Department of Electrical Engineering
Assignment
Date: 20/04/2020

Course Details

Course Title:	Direct Energy Conversions	**Module:**	4th
Instructor:	Sir shayan	**Total Marks:**	30

Student Details

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Note: Plagiarism of more than 20% will result in negative marking.
Similar answers of students will result in cancellation of the answer for all parties.

Q1.	(a)	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.	Marks 10
Q2.	(a)	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	Marks 10

Question 1

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.

Answer

By selecting solar system for malakand is due to unavailbility of electricity ,load shading is more and billing is to high ,while sunlight is not too much warm that solar efficiency should be effected ,while in malakand night is also cold that solar battery storage is enough for lightning or fanning for air due to

mountains and greenery .while fuel cell have no future like solar cells and need wapda electricity for storage purpose ,changing in every 2 to 3years ,high maintenance and it will no charge full due to load shading every hour so solar is more efficient then the fuel cell and much more efficiency output and long life ,low maintenance .solar cell has the power to run electric water motors while fuel cell has not enough power, now a days dc fans ,dc air conditioners are also in market etc

The pros and cons of solar energy:

Advantages of Solar Energy

1. Renewable Energy Source

benefits of solar panels, the one and only good option is solar energy which is the most useful renewable energy in the world, which could be install in all over the world with too low price from the other sources of energy which produce electricity and which is unfinished energy source in the world until the sun dies which is not happening in 5 billion years, so that is why sun is avail everyday for solar energy .

2. Reduces Electricity Bills

By using solar pv channels for the hometown or for the states where transmission line were affected and no hydro or oil generators and gas generators were reached or low avail of sources and the loading shading in every 1hours and the billing is too much higher so then you will be meeting with solar energies by which bills drops by saving a lot of money for dependent solar grid or solar cells for home town or state. More ever not only saving of money but can also pass the surplus voltages of energy to the national grid through smart meters and by earning of it by exporting.

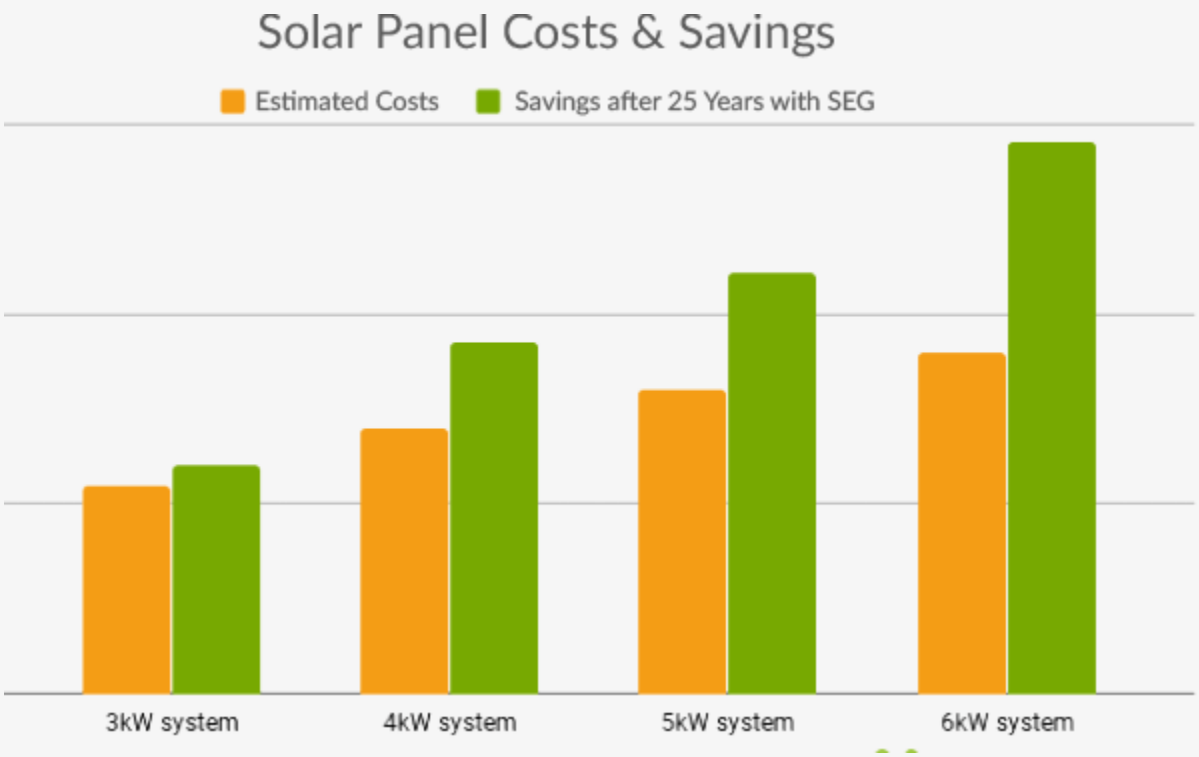
3. Diverse Applications

diverse purposes using of solar channels. By generating electricity (pv) or by heating (solar thermal),by which can be used to avail energy where unavailing of water or grid system. Solar energy can also be used for integrated purposes.

4. Low Maintenance Costs

Maintenance of solar pv channels are almost consider to zero in my opinion by taking some procedures like to make them clean every week so by this it will show very good health and good efficiency of power output. Actually the solar panels have long life warranty upto 25 to 30 years which I think is most reliable. Also it has no moving items no wears and tears, but the only one thing to be change is inverter whose life is about 5 to 10 years depend upon the company or quality of materials or accuracy , because it converts the solar energy to electricity and heat to solar thermal energy ,and also taking care of by changing the cables by making sure of the efficiency of the system.so which is very little cost from the national grids supply coming from them.

System Size	Number of Panels	Roof Space
3kW panel system	12	22 m²
4kW panel system	16	29 m²
5kW panel system	20	32 m²
6kW panel system	24	43 m²



5. Technology Development

Industries engineers advancing and improvements will intensify in the future. they are testing day by day for better uses of it ,new inventions ,quantum physics and nanotechnology can potentially increasing their effectiveness of solar pv channels double and even triple ,the energy which is electrical input of the solar power system.

6 solar hybrid system

System that it overcome and meets of non-electrified remote areas, by where national grids are not yet install. Power generates from solar cells stored in banks (battery). A hybrid renewable energy system of solar cells are used , the reliability of the system is enhanced.

Disadvantages of Solar Energy

1. Cost

By looking initial cost of purchasing a solar system is high. paying different components which are using for installation that is pv channels, inverter for conversion of energy , batteries for storing of charges for night or cloudy weather, wiring or cables ,connectors .but as we know that industries are developing more better channels and its components to work much better so the price will become low day by day because the only reason to overcome losses is solar energy because in the world water and coal is falling down and every one follow the sunlight energy and for making it useful for upcoming years .

2. Weather Dependent

Solar energy can still working in rainy days the system efficiency drops ,because it is dependent on sunlight to effectively gathering of solar energies ,so by having few cloudy days or rainy days have a noticeable effect of the energy system.you should also know that at night that solar energy can not be collected .so on the other hand needing of hot water is also an issue for thermodynamics panels and are alternative consideration.

3. Solar Energy Storage Is Expensive

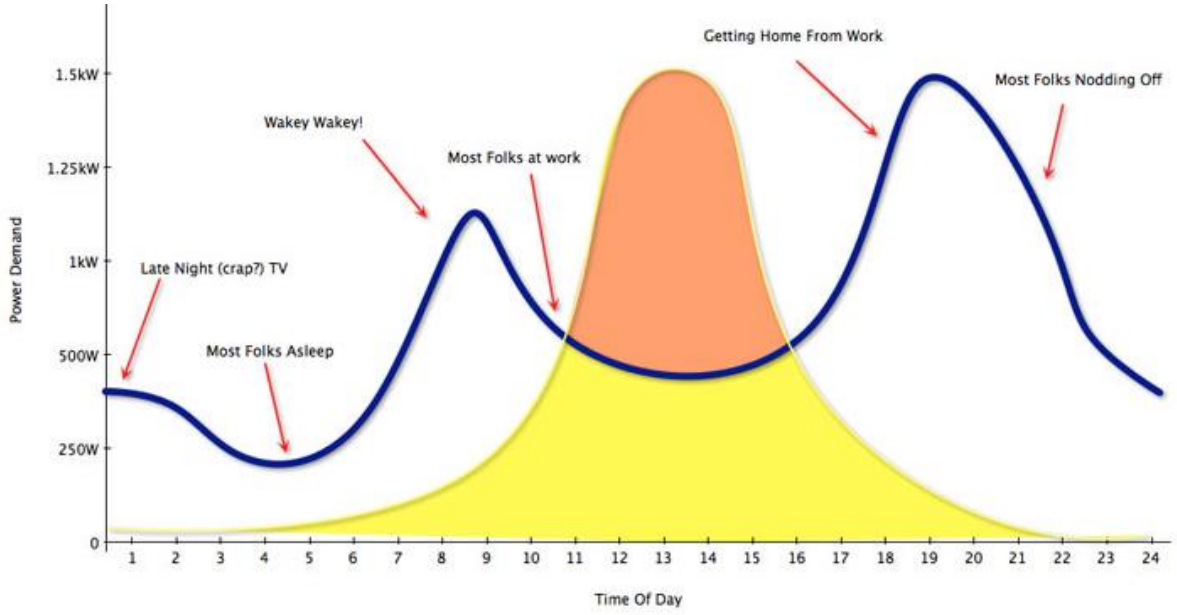
Solar system energy can be used directly or to be stored in lager number of batteries, they are used in off the grid Solar system, it should be charged entire day that may help in night purposes. which is the good solution that use the solar energy full day directly .but it is also expensive .in most of the cases solar system is use in a day and grid energy at night if it is connected to gird system but as we know that in a day our load demand is very high so we can full fill our desired load by solar channel.

4. Uses a Lot of Space

If we want to produce or our demand load is high so we have to energize the more panels to overcome our desired load so that we can collect more sunlight and generated more electricity as possible , but it have to require a lot of area and some roofs are not big as we want to fit our channels and make our wish come true . An alternative that some of panels are to be install or some of them at the roofs but they need to access of light. If you don't have the space for all the panels that you wanted, you can opt for installing fewer to still satisfy some of your energy needs.

5. Associated with Pollution

It is far less compared to other source of electricity it can be associate with pollution. Transportation and installation associate the emission of greenhouse gases. Some of the toxic materials and hazardous products derived during its making of pv , by which it should indirectly affect environment .but solar energy pollutes far less than other alternative energy sources.



Application and users

Ac solar mini grids and smart micro mini grids

Solarization of streets lights which will stored energy in batteries at lightning in the night.

Solarizarion of water pumps like usaid base projects

Solar dc micro girds

Simple or "Stand Alone" PV Systems

PV with Battery Storage

PV with Backup Generator Power

PV Connected to the Local Utility

Utility-Scale Power Production

Hybrid Power Systems

For 10kw load
By making of 10kW solar system
we will need 34channels 300w each.

1pv panels

2+6=8hours
10000 x 8=80000whr
As in thana sun shine is 6hours
80000/6=13333watts
To consider the losses due to temperature, dust , cable losses=40%
So total power system required
13333 x 1.4=18666 watts
Or 18.6kw

2inverter required

As load is 10kw
Apply 30% safety in load
10kw x 1.3=13kw or 15kw

3battery

As backup is 2hours
Let the system voltage is 48volts
Let battery efficiency =85%
D0D=80%
=2 x 10000/48 x 0.85 x 0.80
=612Ah or 800Ah

Question 2

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.

Answer

PV Module and Load Profile

The experimental setup was situated on the roof of our home in malakand. system was consist of two PV modules (Figure 1), each was connected to a (DC) motor. There was no tracking system but the effect of temperature was taken . LAT 34 40 , LON 71 55 TITTAT 55 20

Site data of malakand pakaistan

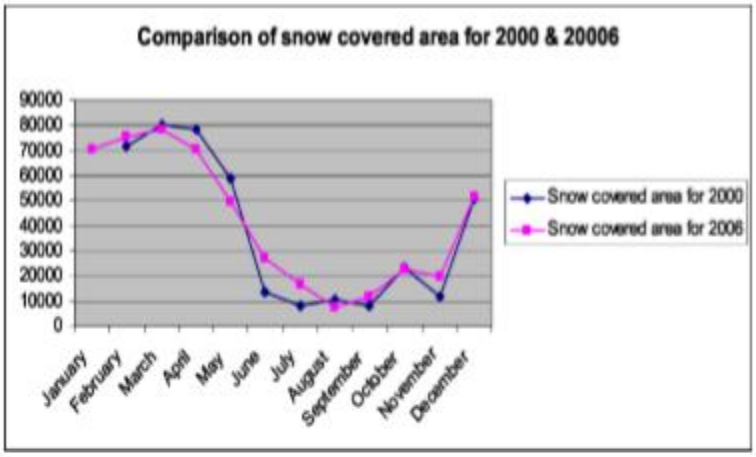
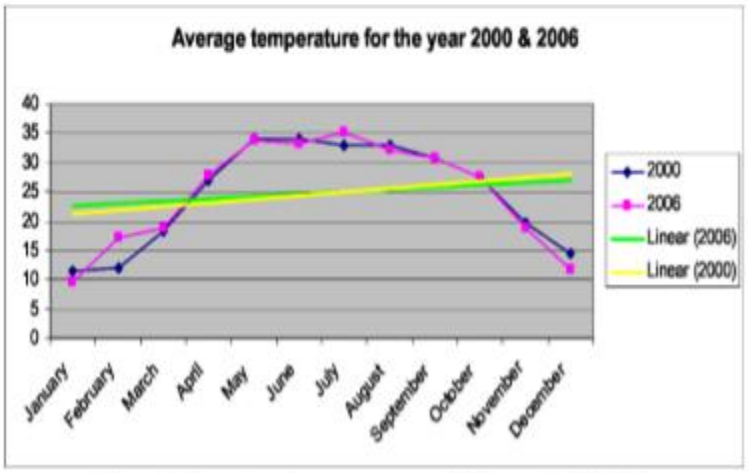


Figure 3: Snow surface area for the year 2000 and 2006



Months	Balakot	Chitral	Dir	Drosh	Kalcal	Saidu Sherif	Garidopatta	Muzaffarabad	Skardu	Bunji	Gilgit	Astore	Chillas
Jan-00	14.1	12	12.9	11.3	13.4	14.9	14.4	16.6	1.8	10.9	10.6	3.6	12.7
Feb-00	14.5	10.8	11.5	10.8	12.6	15.6	15.9	18.4	3.4	12.6	13.3	2.9	14.6
Mar-00	20.4	16.8	16.8	17.1	19	21.5	22.6	24.1	11.9	19.1	19.3	9.5	20.5
Apr-00	28.9	26.4	26.5	26.9	27.2	30.8	31.6	32.7	20.1	25.9	26.5	17.5	28
May-00	35.4	34.2	32.9	35.5	33.9	37.1	37.6	38.9	27.5	33.7	34.9	24.9	37.3
Jun-00	34	35	32.7	36.5	32.3	36.8	36.6	37.4	29.3	34.3	35.2	25.3	37.8
Jul-00	30.5	35.7	31.2	36.4	29	34	32.5	33.5	30.3	34.9	34.6	26.4	38.1
Aug-00	30.5	35.7	31.6	36.4	28.9	34.2	33	33.8	29.6	34.8	35.3	26.5	38.2
Sep-00	30	32.4	28.8	33.3	27.8	32.3	31.4	32.6	26.9	31.8	32.9	23.9	35
Oct-00	28.4	28.6	25.9	29.1	27.3	31.1	29.6	31.7	21	26.6	27.8	19.8	29.7
Nov-00	22.1	17.6	19.1	17.7	20.9	22.9	22.7	24.7	13.3	19.4	19.9	12.1	21.5
Dec-00	18.4	13.3	15.5	12.8	17	18.3	19.1	21.7	4.5	13.1	12.9	5.7	14.9
Jan-06	13.2	8.8	9.8	7.6	12	13.9	13.4	13.2	2.1	9.3	8.5	1.7	10.5
Feb-06	20.2	16	17.4	16.7	18.6	21.6	20.3	21.2	9.2	16.5	16.9	8.5	18.1
Mar-06	20.7	18.3	17.7	18.4	18.4	21.7	20.9	22.7	13.9	19.9	20.3	10.7	21.5
Apr-06	27.7	24.5	24.5	24.5	25.1	28.9	26.6	30.4	18.1	24.4	24.9	14.8	27.3
May-06	34.8	34.8	33.4	36	32.7	37.3	36.8	38.4	27.2	32.6	34	24.5	36.3
Jun-06	34.3	34.6	33.4	35.3	31.9	36.5	36.4	36.3	27.8	31.8	32.3	24.4	35.8
Jul-06	33	37.3	32.4	38.5	30	35.6	35.8	35.6	33.1	37	36.8	29.3	40.9
Aug-60	31	34.8	30.9	36.5	27.9	33.4	32.3	33.2	30.6	32.7	32.5	26.1	37
Sep-06	31.1	31.4	30.3	33.2	28.5	33.1	32.9	33.8	26.8	30.9	30.1	23.3	35
Oct-06	28.2	28.6	28	30.1	26.2	30.4	29.6	30.9	21.8	26.3	27.2	18.8	31.6
Nov-06	20.3	18.1	18.2	18.9	18.5	21.2	20.4	22.2	13.8	18.9	19	11.2	22
Dec-06	15.5	9.6	11.2	9.5	13.1	14.5	16.4	16.8	5.6	11.5	11.2	4.1	13.2

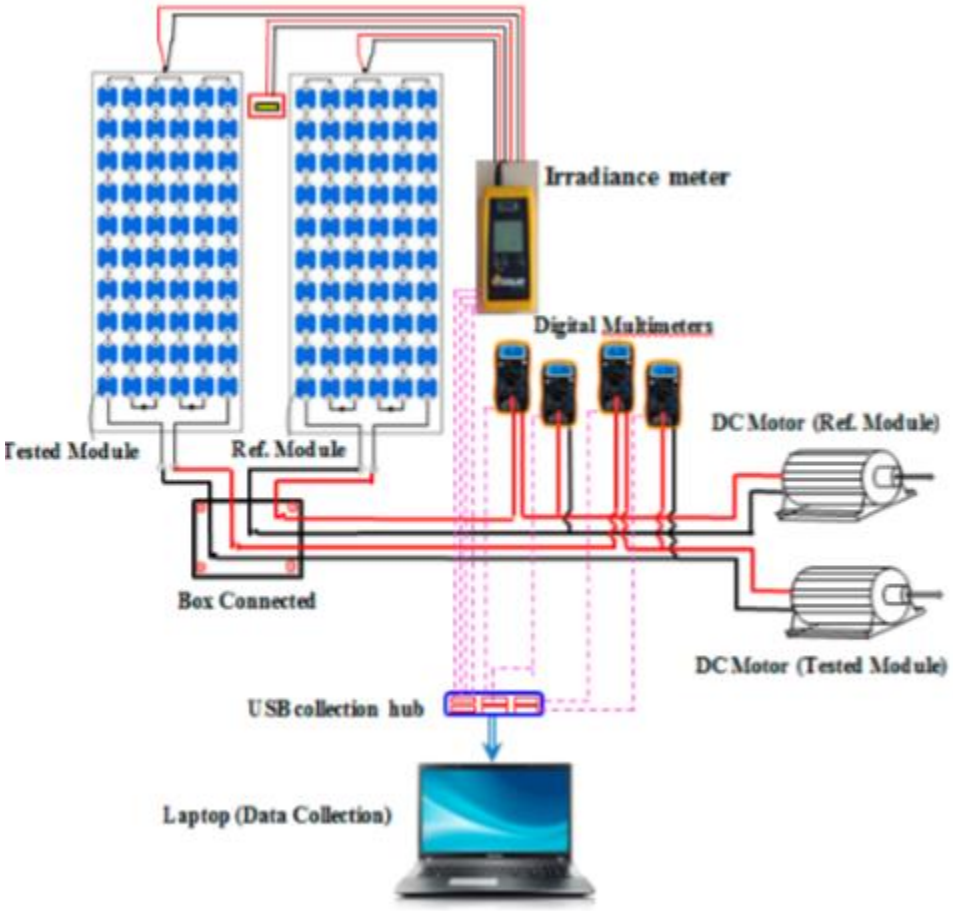


Figure 1. The experimental set-up: two PV modules, multi-meters, a radiation power density meter, and a DC motor.

Table 3. PV module characteristics at Standard Test Conditions (STC) (1000 W/m2, 25◦C, AM1.5).

Photovoltaic PS P36-150W Module

Maximum power (Pmp) 150 + 3% W

Short circuit current (Isc) 8.90 A

Open circuit voltage (Voc) 23.22 V

Current at MPP 8.38 A Voltage at MPP 17.90 V

Maximum system voltage 1000 V

Maximum reverse current 15 A

Module efficiency 15%

Dimensions 150×66×40cm

Operating temperature −40◦C to 85◦C

This device, DMM had been used for measuring of (I,V). The specification Table A1 in Appendix A. The short circuit current (Isc) and load current (Iload) and the open circuit voltage (Voc) and load voltage (Vload) of a 200 V reading. Model as DC motor that converts electrical energy into mechanical energy. The Irradiance meter device was install behind then pannels in order to measure the irradiance (with a daily uncertainty <3%) and the temperature

. The specification irradiance meter is shown.the information display on screen, wind velocity anambient temperature are measured by thermo anemometer .

Solar Radiation

the annual average global solar irradiation is about 5.9 kWh/m2/day, receiving 2600–3500 sunshine hours per year. The site under investigation is located at 31◦9’49.25” N latitude and 35◦45’43.34” E longitude. Figure 2 displays the solar irradiance, per year, of the site under study. It has been observed that the average solar irradiance changed from 3.36kW/m2/day (December) to 7.89kWh/m2/day(June)with a scaled annual average of 5.16kW/m2/day. The annual average ambient temperature and clearness index was 24.5◦C and 0.57, respectively.

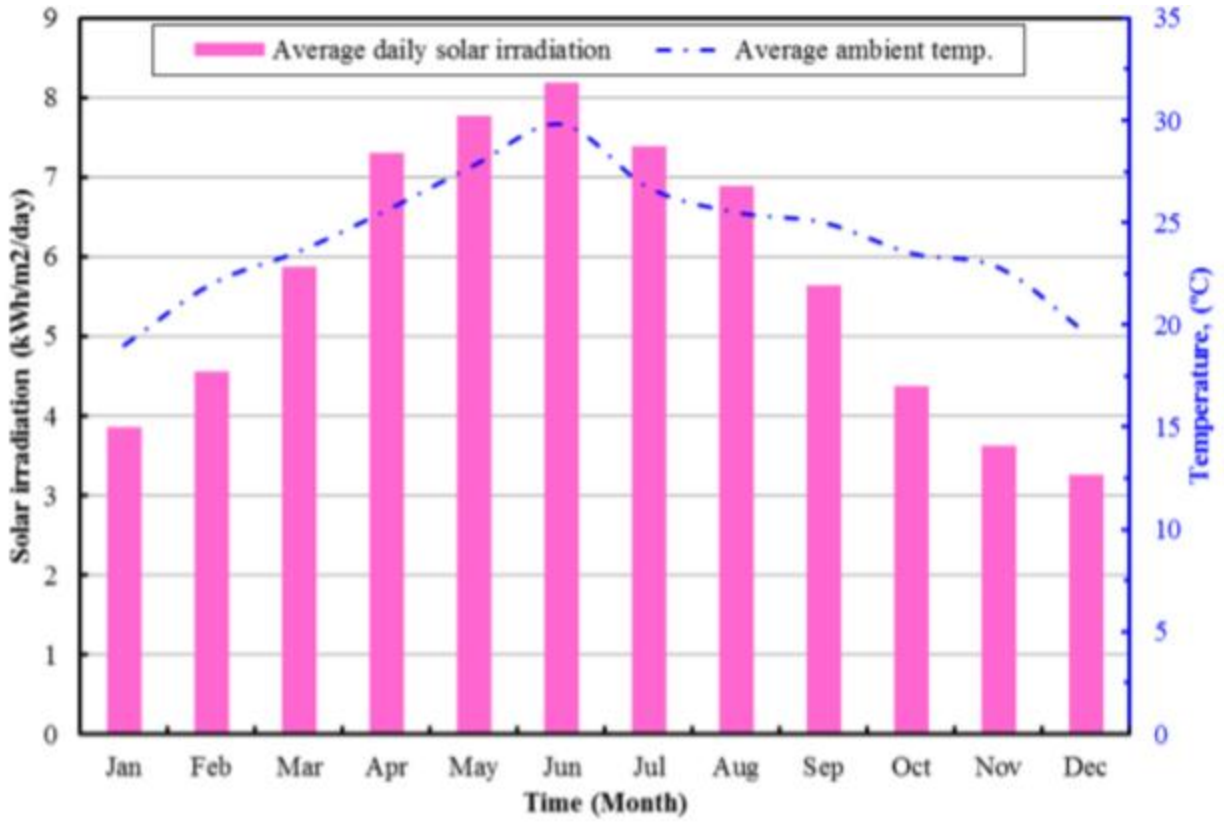


Figure 2. Average daily solar irradiation incident on the PV surface, and the average ambient temperatu re.

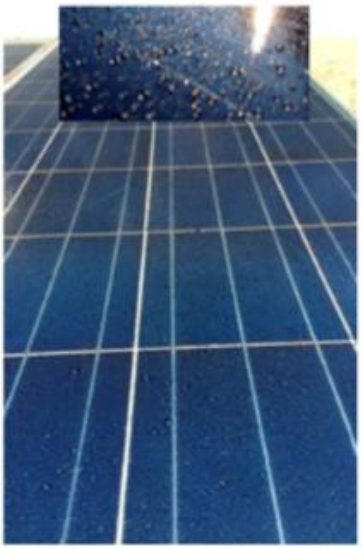
2.3. Experimental

November to February. readings were obtained in summer routine. Data collection was to much difficult due to wintwe season.dut to rainfalls and clouds. Two Polycrystalline PV pannels were energized . One of the PV sets was reference (RPV), possessing a clear surface with no obstructing factors on it, w hile the other, tested PV (TPV). These are dust accumulation, water drops, partial shading, and birds' droppings . The amount of change in PV power output calculated. Temperatures, wind speed, humidity, and irradiance were found.

Figure 3 .affected pictures of solar panel.

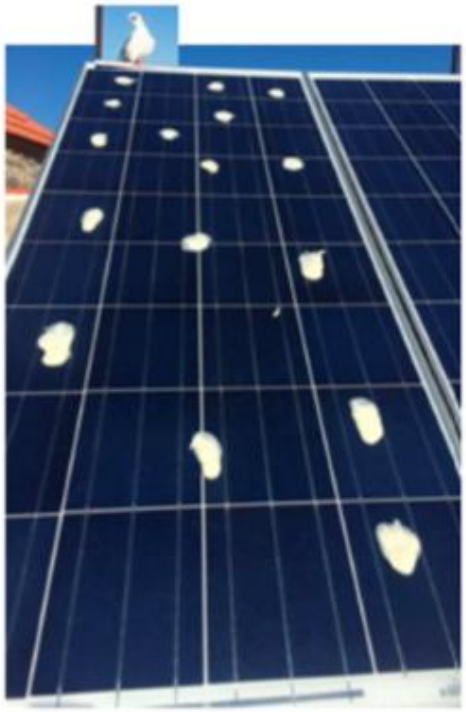
(a) Reference case

(b) Dust module



(c) Module with water droplets

(d) Partial shading



(e) Birds droppings

Figure 3. Real pictures for the considered PV system with the various environmental conditions:

3. Results and Analysis

The results of two PV modules, average of 3 weeks, to study the enivornmental affects and also to know about the pv voltages.

Dust Accumulation

2 numbers of pv pannels were tested for out door several weeks , and power output was monitored for 2hours every. One of the pannel (RPV) clean before the data calculated, and the other (TPV) for dust materials . The daily PV pannel power output, short circuit current, and open circuit voltage for each PV module under investigation was shown in Figure

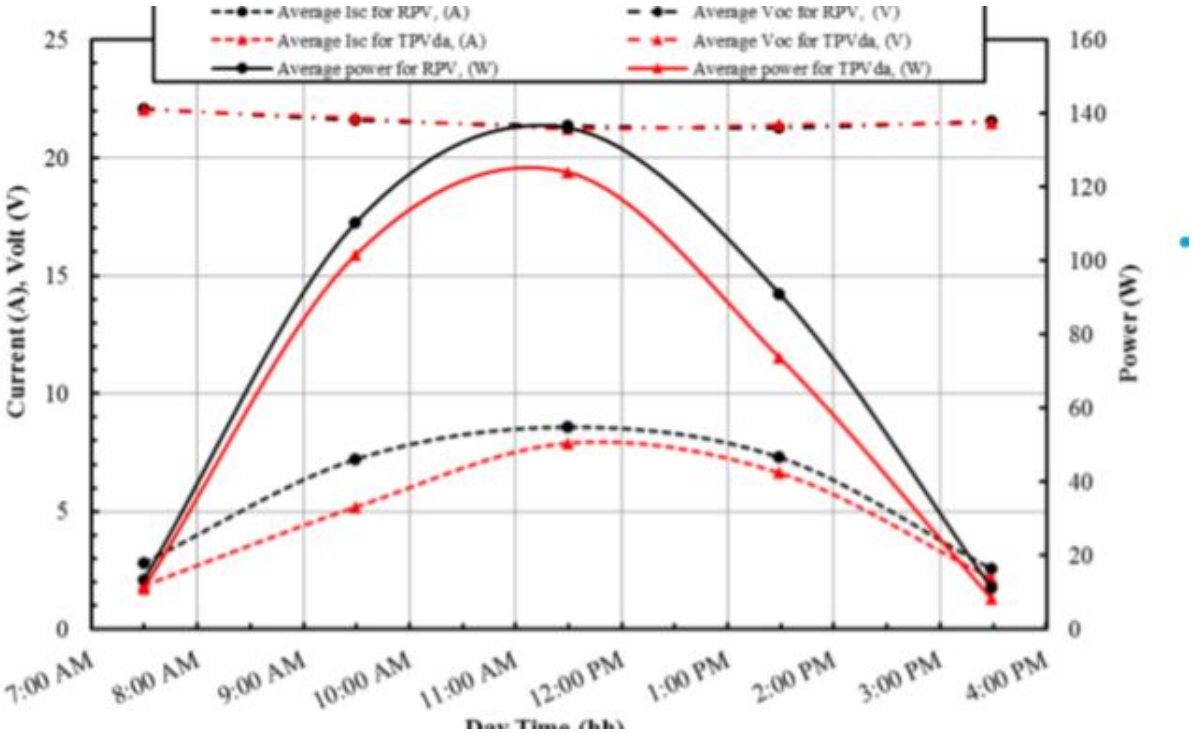


Figure 4. Daily power output, short circuit current, and open circuit voltage of each PV panel under dust accumulation conditions.

This figure shows the difference in the load power output. Dust materials present on the pannel covers and block the soalr radiation of the pannel.and affect the current and power output.that is why the rpv

was more useful form tpvda . Reduction of power and efficiency of PV modules ARE as as follows: $Reduction\ in\ power$ 100%,

(1) $Reduction$ of $\eta\ \eta$ 100% (2)power output RPV at time 11:30 is 136.1 W, while the other was
(2) TPVda at the same time is 119.12 W; , reduction in output power is 12.47%. by calculation RPV efficiency 13.86%, efficiency of TPV 11.7%. loss in efficiency 11.86%.it states that loss of power and efficiency is due to short circuit I of the pv channel with dust particles and ist seems that it cuts the sun rays reaching to the pv channel.therefore the losses of output power occurs . efficiency decreased from 7.2% to 5.6% . in rainy days the output power becomes 7.1%.

3.2. Water Drops

Temperature affect the speed of electrical flows in any electrical circuits.engineers try their best for improving PV system efficiency and their good efficiency under non-optimal temperature conditions, e.g., devising cooling systems which will utilize outside air and water. The day power output, short circuit current, and open circuit voltage of each studied pannel exposed to water drops The figure shows the difference in power output between the RPV and TPVwd which was effected by water droplets.

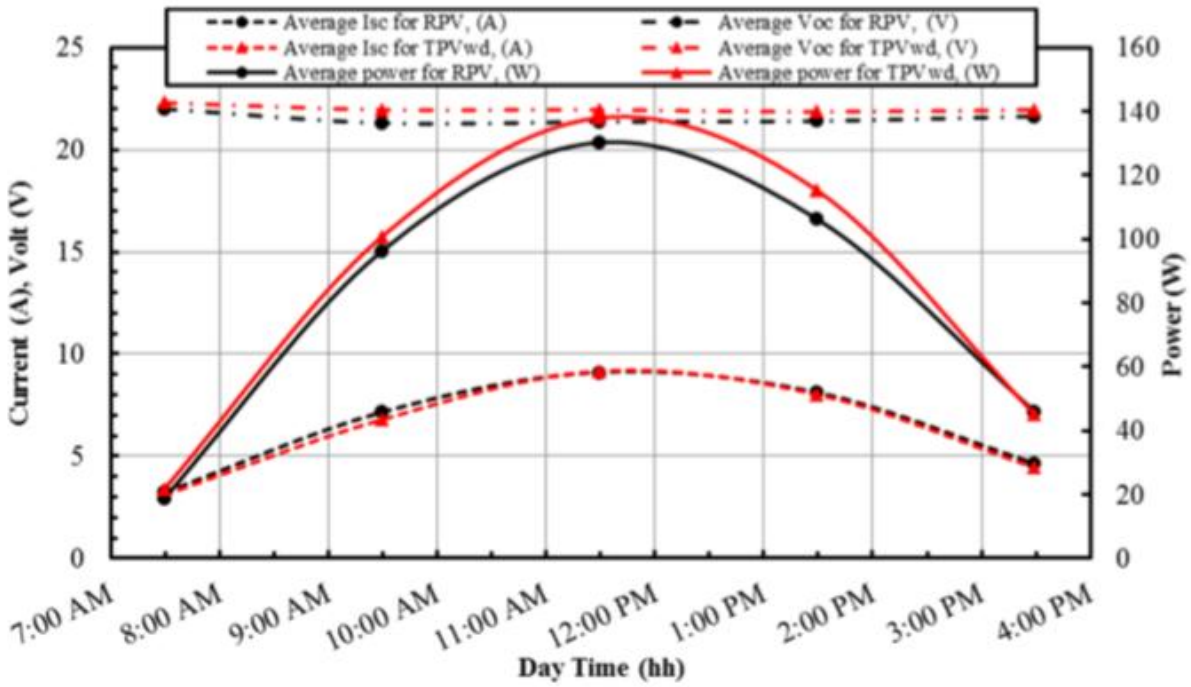


Figure 5. Daily power output, short circuit current, and open circuit voltage of each studied module und er water drops conditions.

It had shown that the output power for the TPwd is higher than the RPV(DRY) RPV at 11:30 , 130.2 W, and for the same time power of TPVwd 137.9 W. good performance 5.6%. because water droplets decreased over temperature, which occur higher volatage.For polycrystalline solar channel if lowing the temperature 1degree celsius the corresponding will be higher to 0.33%, . the output : V,. $Temp.coeff.TT.V$, (3)where Voc,amb denotes the open circuit voltage at ambient temperature Tamb, and Voc,STC and TSTC are the open circuit voltage and temperature at STC. Then, if V,. 0.3325 T.22.06,which shows that by decreasing the temperature high voltage will be obtained. It has also 2benfits for us the 1 is it will cool the pv panels and the other 1 is to clean the pv panels form hot and dusty materials n summer seasons. The rate of cooling channels is 2 °C/min .

3.3. Partial Shading

It is one of the most considered soruces of loss in a PV channel, because engineers try their best and still working on this purpose for good output they installed inverters integrated with global MPPT or by using it for every and each channel .for to avoid the problems whatever is possible . which depends on some parameters. Which includes reduction level of solar irradiance, distribution of shadows above panel area(surface), having bypass diodes, and for configuration of the channel.
This causes all modules within this 'string' to underperform, creating an interdependent dynamic si milar to a domino effect.

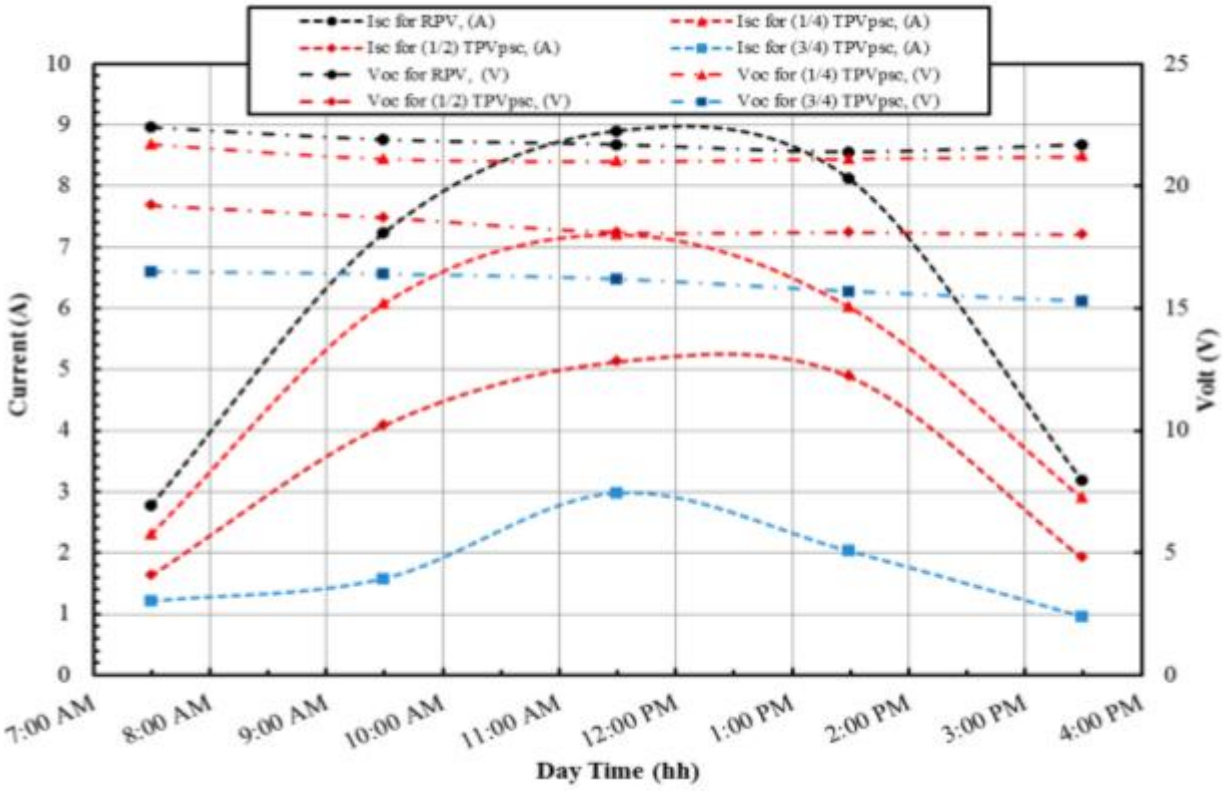


Figure . Impact of PSC on the panel power output.

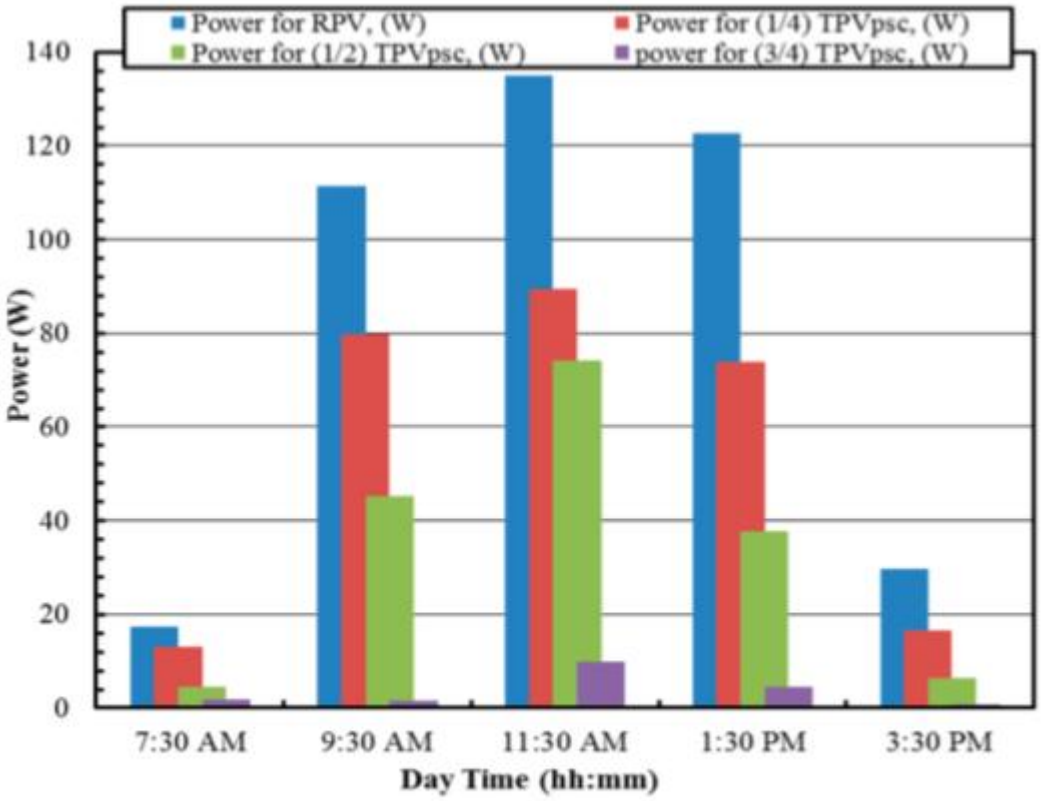
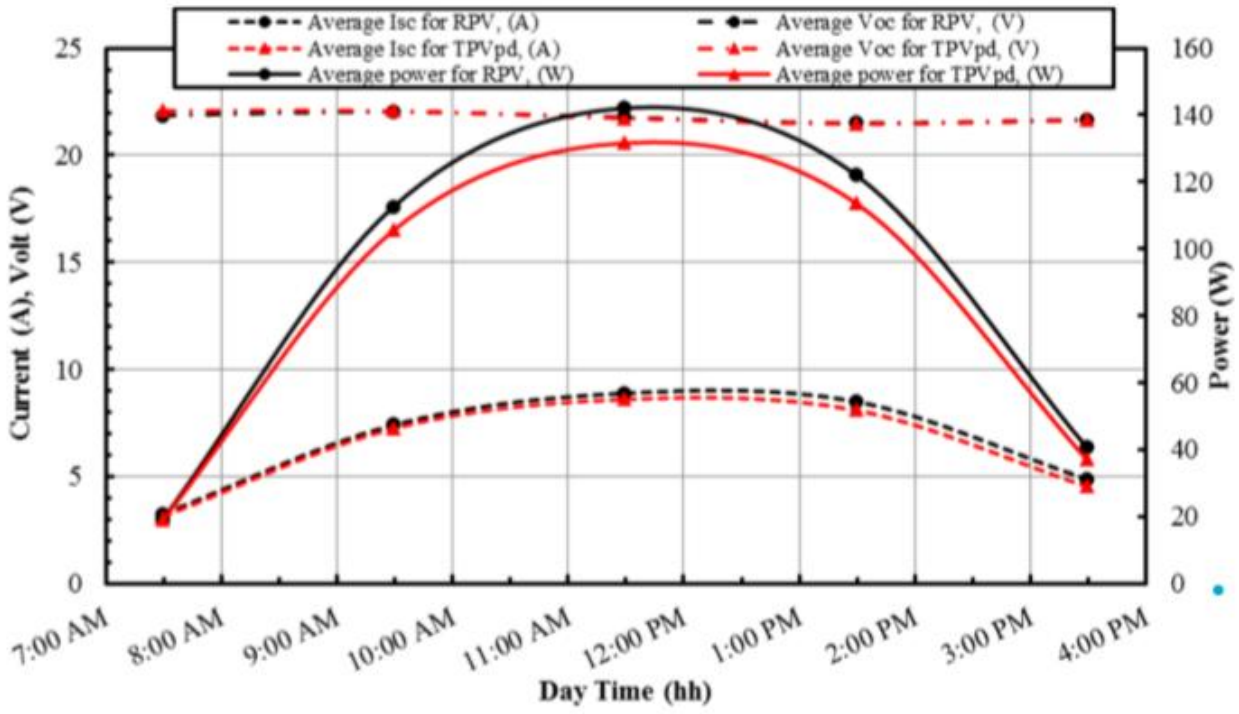


Figure 7. Impact of PSC on the panel power output.

Output power had decreased with the increasing in the shading above the PV panel. quarter, half, and three quarters of shading, the amount of power reduction falls 33.7%, 45.1%, and 92.6%, respectively. A reduction in the power output becomes 30%, for 50% shading of surface area, which was only for one cell.which stated that by shading a very little on the pv channel the output power will be low and effected..

3.4. Birds Droppings Dirt

Like as polluted rain or birds dropping form the sky also result in decreasing the output power and efficiency of solar panels by reducing the transmittance of glass. So losses ranged 25–30% had to occur .for this reason over poor engineers also investigate on it and obtained the result that is form of 'shading,' which affected and cuts the sun rays to reached the pv channel. decreasing the power output 11:30 , 7.4%. which shows the reduction efficiency of PV modules. But which is small affection on pv channel.



4 Conclusions or improving or tecniques

solar cells should clean regularly in accordance of the weather conditions of its applied geographical locale minimum in a week.

the PV channel should must be placed and installed in locations suitable for it for max. efficiency and to avoiding shading for the pv channel.

while increasing the PV voltage or output in hot sunny days using of water as a coolant. surfaces can be an effective cooling process for such surfaces, and by help of which generation of more energy.

Install Your Photovoltaic Panels correctly orientation, as well as the angle it tilts at, should be right. would ensured panels receive optimal sunlight all through the day, as well as all through the year. orientation solar panels should be more to face the true south if you live in the northern area hemisphere. should be facing the north if you are in the southern hemisphere. The panels glass should

be tilted in such a way that they receive sunshine directly without any cutting or disturbance from 9 a.m. to 3 p.m.

Solar concentration

light concentrated with the help of a solar concentrator. It will help these concentrators ot concentrate the light on the glass surface and generate more electricity in cloudy areas.

Tracker

Tracking of solar glass to sunlight will sense the sun and changes its facing and will energized sun rays to generate electricity when the sun is moving the glass will also move towards the sun.

Question 3

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.

Answer

PEM(polymer electrolyte membrane)

Electrolyte

Perfluoru sulfonic acid

Temperature

50 to 100C

122 to 212F

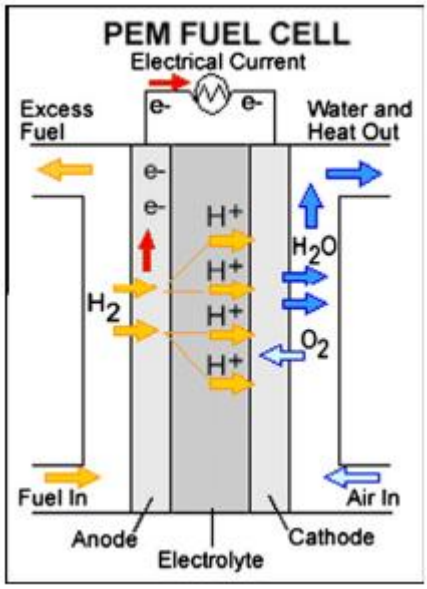
TYPICALLY 80C

Capacity

Less than1KW TO 100KW

Efficiency

60% transportation and 35% stationary

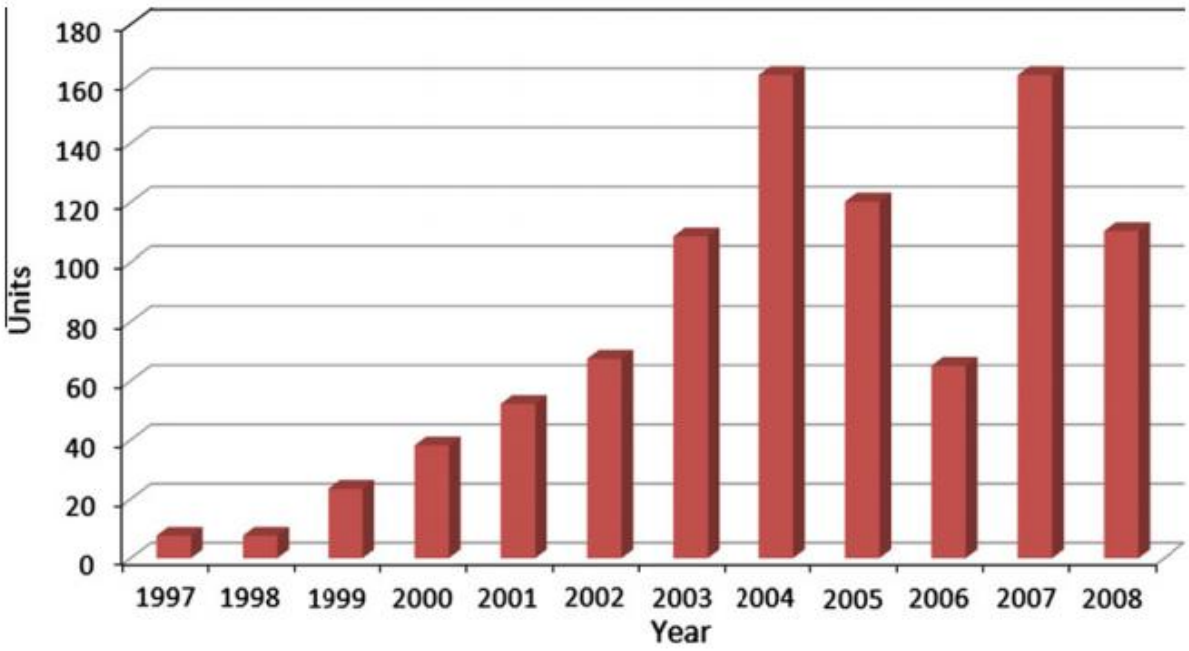


<u>Application and uses</u>

Transportation applications

Light-weight vehicles

Buses



Automobiles graphs

<u>Advantages</u>

Robust

Having rapid load capability or fast starting

Reduction of solid electrolyte

Having fabrication cost is low

High density of power

Has low temperature

Disadvantages

Catalyst are of high prices

Manufacturing cost is also high

Heavy auxiliary equipment

Complex heat and water management

Needed hydrogen (pure)

Impurities

Application

Transportation

Stationary

Portable purposes

generation

Alkaline (AFC)

Electrolyte

Aqueous solution of potassium hydroxide soaked in a matrix

Temperature

90 to 100C

194 to 212F

Capacity

10 TO 100KW

Efficiency

60%

Advantages

Making of electrolyte is not precious metal

Simple designing

High performance

Power density is good

Low temperature operational

Mobile electrolyte cooled easily by circulating of hydrogen

Cathode is less than acid electrolyte fuel cell(activation of voltage)

Disadvantages

Making of electrode is expensive

Installation should be in co2 free

Diaphragm is hazardous to death

Application

Experimental purposes for powering

These cells provides drinking water

Space shuttle purposes

My id is 15045

So my load will 045kw load

In my opinion the PEM fuel cell will be much better than AFC due stationary purposes because it will located a fixed location and as the name implies it will generate power to homes, offices, schools, universities etc , transportation purposes and it will be more cheaper than stationary purposes by providing it to buses cars as a fuel ,low temperature and the best one is quick start up, back up of power, portable power which will enable the consumers to talk ofr a month on cell phones ,laptops etc.

As the technology modular will easily permits units to be added together, distributed power units will be the power that can be used to power hotels, hospitals, or industrial establishments will be required 100s kws of power. And the larger consumers of unit will get the power by stationary fuel cell by

generation 50mw to 200mws of power.

Proton Exchange Membrane	Solid polymer, proton-conducting electrolyte	50–90	Transportation, stationary, portable power	Out of 1,900 small stationary fuel cells deployed as of 2003, 75% are PEM. Plug Power has installed over 100 PEM stationary fuel cells for demonstration. Ballard has produced PEM fuel cells for cars and trucks over the last decade.
Direct Methanol	Solid polymer, proton-conducting electrolyte	40–100	Portable power, transportation, stationary	Of the 3,500 portable fuel cells deployed so far, about 45% are fueled with methanol.

While AFC having higher temperature as a big drawback ,it also required pure oxygen and pure hydrogen that is why it is only used for stationary purposes not for transportation.