



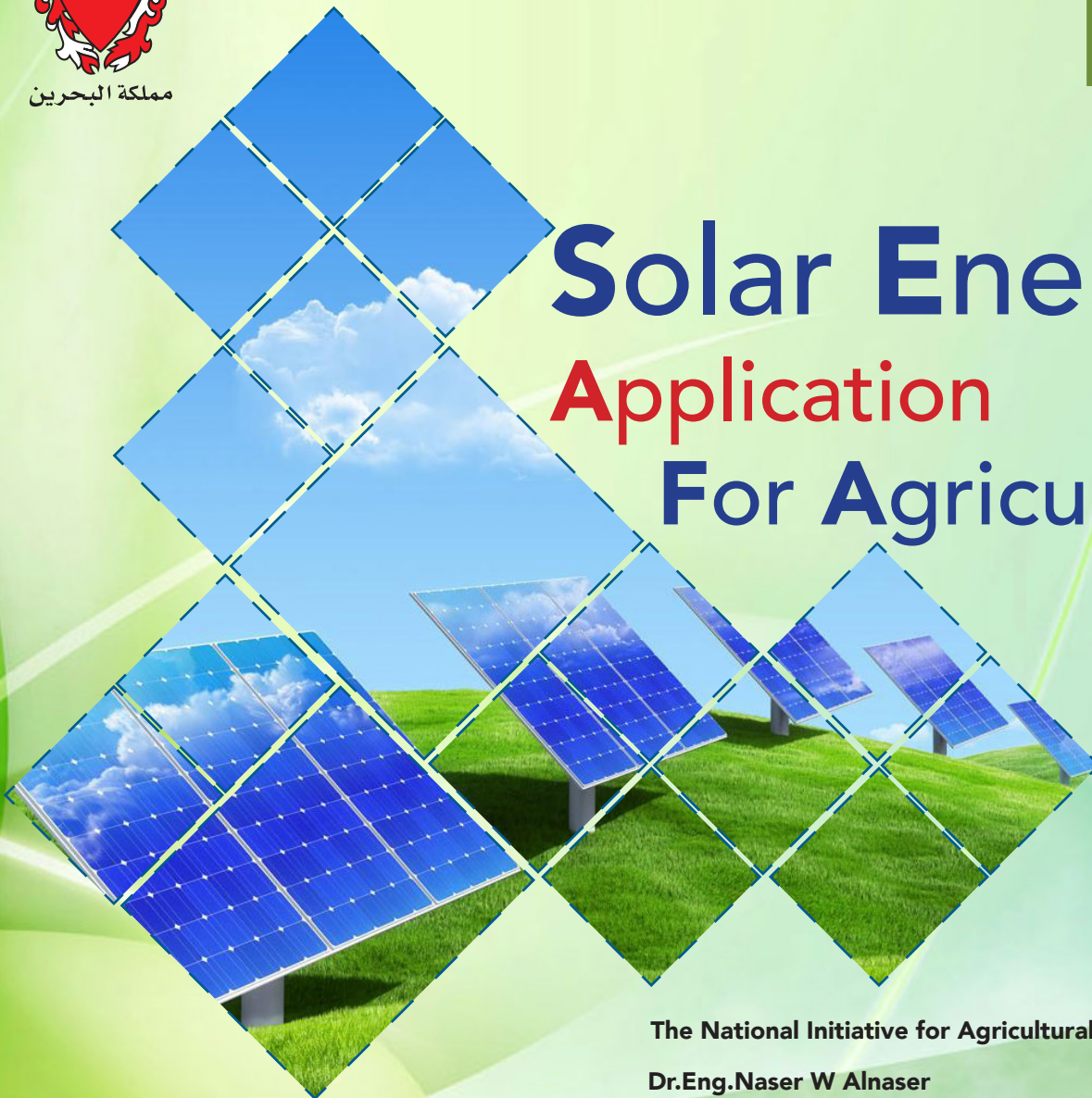
مملكة البحرين

The National Initiative for  
Agricultural Development

المبادرة الوطنية  
لتنمية القطاع  
الزراعي



# Solar Energy Application For Agriculture



**The National Initiative for Agricultural Development**

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## Introduction:

For many agriculture needs, the alternative is solar energy. Modern, well-designed, simple-to-maintain solar systems can provide the energy that is needed, where it is needed, and when it is needed. These are systems that have been tested and proven around the world to be cost-effective and reliable, and they're already raising levels of agricultural productivity worldwide. The kingdom of Bahrain is blessed with relatively high solar radiation, ranging from 5-7 kWh/m<sup>2</sup>/day with an average sunshine duration 9-10 hrs (annual sunshine hours of 3300) and 70-75% clear sky. Moreover, it's a flat small group of island which makes Bahrain typical for solar energy Application. This was demonstrated by installing 500 kW of PV at University of Bahrain and 4500 kW at Awalli City.

## Two types of solar systems

In general, there are two types of solar systems – those that convert solar energy to D.C. power and those that convert solar energy to heat. Both types have many applications in agricultural settings, making life easier and helping to increase the operation's productivity

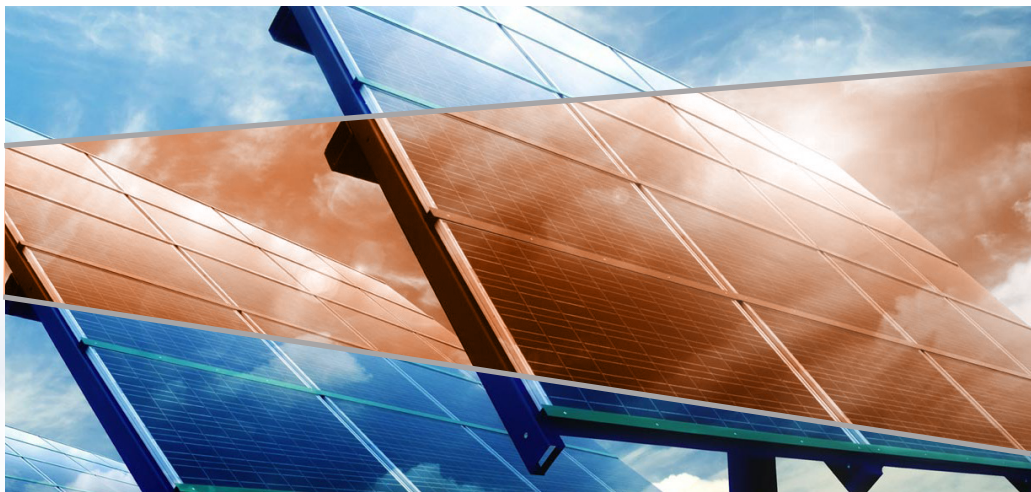
### 1 ) Solar-generated electricity

#### Photovoltaics (PV)

First is solar-generated electricity, called photovoltaic (or PV). Photovoltaic are solar cells that convert sunlight to D.C. electricity. The solar cells in a PV module are made from semiconductor materials.. This electricity can then be used to power a load, such as a water pump, or it can be stored in a battery.

#### Energy storage

It's a simple fact that PV modules produce electricity only when the sun is shining, so some form of energy storage is necessary to operate systems at night. You can store the energy as water by pumping it into a tank while the sun is shining and distributing it by gravity when it's needed after dark. For electrical applications at night, you'll need a battery to store the energy generated during the day.

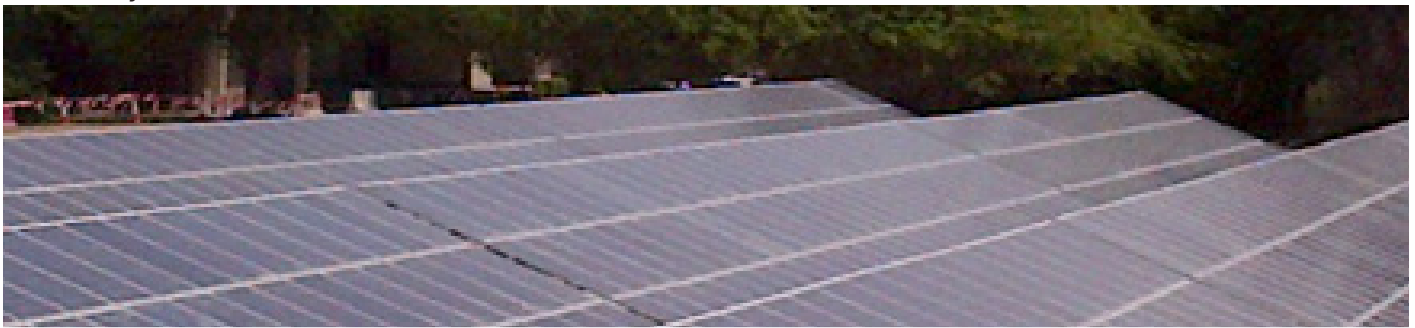


## PV is economic at remote locations

PV systems are very economical in providing electricity at remote locations on farms, ranches, orchards and other agricultural operations. A “remote” location can be as little as 15 meters from an existing power source. PV systems can be much cheaper than installing power lines and step-down transformers in applications such as electric fencing, area or building lighting, and water pumping – either for livestock watering or crop irrigation.

## Water pumping

In fact, water pumping is one of the simplest and most appropriate uses for photovoltaic. From crop irrigation to stock watering to domestic uses, photovoltaic-powered pumping systems meet a broad range of water needs. Most of these systems have the added advantage of storing water for use when the sun isn't shining, eliminating the need for batteries, enhancing simplicity and reducing overall system costs.



Project installation of 500 kilowatts of solar cells at the University of Bahrain

## Other PV uses

Other appropriate uses for PV systems on farms, ranches and orchards include:

- Power for feed or product grinding
- Electric-powered egg collection and handling equipment
- Product refrigeration
- Livestock feeder and sprayer motors and controls
- Compressors and pumps for fish farming
- Electric fencing to contain livestock
- Battery charging.

## 2) Getting heat from the sun

### Solar crop driers



Modern solar crop driers are still very simple, but also more effective and hygienic. The basic components of a solar dryer are an enclosure or shed, screened drying racks or trays, and a solar collector. The collector can be as simple as a glazed box with a dark colored interior to absorb the solar energy that heats air. The heated air in the collector moves, by natural convection or a fan, up through the material to be dried.

### Water heating



Another use of solar energy for higher agricultural productivity is water heating – particularly in livestock operations. Poultry and equipment must be cleaned periodically. Simple solar water heaters are available to provide low to medium temperature hot water for this purpose. These systems require a solar collector, a storage tank, plumbing and pumps. Commercially available systems are widely available and offer simple installation



### Hot water for cleaning



Cleanliness is very important when processing poultry. The use of solar water heaters can provide us with a warm water 60 ° m suitable for this purpose .

The solar heaters commercially available at a reasonable price can also be used in farms and in slaughter cattle and poultry . It can also be used in water heating which might need some technical workshops in manufacturing, or more precisely, in the installation of solar heaters that uses the natural flow of liquid resulting from the difference in density caused by high temperature .

### The use of solarization in fighting agricultural pests



Numerous studies on thermal effects of this process on the composition of the soil , the nutrients in the soil , soil microorganisms , pests , soil gases , volatile substances and others elements. new horizons have been opened of which ones to use two or more layers of polyethylene to cover where the temperature reached 12,5 ° m higher compared with using a single layer , as well as the use of certain pest control materials side by side with solarization .

In one of the experiments in Yemen to test two ways to manage the disease which infects pink onions roots in Hadhramaut valley, It was found that soil solarization was an effective method in the management of pink root disease in nurseries. It was also found that using clear or black plastic to cover the soil during the summer months for a period of 30-50 days led to raising the temperature of the soil at a depth of 10 cm to 50,2 ° C and 47,0 ° C, respectively, compared to 42, 0 ° C in the case of non-coverage of soil.

Covering the soil with plastic sheets significantly reduced the incidence and severity of disease in the seedling pink onion roots as the decrease of the disease ranged between 88.5 and 94.9 % compared to non-covered soil. Transparent plastic covers reduced the occurrence of the disease more than the black covers and the soil solarization has also led to an increase in the growth of onion seedling at a significant proportion. Covering the soil with transparent sheeting for 50 days resulted in improve wet and dry weight of seedlings by 90.3 % and 63.3 % respectively, compared with the soil not covered.

Annuals and perennials Weed control in Hadhramaut valley have been done by using black and transparent plastic covers with thickness of 50-100 microns for periods ranging from 30-45 days where the intensity of annual weeds have been reduced at a significant proportion.

## Greenhouses

greenhouses are widely spreading in Bahrain. it is a galvanized Iron frame covered with a single layer of plastic sheets mostly resistant to UV. Its size ranges from 6 X 54 m and 9 X 60 m, and these are used for the cultivation of roses and other crops that need to be Joe moderately warm.

We have conducted a study with the aim of introducing protected agriculture technology in the conditions of the Republic of Yemen to deal with the problems facing the agricultural production of crops, vegetables, fruit, flowers of seasonal production and low productivity of most vegetable crops beside the limited agricultural land and water scarcity which can be avoided by using this technology. The study Has chosen a 3.5X4X9 meters protected greenhouse that has similar circumstances Hadhramaut valley. Studies have shown that high temperature in greenhouses which must eliminated is equivalent to 22.5 kW, and this can be reduced by using two 50 cm diameter fans of 1 kW power. The size of straw must be 2 X 4 and when the direction of the house and relative humidity of 25% outside the house and 72% inside.

## Solar water pumps

Some of the water pumps that run on solar photovoltaic cells were used during the past ten years and recently the use of this type of solar-powered engines began to increase and is expected to expand because of the complexities of electricity network expansion and the cons of diesel pumps. Its importance was essentially realized for the provision of water in some rural areas. Solar water pumps remain a promising option if their price is reduced.

## Suggestions to activate the application of solar energy in the agricultural sector

Unfortunately, the various applications of solar energy in agriculture usually remains trapped in universities and research centers, so there must be a viable mechanism for the introduction of these technologies in the agricultural reality as it is necessary to test the receptivity of this research and the adoption of their use through seminars and workshops to transfer the knowledge to application as well as benefiting from the feedback and thus the study the application problems and work to overcome them.

For example, it is possible to use the solar cook system and convert it to water sweetener, as well as the sterilization of drinking water, production of distilled water, and the preparation of hot water. It became possible to sterilize 30 liters of water and prepare 45 liters of hot water at a temperature between 50 and 60 °C during six hours. During a similar period it was possible to produce 4 liters per day of solar distilled water at the University of Bahrain and to also prepare 70 liters of hot water in some sunny countries.

To promote solar energy technologies we must introduce the concepts of solar energy within the framework of schools' curriculum hold presentations and shows for solar energy applications in malls and exhibitions (the University of Bahrain continues to do this every year in the annual and gardens exhibition and in green technologies conference held once every two years). Also opening permanent exhibitions in the appropriate areas for these applications, and an knowing the opinion of farmers about those renewable technologies. The government has to encourage researchers in the field of solar energy applications in agriculture and to support associations interested in agriculture and cooperatives that sell products of solar energy crops.

### How can I obtain more info?

You can get in touch with the executive office at the following:

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