



ME 476

Solar Energy

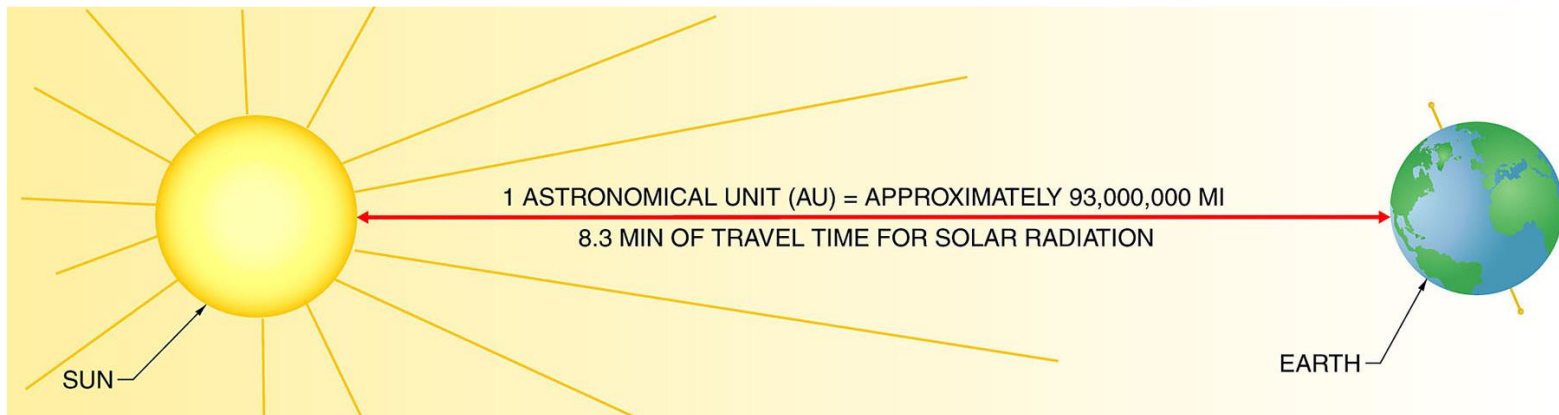
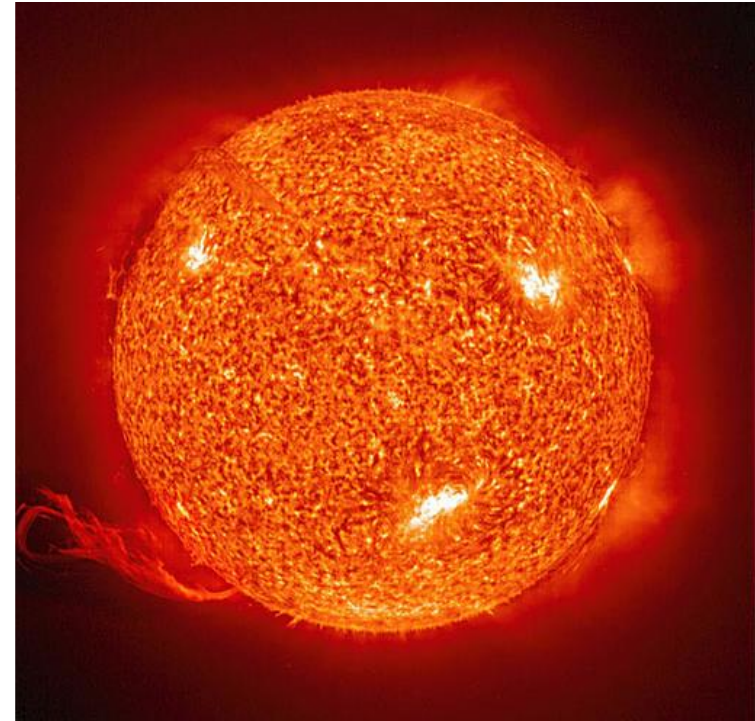
UNIT ONE

INTRODUCTION

- What is solar energy?
- Why is solar energy important?
- How can solar energy be utilized?
 - Power generation
 - Water heating
 - Refrigeration
 - Desalination
- Limitations and challenges of solar energy

What is Solar Energy?

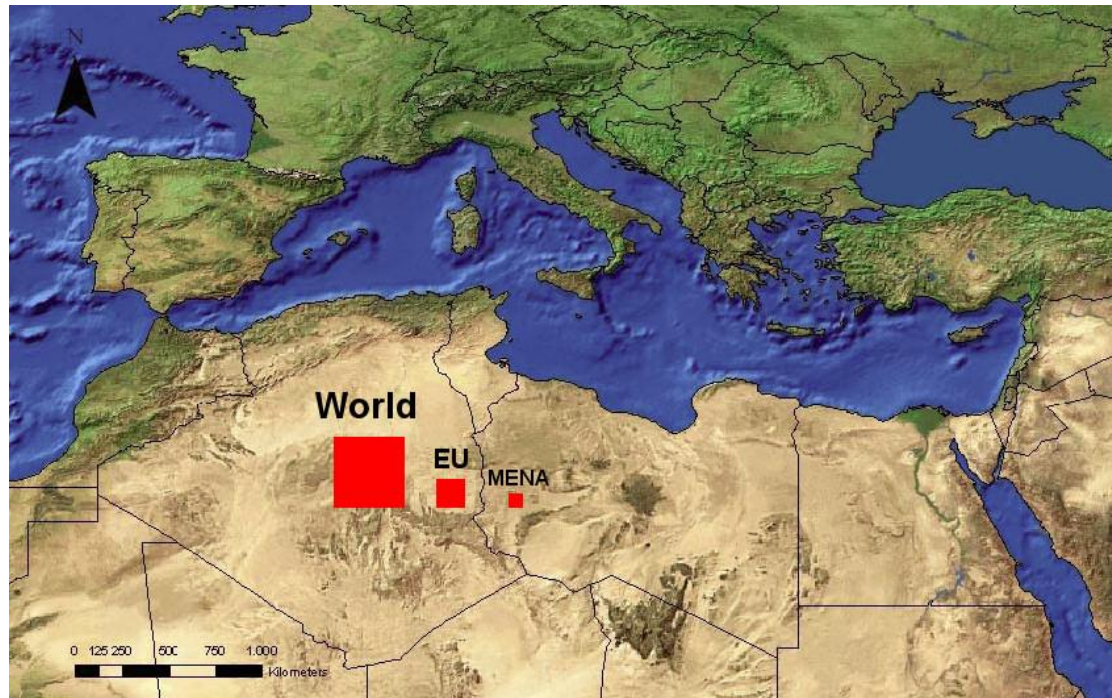
- Solar Energy is the radiant energy emitted from the surface of the Sun and received by Earth
- The amount of energy emitted by the Sun is approximately 3.84×10^{26} J/s.
- The amount of energy the Earth's surface receives from the Sun is roughly 9×10^{16} J/s



- What is solar energy?
- Why is solar energy important?
- How can solar energy be utilized?
 - Power generation
 - Water heating
 - Refrigeration
 - Desalination
- Limitations and challenges of solar energy

Why is Solar Energy Important?

- The amount of solar energy the Earth receives is huge
- Solar energy is free and renewable
- Solar energy is clean (no carbon emissions)
- Less than 0.01% of this energy can provide electricity to the entire world population



Why is Solar Energy Important?

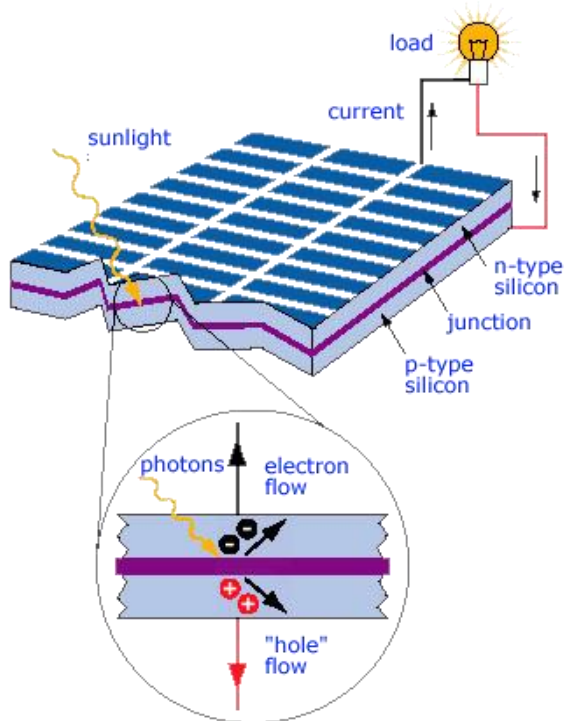
- Solar energy reduces the consumption of fossil fuels
- Fossil fuels can be a valuable resource for other industries
- Fossil fuels contribute to the pollution problem



- What is solar energy?
- Why is solar energy important?
- How can solar energy be utilized?
 - Power generation
 - Water heating
 - Refrigeration
 - Desalination
- Limitations and challenges of solar energy

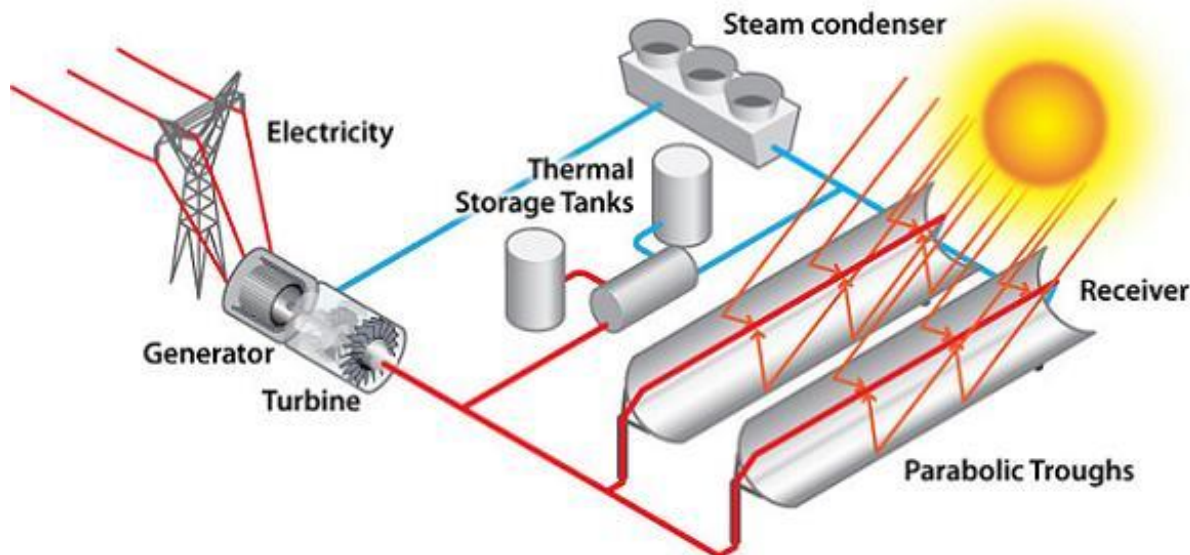
Power Generation Photovoltaic Panels

- Photovoltaic panels convert part of light directly to electricity.



Power Generation Parabolic Trough Collector (PTC)

- PTCs concentrate sunlight on a single tube to heat a fluid
- This fluid is used to generate steam
- The steam drives a turbine



Power Generation Central Receiver Systems

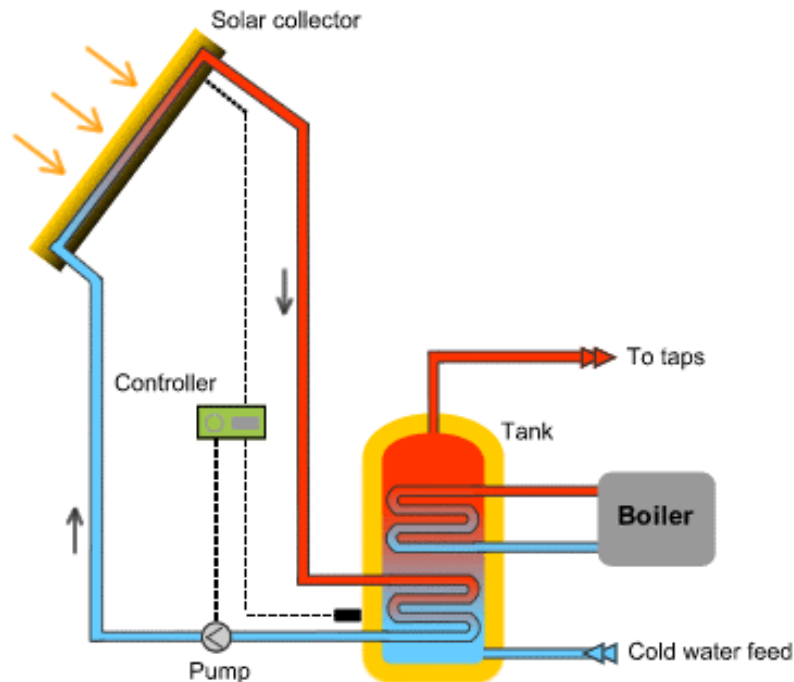
- Mirrors track the sun to focus sunlight on a single point instead of a line.



- What is solar energy?
- Why is solar energy important?
- How can solar energy be utilized?
 - Power generation
 - Water heating
 - Refrigeration
 - Desalination
- Limitations and challenges of solar energy

Water Heating

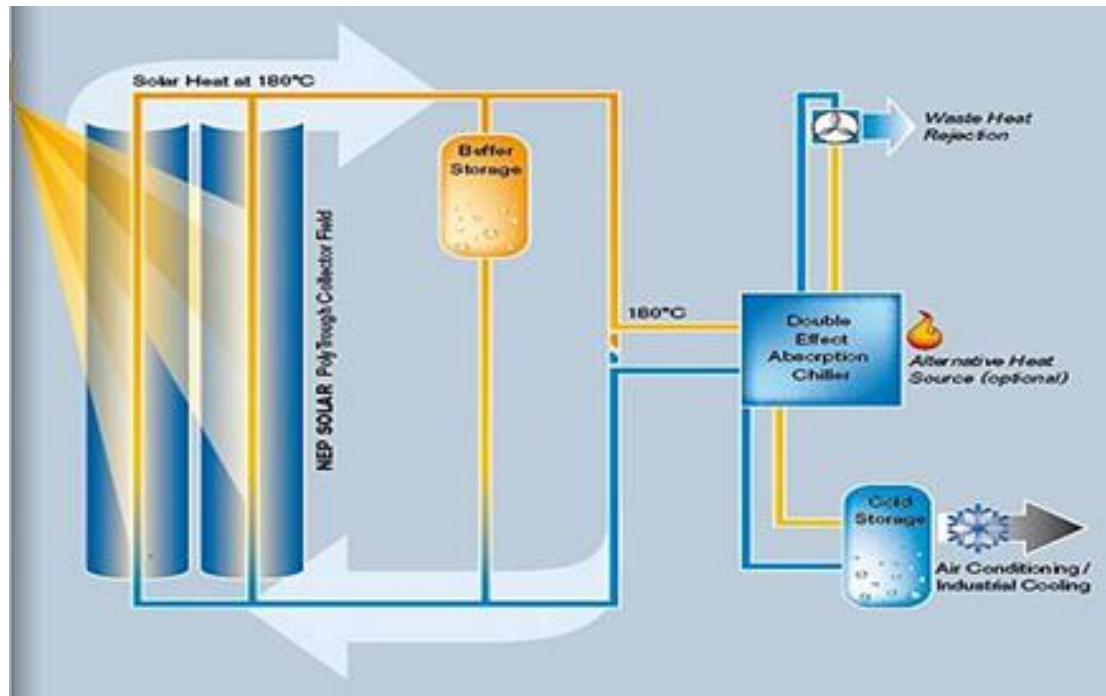
- Usually stationary collectors are used on roof tops
- The collectors absorb sunlight and transfer it to the water (or other fluid) flowing inside the tubes



- What is solar energy?
- Why is solar energy important?
- How can solar energy be utilized?
 - Power generation
 - Water heating
 - Refrigeration
 - Desalination
- Limitations and challenges of solar energy

Refrigeration

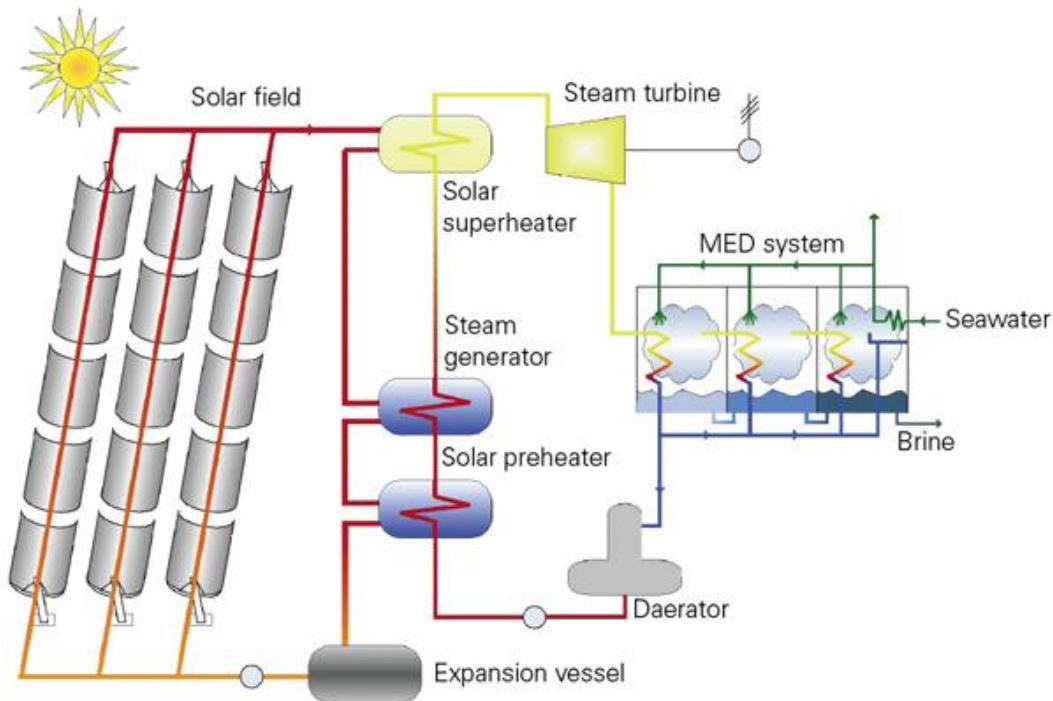
- Electricity can be used directly to operate conventional vapor compression systems
- Alternatively, a fluid is heated to drive an absorption refrigeration system



- What is solar energy?
- Why is solar energy important?
- How can solar energy be utilized?
 - Power generation
 - Water heating
 - Refrigeration
 - Desalination
- Limitations and challenges of solar energy

Desalination

- Electricity can be used directly to operate a reverse osmosis (RO) system.
- Alternatively, a fluid is heated to provide steam to a thermal desalination system



- What is solar energy?
- Why is solar energy important?
- How can solar energy be utilized?
 - Power generation
 - Water heating
 - Refrigeration
 - Desalination
- Limitations and challenges of solar energy

- Solar energy is intermittent
 - **Not available at night**
 - **Limited availability on cloudy, rainy, or dusty days**
 - **Amount received in the early morning and late afternoon is limited**
- System cost is still relatively high compared to fossil fuels (especially when fossil fuel prices are too low)
- Cleaning of collectors is necessary to avoid reduction in performance due to dust