CHAPTER ONE

INTRODUCTION

CHAPTER - I

INTRODUCTION

***

CHAPTER - I

INTRODUCTION

1.1 ENERGY :

1.1.1 Historical Background :

'Energy', the art of the universe, momentum of the matter against resistance. From the physics point of view we can define energy as 'any thing that makes it possible to do work' All matter and all things have energy. On this planet, man relied primarily on the energy generated by his own muscle power to hunt and gather his food and protect himself, from the elements.

In the stone age, man discovered fire - which was almost accidental and was the first attempt of man to use energy from a sources outside his own body. Since then he has continuously and increasingly using outside energy for better living and civilization. The rapid progress of human being that occurred during the historic period from some 3000 or 4000 years ago, is characterised by the use of Solar Energy indirectly through the biological system that produced grain and animals for man's survival.

The first major transition in man's energy use come with his domestication of plants and animals. He understand that, agricultural and animal husbandry were capable of producing far more energy per capita with the energy resources of the sun and renewable crops.

1.1.2 The Energy Crisis :

As the food supply grow more plentiful, populations increased, man's energy need also increased. In the early days of the civilization, the only significant energy source were natural ones i.e. solar and renewable crops, but to fulfil the emerging energy need, man goes on hunting energy from the power of falling water and the use of wind for ships. In industry, the central energy source was fire from the burning of wood. Wood becomes a source of charcoal for reducing ores to metals. Hard wood needed for charcoal production to fuel the early phases of industrialization, was in increasingly short supply. This hastened the transition to coal and the fuel revolution. For the first time, man began systematically to consume the global non-renewable source of energy i.e. fossil fuels. The first fossil fuels to be exploited were surface deposits of asphalt peak and coal, oil from surface seapage and gas venting from underground reservoir

The industrial revolution, however, did lead generally to higher productivity - and the need for more and more reserviors from underground in the form of cheap energy. Petroleum though not extensively used at first, came into prominence in the 17th century. The widespread use of petroleum and petroleum product starting from the early 20th century, particularly for cars, aeroplanes and industry, gave a new dimension to this revolution

The higher productivity made possible by 'cheap energy' that made available from underground. The cheap energy has made possible the worldwide transportation and communication infrastructures which make for increasing global interdependence. But they, in turn, increasingly heighten the expectations and demands of civilization all over the globe.

On the other hand the challenge now before us, as we face the hard reality of the end of the 'cheap energy'. For many of use the awareness of energy has also come about through day to day inconveniences caused by power cuts. Shortage of kerosene and diesel, fuel rationing, and the increasing cost of obtaining energy. Hence this is the time where we can rethink on energy strategies or alternative energy for present limited conventional source of energy.

1.2 ALTERNATIVE SOURCES OF ENERGY :

It is clear that for a few years to come, energy would be mainly coming from conventional sources like coal, hydro, fuelwood, nuclear etc. However, alternative energy sources like solar, wind, tidal, Geothermal and Biomass energy should find wide application in future. Such energy sources are renewable by nature and have also the advantage of generally producing energy in non-polluting form.

We live in a world weith energy all around us. We must know the energy distribution on the earth. To consider the earth and its atmosphere as a total system, the overall flow of energy on and to the earth is shown in Fig.1.1a,b with its conversion units. The energy inputs of the earth are the energy coming from the sun by means of solar radiation and the energy derived from the mechanical, kinetic and potential energy of the earth-sun-moon system which is modified in the wind, tidal, geothermal and biomass energy.

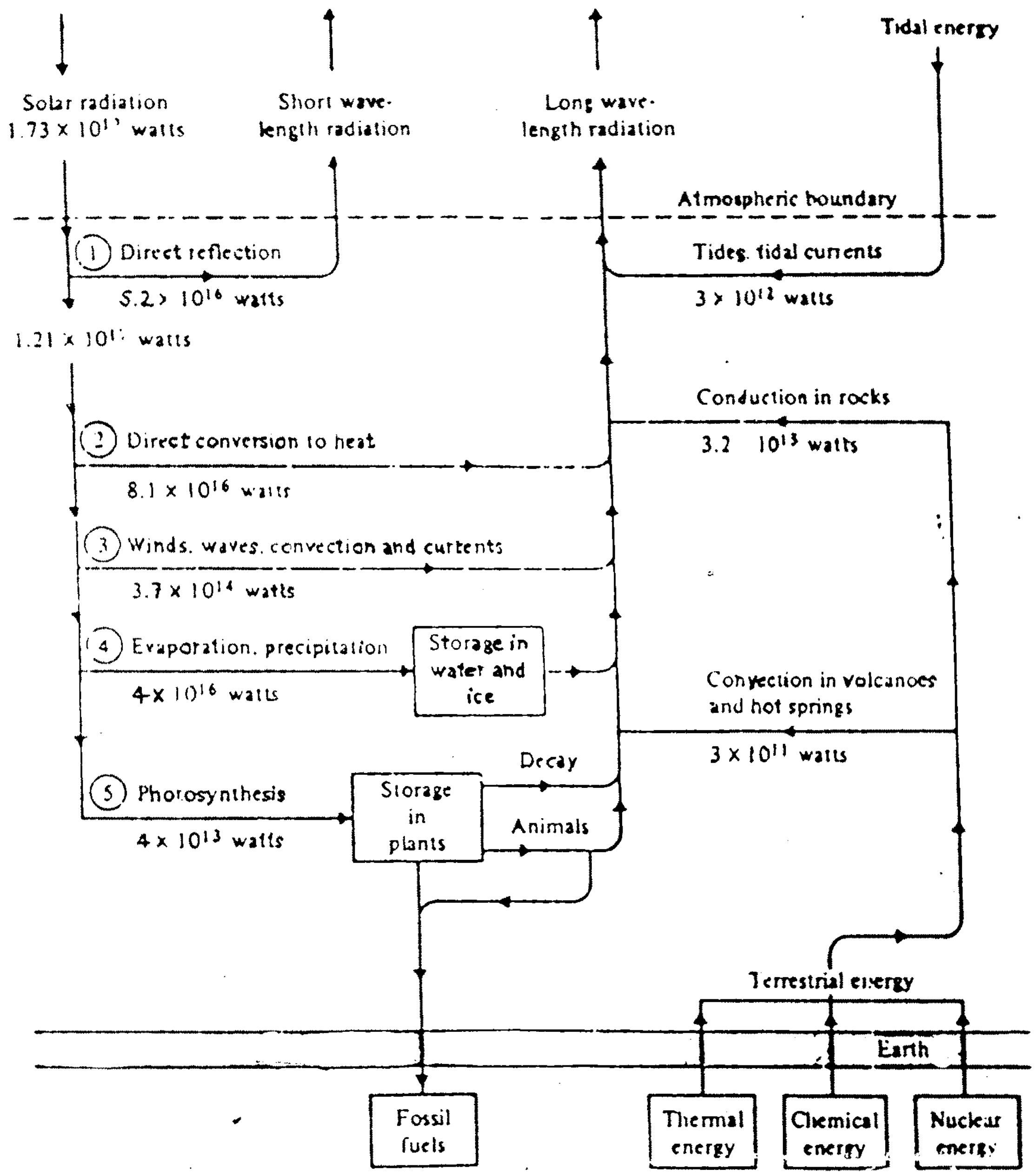

Fig. 1.1a : Energy Flow Diagram of the Earth

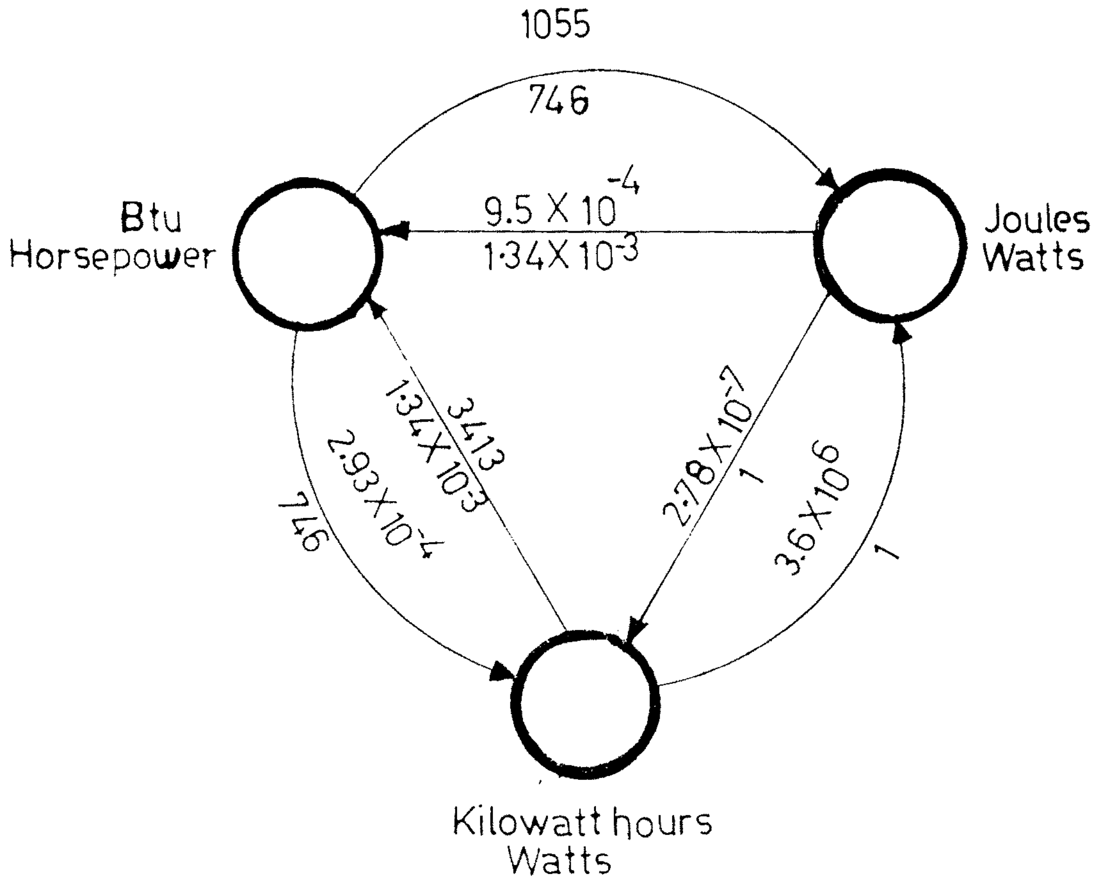

Fig. 1.1b : Energy Conversion Trangle : The number above the line converts the energy unit, and the number below the line converts the power units.

When the solar radiation enters the earth a large part of it (app. 30%) reradiated or reflected back into space as short-wavelength radiation (flow 1). The direct conversion of part of remaining energy is reradiated as a long wavelength (flow 2). Another part (flow 3), hits up differences of temperature in the atmosphere and oceans in such a manner that the convective currents produce the winds, ocean currents, and waves. This mechanical energy is eventually dissipated into heat and radiated into space. Still another part (flow 4), follows the evaporation, precipitation and surface runoff channel of the hydrologic cycle. Heat energy is absorbed during the evaporation of water, but it is again released when the water is precipitated. However, the water vapour being a part of the atmosphere, is convected to high elevations by means of the convective energy of atmosphere. When precipitation occurs at these elevations, the water possess potential energy which again is dissipated back at low temperature heat on the discent to sea level. It is this energy that is responsible for all participation on the land and for the potential and kinetic energy of surface lakes and streams.

A final fraction of the incident solar energy is captured by the leaves of plants by the process of photosynthesis (flow 5). In this process solar energy is stored as chemical energy i.e. Biomass. If energy could be stored in plants and retained indefinitely, as in firewood, the aggregate amount of stored energy could increase rapidly. Due to a wide spectrum of availability under different climatic conditions, it has trimendous scope. It is needed to develope and use it properly as one of the promising alternative energy.

1.3 THE BIOMASS ENERGY :

1.3.1 Biomass :

Biomass includes both terestrial as well as aquatic matter and can be conveniently grouped into new plant growth, plant residues and water. "New plant growth" - includes woods short rotation trees, herbaceous plants, conventional crops, algae (fresh water and marine), aquatic plants. "Residues" - cover not only crop materials, such as straws, husks, bagasse, corn caps etc. but also secondary level products such as cowdung, animal droppings, forest based residues like bark, saw dust, wood shavings etc. 'Wastes' - the term waste has been loosely used. In fact nothing is waste, it is essentially matter of vegetable origin in wrong place. It comprises material of disposable nature like garbage, night soil, sewage solids and industrial refuse. In short Biomass can be defined as the materials derived from biological activities suitable for their conversion to produce energy, are collectively called as biomass.

1.3.2 Biomass Conversion for Energy Use :

The use of biomass as source of energy has tremendous demand. Fig. 1.2 shows the various forms of the conversion for energy use. As per the origin, the Biomass sources may be classified into two broad categories terrestrial biomass and anatic biomass. The terestrial biomass consists of mainly the materials derived from wood, wood plantation, agricultural crops, weeds and organic residues (urban and rural wastes) which are further classified into its content i.e. lignocellulose, starch, saccharose and oil etc. The aquatic biomass consists wet biomass which is available

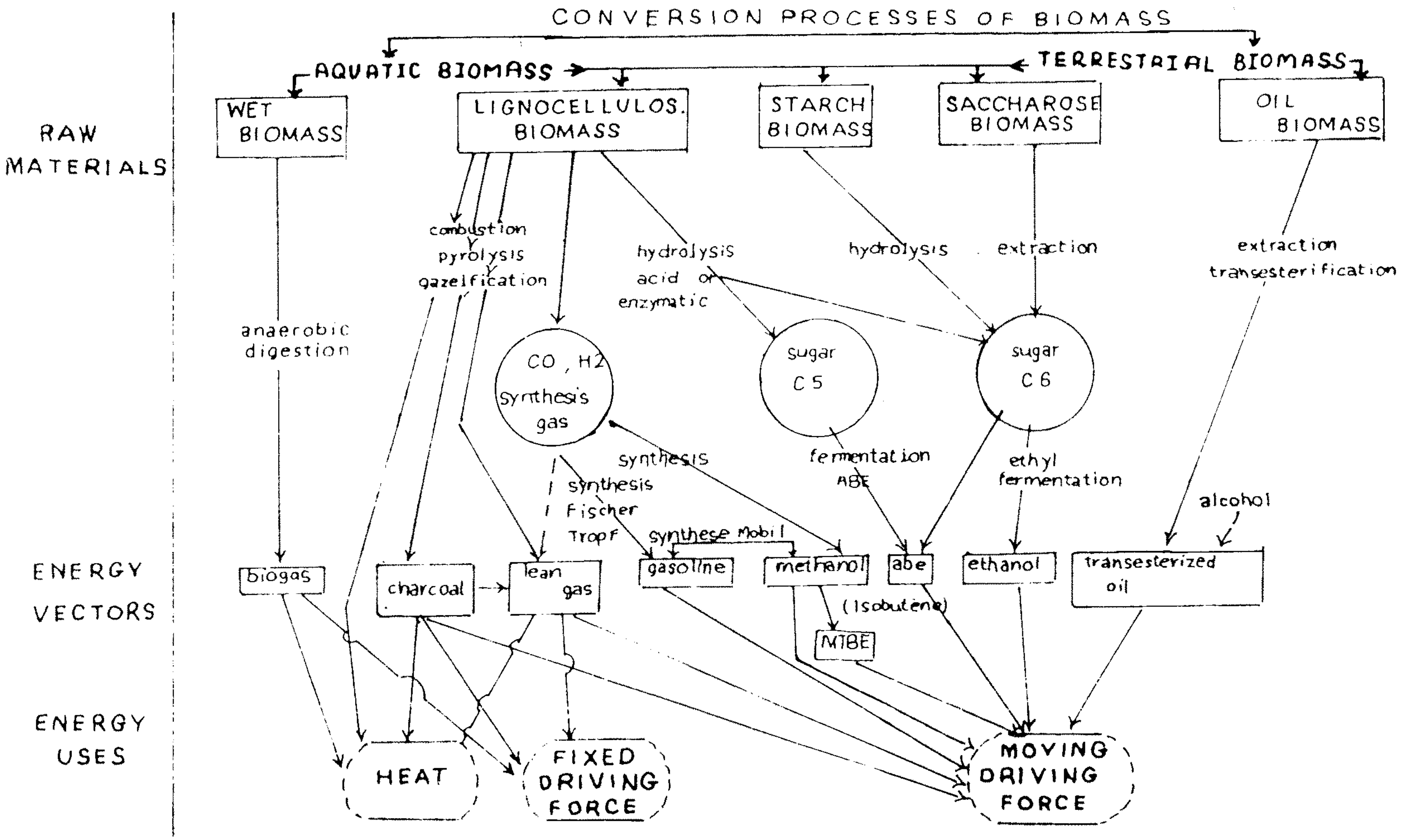

Fig. 1.2: Conversion Processes of Biomass

from micro algae, water hyacinth, duck weeds, graularia, neogradhiella and hypnea etc. which has also ligno-cellulose, starch, saccharose in different purpose. The conversion process of these products into useful energy form is reviewed in following lines.

Biomass i.e. plant products, consists principally of carbon, hydrogen and oxygen which are the basics of energy conversion. There are various biomass energy conversion technologies which can be classified into three fundamental types namely, combustion, production of fuel from essentially dry biomass by chemical means i.e. pyrolysis, hydrolysis (acidorenzymatic), extraction, gassification etc. and aqueous processing means fermentation and anaerobic digestion. The familiar fuels that can be obtained from these conversion processes are biogas, charcoal, lean gas, gasoline, methenol, ethanol and transesterized oil, which can be used for energy use of heating fixed driving force and moving driving force.

1.3.3 Biomass Energy Demand :

It is quite clear that the developing countries will need a mass and growing supply of energy for economic development which is crucial both for their well being and for just and harmonious international relations. At the same time, it must be ensured that the increasing requirements of energy are met from non-oil sources without damage to the environment. In present case special importance is that, all types of energy sources are being used in whole world. High levels of fossil fuel consumption are a special concern. They pose three interrelated atmospheric pollution problems : Air pollution, Acidification of the environment and climatic change.

In developing countries, the increasing energy demand would impose even greater direct damage in terms of resource base, accelerating deforestation, erosion, siltation and flooding and reinforcing the fuelwood crises. There also is an urgent need to reduce noise and air pollution from the vehicles in the urban sectors. So, considering about drawbacks, major attention needs to be given to increasing the use of renewable sources of energy such as hydro, solar, wind and bio-mass. These are all clean and nonpolluting. Among these, biomass energy has its own importance, if used by modern methods such as through fermentation, pyrolysis or modern efficient combustion, can be clean as well as efficient. Besides it, cutting of wood for fuel which in turn is bringing serious environmental consequences in a variety of ways, including erosion of soil, reduction in soil fertility, floods, siltation etc. The demand for fuel wood, which is the most important traditional source of energy for domestic use, has been browing much faster than its production.

It is estimated that against the present requirement of about 133 million tonnes of fuel wood per annum, the annual availability is only around 39 million tonnes. This imbalance eats into the forest in regard to wehich the situation has already been aggravated with the loss of more than 5 million hectares of forest land to agriculture and other developmental activities. Thus, urgent and vigorous steps are needed to undertake a massive programme of biomass energy production and conversion.

1.4 STATEMENT OF THE PROBLEM :

Considering present need and importance of Biomass Energy work has been broadly classified into production and conversion of biomass into useful forms of energy. The objectives of this research work thus includes the fast production of biomass and conversion of it. The complete work is divided into seven chapters.

Chapter I opens with brief introduction of Biomass energy and problem of dissertation. Chapter II consists land location, survey, planning for the energy plantation. After location of land it was tried to test the quality and depth profile of soil. For this, the soil analysis was done. Considering soil plant relation, fourteen species were selected for the plantation. The technique used for plantation was high density agroforestry energy plantation so that maximum yield can be obtained. Plantation study gives the idea about fast growth rate species among the fourteen selected species (including locally adoptable species). Leucaena leucocephala was found the highest growth rate species from the selected fourteen species.

After recognition of fast growing species it was essential to study the biomass production rate of the said plant. The biomass production rate is directly related to the photosynthesis in plants. Hence Chapter III includes detailed study of photosynthesis in Leucaena leucocephala. From the physics point of view, the method used for this study was physico-chemical determination of photosynthesis. The beauty of this method and study is, it measures photosynthetic rate without disturbing plants natural activities. Hence this method is also called as non-destructive measurement method. It was found that Leucaena leucocephala plant is from C_3 plant category. The detailed analysis was also studied which shows coordination between light intensity and photosynthetic rate i.e. as light intensity increases photosynthetic activities also enhancing.

Chapter IV gives the detailed information about the electrical energy conversion from Leucaena leucocephala. In this study, it has been tried successively to generate the electrical current from the Leucaena leucocephala slurry. The various concentrations of the slurry with 0.05 M KCl solution gives different current and constant voltages (1.1V). By successive investigation it will be possible to improve the above resultant current and voltage to run the electrical devices, such as calculators, T.V., Radio etc. by the system.

Chapter V gives the idea to find out the gassious fuel by biological method. The anaerobic digestion of Leucaena leucocephala at room temperature gives the good scope for biogas. The detailed study shows that, it is necessary to optimize some parameters like temperature, pH, conductivity, density of feeding etc. for the efficient biogass production. It is also found that, pure Leucaena leucocephala gives less gas than the biogas produced from system 3:1 (Leucaena leucocephala and cowdung slurry respectively). The maximum biogas produced is 12.5 ml/gam.

In Chapter VI systematic studies on charcoal production by pyrolytic method has been given. The method gives idea about good quality charcoal production. It was found that in 270 to 310^{o}C the cellulosic charcoal quality is good and its calorific value is also maximum. This study reveals that the good quality charcoal and pyrolytic gas can be obtained from Lecucaena leucocephala.

In Chapter VII conclusion obtained from each chapter has been discussed. It was found that Leucaena leucocephala is multipurpose plant for Biomass Energy Programme. It will fulfil, to some extent, the fuel need of rural Indian people.