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Future trends in biofuel

In the past decade, we have seen technological advancements in motor vehicles that run on renewable energy sources. The increasing threat of fossil fuel depletion coupled with the need to maintain renewable sources continues to push for the demand for biofuel.

We live in a world where the global market for biofuels and renewable sources continues to grow in order to maintain the growing population. Our reliance on energy is a global necessity as our government attempts to mitigate the growing issue of climate change as a direct result of increased demand for automobile fuel.

The most obvious benefit of replacing fossil fuels is the environmental impact it will have on carbon emissions. Since biofuels burn faster and cleaner than fossil fuels, it will release greenhouse gases at a lower and slower rate. Secondly, the use of biofuels will allow the economy to reap its benefits.

What is biofuel and how is it made?

In an effort to reduce our use of carbon emissions and replacing fossil fuels to preserve our natural resources, it has led to the widespread use of biofuels.

A biofuel is any type of liquid fuel that can be derived from biological materials such as trees, agriculture, waste, or grass. Some of which, but are not limited to those such as: ethanol, biodiesel and other “green” fuels.

Biofuels are produced directly from organic materials or biomass. The most common producer being plant materials and animal waste. In terms of agriculture, biofuels can be taken from crops, forestry, and animal by-products.

Technology has allowed us to expand the variety of biofuels to include solids, liquids and gases from materials such as woods, crops, and waste. We commonly use biofuels as substitutes for fossil fuels such as petroleum, propane, coal, and natural gas. Biofuels consist of two types: primary and secondary. Primary biofuels refer to organic materials that are primarily used for heating purposes and electricity production. These include wood chips and pellets used to make fire and are usually kept in their natural state. Secondary biofuels refer to the processing of biomass and usually includes liquid biofuels such as ethanol and biodiesel which is commonly used in the production of vehicles.

History of biofuels and how it is used

Over time, with the invention of electricity and motor vehicles, the popularity of using biofuels decreased as the use of fossil fuels increased.

Many early vehicles in the United States ran on corn-based ethanol; these were phased out during the Great Depression when cheaper fossil-fuel based gasoline became available. During World War II, several countries, including Germany, could not procure gasoline, so they turned to biofuels as an alternative. Britain came up with the mixture of grain alcohol and petrol as a makeshift for fuel due to the shortage. In the post-war years, with advances in oil refining technologies, the Middle East became the largest supplier for ch hydrocarbon based crude oil. Biofuel re-emerged in the 1990s due to the rising cost of oil prices and the

emission of greenhouse gases. Despite these efforts to increase the use of biofuels, gasoline is still more widely used than plant-based alcohol.

The two most common types of biofuels that are used today are ethanol and biodiesel. Ethanol is a renewable fuel that consists of plant materials otherwise known as biomass. When ethanol — an alcohol — is mixed with gasoline, it allows flexible fuel vehicles to run with higher ethanol content than regular gasoline. In the United States about 97% of gasoline contains some mixture of ethanol. The process of fermentation, which is a chemical process by which molecules of glucose are broken down anaerobically, is a common method used for biomass to ethanol conversion.

The second type of biofuel is ethanol, which is a liquid fuel produced from vegetable oils and animal fats. It's commonly used as a replacement for petroleum-based diesel fuel. It can also be blended together with petroleum to fuel engines. The most commonly used blend is B20 which consists of 20% biodiesel and 80% petroleum diesel.

Latest trends in biofuel production

A common argument against biofuels, especially ethanol, is that it requires more energy to produce than it generates. Indeed, biofuels take substantially more energy to produce than fossil fuels; however, it is in fact less than the energy that it generates.

The notion that biofuels have a negative net energy balance is somewhat outdated, with advances in agriculture (eg, genetically modified crops and fertilisers) along with better conversion techniques have driven down the energy required to produce a gallon of ethanol. According to the US Department of Energy, ethanol produced by corn delivers at least 30% more energy than is used to produce it. This net energy balance is substantially higher for sugar and soy-based ethanol, such as that produced in Brazil. Similarly, biodiesels tend to have a higher net energy balance.

As such, the case against biofuels is primarily economic, with the future of biofuels being highly dependent on their profitability. It needs to fulfill factors such as environmental and economic stability as well as how technology allows these products to make advancements. As of right now, biofuel production is naturally most profitable in environmentally scarce tropical areas because biofuel yields are higher per acre while input costs are comparatively lower.

Brazil is a second leading middle-income country that produces and exports ethanol produced from sugarcane and soybeans.

They use ethanol and biodiesel in many of their car and truck models and at one time accounted for 70% of the world's production of biofuel. In contrast, the United States, which is currently the leading country in biofuels, was able to replace 75% of imported oil in 2006 with biofuels. American biofuel is primarily corn-based, despite being intensive to cultivate this crop in regard to both resources and land. The main issue with replacing global fuel supplies with biofuels is that it requires a significant amount of land and agricultural production to maintain those resources. In short, it would require agriculture rates to double, which is hard to predict if there is enough land available for biomass cultivation.

Despite their increased usage, fossil fuels are still cheaper to produce than biofuels, calling to question the use of biofuels from an economic standpoint. Feedstock prices have increased 37% for bagasse in Brazil and 40-50% for corn in the United States over the past decade. With this rise in pricing, the cost is even higher now than it was almost a decade ago. Since crude oil is naturally occurring and requires minimal refining to make gasoline and diesel, it carries a lower production cost; however, crude oil prices are driven by a number of socio-political factors and cost speculation. As such, the ratio of crude oil to biofuel feedstock has remained somewhat constant, such any reduction in biofuel costs typically coincides with a drop in crude oil prices.

However, has oil becomes more scarce and only available in unstable regions, biofuels become more appealing from an economic standpoint. Moreover, the oil market is somewhat volatile with socio-political

disruptions in Iran or Venezuela resulting in large fluctuation in crude oil prices. These fluctuation in prices makes it difficult to depend on oil to continue to be a sustainable source of fuel.

This uncertainty has caused the motor industry to move towards electric cars that do not require oil, causing further disruption to oil demand.

As the effects of the COVID-19 pandemic have hit many industries in the United States, it has shown to cause negative effects on the biodiesel industry as well. The situation in which fuel demand is much lower due to supply chain and distribution disruptions as well as the decreased production in feedstocks has placed an immense amount of pressure on the biodiesel industry. European countries who receive their fuel product from corn have also seen a substantial drop in the demand for corn oil.

This is due to less people eating out as a result of the pandemic, which leads to lower demand for corn oil and less output.

In Canadian countries such as Quebec, where the biofuel industry was looming at large prior to the COVID-19 pandemic, their biodiesel plants also remained idle in April. Currently, they are operating at 50-70% capacity and the biodiesel industry has since slowly started to recover.

The Canadian exports of ethanol have also been met with a rise of pricing in May and June where they have produced approximately 17 million litres of pure alcohol. With a lower demand for gasoline in May of 2020, which was reflected by the lower domestic demand for ethanol, it dropped 60% in May. Although the pandemic has increased the market for ethanol-based products such as hand sanitiser, the product is less profitable than fuel-based ethanol. This is because hand sanitizer requires more work and materials to produce which ultimately leads to higher production costs as compared to biofuel.

As a result, the lower demand for ethanol has created many economic challenges for the advancement of biofuel in Canada.

Another region of the globe that is leading in biofuel production is Latin America. Biofuel accounts for the transition to clean energy in Latin American because it utilizes less than 8% of the world's transport energy but is responsible for 23% of the world's demand for biofuels. Argentina and Brazil are just two examples of the largest world markets. In addition, second to America, Brazil has the largest share of transport renewable energy in an effort to the oil crisis of 1973.

Since then, they have been trying to promote more clean energy sources such as biofuels as an alternative to fossil fuels.

As mentioned previously, Brazil receives most of their biofuel energy resources from the sugarcane industry as it is abundant in their country. It has been responsible for creating jobs and employment in the automobile and flex-fuel vehicle companies allowing more consumers access to this new variation of energy.

Similarly, it gives consumers the option to pump either ethanol or gasoline which is dependent on the pricing and consumer preference. As with most global economies, the COVID-19 pandemic has also taken a toll on Latin America's biofuel industry. With a similar problem in a decreased demand in fuel, it led to a drop in sugarcane prices. The impact of this pandemic can create a heavy debt as a result of the loss in competition with the gasoline industry. Although the growth in usage of biofuels appears to be stagnant, they expect the demand to grow over time as longer term investments are made in the effort to replace low oil prices.

The most difficult challenge in developing biofuels for the next few years is the cost for economic feedstocks. These feedstocks which are the raw material that are needed to supply or fuel a machine or industrial process contributes to 80 to 90% of the final fuel price for most fuel-making processes and is important to maintain the viability of future biofuels. When we refer to generations of biofuels, it usually indicates 30 years between each generation. First generation biofuels are usually created from feedstocks made from food such as corn and animal byproducts. Since the limitations for feedstocks include the quantity that can be produced, they have most likely reached their economic market share in order to keep prices low.

Second generation biofuels are usually made from feedstocks usually not consisting of food such as ethanol or agricultural residues. These costs remain high because of the long process that goes into handling and production. Lastly, we have third generation biofuels which are also made from feedstocks not consisting of food but are found mainly in petroleum products.

These are the biofuels that are the most promising for the future because they are usually referred to as advanced biofuels or green hydrocarbons. We are looking to use algae as a feedstock in the near future.

The use of these biofuels as a direct substitution for gasoline and diesel could mean that there will be renewable options that expand far beyond just the scope of fuel. The use of sea kelp is the innovation in biofuel that many researchers are looking forward to expanding in the near future.

Kelp is a raw material that requires minimal natural resources and is a fast growing organism meaning that producing it won't be a problem. Researchers at the University of Southern California are developing the growth of kelp on a larger scale and they plan to use solar-power buoys and underwater tetrahedron structure to bring kelp to the surface of the ocean.

This cycle will produce more biomass and will be maintained at a larger scale so that one day it might be able to meet the needs of the fuel industry in the U.S. and compete to replace the fossil fuel industry.

Conclusion

With the growing pressure to lower carbon emissions, the application of biofuels is a plausible solution to the replacement of oil in the near future. This change in energy source will bring a competitive advantage to the use of alternative fuels. In the near future, if we are able to meet the land requirements to increase the resources available to make biofuels economically profitable, then it might be able to replace the fossil fuel we use today. The key factor of profitability which is dependent on commodities will be able to undercut the high rising oil prices. In the near future, if biofuels become available for countries to utilize globally, then it will have a significant impact on the global economy and the environment.

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