



THE AMERICAN  
UNIVERSITY IN CAIRO  
الجامعة الأمريكية بالقاهرة



# FUNDAMENTALS AND ESSENTIALS OF SPISS

## INTRODUCTION TO SOLAR ENERGY

FEBRUARY 16 , 2021

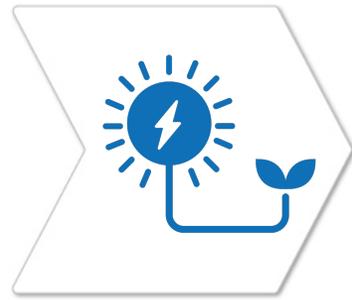
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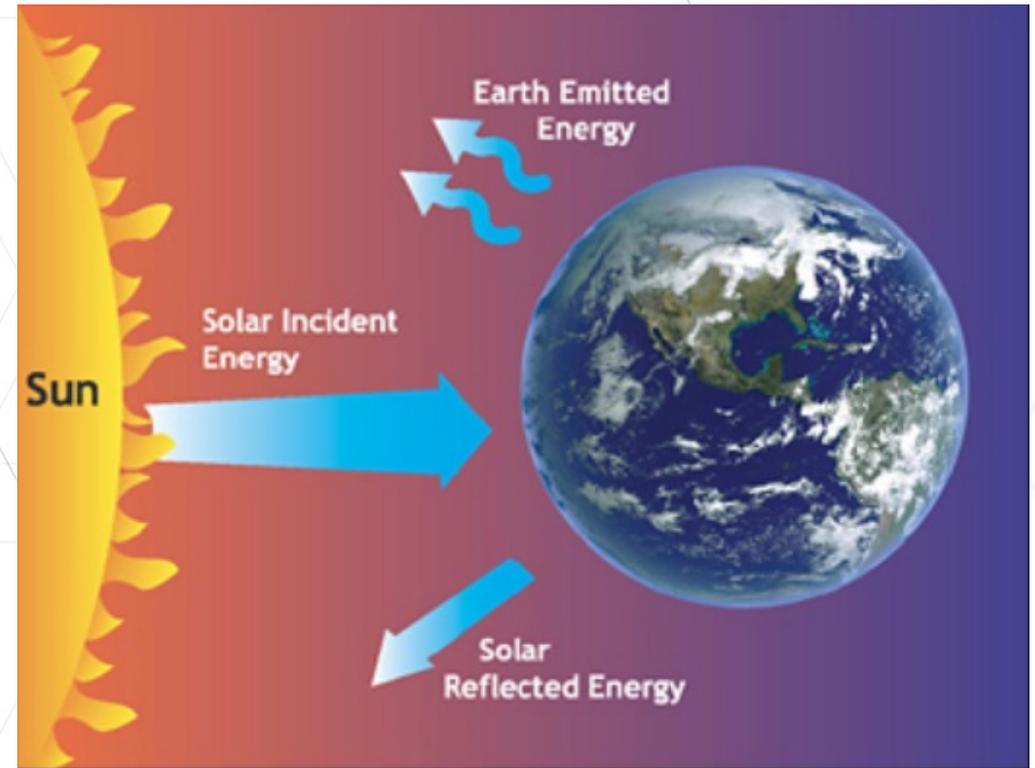
ITALIAN AGENCY  
FOR DEVELOPMENT  
COOPERATION

# INTRODUCTION



Energy is an essential prerequisite for any economic activity. It is vital for all aspects of human life and decent living. Moreover, energy represents a strategic element in achieving economic, social, political, and environmental security. Hence the emergence of the concept of energy security and reliable energy supplies for all regions, social groups and economic activities in quantities which satisfy domestic demand at affordable cost.

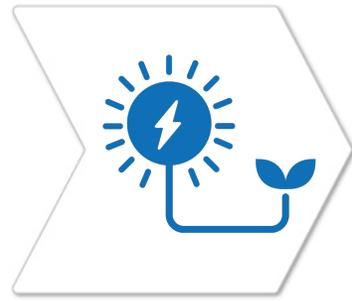
The Sun is an extremely powerful energy source, and sunlight is by far the largest source of energy received by Earth, but its intensity at Earth's surface is actually quite low.



the atmosphere acts like a filter - absorbing and removing some of the solar energy at the higher end of the electromagnetic spectrum

**Source:** solar-facts

# THE ROLE OF SOLAR ENERGY



We obtain energy from the sun in the form of radiant light

- It is the nearest star to Earth
- Its surface temperature is 5000 C°
- The distance to Earth is 150 million Km
- It is about 1000000 times of Earth size
- Radiation energy:

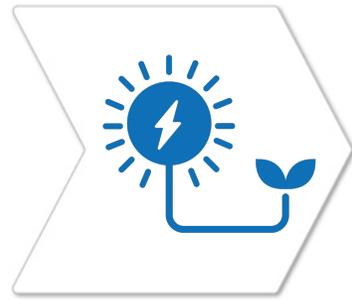
$$E_{\text{sun}} = 3 * 10^{24} \text{ J / year}$$

$$1 \text{ MJ} = 0.2777 \text{ Kwh}$$

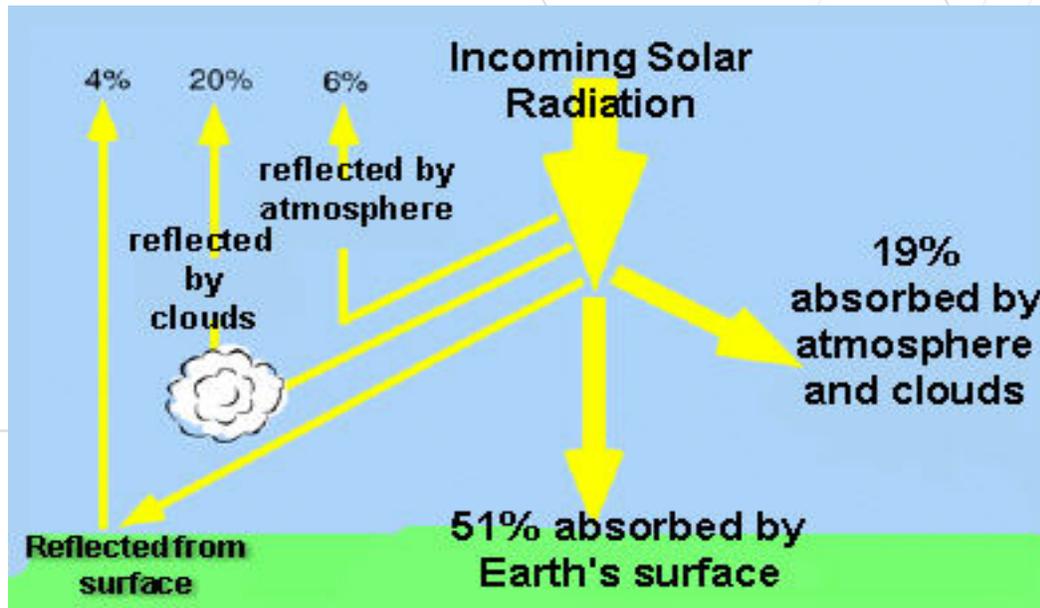
$$G_{\text{sc}} = 1367 \text{ W / m}^2$$



# THE ROLE OF SOLAR ENERGY



- The Earth's energy budget;
- The role of radiation and convection in the distribution of energy;
- The motion of the atmosphere and the oceans;
- Cloud formation;
- The role of heat energy in weather-related phenomena including thunderstorms and hurricanes



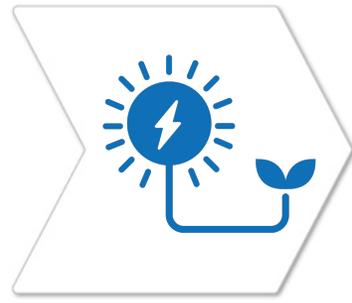
## EARTH'S ENERGY BUDGET

About one third of the sun's incoming energy is reflected back out to space. About one half of the energy striking the Earth is absorbed by the Earth's surface.

Source: Standard 6.3

The potential for solar energy is enormous, since about 200,000 times the world's total daily electric-generating capacity is received by Earth every day in the form of solar energy. Unfortunately, though solar energy itself is free, the high cost of its collection, conversion, and storage still limits its exploitation in many places. Solar radiation can be converted either into thermal energy (heat) or into electrical energy, though the former is easier to accomplish.

# ADVANTAGES OF SOLAR ENERGY



- RENEWABLE RESOURCES
- RENEWABLE MATERIALS
- RENEWABLE ENERGIES
- RENEWABLE TECHNOLOGIES



It can be harnessed in all areas of the world and is available every day. We **cannot run out of solar energy**

- Energy bills Will drop
- Low Maintenance Coste
- Green Energy Source.

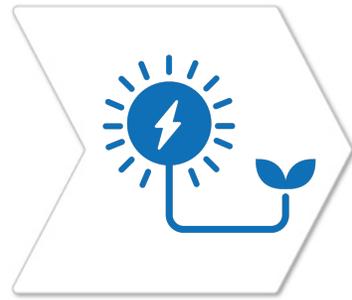


Diverse Applications

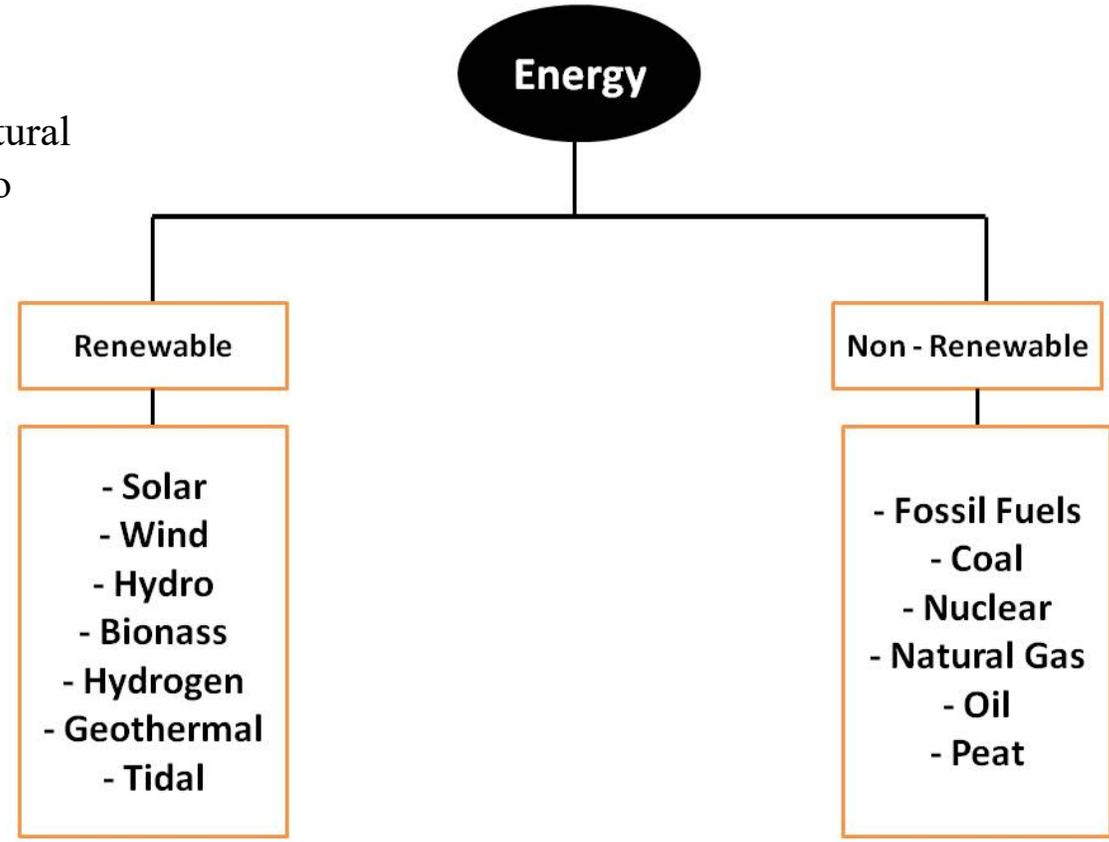
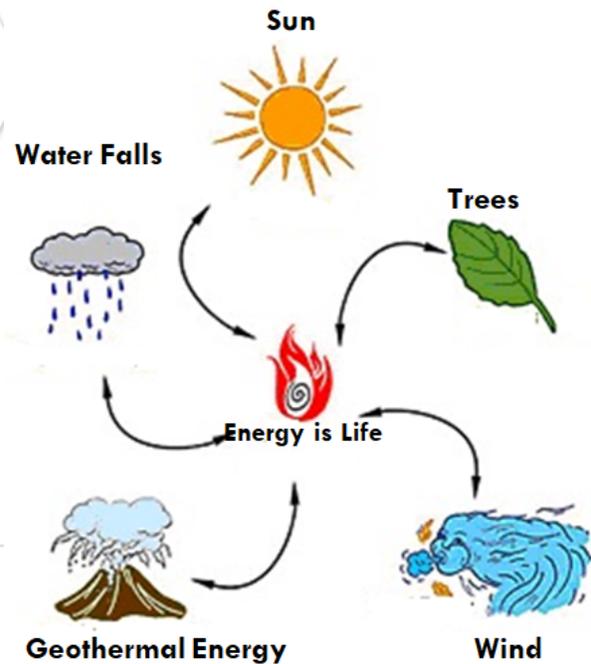


Source: Standard 6.3

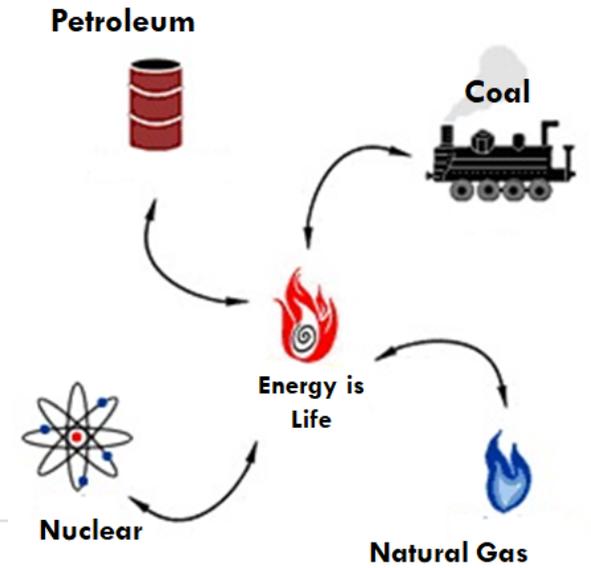
# RENEWABLE AND NON-RENEWABLE ENERGY



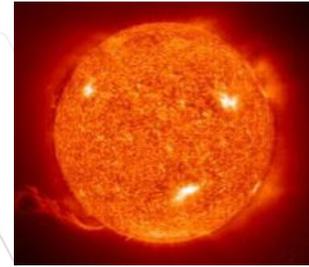
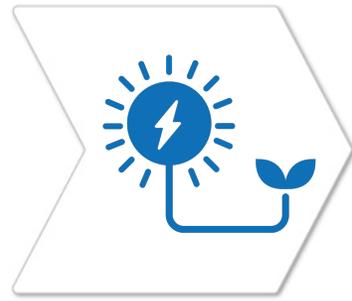
Renewable energy is obtained from natural sources. These resources can be used to produce energy again and again



Non renewable resources cannot be replaced once they are used, these energy resources are limited and would be exhausted within prescribed period of time.

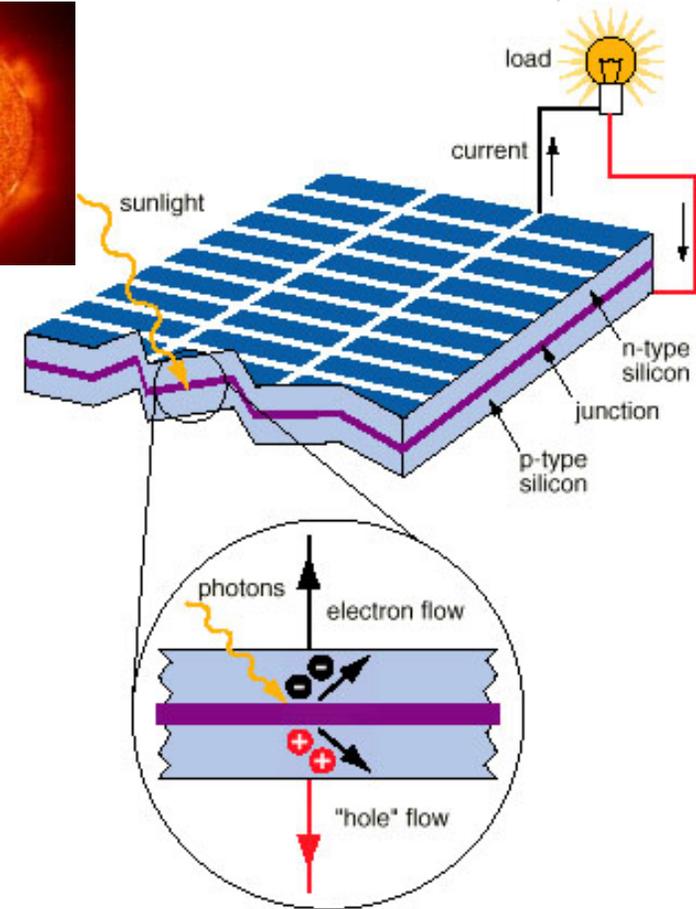


# SOLAR (PV) ENERGY CONVERSION (PHOTOVOLTAIC EFFECT)

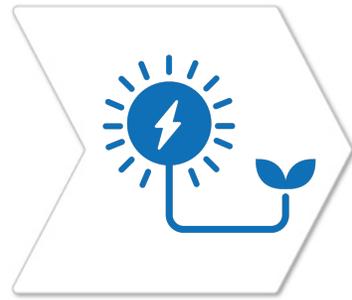


The solar cell is composed of a P-type semiconductor and an N-type semiconductor. Solar light hitting the cell produces two types of electrons, negatively and positively charged electrons in the semiconductors.

Negatively charged (-) electrons gather around the N-type semiconductor while positively charged (+) electrons gather around the P-type semiconductor. When you connect loads such as a light bulb, electric current flows between the two electrodes.



# SOLAR CELL MATERIAL



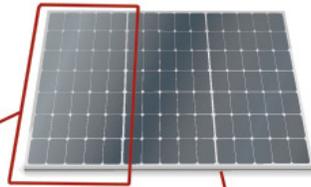
**Solar Cell**



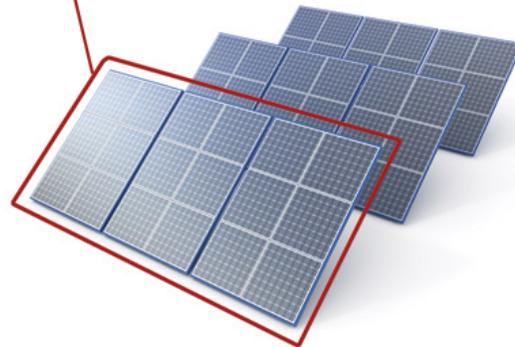
**Solar Module**



**Solar Panel**



**Solar Array**

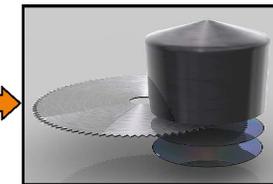


Silicon is the most commonly used material for solar cells. The electrical properties of silicon depend on the type and amount of dopants. Phosphorous and boron are most widely used donor and acceptor dopant respectively.

## Solar PV Value Chain



Polysilicon



Ingot & Wafer



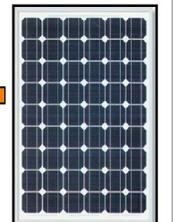
Solar cell



Solar PV Plant

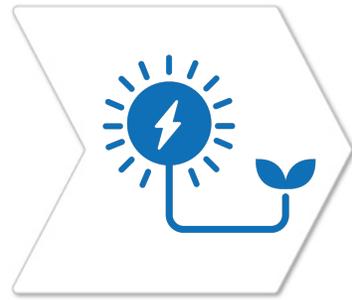


Solar PV Array

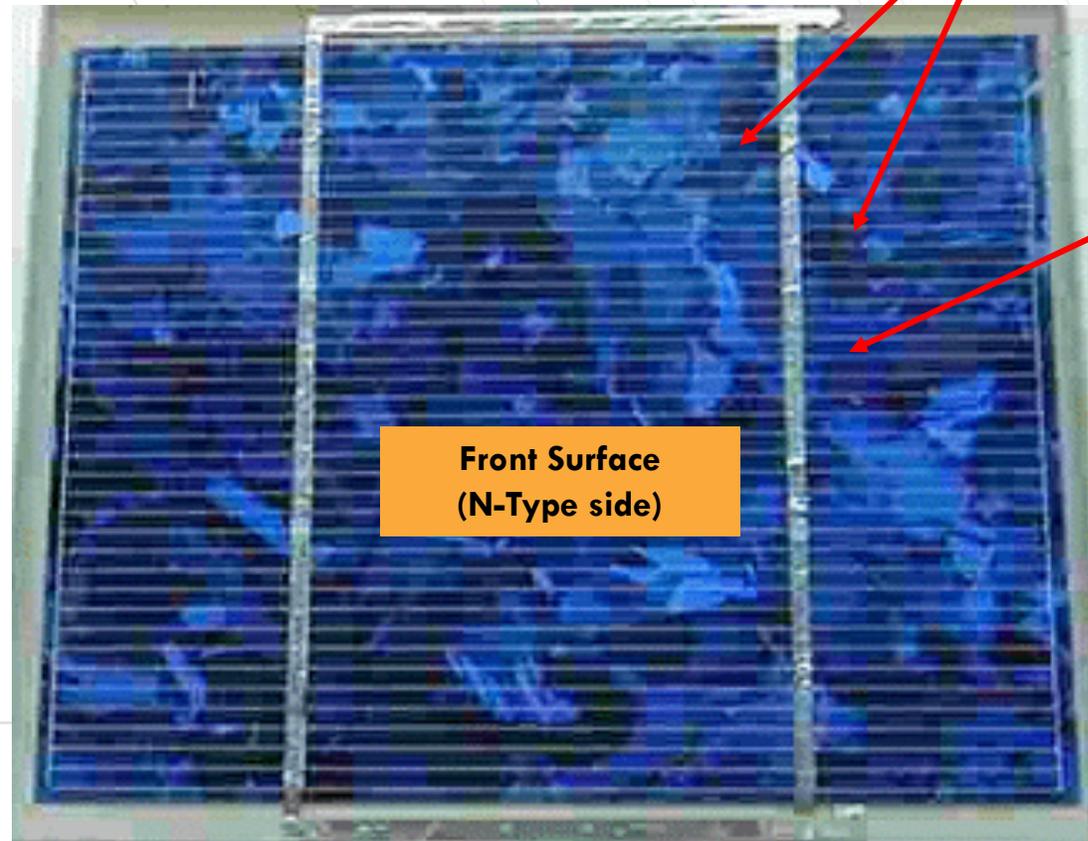


Solar PV module

# SOLAR CELL MATERIAL



- **Aluminum Electrode (Silver colored wire)**
- **To avoid shading, electrode is very fine.**

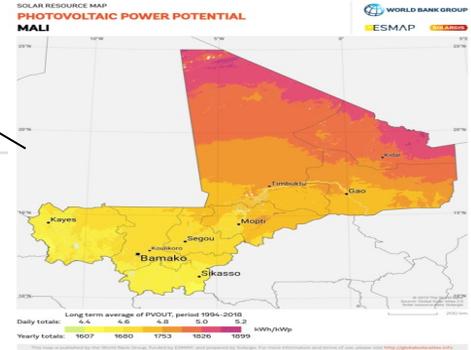
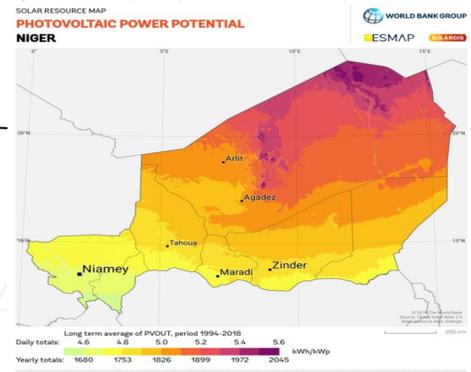
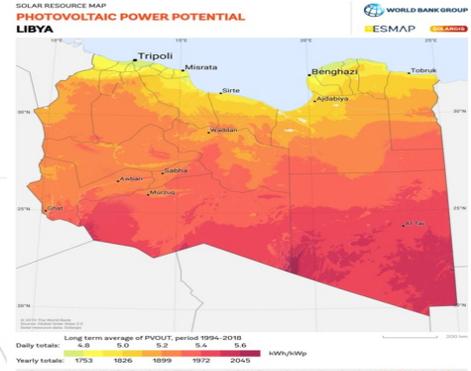
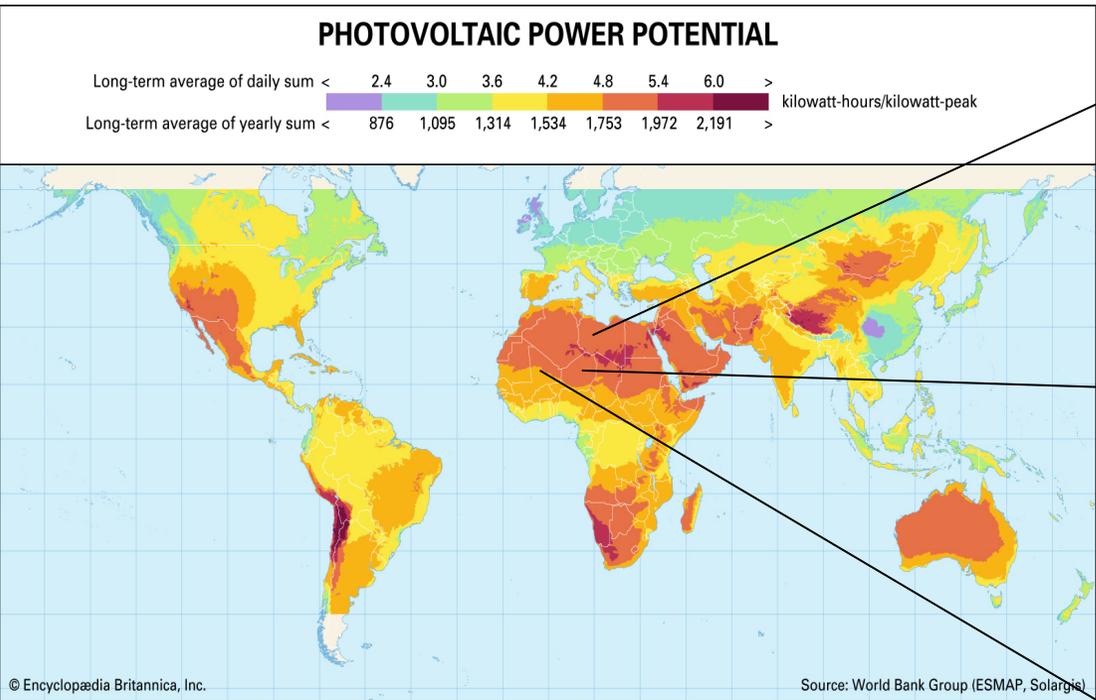
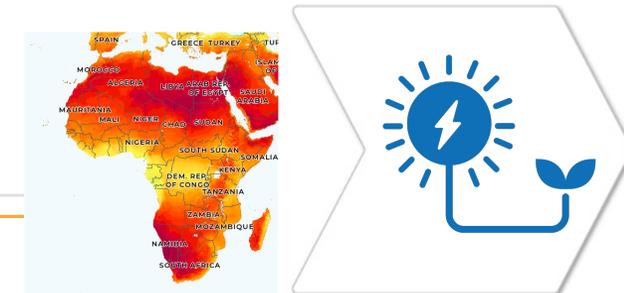


**Front Surface  
(N-Type side)**

**Anti reflection film  
(Blue colored film)**

- **Back surface is P-type.**
- **All back surface is aluminum electrode with full reflection.**

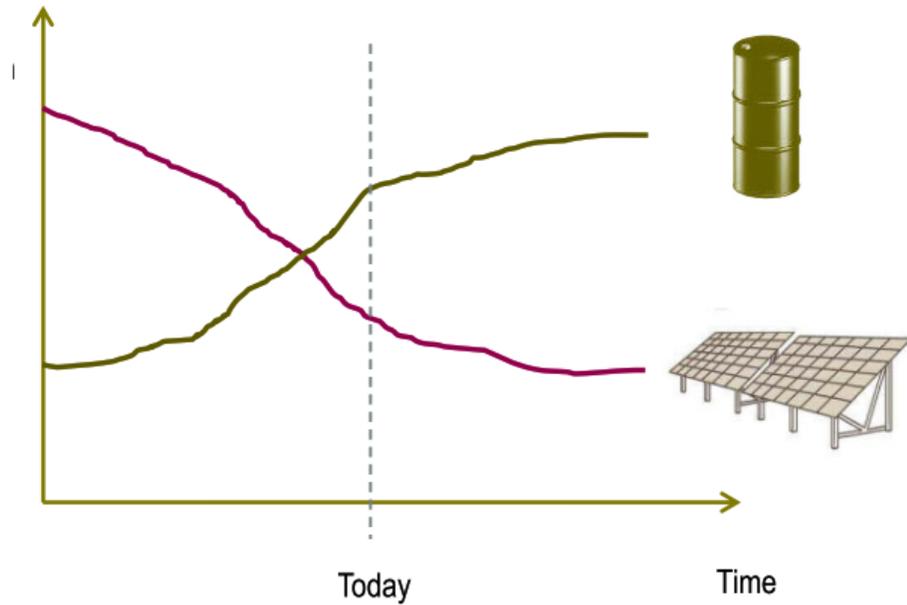
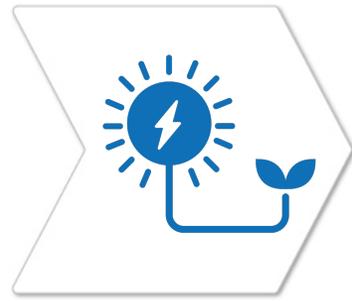
# SOLAR ENERGY POTENTIAL



one of the highest solar radiation in the world , average solar radiation of 1800-2,470 kWh/m<sup>2</sup>/day , The huge potential for renewable energy in Libya , Niger and Mali

Source: world bank Group  
 2019 The World Bank, Source: Global Solar Atlas 2.0, Solar resource data

# TIME TO USE



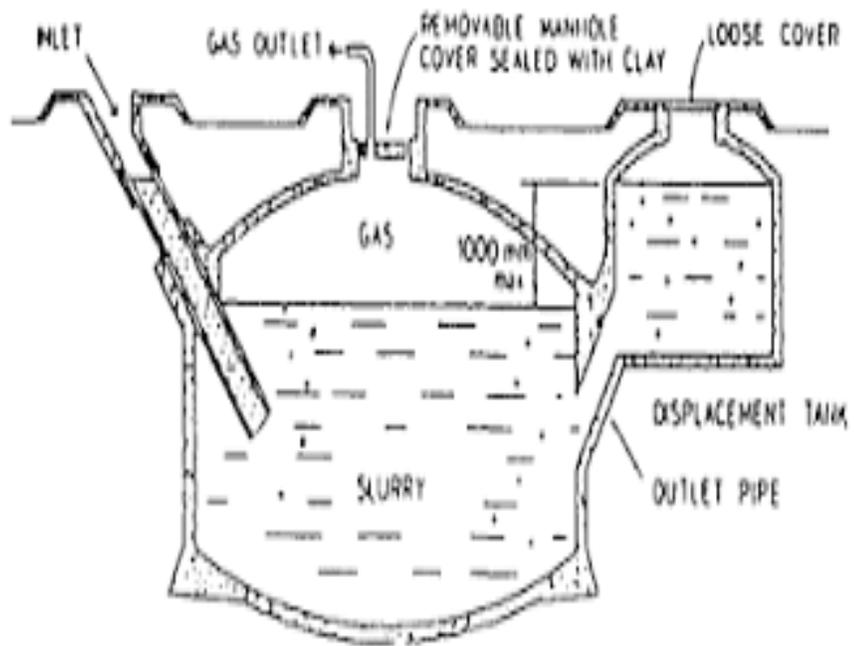
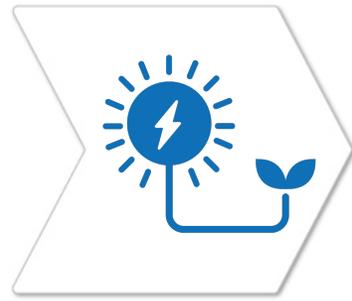
The price for PV systems has decreased by more than 60% in the last 3 years.

Fuel costs for diesel generators are constantly rising

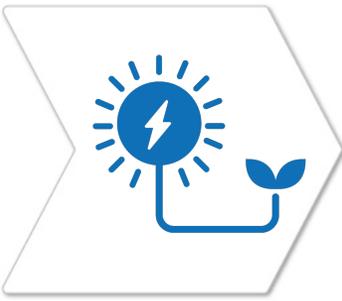
# FIELD APPLICATIONS



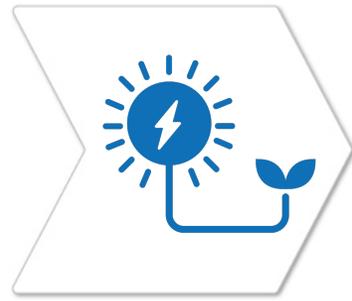
# RENEWABLE RESOURCES



# INNOVATIVE APPLICATIONS



# WISH YOU ALL SAFETY & SUCCESS



GIVE PEOPLE  
THE GIFT  
OF CLEAN  
LIGHT  
AND  
POWER

