

Prospective and Challenging Issues of Biofuels

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Abstract: Utilization of energy is increasing rapidly while sources of energy are limited. Furthermore, because of using fossil fuel, a lot of emissions are observed, which are bad elements for both human and nature, as well as increasing global warming. Biofuels are considered environment friendly than fossil fuel. Biofuels additionally boost rural development by shifting of power from petro to agro-industry at the same time. Having a lot of potentiality, there are some issues need to be considered. If the agricultural resources are utilized for running vehicles and such activities, certainly there will be food crisis. Therefore, some kind of optimization and advancements are required. This study includes introduction of different types of biofuels and compiles the benefit and challenges of it.

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1. INTRODUCTION

Biofuel is any liquid fuel which is produced fully or partially from any biological materials; for example, trees, crops, wastes, microalgae, and bacteria, etc. It is proved that biofuel is more efficient than any fossil fuels. Furthermore, fossil fuel is limited but the bio ingredients are renewable and environment friendly than fossil fuel. At present the population of the world is growing too much rapidly. According to the specialists within 2050 the world total population will be increased by 84%. The expanding worldwide populace demands more vitality supplies for improving the personal satisfaction. Biofuels can be one of the sources to satisfy the worldwide vitality request. Petroleum accumulation is being utilized as a primary wellspring of vitality for a long time; nonetheless, the utilization of them is unreasonable and causes natural issues identified with petroleum collection burning [1]. According to the Nobel Laureate Professor Richard E. Smalley, energy is the most important among the top-ten problems for humanity for next fifty years and energy can help to solve other problems from-water to pollution [2][3]. The number of populations in our earth is increasing day after day. If we still make our interest on consuming rock oil in our daily life. The stockpile of rock oil will be finished one day soon. After that we will have to suffer. We should from now to find out a possible option of energy, which will meet the demand of us. The promising news is that it is

possible for biofuels to supply at least one third of extra fuel [4]. Nowadays because of blast of population the consumption of energy is increasing. It is considered that energy demand is kind of proportional to world population. Although other factors like oil prices, technology, politics and industrial growth have significant impact on energy demand [5]. The majority portions of these energies come from fossil fuels. Most of the energy is using in industrial and transportation sectors, which have bad impact on environment. According to researcher, 28% of total energy is used in transportation sector. On the other hand, according to European Union (EU) transportation is responsible for 21% of Green House Gas (GHG) emissions, which is contributing in global warming [4]. Transportation sector use fossil fuel such as diesel, petrol, natural gas, etc. The incomplete of these fuels combustion produces carbon monoxide (CO) gases, which is easily, get mixed with hemoglobin and decrease the flow of oxygen in blood and reduces blood circulation. It might be the responsible for cause of death. On the other hand, because of using fossil fuel Sulphur dioxide (SO₂) is emitted, which is also a bad element for human and natural both, responsible for respiratory illness [6].

Biofuel can be a possible best option to solve these problems. As a second option for fossil fuel in transportation and industrial sector, biofuel can easily become a good solution for environmental problems because of its eco-friendly behavioral and sustainability [7]. These factors make the biofuel

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more adaptable and attractive. Biofuels additionally boost rural development by shifting of power from petro to agro-industry at the same time [7]. Figure 1 shows the lifecycle analysis of greenhouse gas balances of biofuel & petro fuel.

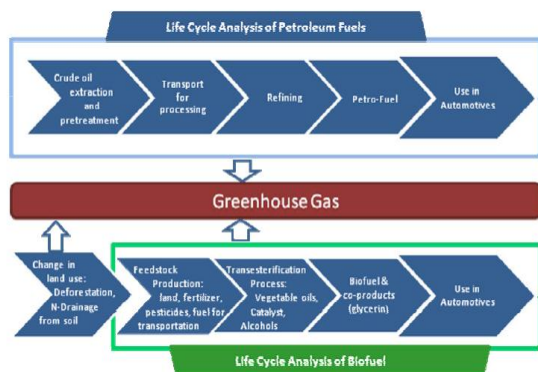


Figure 1. Lifecycle analysis of greenhouse gas balances of biofuel & petro fuel (reprinted from [7]).

Biofuels are fertilized chemical which is produced from biomass. It is an affluence in nature and by the help of photosynthesis that transformed the atmospheric Carbon-di-oxide (CO_2) into sugars, by using solar energy and water [4][8]. At present the biofuel project are more important because the vision of resource efficiency, carbon free environment and exploration of renewable energy. Most developed countries are looking for the development of biofuel. According to the “EU”, France and Germany’s annual production of biofuel is 3190 to 2226 KTOE in 2006. And in USA and Brazil calculate to produce 86,000 KTOE biofuels in a year [4]. This might be helpful for environment to reduce some amount of pollution. But there are problems for producing biofuels at a sufficient amount required many crops which might be used for human and animal feed directly or indirectly. On the other hand, it requires many land which can influence deforestation, and the price of agricultural production might be increased which will affect the economy and more added that the pollution for the production of extra crops will be equal to the decrease of pollution by biofuels [9]. As a result, there need some kind of optimization to use biofuel. Seed-oil bio-fuel gave near execution to diesel fuel without noteworthy obstacles, other than an extended unequivocal fuel use. Tests with cetane and attack seed methyl ester bio-diesel are in like manner presented for assessment [10].

This article is organized in a way that the importance of biofuel described in Introduction section, and then types and production of biofuels are introduced. Sub-sequent sections discussed the prospects, challenges, and policy issues of biofuels.

2. TYPES AND PRODUCTION OF BIOFUEL

Biofuel are commonly pertained to rigid, melted or gaseous fuels [11]. There are mainly two types of biofuel: 1. Primary biofuel, and 2. Secondary Biofuel. Primary biofuel directly comes from the nature such as wood, plants, forest, animal wastes, and crops surplus. Secondary biofuel directly generates from micro-organisms which is classified into four generations. Figure 2 shows the biofuels production sources.

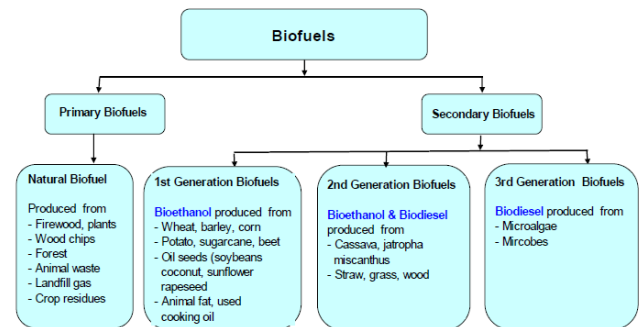


Figure 2. Biofuel production sources (biomasses) (reprinted from [11]).

2.1 1st Generation Biofuels (Vegetable Oil and Animal Fats)

Food carbohydrates, vegetables oils, and animal fats are used to produce 1st generation of biofuels (bio-diesel, bio-ethanol, etc.) [4]. To produce highly purified 1st generation biofuels, CO_2 and water are removed. According to researcher, 2% of the planets agricultural land is used to produce 1st generation of biofuels. It has a significant impact on food prices. Some types of 1st generation of biofuels are included below.

Biodiesel: biodiesel is the very common form of biofuel. It has been available and utilized in European and western countries. Trans-esterification process is used to produce biodiesel. It is like to mineral diesel and its chemical name is fatty acids methyl. This oil is produced when Methanol and sodium hydroxide mixed with biomass and as an output biodiesel is produced. It is used in various diesel engines after mixed with mineral diesels. At present most of the countries produced it.

Vegetable oil: This fuel is used in two purposes either cooking or as fuel for engines. The good quality of vegetable oil is used for cooking purpose. But at warm atmosphere most of the time vegetable oil is used in primitive diesel engines as fuel. For the production of biodiesel most of the countries mainly use it.

Biogas: it is produced by the anaerobic digestion of organic materials. It also produced as a cause of biodegradation of wastage. After the production of biogas, the rest of the wastage can be used as a fertilizer for agriculture. In biogas there is maximum amount of methane is presented if unfortunately, it is get mixed with environment it can be harmful for environment, people and animals both.

Bio alcohols: By using enzymes and microorganisms with the process of fermentation of starches and sugar bio alcohols are produced. If we compare bio alcohols with butanol and propanol it is more popular. Most of the time people call it gasoline because people use it in gas engine as fuel directly.

Syngas: After the combined process of combustion pyrolysis and gasification syngas is produced. Biofuels is used in this process it is converted into CO then into energy by pyrolysis. To keep the combustion under control very low amount of oxygen (O) is supplied during the process. At last step, the organic materials converted into CO and hydrogen (H). This process is known as gasification.

2.2 2nd Generation Biofuels

This type of biofuels is known as an advance level biofuel. Non edible biomass based biofuels, rest of the agricultural production known as lingo-cellulosic resources, which can produce more rational biofuels than 1st generation by reducing of higher greenhouse gas emissions. The major ingredients of lingo-cellulosic biomass are cellulose, lignin, and hemicellulose. Based on lingo-cellulosic, 2nd generation biomass can be divided into two parts.

Biochemical pathways: Fermentation and trans-esterification process of biomass are used in biochemical pathways for the production of bioethanol and biodiesel. It is more complex and expensive than thermochemical pathways [4][12]. Here pressures of shockwave are used to extract the oil from seeds.

Thermochemical pathways: There are three different pathways: heat generation, gasification and pyrolysis. Solid and liquid lingo-cellulosic biomasses are converted into syngas at the temperature of 800–900°C by gasification processes [12]. Thermal decomposition of biomass in an inert atmosphere is produced by pyrolysis process. By this process, char, condensable and non-condensable gaseous products can be produced [4][13].

2.3 3rd Generation Biofuels

The second generation of biofuel is considered as supportable but there are some snags. Here there is a problem of lingo-cellulosic limitation, for additional lingo-cellulosic have to expense in pre-treatment and technologies, which is necessary in transformation of biofuels [14]. To erase the snag the 3rd generations of biofuels, micro and macro algae are introduced. It has an advantage that it can be cultivated all over the year. To cultivate these algae do not require any agricultural lands and also do not require any pesticides, herbicides, and fertilizer. Dry weight per cell of algae can gain oil yields are far better than those of terrestrial crops [15]. For the growth and cultivation of algae required open seas, shallow lagoons, artificial ponds, etc. Just the water availability is required. There are two types of algae. 1. Micro algae, and 2. Macro algae [4]. *Macro algae:* In easy word it is known as seaweed. In size, it is bigger. *Micro algae:* Its common name is phytoplankton. In size, it is smaller. We can find it in river, pond, lakes, etc. These cannot be explored without microscope.

There are two ways to convert the algae into biofuels, which are: 1. Bio chemical, and 2. Thermochemical. Here the oils extracted from algae by the help of trans esterification produce biodiesel and bio ethanol can be derived by the fermentation. The main elements of its carbon dioxide and methane can be further processed to generate electricity or thermal energy. Thermochemical is used to convert algal biomass into syngas and bio oil [4]. Microalgae are potential feedstock to produce different types of liquid biofuels [16].

2.4 4th Generation Biofuel

4th generation technology combines genetically optimized feed stocks which is designed to reduce big amount of CO₂. By the help of genomic ally synthesized microbes, which helps efficiently make the fuels and the process to capture and

sequestration of CO₂ [17]. It is a process that provides 4th generation of biofuel and it is a carbon negative source of fuel. Modified algae and wastage are used as an input in 4th generation biofuels.

2.4.1. Algae

Algae might be an amazing consideration for the production of biofuels, because of its attractive features. Algae has high lipid content, high rate of carbon dioxide absorption. Furthermore, it requires less amount of land for cultivation. Therefore, the production of biofuel from algae will not hamper the food cultivation. The growth rate of algae is so fast, which also will help us to produce biofuel within short time and also essential to make a balance between demand and production of biofuel. As a result, the conflict between food production and bio-crops production will be diminished and green growth can be handled into an assortment of sustainable energies [18].

Another one amazing features of algae particularly microalgae as a biofuel feedstock is that it can be survive in any condition and do not require any special care. For the grow up, it necessary water (not so much as require in plant based bio-crops, it is not necessary to have fresh water for algae, waste water also will be okay for it) and the land (it is also not requiring so much as require for bio-crops, unused and barren land will be okay to cultivate algae). Therefore, by considering algae as an input of biofuel, we will be able to save our fresh water resources and can utilize unused lands [19].

2.4.2. Cellulose

Cellulose is the compound of present day interest and expects a huge activity in hydrolysis of cellulose, a prime piece of plant cell walls [20]. For the making of biofuels, glucose is the most appealing thing which is gained from the hydrolysis of cellulosic substrate via cellulase [21]. Cellulose is produced via biological route using the amount of microorganisms like bacteria and fungi. Among different types of known microorganisms, fungi have better capability than bacteria to make an aggregate cellulase system. Further, a complete hydrolysis of cellulose into glucose requires an absolute cellulose structure; all around it includes of endoglucanase, exoglucanase, and β -glycosidase [22].

2.4.3. Wastages

Wastages are considered a reason of environment pollution, when its starts to get decomposing. However, wastages from various sources such as, foodstuffs, wood products, paper, forest residues, industrial and agrarian residues, household wastes, bagasse, animal squanders and civil squanders can be essential and sustainable input for the production of biofuels. These inputs are available everywhere. Even, to collect these inputs do not require so much effort.

Furthermore, while other source of biofuel raw materials, it is required to wait for a certain period of time to grow up. However, wastages can be acquired immediately as an input of biofuel in regular basis and availability of the wastages are increasing day by day. Moreover, the most attractive matter is that after absorbed biofuel from wastage, the residues can be utilized further as solid fuel, compost fertilizer or land filling [18].

3. BENEFITS OF BIOFUEL

3.1 Cost of Production and Prices

The cost of manufacturing biofuels is quite much less than fossil fuel. Therefore, their prices are pretty affordable and are less costly than gasoline. For example, ethanol is a lot cheaper than gasoline and diesel. With a growth inside the global call for oil, it creates a huge gap between the deliver and demand. This suggests that the expenses of fossil fuels will keep to surge within the destiny.

3.2 Resources and Materials

With regards to petroleum products, we cannot deliver energies after finishing the available resources or maybe we can just utilize these normally happening materials in the wake of refining them. Then again, we can fabricate biofuels through a wide scope of materials like compost, crop squander and other by-products. Therefore, biofuel is an extraordinary case of reusing where we can use squander materials to create vitality.

3.3 Renewable Energy Source

This one is the significant points of interest of biofuels. Petroleum derivatives take hundreds or even a large number of years for their generation through the procedure of common decay. Anyway biofuel is a sustainable power source, as we can develop new harvests and make more biofuel by utilizing these harvests and their byproducts.

3.4 Minimum Carbon Outflow

After consuming, the biofuels oust moderately less measure of carbon in the air. The lethal materials are additionally low in comparison to the non-renewable energy sources. Henceforth, we can utilize biofuels as a more secure option in contrast to petroleum products.

3.5 Growth and Security

Actually, most of the nation can deliver its own biofuels. As a result, there will be no issue of reliance on oil delivering nations, as we see the instance of petroleum products. By limiting the reliance on outer fuel sources, even the smaller nations can secure their honesty. Subsequently, these nations can protect their future with any outside weight or impact.

3.6 Economic Incitement

Since we can create biofuels locally, the plants for its generation can give work to various specialists and gifted representatives. Also, to deliver biofuel, we additionally need a steady supply of biofuel crops. This implies we have to develop these crops on a huge scale. It will not just give opening for work to the laborers yet additionally result in financial incitement.

3.7 Environment Cordial

Traditional fuels which we use in our regular life, are responsible for huge greenhouse gas emission, environmental changes issue and destruction of biodiversity. On the other hand, according to researcher, biofuels can reduce 65% of greenhouse gas emissions. As a result, there will be less poisons, and less carbon yields. In another direction, the plants which we cultivate for the biofuel production, as a raw material, will absorb the CO₂ from the environment. If we turn from traditional fuels to biofuel/renewable energy, we will be able to enjoy a pollution free world.

3.8 Sustainable Energy

Biofuels have been developed as significant hotspot for manageable fuel and are considered for progress in finding new vivacious assets, improving air quality and restricting ozone depleting substance outflows. For financial and natural supportability of biofuels carbon impartial what's more, inexhaustible biofuels are important. As individuals consistently need fuel for warming, living, transportation reason and so on the longing for creation of fuel has been expanded colossally. The worldwide creation of oil and gas has been reached to its immersion point however elective source for the reasonable creation of oil and gas being in the pipeline. Thus, as an elective alternative to petroleum products, the biofuel is thought of as a main and reasonable vitality source in future which has capacity to diminish vehicle emanations, increment gracefully of maintainable vitality and give pay to ranchers as manageable bio resources [23].

3.9 Local and Regional Development

There is a chance of expand agricultural income and products and this opportunity also will be influenced the farmers financial and economical side [24]. On the other hand, this opportunity will be also facilitated the local and regional development of any country [25]. The demand of acquiring bio-crops will be diversified.

4. CHALLENGES OF BIOFUEL

4.1 Energy Output

The vitality yield of biofuels is a lot lower than fossil energies. Consequently, it requires enormous amount of biofuel to deliver the necessary measure of vitality. This has made a few questions with respect to the effectiveness of these energies. Most of the examiners are of the view that biofuels can fill residential need. Henceforth, we cannot get most extreme advantage through these by utilizing them in the mechanical part.

4.2 Indirect Carbon Emissions

Although biofuels are known to have less carbon impressions, there are some different ways they can build carbon discharges. The significant concerns are about the creations procedure of the biofuels. It begins with the development of the yield, which requires a parcel of hardware that sudden spikes in demand for fossil fuels. After the yield is prepared, it again needs mammoth collectors to get the harvest. Also, so as to expand the cultivable land, we are annihilating backwoods at a quick pace, which is the greatest reason for an unnatural weather change. Deforestation could happen to cultivate biofuel raw materials as a result carbon absorption amount will decrease.

4.3 Costly

There are some problems with the cost of biofuel in many regions of the world. But it is a hope that when delivery of biofuel will be in the range of every user, the use of it will be increase and new sources will be increase and introduced. As a result, cost will be more reduced, according to specialist.

4.4 Much Higher Starting Expense

With a view to refine the biofuels and make them more vitality productive energies, it requires to assemble legitimate

foundation. This implies it have to spend an impressive add up to make such an arrangement. At present, the generation of various biofuels is costing more than petroleum derivatives. This may change later on when the innovation will be more progressed and more affordable.

4.5 Engine Problem of Using Biodiesel

There are some effects of biodiesel on engine as shown in Figure 3 [7].

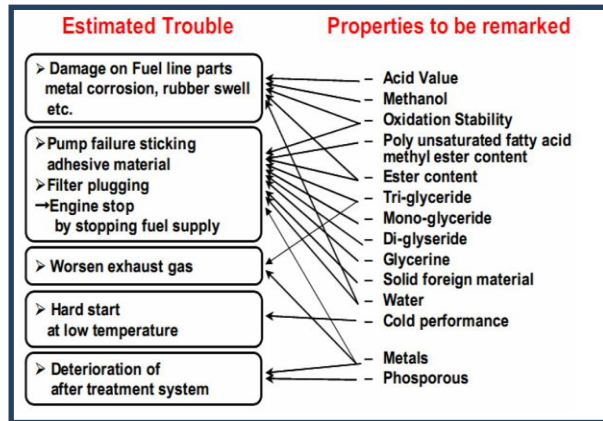


Figure 3. FAME Properties to be remarked and the estimated Impacts (reprinted from [7]).

4.6 Food Costs and Deficiencies

Another worry that causes a commotion of examiners and ecological researchers is the unsettling influence of the nourishment cycle. This is so, when the interest for biofuel will increase, we have to develop increasingly fossil yields for this reason. For example, in the future, we will develop enormous amounts of corn not for the reason to eat it yet to deliver biofuel. Accordingly, the costs of nourishment things will grow up, making it hard for ordinary citizens to meet their nourishment prerequisites. Aside from this, the utilization of significant cropland to develop fuel yields will make a lack of different harvests. The four expenses are associated as time goes on through two co joining associations: one addressing the equalization inside the ethanol business and the other addressing the parity in the oil-refining industry. The ethanol grandstand gives a strong association among corn and imperatives markets, and the expense of ethanol augments as the expenses of both corn and fuel increase, with the expense of corn being the overarching variable when it is commonly high [26].

4.7 May Strain Water Assets

In request to develop diverse fuel crops, makers need a great deal of water. Henceforth, the utilization of enormous amounts of water can put a strain on water assets. This may likewise bring scarcity about circulating the water system framework in certain areas.

4.8 Produce Mechanical Contamination

Biofuels may emanate lower carbon impressions however the procedure engaged with the generation of these energies to a great extent rely upon oil and water. Studies show that the apparatus expected to develop the harvests emanates huge

carbon discharges. Likewise, becoming the plant source requires the utilization of huge volumes of water, making worry that it might strain the nearby and territorial sources if not oversaw carefully. One more issue is the utilization of a lot of engineered composts, herbicide, and pesticides for the escalated development of harvests for biofuels. These agribusiness items can cause water contamination and effectively affect the condition.

4.9 Are Not Effectively Accessible

Biofuels produce from bio-crops are not so effective and efficient. These are not eligible for producing enormous production of biofuel. To solve that problem have required an effective and efficient source of bio-crops. This will help to enormous production of biofuel. On the other hand, the number of filling stations are not sufficient, which are currently available, they are not fully capable to serve a minimum amount of consumer. As an outcome, which reflects that to get this alternative option consumer has to incur a high amount.

4.10 Destruction of Cultivable Land

The development of comparative yields utilized for biofuel generation can influence the efficiency of the land. Monoculture can influence the nature of the dirt by retaining all the fundamental supplements. Biofuel debilitates the yield turn, which will influence the state of the earth and weakens its overall strength.

4.11 Probability of Deforestation, and Soil and Water Pollution

According to researcher because of probability of increase production and demand of bio-crops (raw material used for biofuel production) in future, require more land. When people will be failure to allow more land to cultivate bio-crops then people will start cutting down forests. As a result, deforestation will be occurred, which will affect the environmental biodiversity. The productivity of land will be reduced for excessive use of fertilizer and pesticides. The soil and water also will be polluted due to the use of fertilizer [21]. It is a challenge to produce bio-crops without destroying biodiversity.

5. BIOFUEL POLICIES AND STANDARDS

Most of the advanced and environment concerned countries of the world set many policies regarding biofuel uses in various sectors. Such as biofuel for transportation, biofuel for industry, biofuel technologies, biofuel for export, and biofuel for cleaner environment. Besides various policies, they also set a lot of biofuel blending standards [7]. Biofuel policies and standards set by some Asian countries are compiled in Table 1.

6. CONCLUSION

Biofuel is a wellspring of essentialness that starts from the various things and symptoms of plants. This is a kind of practical power source, which we can make by creating various fuel crops. From the start, we are building up the fuel crops at little scale; in this way the general age of biofuel is not sufficient to address our issues. Additionally, biofuel is a supportable imperativeness source and fills in as an unimaginable alternative as opposed to oil based goods. The limitlessness is without a doubt an amazing

piece of space of biofuel, which prescribes that we can re-establish this essentialness by creating fuel crops.

Table 1. Biofuel policies in selected Asian countries (adopted from [7]).

Country	Targets for 1st-generation biofuels and plans for 2nd-generation biofuels	Blending mandate	Economic measures
China	Take non-grain path to biofuel development	Ethanol: trial period of 10% blending mandates in some regions	Ethanol: incentives, subsidies and tax exemption for production Diesel: tax exemption for biodiesel from animal fat or vegetable oil
India	No target identified Promotion of Jatropha	Ethanol: blending 5% in gasoline in designated states in 2008, to increase to 20% by 2017	Ethanol: excise duty concession Ethanol and diesel: set minimum support prices for purchase by marketing companies
Indonesia	Domestic biofuel utilization: 2% of energy mix by 2010, 3% by 2015, and 5% by 2025 Seriously considering Jatropha and cassava	Diesel: blending is not mandatory but there is a plan to increase biodiesel blend to 10% in 2010	Diesel: subsidies (at the same level as fossil fuels)
Japan	Plan to replace 500 ML/year of transportation petrol with liquid biofuels by 2010. Promotion of biomass-based transport fuels	No blending mandate upper limits for blending are 3% for ethanol and 5% for biodiesel	Ethanol: subsidies for production and tax exemptions
Malaysia	No target identified Promotion of Jatropha, nipa, etc.	Diesel: blending of 5% palm oil in diesel	Diesel: plans to subsidize prices for blended diesel
Philippines	No target identified Studies and pilot projects for Jatropha	Ethanol: 5% by 2008; 10% by 2010 Diesel: 1% coconut blend; 2% by 2009	Ethanol and diesel: tax exemptions and priority in financing
Thailand	Plan to replace 20% of vehicle fuel consumption with biofuels and natural gas by 2012 Utilization of cassava	Ethanol: 10–20% by 2008 (Gasohol 95) Diesel: 5% (B5) mix in 2007 and 10% (B10) by 2011	Ethanol: price incentives through tax exemptions

It furthermore tosses a constructive outcome on our condition by emanating a base proportion of ozone draining substances. Beside the benefits of biofuels, there are a couple of cons as well. One of the critical stresses over these fills is the essential a lot of imperativeness for their age. For instance, by using 2 gallons of non-sustainable power sources, we can convey 12 gallons of biofuels. Furthermore, there are some various costs, which increase its general expense. Concerning using biodiesel to run a vehicle, you need to do a couple of alterations.

By considering all things, biofuels look very promising with respect to convey power or use them to run our vehicles. Since the development is exceptionally new and requires some time for its progression, we believe that one day, biofuels will fill the need to meet the imperativeness needs of our existence.

However, by considering food crisis and other issues, small percentages of biofuels could be used. Moreover, 2nd and further generations' biofuels need to be explored.

7. RECOMMENDATIONS

Biofuel require more research and development so that we can overcome the challenges regarding biofuel. There is some evidence regarding biofuel that it has maximum capability to be the best alternative option for future fuel problem, though there are some obstacles. But ideally, there need more reengineering and innovation to make smooth the rough side of using biofuel and make it more valuable.

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