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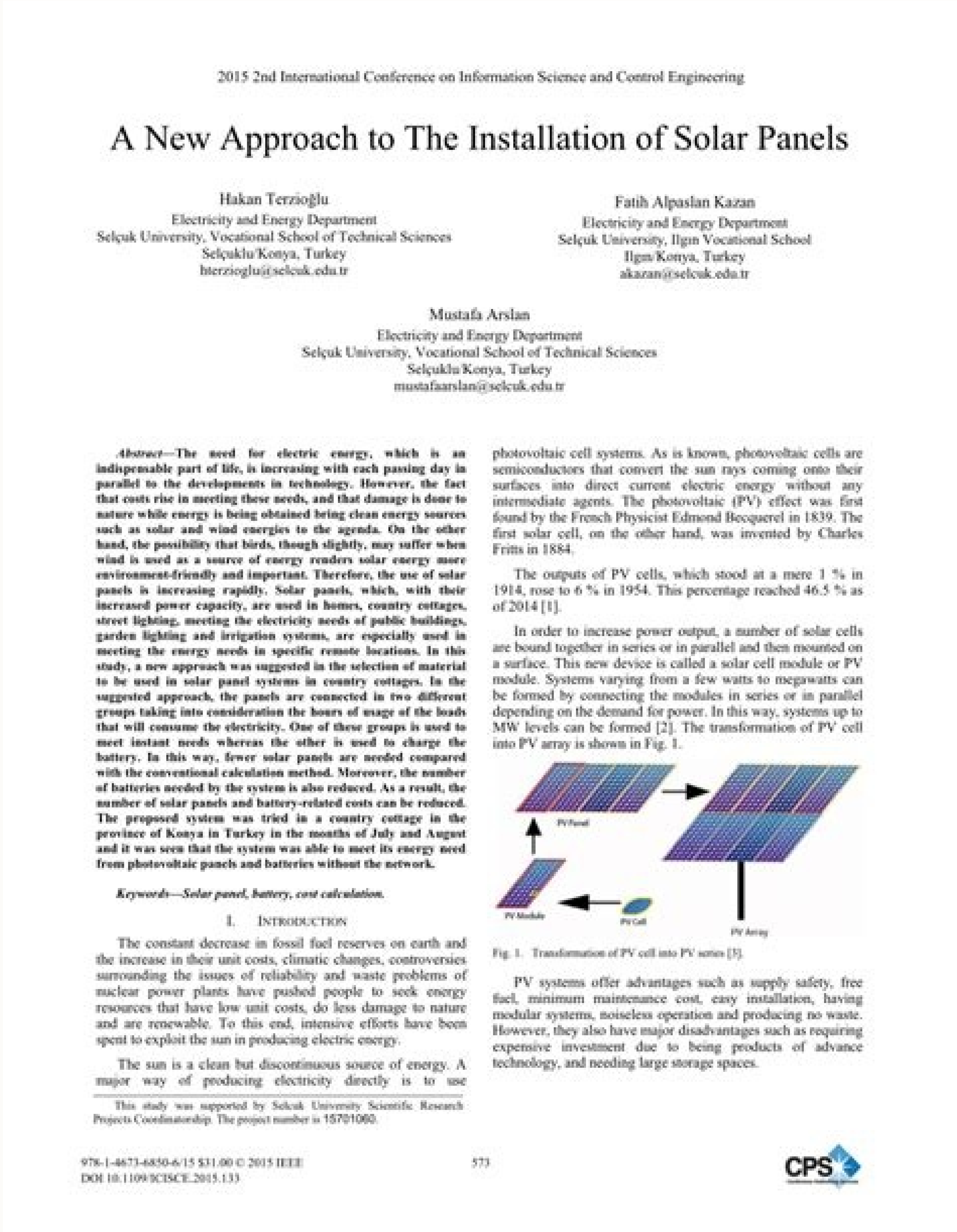

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A New Approach to The Installation of Solar Panels

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***Abstract*—The need for electric energy, which is an indispensable part of life, is increasing with each passing day in parallel to the developments in technology. However, the fact that costs rise in meeting these needs, and that damage is done to nature while energy is being obtained bring clean energy sources such as solar and wind energies to the agenda. On the other hand, the possibility that birds, though slightly, may suffer when wind is used as a source of energy renders solar energy more environment-friendly and important. Therefore, the use of solar panels is increasing rapidly. Solar panels, which, with their increased power capacity, are used in homes, country cottages, street lighting, meeting the electricity needs of public buildings, garden lighting and irrigation systems, are especially used in meeting the energy needs in specific remote locations. In this study, a new approach was suggested in the selection of material to be used in solar panel systems in country cottages. In the suggested approach, the panels are connected in two different groups taking into consideration the hours of usage of the loads that will consume the electricity. One of these groups is used to meet instant needs whereas the other is used to charge the battery. In this way, fewer solar panels are needed compared with the conventional calculation method. Moreover, the number of batteries needed by the system is also reduced. As a result, the number of solar panels and battery-related costs can be reduced. The proposed system was tried in a country cottage in the province of Konya in Turkey in the months of July and August and it was seen that the system was able to meet its energy need from photovoltaic panels and batteries without the network.**

Keywords*—*Solar panel, battery, cost calculation.

I. Introduction

The constant decrease in fossil fuel reserves on earth and the increase in their unit costs, climatic changes, controversies surrounding the issues of reliability and waste problems of nuclear power plants have pushed people to seek energy resources that have low unit costs, do less damage to nature and are renewable. To this end, intensive efforts have been spent to exploit the sun in producing electric energy.

The sun is a clean but discontinuous source of energy. A major way of producing electricity directly is to use photovoltaic cell systems. As is known, photovoltaic cells are semiconductors that convert the sun rays coming onto their surfaces into direct current electric energy without any intermediate agents. The photovoltaic (PV) effect was first found by the French Physicist Edmond Becquerel in 1839. The first solar cell, on the other hand, was invented by Charles Fritts in 1884.

The outputs of PV cells, which stood at a mere 1 % in 1914, rose to 6 % in 1954. This percentage reached 46.5 % as of 2014 [1].

In order to increase power output, a number of solar cells are bound together in series or in parallel and then mounted on a surface. This new device is called a solar cell module or PV module. Systems varying from a few watts to megawatts can be formed by connecting the modules in series or in parallel depending on the demand for power. In this way, systems up to MW levels can be formed [2]. The transformation of PV cell into PV array is shown in Fig. 1.

Fig. 1. Transformation of PV cell into PV series [3].

PV systems offer advantages such as supply safety, free fuel, minimum maintenance cost, easy installation, having modular systems, noiseless operation and producing no waste. However, they also have major disadvantages such as requiring expensive investment due to being products of advance technology, and needing large storage spaces.

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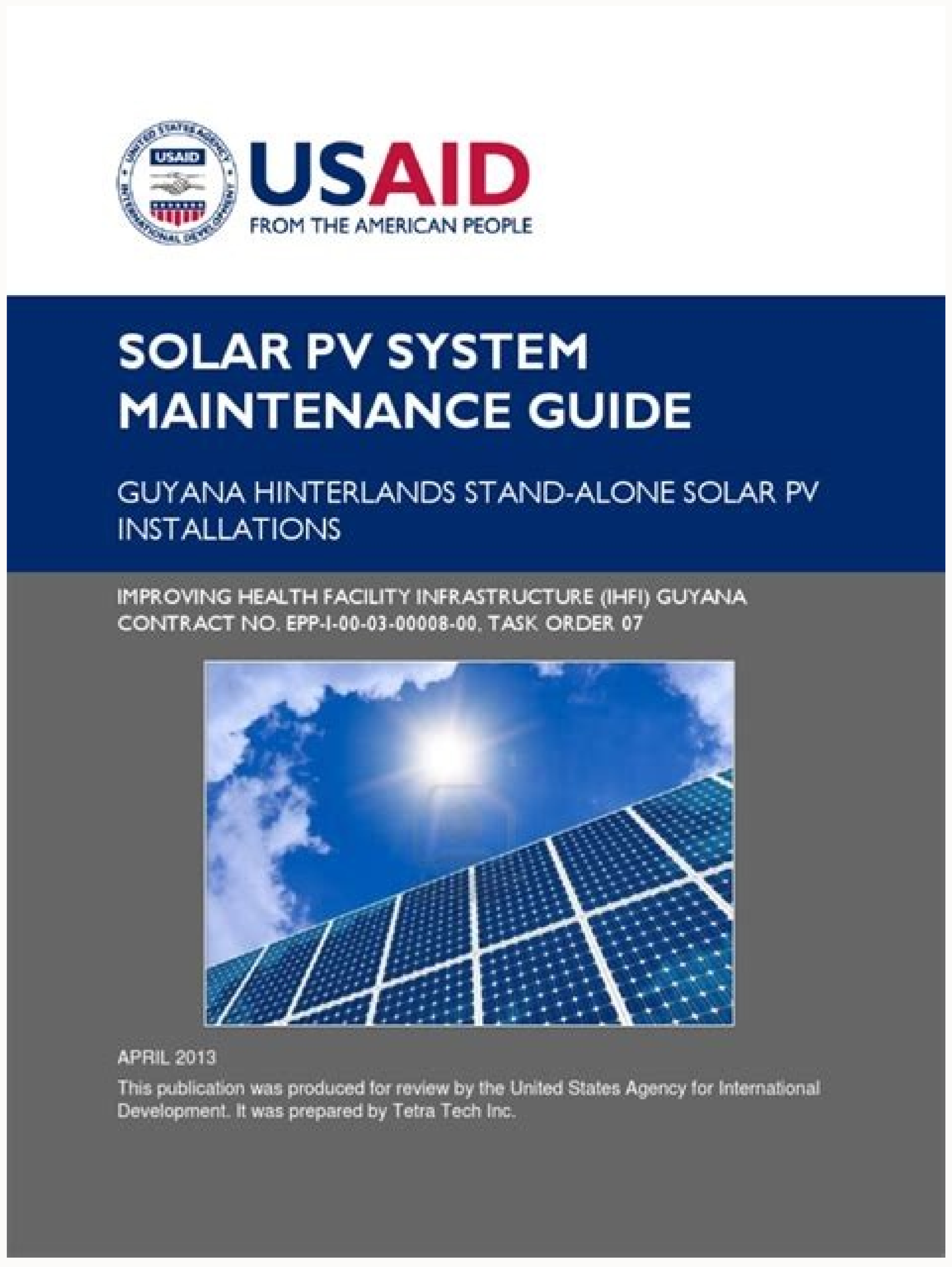

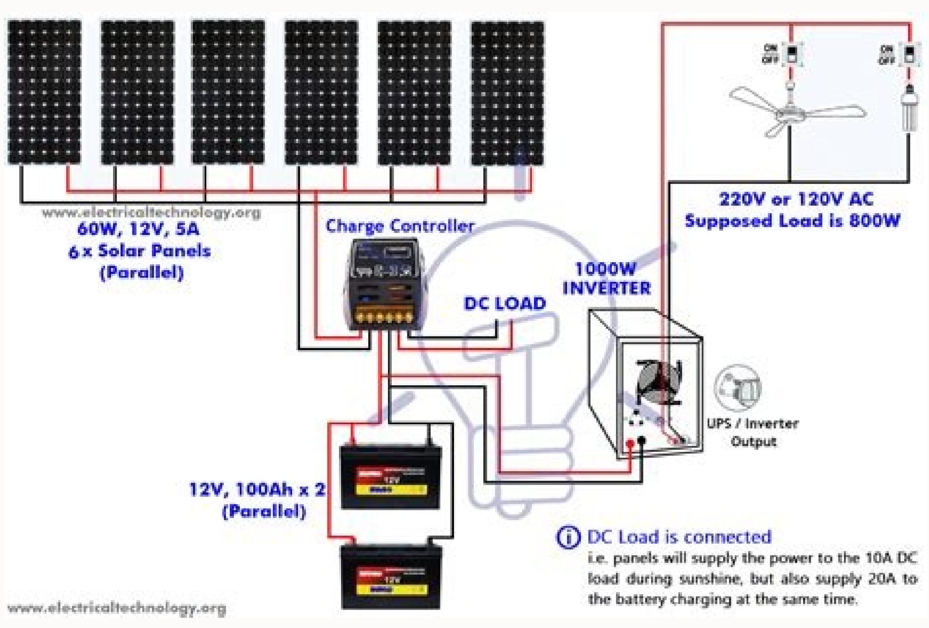

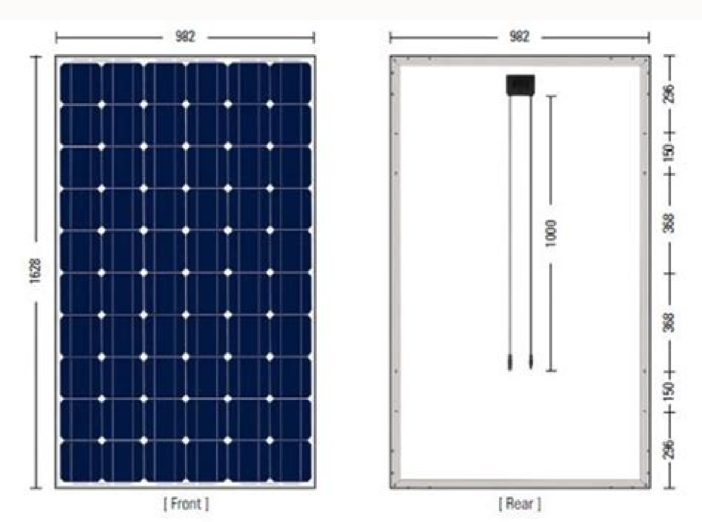

Solar panels design ideas. Solar panel how to build. How to design solar panels. How to design solar panel structure. Solar design standards.

The sun is identical to a big burning ball having an operative blackbody temperature of 5777 K. More interesting the central interior region is valued at 8×106 to 40×106 K with a density of more than 100 times of water emitting a lot of energy for our needs. Remarkably, Photovoltaic panels were designed to fulfill the energy demands for space activities, but they have become the most favorable energy conversion devices as the installed worldwide capacity had been reached up to 632.4 gigawatts in 2019. This popularity is backed by their exceptional properties and efforts in their proper designing to avail the maximum profit. Anyone can estimate the stand-alone, grid-tied, and hybrid solar systems for his use from a few KW to MW by following the formulae given in this blog. In the event that you have an inquiry as a top priority about the top sustainable power sources, at that point, you must look this article. What Are the Top FIve Renewable Energy Sources and Leading Countries, Relatively? PV panels, Inverter, Charge Controller, Battery Bank are core components of any solar energy system. One just has to put the required values in the formulae to calculate the all components capacity therefore designing of solar systems is not a hectic and big deal to do. There are following the simple steps to estimate the solar system capacity and other designing aspects. 1. Load calculation First of all, you should compute your day by day loads to be handle by the solar system. For that reason, there are two strategiesI. Calculate the daily average units (energy use) by using the electric bill (average units) II. Secondly, the LE can be calculated by using the following equation. Le = The total electric load in KWh per day ti = The time of operation of ith appliance per day rated power of the ith item Fig: Calculation of energy usage per day2. PV Panels Calculation At the point when you are finished with load calculations, you need to assess the PV panels maximum capacity (PVMax).Here, PVMax = Peak power of PV array (KWp)LE = Electric load (kWh/d)IP = Peak solar intensity (1 KW/m2 for all over the world) HAvg = Average available radiation in kWh/m2/dCheck HAvg for your location as it differs for different locations. 2A. How to calculate the number of PV panels?The number of PV panels will be according to the available power capacity per panel in the market and very interesting to know the Trina Solar has introduced the Panels up to 600W. The number of PV panels can be easily calculated by the following formula. Here, Pm = Rated power of the selected panel PVN = Number of the PV Panels2B. How to select the type of PV panel?There are two main types of PV panels monocrystalline and polycrystalline. Monocrystalline (23%) are comparatively more efficient than polycrystalline (18%) but they are more sensitive to temperature (lose their efficiency at the rate of 0.5%/C0 above than 25 C0) therefore not suitable for high-temperature sites. Be that as it may, you don't need to stress over in light of the fact that you can pick the mix of the two kinds to benefit both high productivity and temperature obstruction, accessible in the market nowadays.3. Charge Controller If you are designing a hybrid solar system, then the charge controller is required to control the charging and discharging of the batteries as it prevents the overcharging of the batteries by detaching them from the solar system when completely energized. Mostly the charge controllers are rated in terms of current (A) value which can be easily calculated by the following equation It is noteworthy that in modern systems the charge controllers have been eliminated and their function is performed by the invertors. 4. Battery Bank The battery bank is another important component in the designing hybrid solar systems as they are used to store energy to use in the time of sun unavailability. The batteries are quite helpful in the domain of reliability but high cost, limited life cycle, and energy loss in the energy cycle make them unfavorable. Therefore the Grid-Tied systems getting more attention. There are two main types of batteries used in Pakistan one is Led-Acid batteries and Li-Ion batteries. Whatever the type of battery you selected. The capacity of battery of bank can be calculated by following formula. L = Load (W) Cbb = Capacity of the battery bank in AhDd = Depth of discharge infraction VBat = Nominal voltage of the batterya = Number of days for backup (in case of off stand-alone systems) tapp = Minimum back up time in hours of the appliances4A. How to calculate the number of batteries required?In the wake of ascertaining the limit of the battery bank, you need to compute the number of batteries to be associated in the arrangement an equal as indicated by inverter specs.Here,BN = Number of batteriesCbb = capacity of the battery bank (Ah)CB = Capacity of a single battery (Ah) 5. Size Calculation of Invertor The invertor is a device that converts the DC from panels into AC for the load. This device should be able to handle peak load plus surge loads otherwise tripping of invertor is not advisable at any cost. Infect, all recent development in the invertor make the solar systems most acceptable by all corners. The excellent performance of the hybrid system, grid-tied systems, system-related information on the mobile, and successful net metering all are only possible due to the use of artificial intelligence in the invertor. The invertor is usually valued 20-25% more than the maximum solar panels capacity to handle the losses and for safety due to inductive loads and safety factors. The efficiency of the inverter ranges from 90% to 98%. Due to modern electronics, this is the most efficient device in all solar system components. Cinv = 1.2 PVMaxHere Cinv = Capacity of invertor (KW)If the load very inductive and VFDs are not being used, then you should consider the surge factor also in estimating the capacity of the invertor Cinv = 1.2 (PVMax)(Kin)Here,Kin = Surge factor (its value depends upon appliances, but it is taken as 2.5 for average)The number of strings, voltage, and current per string, as well as the input, out-put voltages all, depend upon the invertor specs and it varies from invertor to invertor type. 6. Area Required for PV PanelsDue to lower efficiency, the PV panels required comparatively more area than any other energy source. The minimum area for the PV panels can be estimated by the following equation but note that the area required for their spacing to avoid shading is exempted.Here AT = Minimum total required area for PV panelsAp = Area per panel (dimensions can be seen on the technical list of the panel printed on the backside of the panel) PVN = Total number of PV panels Furthermore, the area can be calculated by the following equation as well 7. Sizing of Electrical CablesThe size of the cables for carrying the required current and voltages is a key factor for efficiency and safety. For the selection of cables, the current rating is more important to consider and by rule, the current is directly proportional to the area of the cable. Click here to find the exact area of the cable according to the current rating (A)What Are the Most Important Softwares Used to Design Solar PV Systems?Undoubtedly, we can design solar energy systems manually, but technological development leads us to more accuracy and easiness. Therefore, there are many softwares that are available to design solar systems in a superior manner. Here is a list of the most famous software for designing and simulation of Grid-Tied, Hybrid, and Stand Alone. You can download and explore them by just clicking on them. 2. PV Sol 3. Sketch Up 4. Solar Pro5. Homer Pro Hope this is will help to design solar systems for your home, industry by yourself. You are most welcome with any sort of question as well as suggestion plz reach me through e-mail (engr.4energy@gmail.com). What is solar PV system? Solar photovoltaic system or Solar power system is one of renewable energy system which uses PV modules to convert sunlight into electricity. The electricity generated can be either stored or used directly, fed back into grid line or combined with one or more other electricity generators or more renewable energy source. Solar PV system is very reliable and clean source of electricity that can suit a wide range of applications such as residence, industry, agriculture, livestock, etc. Major system components Solar PV system includes different components that should be selected according to your system type, site location and applications. The major components for solar PV system are solar charge controller, inverter, battery bank, auxiliary energy sources and loads (appliances). • PV module – converts sunlight into DC electricity. • Solar charge controller – regulates the voltage and current coming from the PV panels going to battery and prevents battery overcharging and prolongs the battery life. • Inverter – converts DC output of PV panels or wind turbine into a clean AC current for AC appliances or fed back into grid line. • Battery – stores energy for supplying to electrical appliances when there is a demand. • Load – is electrical appliances that connected to solar PV system such as lights, radio, TV, computer, refrigerator, etc. • Auxiliary energy sources - is diesel generator or other renewable energy sources. Solar PV system sizing 1. Determine power consumption demands The first step in designing a solar PV system is to find out the total power and energy consumption of all loads that need to be supplied by the solar PV system as follows: 1.1 Calculate total Watt-hours per day for each appliance used. Add the Watt-hours needed for all appliances together to get the total Watt-hours per day which must be delivered to the appliances. 1.2 Calculate total Watt-hours per day needed from the PV modules. Multiply the total appliances Watt-hours per day times 1.3 (the energy lost in the system) to get the total Watt-hours per day which must be provided by the panels. 2. Size the PV modules Different size of PV modules will produce different amount of power. To find out the sizing of PV module, the total peak watt produced needs. The peak watt (Wp) produced depends on size of the PV module and climate of site location. We have to consider "panel generation factor" which is different in each site location. For Thailand, the panel generation factor is 3.43. To determine the sizing of PV modules, calculate as follows: 2.1 Calculate the total Watt-peak rating needed for PV modules Divide the total Watt-hours per day needed from the PV modules (from item 1.2) by 3.43 to get the total Watt-peak rating needed for the PV panels needed to operate the appliances. 2.2 Calculate the number of PV panels for the system Divide the answer obtained in item 2.1 by the rated output Watt-peak of the PV modules available to you. Increase any fractional part of result to the next highest full number and that will be the number of PV modules required. Result of the calculation is the minimum number of PV panels. If more PV modules are installed, the system will perform better and battery life will be improved. If fewer PV modules are used, the system may not work at all during cloudy periods and battery life will be shortened. 3. Inverter sizing An inverter is used in the system where AC power output is needed. The input rating of the inverter should never be lower than the total watt of appliances. The inverter must have the same nominal voltage as your battery. For stand-alone systems, the inverter must be large enough to handle the total amount of Watts you will be using at one time. The inverter size should be 25-30% bigger than total Watts of appliances. In case of appliance type is motor or compressor then inverter size should be minimum 3 times the capacity of those appliances and must be added to the inverter capacity to handle surge current during starting. For grid tie systems or grid connected systems, the input rating of the inverter should be same as PV array rating to allow for safe and efficient operation. 4. Battery sizing The battery type recommended for using in solar PV system is deep cycle battery. Deep cycle battery is specifically designed for to be discharged to low energy level and rapid recharged or cycle charged and discharged day after day for years. The battery should be large enough to store sufficient energy to operate the appliances at night and cloudy days. To find out the size of battery, calculate as follows: 4.1 Calculate total Watt-hours per day used by appliances. 4.2 Divide the total Watt-hours per day used by 0.85 for battery loss. 4.3 Divide the answer obtained in item 4.2 by 0.6 for depth of discharge. 4.4 Divide the answer obtained in item 4.3 by the nominal battery voltage. 4.5 Multiply the answer obtained in item 4.4 with days of autonomy (the number of days that you need the system to operate when there is no power produced by PV panels) to get the required Ampere-hour capacity of deep-cycle battery. Battery Capacity (Ah) = Total Watt-hours per day used by appliances x Days of autonomy (0.85 x 0.6 x nominal battery voltage) 5. Solar charge controller sizing The solar charge controller is typically rated against Amperage and Voltage capacities. Select the solar charge controller to match the voltage of PV array and batteries and then identify which type of solar charge controller is right for your application. Make sure that solar charge controller has enough capacity to handle the current from PV array. For the series charge controller type, the sizing of controller depends on the total PV input current which is delivered to the controller and also depends on PV panel configuration (series or parallel configuration). According to standard practice, the sizing of solar charge controller is to take the short circuit current (Isc) of the PV array, and multiply it by 1.3 Solar charge controller rating = Total short circuit current of PV array x 1.3 Remark: For MPPT charge controller sizing will be different. (See Basics of MPPT Charge Controller) Example: A house has the following electrical appliance usage: One 18 Watt fluorescent lamp with electronic ballast used 4 hours per day. One 60 Watt fan used for 2 hours per day. One 75 Watt refrigerator that runs 24 hours per day with compressor run 12 hours and off 12 hours. The system will be powered by 12 Vdc, 110 Wp PV module. 1. Determine power consumption demands Total appliance use = (18 W x 4 hours) + (60 W x 2 hours) + (75 W x 24 x 0.5 hours) = 1,092 Wh/day Total PV panels energy needed = 1,092 x 1.3 = 1,419.6 Wh/day. 2. Size the PV panel 2.1 Total Wp of PV panel capacity needed = 1,419.6 / 3.4 = 413.9 Wp 2.2 Number of PV panels needed = 413.9 / 110 = 3.76 modules Actual requirement = 4 modules So this system should be powered by at least 4 modules of 110 Wp PV module. 3. Inverter sizing Total Watt of all appliances = 18 + 60 + 75 = 153 W For safety, the inverter should be considered 25-30% bigger size. The inverter size should be about 190 W or greater. 4. Battery sizing Total appliances use = (18 W x 4 hours) + (60 W x 2 hours) + (75 W x 12 hours) Nominal battery voltage = 12 V Days of autonomy = 3 days Battery capacity = [(18 W x 4 hours) + (60 W x 2 hours) + (75 W x 12 hours)] x 3 (0.85 x 0.6 x 12) Total Ampere-hours required 535.29 Ah So the battery should be rated 12 V 600 Ah for 3 day autonomy. 5. Solar charge controller sizing PV module specification Pm = 110 Wp Vm = 16.7 Vdc Im = 6.6 A Voc = 20.7 A Isc = 7.5 A Solar charge controller rating = (4 strings x 7.5 A) x 1.3 = 39 A So the solar charge controller should be rated 40 A at 12 V or greater.

Comprehensive consumer guide for the UK solar market. Get quotes from local solar panel installers at Solar Guide. ☎ 0330 808 1045 Clean Energy Equity Examples – This resource from the Low-Income Solar Policy Guide is a list of clean energy equity examples at the state and city level, which includes equity advisory, ... NABCEP offers board certifications for many professions within the solar industry, including PV design, solar heating installation, PV installation, and ... Learn the steps of the solar panel installation process. These steps ensure homeowners get a safe and reliable installation. ... The Essentials of Passive Solar Home Design ... A Guide to Solar Panel Mounts Solar panel mounts are a common component of almost every solar panel array. Although there are newer solar panel technologies coming out ... Price per watt ($/W) allows for an apples-to-apples comparison of different solar quotes that may vary in total wattage, solar panel brands, etc. Ultimately there are many factors that figure into the price per watt of a solar system, but the average cost is typically as low as $2.75 per watt. 01-06-2022 · Source: Mission Solar Energy Usually, residential rooftop solar panels are approximately 65 inches tall, 40 inches wide, and 2 inches thick. In feet, that would be 5.4 ft. by 3.3 ft.. Commercial solar modules are usually slightly larger in length and width only.. However, with greater technological innovations in recent years, there is no longer a clear cut distinction ... 18-04-2021 · Tilting can significantly increase the power output of a solar panel and therefore needs to be considered at the design stage. If your roof already has a good angle on it, tilting may not be worth the extra expense. ... Complete Solar Panel Installation Guide. Step By Step Guide On Installing Your Solar Panels. Solar Power System. April 18th 2021. 29-11-2020 · Calculate Total Demand Load; Calculate Size of Solar Panel. Select Type of Connection of Solar Panel. Select Rating of Each Solar Panel. Calculate Energy from Solar Panel as per Daily Sun lights. 14-07-2022 · In the previous table, we included each solar panel type's size and the total area covered for a 1 kW solar system. Let's use the most popular solar panel wattage, the 100-watt solar panel from Renogy. Each 100-watt solar panel has the following dimensions: 1044 x 508 x 35 mm (41 x 20 x 1.4 inches) 25-05-2022 · Solar Panels perform at optimum capacity when placed in direct sunlight. When you install your Solar Power system, try to position your photovoltaic panels directly under the noontime sun for maximum efficiency from your photovoltaic unit.. Before Installation, take care of any obstructions to sunlight. Remove all unnecessary obstructions and items such as ...

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