

**Technology Driven Initiatives
for
Green Energy
and
Livelihood Security
in
Remote Villages**

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Critical Issues in Rural Areas :~

- ✓ Non availability of Quality Energy, Infrastructure and Potable Water
- ✓ Environmental Degradation due to cutting of Trees for firewood
- ✓ Unemployment problem in Rural Areas due to non availability of Electricity
- ✓ Inefficient use of local resources and significant contribution to Green House Gas Emission

Barrier towards Electrification of Rural Areas :~

- ✓ High transmission and distribution losses
- ✓ Financial un viability of extending grid to remote and inaccessible areas
- ✓ Dispersed population in small villages resulting in low peak demand
- ✓ Poor financial condition of Power Utility Company
- ✓ Low density of electrical service connection (Average one connection in three poles)
- ✓ Non availability of Industrial or Commercial demand
- ✓ Difficulties in maintaining long distribution line through difficult terrain, forest areas or desert areas

Renewable Energy Sources which are decentralized in character and available all most all parts of the World could be good option to provide low quantum limited hours electric supply to Rural Areas. Indian experience says Solar Photovoltaic and Biomass based Small Power Generation Programmes are most suitable to supply of reliable and more or less affordable electricity to the Rural Mass. However, providing of capital subsidy from the Government is an important issue to make such programme sustainable. In today's context Low Carbon Fund is also available from donar agencies.

Solar Energy :~

Solar Energy is the most widely distributed Renewable Energy sources in the World and used by mankind since time immemorial. In practical terms, Solar Energy consists of Two Components – Heat and Light. In the modern era, the two main routes of utilizing Solar Energy are based on these Two Components –

- ✓ Solar Thermal
- ✓ Solar Photovoltaic



Solar Thermal: For direct use of the Heat Energy for purpose such as Water Heating, Cooking and Drying and for conversion into mechanical energy and electrical power.

Solar Photovoltaic: For direct conversion of light into electricity.

Solar Water Heater



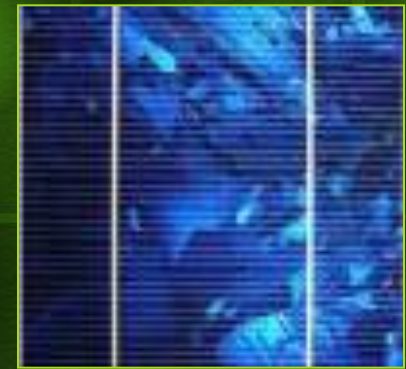
Solar PV Power Plant



Solar Street Light

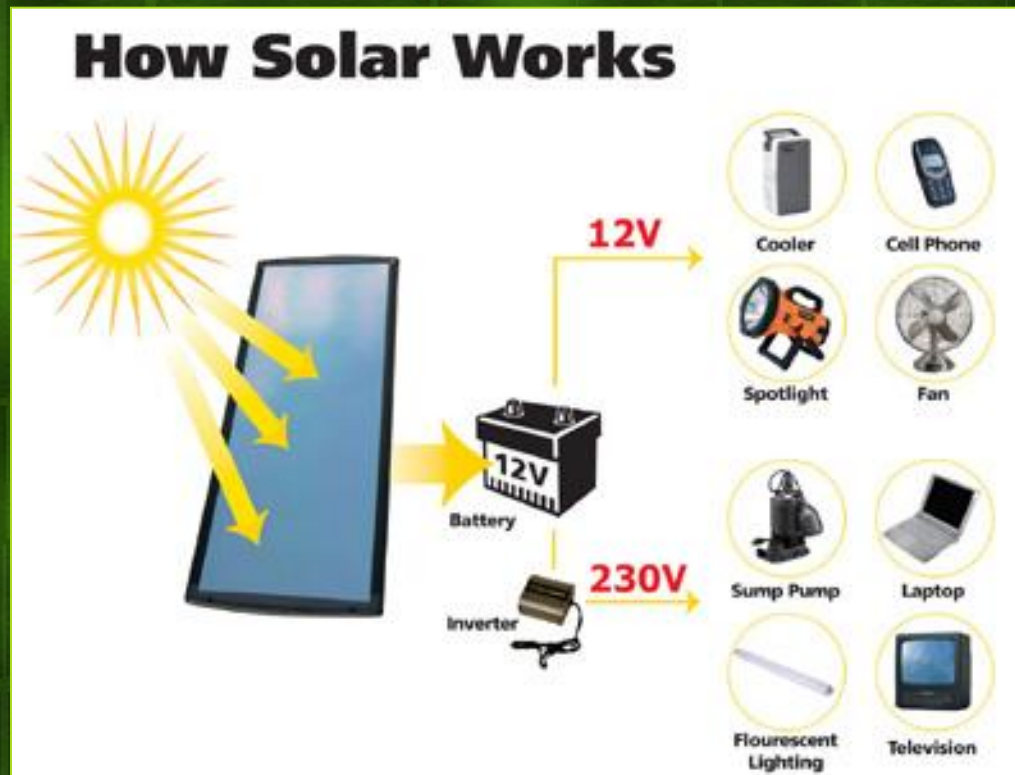


Solar Photovoltaic technology enables the direct conversion of Sunlight into electricity using devices known as Solar Cells.



The most common type of Solar Cell is made from a wafer of high purity Silicon. A typical Silicon Solar Cell generates 3.5 – 4 watts or more of electric power. A combination of Solar Cells makes a Module. The Capacity of Module varies from 1 watt to 300 watts. There are different types of Solar Cells : Multi Crystal Solar Cells or Thin Film Solar Cells.

Once we generate electricity from Solar Cells or Modules the same may be utilized for any purpose like Lighting, Water Pumping, Street Lights and Running of Television even running of Small Motors.



Such systems are stand alone system.

Advantages

- ✓ May be set up in any location
- ✓ Easy to operate and maintain
- ✓ Reliable
- ✓ Environment Friendly
- ✓ Installation time is low
- ✓ Fuel Cost is Nil

Limitations

- ✓ Climate dependent
- ✓ Still expensive
- ✓ Weak storage system
- ✓ 24 X 7 electricity is not ensured
- ✓ Capacity limited

The Capacity of the Power Plant varies from 1 kw to 150 kw.

Bio Energy based power generation in Rural Areas :~

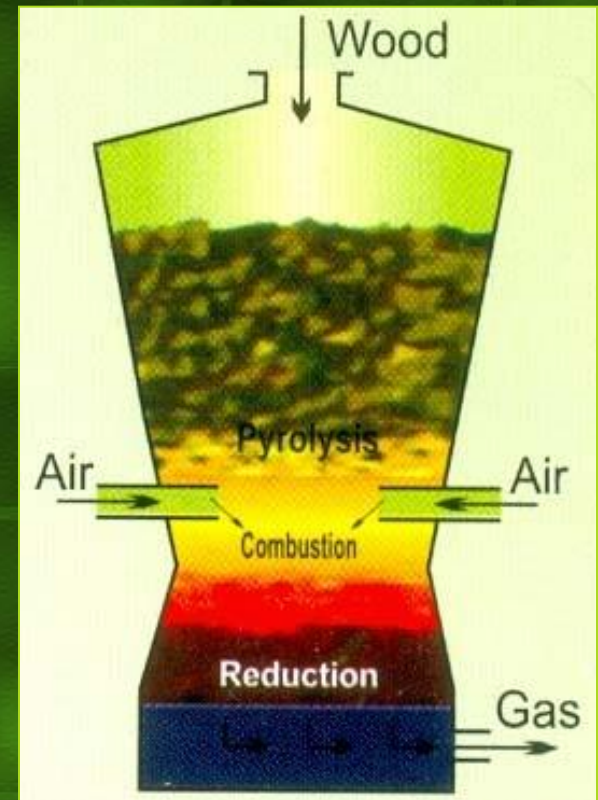
Electricity can be generated from wet or dry biomass.

Simplest way to get energy from Biomass is burning of the Biomass. However, the process is highly inefficient. The best way to produce energy from Biomass is Gasification Process. Biomass Gasification is a process of converting solid biomass fuel into a gaseous combustible gas (Called Producer Gas) through a sequence of thermo – chemical reactions. The gas is of Low Calorific Value. CV of Producer Gas varies between 1000 – 1200 kcal / Nm³. Almost 2.5 – 3 Nm³ of gas can be obtained through Gasification of about 1 kg. of air-dried biomass.

Typical Composition of Producer Gas (%) :~

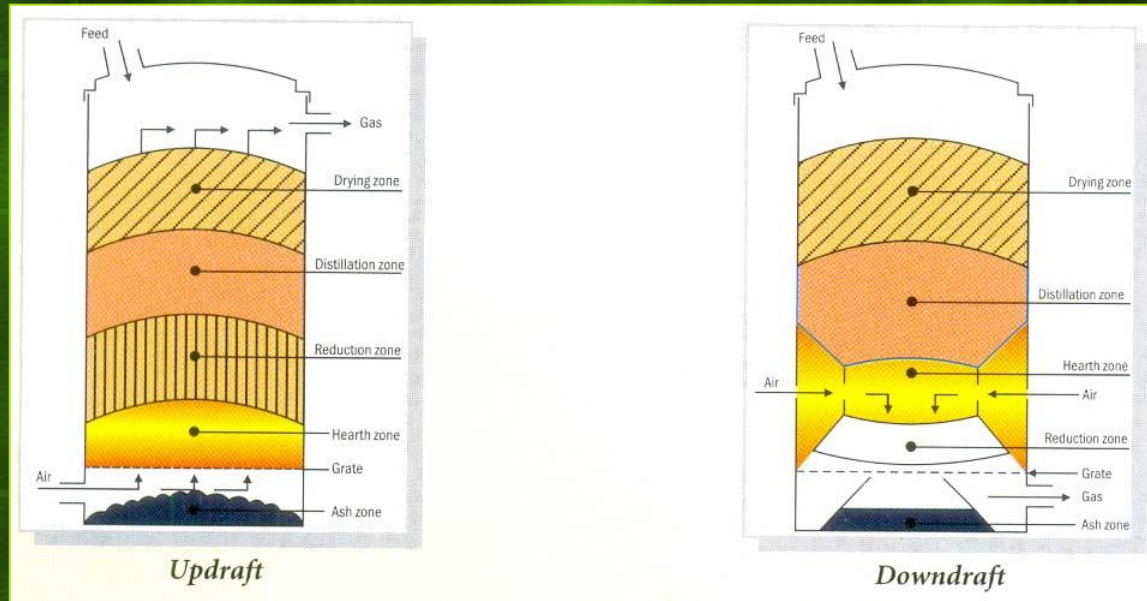
Carbon Monoxide (CO)	20 – 22
Hydrogen (H ₂)	15 – 20
Methane (CH ₄)	2 – 3
Carbon Dioxide (CO ₂)	9 – 11
Nitrogen (N ₂)	45 – 54
Water Vapour (H ₂ O)	10 – 15
Heavy Hydrocarbon	0.2 – 0.4

The gas can be cooled, cleaned and fed into an engine to operate either on dual fuel or in a 100 % Producer Gas mode to generate electricity.



Types of Biomass Gasifier :~

- ✓ Updraft or Counter-current Gasifier
- ✓ Downdraft or Co-current Gasifier



Normally, Updraft Gasifier is less sensitive to fuel size and moisture content compared to Downdraft Gasifier gives relatively cleaner gas (low tar content) and hence, is preferred for engine applications.

Capacity :~

100 % Producer Gas engines are available from 10 kw range to 500 kw range. The engine runs an alternator which finally supplies electricity to the village.



Operational Biomass plant at Sundarbans, West Bengal

Types of fuel and requirement of fuel :~

- ✓ Primary lops and tops of trees etc.
- ✓ Wood Waste, Saw Dust
- ✓ Rice Husk
- ✓ Coconut shells, Cashew nut shells, Lantana etc.
- ✓ Briquettes of agricultural residue

All the above mentioned materials are available in the village. However, captive energy plantation may also be taken up with quick growing plants like Subabul or Acacia etc.

In order to generate 1 kwh of electricity 1.5 kg Dry Biomass is required.

Biomass Gasifier based electricity is cheaper than Solar Electricity.

Comparison of Price

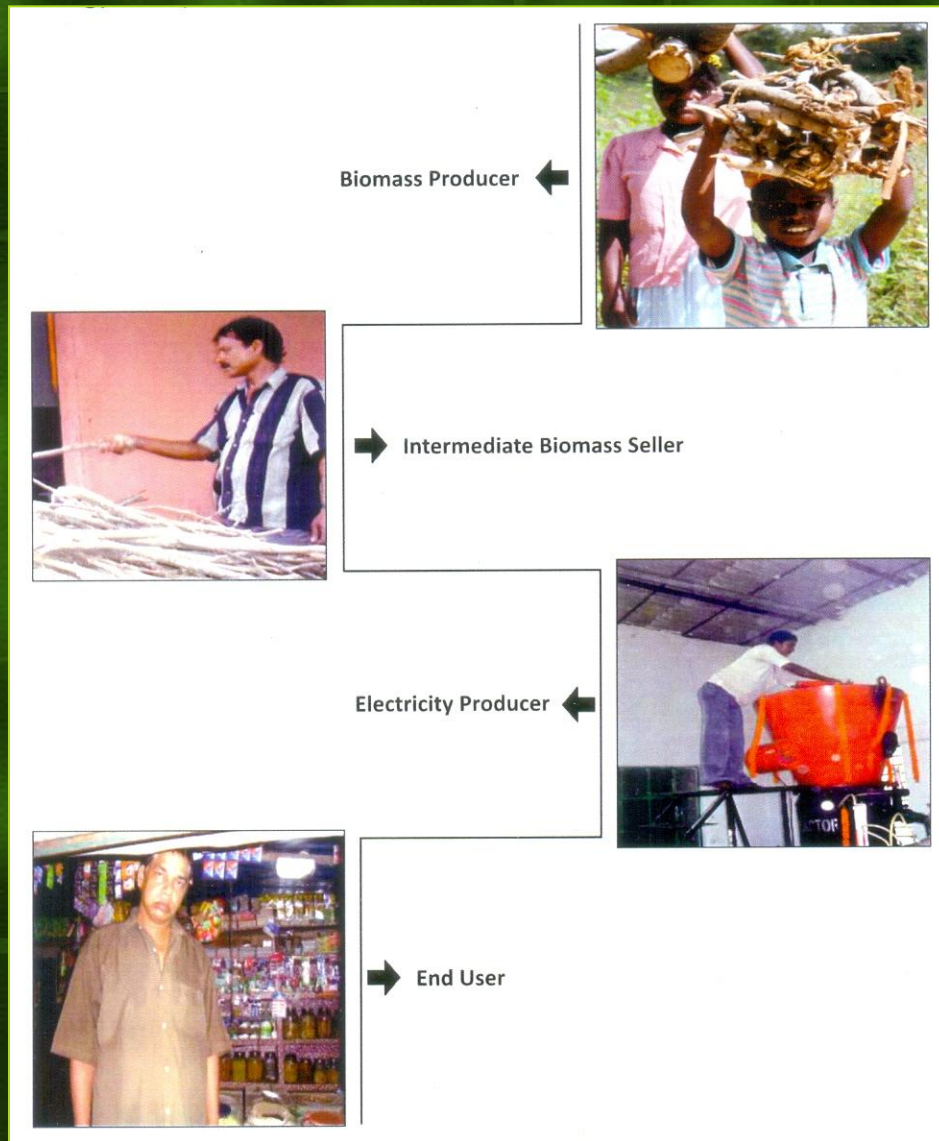
<u>Type</u>	<u>Cost / kwh</u>
Solar PV based electricity (Stand alone type)	40 US cents
Wind Battery Charger	25 US cents
Biomass Gasifier	20 US cents

Capital Cost of Biomass Gasifier Plant (100 % Producer Gas based) - \$ 2500 / kw (Inclusive Civil Works)

Operation and Maintenance :~

Biomass Gasifier needs operator as well as regular maintenance. Routine maintenance include checking of all pipes, cleaning of the filters, use of dry Biomass is an important issue to get better life of Gasifier. With proper maintenance a Biomass Gasifier can run for 7 – 10 Years.

Entrepreneurship development in the Rural Energy Sector :~



Biogas Based Power Generation :~



SVO Based Power Generation :~

Electricity can be generated by using SVO (Straight Vegetable Oil). The Engines are now available in India up to the level of 25 kw.



Participation of Local people in operating off grid power plant is an important issue. Without participation of local people an off grid power plant may not sustain.

Task of the Local Energy Society

- ✓ Tariff fixing
- ✓ Penalty for non payment of electricity bill
- ✓ Linkages with the Local Government
- ✓ Use of electricity for income generation

Provision for future connectivity with the main grid is also important for an off grid power plant.

THANK YOU