REMOTE AREA POWER SUPPLY

Generally in many countries worldwide, most electricity is supplied by utilities or private IPPs from large central located power plants, via power supply networks called grids. These grids transmit and distribute electric power at various voltage levels to the majority of end users. These power generators are using mainly large coal and gas fired power plants, large hydro generation schemes and also nuclear power stations.

More recently some smaller and medium scale wind farms and smaller photovoltaic systems have been introduced in Europe, Asia, and both Americas and also in Australia.

But many remote areas in Asia, Africa, some countries on American continents and also in Australia are not serviced by the main grid. In some of such areas small diesel or gas fired power units providing electric power directly or via a mini grid to the end users.

In the absence of a main grid, remote area power supply systems can be located near end users to meet their electricity requirements.

Remote area power supply systems consist of power generation equipment such as solar electric panels, wind turbines, biomass or biogas fired and micro hydro turbines usually combined with petrol or diesel generators, control equipment and storage batteries. A remote area power supply system that has a combination of energy sources is termed a hybrid remote area power supply system.

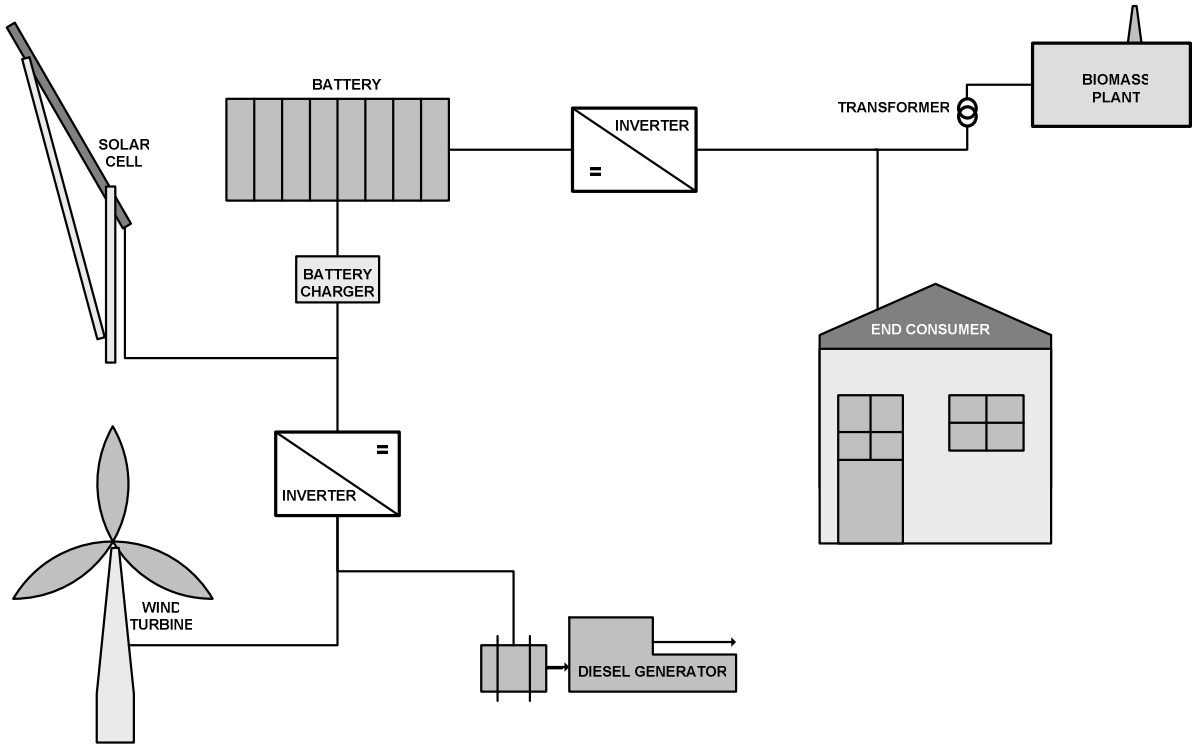

Figure 1
A Hybrid Remote Area Power Supply System using more than one form of Renewable Energy

How does a Remote Area Power Supply system work?

Electricity is generated by solar panels, wind turbines, biogas generators, or micro hydro turbines, and is fed into a bank of specially designed batteries via power inventer or other form of power controller, to be stored for use when required. The power can then be used directly from the batteries with DC appliances, or passed via an inverter for use with normal mains appliances.

Direct AC connection from biomass plant via transformer and/or from wind generator and micro hydro turbine via power controller is also applicable.

Solar Power

Solar panels, located in area with greatest access to the sun, convert solar energy into electricity. Panels can be of fixed design or can be mounted on moving/rotating racks that track the sun for greater efficiency.

Figure 2
Solar Panels

Current design allows around 20 years working life of a solar panel. Generally solar panels require no maintenance, but they shall be cleaned on regular basis as the dust or grime accumulating on solar panels will considerably reduce the panel efficiency.

Wind Generators

Wind generators produce electric power from the wind. Electric power producing wind turbines come in many shapes and sizes, and range from those that can produce small amounts of electricity for small power demands right up to huge machines that can run hundreds of homes.

They consist of a set of blades connected to a generator, which produces electricity as it is turned by the spinning blades. By far the most common type is the 'horizontal axis' turbine, which has blades like an aircraft propeller, and a tail or vane to direct it into the wind.

The average sized turbine used in domestic installations is somewhere between 200 and 2000 Watts. The largest single-unit available today can generate up to 5 MW.

Like solar panels, the electricity from the turbine may be used to charge batteries for later use, so a regulator is required for use with wind turbines, though some smaller machines have the regulator built into them.

Figure 3
Wind Generators in Mojave Desert

On the other side, large units can supply power to major grid via local power collection network and power regulators.

Very important is the choice of the best site for a wind turbine with relatively high average wind speeds, with little or no turbulence (rapid fluctuations in wind speed and direction caused by buildings, trees and other obstructions).

To achieve this, the turbine is normally mounted on a high tower well above all obstructions. Tower height ranges from 12 meters to 100 meters or more, depending on the site.

MICRO HYDRO

A micro hydro turbine works by taking water from a river or creek and using it to drive a set of turbine blades, much like wind pushes a wind turbine's blades.

The hydro turbine drives a generator or alternator that produces electricity. Once the water has left the turbine, it is usually returned to the creek. Flow rates of the creek affect the energy generated.

There are many different designs of micro hydro plants that work in fast or slow flowing waterways at high or low pressures.

BIOGAS GENERATORS

Biomass waste is well available and accessible worldwide. Major biogas energy resources for power generation include:

- **The Forest Residue** PRODUCTION OF → SYNGAS
- **The Free Field Residue** PRODUCTION OF → SYNGAS
- **Waste from Wood Processing Industry** PRODUCTION OF → SYNGAS
- **Urban Wood, Paper & Cardboard Waste** PRODUCTION OF → SYNGAS
- **Waste from Agricultural Products Processing Industry** PRODUCTION OF → BIOGAS & SYNGAS
- **Organic Components in Town Waste** PRODUCTION OF → SYNGAS & BIOGAS
- **Solid & Liquid Animal Manure** PRODUCTION OF → SYNGAS & BIOGAS
- **Agricultural Plant Waste** PRODUCTION OF → BIOGAS, SYNGAS, METHANOL & ETHANOL
- **Waste Waters** PRODUCTION OF → BIOGAS
- **Landfills** PRODUCTION OF → BIOGAS (LANDFILL GAS)

Unlike any other energy resources, biogas use for energy production is often a way to dispose biomass waste materials that otherwise would create environmental risks.

Biogas produced from biodegradable materials can be used for fuelling gas turbines, gas engines and boilers for electric power generation purposes or for production of thermal energy for heating or cooling applications.

For more details on biogas production, please refer to related articles which can be found in our web pages.

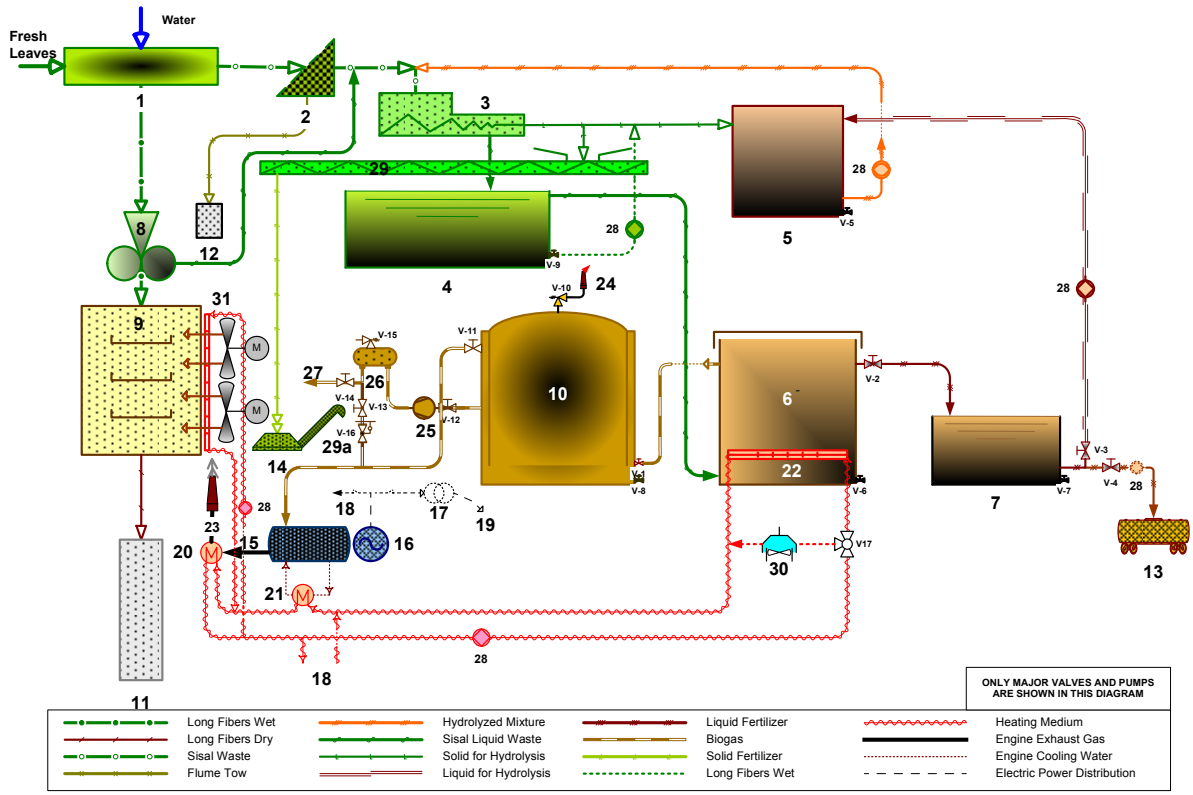

Figure 4
Schematic Flow Diagram – Biogas Production from Biowaste

BIOMASS POWER PLANTS

Biomass waste is well available worldwide. It can be a waste wood, agricultural & farming waste, non toxic parts of municipal solid waste and other combustible non-toxic waste.

Biomass waste may be utilized in boilers for steam production for electric power generation, industrial applications or simple for heating or cooling applications.

Optimal size for remote area power supply plant is up to 10MW, however biomass plants for hey and waste wood utilization larger than 200MW are in operation.

For more details on biomass power plants please refer to related articles which can be found in our web pages.

EXPLANATIONS

REGULATORS

Solar panels, wind and micro hydro turbines usually produce unregulated, highly variable power flow. In order that the system batteries are not damaged, they must be used in conjunction with a device called a regulator (sometimes called a controller).

This device stops the battery bank from being overcharged when it is full, often diverting excess power somewhere else, such as to a water heater.

INVERTERS

Most household appliances use alternating current (AC) electricity, which is what comes out of the power point of a mains-grid connected house. However, the batteries used in remote area power supply systems supply (DC) electricity, this DC electricity must be converted to AC.

This conversion is done by a device called an inverter. The inverter is connected to the battery bank, and provides mains-type AC electricity to the house.

The inverter needs to be sized to suit the house's electrical requirements, a common size being around 2000 watts, or 2 kilowatts.

BATTERIES

Energy is stored in large batteries, similar to a car battery but designed specifically for remote area power supply.

They are usually of the lead-acid variety, either 'sealed' or 'flooded cell'. A properly sized, well maintained battery bank is vital to guarantee a reliable, long lasting system.

Batteries require regular maintenance, flooded cells need to be topped up with distilled water from time to time and charged and discharged to a timetable.