PACE – Useful Guides and Specimen Agreements

	TITLE	DESCRIPTION
	GUIDES	
G1	Users Guide to Off-Grid Energy Solutions	Web - based guide to energy needs and solutions
G2	**Photograph Guide**	**Photograph guide to illustrate typical energy products and services. The guide contains the more common off-grid and on-grid energy appliances**
G3	Tariff Setting Guidelines	Guidance on Tariff setting for sustainability
G4	Livelihoods survey instruments	Guidance and sample questionnaire etc for community consultation process
G5	Types of Public Private Partnerships	Description of the different forms of Public Private Partnership arrangements commonly in existence
	SPECIMEN AGREEMENTS	
S1	Specimen Micro-hydro Constitution	Example of a constitution between members of a micro-hyrdo project development for Micro Hydro power Generation and Consumer Co-operative Society
S2	Specimen Lease Agreement	Agreement between a Lessor and Lessee for a typical micro-hydro project
S3	Specimen PPA	Power Purchase Agreement for independent power projects
S4	Specimen electricity consumer agreement	Example consumer agreement for sale of electricity

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This photograph guide is to be used to illustrate typical energy products and services. The guide is not exhaustive but contains the more common off-grid and on-grid energy appliances. The photographs are only representative, the appearance and brand of the actual products may vary. It should be noted that this is not a catalogue.

1. LIGHTING

Lamps and Bulbs

Incandescent Lights: an incandescent lamp produces light when its wire filament is heated by electricity to 'incandescence. They are highly inefficient, short life span.

Fluorescent Lamps: light emitted from special inert gases (generally neon) when an electric current is passed through it. Fluorescent lamps are much more efficient than incandescent lamps, and are preferred over incandescent lamps for energy efficiency. However, for fluorescent lamps to achieve highest efficiencies, they need a "ballast", a simple device fitted to the fixture that improves the operation, and radiation, of the light.

CFL: Compact Fluorescent Lamp. They have a very high efficiency for low power consumption, and are 4 to 6 times more efficient than incandescent lights and consumption can be reduced by 80%. For example, an 11 watts CFL can provide the equivalent lighting of a 60 watts incandescent. They also last 20-40 times longer than incandescent lights, so while they cost several times more than incandescent lights, CFLs can last for years - it is not unusual for them to last over 5000 hours use.
PLC: Type of CFL, with 2 or 4 tubes

Halogen lamps: lamps with very low wattage, that generate high intensity light through a combination of specially coated, highly efficient reflectors. Very low voltage with high efficiency delivery of light. They are about 1.5 times more efficient than incandescent lights, but much less efficient than CFLs. Their main advantage is that they are small, and can provide intense, low wattage lighting that can easily be supplied with dry cells and other small batteries.

Means of lighting

Kerosene Lamps

Wick lamps use wicks dipped in kerosene to produce a flame. Wick lamps are similar to candles in light output, but give off smoke and particulates. They are very inefficient converters of energy and provide, per litre of kerosene (or diesel) less than one tenth the light equivalent for a pressure lamp.

Hurricane Lamps are like wick lamps but enclose the flame in a glass case, making the lamp portable and safer. Hurricane lamps give off much less smoke than open wick lamps, and have an adjustable flame. However, like other wick lamps, they are very inefficient converters from kerosene or diesel to light.

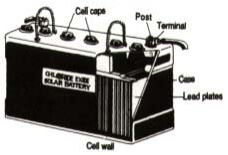
Pressure Lamps vaporise kerosene and burn it on a "mantle" (see far right) instead of a wick. The glowing mantle gives off light that is much brighter than other kerosene lamps. Pressure lamps give off 8 to 10 times as much light as wick lamps, but consume half the kerosene

Solar Lantern: Is a rechargeable lantern usually with a CFL light bulb which can be charged by a solar panel.

Gas Lanterns are like pressure lamps, burn gas fuels (LPG, biogas, etc.) on a mantle. Gas lamps should not be placed in unattended situations, as there is some danger of fire or explosion if flames are accidentally extinguished when gas supply is left on.

2. BATTERIES

Automotive lead-acid batteries are a low-cost first step for powering TVs, lights and radios in rural households and businesses. Many people choose batteries because they are a cheap first step to gain use of appliances. Automotive batteries are designed to provide large currents for a very short duration (e.g. when starting an engine).



Deep cycle battery: a type of battery that is not damaged when a large portion of its energy capacity is repeatedly used. These batteries are not deep discharge batteries.

Ni-cad battery: nickel cadmium (ni-cad) batteries have been used to power small electronic devices for a number of years. They are rechargeable, have higher energy densities than lead-acid batteries.

Dry cell battery: can be made of alkaline cells, consisting of common dry cell carbon or zinc (most common torch/flashlight battery), others used for radios, cassette players, various other small appliances. A dry cell battery contains electrolytes that are in the form of paste rather than liquid.

3. ENTERTAINMENT

Radio commonly use dry cells for power. Rechargeable nicads with small solar modules (i.e. 1-3W) are enough to power most small radios.

Television: Small 12VDC black and white (B&W) TVs are widely available and well suited to rural household needs. Consuming 12-18W, many can be powered by either AC or DC voltages. Small B&W TVs can be powered by systems sized 30 Wp and above (a 12 Wp module can run one B&W TV for a few hours a day in sunny weather).
Colour TVs come in a wide range of sizes. Large 50cm screen units use 120 Watts and above. Smaller units are available that use 60 watts are less. Most colour TVs are rated at 110/240 VAC, but some are available at 12 VDC.

Mobile Phones have lower voltages, and contain their own nicad batteries. Small PV modules (i.e. 1-5 W) can be purchased to charge the batteries inside the phones.

4. REFRIGERATION and COOLING

Absorption Refrigerator: These operate on heat cycle, which is normally powered by a kerosene or gas (LPG) burner. A flame or heat element powers the heating cycle, which creates the cooling affect via a heat exchanger.
In **gas fridges** the flame is powered by LPG, whereas in **kerosene/paraffin fridges** the flame is powered by kerosene or paraffin. These fridges emit particulates (and/or gases).

Vaccine Refrigerators: the World Health Organisation (WHO) has approved a number of low voltage DC PV vaccine refrigerators for vaccine storage and medical uses. These are powered by PV systems.

Domestic Solar Refrigerators: are provided with a high quality DC compressor requiring only very low consumption rates, therefore allowing the fridges to be run on 12V from a solar panel. A high quality polyurethane insulation layer ensures quick refrigeration of food and drinks even at high room temperature. Solar fridges are available in various models, with or without freezer compartment.

Conventional Refrigerators and Freezers are readily available around the world in a number of sizes and fridge/freezer configurations. They run on standard 240/120V AC power. They are ***not*** good choices for off-grid locations, as they generally consume too much power and, therefore, require generators to run continuously to operate them. However, in off-grid applications, people often run freezers for several hours on generators, and then use the cooled products the rest of the time.

Evaporative fridges are a relatively well-tested, proven, low-tech approach to cooling. They can cool produce, food and beverages at about 15-20°C below ambient temperatures. They are most appropriate in hot, dry (not humid) climates where there are no other alternatives (and cannot be used for critical purposes such as vaccine storage).

Fans are available both powered by electricity or batteries.

5. COOKING and HEATING

Gas Rings: Liquid petroleum gas (LPG) is an increasingly popular fuel for cooking. Gas canisters and regulators are normally sold and refilled by petroleum distributors. Often, each distributor (e.g., Shell, Total, Agip) has their own type of canister (or cylinder) and valve regulator. This requires consumers to purchase gas from the same company that supplied the cylinder. The important feature of LPG is that the efficiency of use is much higher than charcoal in traditional stoves (50% for LPG compared with an average of 20% for charcoal).

Paraffin or Kerosene Stoves: designed to be fuelled by paraffin, kerosene, and in some places, by diesel. A kerosene stove can be pressurised to give off higher heat with higher efficiency, or can be a wick stove, as the figure to the right illustrates.

Improved Stoves are designed to improve the combustion performance of wood and charcoal yielding reduced household expenditures and thus better living standards. Several models are available in different countries, such as the Ethiopian **Mirte** for typical Ethiopian flat bread baking (photo on bottom) or the **Lakech** which has been adapted from the **Kenya Ceramic Jiko**/**KCJ** (photo on top) in Kenya. Other adaptations of the KCJ are found throughout the region, including Uganda, Tanzania, Rwanda, Congo, Burundi, Somalia and Malawi.

LPG cylinders and bottles: LPG is transported and stored as a compressed liquid in canisters ranging in size between 3kg and 50kg or larger. For household use, gas is conveyed via simple regulators and pipes to stoves or lamps, which are specially designed for LPG use.

Electric cooker: A varied range of cookers powered electrically are also available for warming up or cooking food.

Kettle and water boilers are used to bring water to boiling point. They usually require very high energy inputs as the heating process is very quick.

Immersion water heaters are powered by electricity and may be used for warming up water or other liquids.

Solar water heaters use solar energy to heat water to temperatures that may reach 70 - 80 °C. The water is then stored in a tank to be used for different applications that require water at a certain temperature, such as sanitary purposes in households, hotels, hospitals, or industrial uses.

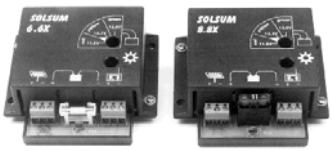
6. PV SYSTEMS

Solar Home Systems (SHS) operate at 12 V and range in size from 10 Wp to 100 Wp. SHS are used to power end use appliances including TV's, fluorescent lamps, and radios (see above). SHS include a number of critical components including the following:

PV modules: available in mono-, poly-crystalline and amorphous types, produce the power for the system Photo on top).

Storage **batteries** are needed to store energy for use when the sun is not shining. Locally manufactured batteries are usually available, the picture is just a reference to illustrate the product(photo on bottom).

Charge regulators: distribute power and protect the batteries and appliances from damage.



Inverters: change 12V power to 240VAC power for larger appliances.

7. SMALL SIZE GENERATORS

Diesel Generators: Diesel gensets are found all over the developing world, and serve as back-ups in most urban and grid-connected settings for essential services (such as hospital operating theatres). Diesel generators can be sized to meet some of the smallest loads (less than 3 kVA) and are portable. They are usually very robust and characterised by ease of operation and ease of repair (generally finding spare parts does not constitute a problem).

Petrol (Gasoline) Generators: Gasoline (petrol or benzene) is widely used for small (less than 3 kVA) generators to produce electricity for commercial establishments, institutions and households. The smallest units petrol/gasoline-driven operate at high rpms (rotations per minute). They get hot very quickly, and, if operated frequently, or as base load, their lifetimes are very limited (perhaps in terms of months).

Kerosene Generators: Kerosene generators are designed to run on Kerosene and are used to generate electricity for small applications. They present the same overheating problems as the petrol gensets.