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| Biofuels  Research | A picture containing text, doll, toy, indoor  Description automatically generated |
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| Inauguration of Biofuels *Energy demand has risen rapidly year after year since the start of the industrial revolution. Electricity has become a vital a part of contemporary life, offering a spread of functions such as illuminating rooms, cooking foods and powering motor vehicles. This energy is coming from fuels. Fuels are compounds that emit heat energy when burned or react with oxygen. The burning of fossil fuels now meets the bulk of our energy consumption. However, with the scarcity of fossil fuels reducing and climate change on the rise, the globe is beginning to turn away from fossil fuels in favor of more ecologically pure energy sources. This is where a different form of fuel comes into play: biofuels. Biofuels are combustible fuels that are produced from biomass. These fuels are a renewable resource since they are all derived from biomass, which is organic matter, and their usage results in fewer carbon emissions than that of fossil fuels. Biogas, biodiesel, and bioethanol are the three primary forms of biofuels, and all three have the potential to be key players in the next era of energy production, with its own set of advantages and limitations. Biogas, biodiesel, and bioethanol are the three primary forms of biofuels, and all three have the potential to be key players in the next era of energy production, with its own set of advantages and limitations.* Biogas ***Production of Biogas***  *Biogas is created naturally through a process known as anaerobic digestion. Anaerobic bacteria are used in this procedure to digest complex molecules of organic waste such as animal waste and food waste, producing two products. One is a clean gas that is mostly utilized in rural regions for cooking, heating, and lighting. Two, a product that is a high-quality organic fertilizer used by farmers.* |  |
| Water | Free Full-Text | Performance of a Full-Scale Biogas Plant Operation  in Greece and Its Impact on the Circular Economy  ***Properties of Biogas*** *- Biogas is composed of 55-65 percent methane, 35-45 percent Carbon Dioxide, 0.5-1.0 percent Hydrogen sulphide, and particles of water vapor.*  ***-*** *The presence of Hydrogen sulfide, Carbon dioxide, and Water, biogas is extremely corrosive and necessitates the use of specialised materials, making biogas storage impractical.*  ***-*** *Methane has a density of roughly 0.75 kg/m3 at normal temperature and pressure.*  ***-*** *Biogas has a slightly greater density of 1.15 kg/m3 cause of Carbon Dioxide.*  ***Advantages of Biogas*** *- Methane is removed away from the environment.  - An efficient and simple method for sanitary disposal of organic waste that improves hygienic conditions.  - Lessens the dependency on fossil fuels. The rate of pollution, global warming and climate change is slowed.* ***Disadvantages of Biogas*** *- Difficulty in condensing methane for use as a transportable source of energy, such as car fuel.  - As impurities, biogas includes several gases that are harmful to the metal elements of internal combustion engines.  - Enhancing the productivity of biogas systems is challenging, and the method is not economically appealing on a large industrial scale.* ***Natural Gas vs Biogas*** *Natural gas is a form of fossil fuel that is a naturally produced gas that originates from fossils. Methane is the major component of both natural gas and biogas. The heat of combustion emitted by natural gas is approximately 860 kJ/mol whereas, biogas, emits approximately 530 kJ of energy per mole of CH4 burnt. Because of the reduced methane concentration, the energy emitted is less than that of natural gas. Although biogas produces less energy than natural gas, it is far more cheaper. Carbon emissions are the most major sort of green house gases in terms of quantity, and they have a wide range of environmental impacts, including reduced water supplies, increase in climatic changes, and coastal flooding. Though natural gas emits 2.8 grams of Carbon Dioxide per gram of fuel or around 45 grams of Carbon dioxide per mole of fuel, biogas emits no direct Carbon emissions since its Carbon neutral. This clearly shows that biogases are considerably better for the environment because their carbon pollution per mole are lower.* |  |
| *Biodiesel  Production of Biodiesel**Biodiesel is made from several feedstocks, the most common of which being vegetable oil or animal fat. Impurities from the fat or oil are removed, and the fluidity is altered so that it may be burned in a standard diesel engine without disrupting the fuel lines. This is accomplished by a chemical event known as transesterification. Transesterification is the biodiesel production process and is basically a reaction of vegetable oil and alcohol, most often methanol (CH3OH), aided by a reagent. Therefore, a layer of biodiesel and a layer of glycerol are formed. After that, the glycerol layer is removed, and the biodiesel is rinsed. The excess liquid is then removed.  Towards sustainability -- from a by-product o | EurekAlert!  Properties of Biodiesel  - It is non-toxic and emits less toxins in vehicle emissions. - Non-miscible with water and less dense than water, with a density of 0.86-0.90 g/ml. - A liquid with a range of colours ranging from golden to dark brown. - Biodegradable, which means it may be degraded by bacteria or other living beings.  Advantages of Biodiesel  - Accessible and renewable. - Improves engine function and may be used in any vehicle engine without modification. - Biodiesel contains insignificant or extremely small levels of sulphur and hence emits no Sulphur dioxide into the atmosphere, minimising the contribution to acid rain in the atmosphere.     Disadvantages of Biodiesel  - It is more costly to create than petroleum diesel. - It performs poorly in cold temperatures. - Energy used in manufacturing the biofuel and cultivating certain crops for biofuel production may result in more energy expended in biofuel production than is returned when the biofuel is utilized.  Diesel vs Biodiesel  Diesel is a combination of several hydrocarbons in varying amounts. Hence, its qualities vary slightly depending on its source, which might be fossil fuels or biodiesel sources such as vegetable oils and animal fats. Biodiesel and diesel have somewhat different chemical compositions. As a result, the chemical characteristics of these two fuels differ somewhat. The heat of combustion emitted by diesel is approximately 8MJ/mole, whereas biodiesel is approximately 11MJ/mole. Additionally, biodiesel emits less Carbon dioxide and Carbon monoxide than diesel. Petro diesel releases 3.4 grams of Carbon dioxide per gram of fuel, or approximately 600 grams per mole, whereas biodiesel emits just 2.8 grams per gram of fuel, or approximately 800 grams per mole. Biodiesel, on the other hand, emits somewhat more nitrogen oxides. Furthermore, during the manufacturing of biodiesel from vegetable oils and animal fats, some extra Carbon dioxide is emitted into the sky. The Carbon dioxide emissions created using biodiesel, on the other hand, are not seen as harmful as those caused using Petro diesel. This is because the same Carbon dioxide is utilized in the manufacturing of the plant materials used to make biodiesel. Furthermore, diesel derived from fossil fuels is far more destructive to the environment since it does not remove Carbon dioxide from the atmosphere after millions of years of production, but it does release enormous volumes of Carbon dioxide into the atmosphere during the refining process and when the diesel is utilized. As a result, biodiesel is considerably better for the environment than diesel derived from fossil fuels.  Biodiesel  Production of Bioethanol  Fermentation, distillation, and dehydration are the three essential phases in large-scale ethanol manufacturing. Some crops require saccharification or hydrolysis of carbohydrates such as cellulose and starch into sugars prior to fermentation. Fermentation is a process that converts glucose and other small sugar molecules to ethanol (CH3CH2OH) and carbon dioxide using yeast enzymes.* Sustainable production of bioethanol from renewable brown algae biomass -  ScienceDirect*It is an anaerobic process since it occurs in the absence of oxygen. The starch is first fermented into sugar, and then it is fermented once more into alcohol. Water must be removed from ethanol before it can be used as a fuel. This is accomplished by distillation. Finally, the ethanol passes through a dehydration process.     Properties of Bioethanol  - Ethanol's oxygen concentration leads to increased efficiency, resulting in a cleaner combustion process at relatively low temperatures.  - 78.5 ° C boiling point and -114.1 ° C freezing point.  - Clear and colorless liquid.   Advantages of Bioethanol  - Decrease in the production of ozone.  - Bioethanol may be manufactured locally. This has the potential to produce new jobs in rural regions for bioethanol production plants.  - It is a renewable source of energy with lower carbon emissions than diesel.  Disadvantages of Bioethanol  - Massive amounts of water are necessary for adequate cultivation of biofuel crops as well as the manufacturing of the fuel, putting a pressure on local and regional water resources.  - Bioethanol production on a wide scale necessitates the cultivation of vast swaths of agricultural land for the cultivation of biofuel crops. This can result in land deterioration such as erosion and deforestation.  - Carcinogens may be present in the emissions of automobiles that use bioethanol as a fuel.  Ethanol vs Bioethanol  Ethanol fuel derived from fossil fuels has a heat of combustion emitted of 30 kJ/g, or approximately 1.4 MJ per mole. Bioethanol, on the other end, produces a heat of combustion of 29 kJ/g, or 1.3 MJ per mole. This demonstrates that the heat of combustion released per mole is scarcely different. Their CO2 emissions, on the other hand, varied substantially. While ethanol releases 1.9 grammes of CO2 per gramme of fuel or around 88 grammes per mole, bioethanol generates no direct carbon emissions since it is 'carbon neutral.' This simply proves that bioethanol is far more ecologically relatively harmless than ethanol derived from fossil fuels, as ethanol derived from fossil fuels produces relatively huge volumes of CO2, which hurt the environment in a variety of ways, eventually contributing to global warming and climate change.  Conclusion  Biofuels such as biogas, biodiesel, and bioethanol are 'carbon neutral' and derived from natural, renewable sources such as plants. As a result, they have significant future possibilities in terms of decreasing our dependence on our finite supply of fossil fuels, thus lowering the danger of climate change. Major advancements in the usage of biofuels will be dependent on the discovery of alternative, low-cost, and efficient methods of converting accessible biomass.* |  |

***References*  
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