

# **MCN-201 :**

# **SUSTAINABLE ENGINEERING**

## **Module 4**

**Bushara A R**  
**AP, ECE**  
**KMEA ENGINEERING COLLEGE**

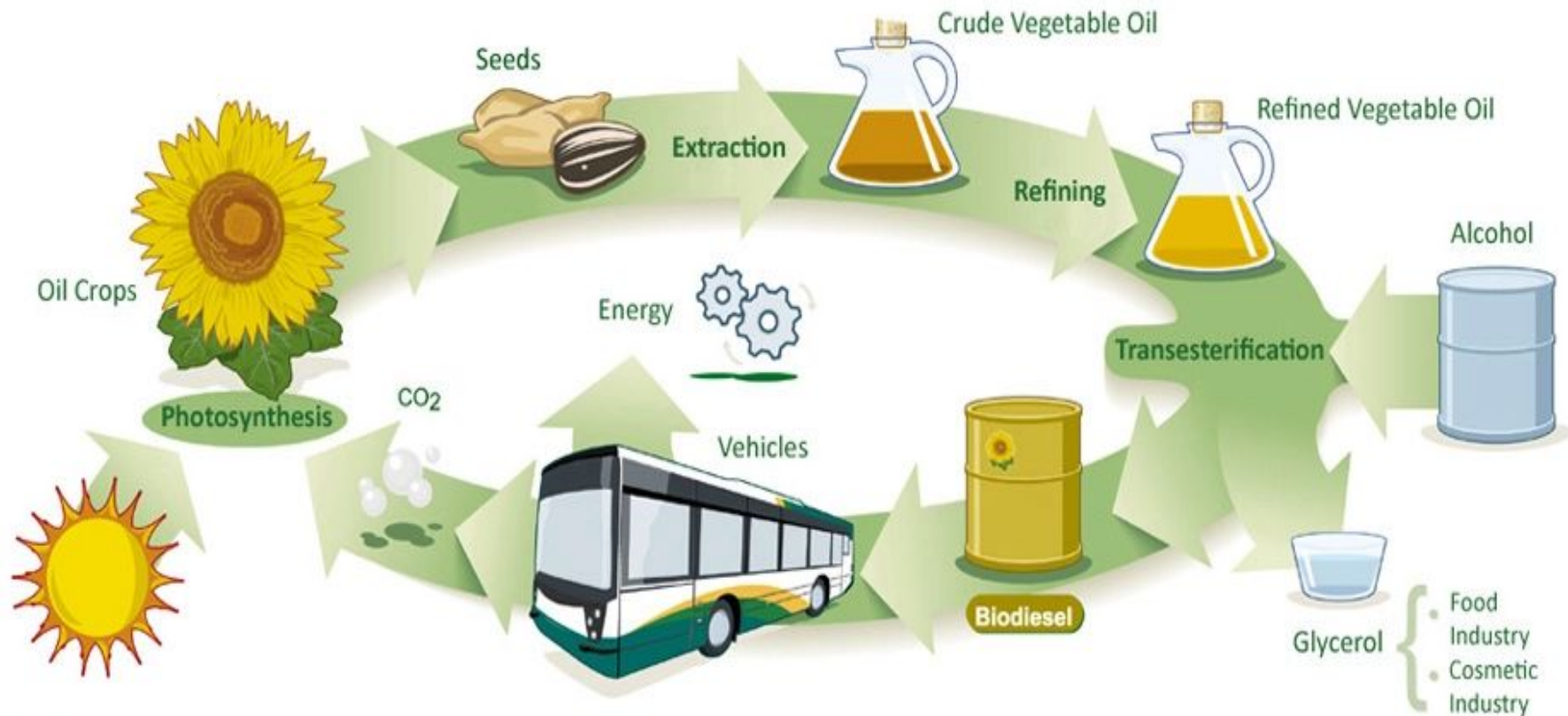
## Module 4

- ★ Resources and its utilisation: Basic concepts of Conventional and non-conventional energy
- ★ Solar energy
- ★ Fuel cells
- ★ Wind energy
- ★ Small hydro plants
- ★ Bio-fuels
- ★ Energy derived from oceans and Geothermal energy.

## 6. Bio-fuels

- ★ **Biofuel**, any fuel that is derived from **biomass**—that is, plant or algae material or animal waste.
- ★ Since such feedstock material can be refill readily, biofuel is considered to be a source of renewable energy

# The Biodiesel Cycle



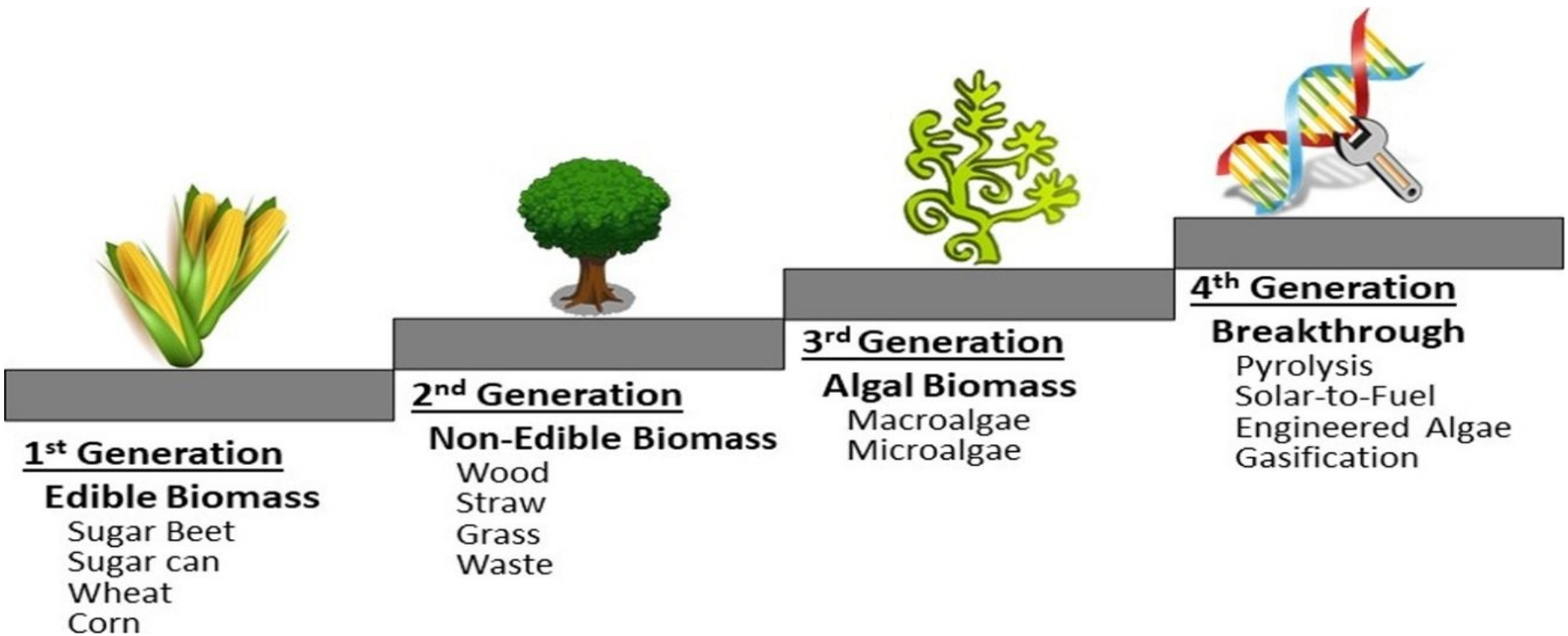
## Types of Biofuels

two categories: gaseous biofuel and liquid biofuel.

- ★ **Gaseous Biofuel:** two types - Biogas and syngas are
- ★ **Biogas and Biomethane :** Biogas is methane generated in the process of anaerobic digestion of organic matter by anaerobes.
- ★ **Syngas:** Syngas is a mix of carbon monoxide, hydrogen, and other hydrocarbons, which is produced by partial combustion of biomass.
  
- ★ **Liquid Biofuel: two types** - bioethanol and biodiesel.
- ★ **Bioethanol:** Bioethanol is a type of alcohol produced by fermentation, often from carbohydrates made in sugar or starchy crops like corn, sugarcane, or sweet sorghum.
- ★ **Biodiesel :** Biodiesel, as the most common biofuel in Europe, is generated from oils or fats using transesterification.

# Biofuel Generations

There are four generations of biofuels based on how they are made.



# Biofuels Advantages

- ***Efficiency***

Biofuel is produced from renewable resources and relatively less-flammable than fossil diesel.

- ***Cost***

As of now, the cost of biofuels in the market is the same as gasoline. As the demand for biofuels increases, it is also possible that they will become cheaper in the future.

- ***Durability***

Biofuels are compatible with current engine designs and work very well in most conditions.

- ***Easy Access to Resources***

Biofuels are made from various sources, including manure, crop waste, algae, other byproducts, and plants grown specifically for fuel.

- ***Reduction in Greenhouse Gas Emissions***

Studies show that biofuels decrease greenhouse gases by up to 65 percent.

# Biofuels Disadvantages

- ***Food Shortage***

Biofuels are obtained from crops and plants that contain large amounts of sugar. However, most of these crops are also accepted as food products.

- ***Weather Limitations***

Biofuels are less suitable for application in low temperatures.

- ***Use of Fertilizers***

This is a problem that biofuel crops, food crops, gardens, and lawns have in common all over the world. The growth of all of these plants is better when fertilized.



## 7. Energy derived from oceans and Geothermal energy

- Ocean Thermal Energy, also called Ocean Thermal Energy Conversion (OTEC), is an electricity generation system
- OTEC using the temperature difference between the deep parts of the sea, which are cold and the shallow parts of the sea, which are cold, to run a heat engine and produce useful work.
- The deeper parts of the ocean are cooler because the heat of sunlight cannot penetrate very deep into the water.
- Greater the temperature difference, the greater the efficiency.

- In open cycle OTEC, the seawater plays a multiple role of a heat source, working fluid, coolant and heat sink.
- Warm surface water enters an evaporator where the water is flash evaporated to steam under particle vacuum.
- Low pressure is maintained in the evaporator by a vacuum pump.
- The low pressure so maintained removes the non-condensable gases from the evaporator.

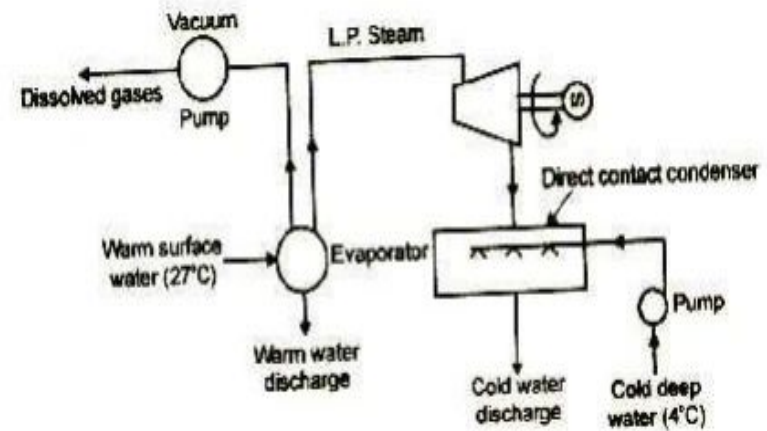


Figure: OTEC – open cycle.

- The steam and water mixture from evaporator then enters a turbine, driving it thus generating electricity.
- The exhaust from the turbine is mixed with cold water from deep ocean in a direct contact condenser and is discharged to the ocean.
- The cycle is then repeated. Since the condensate is discharged to the ocean, the cycle is called open.

- Here, a separate working fluid such as ammonia, propane or Freon is used in addition to water.
- The warm surface water is pumped to a boiler by a pump.
- This warm water gives up its heat to the secondary working fluid thereby losing its energy and is discharged back to the surface of the ocean.
- The vapours of the secondary working fluid generated in the boiler, drive a turbine generating power.
- The exhaust from the turbine is cooled in a surface condenser by using cold deep seawater, and is then circulated back to the boiler by a pump.

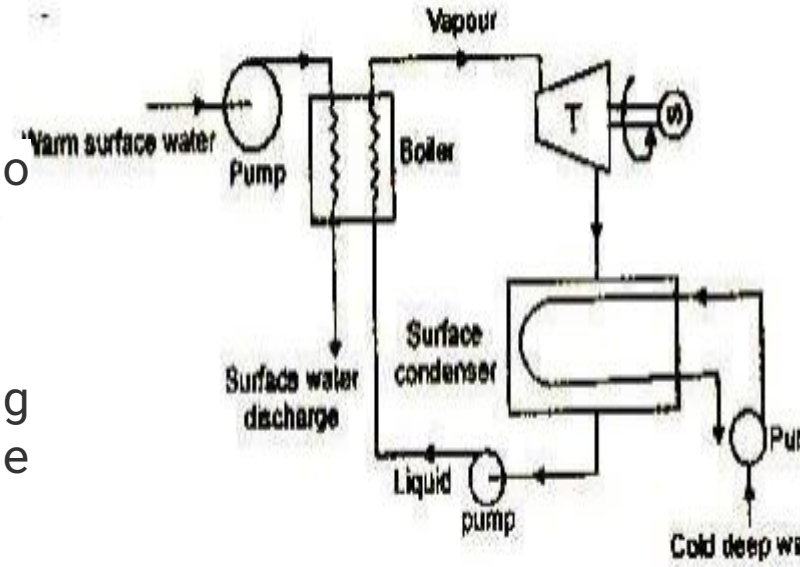


Figure: OTEC - closed cycle

## **Advantages of OTEC**

1. Ocean is an infinite heat reservoir which receives solar incidence throughout the year.
2. Energy is freely available.

## **Disadvantage of OTEC**

1. Efficiency is very low, about 2.5%, as compared to 30-40% efficiency for conventional power plants.
2. Capital cost is very high.