

## Empowering Rural Women through Renewable Energy Technologies

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**Abstract :** There is no denying the fact that women in India have made a considerable progress in decades of Independence, but they still have to struggle against many issues for leading a sustainable life. This is mainly because they are not only the producers but also managers of food, water, fuel and fodder, etc. Women empowerment is the most critical issue of the present time. If women, particularly the rural and tribal women are encouraged and educated about the appropriate and judicious use of energy resources, problems such as food security, energy crises and environmental degradation could be minimized. The focus of this research paper therefore, is on the women empowerment through the adaptation of various renewable energy technologies developed in the recent times to lead an easy, healthy and independent life. In India, about 40% of the total energy consumed is in rural areas, either in the form of wood, agro-waste or cattle dung used for cooking or lightening. These domestic activities are mainly considered as women's task in Indian context. By educating and making women adopt Renewable Energy Technologies, they can be spared from the problems such as fuel wood collection, walking kilometers in search of water; preparing cattle dung cakes, etc. The time which she devotes in all such works can be utilized to reduce drudgery and in gaining occupations; empowering women not only economically but also socially.

**Keywords:** Women empowerment, Renewable energy technologies, Sustainable life, energy security

### Introduction

The most famous saying said by the Pandit Jawaharlal Nehru is "To awaken the people, it is the women who must be awakened. Once she is on the move, the family moves, the village moves, the nation moves". In India, to empower the women, she should be made strong not only physically but also mentally and socially. For this, the education should be started at home from childhood, because the upliftment of women needs healthy family; resulting in the holistic development of the nation. Since Independence, women in India have made a considerable progress, but they still have to struggle against many issues for leading a sustainable life such as struggle against potable water, for which they have to walk miles; struggle against fuel wood, for which they have been denied education and have to go to forest or lonely shrubby places; etc.

Energy availability, both in adequate quantity and quality, is a pre-requisite to sustain targeted economic growth and the

desired levels and speed of social development. There are number of unit operations in domestic, agriculture, transportation and industrial sector consuming bulk of conventional energy sources. In India, about 40% of the total energy consumed is in rural areas, either in the form of wood, agro-waste or cattle dung. At domestic level the energy is consumed for cooking, lightning, drying & dehydration and other thermal heat applications where renewable energy sources can easily be integrated for energy conservation. There is significant potential for application of Renewable Energy Technologies in Rural India. If women, particularly the rural and tribal women are encouraged and educated about the appropriate and judicious use of energy resources, problems such as food security, energy crises and environmental degradation could be minimized.

Women are not only the producers but also managers of food, water, fuel and fodder, etc. By educating and making women adapt these technologies, drudgery will be reduced and women will be gaining occupations; empowering them not only economically but also socially. Few of these Renewable Energy Technologies, available commercially, which will help women in their day to day activities are:

### 1. Solar Energy

Solar energy is a clean and unlimited source of energy. Capturing the sun's energy for light, heat, hot water and electricity can be a convenient way to save money, increase self-reliance, and reduce pollution. Solar technologies can be used to produce electrical or thermal energy. It is estimated that solar energy equivalent to over 15,000 times the world's annual commercial energy consumption reaches the earth every year. India receives solar energy in the region of 5 to 7 kWh/m<sup>2</sup> for 300 to 330 days in a year. This energy is sufficient to set up 20 MW solar power plants per square kilometre land area. The solar thermal energy for cooling, heating, steaming and drying and solar PV for power generation can economically provide energy where the distance is too great to justify new system. Solar electric systems are used to provide electricity for lighting, battery charging, small motors, water pumping, and electric fences etc.

### 2.1 Solar Cookers

Box type solar cookers are capable of cooking different types of food including rice, vegetables, chicken, fish, and for steaming, roasting, boiling etc. It works as an airtight box with double glass covers. A reflector is placed over it for boosting the solar radiation and thus its temperature increases. Because of its simplicity and ease of handling, the box type solar cooker has found wider acceptance especially in rural areas. Whereas, Dish or

Parabolic solar cookers, have an aperture diameter of 1.4 m and focal length 0.28 m. The reflecting material used for their fabrication is anodized aluminium sheet which has a reflectivity of over 75 per cent. The tracking of the cooker is manual and thus has to be adjusted after every 15 to 20 minutes during cooking time. It has a delivering power of about 0.6 kW which can boil 2 to 3 L of water in half an hour.



**Solar Box Cooker**



**Solar Concentrated Cooker**

## 2.2 Solar Water Heating System

These systems are equipped with flat plate collectors (FPC) with built in channels or riser tubes attached (ETC) to the absorber sheet. With a black paint coated on the absorber plate, the water can be heated up to a temperature of 60° to 90°C, while in selectively coated system the temperature of water can be raised from 85° to 100° C. Presently, the solar water heating systems are used for domestic, commercial and industrial applications.



**FPC type Solar Water Heater**



**ETC type Solar Water Heater**

A temperature of 60° C is sufficient for domestic use and as such black paint coated absorbers are normally used in such domestic solar water heating systems. Solar water heating systems have capacity ranging from 100 litres per day to over 200,000 liters per day. IREDA provides the loan to the commercial agencies for the promotion of installation of the solar hot water systems. Besides this, many state governments have been giving special subsidies to domestic users of the solar water heaters of the capacity of 100 litres per day capacity.

## 2.3 Solar Dryers

The solar drying systems have many applications; both at domestic and industrial level. The various designs of direct as well indirect type solar dryers for drying vegetables, fruits, grains, fish, timber, chemicals and other industrial products etc. are available.



**Solar tunnel dryer for industrial purpose**



**Solar domestic dryers**

These dryers not only save energy but also save lot of time, occupy less area, improve quality of the dried product, make the process more efficient and protects environment also. Solar dryers circumvent some of the major disadvantages of classical drying. Solar drying can be used for the entire drying process or for supplementing artificial drying systems,

thus reducing the total amount of fuel energy required. Solar dryer is a very useful device for:

- Dairy industries for production of milk powder, casein etc.
- Seasoning of wood and timber.
- Textile industries for drying of textile materials.
- Agriculture crop drying

Food processing industries for dehydration of fruits, potatoes, onions and other vegetables

#### **2.4 Solar Lantern and Street Lighting System**

A typical solar lantern consists of a small photovoltaic module, a light source, a high frequency inverter/ballast, battery, charge controller and appropriate unit.

During the day hours, the module facing south is placed in the sun and it converts the solar radiation into electricity and charges the battery which is connected to the lantern through a cable. In the evening, the lantern with the charged battery is disconnected from the module and is available for indoor or outdoor use. Whereas; the solar PV based street lighting system has a pole, a battery enclosure, a battery, a LED or CFL based light and Photo voltaic module. During the day hours, the module facing south is charges the battery. In the evening, when voltage through module gets down, the controller automatically starts the light for lighting the street or roads. In the morning, when module starts to produce power, the controller automatically power off the light.



**Solar Lantern and Street Lighting System**

#### **2. UnnatChulahs**

In rural households, food is generally cooked on clay stoves called 'Chulhas'. Chulhas use biomass in the form of fuel wood as fuel. A family of 5 to 6 persons requires about 8 kg fuel woods every day. Surveys show that, on an average, the domestic fuel consists mainly of agricultural residues and cattle dung, supplemented by fuel wood to the extent of about

40%. However, these traditional chulhas are very wasteful as they use only 10% of the total heating potential of the fuel burnt in them. A more serious disadvantage of the traditional chulhas is that they produce a lot of smoke, soot and unburnt volatile organic matter, which not only blacken the pots and the walls of the kitchen, but also lead to Indoor Air Pollution (IAP). It adversely affects the health of the rural householders by slow health degradation and setting the onset of killer respiratory diseases.

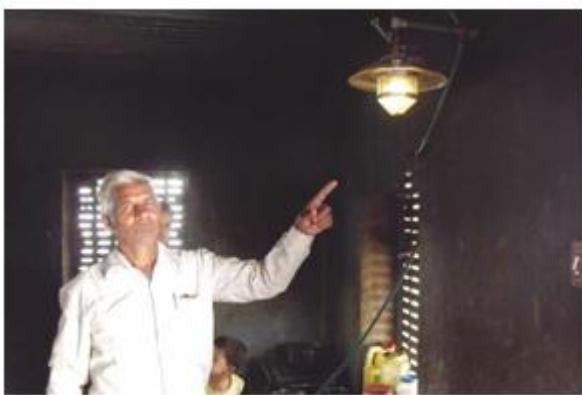
In present, two models of Unnat Chulhas namely, Udaipur and Chetak have been developed by Department of Renewable Energy Engineering, CTAE, Udaipur. Chetak is a one-pot model whereas Udaipur is two-pot model of Unnat Chulhas. These models can also be called as modified traditional chulhas, in which energy loss due to radiation and convection are minimized; resulting in saving of fuels. Like traditional chulhas; these Unnat Chulhas are also made from bricks and cement or clay. Smoke can be exhausted out of the house with the use of an outlet. Due to this, the harmful effects due to smoke are greatly reduced. Their life span is estimated to be of approximately 5 years. Environmental changes such as rainfall, etc. didn't exert much change on their structure. The efficiency of Unnat Chulhas was also measured in actual operation which indicates about 22 percent thermal efficiency. It is also observed that on an average 950 kg of fuel wood can be saved by using one Unnat Chulha in a year.



**Udaipur Unnat Chulha**

#### **3. Biogas Technology**

The main energy source for generating Biogas is organic matter. Generally, biogas is prepared by the anaerobic digestion of cattle dung and water mixed in equal quantities. Biogas comprises of 60-65 percent methane ( $\text{CH}_4$ ), 35-40 percent carbon dioxide ( $\text{CO}_2$ ), 0.5-1.0 per cent hydrogen sulphide ( $\text{H}_2\text{S}$ ) and traces of water vapours. It is almost 20 percent lighter than air. Biogas cannot be converted into liquid like liquefied petroleum gas (LPG) under normal temperature and pressure. The slurry coming from digester is rich in nitrogen which is an essential nutrient for plant growth. Biogas is an easy and healthy cooking fuel since methane emissions from untreated cattle dung and biomass wastes can also be avoided. Since there is no pollution from biogas plants, these are one of the most potent tools for mitigating climatic change and being earth saviors.



#### **Biogas Lamp being used Biogas Plant used for domestic purpose**

The energy liberated by Biogas is not only used for cooking but can also be used for lightning lamps and for power generation. Biogas lamps are commercially available for lightning purpose. Power could be generated using biogas, using Biogas Genset. Subsidy is also provided by Government of India for setting up biogas plant for domestic purposes.



#### **Biogas being used for cooking**

Properties of Biogas which make it an excellent fuel are:

- ❖ Biogas is a non-toxic, colourless and flammable gas.
- ❖ It has an ignition temperature of 650 – 750 °C.
- ❖ Its density is 1.214 kg/ m<sup>3</sup>
- ❖ About 60 percent methane and 40 percent CO<sub>2</sub> content
- ❖ Calorific value is 20 MJ/m<sup>3</sup> (4700 kcal).
- ❖ Almost 20 percent lighter than air
- ❖ It liquefies at a pressure of about 47.4 kg/cm<sup>2</sup> at a critical temperature of - 82.1°C.

- ❖ Purified biogas (bio-methane) has a higher calorific value in comparison to raw biogas.

There are two designs of biogas plant popular in India:

- (a) Floating Gas holder type.
- (b) Fixed dome type

(a) In floating drum type design, the digester is an underground tank constructed in brick masonry, stone masonry, RCC or ferrocement. It has an inverted metallic drum which acts as gas holder. The gas produced in digester is collected in gas holder at a constant pressure depends on the weight of gas holder. The merits of this design are:

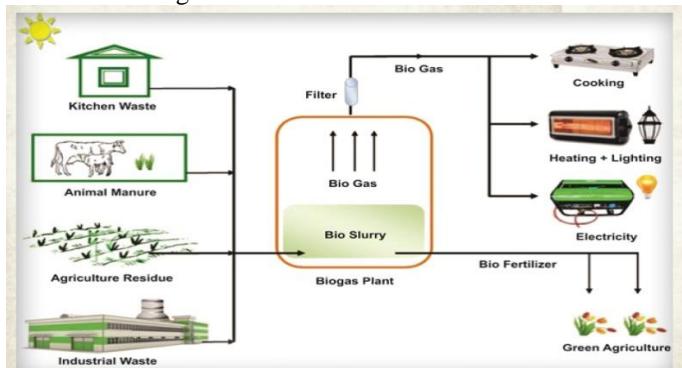
- Gas is supplied at constant pressure
- It has a provision for breaking scum.
- Any local mason can construct the plant.
- At high water table area, horizontal plant can be constructed.
- Different models comes in category are KVIC vertical and horizontal, Pragati Model, Ganesh Model and Ferrocement digester.

(b) The fixed dome type biogas plant is a dome shaped underground construction. The masonry gas holder is an integral part of the digester called dome. The gas produced in the digester is collected in dome at variable pressure by displacement of slurry to inlet and outlet. The merits of these designs are:

The construction is made entirely of bricks and cement which are locally available. Steel gas holder is not required. .

- As there is no moving part, the maintenance cost is minimised.
- Less effected by low temperature.
- The space above the plant is usable as the plant is under ground.
- Other materials along with dung slurry can be charged.

The scope of biogas has been enlarged by coupling all type of organic waste along with dung recycling including fruits & vegetables waste. Presently biogas is not only recognized as gas production from dung recycling but also it is also known as all organic waste recycling for resource recovery system in terms of biogas & enriched manure. In fact there is no waste; all waste can be used as source for wealth. In India there is good potential of waste material, which can easily be converted in biogas.



**Mode of Operation of Biogas Plants and their Uses**

#### 4. Summary

In contrast to conventional energy sources, the potential supply from renewable is essentially infinite and largely free of external costs. Some Renewable Energy Technologies are already competitive with conventional energy sources, for example biomass or biogas applications. Renewable energy provides greater flexibility. Various daily household applications that can be used by women in their day to day activities are as mention under-

S.N.	Application	Renewable Energy Technology
1	Cooking	Biogas, Solar Cooker, Unnat Chulhas
2	Lighting	Solar Home lighting, Solar lantern, Solar Street Light, Biogas Lamps
3	Water Heating	Solar water heating, biogas, Unnat Chulhas
4	Drying	Solar dryers
5	Electricity production	Solar photovoltaic system, biogas genset

To conclude, introducing women to the renewable energy technologies can mitigate drudgery, reduce environmental damage, support meeting of their basic energy needs and foster productive activities for their economic and social upliftment.

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