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Biofuels - The Continuing Controversy

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Abstract

Biofuels produce carbon dioxide in every process of combustion. Biofuels in accomplishing its purpose, thus contribute to the amount of carbon dioxide, the contaminant gas with the longest half-life in the Earth's atmosphere. This tri atomic gas helps to block the irradiation of heat energy from the Earth's surface to outer space. It can thus be deduced that biofuels contribute to climate change. The new paper by the University of Michigan Energy Institute (UMEI) seemed to have open up again the debate about the benefits of biofuels. The current paper strives to be an unbiased referee by reviewing the statements made in a journalistic report about the UMEI paper and the current state of controversy. The researchers interviewed and their research backgrounds and contributions to the field are also researched. A philosophical discussion based on real world data is included to support the conclusion reached.

Keywords: Life-cycle; Carbon; Climate change; Analysis; Innovation

Introduction

Biofuels, like all fuels, give off carbon dioxide as a product of combustion. Since carbon dioxide has been identified as the atmospheric component which is the major cause of climate change, then the objective to minimize climate change would not be helped by any fuels. Without going into the fine details of how the Earth gains a certain amount of energy every single day, suffice it to say that carbon dioxide plays a key role by blocking heat trying to escape from the Earth's surface to outer space. Without as much concentration of carbon dioxide, the loss of heat to outer space would be more effective. Problems caused by climate change include the many brought up by the energy-water-food nexus, occurring in increasing number of places on Earth [1-3].

The burning of any fuel is an irreversible process. From the second law of thermodynamics, entropy is increased. In addition heat is released which contributes to the anthropogenic warming of the Earth [4-6]. Hence, combustion of biofuels is another general process that contributes to climate change. Is there another role which the production of biofuels bring to the field?

"Carbon Balance Effects of U.S. Biofuel Production and Use"

Corn ethanol and biodiesel biofuels may be more harmful to the planet than petroleum gasoline, submitted by a new study from the University of Michigan Energy Institute (UMEI). The title of this section is the title of the paper. Most of the words about and the resulting responses, come from [8], a journalistic article about the new controversy generated by [7]. The startling discovery comes after the research team, led by UMEI researcher John DeCicco, examined the amount of carbon dioxide (CO_2) absorbed as the crops grow and then released when they are combusted as biofuel. They calculated that the aggregate United States crop yield can eliminate only thirty-seven percent of the CO_2 that burning biofuel issues into the air.

"What we found is that when you actually look at how quickly crops like corn and soybeans pull CO_2 from the air and compare that with the emissions that occur when the biofuels like ethanol and biodiesel are combusted, you find out that they are not carbon neutral like everyone has been assuming," DeCicco [7] tells The Christian Science Monitor, for which the author of [8] works.

That is a faulty ground, contends Daniel Schrag [9], a Harvard geology professor. He also counsels the United States Environmental Protection Agency (USEPA) on bioenergy climate issues. He argues that biofuels donot have to be carbon neutral to be an environmentally preferable alternative to petroleum gasoline. "For about 10 years there have been very careful studies of corn ethanol and all of the fossil carbon that is used

to make it ... and those studies have gotten a range of answers, but it is about a 20 percent reduction of net emissions relative to gasoline," states Professor Schrag [9] in an interview with the Monitor. "Nobody ever thought corn ethanol was carbon neutral, because there are lots and lots of fossil inputs to it." It is clear that DeCicco's [7] statement that "biofuels" that are not carbon neutral like everyone has been assuming" is not a true statement. It is at best, an exaggeration. Schrag [9] is a proponent of carbon sequestration for carbon dioxide generated by all fuels, including biofuels. Schrag is an expert on the carbon cycle [10], and co-authored an article [11] in Nature Climate Change, where they warn of current and near-future mankind's policies having an impact on the climate for years to come.

"The biofuel debate has gone on for years, with detractors worried about the impact of the additional land converted from forests to corn fields, and supporters at variance for biofuel as being greener than gasoline. Another group says that it is really too soon to tell.

The conversation has generally been dictated by the food versus fuel debate. This focuses on the indirect consequences of biofuel crop production, such as land use and deforestation, which create a ripple effect felt by the entire global food market" [8]. By going back to basic science and engineering, we scientists and engineers can predict what happens. It is not "too soon to tell." A consensus can be foreseen. It does not have to be a biofuel debate that rages on for a long time.

"DeCicco decided to question the basic life cycle analysis model that earlier studies relied on, some of which had supposed that biofuel is carbon neutral and that only production-related greenhouse gas emissions need to be considered when contrasting biofuel to fossil fuels. Whether you burn biofuel ethanol or petroleum gasoline, he argues, the same amount of carbon dioxide is freed into the troposphere. So examining the fuels' environmental impacts distills to how efficiently that carbon can be extricated from the air, he says – and forests are more efficient in fixing carbon dioxide than cornfields" [8].

"The United States uses forty percent of its corn harvest to produce ethanol, but that does not mean we eat forty percent less corn; DeCicco tells the Monitor. DeCicco explains that as cropland once used for food is transferred to fuel use, food must be produced elsewhere, meaning that more grasslands and forests are converted to production. But, grasslands and forests can neutralize more carbon dioxide than crops, he says.'

'Schrag says that this does not take into account the long-term perspective, when biofuels make up for carbon loss from forests. "In their approach time scale does not come into it," he tells the Monitor. "They are viewing the crop yield data and presuming that you should balance the carbon cycle based on crops produced." Michael Wang, a researcher at the Argonne National Laboratory, tells the Monitor that he also questions the study's carbon accounting, arguing that the study does not properly account for the carbon uptake or that corn production for both ethanol and for food increased over the study period."The carbon uptake by the US farming systems is computed using only grain harvest figures; Wang tells the Monitor; Carbon uptake embedded in above- and below-ground biomass is not taken into account in the paper with an assumption that carbon in these biomass sources are returned to the atmosphere via oxidation" [8]' Both Schrag and Wang are correct. The arguments made by Wang are grounded on basic biology, and are thus valid. Michael Wang is an expert on life cycle analysis, in particular about ethanol and biofuels [12-14].

'Additionally, the research received funding from the American Petroleum Institute, which critics say is grounds for skepticism, but the UMEI researchers stated that "the analysis, results and conclusions presented [in their study] are those of the authors alone" [8]. That form of a statement made by researchers is commonplace, to protect their research sponsors from legal actions.

'Other experts have come out in support of the research. Tim Searchinger, a researcher at the Science, Technology, and Environmental Policy Program at Princeton University, said that the research was limited, but useful. "This article is saying that if you think the reason biofuels are helping to solve climate change is because the US is increasing its production of crops and that increased production of crops offsets the carbon release from burning the biofuels, you're not correct. That is not what is taking place," Searchinger tells the Monitor. "What reduces carbon in the troposphere is not the biofuel, it is the plant uptake of carbon dioxide in photosynthesis." DeCicco says that the solution is not to make biofuel more efficient, but to finance reforestation.' [8] In this respect, DeCicco is correct and so is his supporter, Searchinger. Tim Searchinger is a research scholar whose work combines ecology and economics to take on the task of food for the hungry millions in the world and cutting down on greenhouse gas emissions from biofuels [15]. He is a lawyer by training.

'"We should not be trying to make biofuels at all, any time soon," DeCicco tells the Monitor. "It is much better to reforest and restore ecosystems.... Reforestation is a much better way to remove carbon dioxide than anything we can achieve with biofuels' [8]. This statement is too hasty. Innovation in science and engineering should always be encouraged. For a diminishing resource like petroleum gasoline, biofuels is a good competitive resource. Both resources should be continued to be produced to keep both technologies modernizing and innovating until the engineering systems that require them, have served out their useful purposes.

Discussion

This section looks at the controversy from documented world data. Latest data about annual fuel ethanol production worldwide from 2012 is encapsulated in Table 1, [16-19].

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Table 1: Annual Fuel Ethanol Production by Country (2007–2011) [16-19].

Rank	Country/Region	2011	2010	2009	2008	2007
1	United States	13,900.00	13,231.00	10,938.00	9,235.00	6,485.00
2	Brazil	5,573.24	6,921.54	6,577.89	6,472.20	5,019.20
3	EU	1,199.31	1,176.88	1,039.52	733.6	570.3
4	China	554.76	541.55	541.55	501.9	486
5	Canada	462.3	356.63	290.59	237.7	211.3
6	Australia 87.20	87.2	66.04	56.8	26.4	26.4
7	Thailand	No production starting in 2010				
8	India	No production starting in 2010				
9	Colombia	No production starting in 2010				
10	Other	No production starting in 2010				
	World Total	22,356.09	22,946.87	19,534.99	17,335.20	13,101.70

It is clear that the world production of fuel ethanol is either decreasing, or at best, reaching a stagnant number. It is also obvious that Thailand, India and Colombia stopped production in 2010, and fuel ethanol manufacture was not introduced in any other countries. Their ranking in the table has only historical significance.

For the farming people in poor or medium-income countries, their priority is putting food on the table. They do this by growing various crops for subsistence or cash. Giving up their subsistence land for ethanol production will deprive them of a livelihood. This is not a good route for leaders to pursue in low-income countries. Changing cash crops of small farmers need convincing. The natural inclination of most people is to resist change, especially if they feel comfortable in their medium-income status.

For an illustration, let us consider palm oil as a cash crop. There are three factors that would influence the decision whether to use the palm oil harvest to blend with diesel for a less expensive fuel. The price of cooking oil, price of crude palm oil and price of crude oil. The resulting equation is extremely difficult to balance for thinkers, and thus daunting to farmers themselves.

Many European companies and some American ones have obtained concessions in many sub-Saharan African countries to grow crops for fuel ethanol. It is a commonly accepted fact that people from many parts of Africa are not farmers and would rather hunt wild animals for food or to peddle them. In addition, there is the uncertain political climate in many of these countries. Dramatic policy changes can take place with every change in government. The risks to international companies are high. The data of Table 1 provides evidence to this consequence resulting from risk minimization.

From one philosophical viewpoint, food crops are meant for human consumption, and biofuels should only be produced from the by-products. In many traditional societies, this principal was practiced in that the by-products of food crops were fed to farm animals. In biofuel production, water can be seen to be converted into fuel via crops in a time when the energy-water-food nexus problems are cropping up everywhere in the world [1-3]. The obvious existing energy conversion technology for this is hydrogen energy via batteries, rather than biofuels. The steps are less, and hence risks also much less.

Conclusion

Man should endeavor to produce petroleum gasoline and biofuels. These productions are necessary to focus both technologies and related technologies on modernizing and innovating. Continuous improvements and/or innovative steps, no matter how small, are necessary for engineering systems to be sustainable. In other words, burning of fuels like petroleum gasoline and biofuels should be practiced until society has established other systems to replace the systems that need combustion of such fuels to provide energy.

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