Establishing a minimum biodiesel fuel content mandate for diesel fuel sold or offered for sale in Missouri

MOST POLICY INITIATIVE

Executive Summary

SB 96 creates the Missouri-Made Fuels Act, where all diesel fuel sold or offered for sale in the state shall contain at least 5% biodiesel fuel oil by volume (for April 1, 2022, until March 31, 2023), leading to 10% (for April 1, 2023, until March 31, 2024), and 20% (after April 1, 2024). The minimum content levels would go into effect when the Director of the Department of Agriculture submits notice that the requirements have been met and the state is prepared to move to the next scheduled minimum content level. The minimum biodiesel content levels shall not apply to certain equipment listed in the act.[1]

Highlights

- Biodiesel burns substantially cleaner than petroleum-based diesel fuel.
- Biodiesel enhances oil independence and the local economy.
- Soybean biodiesel has a positive energy balance, meaning that **soybean biodiesel yields 4.56 units of energy for every unit of fossil energy consumed over its life cycle.**
- A mandate will impact the demand for biofuels, which **could lead to the increase of farm income in Missouri.**
- Biofuels often require subsidies and other market interventions to compete economically with fossil fuels, which creates **deadweight losses in the economy**. This means there can be economic inefficiencies because normal market forces will not be in place to determine the demand and supply fueling quantities among the different fueling options.

Limitations

- The exact impact to the environment is yet to be determined, since changes to land use patterns **may increase greenhouse gas emissions (GHE)**, pressure on water resources, and air or water pollution.
- Because of the **resource competition** between growing crops for consumption versus growing crops for transportation, food costs may increase, but it is difficult to determine the exact impact of biofuels on food prices.

Research Background

What is Biodiesel?

Unlike other renewable energy sources, biomass can be converted directly into liquid fuels, called "biofuels". The two most common types of biofuels in use today are ethanol and biodiesel. The

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Department of Natural Resources (MODNR) defines biodiesel as a fuel for diesel engines made from domestically produced renewable fats and oils such as soybean oil. Biodiesel burns substantially cleaner than petroleum-based diesel fuel and it is an option for improving the environment while reducing dependence on foreign oil, stretching fossil fuel reserves, and providing value-added markets for agricultural products. It can be used in compression-ignition (diesel) engines with little or no modifications.[2] Biodiesel is simple to use, biodegradable, nontoxic, and essentially free of sulfur and aromatics.[3,4]

Biodiesel blends

Pure biodiesel (B100) contains no petroleum, but it can be blended at any level with petroleum diesel to create a biodiesel blend. The most common biodiesel blend is B20, which is 20% biodiesel and 80% conventional diesel. According to SB96, B20 is the goal for minimum biodiesel content in diesel fuel by 2024. This blend amount represents a good balance of cost, emissions, cold-weather performance, materials compatibility, and ability to act as a solvent.[3,4]

Comparing fueling options

Today, biodiesel is blended at a rate of 5% or less into almost all the diesel fuel sold in the United States. The primary source for biodiesel in the U.S. is soybean oil, although it is also made from grease, algae, canola, etc. Biodiesel is rarely used in its pure form. It's typically blended with diesel and designated by the amount of diesel it's mixed with. In fact, you can typically find some biodiesel in almost all "regular" diesel sold at gas stations in the U.S., at blends of up to B5.[26]
In 2019, U.S. fossil fuels—petroleum, natural gas, and coal—accounted for about 80% of total U.S. primary energy production and 3% of its petroleum in 2019 was imported **(Figure 1)**.[5]

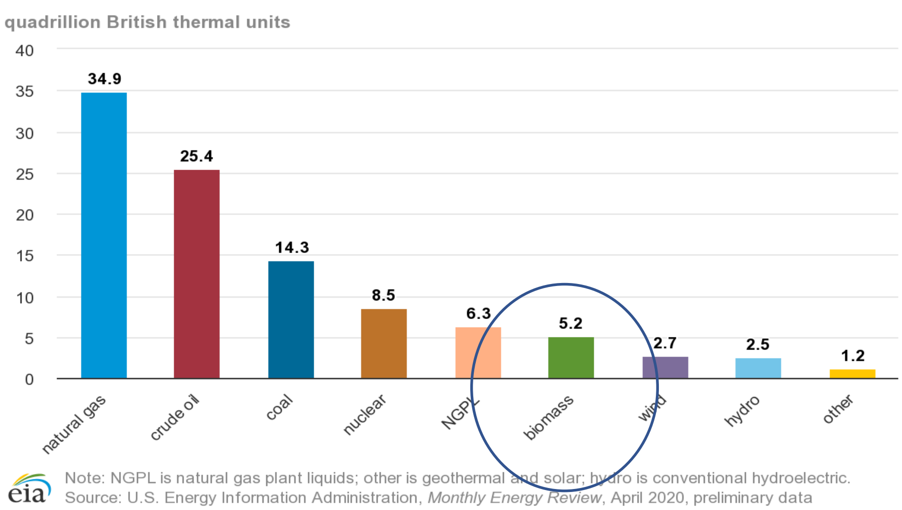

Figure 1. U.S. primary energy production by major sources, 2019[5]

The transportation sector accounts for approximately 30% of total U.S. energy needs and 70% of U.S. petroleum consumption. Biodiesel, other alternative fuels, and advanced technologies can strengthen national energy security and reduce transportation energy costs for businesses and consumers while reducing environmental impact.[24]

While replacing fossil fuels with biofuels has the potential to generate a number of benefits, the comparative analysis among the different fueling options comes down to the considerations of the environmental impact, energy security and economics. As seen in **Table 1**, some of the technical advantages that biodiesel offers are that it prolongs engine life and reduces the need for maintenance (biodiesel has better lubricating qualities than fossil diesel).[6] It is also, safer to handle, more biodegradable and hence less toxic.[7] Another technical advantage of biodiesel is that it is a cleaner and renewable source of energy since it reduces exhaust emissions, minimizes black smoke, odor, greenhouse gas emissions, air toxics and particulates, and does not contribute to sulfur dioxide emissions (acid rain).[3] Some of the technical disadvantages of biodiesel blends are fuel freezing in cold weather, reduced energy density, and degradation of fuel under storage for prolonged periods.[8]

Table 1. Specifications of diesel and bio-diesel fuels[9]

Fuel property	Diesel	Bio-diesel
Fuel standard	ASTM D975	ASTM PS 121
Fuel composition	C10–C21 HC	C12–C22 FAME
Lower heating value (MJ/m^3)	36.6×10^3	32.6×10^3
Kinematic viscosity at 40 °C (mm^2/s)	1.3–4.1	1.9–6.0
Specific gravity at 15.5 °C	0.85	0.88
Density at 15 °C (kg/m^3)	848	878
Water (ppm by wt.)	161	0.05% max
Carbon (wt%)	87	77
Hydrogen (wt%)	13	12
Oxygen (by diff.) (wt%)	0	11
Sulfur (wt%)	0.05 max	0.0–0.0024
Boiling point (°C)	188–343	182–338
Flash point (°C)	60–80	100–170
Cloud point (°C)	−15 to 5	−3 to 12
Pour point (°C)	−35 to −15	−15 to 10
Cetane number	40–55	48–65
Stoichiometric air/fuel ratio (wt./wt.)	15	13.8

Biofuels and the environment

In contrast to fossil fuels, which are exhaustible resources, biofuels are produced from renewable feedstocks. Thus, their production and use could, in theory, be sustained indefinitely.[3] Moreover, replacing fossil fuels with biofuels helps with restricting the undesirable aspects of fossil fuel production and use, including conventional and greenhouse gas (GHG) pollutant emissions, exhaustible resource depletion, and dependence on unstable foreign suppliers **(Table 2)**.[8]

Table 2. Engine emission results in B100 versus B20 blends[12]

Emission	100% Ester fuel (B100) (%)	20/80 Mix (B20) (%)
Hydrocarbons	−52.4	−19.0
Carbon monoxide	−47.6	−26.1
Nitrous oxides	−10.0	−3.7
Carbon dioxide	0.9	0.7
Particulates	9.9	−2.8

In specific, biodiesel produced in the United States and used in conventional diesel engines, can directly substitute for or extend supplies of traditional petroleum diesel. **Soybean biodiesel has a positive energy balance, meaning that soybean biodiesel yields 4.56 units of energy for every unit of fossil energy consumed over its life cycle.**[25] Last, biodiesel in its pure, unblended form causes far less damage than petroleum diesel if spilled or released to the environment.[10]
On the other hand, because of the land required to produce feedstock for fuel production use, biodiesel may pressure the water resources, and may increase air and water pollution. Depending on the feedstock and production process and time horizon of the analysis, biofuels can emit even more GHGs than some fossil fuels on an energy-equivalent basis.[11]

Economic Impacts and Costs of Biofuels
According to the Missouri Soybean Association, Missouri farmers first marketed biodiesel in 1993 and today, more than 200 million gallons of biodiesel are being produced. Biodiesel supports more than 2,500 Missouri jobs directly and 6,400 jobs indirectly. However, these numbers would possibly be greater if there were statewide retail locations that offered biodiesel options for sale.[13] Economic studies on the production of biodiesel suggest that the main economic criteria have been capital cost, manufacturing cost and biodiesel break-even price.[8] The economic performance of a biodiesel plant (e.g. fixed capital cost, total manufacturing cost, and the break-even price of bio-diesel) can be determined once certain factors such as plant capacity, process technology, raw material cost and chemical costs are determined.[14]

Currently, the high cost of biodiesel is the major obstacle to its commercialization. Biodiesel usually costs over \$0.5/l, compared to \$0.35/l for petroleum-based diesel.[15] A major economic factor to consider for the **biodiesel input costs of production is the feedstock,** which is about 80% of the total operating cost.[8] The USDA announced earlier this fall (2020) that it will invest up to \$100 million to increase American biofuel sales. The funds are offered through the Higher Blends Infrastructure Incentive Program (HBIIP) to recipients in 14 states, including Missouri, with grants that would go to replace and install dispensers and storage tanks across the eligible states. HBIIP helps transportation fueling and biodiesel distribution facilities convert to higher ethanol and biodiesel blends by sharing the costs related to the installation of fuel pumps, related equipment and infrastructure.[27]
Because biofuel feedstocks include many crops that would be used for human consumption directly, or indirectly as animal feed, diverting these crops to biofuels may lead to more land area devoted to agriculture, increased use of potentially polluting inputs, and higher food prices. Cellulosic feedstocks can also compete for resources (land, water, fertilizer, etc.) that could otherwise be devoted to food production. Additionally, biofuels tend to require subsidies and other market interventions to compete economically with fossil fuels, which creates deadweight losses in the economy.[11] This means that there would be an inefficient allocation of resources, since the supply and demand of the fueling options would not be established based on the quantities of the market equilibrium. Therefore, biofuels can impact crop prices, although

the range of that impact is hard to determine precisely.[11] Finally, although higher crop prices lead to higher food prices, the impacts on retail food in the U.S. are expected to be small.[17]

Existing biodiesel legislation in Missouri

The growing biofuel industry offers considerable opportunities for Missouri. As of 2018, Missouri ranked 13th in the country for its ethanol nameplate capacity[1] as well as its ethanol operating production.[18] The total nameplate capacity in the state is around 216 million gallons, which roughly accounts for 9% of the nation's capacity of nearly 2.5 billion gallons.[3,4] The Missouri Alternative Fuels Commission is responsible for promoting the production and use of alternative transportation fuels in Missouri. As of April 2020, Missouri had five commercial biodiesel production facilities which utilize both soybean oil and animal fats as feedstock. Currently, there are the alternative fuel vehicle (AFV) acquisition and biodiesel use requirement statutes in Missouri. In regards to AFV acquisition, a state agency that operates a vehicle fleet consisting of 15 vehicles or more must ensure that at least 50% of new vehicles purchased over a defined biennial period are capable of using an alternative fuel. For biodiesel use requirements, at least 75% of the Missouri Department of Transportation (MoDOT) vehicles and heavy equipment that use diesel fuel must be fueled with biodiesel blends of at least 20%. It is also stated in the statue that blended biodiesel fuel in Missouri will be considered commercially available if the incremental purchase cost compared to conventional diesel fuel is not more than $0.25. Finally, MODNR offers grant incentives for the replacement of medium- and heavy-duty transit and shuttle buses with new diesel or alternative fuel vehicles or engines.[19]

Similar biodiesel regulation across the U.S.

Similar to Missouri, Illinois requires any vehicle purchased with state funds that is fueled with diesel fuel to be certified by the manufacturer to run on 5% biodiesel fuel. Illinois has also put in place fuel-efficient vehicle acquisition goals, where by 2025 all agencies that operate medium- and heavy-duty vehicles will have to implement strategies to reduce fuel consumption through diesel emission control devices and to promote the use of biofuels in state vehicles; reduce the environmental impacts of employee travel; and encourage employees to adopt alternative travel methods.[21] Several states also offer biodiesel blend tax exemptions for both consumers and governmental bodies. Indiana has issued a special fuel license tax exemption when individuals use biodiesel blends of at least 20% for personal, noncommercial use. Additionally, anyone who performs essential governmental functions for the state and local government is entitled a 10% price preference for the purchase of fuels containing at least 20% biodiesel.[22] Last, Minnesota has established the Biodiesel Task Force, a mandate where state stakeholders work together toward increasing the production and use of biodiesel fuel. According to the mandate, during the months of April through September, diesel fuel sold in the state must contain at least 20% biodiesel, while for the remainder of the year diesel fuel must contain at least 5% biodiesel.[23]

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[1] Nameplate capacity, also known as the rated capacity, nominal capacity, installed capacity, or maximum effect, is the intended full-load sustained output of a facility such as a power plant, electric generator, a chemical plant, fuel plant, metal refinery, mine, and many others.

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