

Current and future prospects of biomass energy environmental sciences essay



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This report includes, the detail analysis of biomass energy. The advancement made in this sector and the challenges faced by all the stake holders have been thoroughly studied . In the start the basics of biomass and bio fuel is mentioned with its benefits. The process of photosynthesis for the generation and its conversion to other fuels is also discussed in detail. Evaluation of combustion of biomass for the generation of energy was mentioned before presenting its effect on the atmosphere. In the end , the comparison of biomass fuel with fossil fuel is given and also its present market value and future prospects have been included in the report. Table of Contents

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1. Aims

The aim of the report was to select a technical area of my own choice and do a literature survey. I opted for biomass energy for the purpose of research.

2. Objectives

The main objectives are given below: Doing a literature survey in the chosen field. Correct referencingIn depth understanding of the development made in the chosen field.. Effectively communicating my understanding of my chosen topic .

3. Background

Biomass is a renewable energy source, it constitutes of biological matter and is obtained from living things. The main source of Biomass is plants. Biomass sources can regrow because of the growth of plants. Wood is an example of biomass from which we get heat energy. Fuel obtained from biomass having

very low carbon emission is used in most parts of UK. The manufacturing and usage of biomass have several other benefits for the environment. If biomass is used and managed carefully then it can supply fuel in the long term with considerable reduction in carbon emission as compared to fossil fuel.

Advantages of biomass over fossil fuel
Biomass is renewable source of carbon. Emit negligible amount of carbon dioxide
Emit very low amount of methane, sulphate & hydrocarbon
No need to rely on foreign oil

4. Introduction to Bio fuels

Instead of fossil fuel, the remains of living things are used to obtain bio fuels. Food is the main source of the production of bio fuels, other sources include fodder crops. Different types of oils like animal fats and palm oil etc are used to obtain biodiesel. The chemical breakdown of feedstock which contain a high amount of sugar for example sugarcane, maize wheat, are used for the production of bio ethanol. (Steenblik, 2007)
Biomass is basically an organic matter. Heat and electricity can be produced from biomass by burning it. Wood is an example of biomass. Bio energy is the combination of biomass , bio fuels and other fuels. (E. van Thuijl, 2003)

5. Introduction to Biomass

The following steps are used to obtain energy from biomass
The energy from the Sun is seized using the process of Photosynthesis
Energy is stored using compounds having significant amount of Carbon. Production of bio fuels by converting the stored energy through a chemical process. Ignition of bio fuels. Now a days the process of Photosynthesis is used directly to get bio fuel , for example sugar is used for the production of ethanol. In the past bio fuel were obtained indirectly from the process of Photosynthesis. For <https://assignbuster.com/current-and-future-prospects-of-biomass-energy-environmental-sciences-essay/>

example oil obtained from the fat of Whales. In some cases the biomass is used as bio fuel without the requirement of any additional processing e. g the cellulose obtained from the trees. But in most cases the biomass is further processed to get bio fuel because of the high amount of energy stored as is done in case of ethanol. Feedstock is the term used for the further processing of biomass. Sugarcane and corn are feedstock for ethanol. In case of diesel soybeans , palm nuts are feedstock. Feedstock for bio oil consists of hydrocarbons. (Tony, 2006)<http://blogs.princeton.edu/chm333/f2006/biomass/biomass-flowchart.gif>Figure 1 Benefits of using biomass as a sustainable fuel (Tony, 2006)[biomass%20comparison.bmp](http://blogs.princeton.edu/chm333/f2006/biomass/biomass-comparison.bmp)Figure 2 Process of biomass conversion (Tony, 2006)Figure 3 Typical Gas Yields from selected feedstock (A. Barnett, 1978)If managed properly, biomass can offer a number of benefits. (A. Barnett, 1978): Biomass produce very small proportion of carbon. Biomass can help secure the supply of energy on a long term in UK because of its local production. Local production of biomass can help in providing job opportunities and also help in the uplift of the economy. Better management of forest areas can be achieved as it provides financial help due to the production of bio fuel. As biomass can be produced almost anywhere in UK, this greatly reduce cost of transportation. The generation of Sulphur dioxide (leading cause of acid rain) is very low in biomass fuels. Now a days very advance combustion systems are in use, that greatly enhances combustion efficiency.

6. Photosynthesis

The first step involved in the generation of biomass energy is the capture of solar energy in a process called photosynthesis. Energy was naturally

trapped in solar photons thousands of years ago, this is known as photosynthesis. In plants the photons present inside combines with chlorophyll molecules which result in the excitation of electrons to higher energy level. Due to chlorophyll photo reaction the electrons are disunited from electron holes, this separation allow them to react with different molecules present on other side of the photo reaction centre. The electron reduces carbon dioxide & protons to carbohydrates and the electron hole oxidizes water to oxygen , protons and electrons. (Stigliani, 2012)The absorption of light in the chlorophyll structure is in the region of 4000-700nm of the radiation spectrum, this is known as active radiation and consists of 50% of the energy in solar photons. 80% photons are absorbed by plants in the 400-700nm range, the remaining 20% are either reflected , transmitted or absorbed by molecule. 28% of the total 40% of solar energy absorbed by the chlorophyll antenna system change into carbohydrates, the remaining energy is lost in the transfer of electron. So the total efficiency of conversion from solar energy to carbohydrate is $50\% * 80\% * 28\% = 11\%$. Plants uses 40% of the energy for its own chemical processes, remaining $11\% * 60\% = 6.7\%$ of solar energy is stored in the form of photosynthetic energy. The highest conversion of efficiency is for C4 type of plants such as sugarcane and corn. The conversion efficiency for C5 plants is half as efficient because there is a big difference in the photosynthetic system. (Stigliani, 2012)

7. Production & conversion of biomass energy into fossil fuels

Biological energy can be stored in carbohydrates but they are obtained from biomass of plants. The prime reason is that plant biomass contain huge

amount of water. Inside the plants the carbohydrates are present in the form of watery solution such as glucose. They can also be found in the form of moisture. Wood which is obtained by cutting down a tree and then dried is an example of biomass energy in the form of carbohydrate. When carbohydrates are initially extracted they cannot be used for combustion, First they have to be dried due to high amount of water present in it. In case of wood it is called wood drying and for fuels in liquid form the carbohydrates are converted to a form in which there is no water content, which is usually aqueous alcohol from which 95. 6% alcohol is obtained through distillation , it is further purified to get 99. 5% anhydrous alcohol. The process of distillation can be avoided by using plant oil for bio fuel, because it is not possible for both oil and water to form a homogenous mixture. A solvent in which oil can easily dissolve is used to obtain oil from crushed plant. (A. Barnett, 1978)The combustion of crude carbohydrates is not possible inside internal combustion. It is because of two reasons. Carbohydrates can be dissolved by the internal fluids present in plants. They are in solid state when separated from fluids present inside the plants. Solid state is not desirable for internal combustion engine because of the gases present inside the combustion chamber. Liquid form at room temperature without the presence of water content is ideal for internal combustion engine. Carbohydrates in solid form is useful only for external combustion engine such as for use in power plants. In external combustion engines the working gases that are used for the movement of turbine are segregated from combustion gases. The prime example of this is in Brazil where cellulose which is obtained from sugar cane is scorched in refineries to generate power. The generated electricity is then sold to grid station. (Stigliani, 2012)Certain types of oils <https://assignbuster.com/current-and-future-prospects-of-biomass-energy-environmental-sciences-essay/>

extracted from plants for example liquid triglycerides is used in internal and external combustion engine in its raw form, however few changes in the engine is necessary because of the different structure of triglycerides as compared to other liquid fuels. The viscosity of triglycerides is high due to which it cannot be used in conventional engines. (Stigliani, 2012)

8. Combustion of the bio fuels

Energy has to be obtained from bio fuels in some way. Energy is extracted from bio fuels through the process of combustion. In this process oxygen reacts with the fuel and as a result energy is released. During this process atoms in transition state are formed due to the breakage of oxygen and fuel bonds. As the stability of the free atoms is small as compared to bonded atoms therefore some input energy is required. Molecules can be obtained due to the combination of atoms during transition state, which results in the release of energy. For the period of time in which the end product release greater energy as compared to the input energy to shatter the reactant, the reaction will continue and it will result in the release of heat energy.

(Stigliani, 2012) Combustion gases are used by the internal combustion engines in a direct manner, in the reaction chamber pressure is increased due to the release of heat energy and finally pressure is increased to the extent which result in the movement of piston. In external combustion engine the process of combustion takes place outside the piston chamber, and provide heat to pressurised gas(steam). The increase of heat increases the volume of the fluid ultimately increasing the pressure inside the turbine chamber. The turbine is moved forward due to the expansion of steam, as a result some of its energy is lost. In the end it is cooled, due to which the

liquid is compressed and it is then recycled. (A. Barnett, 1978)As biomass can produce carbon dioxide gas doubts were cast over its future advantages, therefore it is essential to understand the difference between fossil fuel and biomass energy. (Stigliani, 2012)Fossil and contemporary carbon is the main difference between biomass and fossil fuel. When fossil fuel is burnt it converts stable carbon into carbon dioxide and when biomass fuels are burned it gives contemporary carbon to the atmosphere which is taken by the growing plants. (Stigliani, 2012)If fuel from wood is obtained from better managed forests, this will result in the removal of carbon from the atmosphere produced during combustion because other trees in the forest photosynthesise. (Stigliani, 2012)

9. Biomass and Carbon Emissions

Energy obtained from biomass through the process of gasification, the total amount of carbon emitted is captured in its life cycle. Which prevents the atmosphere from any additional carbon. In case of fossil fuel, the carbon produced during its production and consumption is locked in the atmosphere for hundreds of years. Biomass Carbon Cycle Diagram Figure 4 Difference between fossil fuel and biomass energy production (McKendry, 2002) Figure 5 Bioelectricity production in EU in 2002 (E. van Thuijl, 2003)

10. Carbon Dioxide Emissions and GHG Profiles

According to U. S Department of Energy the biggest advantage of biomass is that they do not increase the amount of carbon dioxide in the environment if the emitted carbon dioxide are isolated in growing the crop from which biomass fuel is produced. But it is very difficult to determine how much

carbon dioxide is emitted and how much carbon dioxide is isolated in <https://assignbuster.com/current-and-future-prospects-of-biomass-energy-environmental-sciences-essay/>

cellulose. One of the disadvantage of bio fuel is that the area assigned for its growth could be utilized to isolate more carbon dioxide. The table below shows the total emission of carbon dioxide in comparison to other traditional fuels. (Electric Power Research Institute, 1997)carbon%20dioxide %20emissions. bmpFigure 6 Carbon equivalent of the different forms of energy productions (Electric Power Research Institute, 1997)The waste produced by biomass have its own disadvantages. Emission from NOx damage the ozone layer and also causes global warming. Carbon monoxide is harmful for living beings and also increases global warming. (E. van Thuijl, 2003)

11. Global Warming Potentials:

GWP. bmpFigure 7 Source: IPCC (Paolo Bertoldi, 2004)

12. Biodiesel

The use of B20 decreases emission from hydrocarbon , carbon monoxide and carbon dioxide by 30%, 20% and 78. 5% respectively. The figure below show research done by NREL indicating that NOx emission can be reduced by the use of bio diesel. However different research have shown different results. The results from the latest research done by NREL in 2005 is given below. (Faaij, 2006)biodiesel%20pollution. bmpFigure 8 Source: National Renewable Energy Laboratory (Faaij, 2006)

13. Present Biomass Market

In Europe there is an increase in production of electricity through the use of biomass with varying installed capacity. In 2002 the total bioelectricity installed capacity in EU-15 stood at 6300MW, which is 1. 4% of the total

power generated. (A Bauen, 2004)Figure 9 Installed capacity of Bioelectricity in OECD Europe in the year 2002 (A Bauen, 2004)In Europe the percentage of bioelectricity production was 54% in 2001, where the material used for producing electricity was wood. Power plants used for the generation of both heat and power were responsible for the production of 76. 6% of biomass energy, the rest of the energy was produced in plants used only for electricity generation. Power produced from biomass increased from 1990 to 2000, 5. 2% increase was recorded during that period. The fig shows the rate of energy produced from biomass over a period of time. (A Bauen, 2004)

14. Future developments

Except its operation on a small scale on the basis of low cost, the generation of electricity from biomass is not that viable from the economic point of view in comparison to the power produced by the traditional fossil fuel. The situation can improve with the introduction of incentives for this purpose. With the increase in generation of energy from biomass it is essential to assure that it remains competitive provides efficiency and an economical conversion process. The table shows the efficiencies and cost of bio energy from 2002 to 202. (A Bauen, 2004)

Figure 10 Capital costs and efficiencies of bioelectricity technologies (A Bauen, 2004)

15. Comparison

The energy produced from fossil fuel is widely used throughout the world. It has a number of adverse effects on the atmosphere and it is a major problem in the world now a days. The main sources of power supply to these power plants are oil , gas and coal. Energy produced in nuclear power plants <https://assignbuster.com/current-and-future-prospects-of-biomass-energy-environmental-sciences-essay/>

is also non renewable and produces injurious waste and its capital cost is also very high for electricity generation. Electricity generated from fossil fuel is the most popular form of energy used around the world. Alternate sources include Wind, biomass, Solar & Nuclear energy.

16. Environmental Effects

The main problems caused by the production of electricity by the utilization of biomass is given below. (Brown, 2009)The non availability of land suitable for the plantation of organic material. The calorific value of the organic material is usually very low. Takes a lot of space and also very difficult to transport. These days a lot of research is done on biomass technology and it is not convenient to start its operation immediately. Huge investment is done for studying biomass technology and its future benefits giving rise to a number of economic factors. In reference to the cost factor of biomass electricity generation facility, it is important to take note of the following factors. 1.) Capital cost is low but requires huge quantity of raw material. 2.) The cost of operation and maintenance is very low.

17. Market value

The problems associated with biomass market is its reliance on the price the end user will pay in comparison to other fuels. There is a lot of importance given to the distance between the markets because both efficiency and convenience of collection vary with different regions, because of this reason procurement companies supply fuel directly to the facility. Doubts have also been cast over the production of pollution due to burning of glue. (Barzen, 2009)Regarding the biomass market value, some benefits can be obtained within the goods trading by following some specific regulations. Regarding <https://assignbuster.com/current-and-future-prospects-of-biomass-energy-environmental-sciences-essay/>

the waste, the increase in the quantity of agricultural residue can result in the making of new facilities. There should be stability in supply and standard should be followed for quality and other characteristics. New method should be introduced for the collection of data for the purpose mentioned above.

(Barzen, 2009) Few disadvantages that can affect the market value of biomass are mentioned below Energy to density ration is very low No official institution for making standards and enforcing the rules and regulation. Till date there is no organized system for effective contracting. Difficulty in transportation Insecurity persists about the quantity and the price structure. (Barzen, 2009) Some factors which deteriorate the future prospect of biomass are mentioned for purpose of benefit: Factors that can adversely affect the future prospect of biomass are given below Biomass is still a forthcoming product Non availability of stable market for biomass Small amount of price paid for biomass Long distances for delivery of biomass Non efficiency in harvesting. It is better to have a long term agreement between the vendor and the end user because prices at each facility are different. New facilities should be set up near forests and also in crowded cities. In the next few years there will be more opportunities for suppliers in the market. (Barzen, 2009)

18. Conclusion

It can be concluded that a lot of research has been done for the generation of electricity from biomass, it can produce electricity at low cost , provide energy security on a permanent basis and also contributes to the reduction of green house emissions. However the current pace of the progress is slow and that both the government and private sector needs to remove all the

bottlenecks which is hindering the progress of biomass energy production.

Progress can only be achieved if all the stake holders make a combine effort for making and enforcing of the regulations in biomass sector.