An Evaluation of Fossil Fuels' Effect on Public Health and the Economy in Contrast to Biofuels

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Abstract

As global energy demands rise, the environmental and economic tolls of fossil fuel dependency have become increasingly unsustainable. In 2025 alone, fossil fuel combustion released approximately 42 billion tons of carbon dioxide globally, severely threatening public health and forcing the global economy into a volatile cycle driven by finite resource depletion. This literature review evaluates the public health and economic impacts of transitioning from traditional fossil fuels to sustainable biofuels. While critics argue that aggressive biofuel adoption may inflate consumer fuel prices and disrupt food security by diverting arable land, recent advancements in second-generation cellulosic biofuels mitigate these concerns. Derived from agricultural waste rather than consumable crops, cellulosic biofuels utilize a closed carbon cycle that can reduce lifecycle emissions by up to 99%. Supported by government subsidies like the Energy Independence and Security Act (EISA), biofuels offer a stable pricing path that sets the economy away from foreign market shocks. Because biofuels serve as a direct, drop-in replacement for liquid fossil fuels, they leverage existing infrastructure, offering an immediate and structurally viable pathway toward global decarbonization.

1. Introduction

In 2025 alone, fossil fuels released roughly 42 billion tons of Carbon dioxide into the atmosphere (Morrison). Fossil fuels are the main source of energy in the modern world, whether that would be to power major industries, homes, or cars. Fossil fuels are a broad term for coal, oil, and natural gas that come from underground fossilized trees and ancient decomposed organic matter. The issue with using these types of fuels is that there is a limited supply and releases huge amounts of carbon and pollutants that were trapped underground back into the air civilians breathe. This immoral way of energy drives people to seek new energy sources that are not only renewable but environmentally clean as well.

Biofuels are a renewable energy source that can be derived from oilseed crops such as canola, starch crops such as corn, sugar crops such as sugarcane, and even waste biomass such as corn cobs, straw, and wood chippings. (U.S Department of Energy). Instead of re-releasing stored fossilized carbon, the carbon released is from these recently grown crops that took in carbon from the atmosphere to grow. This method means that there is no addition of new carbon into the atmosphere, only the recycling of the same carbon. If biofuels are not adopted, the use of fossil fuels will continue, worsening public health from pollution and increasing economic volatility.

2. Public Health Impacts: Pollution and Pediatric Vulnerability

If biofuels are not adopted, pollution would continue to rise, increasing the chance of worsening public health. Climate change driven by fossil fuel combustion severely impacts pediatric health by exposing children to airborne particles. Due to children's weaker bodies, they

are more sensitive to air pollution, with the chance of acquiring problems such as ADHD, asthma, and even cancer.

"Worldwide in 2011, fossil fuels represent 82% of total primary energy supply. In the U.S, oil, natural gas, and coal account for 81% of current energy use. Energy-related fossil fuel combustion in high- and middle-income countries and biomass burning in low-income countries accounts for most of global air pollution, generating 85% of airborne respirable particulate pollution… all are associated with multiple adverse health effects in children" (Perera).

This evidence weighs the use and emissions from fossil fuels, showing that even with a majority of air pollution being from fossil fuels, there is still a heavy reliance on it as the main source of energy. Additionally, arguments are made that children from infants to the age of 5 are much more susceptible to mental and physical health issues due to pollution that stays for the rest of their lives. These statistics of fossil fuel pollution and strong correlation to children's health hurt the next generation, damaging public health. With pollution on the rise and heavy reliance on fossil fuels, this pushes society to adopt a new energy source that is just as reliable as fossil fuels, but does not contribute to pollution, such as biofuels.

The process of biofuel production lowers emissions by ensuring a closed carbon cycle. Biofuels are derived from corn; this corn must be grown, taking in carbon dioxide from the atmosphere.

With this cycle of releasing and taking in carbon, "Almost 99% of carbon emissions could be prevented by using renewable energy resources and other effective energy-based measures" (Singh et al.)

This data validates the positive restorative effects biofuel usage can have on carbon emissions. With the 99% reduction of carbon dioxide in its life cycle emissions, not only would this lessen the effects of global warming, but it will keep the air that people breathe cleaner. By switching to biofuels, air quality can improve, lessening the damaging effects on public health.

The first source explains the heavy usage of fossil fuels with respect to how much particulate pollution they emit. Whereas the second source validates the positive effects biofuel usage can have on the atmosphere. These claims go hand in hand by identifying the pollution problems of fossil fuels while proposing a solution to this problem: biofuels.

3. Economic Implications: Volatility and Energy Independence

Beyond health metrics, the economics of transitioning from fossil fuels to biofuels is a critical factor. Biofuels decrease dependence on foreign imports of oil, decreasing economic volatility and potential crashes. The economics of the transition from fossil fuels to biofuels is a major factor. By examining the economy of fossil fuels worldwide, the dependence and demand for fossil fuels must be accounted for; the need to transition out of fossil fuels is urgent due to the non-renewable nature of fossil fuels and the limited amount that is left.

Accordingly, "rapid growth in industrializing Asia has driven growth in global demand and in upward price trend for fossil fuels, which are plentiful in several small open economies, but exhaustible at current extraction rates; gas and oil reserves proven to last 110 and 50 years respectively. To put that in perspective, if human civilization was scaled to fit a 24-hour day, these reserves would run out in less than 30 minutes" (Day and Day).

This portrays the reliance and scarcity of fossil fuels that leads to a volatile market. Fossil fuels are a fuel used worldwide that is constantly being traded. With the growth in industries, this reliance on imports would continue to rise. The reliance on fossil fuel imports does not automatically signify economic volatility. However, the limited scarcity of oil reserves does. As

put into perspective by the author, 110 and 50 years in terms of the timeline of human civilization is not a lot of time. This urgency in oil reserves and limited time before depletion drives volatility in the economy heavily. As the oil market becomes more volatile, the transition to another energy source, such as biofuels, becomes urgent. In another study, the feasibility of biomethane production is evaluated based on its circular economy. By projecting potential prices and revenues over a 10-year prediction, it can be concluded that biomethane's price stability is driven heavily by its strong correlation to oil markets.

"Economic modeling indicates high investment returns, with IRR values surpassing 35% in conservative scenarios and payback period from 2 to 6 years" (Fava et al).

Payback periods occurring after 2 years are due to the high initial cost of building new biofuel factories. However, in the long term, there will be investment returns that are a significant 35%. These investment returns highlight the potential of generating energy from waste, improving energy efficiency. This rise in returns is predictable because of its stability. Unlike crude oil, which is mostly imported from other countries, Biofuels are manufactured and processed within, and these statistics show that not only is it economically possible, but a viable option in stabilizing economic growth. This adoption of biofuels can reduce the volatility that fossil fuels place on the economy because biofuels are not set by geography, meaning they will not need to be imported from foreign countries.

Consequently, evaluating the economic lifecycles of these two energies reveals that while finite fossil fuels guarantee long-term market volatility, sustainable biofuels offer a structural pricing path. The results of these evaluations contrast with each other by identifying the problem of fossil fuels, such as economic volatility, and proposing the solution through biofuel sustainability.

4. Counterarguments: Food Security and Cost Barriers

One of the biggest concerns society has with biofuels is their interference with the food industry and high investment costs affecting consumers; however, some types of biofuels don't rely on using fresh crops, and governments offer subsidies to renewable energy producers. Aggressive renewable fuel adoption risks driving up consumer prices at the pump and inflating food costs by diverting critical arable land away from commercial agriculture (Gayer).

This critique suggests, "Forcing the market to produce large amounts of renewable fuel will harm consumers in two ways: it will increase prices at the pump, because biofuels are more costly than gasoline, and it will drive up the price of food, because it diverts crops into fuel" (Gayer).

These claims state that the transition to biofuels is too risky because it drives up fuel and food costs through high initial production costs and making farmland more scarce (sharing land for both fuel and food purposes). Though this is true, biofuels are a broad spectrum, including variations that can be derived from plant waste, rather than consumable crops. The U.S Department of Energy acknowledges this fact, which is the reason they prioritize the use of these waste-derived biofuels. These waste-derived biofuels are also referred to as cellulosic biofuels, and they are more costly. The high cost is due to the lack of starting infrastructure and warehouses to process and produce biofuels.

To overcome this, "EISA also provides cash awards, grants, subsidies, and loans for research and development, biorefineries that displace more than 80 percent of fossil fuels used

to operate the refinery, and commercial applications of cellulose biofuel. There were more than 2300 E85 fueling stations located throughout the US in 2013" (U.S Department of Energy).

This implies that the U.S government is already in line financially with the production of biofuels, specifically cellulosic biofuels. EISA, also known as the Energy Independence and Security Act of 2007, was created to promote the production and usage of renewable energy through cost reductions. By lowering production costs through government assistance, consumers will not bear the brunt of high prices. Along with this, the usage of Cellulosic biofuels will not interfere with the food industry because these types of biofuels rely on plant waste instead of freshly grown crops. As evidence to back the reliability of these claims, it is noted that as early as 2013, there were more than 2300 E85 fueling stations. An E85 fueling station means that 85 percent of the gasoline blend is ethanol from biofuels. This recurring usage of biofuel refueling stations and government-backed claims about cost reductions of cellulosic biofuels show that biofuels do not have to interfere with the food industry nor raise consumer costs.

5. Conclusion

Failure to transition to biofuels will lock society into a cycle of escalating pollution and economic instability. Without the transition to biofuels, the continued use of fossil fuels would increase pollution and foreign imports, which damages public health and raises the chance of economic crashes. This race for the new energy source that powers the future is a big topic within politics and science. Besides biofuels, people are also studying alternative energy sources such as nuclear, wind, and solar power. However, the main component that sets biofuels apart is the existing infrastructure. Unlike other alternative energy sources that generate electricity, biofuels are versatile, a close one-to-one match with fossil fuels. This direct replacement means there is no need to replace current infrastructure. Infrastructure like gas vehicles, stoves, and even the asphalt on roads can stay. Biofuels possess a unique advantage: compatibility with existing infrastructure. The transition to a sustainable energy future does not require inventing an entirely new society; through biofuels, it is already underway.

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