Biofuel policy for the pursuit of multiple goals: The case of Washington State

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Introduction

The Washington State Legislature in April 2007 passed E2SHB 1303, an "act relating to providing for the means to encourage the use of cleaner energy." The legislation calls for recommendations about appropriate market incentives as well as research and development directions -- which are to focus on three basic goals: the development of a viable in-state biofuel and biofuel feedstock industry; the reduction of carbon emissions; and a reduction in petroleum dependency.

This paper provides a synopsis of a set of policy recommendations developed in Yoder, et al. (2008). The recommendations are discussed in the context of biofuel policy developments occurring now in Western North America and particularly in the Pacific coast states and British Columbia. The analysis draws on the rapidly growing economic literature on biofuel and global warming policy as well as the broader literature on policy design and implementation.

The result of the analysis is a unique policy suite designed to provide cost-effective incentives for the development of motor fuel markets that reduce both dependence on foreign oil and greenhouse gas emissions, in Washington and the Western states more generally. The analysis and policy recommendations highlight the differences between western states and the Midwest in terms of comparative advantages in current and potential future biomass based biofuel markets.

Biofuel markets in Washington and the West

Agricultural feedstocks for biofuel including oilseeds, sugar beets, and field corn are likely to account for only a very small fraction of Washington's agricultural production and state fuel needs. Current production of oilseeds and sugar beets in Washington is small. The projected breakeven prices for Washington farmers to produce these crops for biofuels profitably exceed current and projected prices. The few large ethanol and biodiesel processors in the region import nearly all of their virgin feedstocks from other regions. Washington State does not yet commercially produce any ethanol, though there is some production in neighboring Oregon.

This market outcome is partly due to the particular agronomic conditions of Washington. Overall Washington is very competitive in markets for myriad other high-value crops, which implies a high opportunity cost for switching land to biofuel feedstocks. This is not to say that new crops and cultivars will not emerge. To date, many potential biofuel feedstocks have received little research for variety development in Washington State relative to traditional crops

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like wheat, apples, and potatoes. New cultivars and agronomic techniques with high biofuel potential may be developed in the future.

In comparison to crop biofuel feedstocks, the long-run potential for biofuel production from lignocellulosic biomass in Washington State is more promising. Washington ranked fourth after California, Texas, and Oregon among 19 western states in available biomass (Western Governors Association 2008). The lack of maturity in the technology for producing biofuel from lignocellulosic biomass precludes a reliable estimate of the biofuel fraction at this point. It appears that ongoing research has potential to solve the engineering, biochemical, and logistics barriers to utilization of Washington's abundant lignocellulosic biofuel feedstock sources.

The Federal Energy Policy Act of 2005 and The Energy Security and Independence act of 2007 together mandate consumption requirements for biofuels. The requirements increase to 36 billion gallons by 2022. The corn ethanol contribution to the RFS is capped at 15 billion gallons per year beginning in 2015, with the remainder being *advanced* biofuels, such as biomass-based fuels. In the 2008 Farm Bill (H.R. 2419: Food, Conservation, and Energy Act of 2008), tax credits for corn-based ethanol are reduced from 51 cents to 45 cents per gallon (section 15331), while the tax credits for cellulosic are $1.01 per gallon (section 15321). These and other federal programs will likely provide Washington State and Western states an improved relative long-run position in future biofuel markets.

The State of Washington biofuel policy currently includes minor tax incentives for biofuel sales, limited funding for infrastructure development, and a renewable fuel standard (RFS) that was intended to build the percentage of renewable fuels. The actual implementation of the RFS was designed to be conditional on a certain amount of in-state biofuel production, which for biodiesel in particular, has not occurred. In contrast, last year, market-based ethanol sales (all from out-of-state sources) have satisfied the targeted 2 percent average blend rate.

Recommendations for market incentives

If the state wishes to address the three stated goals of biofuel market development, reduction of greenhouse gas emissions and petroleum dependence in a cost-effective manner, then the state should explicitly target greenhouse gas emissions. In addition, there is a trend nationally, regionally, and within some key government organizations in Washington, to move climate change policy toward a regional carbon cap and trade program. The recommendation offered here is that the state focus on price instruments such as carbon taxes to address greenhouse gas emissions and petroleum dependence, and utilize tightly associated tax credits and investment incentives based on net carbon emissions to promote an in-state low-carbon fuel industry. These tax incentives or grants should *not* be funded by general state funds. These and ancillary conclusions are motivated below.

The carbon tax is the centerpiece of the proposed program, but how the resulting revenues are used is integral to the cost effectiveness of the program. The carbon-emissions taxes can be used to develop a "renewable energy fund" which can be used in one (or all) of three ways:

1. to fund tax credits for low emission fuels produced in the State;
2. to support tax credits and research and development for low carbon fuels; and.
3. to reduce other taxes such as sales taxes and Business and Occupation taxes.

Support for a carbon-based policy approach

No state or federal policy in the United States has yet to target carbon emissions directly or explicitly. GHG emissions can be directly targeted for biofuel policy for several reasons. First, targeting greenhouse gases (GHGs) is the most effective way to address all three policy goals. Biofuels are highly variable in the amount of greenhouse gas emissions reduction, and can vary due to differences in feedstock efficiencies, in production processes, and in combustion characteristics. British Columbia recently adopted a carbon tax on nonrenewable energy sources (including motor fuels), but renewable fuels are exempt **(British Columbia Ministry of Small Business and Revenue 2008).** Although British Columbia's design strengthens incentives for renewable fuels over nonrenewable fuels, it does not provide differential incentives for the development of low-carbon *biofuels* over higher-carbon *biofuels*, despite the importance of doing so to insure an emphasis in this direction for biofuel technology development and adoption.

Focusing policy directly on the net contribution of (all) fuels to carbon emissions reduction will provide a foundation for motor fuel diversification and will encourage motor fuel development of the most environmentally benign fuels (renewable and nonrenewable), in both the short- and long- run, reducing the external cost associated with motor fuel.[2] It will spur further development of low carbon fuels on both demand and supply sides. This policy incentivizes a state energy industry that continues to be shaped by the issues of increasing energy scarcity and mitigation of global warming.

Importantly, advanced biofuels and biomass-based fuels show more environmental and economic promise in the long run than do the first generation biofuels (though it is likely that even these first generation fuels can improve their environmental performance if firms are given tangible incentives to do so). Moreover, Washington State has a better potential market position for biomass-based fuels relative to current starch and even oilseed based biofuels. Implementing a carbon-based policy approach will work in favor of Washington's comparative advantage in lignocellulosic feedstocks, especially in the context of developing regional, national, or global carbon policies.

Adoption of a carbon-based policy, though, does not come without additional regulatory and compliance complications, costs and weaknesses. Estimating net carbon emissions over the life of fuels is a complicated problem, especially for biofuels. The analysis entails consideration of the direct combustion emissions, emissions due to the production and distribution of the biofuels and feedstocks, and to the emissions changes in ancillary activities (Searchinger 2008, Fargione 2008). Measuring, standardizing, and applying carbon accounting is administratively costly, and the extent to which a carbon-emission based policy helps reduce carbon emissions cost-effectively depends on how accuracy of carbon emissions estimates.

Pitfalls exist for relying on life-cycle carbon emission estimates as a foundation for policy incentives, especially in the short run. Early integration of carbon intensity measurement and tracking into policy will spur accelerated improvements in carbon intensity measurement and

[2] There are several categories of substantial external costs associated with fuel use and vehicle miles traveled. Parry and Small (2005) find that externality costs related to traffic congestion, traffic related accidents and local air pollution are important external cost related to transportation fuels. However, our focus here is on greenhouse gas emissions.

tracking. Methodological improvements will come faster if they are relied upon in the context of a policy that provides incentives for improving these methods.

Support for a price-based policy approach

With a focus on greenhouse gas emissions as the foundation for policy, there remains a fundamental choice between price incentives (e.g. carbon taxes) versus quantity-based based instruments (such as standards and cap and trade programs). Stavins (2007, pp. 50-53) provides a useful and concise summary of the relative strengths and weaknesses of these approaches. In summary, the potential strengths of carbon emissions taxes over cap and trade include the following: 1) simplicity in implementation for regulators and firms; 2) reduction in political difficulties of allocating allowances; 3) ability to use tax revenues elsewhere in the economy; and 4) avoidance of carbon price volatility (which is introduced by a cap and trade). The potential disadvantages of taxes relative to cap and trade programs are as follows: 1) political resistance to new taxes; 2) potential increased cost to firms compared to traditional cap-and-trade programs without credit auctioning (which is the traditional method, though recent work and proposals tend to favor auctions); 3) compared to taxes, a cap and trade program avoids requests and battles for tax exemptions that might reduce the effectiveness of a tax system; 4) cap and trade programs provide more certainty over carbon emissions; and 5) a new cap and trade systems is easier to harmonize with other cap and trade programs.

A rapidly growing literature on the economic dynamics of climate change and mitigation is shedding light on the relative efficacy of quantity versus price instruments. For instance, Hoel and Karp (2002) and Newell and Pizer (2003) extend Weitzman (1974) to include the stock effects of GHG accumulation, but are based on several different assumptions about the characteristics of uncertainty and policy adjustment. Despite their differences, both find that taxes tend to dominate standards for controlling greenhouse gases. Newell and Pizer (2003) in particular find that the net benefits of using emissions taxes are several times larger than for standards, and that the dominance of taxes over standards is very robust over a reasonable range of parameter values. Karp and Zhang (2008) argue that price instruments are likely to outperform quantity restrictions for three reasons: a) rapidly changing markets and rapidly changing (endogenous) policy targets tends to favor the use of taxes; b) given that GHGs are a stock pollutant, the relative magnitude of the slope of the damage function would have to be implausibly large to favor quotas over taxes. (Hoel and Karp 2002); and c) market investment in abatement capital in response to both market conditions and policy instruments favors price instruments (taxes on GHGs) further. Finally, Pizer (2002), finds that expected welfare gains from an optimal price policy are five times that of an optimal quantity-based policy for mitigating climate change using a stochastic computable general equilibrium model. This literature review is neither exhaustive nor is the existing literature globally decisive in favor of one approach over the other. However, the recent literature suggests increasing support for the use of price instruments such as carbon emissions taxes for GHGs mitigation over quantity instruments such as standards and cap and trade regimes.[3]

[3] In addition to Cap and Trade programs under discussion, The Low Carbon Fuel Standard (LCFS) under development in California is receiving a lot of attention as a policy alternative for biofuels. The LCSF is basically a carbon based renewable fuel standard with credit trading, that restricts the average carbon “intensity” per gallon of fuel, but it does not address changes in total fuel production or consumption. As a result, the findings of Holland, Knittel and Hughes (2007) suggest that a Low Carbon Fuel Standard is not as cost effective as even a carbon cap and trade program.

Subsidies and the importance of revenue source

Along with renewable fuel standards, subsidies are the most common instruments for promoting biofuel markets. Subsidies are costly in two ways (the two terms *tax credit* and *subsidy* are used interchangeably). The direct costs are taxes on the citizens to fund the subsidy. Providing subsidies for fuel blendstocks such as ethanol also may alter the blend rate of blended fuels in favor of biofuels, but they also make blended fuels less expensive than they otherwise would be. This results in higher quantities demanded of blended fuels, reducing the effectiveness of this approach for reducing petroleum dependence and greenhouse gas emissions reduction.[4] It is possible for a subsidized blended fuel program to lead to a net *increase* in the use of fossil fuels.

Despite the weaknesses of tax credits (subsidies), providing tax credits for biofuels produced in the state may still be the most effective way to promote in-state production of biofuels and feedstocks, and this is often an objective of state governments (as is the case of Washington).[5] The *combination* of carbon tax and biofuel tax credit may be more effective in promoting state goals, than either alone. When carbon taxes are used to fund tax credits for low carbon fuels, the taxes increase the price of high carbon fuels relative to low carbon fuels and all other goods. Hence the taxes tend to reduce or reverse the price increase of blended fuel that a subsidy alone creates. The combination mitigates the incentive to increase blended fuel use, and will therefore more effectively support the goals of reducing carbon emissions cost-effectively and increasing the relative competitiveness of low carbon alternative fuels. Financing the subsidy programs from a fund generated by the carbon emission tax revenue avoids creating additional demand on general revenue funds that could lead to either higher general taxes or reprioritization of state spending.

Given that most or all fuels are net positive (lifecycle) carbon emitters, a carbon tax/subsidy combination amounts to a "shifted" carbon tax. This modified carbon tax would be zero for some fuel type with intermediate carbon intensity. It would be positive for high-carbon fuels, and negative -- a tax credit for fuels with lower carbon intensity – all proportionate to carbon emission intensity. The subsidies could be funded by the fuel taxes so that the policy mix could be more or less revenue neutral in the long run.[6]

There are interesting dynamics for the short run. A fixed carbon tax rate would generate relatively high revenues in the beginning due to the dominance of petroleum-based fuels. Since biofuel production is currently small, a revenue fund could build up a large endowment based on relatively low percentage taxes on the high carbon fuels. Given that Washington produces small amounts of biofuel now and likely in the foreseeable future, carbon tax revenues might initially go mostly unclaimed as tax credits, and the fund could accumulate. Even if the tax credits are little used initially, they would provide a long-term promise of tax credits for low-

[4] A series of recent working papers by de Gorter and Just (2007, 2008a, 2008b, 2008c, 2008d) highlight some of the incentive effects of subsidies, including some surprising problems when using subsidies from general tax funds in conjunction with a renewable fuel standard, as the federal government is doing.

[5] Federal biofuel subsidies provide incentives to increase biofuel production, but are not explicitly targeted toward specific states. Those states that have a comparative advantage for producing biofuels benefit most from these subsidies. Washington is not currently one of them.

[6] Galinato and Yoder (2008) develop a theoretical model of a revenue-neutral carbon tax/subsidy combination.

carbon fuels that would create an incentive for private investment in low-carbon fuel production in the State.

Further, early fuel tax revenues could be invested in R&D and infrastructure needs to complement private investment in the State's nascent biofuel industry. As the industry develops and low-carbon fuel production increases in the State, revenues from carbon taxes could increasingly move away from R&D toward tax credits for low-carbon fuels. Ultimately, perhaps, the marginal tax credits might go entirely for in-state low-carbon fuel production.

Using carbon tax revenues on high carbon fuels to support low carbon fuels is reminiscent of a related literature on *revenue recycling*: using environmental tax revenues to offset other taxes such as income, payroll, and sales taxes (Fullerton and Metcalf 2001, Parry 1995, Parry 1997, Bovenberg and Mooji 1994). An example is British Columbia's carbon tax, the revenues from which are targeted for reducing other provincial taxes (British Columbia Ministry of Small Business and Revenue. 2008). The basic argument of this literature is the following. Traditional taxes such as income taxes and payroll taxes reduce after tax returns to labor and business investments, reducing incentives for capital and labor investment. Environmental taxes, on the other hand, are traditionally prescribed to correct a market failure. So, if environmental tax revenues (which in principle improve welfare) can be recycled to reduce other traditional "distortionary" taxes, then this combination provides "double dividends," and if applied appropriately, can improve social welfare relative to traditional revenue-raising taxes.

Were it not for the State goal of supporting the development of a biofuel industry, a more typical revenue recycling approach would likely be an effective approach for reducing greenhouse gas emissions. However, in pursuing all three stated goals, directing at least some of the revenues from the modified carbon tax for incentives to promote in-state biofuel industry will likely reduce the costs of pursuing this last goal relative to tax credits/subsidies that are funded in some other way.

Conclusion

To promote the development of a biofuel industry while facilitating the reduction in state greenhouse gas emissions and reducing petroleum dependence, we propose an integrated biofuel policy approach that includes modified carbon taxes on motor fuels, the revenues from which can be used to fund incentives for low-carbon renewable fuel development and production. In the current market and technological environment, this approach has the capacity to provide incentives to reduce petroleum consumption and greenhouse gas emissions in the short and the long run, while providing a foundation for long run development of a biofuel industry that may have the capacity to be more competitive in advanced biofuel markets than it is today.

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