policy brief

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Integrating Biofuels into Comprehensive Climate Policy
An Overview of Biofuels Policy Options

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Key Messages

- The collective impact of biofuels policy should be considered in climate policy design to create an optimal greenhouse gas (GHG) reduction strategy.
- Creation of a carbon price can provide a price signal favoring the production and use of less-GHG-intensive fuels, but attention must be paid to accounting structures so as not to encourage increased emissions in uncapped areas or sectors.
- A carbon price may likewise represent the most efficient mechanism by which to incorporate biofuels into comprehensive climate policy, but the role of complementary policy should not be overlooked.
- Other biofuels policies—mandates, pricing incentives, enabling policies, and constraints—may play a role in comprehensive climate policy, but are inefficient in achieving GHG emission reductions in and of themselves.
- As potential redundancy and conflict exist between the various policies reviewed herein, a great deal of coordination will likely be required if biofuels policy is to efficiently satisfy the myriad objectives that have been established for it, regardless of the exact policy mix chosen.

Recognizing that GHG emission reduction is but one policy objective that biofuels may potentially serve,[1] this brief evaluates current and potential biofuel policies, and ultimately how effective these policies are in achieving emission reductions. While other reports provide comprehensive catalogs of the policy mechanisms affecting biofuels (e.g., Koplow 2006), the focus of this brief is on the potential GHG implications of individual policies. To provide context to the discussion, an overview of the current policy environment is included below. This is followed by summaries of multiple biofuel policy options, each with a focus on potential GHG implications. The brief concludes with a series of policy design considerations. Polices are reviewed at greater depth in an attached Primer, which provides much of the analytical basis for the discussion here.

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[1] Conversely, biofuels are but one means by which to potentially reduce GHG emissions from the transportation sector. In addition to lowering emissions from fuels themselves, reductions in vehicle miles traveled and improvements in vehicle efficiency are often discussed as part of a three-part strategy for reducing transportation emissions. See, e.g., Sperling and Yeh 2009; Greene et al. 2004.

Policy Context

The subject of climate change is receiving increasing attention in domestic and international policy arenas. In the United States, current and recent Congresses have seen the introduction of multiple pieces of legislation to regulate GHG emissions.[2] At the same time, biofuels have been promoted as a solution to a variety of public policy issues, ranging from energy security to rural support and development to global climate change (Rajagopal and Zilberman 2007). Optimism over the ability of biofuels to achieve public policy objectives, however, must be tempered by supply considerations. Research suggests that biomass only exists in sufficient quantities to supplant a small percentage of total fossil fuel use (Field et al. 2007). With improvements in yield and harvest efficiency and an expansion in energy crops, biomass may be produced in amounts sufficient to displace one-third of year-2005 U.S. petroleum consumption (Perlack et al. 2005). This higher-end estimate no doubt represents a significant contribution to the nation's energy supply, but still leaves two-thirds of the equation unaddressed.

The enactment and implementation of wide-ranging biofuels policies does, however, have the potential to significantly and negatively affect other, broader climate, environmental, and economic objectives. The potential exists for significant conflict, cross-purposing, or other unintended consequences (Bento 2009; Koplow 2006). As a substitute for fossil fuels and as a competitor for land with other activities, such as forest management, food and feed crop cultivation, and urban development, biofuels can have significant implications for GHG emissions (Box 1) as well as the production of other commodities and services.[3]

The development of biofuels policy has historically neglected climate change policy objectives,[4] but ongoing rounds of energy and climate change policy debate provide an opportunity to integrate diverse policy mechanisms to create an optimal GHG reduction strategy.[5] Notwithstanding this opportunity, determining how best to integrate biofuels with climate policy is a difficult undertaking. The dominant role that public policy plays in the production and use of biofuel is one reason. Large-scale production of biofuels requires the development of significant infrastructure and value chains, extending from the field to refinement to distribution and eventual end-use (Vertes et al. 2006), all of which may require policy intervention. Individually, these policies and their distributional effects are varied and complex (Table 1), with an expansive body of literature and research devoted to each.

When implemented as part of a larger policy portfolio, individual policies have the potential to be complementary or counter-productive in achieving policy objectives, instrumental in effecting change or redundant. For example, feedstock constraints can increase the difficulty in meeting mandates or

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[2] e.g., S.3036, Lieberman-Warner Climate Security Act of 2008; S.1766, the Low Carbon Economy Act of 2007; H.R. 6186, Investing in Climate Action and Protection Act; H.R. 2454, the American Clean Energy and Security Act of 2009; S. 1733, the Clean Energy Jobs and American Power Act of 2009.

[3] The focus of this report is on the GHG implications of biofuel production, but biofuel production can also impact soil, water, biodiversity, and other resources and environmental amenities. For an overview of these other issues, see, e.g., Mann et al. 2002; Pimentel 2003; Donner and Kucharik 2008; Marshall and Greenhalgh 2006; Howarth et al. 2009a; Bringezu et al. 2009; and Government Accountability Office 2009.

[4] Recent development of low-carbon fuel standards (LCFS) at the state level and the GHG emission benchmarks included in the renewable fuel standard (RFS) amended by the Energy Independence and Security Act of 2007 (P.L. 110-140) are notable exceptions.

[5] See also Tilman et al. 2009 for a discussion on the importance of evaluating multiple objectives in the context of biofuel policy development.

counteract pricing policies by limiting the number of cost-effective alternatives. A carbon price can provide an added incentive to reduce the consumption of traditional fossil fuels, potentially complementing low-carbon fuel standard (LCFS) compliance. Biofuel demand can be buoyed by the existence of either a renewable fuel standard (RFS) or production tax credits, implying that the existence of both may be redundant from a production standpoint.

Box 1. The GHG impact of biofuels. Although it is not the objective of this analysis to review or debate the full environmental implications of biofuel production and use, a brief note on the current science is warranted for context. In recent years, the biofuels literature has expanded dramatically. As a whole, the literature paints a complex image of the environmental impacts of biofuel production and use, especially with regard to energy balance and GHG benefits. Meta-analyses conducted in the middle of the last decade generally suggest that biofuel production and use can have a positive energy balance as compared to the fossil fuels they displace (Hammerschlag 2006; Farrell et al. 2006). Individual feedstocks such as switchgrass and low-input high-diversity (LIHD) grasslands have shown particular potential (Schmer et al. 2008; Tilman et al. 2006). These findings are not without controversy, however; others suggest that corn-, switchgrass-, and wood-based ethanol, as well as soy- and sunflower-based biodiesel, all produce fuels with energy outputs lower than the fossil energy inputs (Pimentel and Patzek 2005). Discussions surrounding the importance of correctly choosing the factors included in a full lifecycle analysis of the impacts of fuel production have been ongoing for decades (Chambers et al. 1979; Wang 2005), but analyses of indirect land use change conducted in the last few years have raised serious concerns, suggesting that land use change stemming from expanded biofuels production could result in negative consequences in the short term and potentially in the long term as well (Fargione et al. 2008; Searchinger et al. 2008). These issues continue to be explored and debated in the literature and public policy discussions alike.

Table 1. Potential directional impact of biofuel policies on various sectors and objectives. A "+" indicates a positive impact on a given objective, a "-" indicates a negative impact, and "<>" indicates that the impact is uncertain. Adapted from Rajagopal and Zilberman 2007.

Policy mechanism	Policy objective					
	Reduced GHGs	Reduced oil use	Farm income	Consumers (food)	Government expenditures	Biofuel producers
Carbon price/tax	+	+	<>	<>	+	<>
Biofuel subsidy	<>	+	+	-	-	+
Mandates/quotas	<>	+	+	-	<>	+
Vehicle subsidy	<>	<>	<>	<>	-	<>
Tariff	<>	+	+	-	+	+
Acreage control	<>	<>	+	-	-	-
Feedstock price support	<>	+	+	+	-	<>

Another complicating factor in the biofuels policy environment is the large number of Congressional legislative committees and government agencies involved in biofuels policy creation, oversight, and implementation (Table 2). In recent years, biofuels policy has been included in energy, agriculture, job creation, trade, and climate legislation. Implementation is overseen by agencies focusing on agricultural production, energy production, transportation infrastructure, tax administration, and trade. Furthermore, biofuels policy is not exclusively a federal undertaking; policy to encourage the production and use of biofuels is implemented at the state level, as well (Box 2).

Table 2. Committees and agencies/offices with potential biofuels policy jurisdiction or oversight responsibilities. In situations where committee jurisdiction is unclear, jurisdiction is determined through House conference assignments for relevant biofuel provisions in recent legislation (Food, Conservation, and Energy Act of 2008 [P.L.

110 – 246]; Energy Policy Act of 2005 [P.L. 109-58]; Farm Security and Rural Investment Act of 2002 [P.L. 107-171]) and likely Senate counterparts. Source: http://thomas.loc.gov/ (last accessed May 1, 2009).

House committees	Senate committees	Oversight agencies or offices
Energy and Commerce	Environment and Public Works	Environmental Protection Agency
Ways and Means	Energy and Natural Resources	Internal Revenue Service
Judiciary	Finance	Department of Agriculture
Agriculture	Agriculture, Nutrition, and Forestry	Department of Energy
Natural Resources	Commerce, Science, and Transportation	Customs and Border Protection
Science and Technology	Foreign Relations	Department of Transportation
Oversight and Government Reform		Federal Trade Commission
Transportation and Infrastructure		

Box 2. The Role of States. A variety of policy mechanisms are also employed at the state level; as of 2007, 38 U.S. states had biofuel policies or incentives on the books (Kojima et al., 2007). Initiatives undertaken at the local level can be an effective tool to spur adoption of biofuels and other alternative fuels at both national and international scales (Vertes et al., 2006). State policies can also either magnify or counteract federal policies, especially those that involve direct payments or subsidies (Koplow, 2006). In particular, state-level incentives may play a strong role in the siting of biofuels-related projects (Mabee, 2007). While this brief does not explicitly consider the GHG implications of individual state policies in federal climate policy development, relevant state policies are noted where appropriate throughout the attached Primer. In large part, these state-level policies are similar in form, structure, and implementation to the federal policies discussed herein. It is important to consider the muted or magnified effect that federal biofuel policy development may have in light of these existing state initiatives. For more information on state-level biofuel policies in the United States, see, e.g., Koplow, 2006, Kojima et al., 2007, and DeCesaro and Brown, 2006.

With specific regard to climate policy objectives, biofuels are likely not the most cost-efficient mechanism by which to address GHG emissions (Schlegel and Kaphengst 2007). The current suite of biofuel policies is estimated to lower year 2015 U.S., Canadian, and European Union transportation-related emissions by 0.5% to 0.8% (OECD 2008). Costs of these reductions are at approximately $960 to $1,700 per metric ton of carbon dioxide equivalent (tCO_2e)[6] (OECD 2008), implying that GHG benefits delivered by contemporary biofuels policy may be more cheaply achieved if credits were purchased directly from a carbon market (Koplow 2006).[7] Research also highlights the potential inefficiencies of conversion of biomass to liquid fuels as compared to direct combustion (Adler et al. 2007; Howarth et al. 2009b; Campbell et al. 2009). Still others suggest that retention of existing forests, restoration of cropland, and increased efficiency of fossil fuel use present a much more effective land-based approach to GHG mitigation than biofuels in the near term (Righelato and Spracklen 2007). Despite these inefficiencies, however, it is extremely likely that policy to encourage the production and use of biofuels will remain a part of the domestic policy portfolio given the multiple other objectives for which biofuels are promoted, such as energy security and rural development. The question therefore becomes how to best integrate existing biofuels policy with climate policy objectives.

[6] t = metric ton = tonne = 1,000 kg = 2,204.62 lbs.

[7] The potential difference in cost can be significant. Using recent EPA analysis (U.S. Environmental Protection Agency 2009) of the expected allowance prices under H.R. 2454 as an indicator of likely carbon prices in a domestic GHG compliance regime, the difference in cost between GHG reductions through contemporary biofuels policy and purchase of an equivalent amount of allowances from a fully functioning compliance market could approach nearly two orders of magnitude.

A first step in this process is to better understand the climate implications of individual policy mechanisms. These implications are discussed briefly below and in further detail in an attached Primer. To highlight similarities in function or approach, policies are grouped by mechanism into five distinct categories: mandates, pricing incentives, enabling policies, constraints, and ancillary policies.

Mandates

Mandates are policies that require a certain volume or fraction of fuel to be comprised of biofuels or other non-fossil fuel component. Mandates could also include those policies that require aggregate fuel supply to meet a set GHG performance standard, for which biofuels could be one pathway to compliance. Important policies in this category include low-carbon fuel standards (LCFS) and renewable fuel standards (RFS).

An LCFS is a policy mechanism designed to target and reduce GHG emissions resulting from the production and combustion of transportation fuels. An LCFS achieves emission reductions by encouraging a transition from petroleum-based fuels to alternative, lower-emitting fuels. Because biofuels potentially provide a less GHG-intensive source of transportation fuel than gasoline or diesel, biofuels could play a large role in LCFS compliance. Even so, an LCFS may not be a cost-effective approach to meet carbon reduction targets, depending on the approach used to establish the baseline (Holland et al. 2009). An additional question regarding the efficiency of an LCFS is how it will interact with other programs or policies aimed at reducing GHG emissions. Care must be taken if an LCFS is linked to an emissions cap, especially when accounting for emission sources that may be included in one program but not the other. Furthermore, an LCFS would also require additional policies to be effective, such as those targeted to infrastructure development and vehicle efficiency requirements (Sperling and Yeh 2009).

An RFS requires that a specific volume of renewable fuel be blended with traditional fossil fuels over a specific time period. Though successful in inducing increased biofuel production, an RFS may also not be the most cost-effective mechanism to induce production or to reduce GHG emissions in the transportation sector. As a stand-alone policy, a fuel standard requires the production of renewable fuels no matter the cost. A fuel standard likewise does not provide industry with direct pricing benefits. Instead, blenders of transportation fuel are required to blend a specified quantity of biofuel regardless of cost (Tyner and Taheripour 2007). Furthermore, because biofuels are blended with petroleum fuels, the price of biofuels influences the price of retail fuels. If ethanol is cheaper, the final cost of the fuel is cheaper, which can lead to shifts in consumption (Gallagher et al. 2003). Even if total fuel consumption remains static, the establishment of an RFS may not lead to GHG benefits in and of itself absent any restrictions on the GHG content of the required fuel or fuel blends. Finally, the exact impact of an RFS is complicated by other policies currently in place. In the short run, for example, removal of the RFS may have a limited impact on ethanol production if production tax credits are retained (McPhail and Babcock 2008).

Pricing Incentives

Pricing incentives are defined as those policies that influence the production and use of biofuels by altering the pricing relationship between biofuels and competing fuels. These policies include those that create a price for carbon (e.g., cap-and-trade), as well as other policies, such as production tax credits and, potentially, tariff policies as well. Although the interaction of carbon price-induced effects with other policies that promote and govern the production of biofuels is not yet fully explored, it is likely that carbon pricing will amplify the effects of these complementary measures.

A price on carbon, established through either a cap-and-trade policy or a carbon tax,[8] would essentially add a surcharge to fossil fuel–derived fuels based on the amount of carbon those fuels contain. Although a carbon price would likely increase prices for consumers, the magnitude of the increase is unlikely to have a significant effect on overall fuel consumption (especially at low to moderate carbon prices (<\$20 tCO_2e) (Kojima et al. 2007; Raborn 2009). Instead, a carbon price would change the dynamics of how biofuels are produced and how they are blended with traditional fossil fuels (Plevin and Mueller 2008). Furthermore, the manner in which a carbon price is applied to biofuels and the biofuel production process has significant emission implications, especially with regard to emissions from land use and land use change.

Tax credits, a long-time focus of U.S. biofuel policy, could also play a potential role in climate policy, but must be implemented carefully to avoid impeding GHG objectives. Linking credits to the energy content or GHG emission reduction potential of the fuel for example is one mechanism by which to encourage greater GHG reduction (Tyner 2007). The effectiveness and efficiency of such an approach, however, will depend upon other policies in place. Potential redundancy exists if a particular feedstock that is targeted by policy is also supported by traditional farm subsidies. In a similar sense, the short-term impact of tax credits on inducing biofuel production may be diminished in situations where credits exist alongside other policy mechanisms, such as an RFS. Linking the credit to specific market conditions can help to increase the efficiency at which goals are met (Rajagopal and Zilberman 2007). This could also help to avoid situations in which credits cause the price of biofuel to fall below that of conventional gasoline, which could lead to a drop in fuel price and a commensurate increase in consumption (Vedenov and Wetzstein 2008). A failure to link credits and subsidies to commodity prices or other market conditions can result in expensive or inefficient technologies or pathways being perpetually favored, creating a situation of “technology lock-in” (Rajagopal and Zilberman 2007). Alternatively, the uncertainty created by a variable rate may fail to encourage long-term investment in desirable but capital-intensive projects. Limiting the frequency of rate readjustment or even instituting a fixed rate for some initial time period may represent solutions to both sets of concerns.

Tariff policy is relevant from a GHG perspective as it may influence the amount, origin, and production pathway of imported fuels.[9] The United States also employs import tariffs to foster domestic biofuel investment and production while protecting the industry from foreign competition. These policies have been and remain controversial, and have dramatic impact on both domestic and international production and trade of biofuels. Specifically, ethanol tariffs have protected the U.S. ethanol industry and have bolstered domestic prices (Elobeid and Tokgoz 2008).

Enabling Policies

Enabling policies are those that facilitate biofuel production of consumption by acting upon other components of the biofuels production, distribution, or utilization chain. This category includes policies targeted to infrastructure development and aimed at reducing the cost of input materials and creating a market for eventual products. Also included in this category are those policies targeted to research and development (R&D).

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[8] See, e.g., Williams et al. 2007 for a description of the nuances of cap-and-trade versus carbon tax policy mechanisms.

[9] Tariffs are but one component of larger trade policy. Other non-tariff trade restrictions potentially affecting biofuel production and use (i.e., sustainability standards) are explored below.

The high proportion of biofuel production costs attributable to feedstock production and processing implies that the cost-effectiveness of other biofuel policies, such as an RFS or production tax credits, will be influenced by how cheaply adequate feedstock supplies can be secured. Accordingly, numerous programs and policies, including grants, loans, and subsidies, are used to promote biofuel feedstock production in the United States. In this respect, those feedstocks expected to generate greater GHG emission reduction or other benefits can be explicitly targeted. When the targeted feedstock is also a commodity supported by traditional farm subsidies, there is again potential for overlap and redundancy.

A wide variety of policy levers also exist to promote facility construction, renovation, or expansion. These incentives come in the form of loan guarantees, direct grants, or tax write-offs. The mechanism best suited to facilitate plant construction or renovation depends on policy objectives and the desired distributional effects. Demonstration plants are often used as a mechanism to promote technology deployment, but experience suggests that the mere existence of demonstration facilities does not guarantee commercial-level success (Burnes et al. 2005). Alternatively, loan guarantees may represent a relatively low-cost mechanism by which to encourage plant construction or renovation, but are historically characterized by high rates of default (e.g., Koplow 2006; Mensah 1996). Regardless of the mechanism, targeting the deployment of cellulosic and other advanced fuel production pathways is a potential mechanism to further GHG reduction objectives.

Once biofuels are produced, they must be transported from the refinery to the vehicle. Biofuels policy in the United States, however, has generally favored production incentives and mandates. Partly as a result, a major challenge to increased biofuel consumption throughout the United States continues to be distribution and dispensing infrastructure (National Commission on Energy Policy 2009). Efforts to make biofuels cost-competitive with conventional fuels may also be hindered by limited access to biofuel refueling infrastructure (e.g., Greene 1997). This has implications for the impact that a carbon price would have on the contribution of biofuels under a comprehensive cap-and-trade program for GHGs.

Increased consumption of biofuels also requires a reconfiguration of the vehicle fleet. While conventional vehicle fleets can run on low-concentration blends of biofuels with minimal impacts to performance or engine integrity, a larger number of vehicles capable of operating on high-concentration biofuel blends will be necessary to increase biofuel consumption beyond the point where the fuel market reaches E10 saturation (Tyner 2008). Allowing manufacturers to receive credit for flexible fuel vehicles (FFVs) against their Corporate Average Fuel Economy (CAFE) obligations was a powerful driver in the production of biofuel-compatible vehicles, but may have also impeded efforts to reduce fuel consumption (Rajagopal and Zilberman 2007; Government Accountability Office 2007). Issues of FFV policy and production aside, the flexibility granted by multi-fuel compatibility can be a useful attribute in emerging fuel markets (e.g., Sperling and DeLuchi 1989; Wright and Pinkelman 2007).

The ultimate success of emerging biofuel technologies is difficult to predict, but substantial targeted funding and incentives for R&D are likely critical to the development of advanced alternative energy sources (e.g., Hoffert et al. 2002; Hoffert 2006). Government-funded R&D addresses what is generally seen as a common good problem—a level of private investment below the social optimum—without directly inducing consumption or distorting trade (Kojima et al. 2007). The improvement of process efficiency and the commercialization of new fuel pathways are two areas where R&D could help deliver cost-competitive biofuels with improved lifecycle GHG emissions to market.

Constraints

Constraints are policies that place limitations on biofuels sourcing and/or production. They can establish minimum levels of social or environmental performance or minimum quality control standards. Some suggest that development of standards and benchmarks is a role government could play even if biofuel use and deployment of related infrastructure are largely market-driven (Collantes 2008). This is because new technologies or practices are likely to encounter a regulatory vacuum. In the case of biofuels, this can mean uncertainty in the permitting process for infrastructure development, the quality or composition of the fuel, or the environmental performance of the product. Appropriate rule-setting, establishment of standards, or certification can provide a means to ensure that expanding biofuel production does not have negative direct or indirect impacts.

From a quality control perspective, federal efforts are under way to establish minimum requirements for fuel blends. Confidence in fuel quality is necessary for biofuel acceptance and use (Van Gerpen et al. 1996; Tang et al. 2008), but the cost of producing high-quality fuels is also an important consideration (Van Gerpen et al. 1996). Efforts to ensure that biofuel production does not negatively impact GHG emission reduction objectives, biodiversity, water quality, food supply, and other environmental and social objectives have also increased in recent years (e.g., Searchinger 2009). Linking performance requirements to other policy mechanisms, such as in the case of lifecycle GHG emissions under the U.S. RFS, can help ensure acceptable levels of performance.

Related to issues of standard-setting and benchmarking is land use policy. Land use change can comprise a significant portion of GHG emissions from biofuel production, so mitigation of these effects is likely to be an important component of GHG-targeted biofuels policy. Any approach to addressing the land use effects of biofuels policy should be carefully undertaken, however. For example, acreage controls or limits—one type of planning-derived land use control—can increase the cost of feedstock and discourage biofuel production (Rajagopal and Zilberman 2007). These potential conflicts highlight the need for well-reasoned integration of GHG policy objectives with other desired outcomes and results.

Ancillary Policies

Ancillary policies are those that are not directly targeted to biofuels production or consumption, but can impact or are impacted by those that are. The sheer breadth of policies or programs that could be included here prevents an exhaustive review, but the category can be roughly broken down into two separate components: 1) programs that broadly affect or interact with production processes and 2) those that influence demand for fuel. The first subset of policies could include those that affect the agricultural resource base, such as conservation programs (e.g., Conservation Reserve Program [CRP]), payment programs (e.g., price-contingent farm subsidies), and other GHG mitigation opportunities (e.g., carbon offset development and Renewable Electricity or Portfolio Standards [RES or RPS]). The second subset includes programs influencing biofuel consumption, such as vehicle efficiency requirements. The breadth of policies that could be included in either of these two categories once again speaks to the importance of coordinating and establishing clear policy objectives to ensure that they are met in an efficient manner.

Climate Policy Design Considerations

Multiple approaches for integration of biofuels with comprehensive climate policy exist. The exact path chosen will depend on several factors, not the least of which are the non-climate objectives policymakers seek to achieve through biofuel production and use. That said, there are definite advantages and disadvantages of incorporating specific policies into a GHG emission reduction framework.

As noted above and at greater length in an attached Primer, many biofuel policy mechanisms already in use have potential implications for GHG emission reduction objectives. While not insignificant in their effect, the manner in which their collective impact on GHG emissions is achieved can be described as inefficient at best. This is because many of the policies reviewed here focus on encouraging production and use, and are generally implemented without GHG benchmarks or requirements.

The implementation of a carbon price, in contrast, represents a far more efficient mechanism to integrate biofuels into comprehensive climate policy. Assuming that the carbon price applies to all emissions tied to the production and use of biofuels, a carbon price provides a signal in direct proportion to a fuel's GHG footprint. This is very different from policies, such as an RFS, that control only the rate of fuel production and not the quantity of GHG emissions.[10]

The manner in which a carbon price is applied has significant GHG emission implications. Exemption from GHG compliance obligations, for example, is a straightforward way to integrate biofuels into comprehensive climate policy. This is the approach taken in H.R. 2454, the American Clean Energy and Security Act, the climate bill passed by the U.S. House of Representatives in June of 2009. Complete exemption implicitly assumes that biofuel emissions are carbon-free or that emissions tied to the production of the fuel are accounted for elsewhere in the cap. Recent literature suggests that such assumptions are questionable given the large potential role that indirect land use change and other uncapped emissions may play in total biofuel lifecycle GHG emissions (DeCicco 2009, Searchinger et al. 2009).[11] It is possible, however, that emissions from indirect land use change may be moderated somewhat through the creation of an expansive offsets program that provides an alternative market for forest carbon sequestration (e.g., Kindermann et al. 2008).

Notwithstanding this potential accounting gap, exemption of biofuels from GHG compliance obligations is relatively simple in practice, creating a price advantage for biofuels and encouraging a greater share of their use.[12] Since other inputs and processes that contribute to biofuel production are likely to be impacted by a carbon price, a price for carbon could also induce farmers to alter land, fertilizer, and energy management practices, further decreasing the full lifecycle GHG impact of feedstock production, and by extension, the resulting biofuels as well (Biomass Research and Development Board 2008). Carbon prices can likewise affect the energy costs of converting biomass to biofuels, as the fuel used to power the plant is a strong determinant of the GHG intensity of the resulting fuel (e.g., Plevin and Mueller 2008).

A possible variation on this approach, acknowledging only the net emission reductions achieved by the alternative fuel, would allow this price advantage to be influenced by the amount of both capped and uncapped GHG emissions generated in the biofuel production process.[13] Assuming that an accounting

[10] Again, a notable exception is the inclusion of GHG reduction requirements in the RFS established by the Energy Independence and Security Act (EISA) of 2007.

[11] As explored in Primer supra 13, imported petroleum products and derivatives could also comprise a significant source of uncapped emissions.

[12] This is obviously a simplified view of transportation fuel carbon accounting. See DeCicco 2009 for a more nuanced review of transportation fuel carbon accounting under different policy scenarios.

[13] This could approximate, for example, the Fuel and Feedstock Accounting Standard discussed in DeCicco 2009.

structure could be established that accurately captures the direct and indirect GHG emissions of particular fuels, blends, or pathways, this approach would influence both the production process and the volume supplied. Alternatively, GHG compliance obligations could be extended to traditionally excluded sectors, such as forestry and agriculture. Such an approach is likely to have significant land use implications (Wise et al. 2009), and would face significant political resistance (Searchinger et al. 2009).

Even in the presence of a carbon price, the role of complementary policy should not be overlooked. An RFS that requires a set volume be supplied by a higher-emission fuel pathway may miss lower-emission, lower-cost alternatives. Tax credits or other pricing policies can likewise alter the price relationship between low-GHG biofuels, high-GHG biofuels, and traditional fossil fuel alternatives. Other programs, such as an RES and the development of carbon offset markets, can affect or be affected by increased biofuel production through competition for land and resources, issues that also apply to industries, sectors, and commodities outside of renewable fuel and energy production.

Conclusion

Assessing the combined impact of multiple policies is complex and remains an emerging area of study in the literature. Furthermore, the context in which a policy problem is viewed may dictate the relative importance of individual approaches. Complicating matters further are the large numbers of legislative committees and government agencies involved in biofuels policy creation, oversight, and implementation, creating potential for conflict, cross-purposing, or redundancy in policy design or implementation. Individually, policies promoting the promotion and consumption of biofuels and their distributional effects are varied and complex, with an expansive literature and body of research devoted to each. As potential redundancy and conflict exists between the various policies reviewed herein, a great deal of coordination will be required if biofuels policy is to efficiently satisfy the myriad objectives that have been established for it, regardless of the exact policy mix chosen.

While biofuels are not the most cost-efficient mechanism by which to address GHG emissions, multiple options exist for integration into comprehensive climate policy. The current suite of biofuels policy may in and of itself generate GHG reduction benefits. As contemporary biofuels policy was largely designed to encourage production and use with little regard to GHG emissions, the addition of GHG emission criteria or the preferential targeting of incentives to specific feedstocks or pathways is likely necessary to ensure that contemporary biofuels policy does not hinder climate policy objectives. The multiple policy objectives that biofuels seek to achieve necessitate that the distributional impacts of such modifications be fully evaluated.

The creation of a carbon price, through either a cap-and-trade program or the institution of a carbon tax, can provide a price signal favoring the production and use of less-GHG-intensive fuels. The treatment of biofuels under such an approach has strong implications for the strength of the price signal and the segments of the biofuels production process affected. A failure to adequately capture all emissions tied to the production and use of biofuel can have significant land use implications and negatively impact emission reduction objectives. Acknowledging only the net emissions reduction achieved by a particular biofuel blend or production pathway is one potential mechanism by which both capped and uncapped GHG emissions can be addressed.

Biofuels have implications for climate policy and are likely remain a significant component of the policy landscape. But as noted above, multiple options for integration exist. At the very least, policymakers should be aware of the potential climate implications that biofuel production and use can have when evaluating policy for energy security, rural development, or other objectives. Given the potential conflict and cross-purposing identified herein, scarce natural and government resources suggest the multiple policy objectives for which biofuels have been promoted be systematically evaluated as a whole.

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