**Natural Gas**

The government has been the sole authority for fixing the price of natural gas in the country. It has also been taking decisions on the allocation of gas to various competing consumers. The gas prices varies from Rs 5 to Rs.15 per cubic meter.

**Electricity**

Electricity tariffs in India are structured in a relatively simple manner. While high tension consumers are charged based on both demand (kVA) and energy (kWh), the low-tension (LT) consumer pays only for the energy consumed (kWh) as per tariff system in most of the electricity boards. The price per kWh varies significantly across States as well as customer segments with- in a State. Tariffs in India have been modified to consider the time of usage and voltage level of supply. In addition to the base tariffs, some State Electricity Boards have additional recovery from customers in form of fuel surcharges, electricity duties and taxes. For example, for an industrial consumer the demand charges may vary from Rs. 150 to Rs. 300 per kVA, whereas the energy charges may vary anywhere between Rs. 2 to Rs. 5 per kWh. As for the tariff adjustment mechanism, even when some States have regulatory commissions for tariff review, the decisions to effect changes are still political and there is no automatic adjustment mechanism, which can ensure recovery of costs for the electricity boards.

## Solar Energy:

**Introduction:** Solar energy is an important, clean, cheap and abundantly available renewable energy. It is received on Earth in cyclic, intermittent and dilute form with very low power density 0 to 1 kW/m2.Solar energy received on the ground level is affected by atmospheric clarity, degree of latitude, etc. For design purpose, the variation of available solar power, the optimum tilt angle of solar flat plate collectors, the location and orientation of the heliostats should be calculated. Units of solar power and solar energy: In SI units, energy is expressed in Joule. Other units are angley and Calorie where 1 angley = 1 Cal/cm2.day 1 Cal = 4.186 J For solar energy calculations, the energy is measured as an hourly or monthly or yearly average and is expressed in terms of kJ/m2/day or kJ/m2/hour. Solar power is expressed in terms of W/m2 or kW/m2. Essential subsystems in a solar energy plant:

1. **Solar collector or concentrator:**

It receives solar rays and collects the energy. It may be of following types: a) Flat plate type without focusing b) Parabolic trough type with line focusing c) Paraboloid dish with central focusing d) Fresnel lens with centre focusing e) Heliostats with centre receiver focusing

**2. Energy transport medium:**

Substances such as water/ steam, liquid metal or gas are used to transport the thermal energy from the collector to the heat exchanger or thermal storage. In solar PV systems energy transport occurs in electrical form.

## 3. Energy storage:

Solar energy is not available continuously. So we need an energy storage medium for maintaining power supply during nights or cloudy periods. There are three major types of energy storage: a) Thermal energy storage; b) Battery storage; c) Pumped storage hydro-electric plant.

## 4. Energy conversion plant:

Thermal energy collected by solar collectors is used for producing steam, hot water, etc. Solar energy converted to thermal energy is fed to steamthermal or gas-thermal power plant.

## 5. Power conditioning, control and protection system:

Load requirements of electrical energy vary with time. The energy supply has certain specifications like voltage, current, frequency, power etc. The power conditioning unit performs several functions such as control, regulation, conditioning, protection, automation, etc.

## SOLAR COLLECTORS

Solar thermal energy is the most readily available source of energy. The Solar energy is most important kind of non-conventional source of energy which has been used since ancient times, but in a most primitive manner. The abundant solar energy available is suitable for harnessing for a number of applications. The application of solar thermal energy system ranges from solar cooker of 1 kw to power plant of 200MW. These systems are grouped into low temperature .

## Solar Collectors

Solar collectors are used to collect the solar energy and convert the incident radiations into thermal energy by absorbing them. This heat is extracted by flowing fluid (air or water or mixture with antifreeze) in the tube of the collector for further utilization in different applications.

The collectors are classified as;

- Non concentrating collectors
- Concentrating (focusing) collectors

## Non Concentrating Collectors

In these collectors the area of collector to intercept the solar radiation is equal to the absorber plate and has concentration ratio of

1. Flat Plate Collectors (Glaze Type) Flat plate collector is most important part of any solar thermal energy system. It is simplest in design and both direct and diffuse radiations are absorbed by collector and converted into useful heat. These collectors are suitable for heating to temperature below 100oC. The main advantages of flat plate collectors are: • It utilizes the both the beam as well as diffuse radiation for heating.

## Disadvantages

• Large heat losses by conduction and radiation because of large area.

• No tracking of sun.

• Low water temperature is achieved.

The constructional details of flat plate collector is given below

**(a) Insulated Box:** The rectangular box is made of thin G.I sheet and is insulated from sides and bottom using glass or mineral wool of thickness 5 to 8 cm to reduce losses from conduction to back and side wall. The box is tilted at due south and a tilt angle depends on the latitude of location. The face area of the collector box is kept between 1 to 2 m2 **.**

(b) Transparent Cover:

This allows solar energy to pass through and reduces the convective heat losses from the absorber plate through air space. The transparent tampered glass cover is placed on top of rectangular box to trap the solar energy and sealed by rubber gaskets to prevent the leakage of hot air. It is made of plastic/glass but glass is most favourable because of its transmittance and low surface degradation. However with development of improved quality of plastics, the degradation quality has been improved.


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