

Analysis

The main focus of the articles that I read throughout my research is to discuss the possibility of biofuels. While they all agree on what needs to be addressed within the world of biofuels, they have different ways of attacking the similar problems. There are a number of reoccurring themes throughout the majority of the articles, but the language and how they talk separate the discourse community into a couple different groups.

The article by Nanci Dilekl and Faye Dunchin and the article by Puneet Dwivedi are similar in that they both hit heavily on the plausibility of biofuels when taking into consideration The Energy Independence and Security Act (EISA). Their discussion focuses on increasing production and pairing this increase with government assistance to provide affordable biofuel for mass consumption. Dwivedi argues that the government needs to take into consideration the broad strokes they use to consider something as a biofuel; a “60% threshold level of GHG (greenhouse gasses) savings relative to gasoline” (2512). This loose requirement for a biofuel, he says, is “unlikely to create the incentives to use cellulosic feedstocks that could lead to less GHG intensive biofuels but may be more expensive to produce.” (2520). Dilekl and Dunchin make a similar argument stating that in order to meet the government mandated amount of 21 billion gallons of biofuel then “the mandated amount needs to take the form of cellulosic ethanol” and should be “from sustainable and nonfood feedstock” (120). Dilekl and Dunchin conclude that in order to make biofuel a feasible option given the current policies in place that “increasing the size of the subsidy or the stringency of the import restriction given that higher-cost states are called upon” (127). The discourse that both articles take place in are centered within a policy oriented discussion. This difference in language separates them from other articles, but they are still participating in a very similar, if not related, discourse community. Both of these articles fall

under government funded research. They talk in the same language of policy. The aims of their research revolves a lot around probability of biofuels and abiding current US government policies and regulations. They both are talking about how to work with the GHG requirements, which both articles acknowledge as flawed.

The article by Ralph Sims does not go as in-depth into the political needs to improve biofuel, but the article does discuss all the changes that need to come in order to move away from first generation biofuels and to a more commercial second generation of biofuels. Sims list numerous reasons that “their (biofuels) potential to meet liquid transport fuel targets being set by governments to help achieve the goals of oil-product substitution, economic growth, and climate change” (1570) are hindered. Among these reasons are competition for land with food production and high production fees, which could be accounted for by government subsidies, and that there is a widely varying assessment of net greenhouse gas reductions. In this way the Sims article addresses very similar issues as both the previously mentioned articles. The movement away from using food production land, agreement on need for government assistance, and the discussion of greenhouse gas reductions are issues discussed in all three articles. Just as Dwivedi argues that the assessment of what qualifies a biofuel as a biofuel (GHG mitigation), Sims states that investment related to second generation bio fuels should place importance on “evaluating land-use change impacts on GHG emissions” (1557). In this way both Dwivedi and Sims are pointing out what they consider a flaw in the way current biofuels are handled.

The Sims article acts as a kind of bridge between the more policy oriented articles (Dilekl, Dunchin and Dwivedi) and the heavily research oriented discussions (Dornbos and Alder). For example, in the Sims article both of the conversion methods, biochemical and thermochemical, are defined and clearly explained within the article well enough that someone

with little to no knowledge on biofuels would be able to understand the difference. In contrast, the Aldar article references “several biomass conversion technologies” (1518) but does not go in any more detail than to name them, “ethanol production from biorefineries, direct combustion, and thermochemical conversion by gasification/pyrolysis” (1518). In the article by Dornbos similar assumptions are made pertaining to base knowledge by the reader. Dornbos and Alder do not discuss policy at all. They do not use the same kind of language as the other articles. Both of them heavily hit on the scientific side of biofuel and use the same topic specific vocabulary; “affected switchgrass biomass yield and biofuel quality for energy production” (Aldar, 1518) and “provide a baseline from which to evaluate the impact of invasive switchgrass frown on soil organic carbon over years, possibly with or without biomass harvest for ethanol” (Dornbos, 2). Sims connects the two separate discussions by drawing from research heavy papers and fitting them into the policy. The article sections discussing the different ways to discuss cellulosic ethanol in a scientific way (i.e lingo-cellulose feedstocks, conversion routes etc.) and then goes on to apply these findings to the commercial production side that is regulated by government policy (i.e. supply, markets, and technology, GHG mitigation, implications for policy etc.)

The Sims article briefly touches on “lingo-cellulose feedstock” (1572) or simply what are the crops that will be supplying cellulosic ethanol, and what is being done to determine this. The article gives an example of eucalyptus mallee crops being used for biofuel and that while being a good crop for biofuels, they had other benefits, like “drive(ing) down the water table and reduce(ing) the surface salt concentrations that prohibit cereal crop productions” (1572). This idea that a biomass crop may be used to not only benefit the biofuel industry but also improve the land used to grow the biomass is the basis for the study discussed in Professor Dornbos’s paper “Potential for Woody Invasive Species to Produce Biomass for Ethanol and Improve Soil

Quality”. In this way Sim’s article manages to bridge the gap in communication ongoing within the biofuel community. Dornbos’s research aimed to determine if different common invasive species (i.e. glossy buckthorn, autumn olive, and tree-of-heaven) could be harvested for biomass and increase the quality of the soil they grow in. This discussion diverged from the more policy aimed articles, but still touched on the base of biofuel discussion which is improvement towards feasibility.

The article by Dornbos and the call for research into biomass crops is carried out in the research article by Paul Alder. The article reports the results of an experiment which sought to investigate how seasonal time of harvest affect biomass yield and biofuel quality in different crops using different conversion systems. In the research, different crops are discussed and their effectiveness as a biomass given the current conversion methods. This study addressed ideas found throughout all the articles. In the study addresses the cost, production, and efficiency of a specific crop as a biomass for biofuel. This research uses a non-food crop on land currently not being used to produce food, both points made in the first two articles. The affect the possible plants have on the overall soil quality is measured, an idea discussed in both the Dornbos article and touched on in Sims discussion. While both the Alder article and the Dilekl, Dunchin and Dwivedi articles discuss similar topics and agree on the importance of biofuels they do not appear to be communicating. There is a disconnect between the research and policy side.

There is also a third sort of discourse community also discussing cellulosic ethanol. This third group is more of a pop culture side. Both articles “Green Dream” and “Green Gold”, as exemplified by their titles, use flashy and catchy language to market the idea of biofuels. They are both talking about, and generally promoting, the same biofuels discussed in all the academic articles I read, but they do not use language that would allow the reader to connect that they are

talking about the same thing. With “Green Gold” specifically, the article was published in a local Massachusetts business magazine. The audience is well educated business men, the objective of the article being to inform them of new companies, but also to spark their interest in investing within the biofuels, specifically cellulosic ethanol. Just in referring to it as “grassoline” or “green gold” as opposed to the terminology used throughout the rest of the discourse community, “cellulosic ethanol”. In the case of the more politically aimed articles, they appear to be addressing someone well versed in government policy and someone who has a strong base knowledge of biofuels. The scientific articles both focus on the research side of things, generally limiting themselves to an audience well versed in the science of biofuels. The disconnect within the academic community is split on how to discuss and verbalize the topic, so they certainly are not giving off a clear front on how the more popular culture or laymen, should think about and discuss cellulosic ethanol.

Bibliography

Adler, P.R. , Sanderson, M.A. , Boateng, A.A. , Weimer, P.J. , Jung, H.J.G. “Biomass Yield and Biofuel Quality of Switchgrass Harvested in Fall or Spring” *Agronomy Journal*, v. 98, no. 6, American Society of Agronomy, 2006 Nov-Dec.

The main author for the piece, Paul Adler (PhD), is an employee of the United States Department of Agriculture and has 80 published articles all pertaining to environmental science and soil science. Matt Sanderson (PhD) also works for the United States Department of Agriculture. He specifically works with grassland and species diversity. The article was written to discuss the timing of harvest for energy crops which is the combination of the two main authors specificities.

The study aimed to determine the impact of harvest time on energy yield of crops used to produce biofuel. The time of harvest may affect the biofuel quality which also may affect the type of conversion system to use. The concluded that biofuel conversion systems may determine harvest timing. The article takes both direct combustion and ethanol fermentation into consideration when determining which conversion system may be best.

“Our objective was to examine how the seasonal time of harvest, comparing fall and spring harvest, affected switchgrass biomass yield and biofuel quality for energy production from fermentation, gasification, or direct combustion systems.”

The article is a good in depth look at the different kinds of possible biomass choices and why one may be chosen over another in different climates and in areas with different conversion systems available.

Bourne, Joel. “Green Dreams” *National Geographic*, October 2007.

Bourne graduated from North Carolina State with a BS in agronomy (the science of soil management and crop production) and an MS in journalism from Columbia University. He now is a reporter for National Geographic. In this article he explores the different kinds of ethanol biofuels.

The article walks through corn ethanol, cane ethanol, biodiesel, and finally cellulosic ethanol. For each it provides information on how much is produced, the cost of production, the retail cost, energy balance, and greenhouse emissions.

It provides very straightforward statistics about all the different possible biofuels. The article is slightly out of date so it is difficult to know if the statistics have drastically changed without

doing further research. Overall, it is clearly building up to and making an argument for cellulosic ethanol as the next frontier of clear energy.

Chase, Dan. "Green Gold." *BusinessWest* 26.10 (2009): 21. *ProQuest*. Web. 29 Mar. 2017.

Dan Chase is a journalist for BusinessWest magazine. BusinessWest is regional business journal focusing specifically on Western Massachusetts. In this article Chase is interviewing and writing about Professor Huber. Professor Huber works at UMass Amherst and started the company Anellotech to produce "green gold".

This green gold is produced using biomass to make biofuel. The basic idea is that a raw material is added to a reactor with a catalyst, which is heated and then decomposes the raw material into gasoline. The article goes on to address the advantages of 'grassoline', like the raw material not competing with other uses (food, animal feed), potentially halving the United States petroleum based fuel needs, producing useful byproducts, and breaking the US's dependence on foreign fuel.

The article provides an optimistic outlook on the future of 2nd generation biofuel. It also provides a good look at an up and coming company that utilizes biofuels.

It fits into my research because I was looking for more examples of biofuel companies.

Dilekli, Naci and Duchin, Faye. "Prospects for Cellulosic Biofuel Production in the Northeastern United States: A Scenario Analysis." *Journal of Industrial Ecology*, vol. 20, no. 1, Feb. 2016, pp. 120-131. EBSCOhost, doi:10.1111/jiec.12291.

Naci Dileki was a postdoctoral researcher at Rensselaer Polytechnic Institute in Troy, NY, USA, at the time this article was written. Faye Duchin is a professor in the Department of Economics at Rensselaer Polytechnic Institute. The United States government passed the Energy Independence and Security Act which mandated that 21 billion gallons of next generation biofuel be produced 2022. In this article the argues for roughly 60BL of the mandated 79BL come from cellulosic ethanol and that the Northeast seems like a good place for this production.

The article discusses the downfalls of first generation biofuels (compete with food production for desirable land and water resources) and the benefits of second generation biofuels biofuel from feedstock in the form of net forest growth and woody wastes. The study concludes that in order for cellulosic ethanol to be viable then the price must be competitive with gasoline. This can be done through subsidies or through restricting gasoline imports. Up to 22.28 BL of cellulosic ethanol per year can be produced, that is 12.5% of gasoline designated to motorized transport.

The article is clear and to the point. Provides good evidence. This article is perfect for my research. It makes a clear argument for second generation biofuels while clearly articulating their problems and an idea of how to help them take off. It is also a fairly up to date article (2016).

Dornbos, David. "Potential for Woody Invasive Plants to Produce Biomass for Ethanol and Improve Soil Quality" 2009.

Professor Dornbos, the head of the biology program at Calvin College, worked with students in 2009 to research invasive plants and their usefulness for biomass.

The objective of their study was to determine if the invasive species buckthorn, autumn live, and tree-of heaven could be used to produce a lot of biomass for biofuel and improve soil quality. Their research concluded that all of the invasive species would provide good biomass but that further studies would need to be conducted to determine their long term effect on soil.

It provides an interesting take on how to provide material for biomass. Also, the information on soil quality is another interesting take on the possible benefits of biofuels. It is a relatively small scale study which does make it hard to really apply on a larger scale.

Dwivedi, Puneet^{1,2}, et al. "Cost of Abating Greenhouse Gas Emissions with Cellulosic Ethanol." *Environmental Science & Technology*, vol. 49, no. 4, 17 Feb. 2015, pp. 2512-2522. EBSCOhost, doi:10.1021/es5052588.

The rhetorical situation was to determine which of the discussed plants would be effective enough to fall under the Renewable Fuel Standards so they could apply to The Energy Independence and Security Act (EISA). The authors were looking to discuss the GHG intensities and costs as they applied to these government policies.

The study aimed to compare the GHG intensities and costs of corn stover, switchgrass, and miscanthus grown on high and low quality soils. They found considerable differences in GHG intensities and ethanol production costs. They attributed this mostly to differences in yields and soil characteristics. The information gathered can be used to infer a minimum carbon tax rate needed to promote use of cellulosic ethanol.

Overall the article was confusing but the discussion provided a good summary and clear summation of their findings. The findings are easily applied to my paper because they address the benefits of cellulosic ethanol with regards to GHG and they factor in what the government can do to incentivize the use of cellulosic ethanol by making it economically competitive with gasoline.

Hochma, Gal, Zilberman, David, *Algae Farming and Its Bio-Products*, Plants and Bioenergy,

Springer Science+Business Media New York 2014.

Both the authors are professors of Agriculture and Resources. They are adding to a larger discussion of the feasibility of Algae Farming.

The article discusses both why algae works as an attractive option for filtering waste product and producing bio mass. The article provides a clear counterargument as well. The specifics of algae farming and its applicability on a commercial scale are discussed.

It is very straightforward in discussing how the different processes work, but it uses a fair amount of technical information and terminology which can make it difficult for me to understand.

Kells, Bradley J.1,2 and Scott M.2,3, swintons@msu.edu Swinton. "Profitability of Cellulosic Biomass Production in the Northern Great Lakes Region." *Agronomy Journal*, vol. 106, no. 2, Mar. 2014, pp. 397-406. EBSCOhost, doi:10.2134/agronj2013.0397.

This point of this article was to discuss the profitability of switching from mixed hay to either willow, poplar, or switchgrass. Specifically, the authors determine how much biomass would need to be produce to produce a profit.

By producing biofuel feedstock on non-crop lands the “food price feedback” argument can be largely avoided. This article specifically looks at the Northern Great Lake Region and two short-rotation tree crops; willow and hybrid poplar, and switchgrass and mixed hay. The study evaluated the prices and yields needed for biomass crops become at least as profitable as mixed grass hay. As of 2010-2012 cellulosic crops were not competitive. The study concluded that when comparing the northern and southern areas of the Great Lakes region the norther area has an economic advantage over the southern area.

The article presented its case well and had solid findings. However, as far as my research is concerned this was a too specific on the kinds of plants and areas used for cellulosic ethanol.

Ralph E.H. Sims, Warren Mabey, Jack N. Saddler, Michael Taylor, An overview of second generation biofuel technologies, *Bioresource Technology*, Volume 101, Issue 6, March 2010, Pages 1570-1580, ISSN 0960-8524, <http://dx.doi.org/10.1016/j.biortech.2009.11.046>.

The article is fairly critical of first generation biofuels. The frame is certainly one of moving away from corn ethanol and towards second generation techniques. It is pretty clear that both the authors are arguing strongly for second generation biofuels.

The article discussed the limitations of 1st generation biofuels and argued that greater focus should be placed on 2nd generation biofuels. Both biochemical and thermo-chemical route are discussed at length. The conclude by discussing what both private and public sector contributions need to be made to furthering research and funding.

This article is broken up nicely into sections addressing all the different issues with cellulosic issue which are all then addressed. The article is a little dated (2010) and references studies to be completed by 2015 and such which makes it irrelevant on some issues.