UNIVERSITY OF ENGINEERING AND TECHNOLOGY, LAHORE.

Solar System

Project Name	**Installation of PV System**
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SOLAR POWER SYSTEM

A solar power system also known as photovoltaic system is a technology that convert heat energy into the electrical energy. Solar power is considered a renewable and sustainable source of energy because it relies on the continuous and abundant sunlight. Photovoltaic system (PV system) converts sunlight directly into electrical energy using Solar cells.

- Solar panels consist of multiple PV cells connected in a specific arrangement to achieve the desired voltage and power output.
- The generated electricity is fed into the local power grid, and the owner may receive credits or compensation for the extra electricity produced.
- Off-grid PV systems are standalone systems that store excess energy in batteries for use when the sun is not shining.

IMPORTANCE OF SOLAR SYSTEM

The importance of solar system are:

1. **Renewable and Sustainable:**
    - Solar energy is a renewable and sustainable resource means that it will inexhaustible as long the sun exists.
2. **Energy Independence:**
    - Solar energy provides an energy source, reduces dependence on power plants or fossil fuels.
3. **Lower Electricity Bills:**
    - Solar panels can significantly reduce or eliminate electricity bills for homeowners or businesses. Once installed, solar system can generate free electricity for decades.
4. **Low Environmental Impact:**
    - Solar power systems have a minimal environmental impact compared to many other forms of energy generations.
5. **Long-Term Cost Stability:**
    - Solar power systems offer the advantage of stable energy costs over the long term.
6. **Global Impact on Energy Transition:**
    - The adoption of solar energy contributes to global shift towards cleaner and more sustainable energy.

GOALS OF INSTALLING PV SYSTEM

The goals of installing a photovoltaic (PV) system are:

1. **Renewable Energy Generation:**
    - Generate renewable energy from the sunlight to reduce the usage of non-renewable energy resources such as fossil fuels.
2. **Environmental Sustainability:**
    - Contribute to environmental sustainability by reducing the greenhouse gas emissions.
3. **Cost Reduction:**
    - Lowers the electricity bills by generating the solar power electricity.
4. **Financial Returns:**
    - Attain financial returns through long-term savings on electricity bills and, in some cases, by selling excess energy back to the grid.
5. **Energy Efficiency:**
    - Complement the PV system installation with energy-efficient practices and technologies to maximize overall energy conservation.

STEPS TO INSTALL PV SYSTEM

Location Selection:

Selecting a good location for a photovoltaic (PV) system is a critical step in ensuring its efficiency and overall effectiveness. The chosen location should receive good sunlight throughout the year to maximize energy production. Measures the amount of solar energy available in a particular area, and selecting a location with high radiation of sun.

We have to identify any potential obstructions, such as tall buildings or trees, which may cast shadows and diminish the system's performance. The orientation of the PV panels, preferably facing south in the northern hemisphere (or north in the southern hemisphere), ensures that panels receive maximum sunlight exposure.

By carefully considering these factors, the selection of an appropriate location contributes significantly to the long-term success and efficiency of a PV system.

Energy Calculation:

We have to firstly gather the history of the usage of electricity throughout the year and take the average of the electricity usage in one month.

Energy consumption (Average) = Total usage / 12

Then we have to calculate that how much energy will be produced by one panel in a day by multiplying the panel production per hours and the sunlight hours in one day this formula:

Energy produces by 1 panel per day=Panel production * Sunlight Hours in 1 day

Energy produces by panel in 1 month= Energy in 1 day * 30

Now by using the average of one year of consumption we have to calculate that how much solar panels should be used to fulfil the energy consumption of a month by using this formula:

Number of Solar panels=Energy consumption / Energy produces by 1 panel

TOTAL ENERGY COMSUMPTION OF OUR HOUSE

APPLIANCES	RATING (WATT)	QUANTITY (NO)	OPERATIONAL (DAYS)	TIME (HOURS)	ELECTRICITY CONSUMED (KWH)
LED BULB	10	16	30	6	28.8
LED TUBELIGHT	18	4	30	4	8.64
CEILING FAN	80	5	30	12	144
EXHAUST FAN	60	2	30	1	3.6
REFRIGERATORS	90	1	30	24	64.8
1.5 TON AC	1200	1	30	5	180
COMPUTER	200	1	30	4	24
LAPTOP	40	1	30	8	10
ELECTRIC IRON	1000	1	30	1	30
WATER DISPENSOR	100	1	30	2	6
WASHING MACHINE	900	2	30	1	54
ELECTRIC GEYSER	1000	1	30	2	60
MICROWAVE OVEN	1200	1	30	1	36
GRINDER/ JUICER	400	1	30	1	12
HEATER	1500	1	30	2	90
PUMP MOTOR	750	1	30	2	45
TOTAL	-	-	-	-	796.84

TOTAL ELECTRICITY CONSUMPTION = 796.84 KWH

ELECTRICITY BILL

COST OF UNITS:

SLAB	UNIT CONSUMED (KWH)	UNIT PRICE RS/KWH
1	1-100	13.48
2	101-200	18.95
3	201-300	22.14
4	301-400	25.53
5	401-500	27.74
6	501-600	29.16
7	601-700	30.30
8	Above 700 Units	35.22

Total Electricity Consumed = 796.84

As electricity consumed by our house is 796.84 units which is approximately equal to 800 units so according to the above table the price of our unit will be equal to 35.22 so we will multiply our units by 35.22

Price of units = 796.84 * 35.22

=28,064.7 Rs

Now we have to include 17% GST in our bill:

GST Amount = (Original Cost*GST Rate Percentage) / 100

So:

GST Amount = (28,064.7 * 17) / 100

=4770.99

Now add this GST Amount into the Original cost to calculate the Net price by this formula:

Net Price = Original Cost + GST Amount

Net Price = 28,064.7 + 4770.99

=32,835.69

The Average bill of our house throughout the year will be equal to 32,835.69 Rs.

So the yearly cost age of the electricity used in our house will be equal to:

Yearly Cost Age = Monthly Average Price * 12

Yearly Cost Age = 32,835.69 * 12

=394,028.28

SOLAR POWER SYSTEM

The Total energy consumption in one month is about 700 KWH so yearly consumption will be equal to:

Yearly Consumption = Monthly Consumption * 12

Yearly Consumption = 700 * 12

= 8400 KWH

So we have to calculate our daily energy consumption in kilowatt-hours (kWh). If you used 8,400 kWh in a year, our daily consumption would be:

Daily Consumption = 8400 KWH / 365

=23 KWH

The average timing of the daily sunlight is about 8 hours. If we receive approximately 8 hours of sunlight per day and we have to calculate our daily energy consumption to be around 23 kWh, we can calculate the size of the solar power system we need.

Daily Energy Consumption = 23 KWH

Average Daily Sunlight Hours = 8 Hours

System Size (kW) = Daily Energy Consumption / Sunlight Hours

System Size = 23 KWH / 8 Hours

=2.875 KW

So a solar power system with a capacity of around 2.875 kW should be sufficient to meet the daily energy needs in a location with 8 hours of sunlight per day.

So a **3 KW Solar System** could potentially meet our energy needs if we have an average daily sunlight of 8 hours. A 3 KW System Size should provide a bit more capacity than the estimated 2.875 KW needed based on our daily consumption of 23 KWH.

3 KW SOLAR SYSTEM

As we have calculated that 3 KW solar system will meet our consumption of electricity throughout out the year but some energy will also be extra which will be stored in the batteries and this energy will be later used when there is no sunlight or a rainy day. There are many components of solar power system:

1. **Solar Panels**
    - PV solar panel is the component that convert sunlight into electricity.
2. **Solar inverter**
    - Inverter converts the direct current (DC) electricity generated by solar panels into alternating current (AC) electricity.
3. **Solar Charge Controller**
    - A Solar Charge Controller manages the charging and discharging the battery.
4. **Battery Charge System**
    - Batteries store excessive energy generated by the solar panels for the later use.
5. **Mounting Structure**
    - Mounting structures are used to secure and position the solar panels on the roof or the ground.
6. **Mounting Hardware and Wiring**
    - Various mounting hardware, including bolts, nuts, and wiring, is necessary to connect the solar panels to the inverter.
7. **DC Disconnect Switch**
    - This switch allows us to disconnect the DC power generated by the solar panels.
8. **AC Discount Switch**
    - Similar to the DC disconnect switch, this switch allows us to disconnect the AC power generated by the inverter. It is safety feature for maintenance and emergencies.
9. **Monitoring system**
    - Monitoring system allows us to track the performance of their solar system, Monitor energy production, and identify any issues.
10. **Balance of system (BOS) Components:**
    - Small components, such as junction boxes, wiring and connectors.

EXPENDITURE OF 3KW SOLAR SYSTEM

Expenditure of the 3 KW Hybrid Solar System according the company named **SMART SOLAR** is following:

SR.	ITEM	DETAIL	UNIT PRICE	QUANTITY	TOTAL
1	Solar Panels	Phono Solar 550W Mono PERC Half Cut Tier 1	41,250	6	247,500
2	Inverter	3 KW MPPT Solar Inverter 24V	220,000	1	220,000
3	Battery	Tubular Battery Lead-acid TX-1800	67,750	2	135,500
4	Mounting Structure	Galvanized Iron Stand PV 2mm 14 Gauge	7,500	3	22,500
5	Flexible DC Wire	6 MM Flexible DC Cable	30,000	1	30,000
6	Miscellaneous	Circuit Breakers, Changeover Switches, Wires, PVC Pipes & other supporting item including	40,000	1	40,000
7	Installation	Complete Installation	25,000	1	25,000
8	Civil Work	Concrete Block	3,000	1	30,000
9	Transportation	Transportation	7,000	1	7,000
				Total	736,500

Total Price for all the expenses for 3 KW = 736,500

CONCLUSION

The total expenses for yearly electricity is **394,000** and total expenses of the solar power system is equal **736,500**. This cost will be equal to about 2 year of electricity expenses so that if we will install the solar power system in our houses it will surely be benefit for us because our investment of the solar system will be fulfilled after 2 years then after forward electricity will be almost free for us. Then the only expenditure on the electricity for our house will be the maintenance of the solar power system.