RAMA UNIVERSITY

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FACULTY OF ENGINEERING AND TECHNOLOGY

Bio-mass:

•**Biomass** is plant or animal material used for energy production (electricity or heat), or in various industrial processes as raw substance for a range of products.

•Biomass is biological organic matter derived from living or recently-living organisms.

•Bioenergy is the energy contained (stored) in biomass.

•Two forms of biomass

•Raw: forestry products, grasses, crops, animal manure, and aquatic products (seaweed

•Secondary: materials that undergone significant changes from raw biomass. Paper, cardboard, cotton, natural rubber products, and used cooking oils.

•Biomass is considered renewable as either a feedstock or waste and due to government incentives, corporate sustainability goals and climate change initiatives, a majority of the conversion technologies use biomass to produce various forms of renewable energy.

•The type of energy includes electrical power, thermal energy, renewable natural gas, biodiesel, jet fuel, and ethanol.

•Biomass also can be used as a substitute for fossil fuels in the manufacturing of high value products including plastics, lubricants, industrial chemicals, and many other products derived from petroleum or natural gas.

•On combustion, the carbon from biomass is released into the atmosphere as carbon dioxide (CO_2). After a period of time ranging from a few months to decades, the CO_2 produced from combustion is absorbed from the atmosphere by plants or trees.

•There are four types of conversion technologies currently available that may result in specific energy and potential renewable products:

Thermo chemical conversion

Thermal conversion is the use of heat, with or without the presence of oxygen, to convert biomass into other forms of energy and products. These include direct combustion, pyrolysis, and torrefaction.

Combustion is the burning of biomass in the presence of oxygen. The waste heat is used to for hot water, heat, or with a waste heat boiler to operate a steam turbine to produce electricity. Biomass also can be co-fired with existing fossil fuel power stations.

Pyrolysis convert biomass feedstocks under controlled temperature and absent oxygen into gas, oil and biochar (used as valuable soil conditioner and also to make graphene). The gases and oil can be used to power a generator and some technologies can also make diesel and chemicals from the gases.

Torrefaction is similar to pyrolysis but in a lower operating temperature range. The final product is an energy dense solid fuel often referred to as "bio-coal".

Thermochemical conversion is commonly referred to as gasification. This technology uses high temperatures in a controlled partial combustion to form a producer gas and charcoal followed by chemical reduction. A major use for biomass is for agriculture residues with gas turbines. Advanced uses include production of diesel, jet fuel and chemicals.

Biochemical Conversion involves the use of enzymes, bacteria or other microbes to break down biomass into liquids and gaseous feedstocks and includes anaerobic digestion and fermentation. These feedstocks can be converted to energy, transportation fuels and renewable chemicals.

Chemical Conversion involves the use of chemical agents to convert biomass into liquid fuels which mostly is converted to biodiesel.

Ocean Thermal Energy Conversion (OTEC):

- **Ocean Thermal Energy Conversion** (**OTEC**) uses the ocean thermal gradient between cooler deep and warmer shallow or surface seawaters to run a heat engine and produce useful work, usually in the form of electricity. OTEC can operate with a very high capacity factor and so can operate in base load mode.
- Ocean Thermal Energy Conversion (OTEC) technology uses a turbine generator to create renewable energy from the temperature difference between cold, deep seawater circulating in the ocean and surface seawater warmed by the sun. In order to produce power with the low temperature range, a working fluid with low boiling point is used.
- The amount of energy created is dependant on the amount of water available to cool or heat the working fluid.
- The Okinawa OTEC project has a maximum capacity of 100kW, but since it does not always have access to the maximum capacity due to other seawater users, will often produce less electricty.
- This is due to the previous use of water by local industries and the Okinawa Deep Seawater Research Center, and does not hinder the project's goal of demonstration and testing.
- Ocean thermal energy conversion (OTEC) is a process or technology for producing energy by harnessing the temperature differences (thermal gradients) between ocean surface waters and deep ocean waters.
- Energy from the sun heats the surface water of the ocean. In tropical regions, surface water can be much warmer than deep water. This temperature difference can be used to produce electricity and to desalinate ocean water. Ocean Thermal Energy Conversion (OTEC) systems use a temperature difference (of at least 77° Fahrenheit) to power a turbine to produce electricity. Warm surface water is pumped through an evaporator containing a working fluid. The vaporized fluid drives a turbine/generator.
- The vaporized fluid is turned back to a liquid in a condenser cooled with cold ocean water pumped from deeper in the ocean. OTEC systems using seawater as the working fluid can use the condensed water to produce desalinated water.

PRINCIPLES OF OTEC PLANT OPERATION

•OTEC or ocean thermal energy thermal conversion is a technology which converts solar radiation absorbed by the oceans to electric energy. The ocean's can be considered as the world's largest solar energy collector as it covers two third of the earth surface.

•The working principle of an OTEC plant is that it uses the warm water to heat and vaporize a liquid (working fluid) and this working fluid develops pressure which forces it to evaporate and the expanding vapour runs through a heat engine like turbine, generator, and it is condensed back into a liquid by cold water brought up from depth and the cycle is repeated.

•There are basically three types of OTEC power plant:

1. Closed cycle
2. Open cycle
3. Hybrid cycle

•Most of the electricity we use comes from heat engines of one kind or another. A heat engine is a machine that cycles between two different temperatures, one hot and one cold, usually extracting heat energy from a fuel of some kind.

•In a steam engine or a steam turbine, for example, coal heats water to make hot, high-pressure steam, which is then allowed to expand and cool down to a lower temperature and pressure, pushing a piston and turning a wheel as it does so.

•The greater the temperature difference between the hot steam and the cooled water vapor it becomes, the more energy can be extracted

Advantages and disadvantages

Advantage

OTEC sounds immensely attractive: it's clean, green renewable energy that doesn't involve burning fossil fuels, producing large amounts of greenhouse gases, or releasing toxic air pollution. By helping to reduce our dependence on fuels such as petroleum, OTEC could also help to reduce the "collateral" damage the world suffers from an oil-dependent economy—including wars fought over oil and water pollution from tanker spills. It could also provide a very useful source of power for tropical island states that lack their own energy resources, effectively making them self-sufficient. As we've already considered, open-cycle OTEC can play a useful part in providing pure, usable water from ocean water. OTEC can also be used to produce fuels such as hydrogen; the electricity it generates can be used to power an electrolysis plant that would split seawater into hydrogen and oxygen, which could be bottled or piped ashore and then used to power such things as fuel cells in electric cars. The waste cooling water used by an OTEC plant can also be used for **aquaculture** (growing fish and other marine food such as algae under controlled conditions), refrigeration, and air conditioning.

Disadvantages

The biggest problem with OTEC is that it's relatively inefficient. The laws of physics (in this case, the Carnot cycle) say that any practical heat engine must operate at less than 100 percent efficiency; most operate well below—and OTEC plants, which use a relatively small temperature difference between their hot and cold fluids, have among the lowest efficiency of all: typically just a few percent. For that reason, OTEC plants have to work very hard (pump huge amounts of water) to produce even modest amounts of electricity, which brings problems.