Name: ABBAS ALI

ID: 15632

Q1:

In Renewable Energy Systems Solar Photo Voltaic and Fuels Cell are among the popular choice of technologies used for Direct Energy Conversion. For your home town of (State your city), which will be the better option to power a 10 KW load. Explain your answer based on its pros & cons, users, applications, availability and market. Back your reasons with valid data, facts and figures.

Answer1:

Access to electricity is one of the major features that impose on socioeconomic maturity of a country. At present my home town Talash Lower Dir is distressing from a critical electricity problem. Talash is located at the north of kpk with the latitude, longitude, and elevation of 34.741530°, 71.871956°, and 835 m respectively. Around 75% of people are living in villages. The generated power is incapable to assemble the demand, leading to a load shedding up to maximum 12 hours. In this situation Solar Photo Voltaic technology can be a smart effort as compared to fuel cells to solve this problem by harnessing energy the town's free-flowing renewable source such as sun light. In the last 7 years Solar Photo Voltaic installation is increased significantly and now its uses are increasing day by day.

The main components consist of a solar panel, a battery and a charge controller. Solar photovoltaic systems generally represent the technology by which sunlight (one form of energy) can be converted into electricity (another form of energy), without using any moving parts.

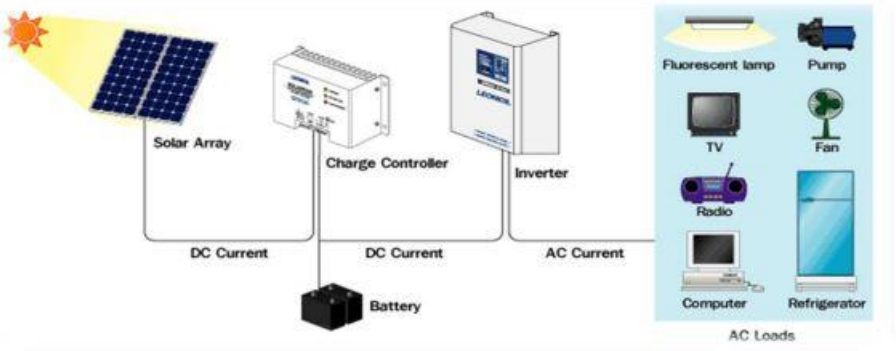

Figure 1 solar photovoltaic system

To find out the daily average load, a family consists of 4 persons using, 6 Led Bulbs for 6 hours, 3 fan for 12 hours daily, Television for 5 hours.
So power requirement of various types of loads are given bellow:

Item /loads	**Rated power**
Television	70W
Led Lights	6W
fans	65W

The daily energy needed for the given family =5*70+3*12*65+6*6*6 = 2,906 Wh =2.906 KWh.

Advantage of Solar Photo Voltaic system:

- Many homeowners save 30% on their electric bills some even completely eliminate their electric bill.
- A typical household uses 2.906 of electricity per Day in our home town. A residential solar installation of 10 kW per day from Renewable Energy Firm would almost entirely offset electricity costs.
- Studies show that solar systems can increase your home value by 20 times the annual electricity savings.
- Fossil fuel supplies are dwindling, which will lead to higher energy costs.
- Carbon Dioxide produces global warming which is intensely disturbing our climate causing glacier loss, shoreline erosion, and risking many animals around the world.
- Putting the sun to work decreases the number of coal and nuclear energy required to power home which helps preserve the earth‘s supply of non-renewable resources.
- Even in tough conditions, photovoltaic systems have verified their reliability. PV arrays prevent costly power failures in conditions where continuous operation is critical.
- Most PV modules accessible today show no degradation after ten years of use. It is likely that future modules will produce power for 25 years or more.
- Since no fuel source is required, there are no costs associated with buying, storing, or transporting fuel.
- PV systems do not require the use of combustible fuels and are very safe when properly designed and installed.
- Large number of supplier & of experience in the solar technology market, resulting the low price of photovoltaic system.

Q2:

PV Cells performance is greatly affected by a location's climate factors which include irradiance, temperature, humidity and wind. Different locations have different climate conditions. For your home town of (State your city and climate conditions), based on its average climate conditions what techniques will you apply to a PV cell to reduce the effects of climate on the cells performance, reduce losses and increase efficiency. Back your reasons with valid data, facts and figures.

Answer2:

The outdoor performance of a PV module is influenced by many features. Some of these problems are linked to the module itself and others are associated to the location and environment. Few of these major factors are:

Solar irradiance, module temperature, humidity, and wind.

The location of my home town is perfect for PV cells because of weather condition. In summer the maximum temperature rise is 35 degree Celsius and that in winter is 5C to 10C. The average wind speed is 10-11km/h and average humidity is around 40% in summer.

Solar irradiance:

The performance of PV modules under variable light conditions will differ significantly, which in turn has a severe impact on the yield of PV systems. Variations in the intensity of solar radiation falling on a PV module affect many of its parameters, including I, V, power, FF and efficiency. Fig. 10 shows the current, voltage and power output of a module with varying irradiance.

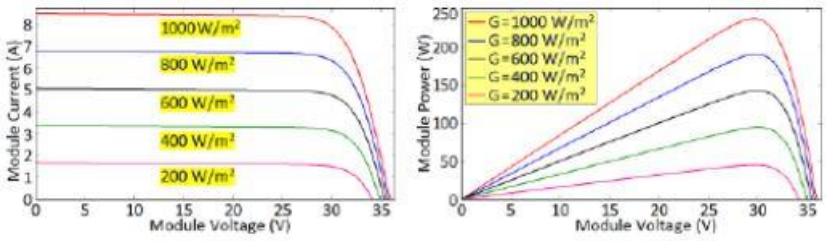

Figure 2. *Impacts of variations in Irradiance on the Current and Output Power of a PV module.*

Module Temperature:

A PV cell, like any other semiconductor device, is very sensitive to temperature. The efficiency and power output of a PV cell reduces with increase in its temperature. This is mainly due to the increase in internal carrier recombination rates caused by increased carrier concentrations. The temperature of a PV module increases with increasing solar radiation and air temperature but reduces with increasing wind speed. During summer noon time when the irradiance is very strong, PV module temperatures may reach 60-65 ºC.

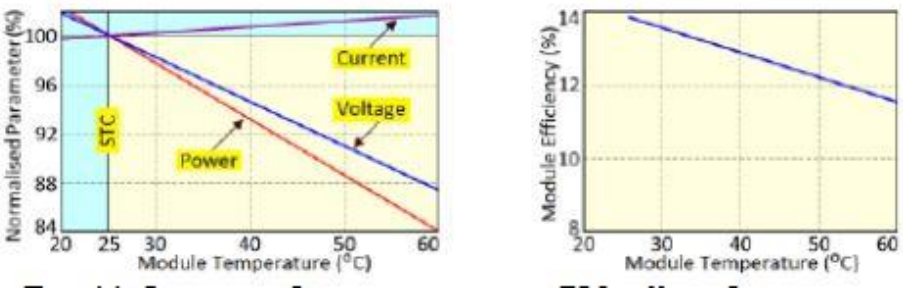

Figure 3 Impacts of temperature on a PV cell performance.

Although good quality solar panels are built to withstand and perform under common weather conditions such as rain, fog, mist and high winds, the performance of these panels will be affected by extreme conditions. Anything that blocks the sun's rays from reaching the surface of the panels will disturb the effectiveness of the panels' solar power, however, these factors will not affect the performance of the solar panels as much as we would think.

The design of the solar panels ensures that the electronic components that are enclosed within the solar panels must be safe. In fact, rain helps to clear out the dust from the solar panels, thereby allowing for more efficient energy conversion. Good quality solar panels are built to withstand winds of 90 miles per hour (mph), as well as hail velocities of over 260 mph.

Lightning could result in voltage surges in the solar panels, but this can be protected to some extent by proper grounding as well as lightning protection systems. Solar panels installed in areas prone to dust storms may be greatly affected due to the deposition of a heavy layer of dust which prevents the solar panels from accessing the sunlight, therefore requiring for a clean-up of the dust.

Q3:

Fuel Cells have many types based on temperature, electrolyte and fuel. What would be the best option and the worst option among the types of fuel cell for providing power to Iqra National University (Take the last 3 digits of your student ID to be the average load KW of INU) located in Peshawar. Explain your choices based on the pros & cons, applications, availability and market. Back your reasons with valid data, facts and figures.

Answer3:

Fuel cell, any of a class of devices that transform the chemical energy of a fuel directly into electricity by electrochemical reactions. A fuel cell look like a battery in many respects, but it can stream electrical energy over a much longer period of time. They generate electricity from the reaction of hydrogen with oxygen to form water in a process which is the reverse of electrolysis.

There are six major fuel cell technologies are now being followed for various applications each with its own characteristics. Some work at high temperatures, some practise exotic electrode materials or catalysts, all are very complex. The Average load of INU is 632KW.

- Alkali----------(5-150KW)
- Phosphoric Acid----------(50kW- 11MW)
- Solid Oxide----------(100-250kW)
- Molten Carbonate----------100kW-2MW)
- Proton Exchange Membrane PEM----(5-250kW)
- Direct Methanol DMFC----------(<5kW)

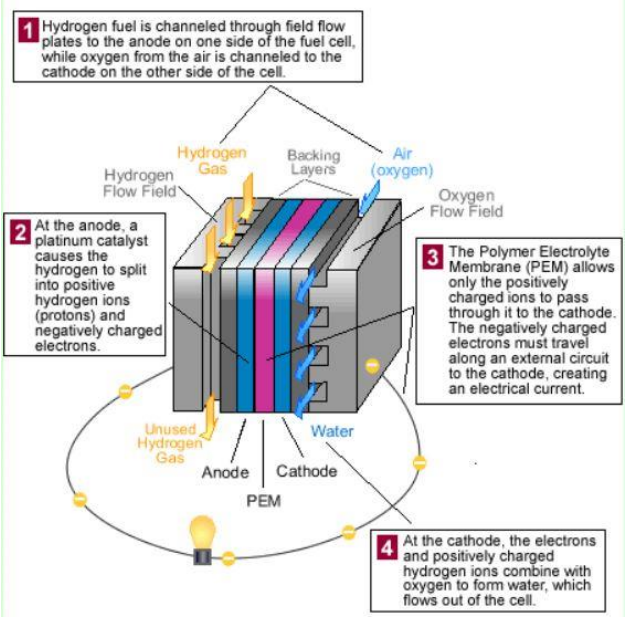

Figure 4 Working of a fuel cell.

Advantages:

- Fuel cell power is usually proposed as the green, alternative to the internal combustion engine, fuelled only hydrogen and leaving no pollutants other than water.
- Simple fuel requirements needing hydrogen fuel only, taking their oxygen from the air.
- No recharging is necessary.
- No time lost through recharging. (Acts like a perpetual primary cell)
- So long as fuel provided, the cells can provide constant power in remote locations.
- Practical fuel cells already have efficiencies as high as 60%
- Fuel cells deliver maximum efficiency at low power levels.(This is the reverse of the internal combustion engine)
- For transport applications fuel cell vehicles offer higher "well to wheel" (WTW) efficiencies than conventional internal combustion engines.

Shortcomings:

- A major factor inhibiting market take off is the lack of available infrastructure to provide the hydrogen fuel. Hydrogen fuel can be supplied in pure form in cylinders or the on board cylinders can be refilled at special refuelling stations. Despite safety precautions there is still a perception by the general public that hydrogen fuel is unsafe.
- The low cell voltage 0.6 - 0.7 Volts means that the system needs a lot of cells to obtain a normal operating voltage of 200 - 300 Volts to power the drive train motor.
- Power is generated as required but the process is not reversible within the fuel cell and so, like a primary cell, it cannot accept regenerative braking loads. Fuel cells generate electrical energy but they cannot store electrical energy.
- Most designs need to work at high temperatures in order to achieve reasonable operating efficiencies. To generate the same efficiencies at lower temperatures requires large quantities of expensive catalysts such as platinum.

For INU the best option is Proton exchange membrane PEMFC because of:

- Temperature is 50-100◦C.
- Zero emission.
- Compact low maintenance.
- High current density.
- Suitable for 5-250kW.