(ONergy)**

## 4.2 Examples for business cases

This section of the catalogue gives some examples for business opportunities. These cases are referring directly to products listed in the catalogue.

**Kommentiert [giz5]:** In den Business cases sollten neben den Investitionskosten auch die Lebenszykluskosten ausgewiesen werden

**Business opportunity: Cold Chain**

**a. PV powered services at a solar kiosk (Somaliland)**

A solar kiosk can provide a variety of services: cooled drinks, mobile charging, battery charging or secretarial services.

In this example an entrepreneur bought a 160 liter solar-powered cooler and a solar-powered battery charging station so he could offer chilled drinks and charge mobile phones. He invested \$2,500 but was able to increase sales by 40%. Now he can sell 45 drinks per day at \$0.60 cents each instead of the previous \$0.45 cents because they are chilled. This makes an additional income of about \$203 a month. Furthermore, he charges 15 mobile phones a day, earning an additional monthly income of \$67. This means that the investment will pay for itself in less than a year. Meanwhile, the kiosk owner has invested more than \$400 to upgrade his solar home system so that he can operate a ceiling fan. (Zwirner, 2014)

Investment:	2,500 \$	(for 160 liter refrigerator and upgrade of PV system)
Additional income		
Per month:	270 \$	based on the assumption that cooled drinks can be sold at 0.60 \$ instead of 0.45 \$ (+ 203 \$) and a mobile phone can be charged at \$ 4.5 (+ 67 \$)

Formatiert: Hervorheben

Formatiert: Hervorheben

**Breakeven point of the economic activity with this system is reached after 11 month**

Kommentiert [giz6]: Hier sollte die Berechnungsgrundlage dargelegt werden! Ich nehme an, dass hier keine Renditeerwartungen / Levelized Cost of Caoital eingeflossen sind. Wenn dies so ist sollte das Dokumentiert werden. Weiterhin wäre ein Cashflow oder P&L Diagramm (das die O&M Kosten berücksichtigt) anschaulich.

### b. BOSS Kit Keep Fresh

The BOSS Kit Keep Fresh consists of the solar fridge Steka PF 166, solar modules and all equipment for charging and installation material. The solar fridge can be used for cooling or freezing.

The scenarios assume a solar irradiation of 4 kWh/m<sup>2</sup>/day, which refers to the minimum irradiation in most African country. With a 120 W solar module, the system generates 480 Wh/day. Assuming an outside temperature of 35°C, the fridge / freezer can cool

- 70 x 0,33l cans of soft drink, beer or water down to a temperature of 15°C per day.
- Or freeze 4 kg of water per day

#### Scenario 1:

A solar kiosk can sell 60 cans (soft drinks, beer, water) a day to his customers. He can charge 0,10 \$ extra for cooled drinks.

Investment: 1,100 \$

Additional income per week: 36.00 \$ based on the assumption that cooled drinks can be sold with a surcharge of 0,10 \$ working time: 6 days/week

**Breakeven of the system is reached after 31 weeks.**

Kommentiert [giz7]: Siehe oben

#### Scenario 2:

A grocery store uses the refrigeration kit to freeze meat, fish as well as fruit juices or water ice.

Investment: 1,100 \$

Additional income per week: 50.00 \$ based on the following assumptions:  
Frozen meat and fish can be sold at a surcharge of 3.00 \$/kg  
In average he sells 2 kg of fish or meat per day  
Income for ice (new product): 0,15 \$ / kg  
It is estimated that 15 kg ice are sold per day.  
working time: 6 days/week

**Breakeven of the system is reached after 30 weeks.**

Kommentiert [giz8]: Siehe oben

**c. BOSS Kit Keep Fresh compare to costs of a refrigerator powered by diesel**

This scenario assumes, that in the absence of a solar system, the entrepreneur would use diesel power to provide electricity for his refrigerator.

At an outside temperature of 35 °C, the Steca PF consumes 156 Wh per day or 1.1 kWh/week.

A diesel generator set with an average efficiency generates 3 kWh from 1 liter of diesel.

Diesel prices are assumed to be 1 \$ per liter.

Service and maintenance costs for the diesel generator are not included in the scenarios.

- 70 x 0,33l cans of soft drink, beer or water down to a temperature of 15°C per day.
- Or freeze 4 kg of water per day

**Scenario 1:**

A solar kiosk can sell 60 cans (soft drinks, beer, water) a day to his customers. He can charge 0,10\$ extra for cooled drinks.

Investment:	500 \$	Conventional A++ refrigerator
Operation cost per week:	3\$	
Additional income per week:	36.00 \$	Based on the assumption that cooled drinks can be sold with surcharge of 0,10 \$ Working time: 6 days/week

**Breakeven of the investment is reached after 15 weeks which is half of the time of the Solar Refrigerator. Nevertheless operation costs will continuously accrue and account for approximately 156 \$ per year.**

**Scenario 2:**

A grocery store uses the refrigeration kit to freeze meat, fish as well as fruit juices or water ice.

Investment:	500 \$	
Operation costs per week:	3 \$	
Additional income per week:	50.00 \$	Based on the following assumptions: Frozen meat and fish can be sold at a surcharge of 3.00 \$/kg In average he sells 2 kg of fish or meat per day Income for ice (new product): 0,15 \$ / kg It is estimated that 15 kg ice are sold per day. Working time: 6 days/week

**Breakeven of the system is reached after 10 weeks, third of the time of the solar Kit, but operation costs will continue to accrue.**

**2. Milling, grinding, hulling**

**a. BOSS Kit Pro Farina**

The BOSS Kit Pro Farina consists of the grain mill, solar generator, module support structure, installation manual and control unit.

**Scenario 1:**

Milling of 100 kg wheat per hour, four hours a day and five days per week.

Investment: 6,000 \$

Additional income per week: 100 \$ It is assumed that 10 kg wheat are milled for 0.50 \$.

**Breakeven of the system is reached after 60 weeks.**

**Scenario 2:**

Milling of 60 kg maize per hour, four hours a day and six days per week.

Investment: 6,000 \$

Additional income per week: 216 \$ It is assumed that 10 kg maize are milled for 1.50 \$.

**Breakeven of the system is reached after 27 weeks.**

---

### 3. Business case: Electricity for Charging

#### a. Unintended business opportunities: mobile phone charging (Kenia)

A customer is investing in a solar panel, lamp, radio connector, mobile connector, and power pack. His investment should cover his personal energy needs, business is not intended.

The fully charged lamp can last up to 6 hours, allowing him and his family to enjoy pleasant bright lighting at night and his children are able to study without hindrance. In addition he can use his radio either using direct sunlight or through the power pack. This saves money he formerly spend on kerosene for the lamp and batteries for the radio.

As mobile phone charging becomes very easy during day time he is requested by friends and neighbors and starts to charge mobile phones for extra income at a charge of KES 20 per charge per phone.

**Investment:** \$

Weekly costs saved

Kerosene: 140 KES

Batteries: 30 KES

Additional income

per week: 360 KES (4.5 \$) He charges 20 KES per charge per phone and charges 3 phones a day on 6 days a week.

**Breakeven of the system is reached after weeks.**

(UNDP, ToughStuff)

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#### b. Battery charging on a fee for service basis

All systems are run on a fee-for-service basis, meaning that even public services pay tariffs to the private operator.

##### Cross-financing

The income generated with the battery charging and lantern rental covers the costs for maintenance of the charging stations themselves and the PV systems for the social infrastructure. It also allows for a reasonable profit for the private operator. The contribution asked from the public users (local

government, schools) are so low that they can only cover replacement cost of batteries and are not enough to ensure benefits for the private service provider.

#### Blocked bank account for battery replacement

The private service providers sign a contract with the mayor and ADER. The money allocated to battery replacement for the systems at the social infrastructure has to be regularly placed on a blocked bank account. Access to the account by the private operators is monitored by ADER.

#### Tariffs

- Social Infrastructure: € 5 / 100Wp per month (The tariff for the social infrastructure had to be based on the capacity of the system (kW) as the energy consumption (kWh) is not measured.)
  - Battery charging: € 3 / month battery rental plus € 0.50 per charging
  - Solar lamp rental: € 0.07 per night (compared to 10€cents for a candle)
- 

#### **c. BOSS Lamp Charging Station**

Assumptions for the business scenarios: The BOSS Charging Station can serve 30 Lamps at the same time. The scenarios assume a solar irradiation of 4 kWh/m<sup>2</sup>/day, which refers to the minimum irradiation in most African countries.

With 2 x 85 W solar modules, the system generates 680 Wh/day (which would serve more than 40 lamps). Therefore the system sizing includes a puffer for days with less sunshine.

#### **Scenario I:**

The entrepreneur invests in the charging system. Clients by their own lamps. The business just takes in mind the fee for charging. Investment costs for the complete charging station are 520,00 \$ . 25 lamps re charged per day, 6 days a week.

Investment: 520 \$

Additional income per week: 15.00 \$ It is assumed that full lamp charging costs 0.10 \$ .

**Breakeven of the system is reached after 34 weeks.**

#### **Scenario II:**

The solar shop owner rents the fully charged lamps, but he keeps the ownership of the lamps. Therefore his investment costs include 100 lamps (50 T-Lite and 50 Ulitium) and the charging station with total investment costs of 4.750,00 \$. During one week every lamp is rented once.

Investment: 4750.00 \$

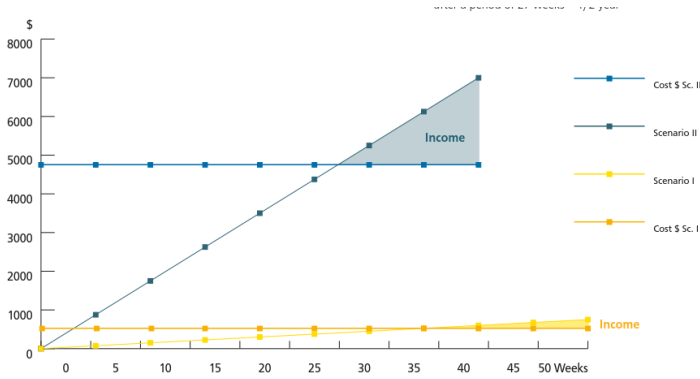


Additional income  
per week: 175.00 \$

Rent of fully charged Ulitium: 2,00\$  
Rent of fully charged T-Lite: 1,50\$

**Breakeven of the system is reached after 27 weeks.**

The graph illustrates the different business scenarios with the BOSS Lamp Charging Station.



#### d. BOSS Kit ProFee

The BOSS Kit ProFee is a mobile phone charging station that can serve 18 SB loads at the same time. In the following business scenarios rely on the following USB loads:

- Mobile phone: (0.5 A, 700 mAh, charging time approximately 2 hours)
- Smart phone (1 A, 1500 mAh, charging time approximately 2 hours)
- Tablet (2A, 4500 mAh, charging time approximately 3 hours)

Furthermore the scenarios assume a solar irradiation of 4 kWh/m<sup>2</sup>/day, which refers to the minimum irradiation in most African country. With a 60 W solar module, the system generates 240 Wh/day, which can serve at least 47 mobile phone, 23 smart phones or 8 tablets a day.

#### Scenario I:

Charging of 20 cell phones, 5 smart phones, and 6 days a week.

Investment: 1,700 \$

Additional income per week: 18.00 \$  
Cell phone charging 0.10 \$  
Smart phone charging 0.20 \$

**Breakeven of the system is reached after 94 weeks.**

#### Scenario II:

Charging of 15 cell phones, 8 smart phones and 2 tablets, 6 days a week.

Investment: 1,700 \$

Additional income per week: 32.00 \$  
Cell phone charging at 0.15 \$  
Smart phone charging at 0.30 \$  
Tablet charging at 0.40 \$

**Breakeven of the system is reached after 52 weeks.**

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#### 4. Business case: Media Entertainment

##### a. BOSS Kit Keep Fit

The BOSS Kit Keep Fit consists of a LED television screen with integrated DVD player and USB connection, DVB-T antenna and Bluetooth audio boxes. It is sized to be used for six hours a day.

The following business scenarios take into account public bars or other public places that use the BOSS Kit Pro Fit to show sports events or video shows and charge an entrance fee for this service. While in addition to the entrance fee more income can be generated due to higher sales of drinks and food, these opportunities are not regarded in the business scenarios.

The scenarios assume a solar irradiation of 4 kWh/m<sup>2</sup>/day, which refers to the minimum irradiation in

**Kommentiert [HO9]:** Business cases erscheinen mir unrealistisch ...  
3 Tage die Woche Fussball mit 25 Zuschauern?  
5 Tage die Woche Filme mit 10 Zuschauern?

most African countries.

With a 120 W solar module, the system generates 480 Wh/day.

### Scenario I:

Viewing a soccer match in a sports bar.

Investment: 1,400 \$

Additional income

per week: 37.50 \$

Entrance fee of 0.50 \$ and estimated 25 visitors a day.  
Opening time: 3 days a week

**Breakeven of the system is reached after 37 weeks.**

### Scenario II:

Village cinema for video watching.

Investment: 1,400 \$

Additional income

per week: 50.00 \$

Entrance fee of 1.00 \$ and estimated 10 visitors a day.  
Opening time: 5 days a week

**Breakeven of the system is reached after 28 weeks.**

## 5. Business case: Electricity for mobile workshop

### a. Mobile Workshop BOSS Sunny Power Unit

BOSS Kit Sunny power unit consisting of a self-contained bike trailer or cart with integrated 130 watt or 175 watt module, a 12 volt 138 amp-hour (Ah) battery or two 12 volt batteries with 85 amp-hours (Ah), charge controller and, optionally, an inverter. Thermoelectric circuit breakers and passive ventilation are integrated to protect the system from overheating. In addition, there is still plenty of interior cargo area.

**Kommentiert [HO10]:** Ist nicht im Katalog, gibt es das System noch?

Opportunities for small businesses:

- Mobile water pumping services in off-grid rural areas.
- Mobile "photo studios" with color printers and camera/ phone charging.
- Mobile carpentry with plenty of room to accommodate tools like a small circular saw, a grinder and a drill and jigsaw.

**We are currently in the launch phase** - our partner, Bavaria Energy Systems, has produced about 40 units. The retail price with an inverter is about €3,000.

Investment: 3.000 \$

Additional income  
per week: .

**Breakeven of the system is reached after 28 weeks.**

Read more: [http://www.pv-magazine.com/news/details/beitrag/phaesun--generating-income-locally\\_100013814/#ixzz3eR2AWezu](http://www.pv-magazine.com/news/details/beitrag/phaesun--generating-income-locally_100013814/#ixzz3eR2AWezu)

Read more: [http://www.pv-magazine.com/news/details/beitrag/phaesun--generating-income-locally\\_100013814/#ixzz3eR1bYCN2](http://www.pv-magazine.com/news/details/beitrag/phaesun--generating-income-locally_100013814/#ixzz3eR1bYCN2)

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