The Viability of Cellulosic Ethanol in Market Penetration

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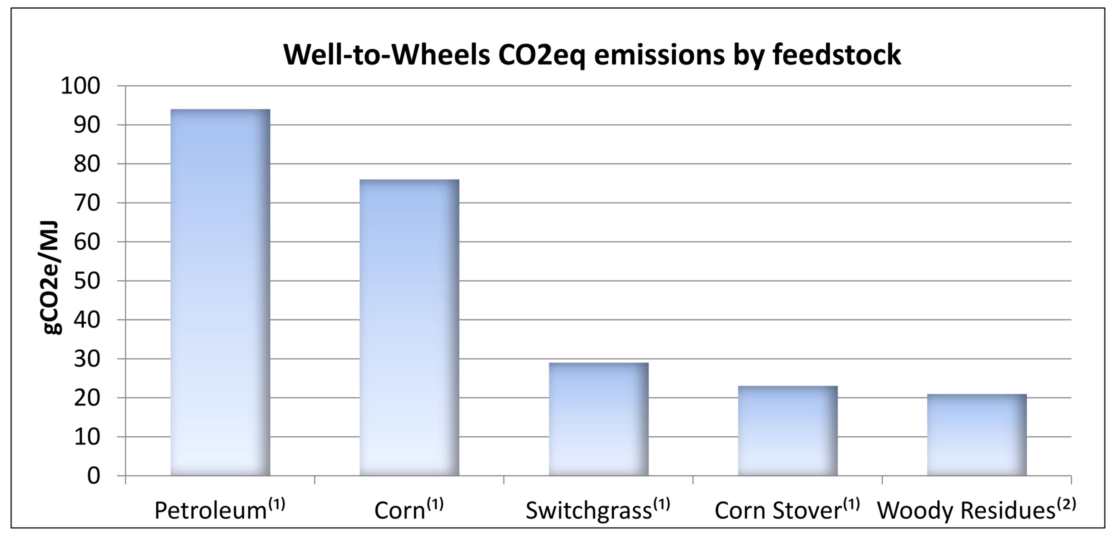
Introduction:

Our project attempts to address the viability of cellulosic ethanol as an alternative to fossil fuels in today's economy. We will look at the comparative benefits, environmentally (and ethically) of producing cellulosic ethanol and focus on the technological barriers in fuel production and the processes used to overcome them.

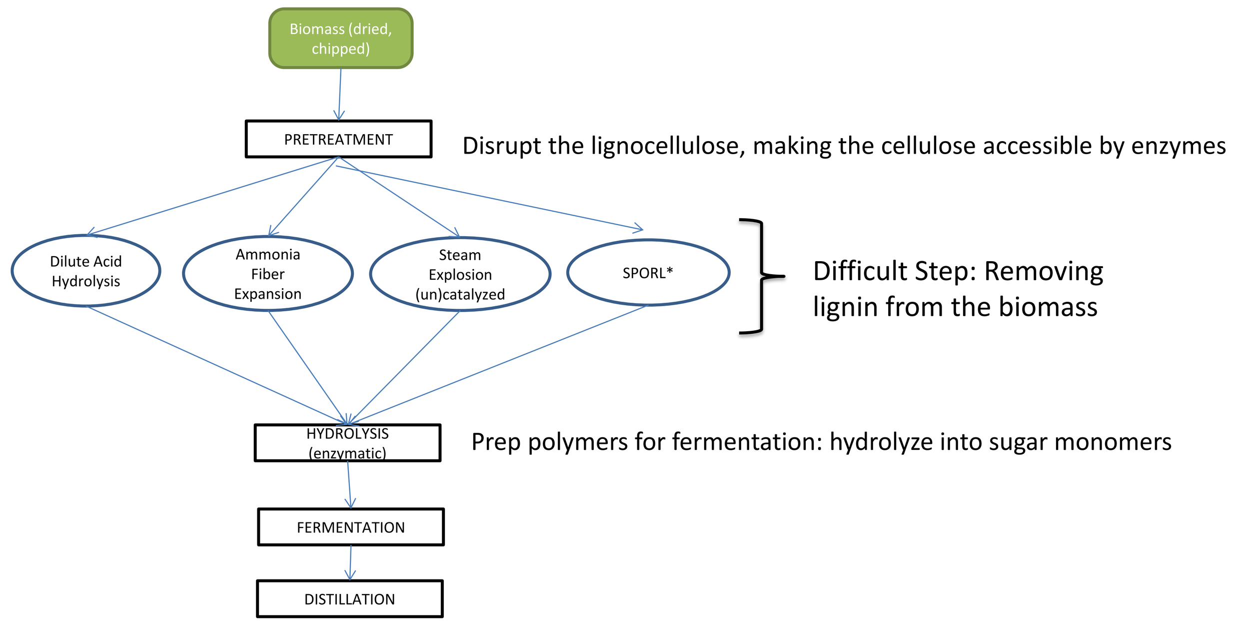
The successful implementation of a biofuel requires immense government support, and in the case of cellulosic ethanol, various government policies have had significant effect s on its commercial markets. We will look at the profitability of current cellulosic ethanol companies in these markets and how they have been affected by economic and policy obstacles.

Technology: benefits and impacts

1.) Resolves Food vs. Fuel Debate
2.) Decreases Energy Dependence on Unstable Foreign Countries
3.) Low GHG Emissions



General Cellulosic Ethanol Process Diagram



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Potential Health and Enviromental Impacts

The potential health impacts of treatment processes involved in cellulosic ethanol production are minimal and occur mostly in the production of the crop and the pretreatment of the biomass. The most dangerous hazards would be from insecticides used on crops, dilute sulfuric acid used in pretreatment, and anhydrous ammonia used in AFEX pretreatment. If possible, crops that don't require use of harsh pesticides should be chosen as feedstock to minimize the leeching of these extremely eco-toxic chemicals into ground and surface water.

Business & Economic Factors:

Commercialization:

A large number of cellulosic ethanol research labs, some pilot and demonstration facilities, but fruition into full-scale commercialization has yet to be seen, to the extent of being able to compete with fossil fuels.

In 2012, the cost of producing cellulosic ethanol was 40% higher than that of producing corn ethanol, at $3.55 per gallon (11). Compare this to the cost of producing gasoline at $2.66 per gallon (12).

Current Company Funding:

USDA Biorefinery Assistance Program-provides loan guarantees up to $250 million for non-corn renewable biomass-derived biofuels. It awarded $250 million to Coskata in 2011, $132.4 million to Abengoa in 2011, and $232 million loan guarantees to ZeaChem in 2012.

Decreased profitability has caused pull back: both BP and Chevron have pulled funding from their cellulosic ethanol divisions in the past several years due to inability to raise profit margins to acceptable levels(10).

Strategies to Reach Commercialization:

Only .24% cars run off of ethanol - profitability may arise from partnering in the vehicular manufacturing market in developing more cars to run off of their fuel. Besides market development, the technology must improve to allow cheaper fermentation/ pretreatment.

2008. First Cellulosic Ethanol plant in the US, *Verenium*.

Company	Location	Feedstock	Capacity	Began Production	Type
DuPont	Nevada, IA	Corn stover	30	est. 2014	Commercial
Coskata, Inc.	Boligee, Alabama	Natural gas?[36]	16	est. 2013	Commercial
Coskata, Inc.	Madison, Pennsylvania	Multiple sources	0.04	October 2009 [39]	Semi-commercial
Fulcrum BioEnergy	Reno, NV	Municipal solid waste	10	est. end of 2013	Commercial
Gulf Coast Energy	Livingston, AL	Wood waste	0.3	before 2008	Demonstration
Abengoa Bioenergy	Hugoton, KS	Wheat straw	25 - 30	est. late 2013	Commercial
Mascoma	Kinross, MI	Wood waste	20	est. 2014	Commercial
BlueFire Ethanol	Irvine, CA	Multiple sources	3.9		Commercial
BlueFire Ethanol	Fulton, MS	Multiple sources	19		Commercial
KL Energy Corp.	Upton, WY	Wood waste			

	Profitable
	Private
	Unprofitable

Companies currently producing cellulosic ethanol production plants, and their profitability (*Capacity in millions*).

Policy Factors:

Renewable Fuel Standard:

The US must produce at least 21 billion gallons of advanced biofuels annually by 2022 of which 16 billion gallons must specifically come from cellulosic feedstock (5).

- The advanced biofuels must also emit at least 60% less of the baseline GHG emissions from reformulated gasoline.
- According to the California GREET model estimates, cellulosic ethanol from forest residues will release 21.4g CO_2/MJ energy produced compared to 95.9g CO_2/MJ energy produced, which is a 77.7% decrease (7).

California Low Carbon Fuel Standard:

Puts a maximum on the amount of greenhouse gas emissions a fuel producer is allowed to emit each year. Companies below that amount can deal their remaining allotment to other companies that go over the limit (6).

Renewable Portfolio Standards:

Requires electricity suppliers to acquire certain amounts of Renewable Energy Certificates (REC's). REC's are produced by demonstrating that the supplier has sourced an appropriate amount of electricity from a renewable energy source (8). Companies can trade their REC's if they have an excess to companies that are not able to meet the standard

- Cellulosic ethanol is not typically used in large-scale production of electricity required by the RPS. This problem is due large in part to the fact that there many production facilities are only in pilot stages.

Cellulosic ethanol is among the list of chemicals covered by the Toxic Substances and Control Act (TSCA) as well as the European Registration, Evaluation, Authorisation, and Restriction of Chemical substances (REACH). Current production methods do not contain any byproducts or contaminants that are hazardous according to TSCA although further studies would need to be done in the case that the contaminants could be concentrated and sold under REACH.

Conclusion:

Cellulosic ethanol will remain as an idealized goal until (1) companies can optimize ethanol production and pretreatment, and (2) companies producing ethanol partner with automotive companies to create a market for their product.

Companies should strive to utilize processes that start with a variety of feedstocks, allowing for flexibility when expanding into new climates. They should also consider feedstocks like forest residues that require minimal pesticides and herbicides, which can be extremely harmful to human health as well as neighboring ecosystems. If the "greenest" process is not the most economical, companies can consider producing higher value coproducts from the lignin components to improve profit margins (9). Once cellulosic ethanol can overcome the technological barriers in production and grow into a large-scale commercial facility, it can be sustained by the numerous policy factors that are already present.

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