Comments on the paper by de Gorter and Just:
The Social Costs and Benefits of U.S. Biofuel Policies with Pre-Existing Distortions

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Comments on the paper by de Gorter and Just: The Social Costs and Benefits of U.S. Biofuel Policies with Pre-Existing Distortions

I found the substance of the author's paper a useful addition to the policy discussion surrounding biofuels incentives. The potentially perverse effects of a double incentive of fuel mandates and tax incentives has not been as thoroughly treated as it perhaps should be. I doubt that most policymakers are aware of the idea that the authors demonstrate: that providing tax incentives for biofuels at the same time as the government requires the use of those fuels leads to greater fuel overall fuel consumption than would otherwise occur in the absence of the tax incentive.

As the authors show, if a renewable fuel mandate – an ethanol mandate in gasoline in the simplified model of the paper – is binding, then a lower ethanol tax rate does not further incentivize ethanol consumption. That level of consumption has been set by the mandate. Therefore, the lower ethanol tax rate – a result of the blender's tax credit in federal law – leads to a lower effective price for motor fuel in general, promoting more motor fuel demand. As a result, demand for gasoline is higher, as the supply and demand of ethanol are pegged at the mandate. That is not to say that the mandate or the tax incentive alone will lead to higher gasoline consumption, but that in the presence of a mandate, gasoline consumption is expected to be higher if there is an ethanol tax credit than in the absence of such a credit.

Independently, both the mandate and the tax credit lead to higher ethanol consumption, but a tax credit on top of a binding mandate creates no additional demand for ethanol. If the tax credit were high enough, then that would lead to greater consumption of ethanol, but in that case the mandate would no longer be binding. Only one policy, either the mandate or the tax incentive, will set ethanol demand. The authors discuss how, for purposes of reducing greenhouse gas emissions, a tax rate could be set that would be based on the per-mile greenhouse gas emissions of ethanol relative to gasoline, and then optimized to balance the social costs of greenhouse gas emissions. Likewise, an optimal mandate level could be set that would achieve the same goal.

However, it should be noted that real-world effects may differ from this simplified model for several reason which will be discussed below. These factors complicate the situation and include questions of whether the mandate is truly binding, what the optimal level of a biofuels tax would be if greenhouse gas reductions was the ultimate goal of a tax, and what other greenhouse gas policies may interact with the mandate and/or tax. In most cases, these are not criticisms of the substance of the paper, but suggestions on how to expand the discussion for the future.

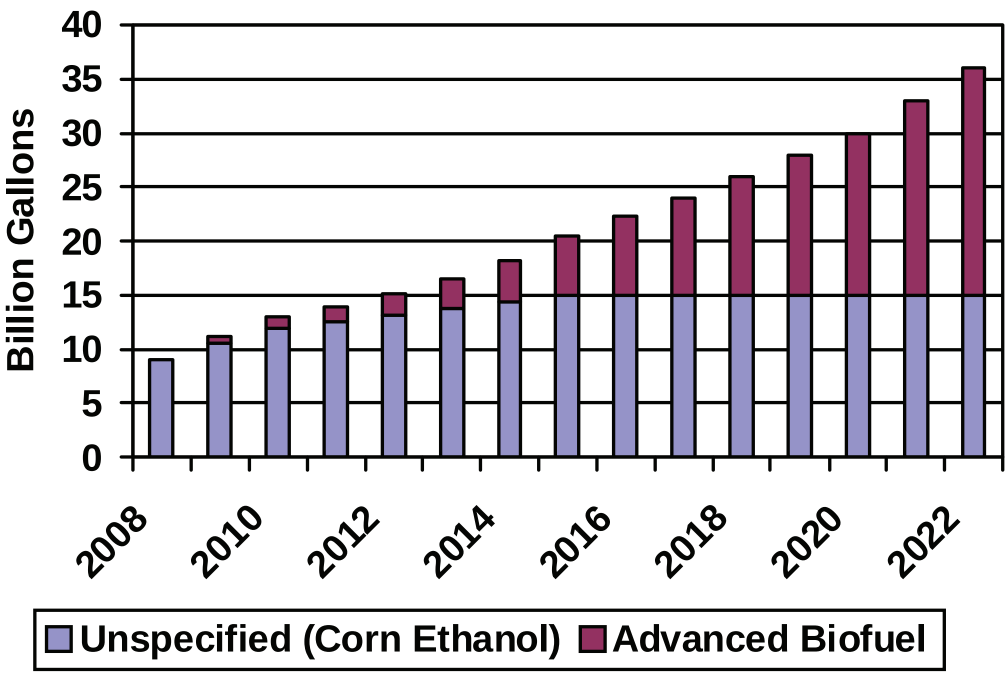
The Value of ξ

In discussing the optimal tax level, the authors assume that the per-mile greenhouse gas emissions from gasoline are constant, equal to ξ_G. Next, the authors present two possible scenarios for emissions from fuel ethanol, one where per-mile emissions of ethanol are 20% lower than gasoline and one where net ethanol emissions are zero. $\xi_E = 0.8 \times \xi_G$ and $\xi_E = 0$, respectively. From these values of ξ_E the optimal greenhouse gas emission-based tax or mandate can be set for a particular value of the social cost of carbon.[1]

However, there is ongoing debate over the actual greenhouse gas emissions of biofuels, including ethanol. Because the lifecycle varies for biofuels produced from various feedstocks, through different processes, and with different chemical and energy inputs, the values for ξ_E (or ξ_B for biodiesel, or ξ_X for other fuels) could vary widely from fuel to fuel. Therefore, the value of ξ would need to represent an average of all biofuels in the market, or there would need to be individual terms for each fuel or fuel pathway.

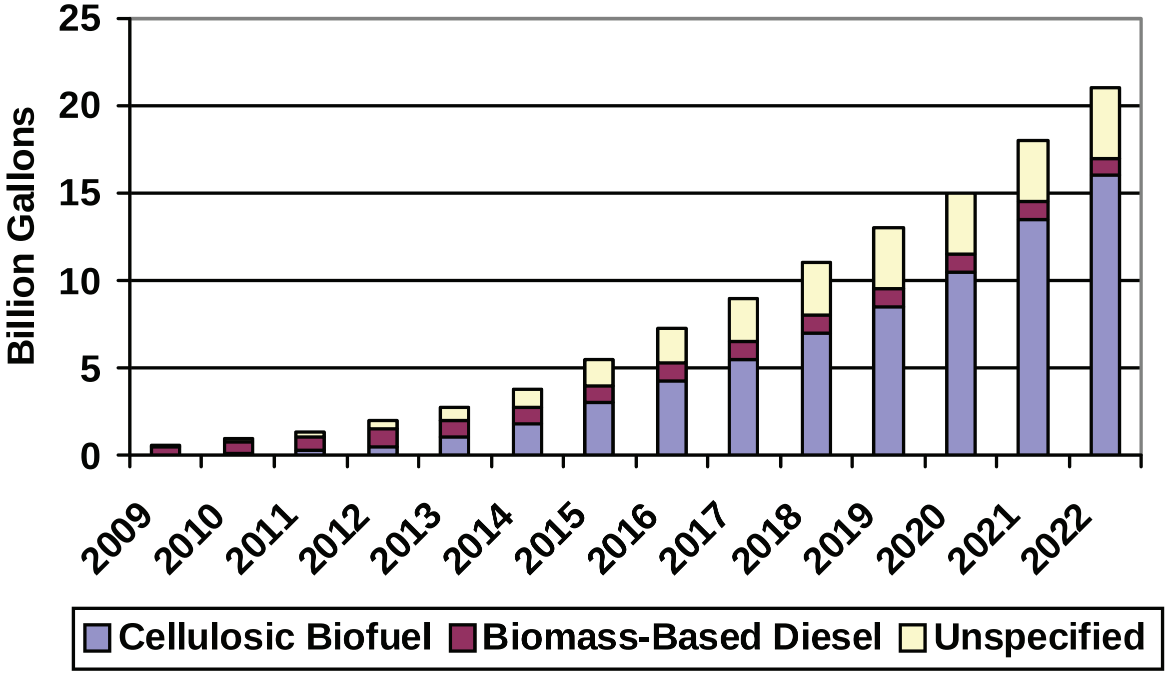
This issue of assessing the lifecycle emissions of biofuels is of key interest at the Environmental Protection Agency (EPA). EPA must quantify the emissions for all renewable fuels under the Renewable Fuel Standard (RFS) that was established in the Energy Policy Act of 2005 (P.L. 109-58) and expanded in the Energy Independence and Security Act of 2007 (EISA, P.L. 110-140).[2] The RFS mandates a substantial increase in biofuels use – from roughly 8 billion gallons in 2007 to 36 billion gallons in 2022. Further, most of this increase must come from "advanced biofuels" – biofuels with at least a 50% reduction in lifecycle greenhouse gas emissions relative to gasoline. (**Figure 1** shows the mandated levels under EISA.)

Figure 1. Expanded Renewable Fuel Standard under EISA



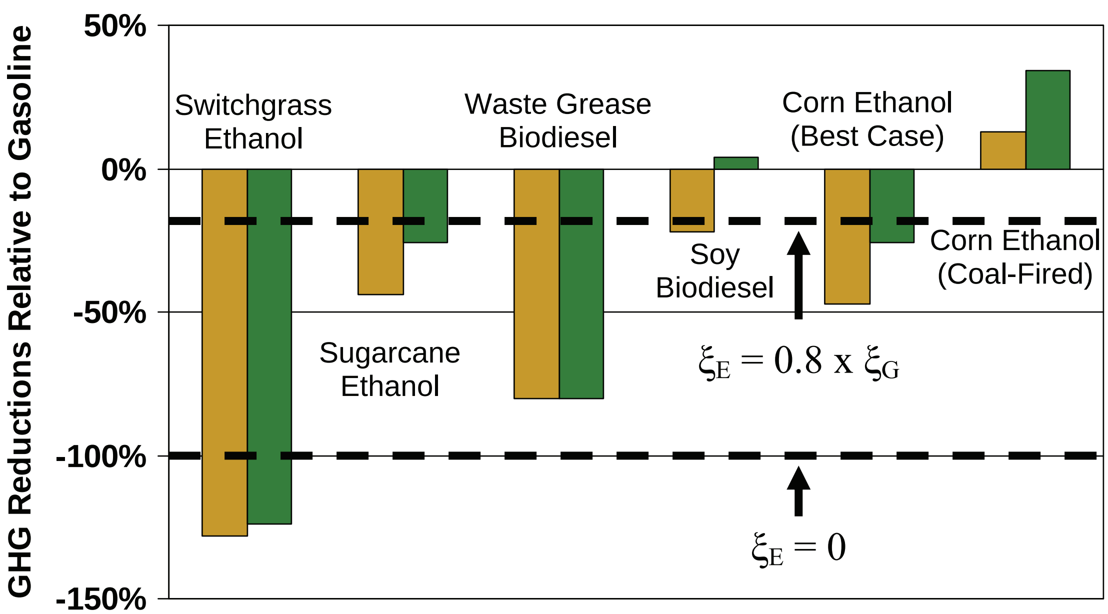
Thus, for advanced biofuels, $\xi_A \leq 0.5 \times \xi_G$. Further, within that advanced biofuel mandate, by 2022 the majority of the advanced biofuels must be cellulose-based, with at least a 60% reduction in greenhouse gas emissions relative to gasoline. (**Figure 2** shows the sub-mandates for various fuels under the larger advanced biofuel mandate.) Thus for cellulosic biofuels, $\xi_C \leq 0.4 \times \xi_G$.

Figure 2. "Advanced Biofuel" Mandate Under EISA



However, as shown in **Figure 3**, EPA's preliminary assessment of different biofuels' lifecycle greenhouse gas emissions for the Agency's proposed rulemaking shows widely different emissions profiles for various fuels, as compared to gasoline. Furthermore, EPA's proposed rule – and the methodology that underlies it—has been widely criticized by many stakeholders. Some of these stakeholders question particular portions of EPA's analysis, while others question the validity of any attempt to quantify a biofuel's lifecycle emissions, especially when EISA requires that EPA consider both direct emissions (emissions from the production of agricultural feedstocks, refinery emissions, etc.) and indirect emissions (including any indirect effects of changes in land use).

Figure 3. EPA Estimates for Lifecycle Emissions from Various Biofuels



U.S. EPA, EPA Lifecycle Analysis of Greenhouse Gas Emissions from Renewable Fuels, May 2009. http://www.epa.gov/otaq/renewablefuels/420f09024.htm. The two values for each fuel represent two different accounting methods proposed by EPA. The first considers emissions changes over a 100-year lifecycle with a 0% discount rate. The second uses a 30-year lifecycle and a 2% discount rate. Values for ξ were added by the author.

To completely model the ideal tax or mandate level, the actual lifecycle emissions of all biofuels would need to be incorporated into the model. Further, as each of these fuels also has different production costs and energy content, each would have its own supply curve, further complicating any model.

How Certain is the Mandate?

One inherent assumption in the authors' analysis is that the mandate is credible and certain. However, it is unclear how firm fuel suppliers assume the mandate will be. In the absence of adequate biofuel supply, production capacity, or feedstock supply, EPA has the authority to partially or fully waive various parts of the RFS. For example, EPA can waive the requirement for biomass-based diesel fuel in a given year if there is inadequate feedstock to produce the fuel. If a feedstock producer or fuel supplier has reason to believe that EPA will grant a waiver that may limit investment in the capital or commodities to produce biofuels.[3]

Using a concrete example, the RFS mandate for cellulosic biofuels begins at 100 million gallons in 2010. However, looking at existing and proposed refineries, it is unclear that the United States will have 100 million gallons of cellulosic biofuel production *capacity* by the end of 2010, let alone 100 million gallons of actual production. This raises the question of whether EPA will grant a partial waiver to the cellulosic biofuel mandate. Further, if EPA were to grant a waiver from the 2010 requirement, would that lead to reduced investment in 2010 that would lead to a shortfall in 2011 capacity, necessitating a waiver in that year? It is conceivable that EPA's waiver authority could lead to a cascade of waivers that result in diminished investment—a "self-fulfilling prophecy" requiring partial waivers every year because the mandate is not credible.

If the mandate is not as credible as has been assumed, tax incentives on top of the mandates could help provide a backstop against more significant shortfalls in production capacity.

Other Potential Policies

Perhaps the key policy proposal outside of biofuels mandates and tax incentives that could interact with them would be an explicit policy to reduce economy-wide greenhouse gas emissions. In the 111th Congress, these proposals to establish a cap-and-trade system have received the most attention, although carbon taxes have also been proposed. Under legislation passed by the House and currently under consideration in the Senate, biofuels would be exempt from carbon controls placed on petroleum fuels. Effectively, if the cap-and-trade proposals were modeled as carbon taxes, $\xi_B = 0$. However, the cost of producing biofuels would likely increase with the cost of chemical inputs that are subject to the program (*e.g.*, fossil fuels, fertilizer). The level of the cost increase would depend on the feedstock/fuel pathway.

The overall effect of the cap-and-trade system would be to effectively raise the tax rate on petroleum fuels relative to biofuels at the same time that overall fuel prices increased. The net effect is unclear, but if the price margin caused by the cap-and-trade program were large enough, the RFS mandate would no longer be binding.[4] However, most economic modeling of cap-and-trade legislation indicates that carbon prices do not reach high enough levels to promote significant reductions in transportation sector emissions from the baseline, and that fuel producers effectively purchase reductions from other sectors.[5]

Because cap-and-trade policies alone are not enough to stimulate emissions reductions in the transportation sector, policies to directly reduce the carbon content of fuels have been proposed. For example, the state of California is in the process of finalizing regulations to require a 10% reduction in the carbon content of transportation fuels by 2020.[6] (Similar standards have been proposed in the U.S. Congress, but have not been approved by either the House or the Senate.) A low-carbon fuel standard would effectively provide an incentive for lower-carbon fuels based on their reduction from baseline gasoline or diesel fuel. For example, if a fuel were able to achieve a 20% reduction from gasoline $\xi = 0.8 \times \xi_G$ and were able to command a premium of X, then a fuel with zero greenhouse gas emissions ($\xi = 0$) would be able to command a premium of 5X—the greater the emissions reduction, the more valuable the fuel.

Thus, the assessment of lifecycle greenhouse gas emissions would be of key importance (see above). It should be noted that a low-carbon fuel standard would not be an explicit biofuels mandate – biofuels would need to compete with other alternatives (e.g., electricity for electric vehicles, compressed natural gas, hydrogen) based on their carbon content. In fact, in California's proposed regulations, some corn-based ethanol fuels have *higher* emissions than gasoline, penalizing those fuels as opposed to incentivizing them.

Conclusion

The authors' paper does a good job of highlighting a potentially perverse situation where combined biofuels incentives effectively incentivize conventional fuels. However, the overall effects of those policies become more complicated as other policies – mainly policies to control carbon emissions – are layered on top of those existing policies.

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[1] The values for the social cost of carbon vary widely. See Richard Tol, The Social Cost of Carbon: Trends, Outliers, and Catastrophes, Economics: The Open-Access, Open-Assessment E-Journal, Vol. 2, 2008-25.

[2] EPA, Regulation of Fuels and Fuel Additives: Changes to Renewable Fuel Standard Program—Notice of Proposed Rulemaking, 74 Federal Register 24903-25143.

[3] See Brent D. Yacobucci, Waiver Authority Under the Renewable Fuel Standard (RFS)—CRS Report RS22870, May 5, 2008.

[4] The Energy Information Administration's (EIA) modeling of the House bill (H.R. 2454) showed that the Renewable Electricity Standard (RES, analogous to the RFS) is not binding under the cap-and-trade system. That is to say that the increase in the price of carbon stimulates more renewable electricity production than would the RES mandate. EIA, Energy Market and Economic Impacts of H.R. 2454, the American Clean Energy and Security Act of 2009, August 4, 2009. p. 23. http://www.eia.doe.gov/oiaf/servicerpt/hr2454/index.html.

[5] See EPA, EPA Analysis of the American Clean Energy and Security Act of 2009, June 23, 2009. p. 11. http://www.epa.gov/climatechange/economics/pdfs/HR2454_Analysis.pdf.

[6] http://www.arb.ca.gov/regact/2009/lcfs09/lcfs09.htm.