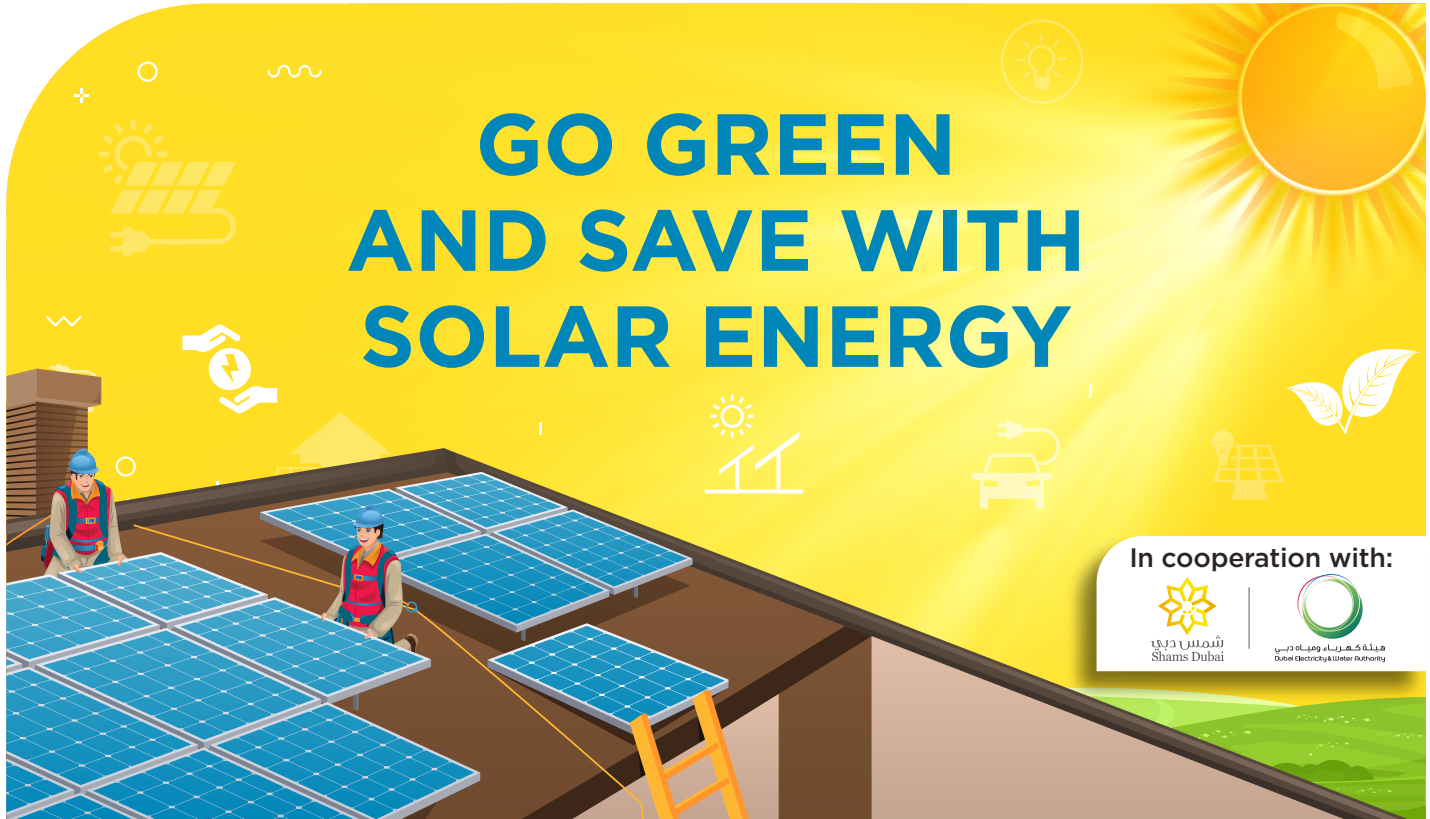


GO GREEN AND SAVE WITH SOLAR ENERGY



In cooperation with:



TABLE OF CONTENTS

| | |
|-----------------------------------|----|
| 1. INTRODUCTION | 5 |
| 2. UNDERSTANDING SOLAR PV SYSTEMS | 7 |
| 3. SHAMS DUBAI | 15 |
| 4. INSTALLING A SOLAR PV SYSTEM | 19 |



WHO IS THIS GUIDEBOOK FOR?

This guidebook can be used by any organisation (government, commercial, industrial) or homeowner seeking to become more sustainable by using solar energy.

The guidebook outlines the general process of planning a solar project. The steps outlined are not intended to replace the need for a professional consultant or contractor enrolled with Dubai Electricity & Water Authority (DEWA), but to facilitate understanding prior to hiring technical experts.

INTRODUCTION

Solar energy is a form of renewable energy that is **clean, secure, and limitless**. It produces no emissions and does not affect the environment.

Using renewable energy **reduces our reliance on depleting traditional sources** of energy, such as gas, oil and coal, ensuring sustainability for future generations.



Renewable energy is a key factor in Dubai's efforts to foster economic and social growth while preserving the environment.

The **Dubai Clean Energy Strategy 2050** aims at **diversifying the energy mix** and promoting the use of clean and renewable energy sources, with **an ambitious target to produce 75% of Dubai's total power output from clean sources by 2050**. The Strategy also focuses on making Dubai a global centre of clean energy and green economy.



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In 2014, **Shams Dubai**, an initiative by **Dubai Electricity and Water Authority (DEWA)**, was launched to support the vision of HH Sheikh Mohammed bin Rashid Al Maktoum, Vice President and Prime Minister of the UAE and Ruler of Dubai **to transform Dubai into the smartest city in the world by enhancing the quality of life in the Emirate and achieving its sustainable development.**

**75% by
2050**

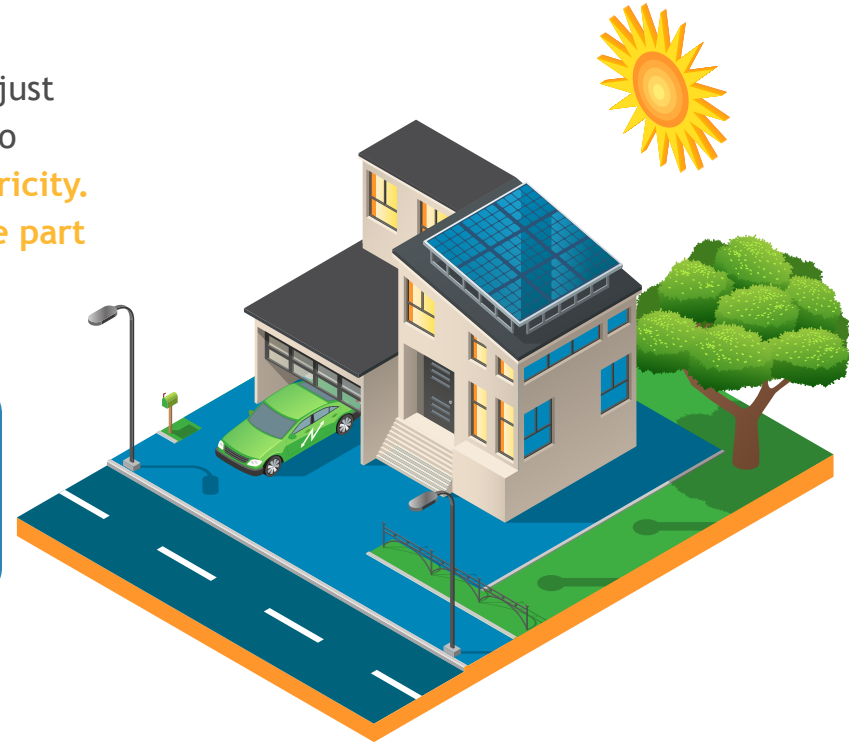


UNDERSTANDING SOLAR PV SYSTEMS

Solar Photovoltaic Energy Systems, referred to as **Solar PV Systems** (or just **PV Systems**) use photovoltaic cells to **convert sunlight directly into electricity**. These systems allow you to **generate part of your electricity needs**.



Solar radiation is what powers Solar PV systems. However not all locations receive the same amount of solar radiation.



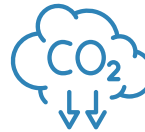
WHAT ARE THE BENEFITS OF USING SOLAR PV SYSTEMS?

Solar power offers benefits to homeowners/businesses, the environment and society as a whole:



Reduces electricity bills

Installing a Solar PV System requires an initial investment, but allows you to reduce your electricity bills over the lifetime of the system (25 years and beyond for a well maintained installation) due to the electricity generated locally



Reduces your carbon footprint

Your carbon dioxide footprint is a measure of how much CO₂ you are releasing into the environment. Solar energy produces no air or water pollution and no greenhouse gases emissions. As such, by using solar energy, you will be able to significantly reduce your carbon footprint



Increases the value of your property

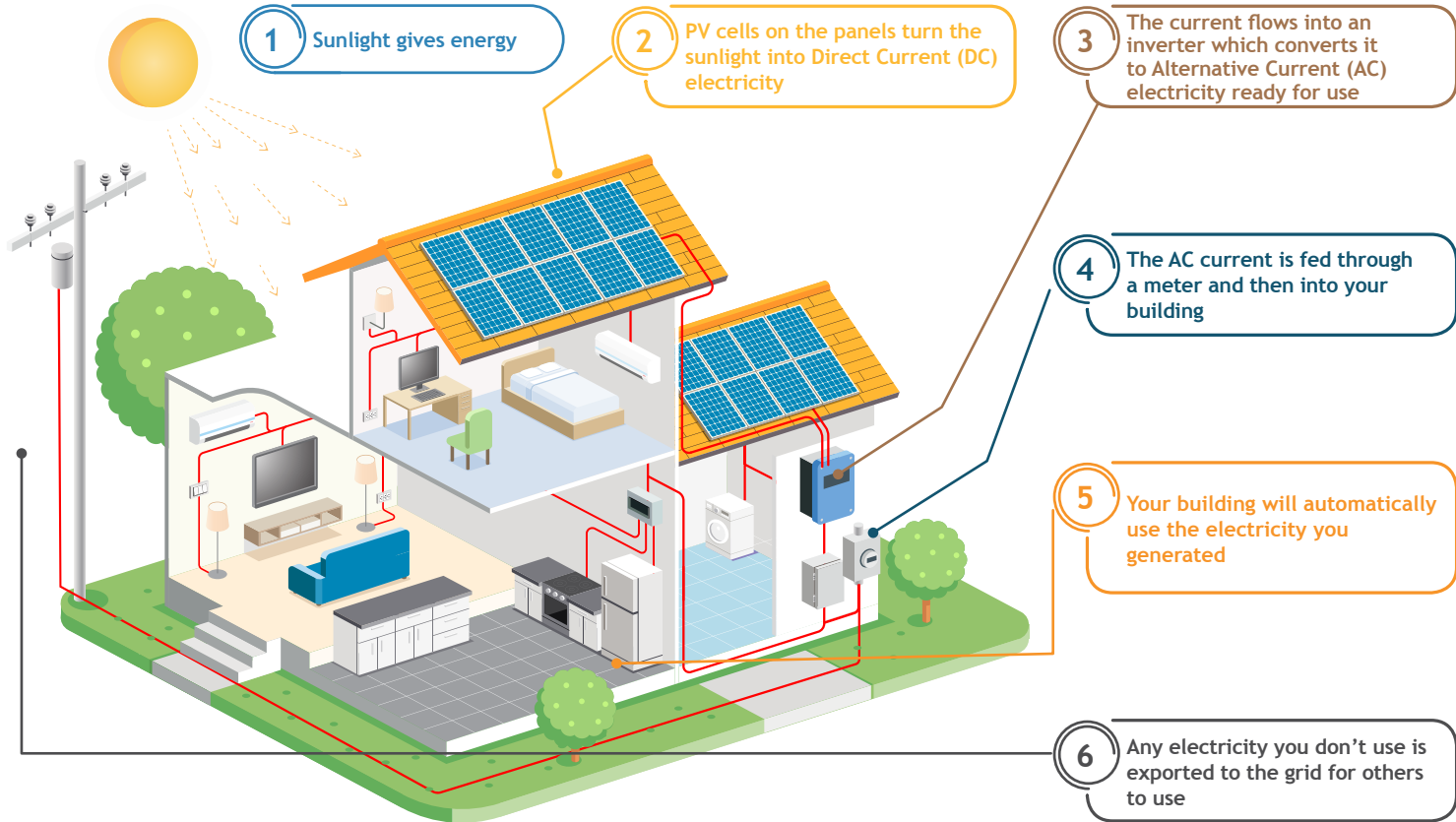
Should you decide to one day sell or rent out your property, if a PV system is installed, it will likely attract a higher price or rent in the market, as the new owner or tenant will enjoy lower electricity bills due to the electricity generated locally



Supports Dubai's economy and ensures its sustainable future

Every kWh of solar energy produced in Dubai reduces demand for conventional electricity

HOW DO SOLAR PV SYSTEMS WORK?



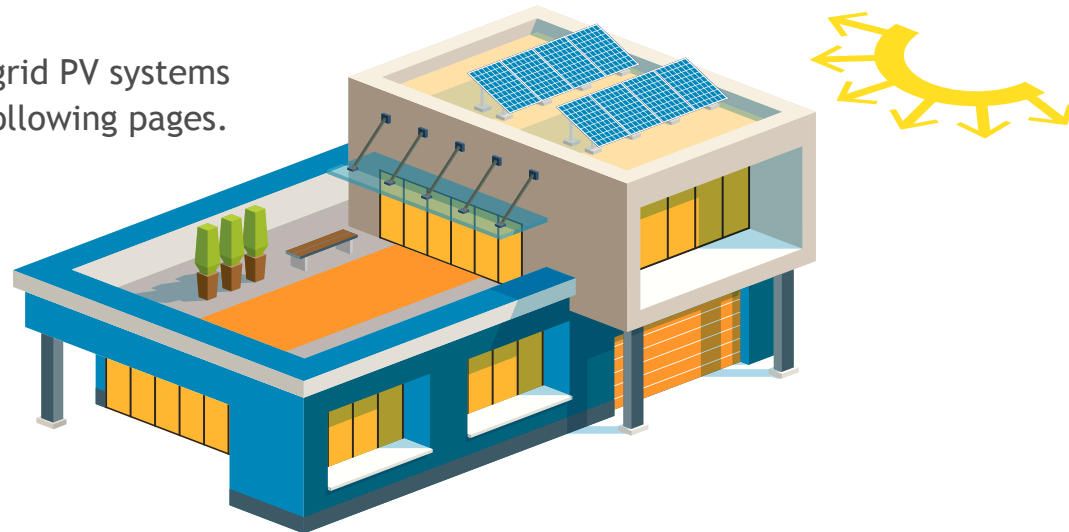
CHARACTERISTICS OF A SOLAR PV SYSTEM

Solar PV systems are **fully scalable and vary in size** according to the local energy needs; they can be used for residential, government, commercial and industrial electricity supply.

Most PV Systems have a **life cycle of up to 25 years**, though this can be longer in some cases.

PV panels are usually guaranteed by the manufacturer for a portion of the lifespan though they undergo some loss of performance over time.

The basic components of on-grid PV systems are briefly explained in the following pages.



TYPES AND SIZES OF SOLAR PANELS

Types

1. Crystalline Silicon (C-Si)

- ▶ Monocrystalline silicon: Single crystalline silicon made with slightly higher efficiency cells. Modules typically cost more than polycrystalline due to higher manufacturing cost
- ▶ Polycrystalline silicon: Multi crystalline silicon made with slightly lower efficiency cells. Modules typically cost less than monocrystalline.

MOST COMMONLY USED

2. Thin Film

This type of solar panel is very thin and can take the shape of the surface on which it is installed. It is less expensive to produce, however it is usually less efficient. Thin film panels exist in two types of materials:

- ▶ Silicone: Amorphous silicon (a-Si)
- ▶ Non-silicone: Cadmium Telluride (CdTe), Copper Indium Gallium Selenide (CIG/ CIGS), Organic photovoltaic (OPV/ DSC/ DYSC)

3. Half Cut Cell

- ▶ Half-cut cell modules have solar cells that are cut in half, which improves the module's performance and durability
- ▶ The popularity of this type of panel is increasing due lower resistive losses and higher cell efficiency

Sizes

60 Cell Panel



99 cm
39 inch

72 Cell Panel



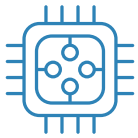
99 cm
39 inch



1. **Solar panels** are the electricity-generating units of a PV system. They are made of PV modules that contain blue or black colored **Photovoltaic (PV) cells** which are made of silicon or other semiconductor material that convert sunlight to flowing electrons.

What are PV panels and PV cells?

PV panels and PV cells are comprised of several layers of materials, each with a specific purpose. Key components include:



Semiconductor - comprised of two distinct (silicone) layers (p-type and n-type), and converts the Sun's energy into useful electricity through a process called the photovoltaic effect



Connectors - used to ensure proper connection



Junction box - houses and protects the electric connections of a solar panel



Conducting material - is on either side of the semiconductor and "collects" the electricity produced



Anti-reflection coating - applied only to the illuminated side of the cell to reduce reflection loss from semiconductors



Glass - protects and ensures robustness of the PV cell

Did You Know?

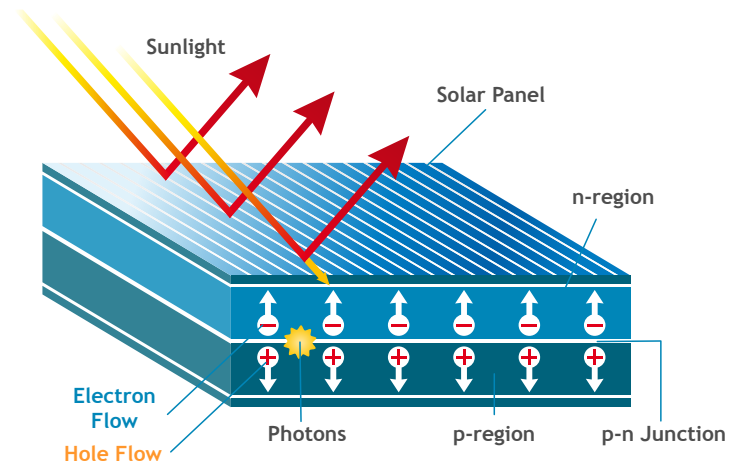
The Photovoltaic Effect

The photovoltaic effect is a process that generates voltage or electric current in a photovoltaic (PV) cell when it is exposed to sunlight.

These PV cells are composed of two different types of semiconductors: p-type (positive) and n-type (negative), joined together to create a p-n junction. This junction creates an internal electric field across the P-N junction of the PV cell.

Sunlight is made out of photons, which are simply small bundles of electromagnetic radiation or energy. When light of a suitable wavelength is incident on these cells, energy from

the photon breaks electrons bonds and releases free electrons. Free electrons are pulled through the electric field into the n-region, while positive holes migrate into the p-region. It is this motion of electrons and holes that creates an electric current in the cell.





2. **The inverter** converts the electricity produced from the solar panels from direct current (DC) to alternating current (AC) that can be used directly in the building or fed into the electricity grid. The inverter also serves as a safety and monitoring device, preventing power from flowing out from the PV system and into the electric grid during a power outage or disturbance events on the grid side. The inverter should be located in an airy, safe and accessible area and protected from direct solar radiation and water. Inverters typically have an efficiency around 95% and a general warranty of 10 years.



3. **A metering system** is used to measure the electricity generated by the PV System and electricity consumed in the premises. Two energy meters are usually installed: one that measures the generated power, and one that measures the power imported/exported to the DEWA grid.



4. **Interface protection** is an automatic protection device that is installed between the PV system and the network connection point. This device disconnects the PV system when a problem is detected on the network. This ensures that the connection of the PV system will not impair the integrity or degrade the safety of the grid.

SHAMS DUBAI

Shams Dubai, a DEWA initiative, encourages households and building owners to install PV systems to generate electricity, and connect them to Dubai Electricity and Water Authority's Grid (DEWA's Network). The electricity is used on site and the surplus is exported to DEWA's network using net-metering.



Grid-connected PV systems are connected to the existing electricity grid. They do not have battery or other forms of storage. The electricity produced by the system can be used to supply part or all of a facility's energy use during the day (to feed local loads), but will not produce electricity during a power outage or at night or on heavy, cloudy or dusty days.



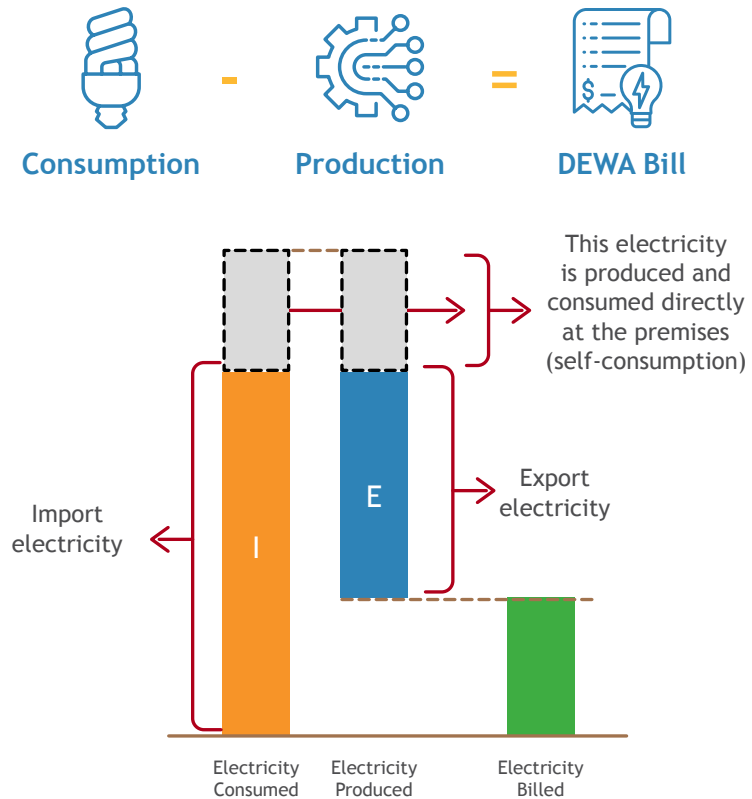
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NET-METERING

Net-metering is a billing mechanism that **credits PV System owners for the electricity they feed to the grid.**

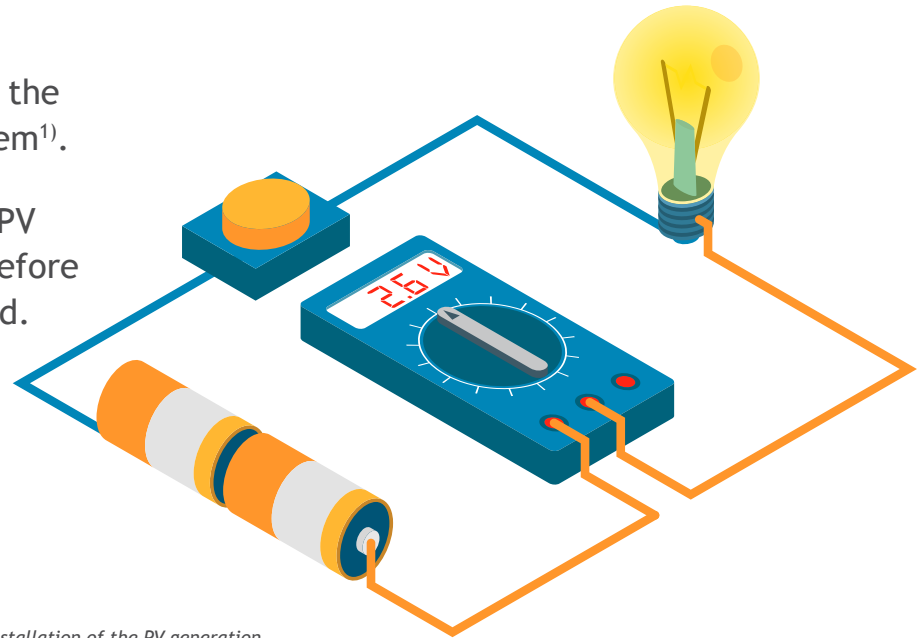
When the Solar PV System generates more electricity than what is needed by the building, the excess electricity (electricity surplus) can be fed back into the DEWA electricity grid. This is called Net-metering. The electricity produced is reflected by **a reduction in the DEWA bill.** Any surplus energy produced is kept as a credit to be used later on by the PV system owner.



TWO METERS ARE USUALLY REQUIRED FOR NET-METERING, SUPPLIED AND INSTALLED BY DEWA:

- 1 The **tariff meter** measures the **power exported to DEWA grid** and the **power imported from DEWA grid**
- 2 The **generation meter** measures the **power generated** by the PV system¹⁾.

During the connection process, the PV system will be inspected by DEWA before the metering system can be installed. The inspection ensures that the PV system complies with DEWA technical and safety regulations.



Note: 1) For individual projects with capacity below 10 kW, the installation of the PV generation meter is not mandatory and can be waived, if certain conditions are met.

INSTALLING A SOLAR
PV SYSTEM

SHAMS DUBAI

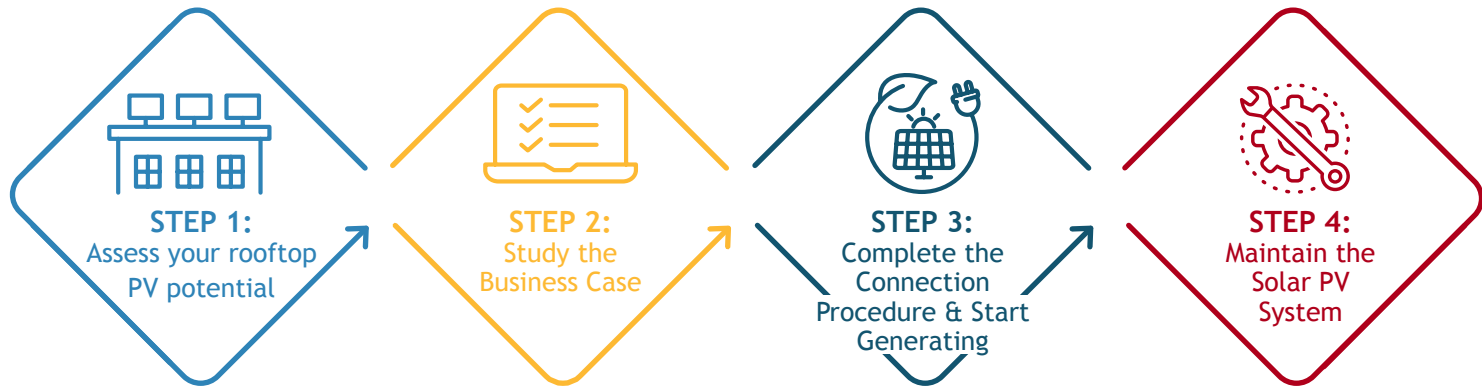
UNDERSTANDING SOLAR
PV SYSTEMS

INTRODUCTION



INSTALLING A SOLAR PV SYSTEM

FOUR SIMPLE STEPS FOR INSTALLING SOLAR PV SYSTEMS IN DUBAI





STEP 1: ASSESS ROOFTOP PV POTENTIAL

WHAT TO CONSIDER WHILE ASSESSING PV POTENTIAL?

The **roof orientation, shading and surface area** will determine whether PV technology is applicable, as well as the type and size of PV panels and equipment required.

There are **three factors to be considered** when planning to install PV panels onto the building's envelope:

1. Panels orientation towards the sun
2. Panels inclination
3. Potential shadow



THE FAVOURABLE ORIENTATION FOR FIXED SOLAR PANELS IN THE UAE THROUGHOUT THE YEAR IS **SOUTH**, AND THE OPTIMAL INCLINATION IS ABOUT **24 DEGREES**. THIS TYPICALLY ALLOWS AN ANNUAL IRRADIATION OF ABOUT **2,100 KWh/m²** **FOR DUBAI**, WHEN BOTH DIRECT AND DIFFUSE RADIATION ARE CONSIDERED.

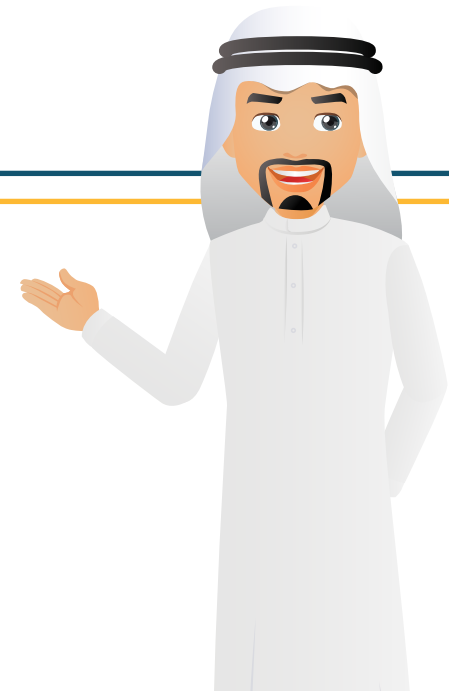
ESTIMATE YOUR ELECTRICITY PRODUCTION:

Shams Dubai Calculator is a web application that enables everyone to estimate potential electricity production and savings on electricity bill that can be achieved by installing Solar PV Systems under the Shams Dubai initiative. The Shams Dubai Calculator is available on the DEWA website:

<https://www.dewa.gov.ae/SolarCalculator/index.html>



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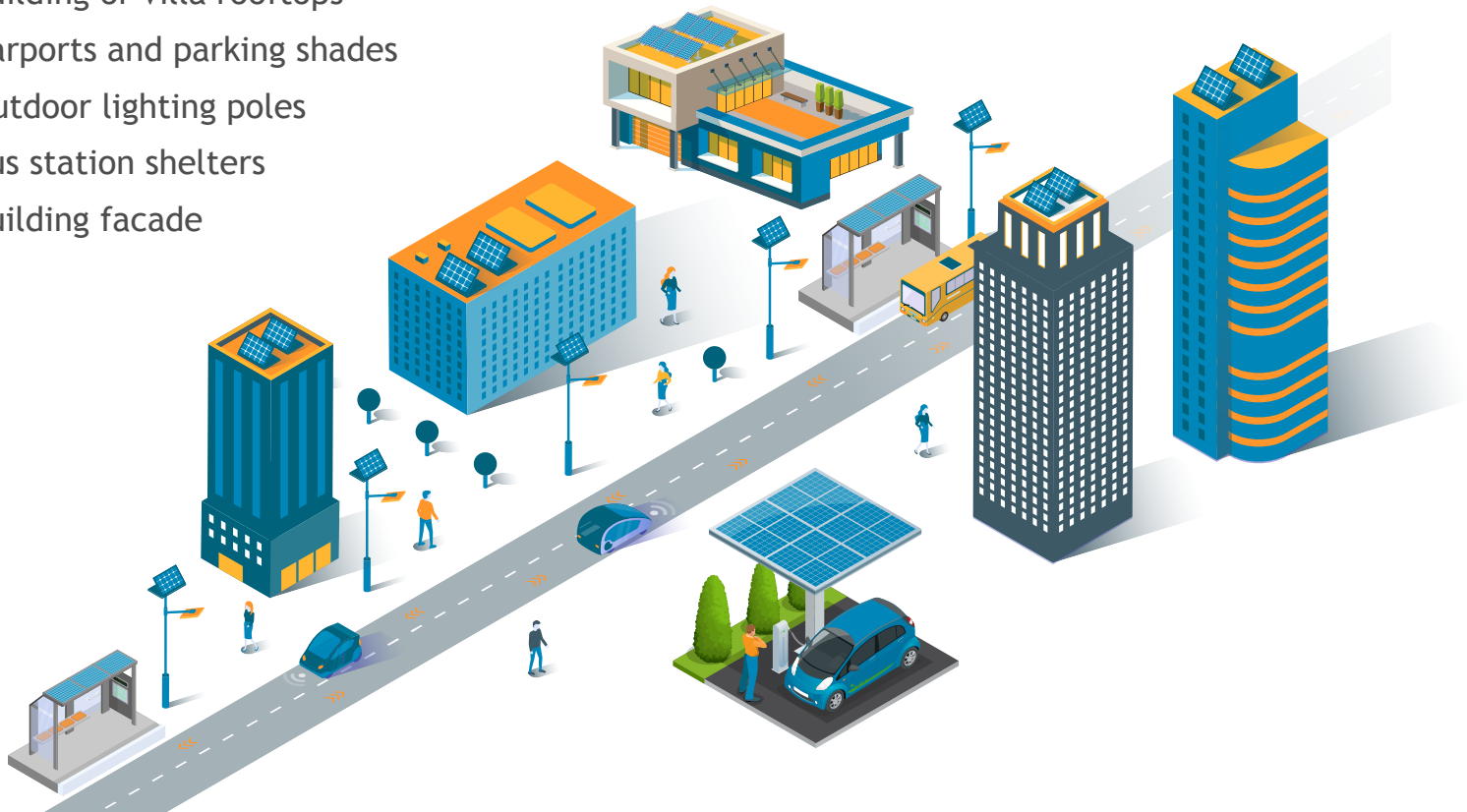
KNOW THE MAXIMUM CAPACITY YOU CAN INSTALL:

Detailed information on the maximum PV capacity that can be installed on a building is available in the DEWA Distributed Renewable Resources Generators (DRRG) Connection Conditions (Version 3 - January 2020) that can be downloaded from the DEWA website:

<https://www.dewa.gov.ae/~media/Files/Consultants%20and%20Contractors/2-4-1%20Shams%20Dubai/DEWADRRGConnectionConditionsEnV3.ashx>

WHERE SHOULD SOLAR PV SYSTEMS BE INSTALLED?

- ▷ Building or villa rooftops
- ▷ Carports and parking shades
- ▷ Outdoor lighting poles
- ▷ Bus station shelters
- ▷ Building facade





STEP 2: STUDY THE BUSINESS CASE

A. CONDUCT COST-BENEFIT ASSESSMENT

1. Costs

- **PV System Cost:** The cost of the PV system depends on the size as well as the type of system used
- **Solar Contractor/Consultant Fees:** The cost of services offered by the Solar Professional to support in designing and connecting your solar PV system
- **DEWA Connection Fee:** DEWA charges a one-off connection fee that equals the fixed amount charged by DEWA for each renewable generator connected to the grid
- **Operations & Maintenance (O&M) Costs:** O&M costs are incurred for the lifetime of the solar PV system and should be taken into account

2. Benefits

- **Lower electricity bills:** The generation of solar energy results in lower electricity bills. The reduction in bills should be estimated as part of the business case
- **Reduced carbon footprint:** Solar energy is more sustainable and greener than conventional energy. The reduced environmental impact can be estimated if needed

B. UNDERSTAND FUNDING OPTIONS (IF ANY)

ETIHAD ENERGY SERVICES is one of the key drivers of Shams Dubai program. Etihad ESCO helps you carry out the solar feasibility study, install and maintain the Solar PV System, and assist in financing the project.

Connect with Etihad ESCO to find out more:

www.etihadesco.ae



C. SELECT TYPE OF OWNERSHIP

1. Direct Ownership

The PV system is owned by the end-user (you). This type of ownership requires high upfront investment; however, the full ownership allows energy savings to be fully reflected on the end user's utility bill.

2. Third Party Financing

Solar Leasing and Build-Operate-Transfer (BOT) models are forms of project financing where the end-user avoids the upfront capital investment and the Solar Financing Company (investor) remains the owner of the PV System installed on the end user's rooftop for a specified period of time.



Once you have a clear picture of costs, benefits and funding options, compare these with the generation potential to decide if the business case is attractive for moving forward with a Solar PV system.



STEP 3: COMPLETE THE CONNECTION PROCEDURE AND START GENERATING

By reaching out to one of DEWA's enrolled consultants or contractors, you can assess your rooftop potential and get advice on the best solution for the Solar PV System in compliance with DEWA's standards. In addition, the Solar Consultant or Contractor will assist you in obtaining all required approvals to get connected.



شمس دبي
Shams Dubai

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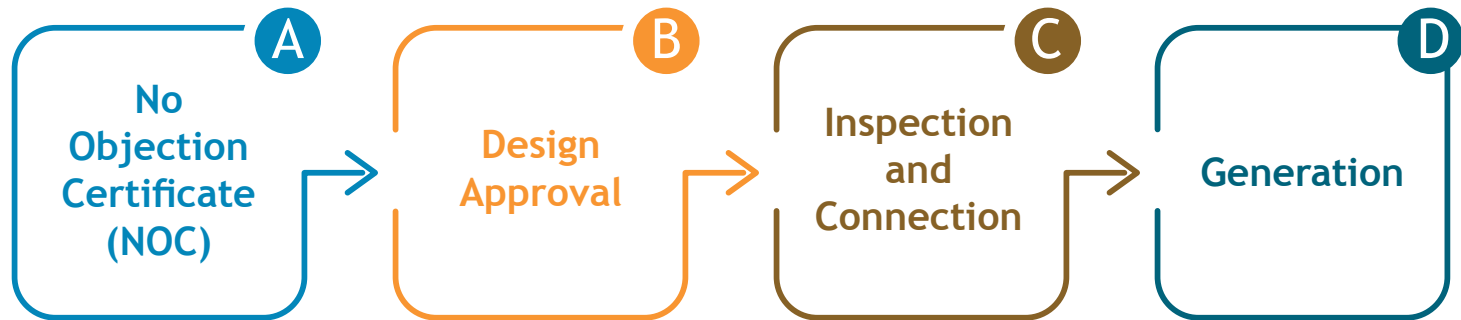


DEWA SOLAR PV CONSULTANTS AND CONTRACTORS

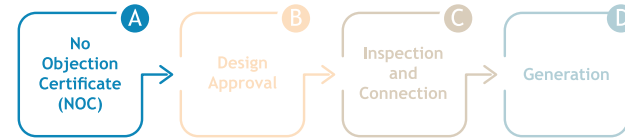
<https://www.dewa.gov.ae/en/consumer/solar-community/enrolled-contractors-consultants>

*A Solar PV System should
always be installed with the
help of a DEWA Enrolled Solar
Consultant or Contractor
regardless of the project size*

THE CONNECTION PROCEDURE CONSISTS OF FOUR DIFFERENT STAGES:



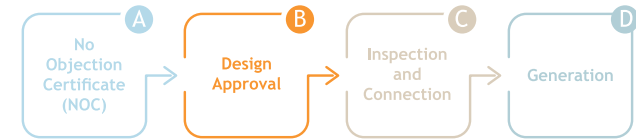
A. OBTAIN NO OBJECTION CERTIFICATE (NOC)



- The Consultant/Contractor will gather all necessary general information and will then submit the online PV connection application form
- DEWA will carry out the application assessment and ensure all necessary documents have been submitted and all the criteria have been met. Upon successful completion of the assessment, DEWA will issue the No Objection Certificate (NOC)



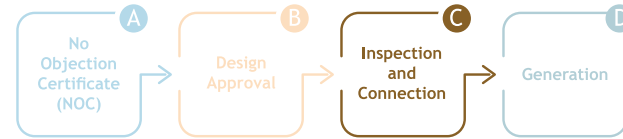
B. APPLY FOR DESIGN APPROVAL



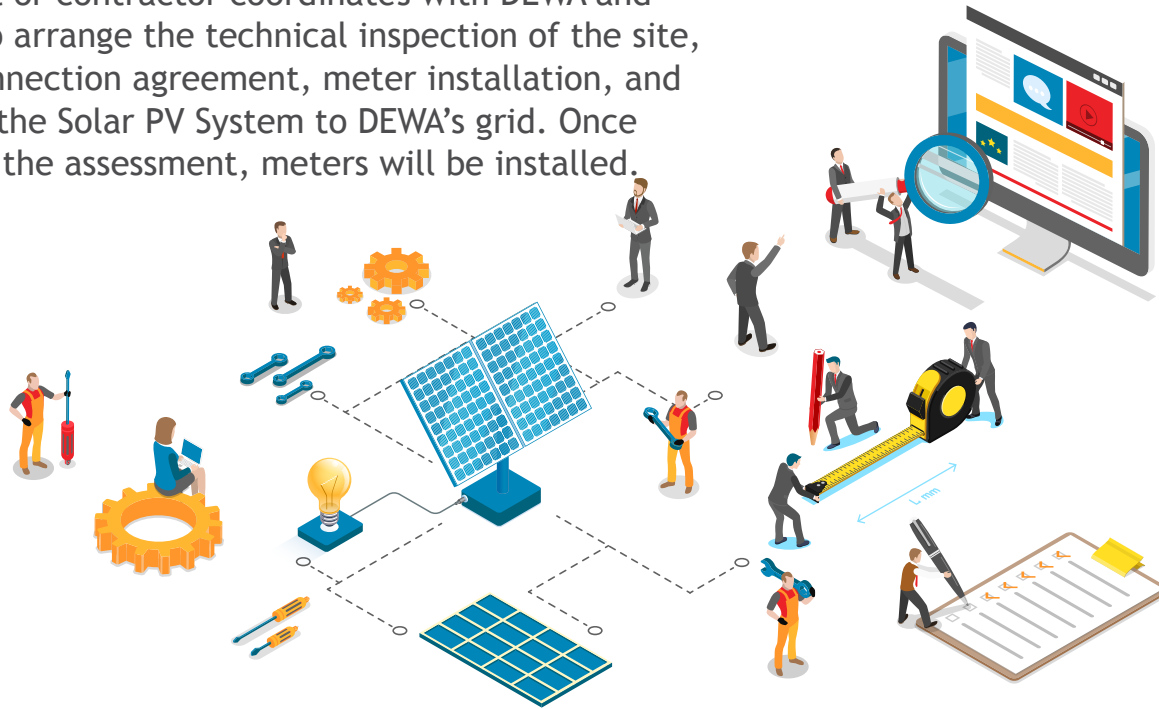
- The Consultant/Contractor must submit the online Application for Design Approval. With this application a number of technical documents need to be submitted to DEWA, such as the site plans, system design plans and details of the proposed equipment, in compliance with DEWA regulations
- Upon successful completion of the application assessment by DEWA, and upon approval by the concerned Authority (Etihad ESCO), the construction and installation can begin



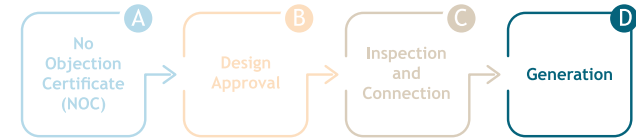
C. SITE INSPECTION AND CONNECTION



- The consultant or contractor coordinates with DEWA and Etihad ESCO to arrange the technical inspection of the site, signing the connection agreement, meter installation, and connection of the Solar PV System to DEWA's grid. Once DEWA finalises the assessment, meters will be installed.



D. GENERATION



- Once the system is connected, the customer can begin electricity generation from solar energy. Any surplus is exported to DEWA grid. DEWA will offset your energy bill accordingly.

NOTE FOR BUILDING OWNERS:

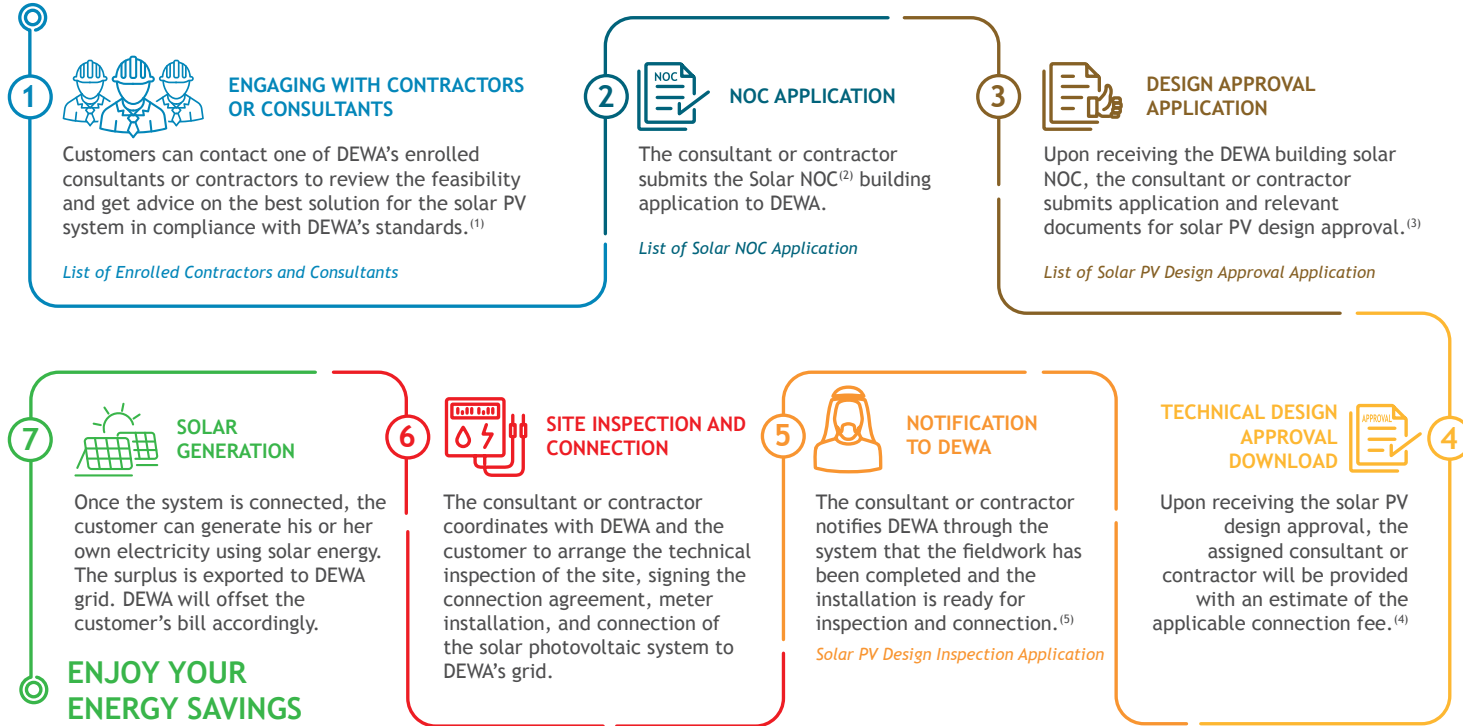
Under current legislation, you cannot offset electricity produced by a PV system against electricity consumed by different end-users. You can only offset electricity consumption of the common areas of the building (lighting, air-conditioning, elevators etc.) measured by meters you own (under the same account). Another option is for individual tenants to install Solar PV Systems for their own use (tied to their own accounts).



CONNECTION PROCEDURE CHART(*)



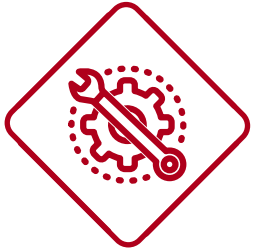
START



(*) Source: DEWA Website www.dewa.gov.ae

CONNECTION PROCEDURE REFERENCE NOTES:

- (1) The Consultant or Contractor will act as your agent and will advise you on the best possible solution for your system.
- (2) The capacity installed in a certain plot may not exceed the applicable share of the Total Connected Load (TCL) set in DEWA DRRG Connection Conditions (Version 3 - January 2020).
- (3) A number of technical documents need to be submitted to DEWA, such as the site plans, system design plans, and details of the proposed equipment in compliance with DEWA regulations.
- (4) For systems with an installed capacity of over 400KW, the cost of some dedicated equipment for grid integration might be added to the standard connection fee. A budgetary estimate of such cost can be provided upon request in the early stages of application process, if the Consultant or Contractor submits the required technical information.
- (5) For installation above 100kW, a successful plant performance test needs to be carried out.



STEP 4: MAINTAIN YOUR SOLAR PV SYSTEM

Maintenance of the system is important to maintain good performance, it is required to have an operation and maintenance contract with a service provider - Solar Contractor or Consultant.

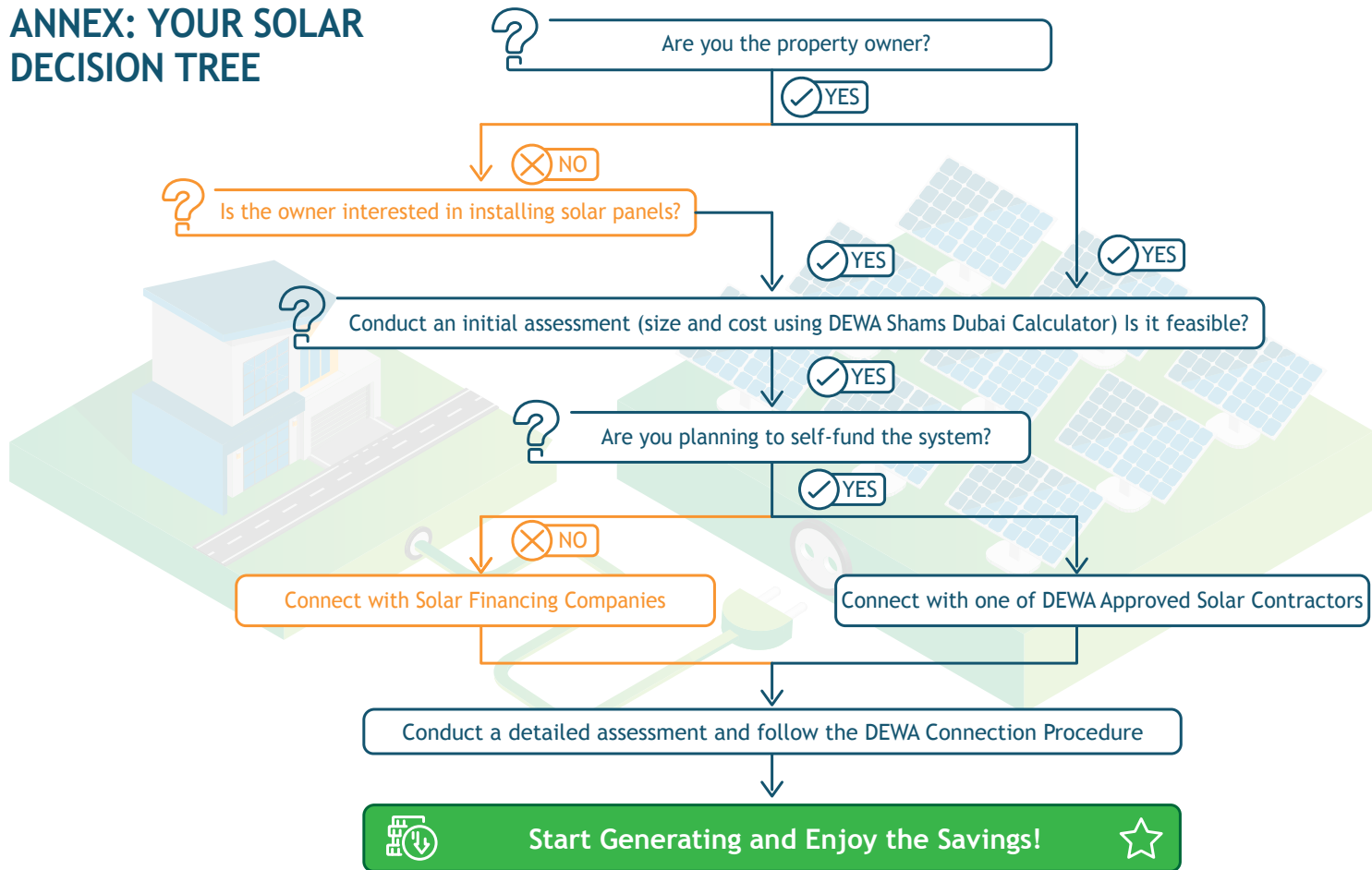
TIPS TO EFFECTIVELY MAINTAIN YOUR SYSTEM

It is important that panels are kept clean and any deposit of dirt and dust is avoided, since these reduce the efficiency of the panels. Dubai is in a region prone to dusty weather, therefore it is recommended that you clean the PV panels frequently.

Avoid shadow/ shade on the panels as this can cause a significant drop in performance, and may even damage the module in some cases.

A solar PV system is generally made up of modular components. This means that one can easily replace a malfunctioning component, and possibly extend the system lifespan into the future.

ANNEX: YOUR SOLAR DECISION TREE



ACKNOWLEDGMENTS

SPECIAL THANKS TO THE FOLLOWING ENTITIES FOR THEIR
SUPPORT AND CONTRIBUTION:



المجلس الأعلى للطاقة
Supreme Council of Energy





For an efficient future

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