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The US biofuel mandate as a substitute for carbon cap-and-trade

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A R T I C L E I N F O

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A B S T R A C T

Environmental economists might recommend a cap-and-trade program as a good way to lower emissions of greenhouse gases (GHGs), but US carbon cap-and-trade legislation was proposed and failed to become law. Instead, the biofuel use mandate is the primary existing GHG reduction program in the United States. The mandate effectively requires a rising amount of GHG abatement each year, but allows regulated parties to buy and sell credits to meet annual obligations. Although many aspects of the biofuel mandate look similar to a cap-and-trade program, there are additional requirements, such as feedstock eligibility limitations and waivers. The existence of the mandates is presumably conditional on all the legal requirements, but these conditions represent a departure from a strict GHG cap-and-trade program.

We estimate GHG abatement costs of the mandate and compare them to a hypothetical cap-and-trade program targeting vehicle fuels. The mandate abatement cost is found to be higher than a hypothetical GHG cap-and-trade. Our results show that the RFS might be judged as a feasible substitute for a cap-and-trade regime that can deliver GHG reductions, but at a higher cost reflecting its multiple objectives.

1. Introduction

A cap-and-trade policy sets a limit on greenhouse gas (GHG) emissions and then allows trade of emission certificates so market forces can help to find the least-cost means of achieving the goal. Legislation that proposed a nationwide cap-and-trade program was passed by the US House of Representatives in 2009, but failed to gain Senate passage.[1] Even before the 2009 effort, however, Congress passed another program for controlling GHG emissions, namely the Renewable Fuel Standard (RFS), and this program was signed into law. The RFS was defined in the Energy Policy Act of 2005 and extended in the Energy Independence and Security Act (EISA) of 2007. The RFS sets biofuel use requirements, or mandates, that are based in part on GHG reduction targets. It has been in place for more than a decade as of the time of writing. The legislation set requirements that expand at least to 2022 and remain in place indefinitely after that point. The RFS is a long-lasting policy that appears to address at least some climate change concerns and goals.

RFS implementation heightens the similarity of this program to a cap-and-trade regime. Each gallon of qualifying renewable fuels sold for domestic use generates a Renewable Identification Number (RIN). Obligated parties, who are responsible for meeting the mandates, must submit sufficient RINs to the (EPA) to demonstrate compliance with their allotment under the RFS. Companies that are short RINs can buy extra RINs from companies that have blended more than they are individually required to do. RINs can be used for compliance in the year they are produced or the subsequent year, allowing obligated parties to smooth compliance over time. The RINs are the part of the RFS that is analogous to the trade component of a cap-and-trade regime.

The RFS is not identical to a cap-and-trade regime. This is not surprising given that the mandate was intended to serve more objectives than GHG reduction alone. The underlying motivations also appeared to target energy markets or energy security, if judged by the names of the legislative acts that created the mandate, and the RFS might also be intended to mitigate taxpayer effects, enhance agricultural sector performance, improve the rural economy, or achieve other goals. For example, the RFS might have been constructed with a view to address or alleviate concerns about the potential food price effects of biofuels. We cannot judge motivations, but the existence of multiple objectives is an important consideration to which we will return.

The rules of the RFS clearly reflect the various objectives. The range of objectives likely helps to explain why the RFS design or

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[1] HR2454, the American Clean Energy and Security Act of 2009, was passed by the US House of Representatives on June 26, 2009.

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implementation departs from a hypothetical GHG cap-and-trade program. One major departure is that the RFS requirement to use renewable fuels that emit less GHG is not the same as an explicit cap on GHG emissions from fuels. Another departure is that the relative treatment of mandates is not driven solely by GHG reduction potential, but also by eligibility of feedstock. RFS mandates must be waived if they are found to cause too much disruption to markets, push beyond existing capacity, or for other reasons, but a cap-and-trade might in theory have no similar waiver clauses.[2] Whereas a hypothetical cap-and-trade would focus exclusively on GHG reduction to the exclusion of all else, the existing biofuel mandates include GHG reduction as one criterion among its many criteria.

The multiple concerns and goals of the RFS make this program unlikely to achieve a GHG reduction at the same cost as a hypothetical, single-purpose cap-and-trade policy. Whereas a cap-and-trade can theoretically deliver the least-cost GHG reductions, each additional goal underlying the actual RFS leads to additional conditions or constraints as compared to a single-purpose cap-and-trade. Feedstock requirements might be a means to alleviate concerns that growing biofuel use leads to higher food prices, but this constraint might raise costs of GHG reduction. Waivers that are intended to limit disruption, by some measures, might be necessary for legislation to do with unknown technologies in an uncertain future, but the waivers can affect investor interest in new technologies and limit GHG reductions over time.

We use a partial equilibrium model of US biofuel markets, including feedstock markets and competing fuels, to compare the RFS GHG reduction costs to a hypothetical policy to cap-and-trade GHGs from liquid fuels. Our results support the hypothesis that the per-GHG reduction cost of the RFS is higher than the per-GHG reduction costs of the hypothetical program. The additional cost of GHG reduction under the RFS might be associated with the additional goals and motivations of the RFS that are manifested in the additional requirements of this program relative to a hypothetical cap-and-trade option. Whether or not these costs had to be incurred in order for the US legislative process to deliver the RFS, which might be the primary existing US GHG reduction program, is a matter of speculation.

2. Background and literature review

The US biofuel mandate legislation and rules are available elsewhere and have been a focus of study for some time. The structure of the program and relevant literature are summarized here.

2.1. The RFS

The EISA defines the RFS as a set of nested requirements. The overall mandate can be met using any renewable fuel that achieves a 20% GHG reduction or is from a production facility that was to be completed by the time the law passed. The advanced mandate is part of the overall mandate. The advanced mandate requires 50% GHG reduction. Moreover, because of additional restrictions to do with feedstock eligibility, the advanced mandate cannot be met with corn starch (conventional) ethanol. Thus, the ability of conventional ethanol, which is the commonly produced type of ethanol in the US, to be used to help reduce GHGs under the RFS is constrained to be no more than the gap between the overall mandate and the advanced mandate.

The advanced mandate has two component mandates of its own. Biomass-based diesel (biodiesel) must be a diesel-type fuel and must also achieve a 50% GHG reduction. The other mandate must be met using renewables that achieve a 60% GHG reduction and are made from agricultural waste or cellulosic feedstocks (cellulosic biofuel). Cellulosic biofuel is intended to be made from inputs that could not be used for food production, as reflected in the feedstock requirement that inputs are from co-products of agricultural commodities such as wheat straw or corn residues, dedicated feedstocks such as miscanthus or switchgrass, or other biomass that seems to have no food use potential.

The legislation includes any number of additional complications, belying further any resemblance of the RFS and hypothetical cap-and-trade. At least initially, small-scale operations and some states were exempt. GHG requirements could be revised, under certain conditions. Of the complications, the requirement that the EPA waive the mandates under various conditions stands out, not least because such waivers have become commonplace. The EPA judged that a legislated trigger to waive the cellulosic mandate in the event of insufficient production capacity has been met in every year of that mandate's life so far. Recently, the EPA has judged that difficulties expanding ethanol use beyond the saturated market for fuel with 10% ethanol by volume (E10) satisfied criteria for waiving other mandate components, including the overall mandate.

The EPA published rules to implement the RFS that relate to RIN generation, storage, trading and use by obligated parties to prove compliance. These rules define the outlines of the market for the "trade" aspect of the RFS. If there were no RIN trade, then each obligated party would have to meet its own share of the overall RFS requirement without any flexibility. RFS compliance costs would be higher without trade that allows expansion of RIN generation among low-cost producers and less RIN generation in high-cost producers. Rules define RINs for each biofuel type, corresponding roughly to the four components of the mandate. The rules also outline the potential for up to 20% of the RINs used for compliance in any year to have been generated in the previous year, opening the door to year-over-year RIN storage or rollover. Rules provide provisions for an obligated party to declare an emergency deficit in any one year and also set penalties sufficiently high that obligated parties have complied. These additional forms of flexibility can affect GHG emission reductions in any particular year without changing the overall reduction over time, but could represent further deviations from a strict, theoretical cap-and-trade policy.

2.2. The literature

There is a vast literature on the RFS, biofuel mandates, GHG reduction policies, GHG reductions from biofuels, and the GHG reductions of the RFS. The following summary relies on recent literature reviews of RFS effects, focusing more specifically on GHG emissions and economic models used to estimate the RFS and its implications for markets that relate to the present exercise. While scientific study has proven again and again that GHG emission estimates are a matter of great uncertainty, however, few articles explicitly assess RIN prices and markets even though those studies that do identify the RIN price as the key indicator of the program cost.

2.2.1. Models of RFS costs and RIN markets

Literature reviews available to date discuss price impacts of US biofuels or mandates, but make little or no reference to RINs. Oladosu and Msangi (2013) discuss food price impacts of biofuels, but note very few studies that have used RIN prices and only identify the role of RINs in smoothing markets over time. Panichelli and Gnansounou (2015) and Zhang et al. (2013) compare models used to estimate biofuel market and GHG impacts, but do not make any reference to explicit modeling of RINs or RIN markets. Rosegrant and Msangi (2014) focus on market impacts, although GHG implications are also noted. They do not discuss RINs or note which, if any, reviewed study includes them. As to the effects of biofuels or mandates in the context of tight markets, there is no mention of the role RIN stocks could play to smooth biofuel demand for crop feedstocks. Condon et al. (2015) state only in passing that some of the reviewed studies represent RINs using structural market models, but no further mention or use of this fact is made. Serra

[2] In practice, of course, a cap-and-trade policy could have limits, waivers, and other characteristics that cause deviations from the theoretical framework that we discuss here.