State and federal subsidies to biofuels: magnitude and options for redirection

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Abstract: Hundreds of government subsidies have fuelled the growth of ethanol and biodiesel in the USA, worth half or more their retail price. Cumulative costs under some mandate proposals exceed $1 trillion by 2030. Even using favourable assumptions, reduced greenhouse gas emissions from biofuels are far more expensive than other options: more than $100/mt CO_2e even for cellulosic ethanol and nearly $300/mt CO_2e for corn-based fuel. Despite rising concerns, environmental screens in existing subsidy policies remain weak or non-existent. A platform- and fuel-neutral policy structure forcing all alternatives to conventional fuels to compete for market share should be deployed instead.

Keywords: Koplow; Earth Track; biofuel subsidies; corn ethanol; cellulosic; biodiesel; RFS; renewable fuel standard; mandates; VEETC; volumetric ethanol excise tax credit; bioenergy.

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Biographical notes: Doug Koplow is the Founder of Earth Track, Inc. (Cambridge, MA), established to provide greater transparency on government subsidies to environmentally harmful activities. He has worked on energy subsidy issues for the past 20 years, including a number of detailed assessments of subsidies to biofuels in the USA.

1 Overview

An expanding array of subsidies has fuelled the growth of ethanol in the USA from virtually zero in 1978 to 7.2 billion gallons per year of capacity this year. Another 6.2 billion gallons are now under construction (RFA, 2008a), expected to enter production over the next 18–24 months. Beginning 30 years ago with exemptions from federal excise taxes on gasoline, government interventions have spread to support every stage of the ethanol production chain, as well as providing tariff protection against competition from imports. Although support for biodiesel took much longer to develop (excise tax credits to biodiesel in 2004 were the first significant federal subsidies to the sector), recent years have brought a growing array of biodiesel subsidies as well, policies that now provide higher subsidies per unit energy for biodiesel than for corn ethanol.

Overall, despite growing concerns about their negative environmental impacts, more than 200 state and federal subsidies support these fuels (Koplow, 2006). As of October 2007, subsidies exceeded $1 per gallon of corn ethanol, and approach $2 per gallon for biodiesel, 40–70% of the retail price of fuels. Even using the most favourable assumptions regarding GHG displacement, biofuels have proven an expensive way to strip carbon from the economy, at a cost of nearly $300 per mt CO_2 equivalent displaced for corn ethanol, and more than $200 per mt CO_2e displaced for biodiesel (Koplow, 2007).

Cellulosic ethanol, which can be made from waste biomass rather than food crops, has a lower GHG footprint than fuels made from corn, sugar, soy or canola. Both industry and politicians have increasingly pinned their hopes for future growth and sustainability in the biofuels sector on cellulosic technologies. Technical challenges aside, even if cellulosic ethanol was commercially available today, at similar prices as corn ethanol and supported by similar subsidies, it would still be expensive: more than $100 per mt CO_2e displaced (Koplow, 2007). In fact, cellulosic ethanol is already more heavily subsidised than conventional ethanol, further reducing the efficiency of relying on the cellulosic approach to address climate change concerns.

Existing biofuel policies make little sense. Tax credits, tariffs and mandates alone are expected to provide roughly $420 billion in federal subsidies to the biofuels sector between 2008 and 2022. Because they scale linearly with production levels, the cumulative subsidy will top $1 trillion between 2008 and 2030, if existing subsidies are be renewed and the Obama administration moves forward with a 60 bgy mandate as proposed during his campaign (Koplow, 2009).

Unfortunately, these policies are not subjected to the market test and do not maintain neutrality across all options. Rather, they favour a politically chosen subset of potential substitutes for transport fuels. This approach increases both the direct and the indirect costs of the needed structural adjustment. For example, ethanol requires broad and expensive changes to vehicle and fuel distribution infrastructure that other fuel variants like biobutanol do not. None of the new fuel options do much to improve the efficiency of the existing fleets either.

In addition, the existing earmarked subsidy infrastructure is grossly overpaying for the carbon reductions it is getting via ethanol and biodiesel. The current market value of the carbon offsets, as measured by the Chicago Climate Exchange, is only about $4 per mt; whereas, in the more mature European Exchange it is only about $30 (CCX, 2008; ECX, 2008). Best-case cellulosic subsidies are 3–25 times as much; corn ethanol is *at least* 10–90 times as much. Neither is close to being cost-effective relative to other GHG reduction options. Consider that in a multi-sectoral study of lower carbon options, McKinsey & Company identified *3 Gigatons* of CO_2-equivalent reductions by 2030 (enough to bring US emissions 7% below 2005 levels) at a marginal cost of $50 per mt CO_2e or lower (McKinsey & Company, 2007). The opportunity costs of our present course should not be minimised: the more society pays for each unit of GHG reductions via inefficient and politically motivated biofuel subsidies, the less total reductions we can buy overall for any given amount of investment.

This paper provides a brief history of US biofuel subsidies, reviews the existing situation, and quantifies the value of these subsidies to the biofuels sector. It then identifies a number of emerging issues of concern in biofuels policy, and explores ways that subsidies can at least be steered away from the more environmentally destructive feedstocks.

2 A brief history of biofuel subsidies

Since the inception of the US liquid biofuels industry in the late 1970s, political capital rather than venture capital has driven sector interest, investment and expansion. Excise tax exemptions were introduced at the federal level in 1978, the year the first US production facility opened. The first of many similar state-level exemptions arrived only a couple of years later. Tariff protection against imported ethanol was also implemented in 1980, along with federal production tax credits for smaller ethanol facilities. Many states added production and investment tax credits to biofuels as well, often with more generous terms than the federal small producer tax credit. Support to the sector from state and local governments continued to expand, adding production grants; provision of transportation infrastructure; favourable tax treatment and refunds to in-state feedstock and fuel producers; and a range of regulatory exemptions. Many state programmes have also mandated the purchase of alternative-fuel capable vehicles (these include those reliant on E85 and increasingly biodiesel as well), and in some cases also the purchase of alternative fuels even when they were more expensive than conventional fuels.

Both ethanol and biodiesel programmes have also long benefited from agricultural supports to the core feedstocks used to make the fuels – most prominently corn, but also soy and sorghum. In the early 1980s, for example, corn subsidies (pro-rated to reflect the share of corn crop used for ethanol) were consistently among the top three largest subsidies to the fuel (Koplow, 2006). Although surging commodity prices in recent years have reduced the importance of counter-cyclical farm support programmes, these declines have been partially offset by the growing share of feedstocks such as corn and soy that are being used in the fuel sector. Commodity prices also move in both directions, with the importance of particular programmes varying by market conditions. In addition, newer support programmes, such as a special tax deduction for domestic manufacturing (the definition includes growing crops as manufacturing) and newer options for farm support under the 2008 Farm Bill, provide an incremental boost to feedstock producers. This law also provides the first direct subsidies to produce cellulosic crops for fuel production.

Credit subsidies for ethanol plants also made their debut in 1980, with federally guaranteed loans (many of which defaulted) and special rules allowing the sector to issue tax-exempt debt. By 1980, state and federal subsidies to corn ethanol (the biodiesel and cellulosic industries did not exist until much later) peaked at between $8 and $10 per gallon produced, and more than $100 per million British thermal units (MMBtu) (in 2006$) (Koplow, 2006). Subsidy levels did drop sharply as the production base grew. Nonetheless, even in 1989, corn ethanol subsidies were still more than $17 per MMBtu, nearly twice the subsidy intensity of nuclear fission, the next most heavily subsidised energy resource. Corn ethanol received subsidies at a level six times that of oil, and 11 times that of natural gas (Koplow, 2006). Thirty years after the inception of the ethanol industry, subsidy intensity remains at $12–$15 per MMBtu (Koplow, 2007). A number of lucrative programmes that have taken effect since December 2007 will further increase this value over the coming years, especially for cellulosic fuels.

Despite a growing base of domestic ethanol producers, core competitive problems remained. Foremost was getting ethanol into the fuel mix, and over a longer term, ensuring that there were vehicles capable of burning more than 10% blends (the maximum level generally assumed existing fleets could handle without damage). The solutions pursued were political ones. In 1988, vehicles capable of burning alternative fuels including E85 were granted credits that offset the efficiency requirements for vehicles under the federal Corporate Average Fuel Efficiency (CAFE) standards. Since the credits did not require actual use of the fuels, the programme had the perverse effect of *increasing* domestic oil consumption by roughly 80,000 barrels per day (MacKenzie et al., 2005). Efforts to contain the damage were added later, capping the allowable reductions in fleet efficiency a firm could earn through the production of FFVs. Recent rules have extended this credit to B20, a move that could expand the number of firms able to earn CAFE offset credits, and generate similar problems as the FFV loophole did 20 years back. Efforts are also underway to mandate that all new vehicles have the capability to burn high blends of ethanol, once again ignoring that E85 may not be the least expensive or best approach to weaning the vehicle fleet from imported oil.

Political efforts to force ethanol into fuel mixtures began in 1990 with the Clean Air Act Amendments (CAAA). In an attempt to reduce local air pollution, the CAAA required oxygenated gasoline in certain regions. Ethanol was a possible oxygenate choice, though the gasoline industry favoured a petroleum-based blending agent, Methyl Tertiary Butyl Ether (MTBE). A 1994 Environmental Protection Agency rulemaking attempted to mandate that 30% of the oxygenates be ethanol; this was struck down in 1995 by the courts (Johnson and Libecap, 2001). Real problems with MTBE in terms of carcinogenicity and contamination of groundwater led nearly 20 states to ban the substance by 2006, opening up the market to ethanol. This has been an important element in the fuel gaining market acceptance.

While the use of ethanol as a blending agent has greatly helped the market in the short term, the MTBE ban alone was not sufficient to address the long-term competitive deficits of the industry: high costs relative to gasoline and market risk from direct exposure to volatile oil and corn markets. Even the niche as a blending-agent provider was not secure: prior to the passage of use mandates for ethanol, the oil industry anticipated they would come out with a less expensive, petroleum-based alternative agent (Hirschfeld, 2006). Finally, with ethanol production capacity doubling every few years (in part due to favourable subsidy policies), there was no guarantee that the ethanol demand associated with the octane enhancement market alone would be sufficient to absorb all of the ethanol coming on line – even if a petroleum-based substitute did not materialise. More acute concerns related to finding additional markets once domestic consumption reached the 10% blending wall (about 14 bgy).[1]

The situation for biodiesel was even worse: many of the new facilities were operating at low-capacity utilisation owing to poor production economics and limited demand. Without a more secure market, the risks of investing in these sectors were quite high. Researchers at the University of Iowa at Ames go so far as to suggest that in a free market

> "… once the opportunity cost of land is taken into account, rational farmers will not grow switchgrass or soybeans for biofuel production, and rational investors will not build these plants. In our results, the biodiesel industry disappears …" (Baker et al., 2008, p.21)

The Energy Policy Act of 2005 brought partial relief to these concerns in the form of a Renewable Fuels Standard (RFS). The RFS mandated numerical targets for consumption of conventional ethanol, and provided supplemental credit towards the mandate for cellulosic fuels. Tariff protection ensured domestic, rather than foreign, producers would be the main beneficiaries.

The mandate was most important in ensuring that biofuels could still find buyers in the plausible market scenario of rising feedstock prices (as has happened) in combination with falling oil prices, rendering biofuels uncompetitive in the marketplace. However, the original mandate did little to force the use of very expensive biodiesel or cellulosic fuels. In addition, the rapid pace of construction of conventional plants was quickly outpacing even the overall mandated level of consumption. Without revisions, all of these fuels would be subjected to market risk from their high-cost structure. Towards this end, the Energy Independence and Security Act (EISA) was passed in late December of 2007. EISA nearly quintupled the prior mandate, from 7.5 bgy in 2012 to 36 bgy in 2022. Even more important from the industry's perspective, EISA added sub-mandates for cellulosic, biodiesel, and 'advanced' ethanol made from feedstocks other than corn starch. Over the next decade, this mandate appears likely to become the single largest subsidy at least within the cellulosic and biodiesel sectors. Its impact would be further exacerbated should proposals by the Obama administration and others to boost mandates to 60 bgy be implemented.

The final threads of subsidy policy support biofuel transportation and distribution. Although some biofuels (biobutanol, for example) can use existing pipelines, ethanol requires a separate and much more expensive distribution system – primarily truck and rail. State and federal tax subsidy and grant programmes have provided support to install biodiesel and ethanol blending, storage and pumping capabilities for a number of years. The industry has been pushing for roughly $4 billion dollars in federal loan guarantees for an ethanol-only pipeline for some years as well (Neeley, 2008). While EISA authorises funding a study of the pipeline, no guarantees have passed.

3 Review of key subsidies to biofuels today

This section reviews the most important subsidies to biofuels in greater detail. Policies are grouped using a standard economic classification scheme, including the following categories: volume-linked support, payments based on current output, subsidies to factors of production, research and development support, and subsidies related to consumption.

The policies presented here are illustrative; more comprehensive listings and descriptive materials can be found in Koplow (2006, 2007), and Koplow and Steenblik (2008).

3.1 Volume-linked support

Volume-linked support, including Market Price Support (MPS) and direct payments to producers, provides subsidies that increase linearly with production levels. MPS can be fairly complicated, as it evaluates the residual impact of a number of interacting policies including purchase mandates and import tariffs. Mandates, for example, do not generally require taxpayer expenditures but do artificially force very large transfers from one group (often consumers) to targeted industries. Direct payments to producers or other market participants based on the gallons of biofuels produced, blended, or sold are more straightforward.

3.1.1 Market price support associated with tariffs and mandates

MPS refers to financial transfers to producers from consumers arising from policy measures that support production by creating a gap between domestic market prices and border prices of the commodity (OECD, 2001). The three most significant policies supporting market prices for biofuels in the USA are tariffs, blending mandates, and tax credits and exemptions (de Gorter and Just, 2007a).

3.1.1.1 Tariffs on biofuel imports

Tariffs are special charges levied on the import of specific goods. The tariffs will affect how high domestic prices can rise above free market rates (by reducing the ability of less-expensive imported fuel to constrain price increases) and how the proceeds from the above-market prices are distributed (boosting the take by domestic producers by making imports more expensive to reach market). *Ad valorem* tariffs on biodiesel and denatured ethyl alcohol are 1.9%, with a slightly higher rate of 2.5% on denatured ethyl alcohol (Koplow, 2006).

A specific-rate tariff on ethyl alcohol imports of 54 cents per gallon is the most significant of the tariff policies. Ostensibly implemented to offset benefits foreign producers could earn from the excise tax exemption first implemented in 1978, Hartley (2006) notes that the supplemental tariff is, in fact, punitive. He notes that the tariff is applied volumetrically to the full mixture (i.e., including the denaturant), and is actually higher than the domestic subsidy it supposedly offsets. This disparity will grow from 3 cpg to 9 owing to the 2008 Farm Bill, when an excise tax credit to blenders drops from 51 cpg to 45 cpg, likely in 2009. The specific-rate tariff will not decline, resulting in a tariff penalty now exceeding the blender's credit by 20%.

Historically, much of the ethanol imported into the USA has not paid net tariffs. Special trade deals were one reason: participants in the North American Free Trade Agreement (NAFTA), or in the Caribbean Basin Initiative (so long as they used mostly indigenous feedstocks and did not supply more than 7% of US domestic ethanol consumption) are exempt (Etter and Millman, 2007). Other nations exporting ethanol to the USA (predominantly Brazil) had to pay the tariffs, but were usually able to recover most of them through drawback provisions that allowed them to offset ethanol tariffs with exports of products such aviation fuel – even if the aviation fuel contained no ethanol. Drawback provisions were tightened to allow offsets only for ethanol exports in the 2008 Farm Bill, though the financial impact from the change on Brazilian exports is not yet clear.

3.1.1.2 Purchase mandates

Purchase mandates, often more innocuously referred to as 'Renewable Fuel Standards' (RFS), were first implemented for biofuels in the Energy Policy Act of 2005. This law set targets of 4 bgy starting in 2006, rising to 7.5 bgy by 2012. Although cellulosic mandates began in 2012 (at 250 mgy) under the statute, the primary effect of the initial mandate has been to support corn ethanol. Domestic consumption of ethanol has been running ahead of these mandates, reaching nearly 7 billion gallons in 2007 (RFA, 2008a). This led to three main concerns within industry:

- *Growing market risk*. Multiple causal factors were increasing market risk to producers. These included record high corn prices; increased lobbying pressure from competing corn users over the impact of biofuels on feedstock and food prices; ethanol gluts primarily in the Midwest owing to transportation bottlenecks; and billions of gallons of new corn ethanol capacity slated to enter the marketplace. All of these factors were likely to reduce producer margins.
- *Hitting the blending wall*. Domestic production capacity plus imports would soon hit the feared 'blending wall' of 10% of domestic gasoline demand. Going beyond this level would require expensive modifications to the vehicle fleet, and could increase political resistance to further ethanol consumption or generate nationwide-gluts and ethanol selling at a growing discount to gasoline.
- *Marginalisation of more expensive fuels*. Although corn ethanol is more expensive than gasoline once subsidies are taken into account, biodiesel and cellulosic ethanol are still more so. Biodiesel risked being outcompeted from the mandate (driven by relative returns to feedstock producers). Cellulosic ethanol risked having too small a guaranteed market to sustain the investment needed to bring immature technologies to plant-scale applications. Provisions in the original mandate giving cellulosic fuels 2.5 times the credit of corn ethanol and scaling biodiesel to reflect its higher heat content were not sufficient to overcome their cost disadvantages.

EISA addressed most of these concerns, though at a high financial cost. Mandate levels for conventional biofuels (i.e., corn ethanol) grow quickly, reaching 12 bgy by 2010, thereby insulating most of the current production base from market downturns. The law also formalised a set of sub-mandates for corn ethanol (as the residual category), certain biodiesel (excluding biodiesels co-processed with petroleum at oil refineries), cellulosic, and a new catch-all category called 'advanced biofuels', which includes anything other than ethanol from corn starch. These sub-mandates allow the less competitive biodiesel and cellulosic fuel segments to trade at their own premium price, unaffected by surging domestic corn ethanol production or imported sugar-ethanol from Brazil. Faced with rising concerns about the environmental impacts of biofuels – Indonesian peat bogs cleared to produce palm oil for biodiesel is said to be the third largest source of GHG emissions in the world, after the USA and Chinese economies (Lewis, 2007) – the Act does include the first environmental screens in any federal biofuels subsidy programmes. The specifics of the new mandate are summarised here in Exhibit 1. Subsidy impacts of the mandates, including valuing them in conjunction with tariffs and tax credits, are discussed in greater detail in Section 4 of the paper. Section 5 of the paper addresses likely weaknesses in the environmental screens being proposed.

Federal purchase mandates interact with a growing number of state mandates and sub-mandates as well. Minnesota had already established a renewable fuels mandate prior to the federal RFS, though newer versions require gasoline in the state to contain 20% ethanol by 2013, higher than both the federal mandate and the blending wall. The State is currently testing the impact of burning higher ethanol blends in conventional vehicles. In 2006, Iowa set a target to replace 25% of all petroleum used in the formulation of gasoline with biofuels (biodiesel or ethanol). Hawaii wants 10% of highway fuel use to be provided by alternative fuels by 2010; 15% by 2015; 20% by 2020.

In 2008, Massachusetts added biodiesel blending mandates of 5% by 2010 and 10% by 2015, including heating oil as well as transport fuels (Bevill, 2008a). A few other states have set more modest requirements, some of which (as for Montana and Louisiana) are contingent on production of ethanol within these states reaching certain minimum levels. Pennsylvania introduced a 10% cellulosic mandate, taking effect the first year after in-state production of cellulosic fuels reached 350 mmgy (Bevill, 2008b). If the state mandates are no more stringent than federal ones, or easy for states to opt out of, they are not anticipated to cause incremental economic costs. Only where state mandates require fuels in quantities not easily available nationally are their economic costs above the federal requirements expected to be large, adding yet another layer of subsidisation to producers.

Exhibit 1 Federal mandates under the Energy Independence and Security Act of 2007

	Total RFS	*Renewable Biofuel (Corn)*	*'Advanced' Biofuel (Total)*	*Cellulosic Carve-out*	*Biodiesel Carve-out*[1]	*Undifferentiated 'Advanced' Biofuel*
Environmental screens						
Land-use change	Land must have been cleared prior to passage of EISA; though need not be in current active production.					
Life cycle GHG reductions[2]		>20% reduction (reducible to 10%)	>50% reduction (reducible to 40%)	>60% reduction (reducible to 50%)	>50% reduction (reducible to 40%)	>50% reduction (reducible to 40%)
Grandfathering		Exempt from environmental screens if construction began prior to 19 December 2007	Other fuels seem to have the same exemptions as for corn based fuels, though not all experts agree	–		
Waiver options	Waiver options if mandates cause 'severe' economic distress. Totals can also be scaled back pro-rata if sub-mandate waivers granted	None mentioned. Most of mandate capacity will be met by grandfathered facilities	None mentioned	Based on production only; price not a factor. After 2016, reductions can be made permanent	Waivers based on price allowed; but only for a maximum of 120 days	None mentioned
Mandated supply						
2006	4	4				
2007	4.7	4.7				
2008	9.00	9.00				
2009	11.10	10.50	0.60		0.50	0.10
2010	12.95	12.00	0.95	0.10	0.65	0.20

Exhibit 1 Federal mandates under the Energy Independence and Security Act of 2007 (continued)

	Total RFS	*Renewable Biofuel (Corn)*	*'Advanced' Biofuel (Total)*	*Cellulosic carve-out*	*Biodiesel carve-out*[1]	*Undifferentiated 'Advanced' Biofuel*
Mandated supply						
2011	13.95	12.60	1.35	0.25	0.80	0.30
2012	15.20	13.20	2.00	0.50	1.00	0.50
2013	16.55	13.80	2.75	1.00	1.00	0.75
2014	18.15	14.40	3.75	1.75	1.00	1.00
2015	20.50	15.00	5.50	3.00	1.00	1.50
2016	22.25	15.00	7.25	4.25	1.00	2.00
2017	24.00	15.00	9.00	5.50	1.00	2.50
2018	26.00	15.00	11.00	7.00	1.00	3.00
2019	28.00	15.00	13.00	8.50	1.00	3.50
2020	30.00	15.00	15.00	10.50	1.00	3.50
2021	33.00	15.00	18.00	13.50	1.00	3.50
2022	36.00	15.00	21.00	16.00	1.00	4.00

[1]EISA states that the applicable volumes of biomass-based diesel after 2012 shall not be less than the mandated amounts for 2012 (Sec. 202).

[2]GHG reductions are against baseline values for conventional gasoline or diesel fuel, depending on the biofuel in question.

Sources: EISA (2007) and US EPA (2008)

3.1.2 Tax credits and exemptions

Enacted in 2004, the federal Volumetric Ethanol Excise Tax Credit (VEETC) is the current formulation of the excise tax exemption first granted to the ethanol industry 30 years ago. It has historically been the single largest subsidy to ethanol, currently providing a tax credit of 51 cents per gallon of ethanol blended into motor fuel. Under the 2008 Farm Bill, this rate drops to 45 cpg once domestic biofuel consumption reaches 7.5 bgy, expected to occur in 2009. A comparable policy for methyl-ester based biodiesel (the Volumetric Biodiesel Excise Tax Credit, or VBETC) historically awarded a $1/gallon blenders credit for production using agricultural feedstocks and animal fats, though only half this amount for recycled oils. Rates for recycled oils were equalised in the Emergency Economic Stabilisation Act of 2008. These excise tax credits are awarded without limit, and regardless of the price of gasoline, to every gallon of ethanol and biodiesel – domestic or imported – blended in the marketplace. While the rules for the renewable fuel mandate try to implement some form of environmental screen, no such constraint yet applies to the tax credits.

Moreover, there remains evidence that the excise tax credit is not subject to corporate income tax as would be a production tax credit, increasing its net value to the recipient (Koplow, 2007). This incremental value boosts the value of VEETC from 45 cpg to roughly 64 cpg and of VBETC from $1.00 to more than $1.40/gallon. The subsidy estimates reflect this higher value, as it is likely that, absence of clear guidance from the Internal Revenue Service, most firms would take this filing position.

A parallel set of production tax credits exists for 'renewable diesel', production processes such as thermal depolymerisation (co-processed with petroleum at oil refineries) that are not eligible for the VBETC. The credit of $1/gallon applies to all feedstocks, with the exception of fuels co-processed with non-biomass feedstocks. This latter exclusion is aimed at efforts to co-process animal fats at petroleum refineries. These processes receive a less lucrative 50 cpg Alternative Fuels Tax Credit.

A new production tax credit specifically for cellulosic ethanol was enacted in the 2008 Farm Bill, though is currently scheduled to expire at the end of 2012. The rate is $1.01 per gallon, though credits obtained via the VEETC (and possibly the Small Producer Tax Credit – see below) must be subtracted first. Unlike the blender's tax credits, the new producer tax credit can be earned only on US-based production that is sold within the USA. This policy structure will further disadvantage imports. All of the production tax credits are includible in taxable income, and are therefore less valuable than the excise tax credits.

Many states provide reductions or exemptions to ethanol from motor-fuel excise or sales taxes. The largest subsidies from these programmes appear to be in Hawaii, Illinois, Indiana and Iowa. With ethanol blends of 10% or less widely used in the country, reduced fuel taxes on E10 are becoming increasingly uncommon. Many states still provide reduced rates for E85, however, and these can be fairly large per gallon. Specific state-level excise tax exemptions for cellulosic ethanol (e.g., in Massachusetts) are also beginning to show up, and are also at higher exemption rates than for lower blends.

Of the states providing relief from motor-fuel taxes to biofuels, the average exemption for E85 was 11.5 cents per gallon; the median exemption was 7 cents per gallon (Koplow, 2007). The largest revenue losses tend to come from states that exempt particular fuel blends from *sales* taxes on fuels. The standard reporting of fuel tax rates provides greater clarity on deviations in excise tax rates than for fuel sales taxes. This may be one explanation for the political preference to subsidise via the sales tax. State motor-fuel tax preferences, along with state-level mandates, seem to exert a big influence on where US-produced biofuel ends up being sold.

3.2 Payments based on current output

Programmes offering a pre-specified payment or tax credits for each unit (usually gallon) of output a plant produces exist at both the federal level and within many states. Supplier refunds also exist in a number of places, and operate in a similar manner.

Small producer tax credit. Introduced in 1990, ethanol and biodiesel plants that produce less than 60 mgpy can claim a 10-cents-per-gallon income-tax credit on the first 15 million gallons they produce (a maximum of $1.5 million per plant). Plant sizes are now rising above the cut-off for this subsidy, especially in the ethanol sector. Without an increase in the cut-off limit (Congress doubled the prior cap in 2005), subsidies to the corn ethanol and biodiesel sectors are more likely to level off. Cellulosic producers are allowed to claim the small producer tax credit on full production levels up to 60 mmgy, and there is conflicting information on whether this credit must be netted from the larger $1.01 cellulosic PTC enacted in the 2008 Farm Bill, or is in addition to it (RFA, 2008b).[2] The Renewable Fuels Association takes a strong position that the PTC is above the small producer tax credit. However, the subsidy estimates in this paper adopt a conservative approach and net the small producer tax credit form the incremental subsidy provided by the cellulosic PTC.

USDA bioenergy programme. Output-linked grants paid an additional bounty per gallon of ethanol or biodiesel produced through 2006. Higher bounties were paid for new production. The 2008 Farm Bill reintroduced a form of this initiative, funded at $300 m over the next five years. The Bioenergy Programme for Advanced Biofuels will support any process other than biofuel from corn starch, and aims to target mostly smaller facilities.

State production payments or tax credits for producers. Some of the programmes require eligible plants to pre-qualify with the government before they can claim a credit. Some cap the total payouts (or allowable tax credits) per year to all plants. This means that the early plants may absorb the entire available funds, or that the actual per-gallon subsidy received is well below the rate nominally noted in the statute.

3.3 Subsidies to factors of production

Value-adding factors in biofuel production include labour, capital, land and other natural resources; each is addressed in turn.

3.3.1 Support for labour used in manufacturing biofuels

Although some states have offered reductions in labour taxes paid by workers in the biofuel industry, the magnitude of these subsidies has been fairly low. In contrast, the Domestic Activities Deduction, authorised in the 2004 American Jobs Creation Act, is much higher. The provision allows extra deductions from taxable income for the funds spent to make things in the USA: 3% of net income earned on domestic activities through 2006, rising to 9% by 2009. Deductions are capped at 50% of wages paid (Patrick, 2006, p.5). Under the definition of the rule, crop production, as well as the biofuel production plants themselves, counts as manufacturing. While the provision is available to all sectors, it clearly favours domestic fuel production over imports and industries with higher net income – even if a key driver of that net income is other government subsidies. Subsidies to ethanol producers are estimated at $40–60 million per year; with less than $5 million/year in benefits to biodiesel producers owing to a smaller production base and lower profitability (Koplow, 2007, p. 25).

3.3.2 Support for capital used in manufacturing biofuels

Scores of incentive programmes have been targeted at reducing the capital cost of biofuel plants. Many of these are specific to biofuels, though others are open to a broader variety of alternative fuels. Government subsidies are often directed to encourage capital formation in a specific portion of the supply chain.

3.3.2.1 Generic subsidies to capital

Biofuel production facilities have been frequent recipients of generic subsidies to capital formation at the federal, state and local levels. These programmes matter for a few reasons. First, although other sectors can also access funding, biofuels have been frequent recipients. The ethanol sector captured more than 60% of the Iowa Economic Development Tax Credits in the first part of 2007, for example (Gearino, 2007). Second, capital subsidies reduce the incentive to substitute away from capital-intensive energy production methods, undermining capital-efficient generation technologies and conservation or demand management approaches. Finally, 'generic' subsidies often have statutory language that is not so generic, but rather provides targeted benefits to specific industry sectors.

Capital depreciation is a good example. Depreciation governs the process by which investments into long-lived equipment can be deducted from taxable income, with a goal of matching asset service life to the income stream the asset generates. However, because more rapid depreciation shelters income from taxation, it generates higher returns to beneficiaries. As a result, Congress often tinkers with depreciation schedules to direct subsidies to favoured groups. Biofuels production equipment has been grouped as a waste reduction and resource recovery plant (Class 49.5) under the Modified Accelerated Cost Recovery System (MACRS) (Laser, 2006).[3] This grouping includes "assets used in the conversion of refuse or other solid waste or biomass to heat or to a solid, liquid, or gaseous fuel", and allows full deduction of plant equipment in only seven years. An additional benefit comes in the form of the highly accelerated 200% declining balance method that can be used for Class 49.5, and that further front-loads deductions into the first years of plant operation. Since 2006, even more advantageous provisions have been available for cellulosic production facilities relying on enzymatic processes: 50% of the investment can be written off in a single year (Yacobucci, 2007).

3.3.2.2 Subsidies for specific production-related capital

Capital grants. Subsidies to biofuel-specific capital are also common in many states. The capital grants support a range of end uses including production facilities, refuelling or blending infrastructure, or the purchase of more expensive alternative fuelled vehicles. Partial government funding of demonstration projects in the ethanol sector is common and growing. The Energy Policy Act of 2005, for example, provided earmarked funds for a number of large biofuel-demonstration projects. EISA authorises $500m in grants (sec. 207) for advanced biofuels resulting in an 80% reduction in GHG. Sections 9003 and 9004 of the 2008 Farm Bill provide hundreds of millions more for facilities to manufacture biofuels other than from corn starch; or to retrofit the existing facilities to reduce their GHG impacts (Capehart et al., 2008).

Credit subsidies. Loans, guarantees and access to tax-exempt debt are common methods to subsidise the development of ethanol production and infrastructure as well. Title XVII of EPACT, for example, will guarantee all of the project debt to build selected new plants, up to 80% of the total project cost. Biofuels are included in a June 2008 solicitation round by the US DOE for $10 billion in guarantee authority for renewable technologies. Programme structures such as this leave little investment risk borne by investors and an increased likelihood of both poor project selection and government losses. Many of the ethanol loan guarantees issued in the 1980s defaulted. The ethanol industry has also been able to tap into tax-exempt special purpose solid waste bonds by having a portion of its production plant characterised as solid waste treatment by the IRS, cutting borrowing costs by more than $100 million per year (Koplow, 2007).

Use of state-level credit capacity is also common. Delaware's Green Energy Fund, for example, provides direct credit subsidies that are open to ethanol production facilities. Others apply their limited allowances to issue tax-exempt bonds to ethanol projects. Hawaii has authorised $50 million of tax-exempt bonds to fund a bagasse-fed ethanol plant, for example. Nebraska has authorised public power districts to build ethanol plants and to use tax-exempt municipal bonds to finance their construction (Dostal, 2006).[4] New Jersey is another example, having approved $84 million in tax-exempt financing for a privately owned ethanol plant.

Tax exemptions for biofuels-related equipment. Montana exempts all equipment and tools used to produce ethanol from grain from property taxes for a period of 10 years. In Oregon, ethanol plants pay a reduced rate (50% of statute) on the assessed value of their plant for a period of five years (Koplow, 2006). These policies reduce the private cost to build a biofuels facility, and are usually not dependent on production levels.

3.3.2.3 Regulatory exemptions for biofuel production facilities

Although biofuels have been sold as a way to 'green' the transport fleet, a number of regulatory exemptions suggest otherwise. Minnesota exempts ethanol plants (though not biodiesel) with a production capacity of less than 125 mmgy from conducting an environmental impact assessment so long as the plant will be located outside of the seven-county metropolitan area.[5] In April 2007, the EPA reclassified ethanol fuel plants from their former grouping as 'chemical process plants' into a less-regulated grouping in which firms producing ethanol for human consumption had been operating, even though the majority of ethanol produced in the USA is for fuel. The Agency characterised the change as one of providing 'equal treatment' for all corn-milling facilities (US EPA, 2007a). However, the change also increased the allowable air emissions from fuel ethanol facilities substantially – from 100 tons per year to 250 tons. In addition, fugitive emissions (i.e., not from the plant stack) no longer have to be tallied in the emissions total. Finally, the plants have less stringent air permitting requirements in that they no longer have to install the Best Available Control Technology (BACT). These types of changes tend to decrease the capital cost of building production facilities, disadvantaging alternative transport options.

3.3.3 Policies affecting the cost of intermediate inputs

3.3.3.1 Subsidies to biofuel feedstocks

Conventional crop support programmes. Government policies in the USA support the use of key biofuel feedstocks indirectly, through farm subsidies. Corn has historically been one of the largest beneficiaries of these policies, garnering nearly $42 billion between 1995 and 2005 from 12 federal programmes,[6] according to the Environmental Working Group (EWG) (2005), which tracks farm subsidy payments. Payments reached over $9.4 billion per year in 2005 (Campbell, 2006). In 2006, corn did not qualify for first instalments on counter-cyclical payments because the effective prices for corn exceeded its respective target price (USDA, 2006). Nonetheless, corn growers continued to receive substantial fixed annual payments on their harvest: the pro-rated share to ethanol was still nearly $500 million. The fuel-related share of subsidies to sorghum was about $15 million, and for soy about $20 million (Koplow, 2007).[7]

The downward trajectory in counter-cyclical payments to crops used for fuels has been somewhat offset by the rising share of production slated for energy markets in terms of absolute dollars of support. FAPRI projections for the 2011–2017 time frame, including the EISA mandates, estimate an average of 35% of the total corn crop will be used for ethanol and 31% of the soyoil production for biodiesel (Westhoff et al., 2008, p.35).

Average Crop Revenue Election option. Crop subsidies per gallon of biofuel produced, however, have been trending downwards, as payments per unit of feedstock produced have declined. A new programme, the Average Crop Revenue Election (ACRE), may reverse this. ACRE is an optional replacement for traditional commodity programmes, open to a variety of commodities including most of those important to fuel markets: soy, corn, sorghum, other oilseeds, plus others. Farmers must enrol all crops, giving up 20% of their direct payments and all counter-cyclical payments, for the period of 2009–2012. Marketing loans are also reduced by 30%. In return, farmers get payments if *state-wide* production yields or price are below the 5 prior year rolling average. ACRE payments are likely to be largest when the rolling average builds to a high level, followed by significantly falling prices (Babcock and Hart, 2008, p.5).

Modelling by the University of Iowa indicated that in nearly all circumstances payments under ACRE would be higher (sometimes significantly so) than under the programmes they replace (Babcock and Hart, 2008, p.5). FAPRI estimates (Westhoff and Brown, 2008, pp.9, 11) mirror these results, projecting significant gains in average payments per year for corn ($436m), soybeans ($610m), wheat ($90m), sorghum, barley, oats ($24m) and sunflower growers. The pro-rated share of subsidies flowing to biofuels would also be significant: another roughly $150m/year for corn ethanol. Because the researchers expected "most producers in states where those are the dominant crops to participate in the programme", and fuel production is concentrated in those states as well, the uptake of the subsidies by the fuel sector could be even larger.

Biomass Crop Assistance Programme (BCAP). Passed via the 2008 Farm bill, BCAP provides the first direct subsidies to cellulosic feedstock producers. While specific funding amounts were not stipulated, the funding is mandatory with no cap. BCAP payments include up to 75% of the cost of establishing an eligible crop in the programme, then dollar-for-dollar matching grants for what a cellulosic refiner would pay, up to $45 per dry ton. The amount would cover feedstock collection, harvest, storage, and transportation to a biomass conversion facility, but payments could be for no more than two years (USDA, 2008).

Nonetheless, meeting a 16 billion gallon per year mandate level in 2022 would require 245 million tons of dry cellulosic biomass using 2007 yield information; or roughly 180 million tons based on projected yield improvements over the next ten years (Hart, 2008a). The $45/dry ton in matching costs would not even cover half the delivered feedstock cost based on 2007 technology; the subsidy could perhaps drop to $30 per dry ton in the future as technology improves. Using Hart's data as inputs on crop cost, and assuming two years of subsidies per acre, result in a maximum subsidy of $11–22 billion over the period of the mandate compliance, or an average of roughly $800m–$1.7b per year over the mandate period (Earth Track calculations).

Crops already receiving farm support payments are not eligible, which in theory might preclude corn stover from tapping into this source of subsidy since corn is so heavily subsidised. However, given the amount of money at stake, and the biofuel industry's past successes – for example, getting a portion of the ethanol production facility classified as waste treatment – there would more likely be an effort to define stover as a distinct crop from corn. This indeed seems to be what is happening. John Moore of the Environmental Law and Policy Center (ELPC) expects the first applications for BCAP subsidies to come from facilities targeting corn stover and other crop residues (Schill, 2008b). ELPC believes USDA will treat stover as eligible for the collection, storage and transport costs, but not for crop establishment subsidies since the corn crops are already well established. They indicate that including stover as an eligible crop was the Congressional intent of the legislation (Johannsen, 2008).

3.3.3.2 Regulatory exemptions for biofuel feedstock production

US corn production remains chemical-intensive. Moreover, both corn and soybeans, like all row crops, typically experience higher rates of erosion than crops such as wheat. Corn production is often water-intensive as well, a problem that is being exacerbated by current trends in corn-based ethanol plants. These are expanding westward, into areas more dependent on irrigation than corn produced in the Central Midwest. Some of that expansion is into counties served by the heavily over-pumped (USGS, 2003) Ogallala Aquifer. In addition to corn production, the ethanol plants themselves also require significant volumes of water (Zeman, 2006; National Research Council, 2007).

Regulatory exemptions for feedstock production play an important role in the distribution and severity of these impacts. Whereas industrial production is normally regulated for pollution and subject to legal challenge when emissions damage surrounding resources or populations, agriculture – even large farms – are not treated similarly. Farmers are cajoled to cut nutrient loadings to waterways or curb soil erosion through outreach, voluntary programmes, special payments, or sometimes by requiring better management to access crop subsidy programmes. These approaches do not always work well, and lax standards can be one factor that contributes to artificially low commodity prices. For example, the EWG estimates that 24 pounds of soil is lost per gallon of ethanol produced (Schill, 2008a). Nutrient run-off is another example: corn plants absorb only 50–60% of the nitrogen applied, resulting in 20–40 pounds of nitrogen per corn acre released in run-off and into groundwater. This is a significant factor in growing seasonal dead zones in the Gulf of Mexico, triggered by oxygen depletion from fertilisers entering the receiving water. Although access to some farm programmes does require the application of soil conservation programmes, EWG argues that much more would be appropriate. They recommend tying eligibility for crop insurance to soil conservation, and to require nutrient management plans and buffer zones (Schill, 2008a).

3.4 Support for R&D on the production side

Federal spending on biofuels R&D hovered between $50 and $100 million per year between 1978 and 1998 (Gielecki et al., 2001). The US Office of Technology Assessment reported that direct research on ethanol within the DOE was less than $15 million per year between 1978 and 1980 (OTA, 1979). It is notable that the federal government started the Bioenergy Feedstock Development Programme at Oak Ridge National

Laboratory nearly 30 years ago to focus on new crops and cropping systems for energy production (Schnepf, 2007). The programme continues to operate in a similar form today.[8] Ethanol-related R&D is estimated to reach $400 million per year annually by 2009 (Koplow, 2007), mainly related to cellulosic ethanol. Subsequent additions in EISA and the 2008 Farm Bill (Capehart et al., 2008) will provide still larger support levels.

3.5 Subsidies related to consumption

Numerous federal and state subsidies support investment in infrastructure used to transport, store, distribute and dispense ethanol. A separate set of policies underwrites the purchase or conversion of vehicles capable of using alternative fuels.

3.5.1 Subsidies to capital related to fuel distribution and disbursement

Getting ethanol from the refinery to the fuel pump requires considerable infrastructure, separate from that used to distribute gasoline. Pure ethanol attracts moisture, which means that it cannot be transported through pipelines built to carry only petroleum products. High ethanol blends, like E85, also have to be segregated and stored in corrosion-resistant tanks, and pumped through equipment with appropriate seals and gaskets. All such investment is expensive.

Under EPACT, a refuelling station can obtain a tax credit that covers 30% of eligible costs of depreciable property (i.e., excluding land) for installing tanks and equipment for E85. This is capped at $30,000 per taxable year per location, and is estimated to cost the US Treasury $15–30 million per year. At least 15 states also provide assistance to establish new E85 or biodiesel distribution or refuelling infrastructure.

The industry has been reliant on more expensive rail and truck shipments, resulting in transportation costs in the order of 13–18 cents per gallon vs. only 3–5 cents per gallon for gasoline (Collins, 2008, based on GAO, 2007). Not surprisingly, the industry has been lobbying (thus far without success) for federal guarantees on a multi-billion dollar ethanol pipeline from the Midwest to the East Coast (Linden and Thurner, 2007, p.7).

3.5.2 Support for vehicles capable of running on ethanol

Both federal and state programmes subsidise the consumption side of the biofuels market. The Alternative Motor Fuels Act of 1988 allowed vehicles *capable* of burning alternative fuels (which included E85) a credit against CAFE standards. Because so few vehicles *actually* burned alternative fuels, the rule has been estimated to increase domestic oil demand by 80,000 barrels per day (MacKenzie et al., 2005). The EISA of 2007 extended these credits, though at declining rates, through model year 2019.

EISA also extended the credits to biodiesel. Once again, vehicles *capable* of operating on 20% biodiesel blends (B20) are eligible to earn credits regardless of what fuel they actually use. According to the US Congressional Research Service, this change

> "could make all diesel passenger cars and light trucks eligible for credits under CAFE. Currently, some diesel passenger vehicles are warrantied to run on B5, but few technical barriers exist to make new diesel vehicles B20-capable." (Capehart et al., 2008, p.4)

The impact of this new exemption on the actual efficiency of the US fleet is not known. Another provision in EISA provides unlimited reductions in CAFE mandates in return for producing vehicles with small electric motors; this is more likely to result in higher petroleum imports as well (Morris, 2008).

4 Subsidy magnitude and intensity

Koplow (2007) has the most recent detailed estimates of total subsidies to biofuels in the USA. These include estimates of the total value of the support that government programmes generate for the biofuels sector, as well as a number of metrics evaluating the subsidy per unit of energy produced and per unit of GHG emissions avoided. Just as there is no single measure of corporate performance that fully explains the health of a company, a mix of assessments on subsidies provides richer insights into the efficacy of the policy choices being made.

Subsidy policy remains fluid, and there have been many changes in government support programmes to biofuels since Koplow (2007). Although it was beyond the scope of this paper to fully update subsidy values to reflect all of these changes, the main policy changes have been described and quantified where possible.

4.1 Subsidy magnitude prior to EISA and subsequent policy trends

Exhibit 2 summarises the subsidies to biofuels in Koplow (2007) and describes the policy trends since that time. Subsidies to ethanol grew by nearly 60% between 2006 and 2008, reaching an estimated $9.2–$11.1 billion. Subsidy growth rates for biodiesel were nearly 200% during the same period, albeit from a much smaller base, reaching an estimated $1.5–$1.9 billion in 2008. In both cases, subsidy growth was largely due to volume-linked subsidies such as the excise tax credits and MPS associated with tariffs and mandates.

A number of policy changes bear watching, as they are more likely to drive subsidy levels much higher in coming years. A generous new production tax credit for domestic cellulosic production, plus expanded eligibility for the existing small producer tax credit, will add at least 46 cpg in incremental tax credits per gallon produced.[9] While the eligibility window for this provision is less than five years, history suggests that it will be extended well after the first cellulosic facilities come on line. Assuming the 2022 cellulosic mandates of 16 bgy are met mostly with domestic production, these new subsidies alone will provide more than $7 billion per year in subsidies to the sector by the end of the mandate period.

Baseline excise tax credits will also continue to rise with production levels, with anticipated growth in ethanol production more than offsetting the 12% reduction in credits per gallon that were implemented in the 2008 Farm Bill. Federal credit subsidies are also expected to rise dramatically over historic levels, primarily due to the multi-billion dollar loan guarantee authority under Title XVII of the Energy Policy Act of 2005. Awards have not yet been announced and information on credit subsidy rates and assumptions not yet available. However, liquid biofuels are expected to be significant recipients of federal support.

The largest subsidy growth is anticipated to come through the MPS associated with the much higher renewable fuel mandates and associated sub-mandates introduced by EISA. These are discussed in more detail in Section 4.5.

Exhibit 2 Estimated total support for ethanol and biodiesel

	Ethanol				*Biodiesel*			
	2006	*2007*	*2008*	*Trends beyond 2008*	*2006*	*2007*	*2008*	*Trends beyond 2008*
Market price support	1393	1694	2276	++Sharply rising cost associated with higher sub-mandates for cellulosic, non-corn ethanol; doubling of ethanol targets. Tariff extended again; drawbacks reduced	–	–	–	++Biodiesel sub-mandates introduced in 2008 with an estimated incremental value of more almost $1.20/gallon
Output-linked support[1]								
Volumetric excise tax credit (low)	2809	3377	4384	++Continued rise with consumption levels, though per gallon reduction from 51 cpg to 45 cpg in 2008 Farm Bill. Credit claims on denaturant limited to 2% of volume, down from 5%. No GHG or environmental screens for eligibility	276	811	826	++Will rise along with biodiesel mandate. Sector not expected to grow much beyond the mandated production levels. Some increases from higher subsidy rates for recycled oils enacted in late 2008
Volumetric excise tax credit (high)	4013	4824	6262	~Conflicting information remains on whether VEETC benefits must be added into taxable income or not	395	1159	1180	~Conflicting information remains on whether VETBC benefits must be added into taxable income or not
Production tax credit	NA	NA	NA	++2008 Farm Bill introduced new production tax credit at $1.01/gallon (other subsidies to blenders or producers must be netted first). Only eligible for domestic production sold in the USA	–	–	175	~Production tax credit for renewable diesel remains in effect. Rates on recycled oils boosted to $1/gallon in late 2008, but co-processing with non-biofuels gets only 50 cpg
USDA bioenergy program	75	Ended in ‘06	–	+Restarted by 2008 Farm Bill (Sec. 9005) with $55m in mandatory funding/year, rising to $105m/year by 2012. Limited to ‘Advanced Biofuels’	20	Ended in ‘06	–	+Biodiesel is eligible as well
Reductions in state motor fuel taxes	394	414	435	~Continued shift to higher ethanol blends, though at much higher incentives per gallon. If E85 consumption grows, subsidy values could rise sharply. States beginning to have higher rates on cellulosic as well	92	97	101	~B20 blends often included under preferential state fuel tax rates. As with ethanol, size of subsidy will depend on whether higher biodiesel blends enter the marketplace

Exhibit 2 Estimated total support for ethanol and biodiesel (continued)

	Ethanol				*Biodiesel*			
	2006	*2007*	*2008*	*Trends beyond 2008*	*2006*	*2007*	*2008*	*Trends beyond 2008*
State production, blender, retailer incentives	121	NQ	NQ	~Current trends have not been quantified	34	NQ	NQ	~Current trends have not been quantified
Federal small producer tax credit	107	149	174	~Will level off if plant size restrictions (60 mmgy) remain. Cellulosic plants can claim credit on all 60 mmgy, vs. only 15 mmgy for corn ethanol	30	168	191	~Will level as fewer new plants expected
Factors of production – capital								
Excess of accelerated over cost depreciation	168	220	680	+General growth with productive capacity; 50% expensing of certain cellulosic equipment through end of 2012 may drive numbers up further	23	44	159	+Will rise along with productive capacity
Federal grants, demonstration projects, R&D[2]	109	286	354	+New additional funding for biorefineries, up to 30% of total cost under Section 9003 of Farm Bill. $75m in mandatory funding in 2009, rising to $245m in 2010	28	36	51	+Biodiesel will also benefit from higher R&D expenditures
Credit subsidies	110	110	110	++Expected to sharply rise with DOE multi-billion dollar advanced energy loan program under Title XVII of EPACT 2005. Additional benefits from classifying part of ethanol production as a solid waste facility to access tax exempt bonds remains	NQ	NQ	NQ	++Biodiesel can also participate in DOE loans, though poorer fundamentals suggest its take will be lower than cellulosic ethanol
Deferral of gain on sale of farm refineries to coops	10	20	20	~No change	–	–	–	~No change
Feedstock Production (biofuels fraction)	506	639	744	+Average Crop Revenue Election (ACRE) program expected to boost payouts to corn and sorghum	15	22	23	+ACRE program under the 2008 Farm Bill expected to boost payments to soy farmers
				++Biomass Crop Assistance Program (Section 9011 of the Farm Bill) underwrites cost of collecting, harvesting, storing, transporting biomass. Funding not stipulated, but Earth Track calculates supporting all acres needed to meet the cellulosic mandate for the allowable two years would average $825m to $1.7b per year during the 2010-22 cellulosic mandate period				+Biodiesel also eligible for Biomass Crop Assistance Program, though funds are more likely to support cellulosic crop production over oil seeds

Exhibit 2 Estimated total support for ethanol and biodiesel (continued)

	Ethanol				*Biodiesel*			
	2006	*2007*	*2008*	*Trends beyond 2008*	*2006*	*2007*	*2008*	*Trends beyond 2008*
Consumption								
Credits for clean fuel refuelling infrastructure	14	29	18	+Tax credits remain; industry pressuring (thus far without success) for ethanol pipeline subsidies ~Efforts to get federal guarantees for ethanol pipelines have thus far been stalled	8	18	11	~Not anticipated to grow so large as transport issues less challenging than with ethanol
State vehicle purchase incentives	NQ	NQ	NQ		NQ	NQ	NQ	
AFV CAFE loophole	NQ	NQ	NQ	+Existing loophole remains through 2019. Expanded via B20 eligibility and even more generous credit offset for electric vehicles	NQ	NQ	NQ	+EISA expands CAFE credits loophole to B20-capable engines, which may be most diesel engine technologies now being sold
Total[3]								
Low estimate	5817	6939	9195		527	1195	1537	
High estimate	7021	8386	11,073		645	1543	1890	

[1]Primary difference between high and low estimates is inclusion of outlay equivalent value for the volumetric excise tax credits. A gap in statutory language allows the credits to be excluded from taxable income, greatly increasing their value to recipients.

[2]Values shown reflect half of authorised spending levels where funds have not been appropriated. This reflects the reality that not all authorised spending is actually disbursed.

[3]Total values reflect gross outlays; they have not been converted to net present values. This follows the general costing approach used by the Joint Committee on Taxation.

[4]NQ: Subsidies exist that were not quantified; NA: Subsidy not applicable to the fuel in question. Items marked with a dash are estimated to be zero subsidy, often due to programme discontinuation. Symbols preceding trend information are: large expected increase (++), increase (+), constant or unknown (~), and decline (–).

Sources: Koplow (2007), Capehart et al. (2008) and Earth Track estimates

4.2 *Subsidy per unit energy output*

Large absolute subsidies distributed across a very large recipient base may trigger only relatively small impacts on market structure. In contrast, smaller subsidies that are much more narrowly disbursed can be highly distortionary. Subsidy intensity metrics provide insights into this issue, normalising subsidies for the size of particular energy markets, and for differential heat rates of similar volumetric units (e.g., gallons). Data on subsidy levels relative to the market value of ethanol and biodiesel are also provided.

Exhibit 3 demonstrates that subsidy intensity levels remain very high for liquid biofuels, but that they fluctuate far less over time than do total support measures. This outcome is an artefact of how reliant the industry is on subsidies that scale linearly without limit with production or consumption levels.

Subsidies averaged close to $1.50 per gallon ethanol during the period of analysis, and $2 per gallon for biodiesel. Even when normalised biodiesel's higher heat rate, support levels for biodiesel ($15–$18 per MMBtu) remained substantially higher than the $12–$15/MMBtu received by ethanol. In both sectors, subsidies averaged 50% or more of the retail price during the period.

Exhibit 3 Subsidy intensity values for ethanol and biodiesel, pre-EISA

	Ethanol				*Biodiesel*			
	2006	*2007*	*2008*	*Average 2006–2012*	*2006*	*2007*	*2008*	*Average 2006–2012*
Subsidy per gallon of renewable fuel (*E100 or B100*)								
Low estimate	1.05	1.05	1.05	1.00	2.10	1.65	1.70	1.80
High estimate	1.25	1.25	1.30	1.25	2.60	2.10	2.05	2.15
Subsidy per GGE/GDE of fuel[1]								
Low estimate	1.45	1.40	1.45	1.40	2.30	1.80	1.85	2.00
High estimate	1.75	1.70	1.75	1.70	2.80	2.30	2.25	2.35
Subsidy per MMBtu								
Low estimate	12.55	12.45	12.70	12.15	17.80	13.80	14.20	15.25
High estimate	15.15	15.05	15.30	14.75	21.80	17.85	17.45	18.30
Subsidy per GJ								
Low estimate	11.90	11.80	12.05	11.50	16.85	13.10	13.45	14.45
High estimate	14.35	14.25	14.50	13.95	20.65	16.90	16.55	17.35
Subsidy as share of retail price[2]								
Estimated retail price ($/gallon of biofuel)	2.70	2.25	1.95	2.05	3.05	3.00	2.85	2.85
Subsidy/market price – low estimate	39%	46%	55%	50%	69%	54%	59%	63%
Subsidy/market price – high estimate	47%	56%	66%	66%	84%	70%	73%	75%

[1]GGE and GDE values adjust the differential heat rates in biofuels so they are comparable with a gallon of pure gasoline or diesel. This provides a normalised way to compare the subsidy values with the retail prices of gasoline and diesel.

[2]Retail price projections are for E100 and B100. They are taken from FAPRI (August 2007) for 2006–2012 and FAPRI (February 2007) for 2013–2016.

Source: Koplow (2007)

4.3 Subsidy per unit Greenhouse Gas displaced

A key selling point of biofuels is their supposedly low carbon impact. There is a great deal of disagreement on how much GHG reduction can actually be achieved via the ethanol and biodiesel fuel cycles (e.g., Searchinger et al., 2008). This disagreement is reflected in Exhibit 4, where the low- and high-end displacement values differ not only in magnitude but also in sign. However, even when taking the most favourable estimates of GHG displacement from biofuels, the cost of the reductions via biofuels is expensive.

In these best-case scenarios, biodiesel subsidies amount to more than $200 per mt CO_2e displaced, and corn ethanol more than $300. In comparison, the current market value of these offsets is roughly $4 in the USA and $30 on the European Climate Exchange. Even assuming all the existing output were cellulosic ethanol, with its more favourable GHG profile, and that this output could be had at no higher subsidies than what is now given to corn ethanol, subsidies would still exceed $100 per mt CO_2e avoided. Whereas these values may seem large, they are actually significantly lower than the rates estimated for the EU, Canada and Australia, where subsidies higher than $1000 per mt CO_2e avoided were not uncommon (Steenblik, 2007; Koplow and Steenblik, 2008).

Exhibit 4 Subsidy cost per unit of CO_2 equivalent displaced, pre-EISA

	Ethanol				*Biodiesel*			
	2006	*2007*	*2008*	*Average 2006–2012*	*2006*	*2007*	*2008*	*Average 2006–2012*
Subsidy cost ($) per metric tonne CO_2 equivalent displaced								
Low estimate	305	300	310	295	280	215	220	240
High estimate[1]	–600	–595	–605	–585	–860	–705	–690	–720
Cellulosic hypothetical case – low	115	110	115	110	NA	NA	NA	NA
Cellulosic hypothetical case – high	200	200	205	195	NA	NA	NA	NA
GHG displacement factors								
Displacement factor – worst 1,2	–24%	–24%	–24%	–24%	–33%	–33%	–33%	–33%
Displacement factor – best	39%	39%	39%	39%	68%	68%	68%	68%
Displacement factor – cellulosic worst	77%	77%	77%	77%	NA	NA	NA	NA
Displacement factor – cellulosic best[3]	114%	114%	114%	114%	NA	NA	NA	NA
Number of tonnes of carbon offsets subsidies could purchase								
European Climate Exchange[4]	12–24	11–22	11–23	11–21	11–35	8–26	8–26	9–27
ECX – cellulosic	5–8	4–7	4–8	4–7	–	–	–	–
Chicago Climate Exchange[4]	130–256	80–157	81–160	89–176	119–368	57–185	59–182	74–226
CCX – cellulosic	48–86	29–53	30–54	33–59	NA	NA	NA	NA

Exhibit 4 Subsidy cost per unit of CO_2 equivalent displaced, pre-EISA (continued)

	Ethanol				*Biodiesel*			
	2006	*2007*	*2008*	*Average 2006–2012*	*2006*	*2007*	*2008*	*Average 2006–2012*
Cost of CO_2-equivalent futures contracts[5]								
ECX – Average prices paid for settlements during year noted	24.9	26.7	26.9	27.3	24.9	26.7	26.9	27.3
CCX – Historical average prices paid for settlements during year	2.3	3.8	3.8	3.6	2.3	3.8	3.8	3.6

[1]Negative values occur when the specific life cycle modelling scenarios estimate that GHG emissions from the biofuels production chain exceed those of the conventional gasoline or diesel they are replacing. This is fairly common with models that more centrally integrate the land-use change impacts of the biofuels production system.

[2]Displacement factors represent the high and low values in the range from a variety of studies: Farrell et al. (2006), Farrell and Sperling (2007), Hill et al. (2006), US EPA (2007b), Wang et al. (2007) and Zah et al. (2007). The most favourable values included generally represent specific technologies rather than the average expected performance of either the current or future batch of plants.

[3]Values above 100% denote net sequestration benefits from the biofuel scenario (in this case, closed-loop poplar farming). It is not clear that the same high level of displacement would be maintained once the production base scaled up to meet the needs of the transportation sector.

[4]Although the subsidies pay for increased GHG emissions in the ethanol and biodiesel examples, subsidy reform would still free up public money that could be used to purchase low-cost carbon offsets on the exchanges. The number of offsets is shown here.

[5]CO_2 futures contract data from European and Chicago exchanges, compiled as of October 2007. Prices represent historical averages of daily transactional data for contracts in the year in question. Markets are not interchangeable; higher prices in Europe reflect tighter constraints.

Source: Koplow (2007)

When this simplified example is adjusted to account for more realistic scenarios, the cost efficiency of biofuels subsidies continues to erode. In reality, cellulosic fuels cannot be brought to market for the same subsidy level as corn; rather, support levels are growing and will be substantially higher per gallon (as shown in Exhibit 6). Furthermore, more detailed life cycle modelling of GHG impacts, including nitrous oxide cycles and land-use change, are far more likely to reduce the most favourable displacement values used in Exhibit 4 than to improve them. And finally, the societal opportunity cost of deploying biofuels rather than some other mechanism for wringing carbon out of our economy is not measured by the subsidy cost alone, but by the total cost of investing in biofuel – including both the public subsidy and the residual private investment. A full accounting would more likely include the costs shifted to other economic sectors (e.g., food) as well to evaluate the full financial cost of GHG reductions from ramping up biofuels.

4.4 Anticipated subsidy growth under higher mandates and production tax credits

Over the past year, much higher mandates have been enacted along with generous new tax credits for cellulosic production. It is useful to estimate the financial impact of at least the largest of the existing and the new subsidy programmes to get a rough approximation of subsidy trends in the new policy environment.

As noted in the discussion of MPS, subsidy policies often interact. For example, purchase mandates set the minimum quantity of a particular fuel that must be bought in the US market, no matter the required price premium. However, when these same gallons also receive excise tax credits (through the VEETC, or the newer production tax credit for cellulosic ethanol), part of the cost to bring the more expensive fuel to market will be paid not by consumers (via higher prices at the pump), but by taxpayers through the tax credit. If the tax credit is high enough to supply the entire mandated quantity, the mandate is classified as 'non-binding' in that it is not causing further distortions in production and pricing decisions.

4.4.1 Mandates can cause problems even when not binding

Despite this econometric definition of when mandates distort behaviour, the mandates always have the potential to distort market decisions and create competitive impediments to other approaches.

First, the tax and mandate policies work in tandem to distort the economics of the transport fuel marketplace. Thus, if a mandate is not binding because the driver of the distortion at the modelled level of production is the excise tax credit, it may be more accurate to conclude that the entire set of policies need scrapping than that the purchase mandate is not causing incremental distortions. It is the combination of policies that creates competitive roadblocks to different fuels, alternative drive trains, and demand-side management options. These impediments can alter the direction of innovation and commercialisation of new technologies, an extremely important misdirection over the mid- to long-term.

Second, from a competitive standpoint, mandates provide extremely important subsidies to the industry *even when they are not binding* in an econometric sense. The most serious risk to investors is on the downside: that costs will rise and the value of their product fall, pushing the facility into financial distress or bankruptcy. This is exactly the protection that mandates provide, greatly reducing the cost of capital to the industries producing the mandated fuels.

That markets subscribe to this view can be seen in the behaviour of share prices for representative firms in the sector (Exhibit 5). Between the first trading day of December 2007 and the day EISA became law (19 December), the key NASDAQ and S&P 500 benchmarks were both down roughly by 2%.[10] Exchange trade funds tracking domestic oil futures were up during the period, but only by about 2%. In contrast, Verenium, a publicly traded cellulosic firm well positioned to benefit from the cellulosic mandate, surged 53% during that time frame, even though it is some years before the cellulosic mandates kick in and before the firm produces commercial quantities of fuel. The fact that the firm now has a guaranteed buyer no matter the price, should it ever successfully commercialise its process, is extremely valuable to investors.

Exhibit 5 Stock price movement in the face of higher mandates under EISA

	Market segment	*Opening price, 3 December, 2007*[1]	*Closing price, 19 December, 2007*[2]	*Percentage Change*
Firm				
Verenium	Cellulosic	3.79	5.80	53.0
Pacific Ethanol	Corn ethanol	6.16	9.15	48.5
VeraSun	Corn ethanol	12.23	15.26	24.8
Aventine	Corn ethanol	9.77	11.97	22.5
Archer Daniels Midland	Diversified agricultural processor	36.60	40.92	11.8
Benchmark				
NASDAQ Composite	Benchmark	2655	2601	–2.0
S&P 500	Benchmark	1480	1453	–1.8
US Oil Fund ETF	Oil sector tracking stock	70.70	72.15	2.1
S&P GSPCI Crude Oil Total Return Index	Oil sector tracking stock	52.16	53.09	1.8

[1]First trading day of December 2007.

[2]Day the Energy Independence and Security Act was signed into law; multi-week trend evaluated since investment patterns begin to reflect new rules even in advance of the official signing as the probability of signature rises.

[3]Although a number of biodiesel firms (e.g., Renewable Energy Group, Imperium Renewables) have filed for initial public offerings, both were cancelled and a comparable firm in the biodiesel sector could not be identified.

Source: Earth Track calculations based on Yahoo! Finance (2008)

Corn ethanol firms also rose sharply: 48% for Pacific Ethanol, which focuses on lower carbon ethanol production. Aventine and VeraSun were up more than 20%, while Archer Daniels Midland, which has a more diversified mix of products, was up nearly 12%.

Whereas these firms have benefitted from EISA, society may not. By providing politically selected downside protection, the policies mask real risks and volatility in the biofuels sector; shift pricing risk entirely to the consumer; and disadvantage alternative industries that do not face same inherent production risks. For example, plug-in hybrids face technology risks in the alternative drive trains, but would not face nearly the same level of commodity risk as do biofuels. The risks go well beyond the fuel sector, as noted by former USDA Chief Economist Keith Collins:

> "The once uncertain increase in corn demand due to biofuels, contingent primarily on strong but highly volatile oil prices, is now a certain increase in demand due to the RFS, regardless of oil or corn prices. The mandate makes the demand for corn by ethanol plants highly inelastic with respect to price changes when corn prices are high and crude prices are low. This feature reduces the normal ability of high corn prices to reduce demand and ration short supplies across users." (Collins, 2008, p.17)

4.4.2 Subsidy cost to meet EISA mandates

Two academic studies have modelled the impacts of the higher mandates on biofuel and feedstock markets in such a way as to be able to segregate the impacts of the mandates and the tariff from other subsidy policies, and to gain insights on the price impact of sub-mandates. Baker et al. (2008) estimated the full support level needed to stimulate sufficient production levels of corn ethanol, cellulosic ethanol, and biodiesel to meet the EISA mandates under high- and low-oil price scenarios. The impacts of baseline tax credits have been subtracted out from the results presented in Exhibit 6. They anticipate quite high support levels for both biodiesel and cellulosic ethanol.

Exhibit 6 Subsidy rate inputs for major programmes evaluated

Subsidy	*Relevant rates*
Volumetric Ethanol Excise Tax Credit, Volumetric Biodiesel Excise Tax Credit	• Ethanol: 51 cpg in 2008, dropping to 45 cpg in 2009. Outlay equivalent values are 73 cpg and 64 cpg, respectively • Biodiesel: $1.00/gallon ($1.43/gallon outlay-equivalent)
Cellulosic producer tax credit	• $1.01/gallon, less amounts claimed under VEETC (45 cpg), leaving incremental benefit of 56 cpg • If Small Producer Tax Credit must be netted as well, incremental credit would drop to 45 cpg
Small producer tax credit	• 10 cpg, though limited to first 15 mmgy for conventional ethanol and biodiesel • Average value/gallon produced likely to be zero for advanced ethanol (mostly imports); 1 cpg for corn ethanol (larger plants, small share of production eligible); 2.5 cpg for biodiesel (only first 15 mmgy eligible) • Values for cellulosic ethanol assumed to be the full 10 cpg since plants smaller than the cut-off and all 60 mmgy eligible for the tax break
Market price support	• 15 cpg for corn ethanol and 'advanced' ethanol assuming it is met by imported sugar-based fuel • Based on FAPRI and CARD economic evaluations, $1.43/gallon for cellulosic; $1.17/gallon for biodiesel. Values assume higher oil prices than those currently in place and may understate the MPS provided

Westhoff et al. (2008) model a wide range of policy scenarios, including one in which the mandates are removed. This scenario provides an approximation of the incremental cost of the higher mandates, but its baseline appears to include the pre-existing (lower) mandates and the tariff. As such, it may understate the overall support levels provided by the tariff and EISA mandates in combination. The Westhoff, Thompson and Meyer analysis also assumes that cellulosic ethanol mandates will be waived entirely. If this was not to occur, then their overall cost estimates would likely rise, perhaps substantially.

These assessments may not be a perfect metric for the MPS with higher mandates and cellulosic tax credits – but they do allow first-order approximations of the scale of these programmes. As illustrated in Koplow (2009), the results are sobering: subsidy costs between 2008 and 2022 (the end of the formal EISA mandate period) are $420 billion ($355 billion on a revenue loss basis). Subsidies per year increase six-fold from 2008 ($9.5 billion) to more than $60 billion in 2022. Support to cellulosic ethanol dominates the totals, with nearly $190 billion in subsidies. This results from high per-unit support levels needed (almost $2.50/gallon, even ignoring growing state subsidies and feedstock support) and high mandated consumption. Corn ethanol may be the conventional technology under these policies, but continues to receive subsidies averaging nearly $11 billion per year in support from just these core programmes ($164 billion in total). Biodiesel remains a niche player, though more likely survives as a result of the mandate, receiving more than $2.50 in subsidies for every gallon the industry produces over the next 15 years ($38 billion in total). Exhibit 6 provides a summary of unit subsidy inputs, whereas total subsidy costs are presented in Exhibit 7.

Exhibit 7 Estimated biofuel subsidies under RFS Mandate, current rules (36 bgy by 2022) Subsidy Period: 2008–2022, $Billions except as otherwise noted

	Mandate by 2022 (bgy)	*Cumulative subsidy during period*				*% by Fuel*	*Average/ year*	*Annual subsidy*		*Unit subsidy*	
		VEETC, VBETC	*PTCs*	*MPS*	*All*			*CY2008*	*CY2022*	*CY2008* ($/gal)	*CY2022* ($/gal)
Other renewable fuel (corn)	15.0	133	3	28	164	39	10.9	8.0	11.9	0.89	0.79
Cellulosic ethanol	16.0	46	40	102	189	45	12.6	0.0	42.0	1.37	2.63
'Advanced' ethanol	4.0	19	0	11	30	7	2.0	0.4	4.1	0.87	1.02
Biomass-based diesel	1.0	20	0	17	38	9	2.5	1.1	2.7	1.59	2.72
Total, outlay equivalent	36.0	219	43	159	421	100	28.1	9.5	60.7	0.93	1.69
% by type		*52%*	*10%*	*38%*	*100%*						
Total, revenue loss	36.0	153	43	159	355	na	23.7	7.1	53.6	0.70	1.49

Source: Earth Track calculations, Koplow (2009)

The relative mix of subsidies begins to change as well. While tax credits remain the most important support for corn ethanol, MPS resulting from the mandates dominates the picture for cellulosic ethanol – even with the recently increased production tax credit for cellulosic facilities. MPS provides almost half the subsidies to biodiesel as well.

Subsidy costs per gallon produced under the new policies are significantly higher than assumed in earlier hypothetical cellulosic scenarios and for biodiesel, and may be lower for corn ethanol (impacts of other subsidies to production and feedstock have not been integrated). As a result, the cost efficiency of GHG reductions is not likely to improve for either biodiesel or cellulosic ethanol. GHG reduction requirements under the mandates may improve the situation somewhat, though most of the mandated capacity for corn ethanol will be grandfathered and not subject to the environmental screens. Grandfathering of biodiesel capacity to meet the biodiesel mandates is less certain based on conversations with staff at the US Environmental Protection Agency, but is certainly possible. It is not clear whether a 60% GHG reduction relative to baseline for cellulosic would be a binding constraint or not.

5 Emerging issues and options for reform

Biofuels continue to capture a growing share of government subsidies despite increasing evidence that many of the programmes are not obtaining energy security or climate change goals in an efficient manner. This section provides a number of options for reforming the existing subsidy process with the goal of reducing the fiscal costs of these programmes and achieving a more favourable environmental outcome.

5.1 Open subsidies to competition

Was a company to issue a $400 billion contract, there is little doubt that they would open it to competitive bidding. The stakes are simply too high not to. The same argument should hold for biofuel subsidies, which will receive subsidies worth at least this amount over the next 15 years. Ideally, the entire range of policies that aim to reduce dependence of the transport fleet to imported oil through assorted earmarked and fragmented subsidy regimes would be combined into a single pot. Bidders able to provide reductions at the lowest subsidy per avoided petroleum vehicle-mile would win. Participants would go well beyond the biofuels sector, including alternative drive trains, fleet management approaches, improved combustion engines, and other approaches that perhaps are not yet well known. Bidding would be done in tranches, at least annually. This would improve pricing transparency and enable cost savings from innovation to be passed through to taxpayers – as regularly occurs already with bids on renewable portfolio resources in the electricity sector.

Competition could be done on the basis of costs per unit GHG reduced as well. However, a number of arguments suggest that the initial focus should be on petrol replacement. First, baseline policies on carbon constraints need to be enacted across the economy for bidding on this attribute to have any meaning. Second, with costs of biofuel subsidies much higher than so many other options, the sector seems unlikely to provide much value added in terms of carbon reduction. The import replacement services are likely more binding, and any competitive process on GHG reduction efficiency (as would occur under cap and trade or carbon taxes) would be unlikely to choose biofuels as an attractive abatement venue owing to its very high cost.

5.2 Establish automatic brakes on subsidy escalation

Many government subsidy programmes to other sectors are limited either in total cost to the Treasury, or set to phase out automatically as market conditions make them unneeded. Both types of constraints should be introduced into existing biofuel subsidy programmes. Triggers could be high oil prices; the spread between an index for corn (or land rental) prices and oil prices; or some other useful metric.

Subsidies could also be more effectively limited to the first 7 or 10 years of a plant's production; or the first certain number of gallons of production. This approach would avoid the uncertainty that national caps can create on investment decisions (because the amount received by any facility would be known ahead of time), but still constrain perpetual payouts. These types of limits are regularly used even within the biofuels sector to constrain financial payouts at the state level.

5.3 Address environmental profile of biofuels more directly

5.3.1 GHG reduction thresholds under EISA

While the EISA mandates have the first GHG reduction targets of any federal biofuel subsidy policies, they remain inadequate. First, grandfathering provisions appear to have enabled huge numbers of facilities to entirely avoid environmental impact constraints. These exemptions appear to apply to foreign as well as domestic producers and may incorporate both domestic and foreign feedstock production as well. Additional analysis is needed on whether land cleared prior to enactment of EISA in December 2007 is exempt from screens regardless of the importance of the converted ecosystem.

Second, because so much money will ride on life cycle determinations for new facilities (reflected in the tradable credits these facilities earn for compliance with the national mandates), one should expect substantial efforts to game the system, as well as potential corruption. Efforts are already underway to convince both the US EPA and the California Air Resources Board to ignore indirect land-use impacts, at least initially (Coleman et al., 2008).

Given the relative lack of transparency of life cycle models to the public, and the difficulty in understanding whether a particular model is accurate or not, the risk of finessing the screens by tinkering with the models is extremely high. Purposeful miscalibration of the model is a lower risk, but should not be entirely discounted. This is because once any facility makes it through the screens, even if it later turns out there were modelling errors, Section 202(c) of EISA grandfathers that facility for its entire operating life. Caution is needed to ensure that any temporary exclusion of indirect land-use impacts or other life cycle factors from EPA's initial rulemaking does not exempt that entire cohort of plants from ever being subject to comprehensive life cycle models. Environmental organisations and universities would do well to build capacity to more systematically vet the models that will be used to screen particular facilities or feedstocks, and to force all aspects of them into the public domain with associated documentation.

5.3.2 Set time limits on any exemptions from environmental screens

Current statute language grants lifetime exemptions from environmental screens for facilities for which construction commenced prior to the enactment of EISA. The goal of grandfathering – to protect capital investments from premature obsolescence due to post-construction regulatory changes – must be balanced against the societal interest in seeing the regulatory changes take effect in the market. This balance could be achieved by an interim strategy, such as grandfathering facilities only for the depreciation period of their initial capital investment. Past experience with US exemptions from air pollution regulations for certain electric utilities provided clear evidence that when the economic benefit of avoiding environmental regulations was high, firms would retain capital long past its normal operating life to avoid having to come into compliance. This mistake should not be replicated in the biofuels sector.

5.3.3 Expand GHG reduction screens to other subsidies

Subsidy programmes such as the excise tax credits for blenders provide billions of dollars per year to the industry, yet have no restrictions based on lifecycle GHG emissions. The disparity between this policy and the terms of the RFS do not make sense, and both excise and production tax credits should also be subject to environmental screens.

5.3.4 Environmental impacts of feedstock production

All biofuels are reliant on large land areas producing biomass for conversion into fuels. Yet, the agricultural system that will generate this material is too often treated as an artisanal producer with voluntary environmental standards, rather than as the large industrial production system that it really is. Water and topsoil depletion, and chemical contamination from farming are already on the rise owing to large-scale trends to pull conservation land and boost production of corn. There is no reason that farms should be exempted from appropriate regulation of their pollutant effects on the surrounding environs and that the costs of appropriate controls be incorporated into feedstock prices.

More challenging issues involving proper pricing of irrigation water also deserve evaluation. Whereas irrigation subsidies are politically well entrenched, they should at least be more directly mapped against biofuel production centres across the country. The additional distortions caused by unsustainable use of subsidised irrigation water should be visible in assessments of the biofuel industry. A joint effort between policy specialists, agricultural economists and a geographical information system specialist could do much to improve the state of knowledge here.

5.3.5 Monitor and block double-dipping from carbon offsets

Under carbon permit or tax systems, industrial emitters of GHG will need to buy permits or pay taxes for their emissions. In the USA, if these industries figure out how to do their jobs with less carbon, they avoid additional costs. They are not paid for ‘offsetting’ pollution that they may otherwise have generated.

Once again, farming seems to be different. Already the Chicago Climate Exchange is selling carbon offsets for no-till and grasslands agriculture. Payments through summer of 2007 sectorwide to farmers under these contracts have been roughly \$15–20 m. The share associated with biofuel feedstock producers is not known, but total payments remain small at present. The potential payouts are much larger, however. Will Ferretti of the Chicago Climate Exchange estimated that broader adoption of these techniques, assuming US offset prices rise to European levels, could earn \$4–\$6 billion per year for US farmers (Gardner, 2007). Payments at this level would have a material effect on key biofuel feedstocks. In addition, CCX has done preliminary work on a carbon offset contract for biofuels production facilities, though no contract has yet been finalised (McElroy, 2007).

While reducing climate impacts of agricultural and industrial production is a good thing, an alternative viewpoint in both of these areas is that the industries should pay for carbon emissions like everybody else, not get paid for making them smaller than they might otherwise have been. Developments in the no-till and grassland contracts as they relate to biofuels need to be watched, and may already be a bigger issue within Europe.

5.4 Reduce structural bias in existing biofuel subsidy policies

If forcing biofuel subsidy recipients to compete for their federal pork proves difficult to implement, steps should be taken at least to remove the current bias amongst biofuels to achieve some degree of financial improvement. Examples of existing policy distortions even among biofuel options include the increasing relative barriers to imported biofuels, stipulation of specific biofuel production approaches (e.g., methyl esters rather than thermal co-processing for biofuels; or enzymatic processes for cellulosic ethanol), mandates for specific vehicle technologies to handle E85, and targeted subsidies to ethanol pipelines that more advanced biofuels might not even need. In all of these cases, policies have rewarded political niches, in the process driving up taxpayer costs and reducing competitive pressures amongst alternatives to excel in the marketplace.

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Notes

[1]Iowa State researchers (Baker *et al*., 2008, p.19) noted that hitting the blending wall was likely to have severely negative impacts on ethanol's pricing:

> "There is a much more serious bottleneck that occurs once all gasoline contains a 10% blend. To go past this point, ethanol needs to sell below its energy value to incentivise the sale of 85% blends. This new price is substantially below that which can be charged when ethanol is being used as an oxygenate, and the need for this price change cannot be eliminated by the construction of new infrastructure."

This was different from localised bottlenecks experienced by the industry in the summer of 2007, when better transport links would have eliminated the problem and firmed up ethanol prices.

[2]Capehart *et al*. (2008, p.20) suggest the small producer credit must be netted from the total; the Renewable Fuel Association specifically indicates the credit is incremental (RFA, 2008c).

[3]Choosing the proper grouping is not always easy. This classification reflects input from Mark Laser, who studied biofuels on the faculty at Dartmouth University. Based on his reading of the IRS classifications, and "discussions with colleagues from NREL and Princeton", class 49.5 seemed the proper fit (Laser, 2006).

[4]The subsidies associated with this power may not always be direct. The Nebraska Public Power District, for example, can provide coal and operate coal-fired boilers for ethanol plant operators (Dostal, 2006).

[5]See MN Statutes 2007, section 116D.04, Subd.2a.

[6]These included production flexibility; loan deficiency; market loss assistance; direct payments; market gains farm; advance deficiency; deficiency; counter-cyclical payment; market gains

warehouse; commodity certificates; farm storage; warehouse storage. EWG data deduct negative payments or federal recaptured amounts from the total. See http://www.ewg.org/farm for more details.

[7]Biofuel proponents sometimes argue that reduced payments under conventional agricultural support programmes owing to the rise in commodity prices from the biofuel demand are an offsetting cost of the fuel subsidies. de Gorter and Just (2007b, p.7) disprove these claims, noting that counter-cyclical agricultural loan programmes

> "increased the tax costs of the tax credit by 50%. Furthermore, the tax credit itself doubles the deadweight costs of the loan rate. Ethanol policies can therefore not be justified on the grounds of mitigating the effects of farm subsidy programs."

They further note that part of the apparent tax savings from lower deficiency payments "represents increased costs to consumers of corn (both domestic and foreign)" and part are merely a transfer of loan deficiency payments to tax expenditures.

[8]http://bioenergy.ornl.gov/

[9]As much as 56 cpg if the industry position that small producer tax credits are in addition to the cellulosic PTC is upheld.

[10]Since speculators bid up share prices as the probability of EISA passing grow, it is important to track share price movements over a longer period of time than simply tracking movement on the day the law was signed.