Design a Solar energy system for the faculty of Engineering at Zawia

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Abstract :

The Solar energy has wide use these days because it is clean, free, and non-polluting energy, additionally the increase of solar energy technology because of the enormous increase in economic support for solar energy research. From that issue and more enormous use of energy contributed to develop more clean resources to create energy, so renewable energy is the important issue to get a large amount of energy without pollution. However, the leading of renewable energy is solar energy. A solar electric system reduces high-energy costs and keeps your building up and running during power out-ages. The advantages to buying a solar electric system include saving a significant amount on your electric bill. Enjoying reliable, clean, free power for 25 to 30 years. Helping and assist to boost our economy by creating jobs and new solar companies.

In this paper designed a solar energy system for the faculty of Engineering at Zawia.

Key words: Solar energy**,** Photovoltaic (PV), renewable, pollution.

الملخص:

تستخدم الطاقة الشمسية على نطاق واسع هذه الأيام لأنها طاقة نظيفة ومستدامة وغير ملوثة، بالإضافة إلى زيادة تكنولوجيا الطاقة الشمسية في الدعم الاقتصادي لأبحاث الطاقة الشمسية.

من هذه القضية، ساهم الاستخدام الهائل للطاقة في تطوير المزيد من الموارد النظيفة لتوليد الطاقة، وبالتالي فإن الطاقة المتجددة هي الوسيلة الهامة للحصول على كمية كبيرة من الطاقة دون تلوث، وتعتبر الطاقة الشمسية أفضل الطاقات المتجددة. يقلل النظام الكهربائي الشمسي من تكاليف الطاقة العالية، ويحافظ على استقرار النظام خلال فترة انقطاع الكهرباء. وتشمل مزايا شراء نظام الطاقة الشمسية توفير قدر كبير من التعريفة الكهربائية، وتتمتع بموثوقية عالية

ونظيفة وخالية من التلوث البيئي لمدة 25 إلى 30 عامًا. كما تساعد في تعزيز الاقتصاد من خلال توفير فرص العمل في محطات توليد الطاقة الشمسية.

في هذه الورقة تم دراسة وتصميم نظام تغذية بالطاقة الكهربائية لكلية الهندسة بالزاوية وذلك باستخدام الطاقة الشمسية.

Introduction:

Solar energy is a sustainable energy and it is inherently more sustainable than fossil fuel energy sources, as a way of converting the sun's energy into electrical energy, solar panels make use of the single most sustainable resource on the planet - the light of the sun.

Renewable resources such as the sun can provide an alternative energy source to people in remote areas of developing countries, where expanding the traditional electrical grid becomes economically inefficient. Solar panels recognized for capability of turning solar energy into electricity. Solar panels do not produce any local pollution, does not require fuel consumption, possesses size flexibility, simple maintainability since no moving parts, and produces no noise. The cost, dependency on climate variability, and does not provide continuous energythroughout the day [1].

A solar electric system typically madeup of solar panels, an inverter, battery, chargecontroller, wiring, and support structure. The three most common types of solar electricsystems are grid-connected, grid-connected with battery backup, and off-grid (stand-alone).Solar electricity produced by changing sunlight to power using the photovoltaic (PV)effect. The PV effect causes an electrical current to flow through a solar cell when exposed tosunlight. Solar cells power everything from calculators and remote highway signs to homes,commercial buildings, and large power plants. Solar cells power all satellites in space, makingthem responsible for the world's communications products.Most solar electric systems last 30 years and pay for themselves in 4 to 5 years after taxcredits and rebates. That means homeowners can enjoy free electricity for years. If you installbatteries to back up your solar electric system, it will provide emergency power in areas withfrequent storms, hurricanes, and other natural disasters. In addition, going solar adds value toyour home. According to the Appraisal Journal, a solar electric system increases your home'svalue by 20$ for every 1$ in annual utility bill savings, which means a system almost pays foritself with the appraisal value increase in some cases. See the Costs and Financial Incentivessection. Solar power reduces America's dependence on foreign oil and fossil fuels, making ournation more secure while reducing air pollution and greenhouse gases [2].

According to recent studies, one-quarter of the world's population live without electricity.Without electricity, there will be no clean water available, no safe medical care, andunhealthy food supplies. Many people living in developing countries often

use wood,lumps of coal or even dung to heat and cook in their homes, resulting in indoor air pollution that roughly kills around 2 million people a year [2].

Solar energy and sustainable development

In the last twenty years, sustainable development in different ranges of life and work has been in the limelight worldwide. Concerning this, it is essential to appearance at the relationbetween energy and sustainable development. Traditional sources of energy comprise coal, wood, oil and water.

Renewable sources of energy include sun, wind and geothermal energy apart from these, nuclear energy is used worldwide, the use of burnable sourcesof energy (coal, wood, oil) and nuclear energy brings forth contamination and environ-mint pollution. The cleanest source of energy is the sun whose irradiation is free of charge and more or less accessible to the whole Earth [12].

Types of solar electric systems.

A solar electric system is usually made up of solar panels, an inverter, battery, charge controller, wiring, and support structure. The three most common types of solar electric systems are grid-connected, grid-connected with battery backup, and off-grid (stand-alone). Each has distinct applications and components.

On Grid-Connected.

In this system, the solar panels are connected to your local utility electrical grid tocomplement your normal power supply from your utility company. Grid-connected systemsconsist of (Fig -1):

• Solar panels mounted on the roof.

• An inverter to convert electricity produced by the system from direct current (DC) energyinto alternating current (AC) energy.

• A junction box that connects the solar panel wiring to the breaker panel on the home.

• A power meter that displays how much power the facility produces and uses.

• A disconnect switch that, for safety reasons, prevents the system from sending power tothe grid during power outages (this is called islanding) [2].

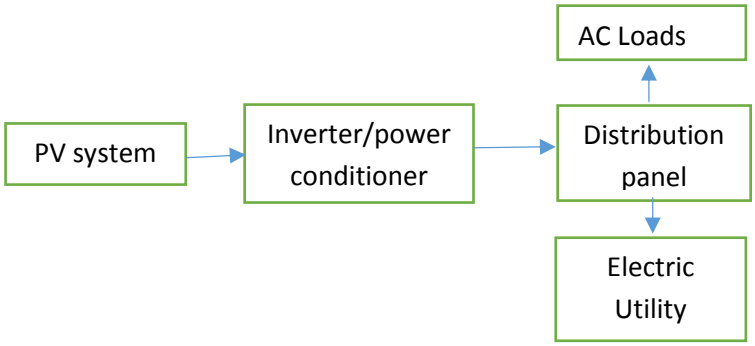

Figure (1): Grid connection system [2].

Grid-Connected with Battery Backup.

Very similar to the on grid-connected system, this system adds a "battery bank" to collect thepower generated from the solar panels. Power stored in the batteries can be used during poweroutages. The battery bank collects power produced by the solar panels, sends it to the breakerbox, and then into the house power system. The components of this type of system consist of[3]:

• Solar panels mounted on the roof.
• An inverter to convert solar electricity from DC energy into AC energy.
• A battery bank for power storage.
• A charge controller to prevent overcharging the battery.
• A junction box that connects the solar panel wiring to the breaker panel on the home.
• A power meter that displays the amount of power used, produced, and stored in thebattery bank.
• A disconnect switch to prevent islanding during power outages.

Off-Grid or Stand-Alone.

Off-grid systems are not tied to any utility power lines and are most common in re-moteareas where connecting to the utility grid is more expensive than purchasing an off-gridsystem. In off-grid systems, the solar electric system represents the institution's main source ofpower. Batteries store unused solar energy for use at night. Generators, small wind systems,and other backup fuel sources are sometimes used as backup power when the solar powerstored in the batteries is not enough to meet household needs. These systems consist of the following [2]:

• Solar panels mounted on the roof.
• An inverter to convert electricity produced by the system from DC into AC energy.
• A rectifier (sometimes used to change AC to DC and back again to get the most use out ofa system).

• A charge controller to prevent overcharging the battery.
• A junction box that connects the solar panel wiring to the breaker panel on the home.
• A junction box for backup power supply from a generator.
• A power meter that displays the amount of power used, produced, and stored in thebattery bank.
• A disconnect switch to prevent islanding during power outages.

Solar electric (photovoltaic or PV).

Systems are made up of modules containing PV cells that generate direct current (DC)electricity when exposed to sunlight. An inverter converts the DC power to the alternatingcurrent (AC) electricity that's necessary to power the home. These PV systems have beentested to rigorous standards by public and private organizations. They have no moving parts,require almost no maintenance, and last for decades. A solar energy system will have nearly thesame output in year 25 as it did on day 1.Today's PV systems come in a range of efficiencies and configurations. PV systems withmodules that are mounted on top of existing roofing are still the most common, but buildingintegrated photovoltaic (BIPV) systems are gaining in popularity. In a BIPV system, themodules do double duty they generate electricity and can replace traditional buildingmaterials such as roof shingles and window awnings. Some example for using PV systems The Kokonoe Solar Power Plant, which is a solar photovoltaic power generation facility designed to take advantage of the abundance of solar radiation in the town of Kokonoe-machi, Kusu-gun, Oita Prefecture. A clean power plant using solar energy, it commenced operation in May 2015.At least 100,000 photovoltaic panels have been installed on a site with an approximate area of 295,000 m², equivalent to 6.3 times the area of Tokyo Dome baseball stadium. The plant generates power equivalent to the annual consumption of nearly 7,000 general households. It is expected to help reduce CO_2 by 14,000 tons per year [4].

Figer 2 Kokonoe Solar Power Plant [4]

Other example of PV systems isSuigoItako Solar Power Plant is a solar photovoltaic power generation facility intended to take advantage of the abundance of solar radiation in the city of Itako in Ibaraki Prefecture. As a clean power plant using solar energy, it commenced operation in February 2014.At least 60,000 photovoltaic panels have been installed on a site with an approximate area of 180,000 m², equivalent to 3.8 times the area of Tokyo Dome baseball stadium. The plant generates power sufficient to meet the annual needs of nearly4,000 general households. It is expected to help reduce CO_2 by 5,500 tons per year.[5]

Finger 3: SuigoItako Solar Power Plant [5]

How A PV System works.

Solar electric systems, also known as PV systems, convert sunlight into electricity. Becausethey are made up of individual modules, PV systems can be designed to meet most electricalrequirements, both large and small. The size of a residential PV system is expressed in terms ofkilowatts (kW) of power, and the electricity produced by a PV system is expressed in kilowatt-hours (kWh) of energy. Systems are said to be “grid-connected” when they remain plugged intothe local utility (Fig: 4). Grid-connected PV systems may have a battery back-up system,but most do not. Battery backupis typically used for off-grid systems and provides power atnight when the sun is not shining. Grid-connected systems rely on their utility to provide powerat night. The diagram on the right illustrates a basic PV system installation. Maintenancerequirements for PV systems are minimal they may require occasional cleaning for optimalperformance, and often require a new inverter after 10-15 years. The best way to ensure a PVsystem is working well is to install a monitoring device

that tracks the electricity output of thesystem. Numerous online system-monitoring tools are available, and some are included in thecost of the installation.

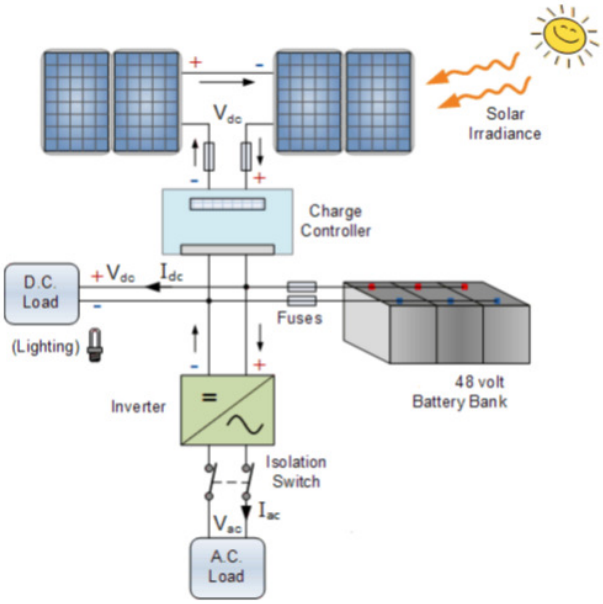

Figure (4): The connection of PV system [6].

Solar energy is the most potential of all renewable energy resources.

One great advantage of solar energy is that it is ubiquitous and it is available for use in any time, when compared with other sources, solar energy has created ubiquitously so it has used widely these days in most countries as clean energy, also it contributes to supply enormous energy to reduce use of non-renewable energy resources. However, the growing of population and devices which need to use energy also, the majority of this energy is coming from non-renewable sources that effect to use solar energy as a alternative to reduce the use of non-renewable energy [7].

Solar energy it has extensively available product with enormous capacity which to this point with the exception of biological products has been sparingly harvested. Furthermore, solar energy probable will be increasing to use of the energy market. However, efficiently using solar energy should be presented many uses such as, mainly for electrical creation and hot water which is the solar collectors use for heating purposes have been the main method of harnessing distributed solar energy additionally PV technology is progressing. In order to give such technology a substantial portion of the market, vast government subsidization is required [8], [9]. The method for consumption of solar energy, connected to solar-chemical creation and

solar-hydrogen creation. Though, fuel improvement is not a new technology, in fact, the majority of hydrogen created commercially is generated through the procedure known as steam-methane reforming while, improvement procedure are energy consuming, they create higher grade produce in conditions of heating value [8]. If energy is supplied to such a procedure by renewable resources, this will be a method of fuel improvement, addition a clean efficiency proportion to any system which using the improved fuel qualified to the efficiency of the original fuel. Also should be use this energy for restricted fuel improvement, the conventional fuel such as, natural gas or propane, in addition to an unconventional fuel such as the renewable resource of solar energy [8]. However, it is clear that fossil fuels will continue to make a significant function in the energy market. If this technique of improvement were to become accepted and available, efficiency developments might be recognized. In current times, the developments of efficiency in conventional devices transpire in relatively small increases as technology progresses. In addition, the cost of the majority new systems community indecision to makes it very difficult to bring new thoughts into reality. Moreover, using renewable energy to assist fuel improvement should be inserting a considerable amount of energy to the fuel. Considerable decreases in energy utilization could be realizing during improvement older applications or systems from times where energy utilization was not a major focus [8], [10].

Why need to supply the faculty from PV systems

Power outages

The General Electricity Company of Libya (GECOL) said the power cuts are necessary to preserve the general network and save it from collapse and thus save the country's major cities from total blackouts.Since 2014, Libya has been in a state of lack of public services such as water, electricity, fuel and cooking gas, due to the ongoing military escalation and the split in government institutions[11].

Sources of generation in the region

The power generation, transmission and distribution networks of a region define the development of the region. Electricity has become an essential commodity for the functioning of industries and the society alike. Huge investments are made in the development of power generation, transmission, and distribution networks worldwide. Power generation uses a variety of sources ranging from fossil fuels like coal and oil, to renewable sources like wind and solar. The energy mix for electricity generation is dominated by fossil fuels like coal, oil and natural gas, with the three constituting almost over 65 percent of the global energy mix. However, a gradual shift towards

renewable energy the world over and this is seen as a growing threat to the conventional power generation industry.

Renewables are also being promoted by international agreements like the Paris Climate Change Agreement. They are seen the world over as the future of the power industry, however conventional sources will be the major source of power in the world, during the study period. A gradual transition can be expected in the long run in the power generation mix, to incorporate more of renewables. Another major factor that is holding back development in the power market is the huge investment that is required for setting up or modernizing a power generation, transmission, or distribution network, the power market will show growth, thanks mainly to the power shortage that the world is facing. The global population is growing, and in addition to this, rapid urbanization can be observed leading to improved living standards the world over. Transmission and distribution losses is another major issue that is eating into the revenues of the power industry. An increase in investment in technologies like smart grid, which help improve the efficiency of the present day power generation, transmission, and distribution systems; in addition, improving the control over power networks is seen as a solution to this problem. Libya is expected to develop its power transmission and distribution network during this forecasted time period, in order to cope up with the growing power demand.Libya power market report provides a division of the power generation sector based on the type of fuel used into - thermal, gas, nuclear and renewables, among others. Libya power transmission and distribution networks have also been analyzed in the report. The key company analysis section is aimed at analyzing the companies involved in the power generation, transmission, and distribution sectors. In addition to this, an analysis of key upcoming and pipeline projects in each of these segments has also been conducted [11].

Calculation of PV systems for the faculty of Engineering at Zawia

The full load of the faculty include all facilities, which are main building, study building, coffee, laboratories, and library. The full load that we need covered is One MW/h.

By this calculation we use the on grid connected, which we do not use the battery because it make the system is more expensive.

Solar PV

The solar cell which we need to supply 1 MW/h are

Solar cell has 315 watt so the number of solar cells will be 3000 cells

Name	Description	Unit price	Quantity	Amount(USD)
CNCB315W 315W Mono solar panel	Voltage:37V Size:1640*992*40mm Gross weight:18kg A grade solar cell Warranty:25 years	$78.50	3000	$235,500.00
80KW Grid Tied Inverter THREE MPPT WIFI,DC switch	Out Voltage:380V 50Hz Dimension:860*600*300mm Net weight:83.5kg Warranty:5 years	$3,650.00	12	$43,800.00
PV Cable	4mm2 Solar cable Temperature rating:120C Voltage rating:1KV	$0.55	5000	$2,750.00
MC4 Connector	Rated current:30A Rated power:1000VDC	$0.40	360	$144.00
Rooftop solar mounting With ground screw 2*18	Install Site: Pitched roof Max wind speed: up to 30m/s Snow Load: up to 1.4KN/m2 Material: Anodized aluminum alloy & Staginess steel Warranty:5 years	$1,296.00	85	$110,160.00

The area which to need to insulate the PV systems are 5000 m^2.

Location Data		
Elements	Value	Measuring unit
Annual Solar Radiation	3077	KWh/m^2
Latitude	32.76855	North
Longitude	12.72679	East
Production of solar panels with best angle of installation throughout the year: 28		

Conclusion

The increase in the price of electricity is make the solar energy more importance in domestic uses. Because the solar energy is lower power costs, especially in households and during a power outage، the advantages of getting a solar energy system are provide clean and continuous energy for a period of 25 to 30 years and the cost of maintenance of the solar systems is low. The solar electric system consists of photovoltaic panels, reflector, battery, charging ruler, connecting wires, and metal chassis the three main types of solar systems areconnecting to the network without batteries, connecting to the network with storage batteries and a separate system (often used in remote areas).Global warming is a serious issue and can destroy our entire plant, the major cause of this problem is CO_2 emissions that produced from combustion processes which used by electrical thermal plants to produce electricity and so the usage of renewable resources for electrical energy is becoming a must impotently. The use of solar energy is become more widely because it is the most sustainable issue in the renewable energy that used today.

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