DOE Actively Engaged in Investigating the Role of Biofuels in Greenhouse Gas Emissions from Indirect Land Use Change

DOE Response based on contributions from Office of Biomass Program; Argonne National Lab, National Renewable Energy Lab, Oak Ridge National Lab, Pacific Northwest National Lab; USDA

Recently, the issue of greenhouse gas emissions resulting from indirect land use change has been a topic of much media attention and public debate. There is very little peer-reviewed literature on the role of biofuels in this relationship between biofuel production and land use change. Fortunately, researchers around the world are working to understand these issues better through detailed modeling and technical analysis.

The debate surrounding the impact of biofuel production on land use patterns was sparked by two studies in ScienceExpress—an advance web version of Science Magazine. These studies focused on the impact of biofuel production on land use patterns and the associated GHG emissions implications.

As some of the first peer-reviewed studies on the topic, they require much further work, refining assumptions, improving datasets, and strengthening of the models used. In addition, these two studies neglect to account for local forces behind land use change which some experts state are by far the primary drivers of deforestation. It is reasonable to expect that rigorous, peer-reviewed, science-based land use models will show that indirect land use change impacts of biofuels production are far smaller than these articles suggest.

The Fargione, Hill, Tilman, Polasky and Hawthorne study ("Land Clearing and the Biofuel Carbon Debt") claims that biofuels production on agricultural lands is creating a "carbon debt" by initially releasing 17 to 420 times the amount of greenhouse gas emissions that it will save on an annual basis, through land conversion activities. The study relies on many assumptions, such as stating that the US will widely use CRP land for biofuels production. In fact, much of CRP land is unsuitable for use for annual row crop production, but could be used for dedicated *no-till* perennial energy crops. However, a joint DOE/Oak Ridge National Laboratory study demonstrates that no CRP land is required to meet the new Renewable Fuel Standard requirements, as mandated by the *Energy Independence and Security Act of 2007 (EISA)*.

While many of the assumptions can be challenged, a few points made by the Fargione study are irrefutable. For example, we strongly agree that clear-cutting of rainforest or other carbon-rich lands makes no sense. In fact, it doesn't make sense for any purpose, not just in the case of biofuels. An important point to remember is that EISA explicitly protects carbon-rich land by lifecycle greenhouse gas analysis that demonstrates a reduction of at least 50 percent in greenhouse gas emissions for

advanced biofuels and at least a 60 percent reduction for cellulosic biofuels.[1] EISA defines renewable fuels as those produced on land already in production prior to enactment of the law, thereby discouraging potentially detrimental land-use changes (e.g. deforestation and wetland conversion).

The Searchinger study ("Use of US Croplands for Biofuels Increases Greenhouse Gases through Emissions from Land Use Change") claims that biofuels production in the US, whether by corn or switchgrass, will trigger harmful land use changes elsewhere, in response to higher agricultural commodity prices, and thereby lead to huge GHG increases initially. The study claims that no greenhouse gas benefits will occur for the first 167 years of corn ethanol production.

The Searchinger study contains some unrealistic assumptions and obsolete data. The key issues are as follows:

- The study assumes a corn ethanol production scenario of 30 billion gallons per year by 2015, which is double the amount established by EISA (see Figure 1). To meet the new RFS, after 15 billion gallons, biofuels must come from feedstocks other than grain, and primarily be produced from cellulosic feedstocks, such as agricultural wastes and forest residues.
- The study relies on a worst-case scenario by assuming that land use and deforestation in 2015 will mirror that which occurred in the 1990s. Better land management practices and avoided deforestation credits, if adopted, could reduce deforestation rates. In fact, deforestation rates have slowed down over the past decade.
- The assumption that corn exports will decline by 62 percent is contradicted by historical trends. As Figure 2 shows, U.S. corn exports have remained fairly constant at around 2 billion bushels per year throughout the entire growth phase of the ethanol industry. Specifically, the 2007 exports represent a 14% increase compared to 2006 level, while US corn ethanol production has reached close to six billion gallons that same year.
- The premise that dramatic land use will result from U.S. corn ethanol use production is flawed. US corn production for food and feed has increased by 1 percent per year for the past two decades. Moreover, Figure 3 shows the increase in protein-rich U.S. Distiller Dry Grains (DDGS) exports, which are growing significantly as U.S. corn ethanol production expands. DDGS export growth will be a growing contributor to the global food supply.[2]
- One scenario analyzed in the study incorrectly assumes the conversion of US corn cropland to switchgrass. No farmer would convert corn acreage to switchgrass as the value of corn will most likely exceed that of a non-food crop. Furthermore, a DOE/Oak Ridge National Laboratory study found that more than 1 billion tons of biomass resources are available in this country (Figure 4) without displacing corn cropland.

[1] Facilities built before December 2007 are exempt from GHG reduction requirements. Future corn-starch ethanol will have to meet a GHG reduction of 20%.

[2] DDGS can partially replace the nutrient value of corn as animal feed. However, they are not directly interchangeable and some modifications to feed rations are needed.

DOE Commitment to Environmentally Sound Biofuels Development

DOE is committed to ensuring environmentally responsible growth of the biofuels sector. To that end, we are working with USDA, EPA and other agencies to examine the issue of direct and indirect land use, as well as many other sustainability challenges (water use, fertilizer use). DOE's research, development, and demonstration efforts focus on hastening the emergence of an advanced cellulosic biofuels industry, which will use primarily agricultural wastes, forest residues and energy crops that do not compete with food. The Department has announced more than $1 billion of investment over the past year, which include ten major cellulosic biofuels demonstration projects (which mostly use waste materials) and three Bioenergy centers led by our major research universities and national laboratories, which aim to achieve transformational breakthroughs in our nation's ability to produce sustainable, competitive biofuels.

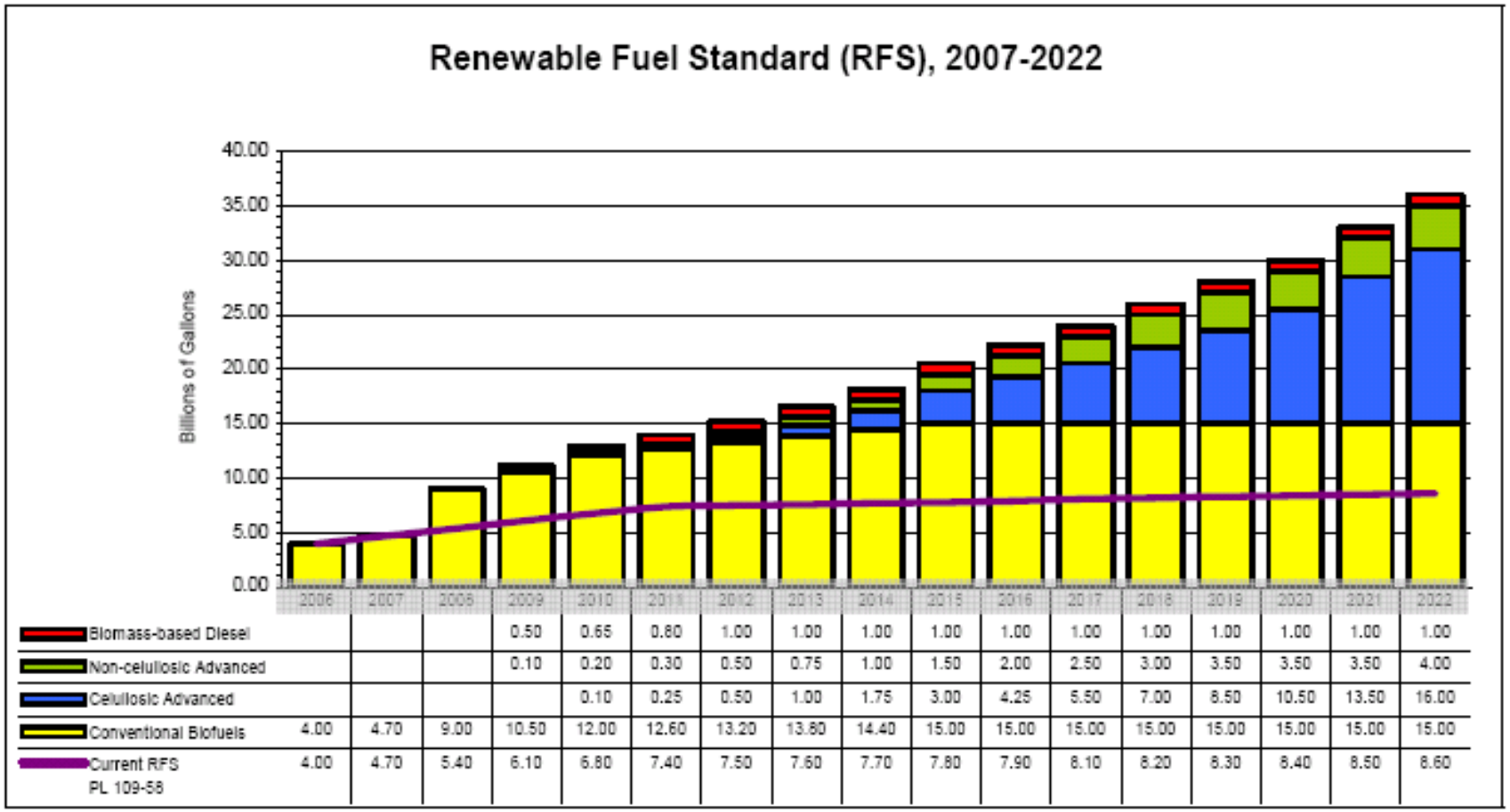
One must keep in mind that land use is a critical issue that must be addressed as we grow our nation's biofuels production, but this issue is not unique to biofuels. Our nation needs smart land use policy to govern whatever growth and development occurs, whether we are considering biomass production or something entirely different. DOE and the recently passed EISA are calling for sustainable biofuels, not planting crops on every inch of arable land. In fact, as we move toward cellulosic biomass, these feedstocks can grow on more marginal lands. In terms of land use, we would only need about one-third of the land identified in the Billion Ton Study to produce the entire 36 billion gallons required by 2022.

Just as the US must adopt and enforce land use policies that prohibit development of ecologically sensitive lands, this must be the case worldwide. To that end, DOE and the State Department are working to address global sustainability issues with international partners, including environmental organizations, industry, and others.

Assumption	Study Position[3]	DOE Position
US 2015 Corn Ethanol Production	30 Billion Gallons per Year	15 Billion Gallons per Year RFS Cap (see fig. 3)
Land Use Change Paradigm	Additional Biofuels Acreage in one place causes harmful land use conversion elsewhere	Agriculture competes with many other land uses. Higher value of agriculture land may prevent urbanization which results into permanent loss of carbon sink.
Land Use Change - Model	Study Model use 1990s data – with high deforestation rate – leading to excessive carbon "debt" results	Deforestation rate is slowing down and forests are growing in 22 of 50 countries, led by US and China[4]
US Biomass Land Use	Corn production will be converted to switchgrass production	Neither policy nor market incentives will lead to this outcome; we have enough resources without impacting corn acreage (see fig. 6)
Brazil Biomass Land use	Brazil will use deforestation to plant biofuel crops	Sufficient pasture land is available in Brazil for biofuels without impacting Brazil rainforest; Cellulosic ethanol bagasse could double Brazil ethanol production with no additional land
Switchgrass productivity	Constant	Yield increases can be substantial – because of new domesticated varieties developed for agricultural productivity
US Corn Exports	Will decline by 62%	Inconsistent with Historical Track Record (see fig. 4)

[3] Searchinger study.
[4] Proceedings from National Academy of Sciences, November 2006.

Figure 1: Renewable Fuels Standard Volume Requirements



	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Biomass-based Diesel				0.50	0.65	0.80	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Non-celullosic Advanced				0.10	0.20	0.30	0.50	0.75	1.00	1.50	2.00	2.50	3.00	3.50	3.50	3.50	4.00
Celullosic Advanced					0.10	0.25	0.50	1.00	1.75	3.00	4.25	5.50	7.00	8.50	10.50	13.50	16.00
Conventional Biofuels	4.00	4.70	9.00	10.50	12.00	12.60	13.20	13.80	14.40	15.00	15.00	15.00	15.00	15.00	15.00	15.00	15.00
Current RFS PL 109-58	4.00	4.70	5.40	6.10	6.80	7.40	7.50	7.60	7.70	7.80	7.90	8.10	8.20	8.30	8.40	8.50	8.60

Source: Hart Energy Consulting, Government Affairs, 2007

The law establishes definitions for categories of renewable fuels identified in the RFS:

Figure 2: US Corn Exports have recently Increased

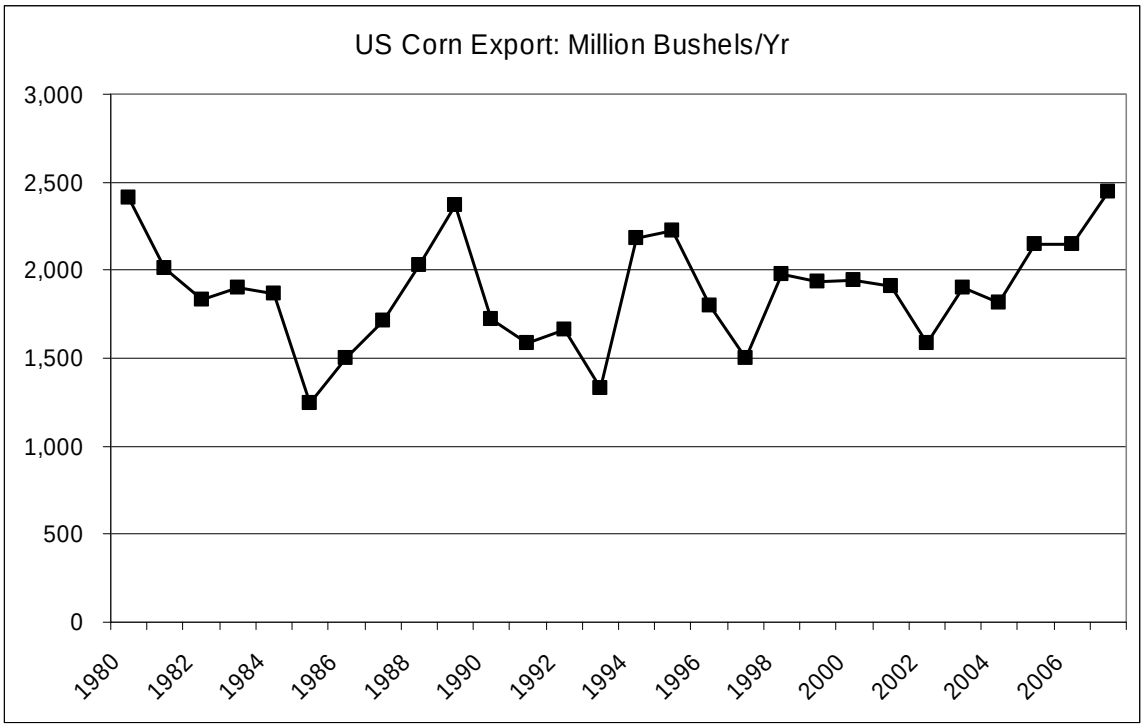


Figure 3. U.S. DGS Exports Have Increased Dramatically

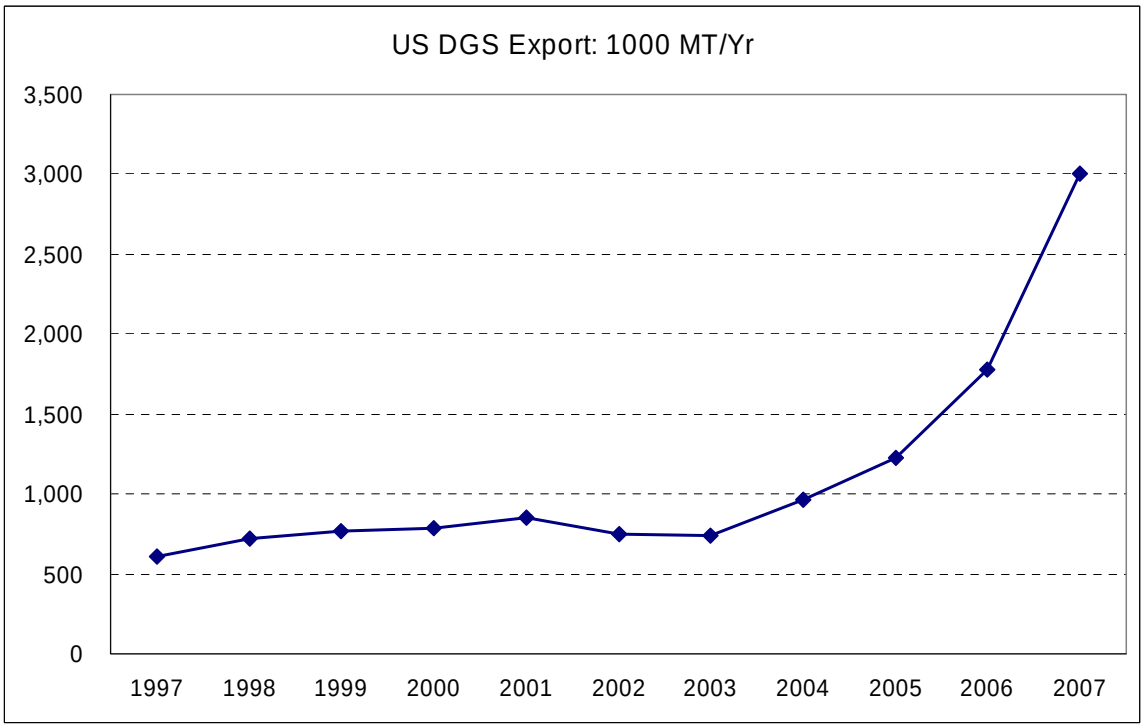
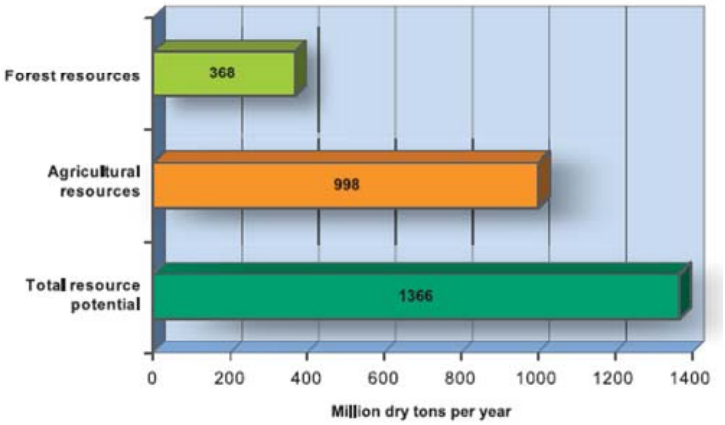


Figure 4: US Availability of Biomass Resources

Are There Sufficient Biomass Resources to Replace 1/3 of the U.S. Petroleum Requirements?

- Yes, land resources can provide a sustainable supply of more than 1.3 billion dry tons annually and still continue to meet food, feed, and export demands (USDA baseline)
- Realizing this potential will require R&D, policy change, stakeholder involvement
- Required changes are reasonable given current trends and time for biorefinery scale-up and deployment



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