BIOFUELS - AT WHAT COST ?

Government support for ethanol and biodiesel in the United States : 2007 Update

One of a series of reports addressing subsidies for biofuels in selected OECD countries.

October 2007

Prepared by :
Doug Koplow, Earth Track, Inc.

Prepared for :
The Global Subsidies Initiative (GSI)
of the International Institute for Sustainable Development (IISD)
Geneva, Switzerland

GSI Global Subsidies Initiative

The GSI is a programme of:

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Biofuels – At What Cost? Government support for ethanol and biodiesel in the United States: 2007 update

October 2007

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ISBN 978-1-894784-06-1

The document updates information provided in *Biofuels – At What Cost? Government support for ethanol and biodiesel in the United States*, published in 2006 (ISBN 1-895536-94-4).

Acknowledgments

This report was written by Doug Koplow (Earth Track). Continued input and support by Ron Steenblik, GSI's Director of Research, has once again been instrumental in the production of this study. The author is also extremely grateful to Tara Laan, Assistant Researcher at the GSI. In addition to her research help in a number of important areas of the paper, she oversaw the complex process of report finalization and formatting.

IISD's Chris Charles provided useful comments on the draft text and invaluable support in finalizing the document.

In addition, the project team wants to thank to a large number of sources, some of them anonymous, who shared their time and expertise on a variety of technical issues related to biofuel subsidies. Their input greatly enhanced the final report. That said, any remaining errors or inaccuracies remain the responsibility of the author.

This effort could not have been undertaken without the generous support for the GSI's work provided by the governments of Sweden, the Netherlands, and New Zealand, and the William and Flora Hewlett Foundation. The views expressed in this study do not necessarily reflect those of the GSI's funders, nor should they be attributed to them.

Table of contents

List of Tables and Figures

Figures

Tables

Annex tables

Abbreviations and acronyms

ACP	Africa Caribbean Pacific
AFDC	Alternative Fuels and Advanced Vehicles Data Center
BACT	Best available control technology
BER	Biomass energy reserve
B5	A blended fuel comprised of 5 percent biodiesel and 95 percent petroleum diesel
B20	A blended fuel comprised of 20 percent biodiesel and 80 percent petroleum diesel
CAFE	Corporate Average Fuel Economy
CCC	Commodity Credit Corporation (part of the U.S. Department of Agriculture)
CCX	Chicago Climate Exchange
CEI	Competitive Enterprise Institute
CRP	Conservation Reserve Program
DDGS	Distillers dried grain with solubles
DOE	U.S. Department of Energy
DOT	U.S. Department of Transport
E10	A blended fuel comprised of approximately 10 percent ethanol and 90 percent gasoline
E85	A blended fuel comprised of approximately 85 percent ethanol and 15 percent gasoline
ECX	European Climate Exchange
EIA	U.S. Energy Information Administration (part of the U.S. Department of Energy)
EPA	U.S. Environmental Protection Agency
EPACT05	U.S. Energy Policy Act 2005
EU	European Union
FAPRI	Food and Agricultural Policy Research Institute
FFV	Flexible-fuel vehicles
GDE	Per gallon diesel equivalent
GGE	Per gallon gasoline equivalent
GHG	Greenhouse gas
GJ	Gigajoules
GREET	Greenhouse Gas, Regulated Emissions, and Energy Use in Transport, model developed by Argonne National Laboratory
GSI	Global Subsidies Initiative
GWI	Global Warming Intensity
H.R.	Pending legislation introduced in the U.S. House of Representatives
IISD	International Institute for Sustainable Development

IRS	Internal Revenue Service
ITC	U.S. International Trade Commission
JCT	Joint Committee on Taxation (of the U.S. Congress)
LEM	Lifecycle Emissions Model
MMBtu	Million British thermal units
MPS	Market price support
NBB	National Biodiesel Board
PAB	Private activity bond
PTC	Production Tax Credit
REC	Renewable Electricity Credits
RFA	Renewable Fuels Association
RFC	Renewable Fuel Credit
RFS	Renewable Fuels Standard
S	Pending legislation introduced in the U.S. Senate
SEC	U.S. Securities and Exchange Commission
USDA	U.S. Department of Agriculture
VBETC	Volumetric biodiesel excise tax credit
VEETC	Volumetric ethanol excise tax credit
WTO	World Trade Organization
$	U.S. dollars at their year-2006 value

Executive summary

This report updates information on government support for fuel-grade ethanol and biodiesel[1] in the United States, originally detailed in the 2006 study commissioned by the Global Subsidies Initiative (GSI) from Earth Track, *Biofuels – At What Cost? Government Support for Ethanol and Biodiesel in the United States*. The analysis reviews market developments over the past year, re-examining the policy environment at the federal level and updating subsidy values based on recent biofuel production and consumption information. State reductions in motor fuel taxes were also re-evaluated. Scores of other state and county subsidies continued to proliferate during the past year but were beyond the scope of this update. Readers should rely on the original report for historical information and more detailed descriptions of programs.

Biofuel subsidies expected to approach US$ 100 billion for the 2006–2012 period

Total government support for biofuels in the United States reached approximately $ 6.3–$ 7.7 billion in 2006, the majority of which was directed to ethanol (see table below). Total support is projected to reach around $ 13 billion in 2008 and almost $ 16 billion by 2014. Under existing policies, the industry will, in aggregate, obtain subsidies worth more than $ 92 billion over the 2006–2012 time frame. These estimates should be viewed as conservative, given that they do not incorporate many state subsidies now in effect nor the cost of a more stringent renewable fuels consumption mandate.

Subsidies to ethanol and biodiesel

	Ethanol				Biodiesel			
	2006	2007	2008	2006–2012	2006	2007	2008	2006–2012
Total subsidies ($ billions/year)	5.8–7.0	6.9–8.4	9.2–11	Total 67–82	0.53–0.65	1.2–1.5	1.5–1.9	Total 9.0–10.8
Per gallon biofuel consumed ($ gallon)	1.1–1.3	1.1–1.3	1.1–1.3	Average 1.0–1.2	2.1–2.6	1.6–2.1	1.7–2.1	Average 1.8–2.2
Per gigajoule ($ /GJ) produced	12–14	12–14	12–14	Average 12–14	17–21	13–17	13–17	Average 14–17
Per gallon of petrol or diesel equivalent ($ /GGE or $ /GDE)	1.4–1.7	1.4–1.7	1.5–1.7	Average 1.4–1.7	2.3–2.8	1.8–2.3	1.8–2.3	Average 2.0–2.4

Source: main report.

Government support is provided at all stages of production and consumption

Support is often delivered through overlapping policies of federal, state and municipal jurisdictions. At the federal level, the largest contributor remains excise tax credits provided to biofuel blenders. Over the 2006–12 period, we estimate these credits will be worth $ 48 billion in subsidies to the ethanol sector, or nearly 60 percent of total support. The credits will provide nearly $ 5 billion in support to biodiesel, or roughly 45 percent of its total support.

Market price support measures how barriers to imports and domestic purchase mandates protect biofuel producers and enable them to earn more revenue than would otherwise be the case.

[1] *Biofuels* refers to renewable fuels such as ethanol (an alcohol fermented from plant materials) and biodiesel (fuels made from vegetable oils and animal fats) that can substitute for petroleum-based fuels. Although specially modified vehicles can operate on pure versions of these fuels, most biofuels are sold mixed with conventional gasoline or diesel for use in standard production vehicles. Mixes are usually indicated by the percent biofuel, such as B5 (5 percent biodiesel) and E85 (85 percent ethanol) blends.

Generally, it results from above-market prices paid by consumers. Market price support is currently the second-largest element of support for ethanol. Transfers generated under the current 7.5 billion gallon per year federal mandate during the 2006–12 period were estimated to be roughly $ 17 billion.

Crop subsidies provide lower-priced feedstocks to biofuel producers and remain an important form of support, especially in the ethanol sector. Although some types of crop payments have declined greatly due to higher market prices, direct payments are still expected to top $ 5 billion for the 2006–12 period. The decline in certain forms of support has been offset to some degree by a rising share of key crops (corn, soy, sorghum) that is being diverted to energy markets.

As capacity booms, so does the cost of subsidies

The majority of support at the federal level continues to be indiscriminately linked to production and consumption. Support will therefore continue to rise in proportion to the growth of the biofuels sector. The ethanol industry added 1.1 billion gallons of capacity in 2006 and nearly 700 million gallons more through July 2007. Over six billion gallons of additional capacity are planned or under development, with scheduled completion before the end of 2009. Once all these plants come on-line, capacity will exceed 17 billion gallons per year. The capacity of the biodiesel industry has doubled since 2006, reaching 1.4 billion gallons per year in 2007, with an additional 1.9 billion gallons due to come on-stream in the next two years. This sector-wide growth, combined with other factors, pushed 2006 subsidy levels for ethanol and biodiesel beyond those estimated in last year's report.

From growth to glut?

This current expansion belies a less positive industry outlook. Ethanol prices have fallen 30 percent since June 2007; margins even more. Contributing factors include problems associated with blending and distribution, and rising corn prices. Time will tell whether these prove to be long-term trends.

The U.S. biodiesel industry has grown faster than has demand for the product. Current capacity utilization is estimated to be around 50 percent and could fall even lower as new plants come on-line. Utilization is expected to drop too low for some operators to be able to meet their operational costs, and a contraction of the industry is therefore likely in coming years. Longer-term subsidy levels are therefore expected to be lower than previously estimated, in proportion to reduced production.

The benefits are marginal and come at a disproportionate cost

Sustained high subsidy levels have reinforced the findings of the original report that biofuels are an expensive way to achieve various policy objectives, such as greater energy security and the lowering of greenhouse gas (GHG) emissions (see table below).

Subsidies per unit of petroleum, fossil fuel or CO_2 displaced

	Ethanol				Biodiesel			
	2006	2007	2008	Average 2006–12	2006	2007	2008	Average 2006–12
Per GJ petroleum displaced ($/GJ)	12–18	12–17	13–18	12–17	19–30	14–25	15–24	16–25
Per GJ fossil fuel displaced ($/GJ)	23–58	23–58	23–59	22–57	27–34	21–27	22–27	24–28
Per tonne CO_2-equivalent displaced ($/tonne CO_2-equiv.)[1]	305–(600)	300–(595)	310–(605)	295–(585)	280–(860)	215–(705)	220–(690)	239–(720)

(1) Values in parentheses are negative, indicating the amount paid to increase CO_2 emissions relative to a gasoline or diesel baseline.

Source: main report.

In terms of energy security, the average subsidy costs of replacing petroleum with biofuels over the 2006–12 period are high: $ 12–17 per gigajoule (GJ) of petroleum displaced for corn ethanol and $ 16–25 per GJ for biodiesel. This translates to roughly $ 1.40 to $ 1.70 per gallon of gasoline equivalent and $ 2.00 to $ 2.35 per gallon of diesel equivalent—both a sizeable percentage of the current market value of motor fuels. The cost would be comparable were cellulosic ethanol being produced, even though they were assumed to have a more favorable environmental and energy profile ($ 19 per GJ of petroleum displaced).

The cost of displacing fossil fuels by subsidising biofuels is even more expensive than for displacing petroleum: $ 22 to $ 57 per GJ fossil fuel displaced for corn ethanol and $ 24 to $ 28 per GJ for biodiesel. This is because the biofuel fuel cycle relies on large quantities of coal and natural gas, though cellulosic ethanol has a lower impact ($ 12 to $ 15 per GJ).

To test the efficacy of subsidizing biofuels as a way to address climate-change concerns, this study estimates the average subsidy cost for each tonne reduction in greenhouse gas emissions (expressed in CO_2–equivalents). The minimum subsidy cost per tonne of CO_2-equivalent reduced over the 2006–12 period is $ 295 for corn ethanol; $ 239 for biodiesel; and $ 109 for a hypothetical cellulosic ethanol case. This is the *minimum* cost, calculated by taking the *lowest* subsidy estimate and dividing it by the *most favorable* GHG displacement factor. For each one tonne of reductions obtained via current subsidies to biofuels, 89, 75, and 33 tonnes of carbon offsets respectively could have been purchased on the Chicago Climate Exchange (CCX). CCX is the most appropriate benchmark for the U.S. market; though even on the more expensive European exchange (ECX), the supports could have bought 11, 9, and 4 tonnes, respectively. For all three fuels, the other end of the range (using the high subsidy value and lower estimate for GHG displacement) was also estimated. In many cases, emissions actually *rose*, which means actually paying large sums to *increase* emissions.

Pending legislation seeks to expand support

Despite a growing awareness of both the fiscal and environmental concerns about biofuels, legislative support has not abated. The most "aggressive" proposed reforms (both contained in the tax section of the 2007 Farm Bill) involve reducing the excise tax credit by five cents per gallon (less than 10 percent) once the existing mandate is reached. None of the major bills would phase out the tax credits under high oil prices (when biofuels are more competitive) or remove an existing loophole that allows claimants to exclude the tax credits from their taxable income, further increasing the cost of the provision.

Several major bills currently under consideration by Congress, including a large proposed energy bill and the 2007 Farm Bill, seek to increase levels of support for biofuels, particularly ethanol. By increasing the national mandatory consumption requirement (the Renewable Fuels Standard), lawmakers hope to reduce risks to the industry of a sustained market downturn. The Senate Energy Bill (H.R. 6), for example, would mandate 36 billion gallons per year by 2022. Senate Bill 23 includes a 60 billion gallon per year target by 2030. The costs of these rules are likely to be extremely large. The Energy Information Administration recently estimated that the additional cost within the fuel sector alone of a 25 percent renewable fuels mandate (on par with 60 billion gallons per year) would be in excess of $ 130 billion per year by 2030. This translates to a cost per metric tonne of CO_2-equivalent reduced of more than $ 115, roughly 30 times the current cost of a carbon offset on the Chicago Climate Exchange. Costs of vehicle infrastructure and increased food prices would be extra.

While the specifics of the mandates vary, most do not take into account lifecycle environmental impacts of biofuel production chains. In addition, none provide a neutral framework within which alternative ways to wean the country from imported oil and reduce greenhouse emissions can compete on a level playing field. Such alternatives include improvements in vehicle efficiency, improved maintenance and tires, and hybrid and plug-in hybrid drive trains.

To further boost ethanol consumption, proposals are also being considered to increase the allowable limits for ethanol blends in gasoline for unmodified engines (currently 10 percent) and improve distribution infrastructure for E85 (a blend containing about 85 percent ethanol).

Some proposals seek to diversify the current industry by creating specific incentives for ethanol derived from feedstocks other than corn kernels, and by expanding support for cellulosic ethanol and widening the definition of "advanced biofuels" (a definition that in some bills put before Congress would include fossil-derived fuels). As such, the new legislation compounds the current distortions to crop markets with a host of new programs to underwrite production, harvesting, storage and the transport of cellulosic feedstocks. Some legislation makes compliance with the Renewable Fuels Standard contingent on lowering the greenhouse gas profile of biofuels, but the study did not find any that would similarly restricting access to the excise tax credits.

Most importantly, the U.S. government has not indicated an exit strategy to wean the biofuel industry from protection and subsidies. Indeed, as is often the case with subsidies, current legislative proposals appear to entrench existing arrangements, which will ensure that the biofuel industry remains a significant drain on U.S. taxpayers for decades to come.

Conclusions and recommendations

Before increasing government expenditure and support, U.S. lawmakers should consider whether mandating and subsidizing biofuels, especially current generation biofuels, is the best way to achieve the declared policy goals. They should ensure that any new measures put in place can be dismantled, rather than "set in stone." And they should ascertain whether support for biofuels is actually undermining the outcomes they seek to achieve.

With this in mind, this report recommends that the U.S. federal and state governments:

- resist increasing mandatory consumption levels for biofuels and instead adopt a neutral policy position favoring all options to reduce reliance on oil in the transport sector;
- eliminate tariffs on imported fuel ethanol;
- avoid providing new subsidies to the industry, and move to re-instate fuel-excise taxes on biofuels in states that are currently providing relief from them; and
- improve the transparency of information available on biofuel subsidies.

Regarding policies already committed, at a minimum, federal and state policy-makers should:

- introduce mechanisms to reduce subsidies to biofuel manufacturers during times of high oil prices;
- take into account the environmental effects of particular biomass production cycles in the design of any subsidy program;
- open competition in transport sector to all methods that can displace carbon and imported oil, including demand reduction; and
- establish an evaluation process that can thoroughly assess the cost-effectiveness of support policies at all levels of government (but particularly the Renewable Fuels Standard) in attaining the key objectives behind U.S. biofuel policy.

1 Introduction

1.1 Overview

In October 2006, the Global Subsidies Initiative (GSI) published *Biofuels: At What Cost? Government Support for Ethanol and Biodiesel in the United States*, a report commissioned from Earth Track. Since then, government support to biofuels has continued to expand at a rapid pace. This update to the 2006 report examines how the policy environment at the federal level has evolved over the past year and updates subsidy values with improved information on biofuel production and consumption levels. It also analyses the potential impact that forthcoming legislation, such as the proposed energy and farm bills, could have on overall government support to biofuels. Readers should continue to rely on the 2006 report for historical data on subsidies and for more detailed descriptions of subsidy programs.

The updated data includes a number of changes of note:

- *Limited review of state policies.* Time constraints precluded a full re-evaluation of state-level subsidies—an area that remains in tremendous flux. The only updates involved reductions or exemptions to state motor fuel taxes. Subsidies to production, consumption and vehicles were not re-examined, though remain important. Special laws and incentives for ethanol and biodiesel now exist in 49 states and the District of Columbia, according to tabulations by the Alternative Fuels and Advanced Vehicles Data Center (AFDC) of the U.S. Department of Energy (DOE). Nine states each have more than 20 policies in place affecting these two fuels. Were access to economic development grants and loans added to the mix (biofuel plants have been frequent recipients), this number would undoubtedly climb.

- *Expanded subsidy intensity metrics.* An important element of our first report was the subsidy intensity metrics that converted subsidy values into measures per unit of energy output or oil or greenhouse gases (GHG) displaced. A growing number of biofuel production lifecycle assessments have enabled us to expand our evaluation of subsidy intensity metrics, including more detail on biodiesel greenhouse gas displacement values and bounded values (rather than a point estimate) for our hypothetical cellulosic case.[2] The ranges are also wider than in the first study.

- *Expanded discussion of credit subsidies*. Credit subsidies, particularly loan guarantees and tax exempt bonding, are becoming increasingly important to the biofuel sector. These new policies, and a

[2] The hypothetical cellulosic case applies the more favorable fossil fuel and GHG displacement characteristics to the existing subsidy base that overwhelmingly supports corn ethanol. The objective is to test whether the subsidies would be an efficient way to procure GHG reductions and reduced reliance on imported oil, even if the product were sourced from cellulosic feedstocks. In the 2006 report, commodity subsidies to corn and sorghum were stripped out of this scenario. Babcock *et al.* (2007) indicate that cellulosic ethanol would need feedstock subsidies to be economic. Pending legislative proposals include provisions to do so. As a result, we have left commodity payments in for this analysis.

growing public record of past awards, enabled us to more comprehensively present this issue and to quantify the subsidies in some cases.

- *Greater resolution for projected subsidies in future years*. Based on reader feedback to the first analysis, we have included single-year measures over a long time-frame. This approach provides a clearer picture of how subsidies rise over time with production or other factors. As is always the case with projections, the subsidy estimates are sensitive to core assumptions on production levels, commodity prices and consumption; as well as to the renewal of various subsidy policies over time. Our baseline assumes existing support policies will be renewed. Our projections utilize the well-respected modeling efforts by the U.S. Energy Information Administration and the Food and Agricultural Policy Research Institute (FAPRI).[3]
- *Discussion of pending legislative proposals*. Although pending legislation often changes prior to becoming law, activity regarding a large federal energy and farm bills warranted evaluation. Elements of these proposals, especially regarding renewable fuel mandates, will greatly affect the future structure of biofuel markets and could expand the overall level of subsidies received by tens of billions of dollars per year.

1.2 Outline of the study

This report begins with an update on the ethanol and biofuel markets, followed by a discussion of the major subsidy elements. Existing subsidies are examined in terms of overall magnitude and with respect to a variety of metrics including subsidies per unit energy produced and per unit GHG emissions displaced. A separate chapter discusses pending subsidies at the federal level. A recap of the methodology used in this study (as well as the one last year) can be found in Annex 1. Annex 2 contains detailed multi-year tables showing estimates for total support and subsidy intensity.

1.3 Objectives and framework for analysis

This report examines public support for biodiesel and ethanol for road transportation in the United States. It forms part of a multi-country effort by the Global Subsidies Initiative (GSI) of the International Institute for Sustainable Development (IISD) to characterize and quantify government support for biofuel production, distribution and consumption, as well as the subsidies to producers of key factor inputs. Such information, the GSI believes, is vital to understanding the cost effectiveness of different policy options. Given the growing share of crops that are being diverted to energy production, the amount and form of support provided to biofuels is also relevant to issues relating to agriculture, such as trade and food security.

Figure 1.1 illustrates the framework used in the report to discuss subsidies provided at different points in the supply chain for biofuels, from production of feedstock crops to final consumers. Defining a baseline requires deciding how many attributes to look at, and determining what

[3] We used actual data on production and consumption where it was available. Future year projections took an average of the EIA and FAPRI values, as they usually did not agree. Where one of the sources modeled a different policy baseline (e.g., EIA assumed biodiesel excise tax credits would not be renewed), we relied on projections from the other data provider.

programs are too broadly cast to consider in an analysis of one particular industrial sector. In our analysis, we have focused on subsidies that affect production attributes that are significant to the cost structure of biofuels, including subsidies to producers of intermediate inputs to production, namely crop farmers. Since biofuel production systems can be energy-intensive, the inclusion of subsidies to input energy would have been appropriate, but we had insufficient data to do so. More remote subsidies, such as to particular modes of transport used to ship biofuels or their feedstocks, were beyond the boundaries of this analysis.

Support to production and consumption is provided at many points in the supply chain. For the purpose of this report, the dividing line between production and consumption is taken as the point at which the biofuel leaves the manufacturing plant. The one exception is volumetric (i.e., per-gallon) subsidies provided to blenders, which are treated in this report as falling on the production side of the dividing line.

At the beginning of the supply chain are subsidies to what economists call "intermediate inputs"—goods and services that are consumed in the production process. The largest of these are subsidies to producers of feedstock crops used to make biofuels, particularly corn (for ethanol) and soybeans (for biodiesel). Although these subsidies do not result in a one-for-one reduction in the feedstock prices, and therefore the input costs for biofuel manufacturers, they are believed to have some depressing effect on prices. Fabiosa *et al.* (2006), for example, estimate that full liberalization of agricultural markets with the removal of trade distortions would raise world (and therefore U.S.) prices of corn by 5.7 percent. Moreover, to the extent that production of the feedstock crops creates a demand for subsidies, the proportional share of the total subsidies to those crops used in the production of biofuels can be considered one element of the gross costs to government of promoting biofuels. (The net cost would take into account any increased taxes paid by farmers as a result of their increasing taxable incomes). Ducks Unlimited, for example, has pointed out that subsidies for crops—and the expansion of biofuels in particular—are contributing to the conversion of former grasslands to row crops and the loss of small wetlands in the Dakotas (Niskanen, 2006).

Subsidies to intermediate inputs are complemented by subsidies to value-adding factors—capital goods; labor employed directly in the production process; and land. In the case of biofuels, most of the federal subsidies supporting value-adding factors in the United States are linked to productive capital. These typically take the form of grants, or reduced-cost credit, for the building of biofuel manufacturing plants. Some localities are providing land for biofuel plants below market prices or for free; or exempting land from property taxes. Many others are paying, at the taxpayer's expense, for upgrades to roads or rail lines servicing biofuel plants. These types of subsidies lower both the fixed costs and the investor risks of new plants, improving the return on investment.

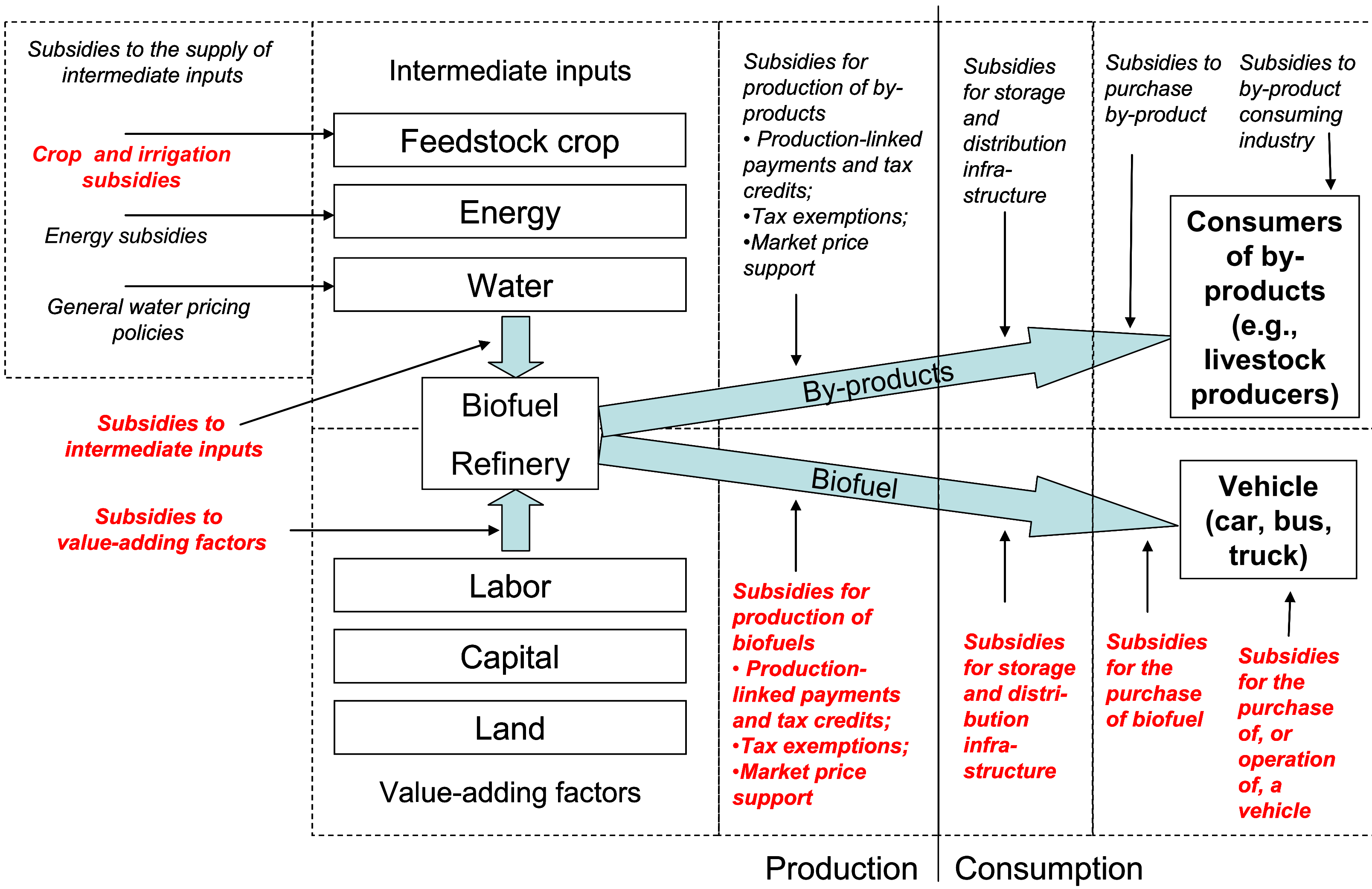
Further down the chain are subsidies directly linked to output. Output-linked support includes per-gallon federal tax credits to both the biodiesel and ethanol sectors. These are nominally provided to fuel blenders, and they enable those blenders to pay a higher price for the biofuels they purchase than they could without the subsidy. Production-linked subsidies are also common at the state level. Government policies that artificially elevate the price of biodiesel or ethanol are also relevant here. Import tariffs that protect domestic producers from cheaper imports are one example, impeding the ability of foreign producers to capture domestic market share. Tariffs are particularly costly to consumers at points of the country that are far geographically from domestic biofuel production, but easily accessible to imports, most notably the east and west coasts.

Subsidies are also being provided to help reduce the costs of building or refurbishing the storage tanks and infrastructure required for distributing biofuels, particularly E85 (a blend of 85 percent ethanol and 15 percent gasoline). These help increase the availability of biofuels and reduce the total cost of supplying them to final consumers.

Subsidies and government-procurement preferences for the purchase of vehicles that are intended to run on biofuels increase the potential size of the market for biofuels, albeit indirectly. Nonetheless, these policies are often drivers behind other policies to increase the production or availability of biofuels. For example, having purchased flex-fuel vehicles (vehicles capable of running on ethanol-gasoline blends containing up to 85 percent ethanol) in the past, many federal and state agencies are now requiring that these vehicles run on E85 whenever practical.

Subsidies and regulatory requirements more directly affect the demand for biofuels. Subsidies for consumption are minor, and have been provided mainly through government procurement programs that give preference to biofuels (such as that of the U.S. Navy for biodiesel) and assistance to school districts and municipalities that run vehicles (particularly buses) on biofuels. Of much greater influence have been so-called "renewable fuel standards," which require that a specified percentage of biofuels be used in total transport fuels consumed. Such standards—particularly if they are mandated and not just indicative targets—set a floor for the amount of biofuels that will be sold, independent of price. These are expected to become an increasingly important source of subsidies in the future.

Figure 1 Subsidies provided at different points in the biofuel supply chain



2 Market update

Over the last year, the capacity of both ethanol and biodiesel producers in the United States has expanded at a rapid pace, though warning signs have become more evident. The role of subsidies in this growth has continued to be central. One study evaluating the impact of subsidy elimination is illustrative:

> *In the event that the biofuel tax credits and ethanol import tariff are permitted to expire, the ethanol production would contract by 30 percent and biodiesel production by more than half. These results even take into account the recent surge in capacity, but net returns would fall so dramatically that many of these plants would be unused for their inability even to cover operating costs.* (Kruse *et al.*: 21)

Market projections by both the U.S. Energy Information Administration (EIA) and the Food and Agricultural Policy Research Institute (FAPRI) suggest that ethanol will continue to grow at a rate faster than current mandated consumption levels under the Renewable Fuel Standard (RFS); and that non-corn feedstock will remain insignificant for many years to come. Both groups project biodiesel demand stalling out at roughly 500 million gallons per year, well below the current productive capacity.

The FAPRI expects that net returns will decline in both markets. In the ethanol sector, they estimate net returns of $ 0.20/gallon or less in 60 percent of their scenarios for 2009 and beyond. In their biodiesel scenarios, low net returns are estimated to begin next year, with negative returns in most of their scenarios after 2009 (FAPRI, March 2007: 3).

2.1 Ethanol

Based on data compiled by the Renewable Fuels Association (RFA), the leading trade association for the ethanol industry, the ethanol industry added 1.1 billion gallons of capacity in 2006, and nearly 700 million gallons more through July of 2007. More than six billion gallons of additional capacity are planned or under construction, with slated completion times before the end of 2009. The plants continue to rely almost entirely on corn. A handful of cellulosic plants are in the early development stages, mostly the result of concentrated funding from government entities. The average size of corn-based facilities continues to grow, reaching almost 52 million gallons per year in 2007, compared with an average of 32 million in 1999.

Capacity utilization remains quite high. Based on comparisons with the EIA's *Monthly Oxygenate Survey* and industry-reported productive capacity, utilization as of August was running above 95 percent. Although the EIA is confident that they are capturing all production in their surveys (Conner, 9 August 2007), industry reports regularly state that plants are running 10–20 percent above their nameplate capacity—suggesting that utilization levels above 100 percent might be more accurate. Some plants can run as high as 40 percent above nameplate (Havran, 2 August 2007; Corle, 2 August 2007). We were unable to resolve this discrepancy. In reporting capacity data to the RFA, some biofuel producers provide actual production levels, others provide nameplate capacity (Hartwig, 20 August 2007). To the extent that reported consumption is smaller than actual market outcomes, our subsidy estimates will be understated.

Despite continued investment and growth, not all of the signs in the market are positive. Once all the in-process plants come on-line, cumulative capacity will be more than 17 billion gallons per year. The "blending wall"—the point at which all gasoline vehicles are using a 10 percent ethanol blend, will be surpassed. Higher blends have historically been resisted due to concerns that they could damage some vehicles in the existing auto fleet. The industry has therefore been pushing hard to expand the number of vehicles able to burn higher blends (especially E85) and the associated refueling infrastructure. They have also been pushing for higher concentrations of ethanol allowed in the gasoline mix used by regular vehicles (Irwin, July 2007: 123).

Margins have declined sharply in recent months. Ethanol prices have fallen 30 percent since early summer, with margins falling even more (Gutierrez, 20 September 2007; Etter and Brat, 1 October 2007). The stated reasons have been technical problems with blending the ethanol fast enough and transportation bottlenecks (Krauss, 30 September 2007), though rising corn prices are also likely a factor. Time will tell whether these constraints will prove to be merely short-term.

Plant construction costs have risen sharply as well, due to bottlenecks among the firms skilled at building the plants and a more general surge in the cost of the raw materials used in plant construction. Investment capital costs per gallon of capacity had risen from roughly $ 1.20 in early 2006 to an estimated $ 2.00 in early 2007 (Kram, July 2003: 67). Estimates from October 2007 are even higher, at $ 2.20 per gallon of capacity (Etter and Brat, 1 October 2007), though costs would likely decline if plants began to slow construction in the face of lower margins. Compounding these challenges, credit has become more difficult to access, driving up the cost of private capital in the industry.

Costs aside, high demand for new plants has extended construction times from 12 months to 18–24 months (Kram, July 2007). Longer construction times increase the investor risk to changing market conditions. Finally, plant siting issues have grown sharply in many jurisdictions. They are the result of a variety of problems evident at existing plants, ranging from air emissions and water depletion to large increases in traffic flows.

These factors are just beginning to trigger changes in investment behavior. In early October, Vera Sun suspended construction on a $ 40 million facility in Indiana due to declining margins (StreetInsider.com, 2 October 2007). Other new-plant suspensions and cancellations have followed (Feinman, 16 October 2005).

2.2 Biodiesel

Like the ethanol industry, biodiesel productive infrastructure continues to undergo rapid and widespread expansion; the National Biodiesel Board (NBB) reports capacity nearly doubling since 2006, reaching 1.4 billion gallons per year in 2007. More than 800 million gallons of capacity entered production in the last 18 months, with an additional 1.9 billion slated for completion over the next two years or so. Because the NBB's definition of "in construction" means that ground has been turned, industry analyst Leland Tong expects that most of these facilities will be completed (Tong, 27 July 07). Although biodiesel plants remain smaller than ethanol plants, there is a similar trend for newer facilities to be larger in size.[4]

The impetus behind this continued investment remains a mystery, as capacity utilization in the U.S. plants appears to be quite low. Carriquiry (2007) estimates U.S. plants are currently operating at only 43 to 57 percent of capacity. This level is likely to fall further as new plants come on-line. By comparison, European plants operate at roughly 80 percent of capacity (Carriquiry, 2007: 13).

The U.S. utilization levels seem too low to support continued operations on a long-term basis, and certainly too low for investors to continue to invest hundreds of millions of dollars in new capital. While plants do produce some non-fuel products (mainly glycerine), neither the quantities nor the product prices are sufficient to support the large capacity added in recent years to make fuel (Carriquiry and Paulson, 16 August 2007, 17 August 2007, 24 August 07). While it is possible that some U.S. production is being exported to Europe that, for political reasons, is not being reported in the industry trade association's tally,[5] industry sources suggest this is not happening. U.S.-

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4 Paulson and Ginder (p. 3) note that there are slight economies of scale for a 60 million gallons per year plant versus 30 million gallons per year, but that these would "quickly be eroded away if the plant was unable to run at capacity."

5 The European Biodiesel Board has initiated an anti-dumping case against shipments from the U.S., arguing that the blenders' credit of $ 1 per gallon constitutes an illegal trade barrier.

sourced exports (including both U.S. production and foreign shipments that touch into U.S. ports to blend in a splash of diesel in order to obtain excise tax credits before being trans-shipped to Europe) have been estimated by industry sources to run into the hundreds of millions of gallons per year.[6] However, information on the U.S. portion is more anecdotal than statistical.

The industry has gradually improved operations, though these factors are not sufficient to overcome low-capacity utilization. Carriquiry (2007: 23) notes that new plants have nearly 100 percent efficiency in their trans-esterification process, versus only 85 percent in the early plants. In addition, most of the newer plants (and roughly 45 percent of total capacity) are "multi-feedstock," in that they can produce methyl esters from a variety of vegetable oil or animal fat sources (Paulson and Ginder, 2007: 8). This provides some protection against volatility in supply for a single commodity, though not against a general rise in the prices of oils and fats. However, the majority feedstock in the U.S. remains soybean oil, and despite much unused production capacity in 2006, the industry still consumed nearly 10 percent of all soybean oil produced in the country (Kram, July 2007: 49).

The industry could become feedstock-constrained, a situation not helped by the widespread transfer of soy acres into corn. Driven by significantly higher returns per acre, farmers boosted corn planting by 19 percent between 2006 and 2007 to levels not seen since 1942. In contrast, soy acreage declined by 15 percent over the same period, from 75.5 million to 64.1 million acres (Brasher, 29 June 2007).

Methyl ester biofuels also face potential competition from "renewable diesel," a diesel substitute that is co-produced in oil refineries from waste animal fats using a hydro-thermal process. Although these fuels are not eligible for a blender's credit, they can access a production tax credit of similar magnitude.

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[6] In contrast to industry data, the Joint Committee on Taxation (19 June 2007b) pegs shipments at only 30 million gallons per year or so. In the absence of clear data on from where the JCT estimate came, this study relied on industry sources.

3 Current support for liquid biofuels

3.1 Market price support

Import tariffs on ethanol constrain the gallons brought in from outside the country. Were the borders open, a larger quantity of less expensive foreign ethanol would enter the country, bringing U.S. ethanol prices down. Renewable Fuel Standards (RFS) constrain the ability to meet demand with other fuels, generating an artificial price premium on the blends allowed under the particular RFS statute. This premium will flow to domestic or foreign producers of eligible fuels. In practice today, the beneficiary of this policy is predominantly domestically-produced corn-based ethanol.

Market price support is a measure of how much extra income U.S. ethanol producers receive as a result of market interventions that artificially raise domestic returns. Some of this return may come through higher market prices for their product. However, another important source of subsidy is through the value of Renewable Fuel Credits (RFCs) they earn by making a particular fuel. Although it is government policies that create market price support, the actual financial flows usually involve a transfer from consumers to producers through higher prices.

Elobeid and Tokgoz (2006) have estimated this value econometrically, updating their earlier work on the subject. Were trade barriers to be removed alone (retaining the existing renewable fuel mandate of 7.5 billion gallons per year), they estimate the average U.S. ethanol prices from 2006–2015 would fall by 13.6 percent, or $ 0.27 per gallon.[7] Applying this to domestically-produced ethanol generates a subsidy of $ 1.3 billion in 2006, rising to more than $ 3 billion per year as domestic production grows. Should the import tariff remain in place while more stringent Renewable Fuel Standards are implemented (as are proposed in pending energy legislation), the MPS would be expected to rise significantly.[8]

Though importers also benefit from the higher-than-market prices, the tariff serves to direct most of the benefits to domestic producers. Foreign producers that do access the U.S. market (and its associated market price support) must first pay an "entry fee" in the form of the tariff. This reduces their effective MPS subsidy, though apparently

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7 Removal of both the import tariff and ethanol volumetric excise tax credit would generate even larger declines in domestic prices (between $ 0.29 and $ 0.36 per gallon, per Elobeid and Tokgoz (2006) and Kruse *et al.* (2007)). However, the tax credit subsidies are captured directly in our totals, while the MPS from the tariffs and RFS are not.

8 In its rulemaking for the Renewable Fuel Standards, the U.S. Environmental Protection Agency (EPA) also modeled the anticipated market impacts of up to a 9.6 billion gallon per year standard. Their results suggested that prices, net of excise tax credits, would actually fall after the mandate was enacted. This counter-intuitive result came from a few factors. First, they attributed quite large savings to the petroleum sector, an artefact of historically low import prices for low-octane gasoline that would enable refiners to avoid capacity expansions. Second, they attributed most of the current growth in ethanol production to blending credits and very little incremental cost of ethanol production to the standard itself Third, their results are driven by compliance costs, not full market impacts (that, for example, would include margins to market participants). The EPA acknowledged that their assumption regarding refinery capital costs needed revisiting, and noted that the timeline for the rule had been too tight as to allow adequate time by their staff or their contractor to vet and redo model runs. However, they felt that their overall estimates were still valid, noting that for the draft rule they had used a different approach and reached similar cost estimates (Wynborny, 10 February 2007). We do not believe that significant increases in fuel mandates, often within a relatively short period of time, would be likely to save money. The items noted above likely explain at least part of the EPA's counter-intuitive results, and led to our decision not to use their estimates in our calculations of MPS. Because we believe the pending RFS will have far more significant costs to the economy than the present one, and will drive the structure of the transport fuels market, we hope that the three organizations now evaluating this issue (EIA, EPA, and FAPRI) will work together to ensure consistent assumptions and analysis.

not to zero. Official tariff rates on ethanol imports include a 2.5 percent ad valorem rate and an additional 54 cents per gallon secondary tariff on certain source countries (most notably Brazil). However, data compiled by the U.S. International Trade Commission (USITC) indicate that actual duties collected on imported ethanol during 2006 and the first half of 2007 were much lower, averaging only 14 to 16 cents per gallon. This may be the result of drawbacks under existing law that allow tariff rebates if a duty-paid good, or a substitute good, is exported. In practice, a "person who manufactures or acquires gasoline with ethanol subject to the duty imposed...can export jet fuel (which does not involve the use of ethanol) and obtain a refund of the duty paid..." (Joint Committee on Taxation, 2 October 2007a: 48).

Based on Elobeid and Tokgoz (2006), these imports would still have received a partial level of support of more than 10 cents per gallon. This would boost the overall MPS subsidy by $ 80 million in 2006, and by $ 30–35 million per year in future years assuming projections for lower imports come to be.

In theory, biodiesel could also benefit from some level of market support. There is a most-favored nation ad valorem tariff of 4.6 percent that applies to imports from countries with which the United States does not have a free-trade agreement.[9] In addition, biodiesel is eligible under the RFS. In practice, the MPS for biodiesel does not seem significant at present for two reasons. First, imports of biodiesel remain relatively low. Second, capacity within the RFS is primarily met by ethanol, which is currently more profitable to produce.

Ten states have some form of a purchase mandate for ethanol or biodiesel (Alternative Fuels and Advanced Vehicles Data Center, 27 August 2007; Pew Center on Climate Change, 9 August 2007). The cost impacts will vary depending on the region and the specific mandates. In some cases they are expected to trigger incremental price distortions to the federal mandate, effectively creating an additional level of price support. The U.S. Energy Information Administration estimates that the ethanol mandate in Minnesota (currently 10 percent) has no impact on prices since fuel ethanol is currently competitive; but that the Hawaiian mandate (85 percent of ethanol must be E10) does drive up prices since both imported ethanol and local feedstock are more expensive than gasoline (EIA, AEO 2007: 24). The MPS subsidy in Hawaii would be above the subsidies the state already provides to ethanol consumption by exempting E10 or higher from the state sales tax on gasoline. States mandating higher blend ratios than commonly available (Iowa at 25 percent; Minnesota at E20 percent if allowed by regulators by 2013) will also likely induce local price distortions. Mandates focusing only on small market segments, such as a B5 mandate for government and school usage in New Mexico, may drive up operating costs for the related government entities, but are unlikely to affect enough volume to skew market prices.

A variety of more stringent Renewable Fuel Standards are currently under consideration by Congress, including some that mandate specific quantities of biodiesel. Under many of these proposals the market shifts created by the RFS will generate subsidies to eligible fuels well in excess of even the excise tax credits. The details of these proposals are discussed in more detail in Chapter 5.

3.2 Volumetric support

3.2.1 Volumetric ethanol excise tax credit (VEETC) and volumetric biodiesel excise tax credit (VBETC)

The volumetric excise tax credits for blending biofuels remain the single largest implemented subsidy to both ethanol and biodiesel. Rates have remained the same over the past year, with every gallon of ethanol (including imports) receiving a 51 cents per gallon blender's credit. For biodiesel, rates have remained at 50 cents per gallon

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9 U.S. International Trade Commission, 2007 Tariff for HTS 38249040, accessed 10 April 2007.

for biodiesel from waste cooking oils and $ 1.00 per gallon for biodiesel made from virgin agricultural feedstock. No caps or linkage to oil prices have been instituted; as a result, the subsidy cost has risen linearly with domestic consumption.

In our October 2006 report, we noted the existence of a further tax loophole that enabled the excise tax credits to be excluded from taxable income (most tax credits are added to taxable income, reducing their cost to the Treasury). Sources within both the Joint Committee on Taxation of the U.S. Congress (JCT) and the U.S. Department of Treasury (Treasury) have confirmed that there have been no technical corrections in how the excise tax credits are treated by the Internal Revenue Service (IRS). As a result, the credits are still excludible from taxable income. The incremental benefit of this exemption was $ 1.2 billion for ethanol in 2006 on top of a direct revenue loss of $ 2.8 billion; and $ 105 million for biodiesel, on top of $ 250 million direct revenue loss. The incremental subsidy from this tax loophole, supposedly a policy accident, has become the third largest subsidy to ethanol and the second largest to biodiesel.

By 2015, even if there is no increase in the RFSs, the VEETC will generate subsidies of $ 6.3 billion per year on a revenue loss basis and $ 8.9 billion per year on an outlay equivalent basis. The comparable figures for the VBETC on biodiesel are $ 470 million and $ 670 million per year. The low values for biodiesel result from quite negative predictions of how much the industry will grow over the next five to seven years.

Also of interest is the fact that ethanol credits are earned on both the ethanol volume and the denaturants included in these blends to improve their usability. Currently, the U.S. JCT estimates that roughly $ 60–80 million per year in credits (already reflected in the above totals) are associated with the denaturants (Joint Committee on Taxation, 19 June 2007a: 2).

On the biodiesel side, there is evidence of increasing shipments of subsidized biodiesel from the United States to Europe. The source of these exports can either be biodiesel produced in domestic plants or cargo shipped from foreign suppliers and imported to, and then re-exported from, the United States. Were substantial domestic production being shipped abroad but not reported in the NBB numbers, it would help bolster capacity utilization to levels that might make the massive build out continuing in the sector seem rational. However, while data on international trade in biodiesel are not accurately tracked at present (Jarrell, 18 July 2007 and 27 July 2007), industry sources were not aware of any specific incidents of under-reporting. Two requests to the NBB for more information on the source and magnitude of these exports went unanswered.

Whether from U.S. production or foreign tankers that touch in port briefly to blend in 0.1 percent regular diesel and qualify for the excise tax credit (a practice referred to as "splash and dash"), an estimated 150 million gallons will head to Europe in 2007, along with taxpayer subsidies of $ 150 million ($ 215 million on an outlay equivalent basis). Of this, we estimate from conversations with industry participants that roughly 90 million gallons are from outside of the United States and 60 million from U.S. biodiesel plants. In the aggregate, the exports mark a sharp increase from only 30 million gallons in 2006.[10] Once in Europe, shipments generally receive additional subsidies prior to consumption.

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10 "Europe's biodiesel industry acts on 'dumped' imports," *Bioenergy Business*, 27 July 2007. Data for 2006 come from Mark Clayton, "Biofuel boondoggle: U.S. subsidy aids Europe's drivers," *Christian Science Monitor*, 8 June 2007. Garofalo, Raffaello and Gaede, Moritz. "Re: International trade of biodiesel - unfair competition from 'B99' subsidised exports from U.S. and Argentinean Differential Export Taxes," Letter to Peter Mandelson of the European Commission, 19 March 2007.

3.2.2 Renewable biodiesel credit

The renewable biodiesel credit is a distinct tax break from the VBETC. It was implemented in the American Jobs Creation Act of 2004 and extended in EPACT05 (Yacobucci, 3 January 2007). Although the rates are the same ($ 1.00 for agricultural feedstock including animal fat; $ 0.50 for waste oils), the producers, rather than blenders, claim the credit. However, as an income tax credit rather than an excise tax credit, it is subject to standard requirements that the tax credit be included in taxable income. As a result, its financial value to the industry is lower than the excise tax credits.[11]

The potential importance of this credit grew with an April 2007 notice (#2007–37) from the U.S. IRS allowing eligibility for "renewable diesel" that is made via the thermal depolymerization of animal fats. The product is not a methyl ester diesel product, but according to the industry is almost identical to conventional petroleum-based fuel. Benefits of this similarity include the ability to use existing distribution infrastructure and fewer problems in cold weather. Tyson Foods and ConocoPhillips have a joint venture for a 175-million-gallons–per-year renewable diesel plant at their Borger petroleum refinery in Texas. In addition to Tyson, there are six other companies considering bringing renewable diesel to market (Kotrba, July 2007: 91).

The implications for biodiesel economics are not yet clear; and the likelihood of production capacity is also unclear. Nonetheless, the traditional biodiesel industry has been quite vocal in opposing the IRS's decision (see, for example, Jobe, 3 May 3007); so too has the soap and detergent industry, which must now compete for animal fats with a competitor receiving a $ 1.00 subsidy that they do not (The Hill.com, 24 May 2007). Relying on industry estimates (McAdams, 2007), we assume the first capacity will come online in 2008 with steady growth subsequent to that facility since the product can tap into existing production and distribution infrastructure. From zero cost in 2006, the renewable diesel credit is estimated to reach $ 175 million in 2008 and grow to nearly $ 500 million per year in the ensuing five years.[12] There are a number of legislative efforts to exclude co-processed biodiesel from eligibility for this tax break; such changes would obviously affect both production and subsidy levels.

3.3 U.S. Department of Agriculture's Bioenergy Program

This program provided output-based subsidies to eligible producers of biofuels until it was discontinued in 2006. The subsidy varied annually based on budget appropriations. Some version of the program may be re-instituted in the Farm Bill of 2007, or via other pending energy legislation. Current versions of legislative language on this issue

[11] Monte Shaw (August 2007), Executive Direct of the Iowa Renewable Fuels Association argues that the structure of the renewable diesel credit disadvantages conventional biodiesel. He raises the interesting point that co-processing is more likely to award a tax credit for impurities and water than is conventional biodiesel (this issue also applies to ethanol, for which denaturants often get a tax break as well). However, he also claims that renewable diesel producers get 100 percent of the credit while other producers must "negotiate for its part of the credit with its customers in the marketplace." In fact, all subsidies and taxes are shared among various market participants depending on their relative bargaining power. The outcome is not determined by the point at which the credit is awarded. Shaw also overlooks that conventional biodiesel excise tax credits are excludible from income for the time being, while renewable diesel credits are not. This is a substantial incremental benefit to the conventional biodiesel supply chain.

[12] The Joint Committee on Taxation has estimated this tax expenditure at only $ 50 million for roughly two years, before dropping to zero. Because the JCT assumptions are proprietary, it is not possible to evaluate what is driving their estimate. However, it is likely that they assume that the Tyson/ConocoPhillips plant will open late in 2008 (so throughput will be well below capacity during that year) and that the tax break will be eliminated even for existing plants soon after. This seems unlikely, given that the joint ventures are likely to be pursued by quite powerful interests that include the major meat and oil firms in the country.

(see Chapter 5) suggest that changes in eligibility are likely. In addition to ethanol and biodiesel that formed the bulk of the original program, a variety of other biofuels, including non-transport applications, would be eligible. Current language also excludes ethanol made from corn starch and biodiesel coproduced at petroleum refineries.

3.4 Reductions in state motor fuel taxes

With ethanol blends of 10 percent or less widely used in the country, few states continue to give reduced fuel excise taxes on these blends. Many still provide reduced rates for E85 and biodiesel blends. Tax reductions for E85 blends can be fairly large. Based on the states we quantified, the average exemption for E85 was 11.5 cents per gallon; the median exemption was seven cents per gallon. Despite these benefits, the total gallons of ethanol consumed in E85 remain quite low—less than 15 million gallons in 2006 according to the EIA. This is equivalent to roughly 17.4 million gallons of E85, assuming an 85 percent blend rate. The actual blend rate is a guess: one official in a prominent biofuels state notes that "we suspect that the majority of the E85 is 70 percent to 75 percent ethanol but cannot support [prove] that statement." States such as Minnesota allow winter blends as low as 60 percent ethanol to count as E85. Lower blend rates would drive up the overall subsidy costs of E85 within a state; however, given the low aggregate value at present, the impact on our subsidy totals would not be significant.

The largest revenue losses tend to come from states that exempt particular fuel blends from *sales* taxes on fuels; and that provide subsidies to the more widely-traded fuel blends. Sales tax exemptions are more difficult to observe than excise-tax exemptions in the standard reporting of fuel tax rates. Sales tax exemptions, along with state-level mandates, seem to exert a big influence on where U.S. production ends up being sold. For example, although the data on where biodiesel is being sold and in what concentrations remain extremely poor, one source working with the industry reported that 25 percent or more of domestic production is believed to go into the single state of Illinois. Biodiesel blends of 11 percent or more are exempt from the state's 6.25 percent sales tax on fuel. Another 20 million gallons per year is believed to supply Minnesota, which mandates the use of biodiesel blends. An additional 50–70 million gallons of domestic production is believed to go into export markets—most likely to take advantage of additional downstream subsidies in European markets.

The states below are believed to have the largest revenue losses from reductions in state fuel taxes. However, this group will change over time. New York, for example, has very large tax reductions now in effect for E85 and B20, and subsidies will rise sharply as intra-state consumption grows.

> **Hawaii.** Hawaii mandates that 85 percent of its gasoline be E10 while at the same time exempting E10 from fuel sales taxes. This combination triggers a revenue loss of close to $ 90 million per year—in addition to potentially higher consumer prices from having to import ethanol for blending (more than 55 million gallons in the first 12 months of the mandate) from the mainland (Hao, 25 June 2007). The state hopes to eventually jump-start island-based biofuel production of sugar- or cellulosic-based ethanol products with a number of other producer subsidies. But the market price is still expected to exceed that of standard gasoline.
>
> **Illinois.** Illinois offers a 2 percent reduction in the state sales tax for E10 (ACE, 2007: 15), but a full 6.25 percent reduction for E85 and B11 or higher. At current prices, this translates to roughly 20.2 cents per gallon of the blend. A tax reduction of this amount for a B11 blend translates to $ 1.83 revenue loss per gallon of B100. This large subsidy explains why industry sources estimate that at least one-fifth of the biodiesel made in the U.S. in 2006 was sold in Illinois, generating a subsidy to biodiesel of more than $ 90 million per year. Revenue losses associated with E10 were an additional $ 270 million for 2006, the result of ethanol sales in excess of four billion gallons of E10 (FHWA, 2007). Sales of E85 remain low enough that revenue losses associated with its sale are still small.

Indiana and Iowa. Both states have small reductions in the state excise tax for ethanol blends, combined with large sales. Calculated losses for Indiana are approximately $ 26 million per year for E10. For Iowa, the computed revenue loss for 2006 is roughly $ 29 million. However, the Iowa Department of Revenue reports only $ 1.5 million in rebates claimed for that year. We use the lower number, though are not sure why there would be such a discrepancy (IA Fuel Tax Monthly Reports, accessed August 2007).

In total, we estimate state fuel tax reductions resulted in more than $ 390 million in subsidies to E10 in 2006; less than $ two million in subsidies to E85; and more than $ 90 million in subsidies to biodiesel.[13] Revenue losses in future years are assumed to grow at 5 percent annually. This is much slower than projected growth in biofuel consumption, implicitly assuming that most of the growing consumption will be in formulations and states that do not receive reduced excise or sales taxes.

More accurate information on actual state-level sales of both biodiesel and E85 would generate higher aggregate subsidy values. Especially in the case of biodiesel, we have virtually no information on state-level consumption; and relatively little on state tax reductions. As data on biodiesel tax rates have recently begun to be reported under the International Fuel Tax Agreement, this situation should improve over time.

3.4.1 Small producer tax credit

The small producer tax credit provides a 10-cents-per-gallon production tax credit, up to $ 1.5 million per year per plant, for any ethanol or biodiesel producer with less than 60 million gallons per year in capacity. Prior to the Energy Policy Act of 2005 (EPACT05), the production cut-off was only 30 million gallons per year, and less than 40 percent of the plants then producing were able to qualify based on size. In 2006, when the new limits took hold, the share of ethanol plants qualifying jumped to nearly 85 percent. This has been declining as newer plants entering the market tend to be larger than 60 million gallons per year. By the end of 2009, less than 60 percent of the plants will meet the 60 million gallons per year cut-off, based on construction trends. The PTC is capped at $ 1.5 million per plant per year. While this subsidy may have influenced plant sizing in the early days of the ethanol industry, most new ethanol facilities seem to be above the cut-off. The effects may be more relevant for biodiesel producers, where plant sizes tend to be smaller.

Industry-wide, maximum small-producer tax credits are estimated at $ 110 million per year, rising to roughly $ 170 million annually over the next couple of years. Actual levels may be lower, depending on how joint ownership requirements are interpreted. The capacity limits on the credits disallow the subsidy if combined capacity for a single investor exceeds 60 million gallons per year. While each plant will be a separate corporation, it is likely that at least some of the majors would have these PTCs disallowed on the basis of cross-ownership patterns, reducing the national magnitude of the subsidy.

Because biodiesel plants tend to be smaller than ethanol plants, most biodiesel plants continue to be eligible for the small-producer tax credit. Based on current production levels, the subsidy will reach $ 190 million per year by 2008. Although capacity may continue to increase in subsequent years, low capacity utilization suggests new construction should slow down and that there may even be closures. We therefore assume steady producer credits in years subsequent to 2008 in the absence of more stringent renewable fuel mandates.

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[13] Absent state-specific data on E85 consumption, sales were allocated by state based on their share of E85 refueling outlets.

3.5 Subsidies to factors of production: capital

3.5.1 Excess of accelerated over-cost depreciation

Legislatively-determined *asset classes* stipulate how quickly capital investments can be deducted from taxable income. Accelerated deduction allows firms to deduct investment costs more quickly than the assets actually wear out, in the process deferring taxation on this income for many years. Biofuel facilities are classified in class 49.5, "assets used in the conversion of refuse or other solid waste or biomass to heat, or to a solid, liquid, or gaseous fuel." As a result, they benefit from a shortened depreciation life (seven rather than 30 years), and an accelerated depreciation method (200 percent declining balance rather than straight line).[14] Investors have also had success with "asset segregation" studies that get many of the structures associated with processing equipment reclassified as equipment rather than buildings, and hence eligible for more favorable depreciation schedules (McCurry, February 2007: 56).

Rapid growth in installed capacity in both the ethanol and biodiesel sectors has driven up the capital investment that is being depreciated at an accelerated rate. As a result, the tax benefits to the industry are likely to rise sharply in the next few years. Cumulative capital investment in ethanol production, including projects now in process, is nearly $ 18 billion since 2000; and nearly $ 3 billion in the biodiesel sector. These figures do not include substantial investments in transport infrastructure to move the fuels, and in storage and dispensing infrastructure. The EPA estimates that each gallon of ethanol production capacity requires supporting investments of 0.5 cents for mobile facilities (rolling stock); and 0.7–0.9 cents per gallon of capacity for fixed distributional and delivery infrastructure (EPA RIA, April 2007: 288). This translates into roughly $ 150 million in additional investment, a seemingly quite low 0.8 percent of production investment. Should dedicated ethanol pipelines actually be built, the costs would rise substantially.

The resultant tax subsidies run into the hundreds of millions of dollars per year. In the ethanol sector for example, revenue losses of roughly $ 170 million in 2006 jump to $ 680 million in 2008 and $ 935 million in 2009. Because we have estimated capacity additions only through 2009, accelerated depreciation subsidies drop off starting in 2010; were capacity to continue to grow, this decline would not occur until later.

We estimate that accelerated-depreciation subsidies to biodiesel also rise sharply, from less than $ 25 million in 2006 to $ 160 million in 2008 and more than $ 200 million in 2009. This reflects the sharp increase in capacity now in process. Revenue losses begin declining in 2010 absent continued growth in the capacity-base.

Should higher fuel mandates become law, however, accelerated depreciation subsidies under most of the proposals under consideration would continue rising strongly for both ethanol and biodiesel over the next fifteen years.

3.5.2 Special depreciation allowance for cellulosic biomass ethanol property

A new provision established through the Tax Relief and Health Care Act of 2006 allows certain taxpayers to write off 50 percent of their capital investment in a single year (Yacobucci, 3 January 2007). The subsidy is available only to enzymatic processes; gasification is not eligible. However, it would generate substantially more rapid write-offs of the investment than under the asset class 49.5 categorization, and therefore higher tax subsidies as well. For the moment, the subsidies from this provision are quite low since there are no cellulosic plants in operation. However, as cellulosic plants begin to enter the market, the tax losses under this provision will rise. Pending

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[14] Additional details on the asset classification and workings of accelerated depreciation can be found on page 31 of the October 2006 report.

legislation that would dramatically increase mandates to use cellulosic fuel would also greatly increase taxpayer subsidies under this provision.

3.5.3 U.S. Department of Energy R&D and demonstration plants

The Department of Energy's (DOE's) Biomass and Biorefinery research and development program includes a variety of areas related to biofuel research. This includes feedstock infrastructure, production methods, utilization of production outputs, a reverse auction to support cellulosic ethanol facilities and a variety of congressionally-directed activities. The estimated share of these programs for ethanol is in the range of $ 110 million in 2006, rising to close to $ 400 million per year by 2009. Similar values for biodiesel are $ 30 million to $ 80 million.

The EPACT05 included a cellulosic ethanol production incentive in the format of a reverse auction, in which firms would bid for the lowest required subsidy to deliver a certain amount of cellulosic ethanol. The approach was innovative in that it established market discipline in the granting of federal subsidies. It is notable that the program, originally slated to be funded at around $ 100 million, is now being funded at only $ 5 million—and not until 2008. Instead, the standard model of large grants to specific demonstration projects has been followed, using up most of the DOE's capacity for this type of support.

The distortions from the program are contained somewhat by the fact that they mostly support cellulosic ethanol, rather than grain-based systems. Described below, the subsidy costs associated with these grants have been annualized in our subsidy totals over the fiscal years during which they will be awarded:

> *Cellulosic grants.* In February 2007, the U.S. DOE announced six cellulosic grants, up to $ 100 million per project, and totaling $ 385 million over multiple years. The grant program requires a 60 percent industry cost share. The federal funding awarded included up to $ 76 million to Abengoa Bioenergy Biomass of Kansas LLC; up to $ 33 million to Alico, Inc.; up to $ 40 million to BlueFire Ethanol Inc.; up to $ 80 million to Broin Companies (since renamed Poet LLC); up to $ 80 million to Iogen Biorefinery Partners LLC; and up to $ 76 million to Range Fuels Inc. (EPM Industry News, April 2007: 26). When fully operational, the plants supported by these grants are expected to produce 130 million gallons of cellulosic ethanol per year (DOE, 26 June 2007). Including the 60 percent industry share, the total investment in these plants will be approximately $ 962 million, or roughly $ 7.40 per gallon of capacity. Current costs for conventional plants are around $ 2 per gallon.
>
> *Bioenergy Research Centers.* Announced in June 2007, three research centers (Oak Ridge, Tennessee; Madison, Wisconsin; and near Berkeley, California) will be funded with up to $ 405 million in federal money. The goal is to accelerate basic research into the development of cellulosic ethanol and other biofuels (DOE, 26 June 2007). Although funding was originally slated to begin in 2008, the DOE has accelerated funding with a supplemental $ 30 million allocation in the final quarter of 2007 (DOE, 11 October 2007).
>
> *Small scale bio-refineries.* Announced in May 2007, the DOE will fund up to $ 200 million over five years (starting in 2007) to "produce liquid transportation fuels such as ethanol" from small-scale plants (DOE, 26 June 2007).
>
> *Cellulosic Biofuel Processes.* Announced in August 2007, roughly $ 34 million in cost-shared research funding will support research into cellulosic enzymes over FY 2008–11 (EERE News, 27 August 2007).
>
> *Other announced projects.* $ 17.5 million will be spent over three years for cellulosic biomass conversion to help make it competitive with fossil fuels (DOE, 11 October 2006): $ 3 million to improve E85 engine efficiency (DOE, 23 January 2007); $ 23 million to support development of better cellulosic enzymes (DOE, 27 March 2007); $ 13 million to support product development from cellulosic feedstock (DOE, 11 June 2007); and $ 15.3 million to support improvement in E85 engines (DOE, 7 August 2007).

In addition, a variety of other projects benefiting biofuels were authorized in the EPACT05, but have not yet been appropriated. Following the approach used in the October 2006 study, we assume 50 percent of the authorizations will ultimately be funded, with the first funding not taking place though until FY 2009. This adds roughly $ 20 million per year in total support for ethanol, and $ 25 million per year for biodiesel.

3.5.4 Credit subsidies

3.5.4.1 Title XVII Advanced Energy Loan Guarantees

Title XVII of the EPACT05 includes a variety of liquid biofuels among its definition of "advanced energy" that are eligible for large federal loan guarantees. The DOE issued its final rule on the structure of these loans in early October 2007. Modifications in the final rule allow the DOE to guarantee up to 100 percent of project debt, constituting up to 80 percent of the total project cost (U.S. DOE, Loan Guarantee Final Rule, 4 October 2007) and somewhat weakening the federal position in case of a project bankruptcy.

Although the current process focuses on loan guarantees of under $ 9 billion, this authority is likely to rise sharply. A group of U.S. Senators is pushing for the program to be able to issue $ 100 billion in loan guarantees over the next few years.[15] Although they claim that credit authorizations of this magnitude are common, statistical data indicate otherwise. A Congressional Research Service summary (Bickley, 25 April 2006) of loan guarantee authorization as of FY2005 indicates only three programs with guarantees outstanding in excess of $ 100 billion; all of them servicing thousands of small borrowers, not a handful of very large projects.[16] The Export Import Bank, used as an example by the Senators for much higher credit limits for energy loans, had guarantees outstanding of only $ 39 billion in 2005; and this supported projects across multiple sectors and countries.

Although no guarantees have yet been issued, a round of "pre-applications" was conducted last year. Liquid biofuel technologies requested guarantees of $ 2.5 billion. Of this, roughly half came from cellulosic ethanol technologies; one quarter from biodiesel technologies; and the remainder from conventional ethanol or approaches that generated a mix of fuels including ethanol and biodiesel.[17] The DOE's final rule authorizes a subset of these projects to submit final applications. Of the 16 projects so far authorized, biomass comprises the largest category with six projects. All of them will produce ethanol or biodiesel,[18] though the amounts requested were not publicized by the DOE.

The loan guarantees require "pre-funding" of the estimated credit subsidy by project sponsors. The industry has argued that this results in there being no federal subsidy from the provision. This argument is incorrect in two

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[15] A letter to President Bush dated 8 August 2007 and signed by 18 U.S. Senators notes that "...even a cap of $ 25 to $ 30 billion for these domestic projects would be far smaller than the typical $ 100 billion cap for similar loan guarantees made by the Export Import Bank for projects overseas. And unlike some other federal loan guarantee programs, the EPACT05 guarantees require *no* appropriation of federal dollars for the 'cost' or risk premium because the borrower pays that into the Treasury as a condition of the guarantee."

[16] The three programs are the Federal Housing Administration Mutual Mortgage Insurance Fund, the Veterans Administration Mortgage Program and the Federal Family Education Loan Program. See Bickley, Table 1, 25 April 2006.

[17] U.S. Department of Energy. "Review of Pre-Applications Requesting Loan Guarantees under August 2006 Solicitation Sorted by Category," 15 June 2007.

[18] These include Alico, Inc. (cellulosic ethanol), Blue Fire Ethanol (cellulosic ethanol), Choren USA (biomass gasification to produce biodiesel), Endicott Biofuels, LLC (biodiesel), Iogen Biorefinery Partners (cellulosic ethanol), and Voyager Ethanol LLC (cellulosic ethanol). See U.S. DOE (4 October 2007).

important respects. First, it is quite difficult to accurately predict the likely default rates on particular loans to emerging industries in advance. In fact, both the U.S. Government Accountability Office and the Congressional Budget Office have expressed concerns that these risks will be understated, leaving a residual liability for the taxpayer (GAO, 28 February 2007: 17,18; CBO, 7 June 2007: 8). Similarly, the Office of Management and Budget has expressed concerns about the loss of lender due diligence if the federal guarantees grow too large (OMB, 12 June 2007: 2).

In addition, even if there are no defaults, the loan guarantees dramatically reduce the cost of capital to the selected projects. Debt costs drop to the federal cost of borrowing (known as the "risk free" rate), and investors are able to ratchet up the amount of debt they use on the project as high as 80 percent. Since debt costs much less than equity, this shift also results in far lower financing costs. Were the program only to support a handful of projects, the energy market distortions will not be large. However, if the guarantee authority grows to $ 100 billion or more, the DOE's bureaucrats will exert an enormous influence on the path of investment across energy technologies. This is likely to generate a selection bias away from less powerful industries, smaller-scale projects and demand-side solutions.

3.5.4.2 Access to tax-exempt solid waste bonds

Sometime in 2001 or 2002, an anonymous ethanol facility submitted a query to the IRS as a request for a *Private Letter Ruling*. Since the wet stillage their plant produced in the midst of a longer set of production steps had no value, could they define that portion of their facility as a solid waste disposal plant?

Private letter rulings request advance decisions on gray areas of tax law from the IRS, to reduce the audit and penalty risks to the taxpayer. Unlike tax court decisions, private letter rulings do not have legal value as precedent. The reality, however, is that the rulings can greatly reduce the risk of being disallowed for other taxpayers with similar fact patterns as what was submitted. As a result, they often trigger widespread changes in tax positions taken by filers.

As described by the IRS reviewer, the claimant argued that they were investing in further processing so they could convert this waste into animal feed, and that "[n]o person is willing to purchase the stillage for any price in the form it is when it is removed from the manufacturing process for input into the Project." The materials would be converted into "distillers dried grain with solubles" or DDGS. After a series of processing steps to concentrate, dry, and cool the stillage, the DDGS is "removed from the dryer and sent to the storage building" where it "is for the first time in a form in which it may be sold as animal feed."

The logic of the argument seems problematic in two main respects. First, many industries have complex production processes that generate intermediate products with no value without further processing. This fact is a main driver of integrated production across the economy. However, granting access to tax exempt solid waste bonds for all of these processes would dramatically increase subsidies to industries of all sorts, and is counter to what most of us intuitively consider "waste management." Second, growing efforts to use wet distillers, grains and even thin stillage as animal feeds to save the energy costs of drying (see, for example, Loy and Miller, 2002; Iowa Renewable Fuels Association, 2007) raise technical issues about the point at which the "waste" becomes a "product." As processing steps are removed to make the intermediate production "marketable," logic dictates that the portion of ethanol production deemed waste management should similarly decline, and along with it the ratio of investment using tax-exempt solid-waste bonds.

Nuance aside, however, the IRS accepted the industry's argument, referencing the extremely broad statutory definition of solid waste in Section 203 of the Solid Waste Disposal Act (42 USC 3254). The service described their decision in Private Letter Ruling Number 159406-01, released 28 June 2002 (IRS, 28 June 2002). Since that time, the integration of tax-exempt, solid-waste bonds into ethanol facilities has become routine, though it generally requires permission from state or county officials to use part of their allotted bond cap.[19]

The exact percentage of total debt that can be classified as part of the solid waste plant is not always obvious. A review of a handful of deals for which authorizations were internet-accessible found a range of between 20 and more than 40 percent of total project costs ascribed to solid waste functions, with an average of 31 percent.[20] Since mid-2002 when the ruling was issued, and including in-process plants, an estimated $ 17.4 billion has been invested in ethanol production facilities. Using the average share of plant costs assigned to solid waste functions in our informal review, more than $ 5 billion in solid waste revenue bonds would have been issued as a result of this one letter ruling. The exact amount issued for ethanol facilities is unfortunately not something that can be discerned from data on the issuances collected by the U.S. Treasury (Belmonte, 21 August 2007).

The resulting savings in interest costs to industry are substantial. Between 2000 and 2005, the interest rate on municipal bonds was, on average, 2.08 percent lower than the interest rate charged on low-grade (Baa) corporate debt (Executive Office of the President, 2006). The associated savings in interest rate payments on $ 5.4 billion in debt (31 percent of $ 17.4 billion) would be more than $ 110 million per year. This is also the amount that would have been paid in taxes on the higher cost corporate debt.[21] The revenue loss after the current in-process projects come on-line in 2008 has been escalated based on the projected growth rate in domestic ethanol production capacity estimated by the FAPRI (February 2007). These figures should be viewed as conservative, as there is some evidence that ethanol facilities may normally pay a higher interest rate than corporate Baa firms. For example, even before the erosion of ethanol margins, Standard & Poors rated ethanol bonds to be "speculative" (BondsOnline.com, 8 June 2006). Similarly, filings with the SEC by Panda Ethanol noted a tax-exempt bond rate of 3.7 percent for March 2007, versus its senior debt (first in line in a bankruptcy) of 9.0 percent (Panda Ethanol, 15 May 2007).

3.5.4.3 USDA Business & Industry Program and Renewable Energy and Energy Efficiency Program Loan Guarantees

Supporting a variety of rural initiatives, these programs have offered credit support to biofuel productions over the years. Compiled statistics on their credit commitments are not easily attainable, so an aggregate estimate of the credit subsidies provided to the sector could not be produced. However, the support appears to be significant: in 2007, the Department awarded $ 78 million in guarantees to three biofuel firms; of this, $ 43 million will support biodiesel and $ 35 million ethanol (Renewable Energy Access, 23 August 2007). Without details on the loan terms it is not possible to estimate the subsidy associated with this sizeable guarantee; as a result, the program is not included in our subsidy totals.

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[19] Private activity bonds (PABs) are authorized by government entities, but issued on behalf of private actors. The range of applications PABs can be used for are qualified, a response to widespread abuses of the system through the early 1980s. Because the Federal government loses tax revenue on these issues, it caps the total amount that can be issued. This helps prevent new abuses, though not all PABs are subject to the cap. For those that are, caps exist at both the state the national level. These are determined by a formula that sets a minimum per state, and then allows a certain amount of debt per person in the state. Qualified uses of PABs, including for solid waste facilities, are tax exempt. Other uses of PABs are not. See Maguire and Negley (2007) for additional information.

[20] Projects included were located in Darke County, Ohio; Hereford, Texas; Cass County, North Dakota; Garne, Iowa; Lu Verne, Iowa; and Fergus Falls, Minnesota.

[21] Taxes foregone can be approximated by multiplying the marginal tax rate by the interest payments that would have been made at the higher corporate Baa rate. Market competition normally works to equalize the after-tax interest earned by investors across the corporate and municipal bond issuances of similar risk and duration.

3.5.5 Other tax-exempt financing and credits

Use of state-level economic development grants and loans is common across the country—though quite difficult to aggregate. These programs are commonly mentioned in press articles for any biofuel plant under consideration. The magnitude of support can be quite large. In Iowa, for example, total Economic Development Tax credits awarded by the state have grown from $ 110 million in FY 2000–01 to $ 312 million in the first two-thirds of FY 2007. Gearino (20 April 2007) notes that the "bulk of those credits are from programs administered by the economic development department and its board ... [E]thanol plants account for more than 60 percent of the credits awarded by the department in the last two years."

Due to the limited scope of this revision we were unable to quantify the scores of state tax and credit subsidies to biofuels that have proliferated over the past 10 years.

3.5.6 Deferral of gain on sale of farm refineries to co-ops

This provision allows taxes that would normally be due on the sale of a major asset to be deferred if the nature of the sale converted an ethanol plant into a co-operative structure. As most new facilities are built in a corporate structure (most commonly a limited liability corporation), we assume that the tax losses on this provision will not grow over time, but remain at roughly the $ 20 million per year currently estimated by the JCT.

3.5.7 Air emissions

Less stringent regulation of pollutants from the biofuel sector can also provide a benefit to the industry, by reducing its capital or operating costs. In April 2007, the U.S. Environmental Protection Agency (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. The Agency characterized the change as one of providing "equal treatment" for all corn milling facilities.[22] However, the change also increased the allowable air emissions from fuel ethanol facilities substantially—from 100 tonnes per year to 250 tonnes. 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). Even an industry trade magazine notes that

> *[r]egardless of the legislative tributaries that many producers will have to navigate, barring litigation, most facilities will be able to take advantage of the new rule to expand and ramp up production, to build new plants with greater capacities or to potentially switch to a different power source, such as coal.* (Ebert, July 2007).

The majority of ethanol produced in the country is for fuel purposes, not human consumption. Two inquiries to the EPA's manager for this rule seeking information on cost savings to industry from the change went unanswered.

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[22] U.S. Environmental Protection Agency, *Fact Sheet – Final Changes for Certain Ethanol Production Facilities Under Three Clean Air Act Permitting Programs*, accessed 28 August 2007.

3.6 Subsidies to factors of production and to consumption

3.6.1 Labor

Although some states have offered reductions in labor taxes paid by workers in the biofuel industry, the magnitude of these subsidies has been fairly low. However, the subsidy cost of the Domestic Activities Deduction is much higher. Passed in the American Jobs Creation Act of 2004, the domestic production activities deduction allows taxpayers extra deductions for funds spent to make or grow things in the United States. The deduction is open not only to biofuel production facilities, but to the farmers producing the core feedstocks as well. Because the provision is available to all domestic industries on exactly the same terms, we have not included the subsidies in our total support metrics to ethanol.[23] Nonetheless, the deduction is worth noting as the kind of tax provision that particularly favors expanding industries—in this case, an industry that is expanding in large measure because of other government incentives.

The allowable deductions under the Domestic Activities Deduction were 3 percent of net income earned on domestic activities through 2006, rising to 6 percent in 2007 and 9 percent in 2009, and are capped at 50 percent of wages paid (Patrick, 2006: 5).

Despite this limitation, the special deduction has been lucrative for the energy sector. For example, it is expected to generate an extra $ 1.1 billion per year in tax subsidies to the oil and gas sector between 2008 and 2017 (Joint Committee on Taxation, 19 June 2007b: 2). Subsidies to ethanol producers are estimated at $ 40–60 million per year. Its worth to the biodiesel industry is much smaller (less than $ 5 million per year), the result both of much lower investment and to projected operating losses that will make the deductions difficult to use.

3.7 Support for feedstock producers

U.S. farm policy has long provided subsidies to a variety of crops. The major biofuel-related beneficiary of these programs has been corn, with some benefits flowing to soy and sorghum producers as well. To estimate how these subsidies benefit biofuel producers, total crop supports have been pro-rated to the biofuel sector based on the share of total production used to make energy.

3.7.1 Pro-rated crop subsidies

Rising prices for all crops, driven in part from high demand for corn use in the ethanol sector, has reduced federal payouts under counter-cyclical and loan-deficiency programs almost to zero. These types of programs aim to support farmer incomes when commodity prices are weak. However, direct payments (not linked to prices) continue to be paid to producers of program crops (including corn and soybeans), and the share of total harvests going into fuels has continued to grow. As a result, the pro-rata share of crop subsidies to biofuel producers have not fallen as steeply as might have been expected given surging crop prices. Ethanol's pro-rata share of corn subsidies are an estimated $ 490 million for 2006, rising to nearly $ 775 million by 2012; the similar value for sorghum is roughly $ 15 million per year. Biodiesel's pro-rata share of soy subsidies is slightly higher than $ 20 million per year.

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23 The determination of "baseline" conditions is not always clear cut. For example, the domestic production activities subsidy certainly disadvantages imports. It also subsidizes new manufacturing over changes in usage patterns—an important distinction in the context of energy conservation. Other provisions, such as accelerated depreciation, are also available across economic sectors. However, we include it in our tally because sector-specific rules are routinely introduced, exacerbating distortions across industries.

3.7.2 Domestic production activities deduction for feedstock production

As noted above, farmers are also able to take advantage of the special domestic production tax deduction. Ethanol's pro-rata subsidy from this program support of corn and sorghum production is roughly $ 50 million in 2006, rising to more than $ 250 million per year by 2010. Similar values for soy (biodiesel) are roughly $ 10 million per year. As was noted in the description for this subsidy as it related to production facilities, it has not been added into our total subsidies to biofuels because it is available with exactly the same rules across the domestic economy.

3.8 Water

Water remains an important, albeit not well characterized, problem in the biofuel sector. Press reports have been fairly common over the course of the past year detailing over-pumping of aquifers, or other water-related concerns with ethanol production. Keeney and Muller (2006) estimate ethanol production requires 3.5 to 6.0 gallons per gallon of ethanol produced, with an average of roughly 4.2 gallons of water per gallon of ethanol in 2005. Less attention has been focused on the full water lifecycle costs of biofuels; Hovey, (21 September 2007), however, estimates that 1,800 to 2,000 gallons of water are needed to produce a single bushel of corn. The full water cost of producing corn and converting it into ethanol is roughly 780 gallons of water per gallon of ethanol (NAS, 2007: 38). Of this, 99 percent is associated with crop irrigation, and 1 percent with the ethanol production facility itself.

A recent report by environmental group Environmental Defense called attention to the problems with biofuel production in the Ogallala Aquifer region, a hot spot we noted in our report last year. They observe that "the Ogallala region is experiencing rapid rates of ethanol production growth in areas where water resources are most under stress." (Roberts, Male, and Toombs, 2007) Unfortunately, neither their study nor other reports have focused on the issue of water pricing and subsidies. Water regulation is often a county- or state-specific issue, and rules vary widely. Often, however, there are poorly defined markets and individual rights holders do not face higher prices for water usage if the water table overall drops faster than its recharge rate. With nearly 800 gallons of water used to produce each gallon of ethanol, it is evident that any baseline subsidies to water throughout the country have important ripple effects through ethanol markets, and in cropping and plant siting decisions.

Biofuel proponents often point to cellulosic ethanol as a way to reduce the environmental impacts of biofuel production, with reduced irrigation needs being an important part of these claims. However, this assertion has not been tested, and conditions prevalent under indigenous cropping may change dramatically as production scales to supply a significant portion of the nation's motor fuels.

A recent National Academy of Sciences paper raises a number of important caveats about the water needs of a cellulosic industry, noting that there "are fundamental knowledge gaps that preclude making reliable assessments of water impacts of these future crops." (NAS, 2007: 17). The report also notes that data on water requirements are less available for cellulosic crops or any crops grown on marginal lands, and that "while irrigation of native grass today would be unusual, this could easily change as cellulosic biofuel production gets underway" (NAS, 2007: 18).

3.9 Support for consumption

3.9.1 Alternative fuel refueling property credit

An income-tax credit is allowed on up to 30 percent of the cost of installing qualified clean-fuel vehicle refueling property (which includes E85 and biodiesel) remains in effect. This is capped at $ 30,000 per taxable year per location, and is estimated to provide $ 15–30 million per year in subsidies to the ethanol industry and $ 8–15 million per year to biodiesel. As with many of the other existing subsidies, the cost of this provision would rise substantially with the passage of more stringent RFS.

3.9.2 Other subsidies to consumption

Two other subsidies to consumption covered in our October 2006 report remain in place today. Vehicle purchase incentives for cars that can run on alternative fuels are present at both the state and federal level. Many of these incentives are available to vehicles able to burn E85 or higher blends of biodiesel.

Reductions in Corporate Average Fuel Economy (CAFE) requirements for firms selling Flexible-fuel Vehicles (FFV's) also remain in place, whether or not the vehicles actually do use alternative fuel during operations. The resultant net reduction in the efficiency of the U.S. vehicle fleet has been estimated by the Union of Concerned Scientists to increase our oil imports by 80,000 barrels per day (roughly 1 billion gallons per year) (MacKenzie *et al.*, 2005). Pending legislation, discussed in Chapter 5, could extend the CAFE exemptions to a wide variety of biodiesel vehicles, worsening this problem.

4 Subsidy totals and intensity metrics

4.1 Total support

To develop a better sense of how all of the individual subsidy programs affect the overall environment for biofuels, we have compiled a number of aggregate measures of support. The aggregate data provide important insights into a variety of policy questions. These range from the financial cost of the subsidy policies to taxpayers, to estimates of the costs of achieving particular policy goals. Among arguments put forth in support of biofuel subsidies are that they help the country to diversify from fossil fuels in general, and petroleum in particular; and that they have a better environmental profile that fossil fuels. Chapter 4 discusses total financial support to the sectors under current policies, as well as subsidies per unit of energy output; subsidies per unit of conventional energy displaced; and the subsidy cost for greenhouse gas reductions. Changes in federal biofuel subsidies are discussed in Chapter 5; Chapter 6 addresses recommendations and areas for additional research.

4.1.1 Ethanol

Assuming no change in the RFS, we estimate that total support for ethanol was between $ 5.8 billion and $ 7.0 billion in 2006, and will rise sharply to $ 11 billion by 2008 and $ 14 billion by 2014 (see Table 4.1). Total undiscounted subsidies to ethanol from 2006–2012 are estimated at between $ 68 and $ 82 billion. Implementation of a higher RFS (e.g., 36 billion gallons by 2022) would increase total subsidies by tens of billions of dollars per year above these levels.

These figures are higher than what we estimated last year. The increase is driven primarily by higher consumption of ethanol fuels than what we had previously estimated. Other changes included lower pro-rata corn subsidies (due to declining counter-cyclical payments), the incorporation of estimates for tax-exempt solid waste bonds used by ethanol plants, and better characterization of market price support for imports.

Market price support, related to the combination of high barriers to imports and domestic purchase mandates, comprises the second largest subsidy to ethanol, at $ 1.3 billion in 2006, rising to more than $ 3 billion per year by 2010. As noted earlier, it is likely to become the largest subsidy if modified to 35 or 60 billion gallon levels.

For now, however, the largest element remains the VTEEC. Worth $ 3–4 billion in 2006, this program will subsidize the ethanol industry by $ 34 to $ 48 billion during the 2006–12 period. Feedstock support also remains important, despite falling countercyclical support, as direct payments remain high and ethanol is absorbing an ever-higher share of the total corn crop.

State policies beyond reductions in motor fuel taxation were quantified only for 2006, based on last year's analysis. Had these many state supports been catalogued and quantified, the magnitude of state and county supports would be much larger than what is shown in Table 4.1.

4.1.2 Biodiesel

Biodiesel subsidies in the update are $ 520–640 million for 2006, rising to $ 1.9 billion by 2008 along with production. However, both the FAPRI and the EIA project flat or slightly negative growth in the next five to seven years as the biodiesel industry struggles financially. Under the current policy environment, biodiesel is expected remain a small player in the liquid biofuel sector. While subsidies for the 2006–12 period are still estimated at the quite sizable level of $ 9–11 billion, aggregate total support levels are a small portion of that flowing to ethanol.

Table 4.1 Estimated total support for ethanol and biodiesel (millions $)

	Ethanol				Biodiesel			
	2006	2007	2008	Total, 2006–12	2006	2007	2008	Total, 2006–12
Market Price Support	1,390	1,690	2,280	17,450	-	-	-	-
Output-linked Support [1]								
Volumetric Excise Tax Credit (low)	2,810	3,380	4,380	33,750	250	720	730	3,440
Volumetric Excise Tax Credit (high)	4,010	4,820	6,260	48,220	350	1,030	1,050	4,910
Production tax credit (renewable diesel)	NA	NA	NA	NA	-	-	175	1,625
USDA Bioenergy Program	80	Ended in 2006	-	80	20	Ended in 2006	-	20
Reductions in state motor fuel taxes	390	410	440	3,210	90	100	100	750
State production, blender, retailer incentives	120	NQ	NQ	120	30	NQ	NQ	30
Federal small producer tax credit	110	150	170	1,100	30	170	190	1,150
Factors of Production – Capital								
Excess of accelerated over cost depreciation	170	220	680	3,250	20	40	160	750
Federal grants, demonstration projects, R&D [2]	110	290	350	2,140	30	40	50	380
Credit subsidies	110	110	110	880	NQ	NQ	NQ	NQ
Deferral of gain on sale of farm refineries to coops	10	20	20	130	-	-	-	-
Factors of Production – Labor	NC	NC	NC	NC	NC	NC	NC	NC
Feedstock Production (biofuel fraction)	510	640	740	5,010	20	20	20	150
Consumption								
Credits for clean fuel refueling infrastructure	10	30	20	140	10	20	10	80
State vehicle purchase incentives	NQ	NQ	NQ	NQ	NQ	NQ	NQ	NQ
AFV CAFE loophole	NQ	NQ	NQ	NQ	NQ	NQ	NQ	NQ
Total [3 & 4]								
Low estimate	5,820	6,940	9,200	67,260	530	1,200	1,540	9,020
High estimate	7,020	8,390	11,070	81,720	650	1,540	1,890	10,770

Notes:

(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 authorized spending levels where funds haven't be appropriated. This reflects the reality that not all authorized 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) Totals may not add due to rounding.

(4) NC = Subsidies were quantified but not counted because provision was generally applicable across the economy. 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 program discontinuation.

Compared with our October 2006 estimate, subsidy estimates in the next few years are higher due to the somewhat higher than predicted production; the rise in "splash-and-dash" shipments exporting product to Europe; the emergence of renewable diesel from animal fats as an additional constituency tapping into existing subsidies; and better data with which to estimate reduced tax rates on biodiesel blends in Illinois. The longer-term estimates are actually lower than in the 2006 report, again reflective of a general expectation of a leveling of production and difficult competitive times ahead for methyl ester-based biofuels.

As with ethanol, the VBETC is the single largest subsidy to the sector. It is assumed to grow slowly, then actually decline starting in 2014 based on market projections from the EIA and the FAPRI suggesting a weak competitive environment. Should existing and pending plants actually operate to capacity levels commensurate with European biodiesel plants, the subsidies would be billions of dollars higher. A number of legislative proposals discussed in Chapter 5 would specify mandated consumption levels of biodiesel fuels in particular; should such rules pass, the subsidy levels flowing to the biodiesel industry would also be much higher.

4.2 Subsidy per unit energy output and as a share of retail price

Estimates of total support provide only a first-level indication of the potential market distortion that the subsidies may cause. Large subsidies, spread across a very large market, can have less of an effect on market structure than much smaller subsidies focused on a small market segment. Subsidy intensity metrics normalize subsidies for the size of particular energy markets, and for differential heat rates of similar volumetric units (i.e., gallons). We also compare subsidy levels to the market value of the ethanol and biodiesel. In later sections, the efficiency of biofuel subsidies in displacing fossil energy or GHG emissions is discussed.

The values shown here reflect subsidies per gallon of biofuel, and per unit energy produced, in both million British thermal units (MMBtu) and gigajoules (GJ).

A higher than expected growth in supply could in theory bring down subsidy intensity values as supports are spread over a bigger production base. However, this shift is muted by the fact that the largest subsidy for both fuels, the excise tax credit, rises linearly with production levels. Market price support, triggered by renewable fuel mandates and import tariffs, also rises along with production levels. More stringent mandates may actually intensify per-gallon levels of support. So too would shifts to cellulosic production which is at present much more expensive, and eligible for an additional layer of federal support. Few programs taper down or off entirely once production or oil prices (with which biofuels compete) reach certain levels. One piece of pending legislation (see Chapter 5) would introduce such a phase-out for the excise tax credit, albeit only to a very small degree.

In both Table 4.2 and a more detailed version in the Annex, subsidy values per unit output illustrate the strong continuing linkage to production levels and do not change significantly during the period through 2012. While the values are stable over time, they remain quite high. The subsidy per gallon of ethanol is $ 1–1.30 per gallon of ethanol, and roughly $ 1.30–1.70 per gallon of gasoline equivalent (GGE). The average subsidy per GJ of ethanol energy produced is between $ 12 and $ 14.70 during the 2006–12 period. Despite lower overall aggregate subsidies to biodiesel, a small production base yields higher subsidy intensities than for ethanol. Subsidies per gallon of B100 produced are $ 1.60 to $ 2.55 per gallon of B100 during the 2006–12 period; and $ 1.80–2.80 per gallon diesel equivalent (GDE).

Subsidies per unit energy produced via ethanol subsidies top $ 11 per GJ in all years, reaching as high as $ 14.50 per GJ in 2008. Biodiesel supports are even higher, averaging nearly $ 14.50 to $ 17.30 during the 2006–12 period;

and as high as $ 21.50 per GJ in 2006. These levels are lower than those in the EU and Australia for ethanol, though on par with the EU (and higher than Australia) with regards to biodiesel (Steenblik, September 2007: 58).

For the 2006–12 period, subsidies to ethanol will be equal to half or more of its projected retail price; and more than 60 percent in the biodiesel sector. Actual price drops for ethanol in the past few months have brought prices well below the values shown in our calculations. At current prices of $ 1.58 per gallon (Kmetn, 5 October 2007), ethanol subsidies are equal to as much as 80 percent of the fuel's retail price.

Table 4.2 Subsidy intensity values for ethanol and biodiesel

	Ethanol				Biodiesel			
	2006	2007	2008	Average 2006–12	2006	2007	2008	Average 2006–12
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%

Notes:

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

(2) Retail price projections are for E100 and B100. They are take from West Westhoff and Brown (August 2007) for 2006–12; and FAPRI (February 2007) for 2013–16.

Box 4.1 A note about displacement values

Biofuel subsidies are politically supported on the premise that they help solve particular problems facing the country. The most often mentioned are energy security (by reducing our reliance on imported petroleum) and environmental quality (by curbing our demand for all fossil fuels, thereby reducing our emissions of greenhouse gases). While biofuels may offer some benefits in these areas, they are by no means the only option, and may well not be the quickest or least expensive. For example, there are tens of thousands of ways that we can reduce our GHG emissions across all sectors of the economy. Even in the arena of petroleum energy security, improved fleet maintenance, higher efficiency vehicles, other fuels, and hybrid (and plug-in hybrid) drive trains can all contribute to reduced reliance on imported oil. Some of these strategies even work with the existing vehicle fleet. Ideally public policy would be neutral with respect to all of these options.

To assess this neutrality, one needs to be able to compare performance across fuel systems on an equal basis. Specifically, what is the *relative efficiency* of biofuel subsidies to displace a set amount of petroleum or fossil fuel demand; or a metric tonne of CO_2-equivalent emissions? Since biofuel production itself does use some oil and other fossil fuels, and does emit some carbon, a series of displacement values must be used to be sure the *net* benefits of the policies are captured rather than the *gross* benefits.

Displacement values are the result of lifecycle modeling of complex biofuel production chains. Work on this question has been accelerating, and there was more to draw upon this year than last. However, the models continue to have important gaps and do not all measure emissions the same way. For example, the Greenhouse Gases, Regulated Emissions, and Energy Use in Transportation (GREET) model developed by Argonne National Laboratory, one of the most commonly used tools, has little integration of land-use changes from biofuels though this is a very important element to the overall GHG displacement profiles. Farrell and Sperling (2007: 43) note that lifecycle models may treat the same emissions in very different ways. The GREET model, they point out, "does not include N_2O emissions from atmospheric nitrogen fixed by soybeans, while LEM [the Lifecycle Emissions Model, containing more complex, though not peer-reviewed, treatment of land use changes] does, contributing to an almost order-of-magnitude greater estimate of GWI [Global Warming Intensity] for soybean biodiesel."

The challenges of modeling these complex systems will continue for many years to come, and obviously could not be resolved here. Rather, we took the upper- and lower-bound estimates in the literature for biofuel displacement of petroleum, fossil fuels, and GHG emissions. In many cases, the range is actually wider than last year, the result of a larger body of work evaluated in combination with continued uncertainty and disagreement amongst researchers on core modeling elements. Despite the wider range, however, our basic conclusion remains the same: even using the most favorable assumptions regarding displacement values for biofuels, the cost per unit displaced was far higher than other options existing in the economy. This held true even in our hypothetical cellulosic case where we assume the existing production base, with the existing subsidies, is credited instead with the much more favorable displacement values of cellulosic ethanol.

4.3 Subsidy per unit petroleum displaced

Public subsidies to biofuels are often proposed as a way to wean the country from its dependence imported oil, thereby enhancing our energy security. Petroleum is particularly relevant in this regard due to the central role oil plays in transportation. To estimate how efficiently biofuel subsidies help us reduce reliance on petroleum, we need avoid crediting the ethanol or biodiesel for the expenditure of petroleum to create and deliver that gallon, which is what the petroleum displacement factor does. As shown in Table 4.3 below, there are fairly sizable ranges in displacement factors. However, even using the most favorable ones, oil displacement using biofuel subsidies is expensive: $ 12–18/GJ for corn ethanol and $ 15–30/GJ for biodiesel. Cellulosic is also expensive at $ 12–20/GJ petroleum displaced—though actual subsidies to make cellulosic plants competitive will be much higher than in our hypothetical case.

Table 4.3 Subsidy per unit petroleum displaced

	Ethanol				Biodiesel			
	2006	2007	2008	Average 2006–12	2006	2007	2008	Average 2006–12
Subsidy cost per MMBtu petroleum displaced by using biofuels								
Low estimate	13.00	12.90	13.15	12.60	19.50	15.15	15.55	16.75
High estimate	18.50	18.35	18.70	18.00	31.90	26.10	25.50	26.75
Cellulosic – hypothetical case – low estimate	13.50	13.40	13.70	13.10	NA	NA	NA	NA
Cellulosic – hypothetical case – high estimate	20.80	20.65	21.00	20.25	NA	NA	NA	NA
Subsidy cost per GJ petroleum displaced by using biofuels								
Low estimate	12.30	12.25	12.50	11.95	18.50	14.35	14.75	15.85
High estimate	17.55	17.40	17.70	17.10	30.20	24.70	24.15	25.35
Cellulosic – hypothetical case – low estimate	12.80	12.70	13.00	12.40	NA	NA	NA	NA
Cellulosic – hypothetical case – high estimate	19.70	19.55	19.90	19.20	NA	NA	NA	NA
Petroleum displacement factors								
Displacement factor – worst	82%	82%	82%	82%	68%	68%	68%	68%
Displacement factor – best	96%	96%	96%	96%	91%	91%	91%	91%
Displacement factor – cellulosic, worst	73%	73%	73%	73%	NA	NA	NA	NA
Displacement factor – cellulosic, best	93%	93%	93%	93%	NA	NA	NA	NA

Notes and sources:

(1) 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); U.S. EPA, Chapter 6 (2007); Wang *et al*. (2007) and Zah *et al*. (2007). The most favorable values included generally represent specific technologies rather than the average expected performance of either the current or future batch of plants.

(2) NA = Not applicable.

4.4 Subsides per unit fossil fuel displaced

As with petroleum displacement, the ability to move the U.S. away from reliance on fossil fuels has been touted as a benefit of subsidizing the sector. The challenge is that while existing production does a fairly good job displacing petroleum, it often does so by relying instead on natural gas and increasingly coal. This is why the subsidy cost per

GJ of fossil fuel displaced is so much higher than per GJ of petroleum. In addition, there is much greater variance in the estimated displacement factors for fossil than there was for petroleum alone. This results from two factors: more complexity in the systems modeled; and more modelers focusing on overall fossil energy displacement than on petroleum alone.

For corn ethanol, subsidies per GJ of petroleum displaced exceed $ 55 under some scenarios, a level higher than that found in other countries evaluated by the GSI (Steenblik, September 2007: 58). For biodiesel, values always exceeded $ 20 per GJ, higher than the EU, Australia, and Canada (Steenblik, September 2007: 58). Even the hypothetical cellulosic case had subsidy costs in the range of $ 12.50 to $ 16 per GJ fossil energy displaced. These patterns are indicative of the likely high costs of GHG abatement as well. This is explored in the next section.

Table 4.4 Subsidy per unit fossil fuel displaced

	Ethanol				Biodiesel			
	2006	**2007**	**2008**	**Average, 2006–12**	**2006**	**2007**	**2008**	**Average, 2006–12**
Subsidy cost ($) per MMBtu fossil fuel displaced by using biofuels [1]								
Low estimate	24.20	24.00	24.50	23.45	28.95	22.45	23.05	24.80
High estimate	61.50	61.10	62.15	59.95	35.45	29.00	28.35	29.75
Cellulosic - hypothetical case - low estimate	13.45	13.35	13.60	13.05	NA	NA	NA	NA
Cellulosic - hypothetical case - high estimate	16.70	16.55	16.85	16.25	NA	NA	NA	NA
Subsidy cost ($) per GJ fossil fuel displaced by using biofuels								
Low estimate	22.95	22.75	23.25	22.25	27.45	21.30	21.85	23.55
High estimate	58.30	57.90	58.90	56.80	33.60	27.50	26.90	28.20
Cellulosic - hypothetical case - low estimate	12.75	12.65	12.90	12.35	NA	NA	NA	NA
Cellulosic - hypothetical case - high estimate	15.80	15.70	16.00	15.40	NA	NA	NA	NA
Fossil fuel displacement factors								
Displacement factor - worst	25%	25%	25%	25%	62%	62%	62%	62%
Displacement factor - best	52%	52%	52%	52%	62%	62%	62%	62%
Displacement factor - cellulosic, worst	91%	91%	91%	91%	NA	NA	NA	NA
Displacement factor - cellulosic, best	93%	93%	93%	93%	NA	NA	NA	NA

Notes and sources:

(1) 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); U.S. EPA, Chapter 6 (2007); Wang *et al*. (2007) and Zah *et al*. (2007). The most favorable values included generally represent specific technologies rather than the average expected performance of either the current or future batch of plants.

(2) NA = Not applicable.

4.5 Subsidies per unit greenhouse gas displaced

Biofuels supposedly form part of a transition to a society with a low carbon footprint. To test how efficient existing policies are in getting us there, we examine the subsidy cost per metric tonne of CO_2-equivalent displaced, and then compare this cost with the value of carbon offsets on the world's two major climate exchanges in Chicago (CCX) and Europe (ECX).

The GHG displacement factors show larger variation across sources than in the other areas evaluated, likely due to the complexity of the systems being modeled. This is a critical issue. As Kammen *et al.* (2007: 4) note:

> *the indirect impacts of biofuel production, and in particular the destruction of natural habitats (e.g. rainforests, savannah, or in some cases the exploitation of 'marginal' lands which are in active use, even at reduced productivity, by a range of communities, often poorer households and individuals) to expand agricultural land, may have larger environmental impacts than the direct effects. The indirect GHG emissions of biofuels produced from productive land that could otherwise support food production may be larger than the emissions from an equal amount of fossil fuels.*

For corn ethanol and biodiesel, researchers can't even agree on the direction of impact. Thus, the lower end of the displacement factors normally indicate that GHG emissions rise rather than fall from biofuel production. As a result we are paying very large subsidies per tonne of *extra* CO_2-equivalent we emit ($ 600 per metric tonne in the case of corn ethanol; over $ 850/metric tonne for biodiesel). Similarly, the upper bound estimate for cellulosic is a closed-loop poplar feedstock, believed to generate net sequestration (hence its 114 percent displacement value). Whether the impacts are really so low once actual crops are produced on a large scale, move outside of their optimal range, and possibly require irrigation is an open question.

The best possible case for corn-based ethanol uses lower bound subsidy estimate and divides it by the most favorable studies about GHG reductions in the ethanol fuel cycle. Even here, subsidies per metric tonne displaced are around $ 300.[24] Based on historical prices for carbon offsets, this same investment could have purchased 90–120 times as much displacement on the CCX, the most appropriate benchmark for the U.S. carbon market. Even on the more expensive ECX, the subsidies could have purchased 11 metric tonnes of offsets.

Biodiesel subsidies as a climate change mitigation strategy remain equally unimpressive. Best-case scenarios for soy-oil methyl ester normally run well over $ 200 of subsidies per metric tonne of CO_2-equivalent displaced, enough to purchase 8–11 metric tonnes of offsets on the ECX and an average of 75 tonnes on the CCX. While reuse of waste oils for biodiesel provides substantially lower costs per metric tonne GHG reduced, there are insufficient quantities of these byproducts for them to provide a substantial source of future energy.

The hypothetical cellulosic-ethanol case provides better tradeoffs than for corn ethanol. However, the subsidies are still extremely high: $ 110–204 per metric tonne of CO_2-equivalent displaced. These funds could have purchased —four to eight times the offsets on the EXC or 30–85 times on the CCX.

Summary

Despite increasing attention given to some of the limitations of large scale biofuel production, government subsidization has continued to climb. Even using best estimates for ability of the fuel to displace petroleum, fossil fuels, and GHG emissions, biofuel subsidies are horribly inefficient. The same outcomes could be achieved for far less public money; or the same money could buy far more environmental improvements if deployed in a different way.

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[24] This value is lower than in our October 2006 study due to the use of a more favorable upper-end displacement value based on new work by Wang *et al.* (2007) and a plant using natural gas and wet DDG by-products for fuel. This scenario performs well above the average corn ethanol plant of the future also modeled in that same paper.

Table 4.5 Subsidy cost per unit of CO_2 equivalent displaced

	Ethanol				Biodiesel			
	2006	2007	2008	Average 2006–12	2006	2007	2008	Average 2006–12
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	110	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	89–167	119–368	57–185	59–182	74–210
CCX – cellulosic	48–86	29–53	30–54	33–59	NA	NA	NA	NA
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

Notes and Sources:

(1) Negative values occur when the specific lifecycle modeling scenarios estimate that GHG emissions from the biofuel 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 biofuel 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); U.S. EPA, Chapter 6 (2007); Wang *et al*. (2007) and Zah *et al*. (2007). The most favorable 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.

5 Pending federal legislation

Biofuels continue to be a popular legislative item in both the U.S. House and Senate. The Congressional Research Service of the U.S. Congress notes 79 distinct bills (i.e., adjusting for identical bills introduced in both the House and the Senate) addressing liquid biofuels as of September 2007. There are 15 bills focused on the Renewable Fuel Standard (RFS) alone (Sissine *et al.*, 21 September 2007: 1,10). Wherever biofuel markets have run into a snag, there are Congressional efforts to address the problem through federal interventions and subsidies. Although the time and resources available for this study did not allow for a review of all of these legislative initiatives, we did examine the bills most likely to become law: the large energy bill (different versions have currently passed, with H.R.3221 in the House and H.R.6 in the Senate); and on the 2007 Farm Bill (H.R.2419 plus separate tax expenditure portions), which also contains a large focus on bioenergy. We also reviewed all RFS proposals introduced as of September 2007. We expect that these mandates will become the single largest support measure for biofuels in the future, and wanted to provide an overview of the ideas under consideration. Aside from the RFS, other bills are mentioned in this Chapter if they contain an item of particular interest, but they are not reviewed systematically.

The description of support policies in pending legislation follows the same structure as Chapter 3: market price support, output-linked supports, subsidies to factors of production, and subsidies to consumption. The information in the following sections regarding H.R. 3221 and H.R.6 draws heavily on the comparative analysis done by Yacobucci (21 August 2007).

5.1 Market price support under future renewable fuels mandates

One of the biggest commercial risks to biofuels is eroding demand. This can result from some combination of three main factors: falling oil prices (making oil substitution less valuable), rising corn prices (driving up ethanol production costs), and surplus ethanol from inadequate capacity or commercial incentive to blend with gasoline. These shifts could put many producers at risk. The concern is a real one: ethanol prices as of October 2007 were down 30 percent from the previous spring, and evidence is mounting of an ethanol glut (Etter and Brat, 1 October 2007).

Renewable fuel mandates solve this problem, at least in the short-term, by mandating the consumption of a pre-specified quantity of renewable fuel across the country. As the market price protection resulting from much higher renewable fuel mandates is likely to be the single largest source of subsidy going forward, we have evaluated it in a fair amount of detail. In general, the higher the mandate, the greater the buffer to producers against the risk of not being able to sell their high-cost product during a time of lower cost substitutes or rapidly growing supply. Higher mandates also mean that the price premium for RFS-eligible fuels over standard gasoline will grow. For the present time, the mandates primarily protect domestic corn ethanol. However, under most proposed legislation the mandated carve-out for non-corn sources (not all of which are cellulosic) of supply will grow sharply.

The proposed revisions to the RFS differ from the present one in a number of respects:

- **Much higher mandate targets.** Some legislation boosts mandates from the present 7.5 billion gallons per year to as high as 65 billion gallons per year by 2030. H.R. 6, which has passed the Senate, targets 36 billion gallons by 2022. Production at these levels, even of cellulosic fuels, would require very substantial changes in land-use patterns. A handful of the proposals explicitly require lower carbon footprints from biofuels, although they do not specify how these lifecycle emissions would be modeled or tracked.

- **Larger mandates for non-corn biofuels.** Pending legislation creates large carve-outs for fuels other than ethanol from corn starch. Not all of these have a significantly better environmental profile. The present standard under the Energy Policy Act (sec. 1501) mandates a minimum of 250 million gallons per year of cellulosic ethanol beginning in 2013. However, it counts ethanol from corn-starch so long as the plant runs on 90 percent or more renewable energy. Fuels meeting this definition prior to 2013 earn 2.5 credits per gallon of ethanol, rather than the 1 RFS credit per gallon earned by corn ethanol. H.R. 6 (sec. 111) requires 3 billion gallons of "advanced" biofuels by 2016, rising sharply to 21 billion by 2022. Two bills set separate mandates for biodiesel rather than just including it as an allowable "advanced" fuel.

- **Generous definition of "advanced" biofuels.** Although the new proposals have much higher mandates for non-corn ethanol, the carve-outs are open to a fairly wide range of fuels. These include most forms of biodiesel (renewable diesel co-produced at petroleum refineries is excluded); all forms of ethanol other than corn-starch (sugar and sorghum would count); and even biogas. In most, though not all, proposals, advanced biofuels earn credits in proportion to their heat rate relative to corn-ethanol. This reduces the cross-fuel bias of the rules somewhat. A few of the legislative proposals go well beyond traditional biofuels. For example, S.1158 would allow a wide range of fossil-derived fuels that are not commonly used in vehicles, such as coal liquids and fossil-derived electricity, to qualify for credits. S.1158 illustrates a focus on transport fuel diversification, rather than on GHG reductions or support for farming interests.

- **Expansion of supplemental credit for use of renewable energy in biofuel production facilities**. EPACT05 allowed conventional facilities meeting 90 percent or more of their process energy with renewables to count under the "cellulosic" definition that is eligible for 2.5 credits per gallon through 2013. Current proposals go much further (H.R. 6, sec. 112). The supplemental credit, also worth up to 1.5 additional credits per gallon, is awarded independently from the type of fuel being produced; and without expiration. This means that a cellulosic ethanol facility that uses renewable energy in its facility and that enters production prior to 2015 would earn 4.0 RFS credits per gallon produced (2.5 for being cellulosic and an additional 1.5 RFS credits for using renewable energy in the plant). EIA (August 2007) has estimated the value of each RFS credit under the more stringent new standards could approach $ 2.20. Each gallon of cellulosic ethanol produced prior to 2015 under this scenario would generate more than $ 8.50 in RFS credits, in addition to all of the production and excise tax credits.

- **Possible Interactions between RFS and REC markets**. The large incentive via the extra RFS credits to use renewable energy in the production of biofuels creates some potentially damaging interactions with markets for renewable electricity credits (RECs). There is no indication in the statutory language that biofuel plants must actually generate their own renewable energy on-site to garner the additional RFS credits.[25] In theory, a low-cost, coal-fired ethanol manufacturing facility could purchase the RECs needed to meet the 90 percent renewable energy target from outside. Such behavior would be fully rational for producers, and should be expected in any situation where the value of the additional RFS credits is greater than the purchase costs of the necessary RECs (Harmon, 1 October 2007). Although RFCs do not seem to have any value currently (OPISnet, 31 August 2007), this is unlikely to be the case over the long term. Legislators awarding the credit premiums on the basis of self-generation would be well-served to validate

[25] The specific language of the RFS in H.R.6 (section 112(b)) states that "The President shall provide a credit under the program established under section 111(d) to the owner of a facility that uses renewable energy to displace more than 90 percent of the fossil fuel normally used in the production of renewable fuel." The term "displacement" would seem applicable whether that displacement occurs at the ethanol production facility, or elsewhere in the country via the purchase of RECs or other forms of marketable green tags.

their premiums based on the ability to comply via RECs. This exercise will help avoid granting much larger incremental subsidies to renewable fuel producers than needed to induce the use of renewable energy in production.

Some of the pending legislation (e.g., the tax portion of the 2007 Farm Bill) would also further extend the import tariffs on ethanol. This same bill would make tariff rebates (drawbacks) more difficult to obtain, increasing the effective tariff rates (Joint Committee on Taxation, 2 October 2007a: 47, 48).

Table 5.1 Overview of selected legislation containing renewable fuel mandates

Target at specified end-point	Special carve-outs/other features	Renewable Fuel Standard credit premiums
1) Current Law (EPACT 2005, sec. 1501) • 2012: 7.5 billion gallons per year (bgy)	• 0.25 bgy of cellulosic by 2013 • If plant uses 90% renewable energy, corn-ethanol counts as cellulosic.	• 1.5 additional RFS credits for cellulosic or corn-based fuelled with >90% renewable energy. • Good through 2012.
2) Most Likely Changes (H.R. 6 that has passed the Senate) • 21 bgy by 2017; 36 bgy by 2022. • Includes heating oil as well as transport fuels. • *"Advanced"* fuels include almost all biomass-based energy other than corn-starch.	• 15 bgy cap for ethanol from corn-starch. • Eligibility requires 20% reduction in lifecycle GHG emissions relative to current fuel.	• 1.5 additional RFS credits for cellulosic through 2015. • 1.5 additional RFS credits for production using >90% renewable. • Change in wording relative to current law would allow cellulosic production powered with renewables to earn 4.0 RFS credits per gallon of fuel through 2015.
3) Introduced changes in other legislation		
A) Increasing national mandates • 2010: 10% of fuel supply (~15 bgy) (H.R. 349/S1358) • 2012: 12bgy H.R. 791); 10% of fuel supply (~15 bgy) (H.R. 635). • 2022: 36 bgy (S. 1321) • 2025: 25 bgy (H.R. 791) • 2030: 33 bgy (S386); 30% of fuel supply, met at each state level (~45 bgy)(HR2032); 60bgy (S.23) • Most escalate proportionately to rising gas demand in subsequent years. S1321 mandates 60% of increases are no-corn fuels.	• Mandates must be met at each state level, not through national averaging H.R.2032). This would drive costs up significantly. • Corollary mandates for dual-fueled vehicles and E85 pumps (S23). • Cellulosic mandates of 20.3 bgy by 2030 (S386), of which 30% must be regionally sourced. 21 bgy by 2022 (S.1321).	• 1.5 additional RFS credits for E85 blends H.R.791). • 1.5 additional RFS credits for cellulosic through 2015 (S.1321). • 1.5 additional RFS credits for >90% renewable energy used in production (S.1321).
B) Biodiesel-specific mandates • 2% national mandate within 5 years of enactment (H.R.2178).	• Higher state mandates pre-empt federal standards (S. 1616).	

Target at specified end-point	Special carve-outs/other features	Renewable Fuel Standard credit premiums
• 1.25 bgy by 2012 (S.1616)		
C) Mandates with expanded mix of fuels • 2017: 35 bgy (S.1158) • 2022: 36 bgy (H.R.6).	• S.1158: Includes a wide variety of fossil-based fuels not normally used in transport (e.g., electricity, coal-to-liquids). • H.R.6: Includes all biomass but corn-starch and renewable diesel co-processed in oil refinery:	• 1.5 additional RFS credits for waste-derived ethanol (S.1158).
D) Low-carbon mandates • H.R.6 would affect >20 bgy by 2030. • S.1297 mandates by 2022 that 20 bgy have >20% GHG reduction; 3 bgy >50% reduction; and 1.5 bgy have >75% reduction. • S.309 mandates 5 bgy have >75% reduction by 2015.	• 20% reduction or more (H.R.6; Phase I of S1297). • 50-74% reduction (Phase II of S.1297; S.309). • >75% reduction (Phase III of S.1297).	

Subsidy cost of more stringent Renewable Fuel Standards

While none of the efforts to model the market impacts of higher mandated use of renewable fuels match the 36 billion gallons per year target in H.R.6, existing assessments do help to bound the likely cost of that proposal. Most of the cost of this mandate comes in the form consumer transfers to producers: higher prices at the pump and higher prices on food—rather than through lost tax revenues or Congressional appropriations. In fact, the mandates may actually reduce farm subsidies in other areas. For example, the CBO estimated that spending for farm price and income supports would decline by an average of $ 47 million per year to reach an RFS consumption level of 21 billion gallons per year in 2017 (CBO, 11 June 2007: 10). This estimate represents only one bit of the story, and it would be wrong to conclude that the mandates therefore have little or no cost to the country. Nonetheless, the example clearly illustrates the political allure of delivering large subsidies to constituent groups without the need to defend recurring appropriations.

Westhoff (June 2007) at the Food and Agricultural Policy Institute estimated the cost of 15 billion gallons per year mandate by 2015 (roughly double the current 2012 target), assuming continuation of current tax subsidies and import tariffs. His analysis indicated an incremental rise in ethanol plant prices by 21 cents per gallon in 2015 and 25 cents per gallon in the 2015–16 marketing year relative to the baseline of a 7.5 billion gallons per year mandate. This cost would be in addition to the estimated 29 cents per gallon in MPS estimated by Elobeid and Tokgoz (2007), bringing total MPS up to 50–55 cents per gallon. The effort modeled corn ethanol only (though recognizing the legislative proposal included a carve-out of 3 billion gallons per year of "advanced" fuels that would likely be even more expensive). Assuming a linear relationship to production levels (per gallon costs were actually be more likely to be higher), price impacts would translate to roughly $ 18 billion per year for the type of mandate being considered under H.R.6.

Impacts on biodiesel prices in the Westhoff analysis were smaller, at one to five cents per gallon between 2010 and 2015. The estimated price impacts from the mandate were sensitive to the cost of the alternatives—primarily the price of oil. At oil prices above $ 80/barrel, the FAPRI estimated no marginal impact of the mandate; however, at oil prices below $ 30 per barrel, the MPS rises to $ 0.50 per gallon (incremental to meeting the current RFS) (Westhoff, June 2007: 31). This result illustrates the primary motivator behind the mandates: to protect producers from the very substantial risks of a down-turn in the market. It demonstrates also the inefficiency of subsidies that remain in-place even during times of very high oil prices.

The EIA modeled the impacts of a much more aggressive fuel mandate. The 25 percent RFS target by 2025 translates to roughly 60 billion gallons of renewable fuels. This target is similar to RFS proposals in S.23, and to that advocated by the 25x25 Coalition, a consortium of mostly agricultural groups. The costs of the policy arise in three main areas: the fuels; associated infrastructure, including vehicles capable of using high ethanol blends; and in the cost of alternative uses for the feedstocks or land being diverted to fuels (reflected in large part in the price of food). Although the EIA did not estimate the costs of all these areas, the costs they did evaluate are sizeable:

- *Costs to the fuel system*. The EIA notes that the "RFS credit price, which reflects the payment above market value that is required to bring the marginal gallon of renewable fuel to market in the Policy Case, is $ 2.18 per gallon in 2025 and falls to $ 2.02 per gallon in 2030" (EIA, September 2007: xii). With 61 and nearly 66 billion gallons per year mandated in the rule for 2025 and 2030 respectively, the market premium to biofuel producers tops $ 130 *billion* per year. Part of this amount is recovered from consumers via higher prices on liquid fuels. (The EIA estimates expenditures on this would rise by $ 28 billion per year in 2020 and $ 50 billion per year by 2030.) Part is a transfer from petroleum producers to agribusiness. EIA further noted that these costs would rise should other nations also be trying to boost their requirements for renewable motor fuels (EIA, September 2007: 34). This amounts to roughly $ 137 per metric tonne of CO_2-equivalent reduced by 2025, and $ 116 in 2030.

- The policy creates strange outcomes with respect to high blend mixtures such as E85. The EIA notes that "[u]nlike gasoline and diesel fuel prices, E85 prices in the Policy Case fall, because revenues from RFS credits reduce the price of ethanol production" (EIA, August 2007: 24). The revenues from the RFS are more of a transfer than a reduction, but the market dynamics are still the same, effectively decoupling the energy content of the fuel from its market value. The artificial price premium for the eligible renewable fuels is priced into the credits at the point of production. These serve to separate the core fuel price from the scarcity value of the renewable fuel in meeting the proscribed mandate.

- *Costs of infrastructure*. The EIA study noted that converting the economy to handle specialty fuels such as E85 (which they estimate will grow from a 1 percent market share with no mandate to over 30 percent with a 25 percent RFS mandate) would "require massive investment to ensure that vehicles and delivery and refueling infrastructure are in place to meet the needs of the market." There was no quantification of this value; Brown (11 October 2007) noted that studies of this issue tended to be old, and to address quite different mandate levels than what they analyzed.

- *Impacts on food prices*. The higher the mandate, the more land and harvest directed to fuel production and away from other uses. Under the 25 percent RFS scenario, the EIA estimates that 60–64 percent of domestic corn production would be used for ethanol, and projects that the U.S. would need to become a net corn importer as well. Cost impacts have been fiercely contested in analysis of earlier mandate proposals. Global Insight (2005) projected cost increases in the food and feed sectors of $10 billion per year in a study for the American Petroleum Institute. Urbanchuk (2003) concluded there would be no price increase in an analysis for the ethanol industry. Urbanchuk (2007) reassessed this situation in light of large price increases to food and feed over the past few years, and concluded that they were far more associated with rising energy prices than with fuel-driven demand for feedstocks.

Because the EIA baseline case assumes no tariff, no VEETC or VBETC, the mandate drives all of the observed policy distortions. In the current policy environment, however, the impacts result from a mix of other drivers (most notably the excise tax credit). A higher mandate in the presence of an extended blenders credit would likely reduce the market RFS credit price by roughly the amount of the credit. This is because the supply chain would have an additional source of revenues to cover its higher production cost. Because the very high mandates are using a marketable credit system, and are likely to be the ultimate driver of investment, we would expect that the total level of support under the mandate-only model or the mixed policy model would be similar.

Table 5.2 Estimated impacts of a 25 percent Renewable Fuel Standard by 2025

	2025	2030
Total ethanol production (billion gallons per year)	61.3	65.6
% from cellulosic	46%	48%
$ value per RFS credit	$ 2.18	$ 2.02
Cost Impacts		
Increased cost of fuels ($ billions) [1]	$ 134	$ 133
Increased costs recovered via higher liquid fuel prices ($ billions/year)	$ 28	$ 50
Increased cost of supporting infrastructure outside of fuel system (e.g., vehicles)	NQ	NQ
Increased cost of non-fuel products reliant on key biofuel inputs (e.g., food)	NQ	NQ
Minimum estimated total costs ($ billions per year)	$ 134	$ 133
Cost Efficiency		
Estimated reduction in CO_2-equivalent emissions, million metric tonnes per year	972	1,138
RFS costs/metric tonnes CO_2 equivalent reduced	$ 137	$ 116

Notes:

(1) The cost to the fuel system includes increase prices to refineries and other participants, not just higher prices at the pump. This cost category is the most closely linked to market protection for biofuel producers. The total protection can be estimated by multiplying the market value of the renewable fuel credits (a proxy for the above market cost to bring the marginal gallon of this fuel into market) by the number of mandated gallons. The forced expenditure to modify fleets to handle the new fuel blends would also be relevant in terms of artificially boosting the ability of biofuels to compete. Impacts on food prices, which are significant, would not likely generate market protection for the production and sale of biofuels.

(2) NQ = not quantified.

Source: Adapted from EIA (August 2007).

5.2 Output-linked support

5.2.1 Excise and production tax credits

The central role that biofuel subsidies from excise tax credits remains evident in pending legislation. In addition to extending existing supports, Congress plans to add an incremental tax credit for cellulosic ethanol, perhaps reflecting concerns that farmers will not choose to grow the crops if relative returns are lower than for corn (as noted in Babcock *et al.*, 2007).

- *Extension of existing biodiesel and ethanol tax credits*. H.R. 3221 (sec. 12002) would extend the blenders tax credit for biodiesel by another two years, until the end of 2010. The tax portion of the Farm bill would extend the small producer tax credits for ethanol and biodiesel through 2012; and the VBETC through 2010 (Joint Committee on Taxation, 2 October 2007a: 34). However, it would also reduce the VEETC from 51 cents per gallon to 46 cents per gallon once domestic consumption of renewable fuels (as measured by the RFCs that began trading on 1 September 2007) reach the 7.5 billion gallons per year mandated level (*Ibid*: 50). The Farm Bill would furthermore exclude ethanol denaturants from access to the VEETC (*Ibid*: 53).
- *Continuation of loophole allowing VEETC and VBETC proceeds to be excluded from taxable income*. Also of note, there is no language in the pending legislation to make funds earned from the excise tax credits on ethanol and biodiesel includible in taxable income, as is the norm for most other tax credits.
- *Restriction on credit access for foreign producers*. H.R. 3221 (sec. 13012) would restrict the eligibility for both the ethanol and the biodiesel credit to fuels produced or consumed in the United States, though imported fuel sold in the United States would also receive it. The language still allows U.S. producers to get the credit and then export the fuel.
- *Eliminates access to credit for biofuels co-produced at petroleum refineries*. H.R. 3221 (sec. 12003 and 13011) would restrict the Renewable Diesel Tax credit of $ 1.00 per gallon to exclude co-production of "renewable diesel" at oil refineries (as has been proposed using animal fat in a joint venture between Tyson and ConocoPhillips). The tax portion of the 2007 Farm Bill would cap rather than eliminate the eligibility of co-produced renewable diesel at 60 million gallons per year per facility (Joint Committee on Taxation, 2 October 2007a: 41).
- *Producer tax credit for cellulosic ethanol*. H.R.3221 (sec. 12004) would introduce a new tax credit for the production of cellulosic ethanol. This would be in addition to the VEETC, and would be worth an incremental $ 0.50 per gallon. A similar provision is included in the tax provisions to the Farm Bill, capped at the first 60 million gallons per year per ethanol plant or once 1 billion gallons per year of cellulosic capacity exists nationwide (Joint Committee on Taxation, 2 October 2007a: 30). The JCT (Joint Committee on Taxation, 19 June 2007b) estimated very low costs for this program (around $ 24 million total) assuming it would expire before production ramped up. Later estimates (Joint Committee on Taxation, 2 October 2007b) show somewhat higher subsidies (roughly $ 830 million for 2008–17). However, were the credit to be retained while large cellulosic mandates took effect subsequent to 2015, the revenue losses would quickly mount to several billions of dollars per year.
- *New tax credit for "fossil-free" alcohol producers*. The tax portion of the Farm Bill would create a new 25 cents per gallon for any ethanol producer using 90% or more biomass energy to make the ethanol. Other non-fossil, non-biomass energy resources do not seem to count. Producers are eligible if production capacity is less than 60 million gallons per year (Joint Committee on Taxation, 2 October 2007a: 38).
- *Extension of definition of "taxable fuel" to include ethanol and biodiesel*. Current definitions of taxable fuel exclude biodiesel and ethanol. They are normally captured via backup rules that capture biodiesel used in diesel powered highway vehicles or trains; or that are used to produce a blended taxable fuel. The tax portion of the 2007 Farm Bill would include these fuels in the standard listing of taxable fuels (Joint Committee on Taxation, 2 October 2007a: 31). This would likely be to close some existing loophole that allows the fuels to escape taxation.

5.2.2 USDA Bioenergy Program

Between 2001 and 2006, the U.S. Department of Agriculture's (USDA) Bioenergy Program paid nearly $ 550 million in bounty payments to biodiesel and ethanol producers who increased their capacity. The program ended in 2006, but would be reconstituted and restructured in some of the pending legislation. The new rules would greatly expand eligibility to combined heat and power using biomass and to biomass gasification. They would also exclude ethanol from corn starch and renewable diesel co-produced with petroleum. Legislative language stipulates mandatory funding through USDA's Commodity Credit Corporation (CCC). The funding levels are $ 1.2 billion for FY08–12 period, significantly higher than the $ 150 million per year provided under the original program. Section 9007 of the Farm Bill includes similar eligibility language, but somewhat higher mandated funding ($ 1.4 billion for the 2008–12 period).

Much of the statutory language from the original program seems to apply to the new one as well. For example, bounties are paid based on available funding and on *increases* in production capacity over the prior year. Payment ratios are higher for smaller plants, with 1 *feedstock reimbursement unit* per 2.5 units of increased production for plants less than 65 million gallons per year. The ratio for larger plants is 1:3.5. Additional guidance will be needed on how production units will be normalized. The original approach based on gallons will no longer work now that gaseous fuel and combined heat and power will be eligible.

5.3 Subsidies to capital

5.3.1 Accelerated depreciation and expensing of capital

There are a number of provisions under consideration that would drive up subsidies through rapid deduction of capital investments from taxable income.

- *Expensing capital to convert to coal-fired ethanol production.* In the midst of increasing concerns about coal-fired ethanol plants nullifying the potential carbon reduction benefits of this fuel source, it is interesting to see that at least one bill (H.R. 683) aims to subsidize the conversion of natural-gas fired ethanol plants to coal. Section 8 of the bill would allow 50 percent of the capital related to powering the ethanol facility to be expensed (written off from taxes immediately), rather than deducted over multiple years as the plant wears out as is the norm.

- *Expanded special depreciation for cellulosic ethanol plants.* Current law allows 50 percent of the investment into cellulosic ethanol production facilities to be deducted from taxable income in the first year. The tax break is not affected by alternative minimum tax rules that often reduce the realized benefit of other provisions. The 2007 Farm Bill would expand the properties eligible to take this deduction by removing the current restriction that the property must be used in the United States. It appears to make U.S.-owned property operating in other countries eligible for the deduction (Joint Committee on Taxation, 2 October 2007a: 39).

- *Growth in accelerated depreciation subsidies from construction boom driven by higher RFS.* Although existing depreciation classifications for most biofuel assets do not change in pending legislation, the implementation of large new renewable fuel mandates triggers a decades-long surge in sectoral investment. This would occur in both the production and distribution infrastructure. To meet the mandated target of 36 billion gallons per year by 2022, more than 24 billion gallons of capacity would need to be built. Even assuming conventional ethanol construction costs of roughly $ 2 per gallon of annual capacity, the investment amounts to nearly $ 50 billion. However, building cellulosic capacity is likely to be two to three times as expensive. With a substantial portion of the final targets expected to be met with cellulosic ethanol, the total investment tab could top $ 100 billion over the next 15 years. Building out the supporting infrastructure to ship, store, and dispense these fuels would generate additional tax expenditures.

5.3.2 Federal research and development and demonstration projects

Government involvement in funding biofuel research, and in helping to pay to build new facilities, has been growing in recent years. This trend appears likely to continue with a wide range of new programs in this area, many measured in the hundreds of millions of dollars. The funding is often directed through universities, with language aimed at spreading the largesse across multiple institutions and sometimes across specific geographic regions. Although liquid biofuels are usually a central tenet of these spending programs, the research often includes additional bio-based products as well. It is difficult to tell how these initiatives are structured to ensure efficiency and to avoid duplication. While House and Senate Energy bill language usually authorizes particular spending, the Farm Bill often mandates it.

- **Increased authorization for R&D on biomass, bioenergy and bioproducts.** Current law authorizes $ 525m for FY 2008–09; H.R. 6 (sec. 122) would boosts this to $ 775 million, while H.R. 3221 would raise it to $ 1.2 billion for the FY 2008–10 period. H.R.2419 (sec. 9006) calls for a similar program, to be run jointly by the USDA and the DOE. It contains mandatory funding of $ 420 million for the FY 2008–12 time frame, with additional authorized spending of up to $ 200 million per year for FY 2008–15. The language does not appear to restrict access to research associated with conventional (corn-based) ethanol.
- **New bioresearch centers.** Several bills would provide R&D funding and establish bioresearch centers (at least five in H.R. 3221 sec. 4406; at least 11 in H.R. 6, sec. 123).
- **New biofuel information transfer centers.** H.R. 3221 (sec. 4402) and H.R. 6 (sec. 127) would establish a biofuels and biorefinery information center to provide and transfer information on biofuels and biorefineries. The Farm Bill (sec. 9011) has a similar provision to establish research centers focused on enhancing coordination among the USDA, the U.S. DOE and universities in developing, distributing, and implementing bio-based energy technologies. Funding under this section is authorized at $ 75 million per year for 2008–12.
- **Commercial applications R&D.** Two bills (H.R. 3221, sec. 4407; H.R. 6, sec. 125) would provide an additional $ 25 million/year for R&D and commercial application of biofuel production (both starch-based and cellulosic ethanol). H.R. 2491 (sec. 7410) establishes an Agricultural Bioenergy and Bio-based Products Research Initiative with a core focus on biomass production and conversion to energy, including the production of enzymes, fermentation, ethanol by-product utilization, and basic fuel chemistry.
- **Demonstration programs.** The Biomass Research and Development Program proposed under H.R. 3221 (sec. 507) would boost funding to R&D and demonstration projects on biofuels and bio-based chemicals. Mandatory funding through the CCC would total $ 350 million over four years (FY 2008–12). This funding would be on top of current authorizations of $ 200 million per year for FY 2008–15 under current law.
- **Extended funding for R&D as "Sun Grant" centers.** H.R. 3221 (sec. 5009) would extend R&D into bio-based energy technologies and products through 2012. Conducted through five "Sun Grant" research centers around the country, it would fund the institutions at $ 75 million per year.

- **Targeted R&D on wood biomass.** Section 5011 of H.R. 3221 would mandate funding, via the CCC, of $ 36 million over the FY 2008–12 period on a forest bioenergy research program to promote the use of woody biomass in biofuels. Section 9019 of H.R. 2419 is similar.
- **New biofuel research funding to minority institutions.** H.R.3221 (sec. 9312) authorizes spending of $ 50 million on a Cellulosic Ethanol and Biofuels Research program and provides R&D grants to 10 institutions serving predominantly Native American, African American, or Hispanic populations.
- **Small-scale production.** H.R. 3221 (sec. 4413(c)) would establish a DOE research program focused on small-scale production of biofuels and local or on-farm usage.

An emerging theme in research is the need to reduce the negative environmental impacts of biofuels. This appears to be a recognition of the rising impacts that biofuels have had on air, water, and soil resources around the country.

- **R&D into low-impact production.** H.R. 3221 (sec. 4413(a)) would mandate the expansion of a biological R&D program to include the environmental effects of biomass fuels, ways to reduce GHG emissions, and options for more sustainable agriculture .
- **Better measurement of lifecycle impacts.** Several bills call on the government to study and develop tools for improving the evaluation of lifecycle impacts of biofuels, especially in respect of greenhouse gas emissions (H.R. 6, sec. 148; H.R. 3221, sec. 4413(b)) and lifecycle energy consumption (H.R. 3221, sec. 4413(b)).
- **Energy efficiency and conversion away from corn.** H.R. 3221 (sec. 4408) would fund research on improved energy efficiency at existing plants, and on technology to convert from corn-based to cellulosic materials..
- **R&D focus on low-carbon fuels.** H.R. 6 (sec. 132) authorizes $ 275 million for the FY 2009–13 period to be spent on R&D for low-carbon fuels, including cellulosic biofuels.
- **Environmental impacts**. H.R. 6 (sec. 164) would require the EPA to study the potential adverse effects to air quality from the RFS and promulgate regulations to mitigate them. Section 211(c) of H.R. 6 would give the EPA more leeway to regulate fuels, engines, and emissions to water area as well as to the air.

5.3.3 Grants and credit subsidies

5.3.3.1 Title XVII Loan Guarantees and Guarantees to Biofuel Facilities

Subsidized credit for new biofuel capacity appears to be a central element of federal biofuel policy. This is a significant change from October 2006, at which point the loan-guarantee capacity of Title XVII of the EPACT05 was more theoretical than actual. In the past year, legislative efforts have worked to strip much of the fiscal oversight of the Title XVII loan guarantee programs, as described above in section 3.5.4.1. At least for now, it appears as though efforts by Congress to exclude these energy loans from the standard oversight of the Federal Credit Reform Act have failed.

However, new legislation would create additional large pools of capital outside of Title XVII that are earmarked for biofuels in particular (Title XVII loan guarantees are open to multiple energy technologies). The House Energy Bill (H.R. 3221, sec. 5003), for example, provides total guarantee authority of $ 600 million for "smaller" loans (less than $ 100 million each); and $ 1 billion for larger loans (up to $ 250 million each). Funding is mandatory under the CCC in the amount of $ 590 million for FY 2008–12, and guarantees can cover up to 90 percent of an eligible loan. The House Energy Bill version of this credit program seems to allow all types of biomass to apply, while the Senate version excludes corn starch. Eligible sources would also include biomass electric.

Even more generous funding has been proposed via the 2007 Farm Bill (H.R.2419). Section 9003 modifies the terms for a grant program originally implemented under the 2002 Farm Bill to be more focused on credit subsidies. While current law capped federal cost sharing on the grants at 30 percent of a project's cost, the loan guarantee program does not seem subject to the same constraint, guaranteeing up to 90 percent of the principal and interest due. H.R.2419 provides larger funding than the energy bills, with a guarantee authorization of up to $ 2 billion. Mandated funding levels to cover the subsidy costs of the guaranteed loans are $ 800 million through 2012, versus only $ 590 million under H.R.3221. Half of the guarantee authority would be available for loans of less than $ 100 million; the remainder for loans between $ 100 million and $ 250 million. Furthermore, unlike the Senate energy bill, the 2007 Farm bill would allow plants manufacturing ethanol from corn starch access to the guarantees. There are no stated restrictions based on the lifecycle GHG emissions of a particular plant either.

With the private investors facing so little risk from defaults, neither the plant owner nor the banks have sufficient incentives to do proper due diligence, and to rigorously cull the less favorable investments.

5.3.3.2 Rural Energy for America Program

Combined loan guarantees and grants under the "Rural Energy for America Program" comprise yet another source of subsidized credit for the biofuel sector, though the program supports other resources as well. Although the program has existed under a different name since the 2002 Farm Bill, mandatory funding has been increased and the maximum federal cost share (grants plus loans) boosted from 50 to 75 percent of the project costs. Mandatory funding under H.R. 3221 (sec. 5006) is $ 425 million between FY08–12.

5.3.3.3 Targeted Grants

Below are a handful of the grants mentioned in the pending energy and farm bills.

- **Grants for cellulosic ethanol production extended and expanded.** H.R.3221 (sec. 9308) authorizes funding of $ 1 billion over the FY 2009–10 period. Current law provided $ 750 million over three years for the FY 2006–08 period.
- **Grants to new regions.** H.R. 3221 (sec. 9315) and H.R. 6 (sec. 125) authorize $ 25 million per year for three years (FY 2008–10) in grants for renewable fuel production in states with low rates of ethanol and cellulosic ethanol production.
- **Grants to low-carbon fuel production.** H.R. 6 (sec. 161) would provide grants for producing advanced biofuels, defined as those with at least a 50 percent reduction in lifecycle GHG emissions relative to current fuels.

5.4 Support for other factors of production

5.4.1 Feedstock producers

There are two main themes in support to feedstocks in pending legislation. Some provisions are trying to address anticipated weaknesses in the production of generic classes of feedstock, such as for cellulosic ethanol. Others are narrowly worded provisions to bolster the use, in energy markets, of specific crops.

Provisions promoting specific feedstocks

- *Algae*. H.R. 3221 (sec. 4416) mandates that a report be prepared for Congress on progress in using algae as a feedstock for biofuel production.
- *Sugar*. The Feedstock Flexibility Program (H.R. 3221, sec. 5012) for bioenergy producers would require the USDA to initiate a sugar-to-ethanol program in order to absorb surplus sugar. The Farm Bill (H.R. 2419, sec. 9013) contains a similar provision. While the CBO (24 July 2007, 10) estimates that the program could reduce sugar support payments by $ 10 million per year , the savings to the government come by driving up sugar prices to consuming markets. Notably absent from any of the analysis is the idea of letting standard supply and demand pressures establish appropriate production levels.

  Section 1301 of H.R.2419 seems to allow exemptions from sugar mandates if the crop is diverted to fuel markets rather than food.[26] Sugar crops being handled under the Feedstock Flexibility Program would still be subject to the mandate.
- *Sorghum*. High-priority research by the USDA includes a sorghum research initiative to expand the use of sorghum in biofuel production. Under proposed legislation (H.R. 2419, sec. 7305), sorghum-ethanol would be considered an "advanced biofuel."

  Another sorghum-specific program (H.R. 2419, sec. 9020) is classified as "supplementing corn as an ethanol feedstock." It provides $ 20 million in funding to 20 universities (maximum funding of $ 1 million each) to demonstrate ways to replace corn feedstocks with sweet sorghum or switchgrass. Although switchgrass is mentioned in the introduction to this section, the details focus entirely on sweet sorghum. In fact, a condition of eligibility for the grants is access to multiple lines of sweet sorghum, with no mention of access to switchgrass.
- *Woody biomass*. H.R.2419 (sec. 9019) targets R&D to encourage use of woody biomass for bioenergy production. The provision includes mandatory funding via the CCC of $ 15 million per year for FY08–12 period. Section 5011 of H.R. 3221 is similar.

General reforms to farm subsidy programs, with potential effects on biofuel feedstocks

- Advance Payments, a portion of the producer's final payment made before the end of each fiscal year, would be eliminated beginning with the 2012 crop. The savings would average about $ 110 million per year, with a smaller fraction affecting corn (CBO, 24 July 2007: 5). The impacts are likely to be quite small: according to CBO, as the change would not take effect until 2012 and savings in early years are expected to be roughly offset by increased payouts after 2017.
- Higher loan rates on oilseed crops (CBO, 24 July 2007: 6) could increase the crop subsidies associated with biodiesel feedstocks slightly.

General biomass resources

- *Size of resource base*. H.R.2419 and H.R.9014 both call upon the USDA to produce a county-level inventory of biomass resources to estimate the amount of farmland that could be used for fuel production.

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[26] In order to "balance" the sugar market, the 2002 Farm Bill provides the USDA with a couple of tools to reduce sugar supplies solid in U.S. markets. They can restrict imports that exceed their trade agreement obligations; of they can control the amount of sugar U.S. famers are allowed so sell via the Overall Allotment Quantity (ASA, 2007).

- *Biomass energy reserve* (BER). H.R.2419 (sec. 9018) establishes a biomass energy reserve to help protect against supply disruptions caused by drought or other crop failures. The dollars involved could be very large, though it is difficult to tell from existing language. Eligibility would be limited to farms located within a 50 mile radius of a bio-energy facility; the language seems to allow a wide variety of biomass plants (not just biofuel manufacturers) to participate. The program has two main elements:
    - Subsidizing land used to produce cellulosic crops. The legislation would establish financial and technical assistance to landowners and operators to grow dedicated energy crops to be used in cellulosic and production of other forms of energy. Payments would include an "establishment payment", to cover the cost of seed, stock and crop planting. The rental payments are reduced if energy crop is sold, making the program operate like a price floor. The wording seems to exclude corn, although it is possible that corn stover might be allowable. The approach would be similar to the current Conservation Reserve Program (CRP), where five-year rental contracts with farmers would be set up under which they would grow the allowable cellulosic crops. Lands currently enrolled in other federal reserve programs (e.g., CRP or wetlands reserve) are eligible to participate in the BER, though must modify their CRP contract first. Such modifications would normally be allowable so long as the land use changes wouldn't affect birds during their nesting and brooding seasons; and if CRP payments are adjusted accordingly for the change in acreage. However, it does imply that BER contracts would be deemed more important than CRP contracts. BER lands would be allowed to be used concurrently for seed harvesting or personal use, however.
    - Matching grants to underwrite the cost of cellulosic harvesting, storage, and transport to processing plants. The USDA would pay a matching \$ 1 per tonne for each \$ 1 paid by bioenergy facilities, up to \$ 45 per tonne for a period of two years. This payment would cover the costs of harvesting, collecting, storing, and transporting biomass to points of use. Eligible producers would be wide ranging, and include those (a) enrolled in BER contracts; (b) collecting "waste" agricultural biomass; (c) sustainably harvesting agricultural or forestry residue (following a forest stewardship plan) for use in the energy sector; or (d) removing noxious or invasive species.

    Information on funding for these provisions is not given in the bill, which refers only to "such sums as may be necessary." Using information from USDA Chief Economist Keith Collins on the cost per tonne of dry biomass, the Competitive Enterprise Institute (2007) estimated annual program costs of this provision at approximately \$ 200 million for the period FY 2008–12, growing sharply in later years as cellulosic production increases. They estimate that the cumulative subsidy over the 2008–22 time frame of the legislation would be of \$ 4.1 billion.[27] In dramatic contrast, H.R.6 authorizes a mere \$ 4 million per year for the 2008–12 period, a level of funding that seems so far below that provided for the other reserve programs as to be highly unlikely.

    - *Disaster assistance.* Although not currently in legislative proposals, some analysts (CEI, 2007) have noted that the USDA has provided disaster assistance for all core crops, and will likely do so for

[27] The CEI assumed (based on Collins) that 1 billion gallons of cellulosic ethanol would require 11.1m tonnes of biomass feedstock. Cost per tonne of dry biomass of roughly \$ 60 in 2007, dropping to \$ 30/tonne in 2010–12 (CEI, 2007: 13). Subsidy cost per tonne used by the CEI starts at 20 percent, dropping to 10 percent over time; results in a subsidy cost per dry tonne of \$ 10 in 2009. These estimates don't seem outrageous given that the proposed language in the Farm Bill would allow matching funds of up to \$ 54/dry ton.

cellulosic ethanol feedstocks as well. They estimate the cost of such a program for cellulosic ethanol feedstocks would be around $ 50–70 million per year.

5.4.2 Labor

The proposed legislation (H.R. 2419, sec. 7312) includes one program targeting labor in the biofuel sector, the New Era Rural Technology Program. To be funded by USDA, the program would offer grants for technology development, applied research, and worker training in order to develop an agriculturally-based rural energy workforce.

5.5 Support for consumption

5.5.1 Increased subsidies to alternative fuel refueling property

Although biodiesel does require some new infrastructure to ensure blends are consistent, the biggest distribution challenges relate to ethanol. The fuel does not ship well by pipeline, and as a result has had to rely on barge, truck and rail. As would be expected, given the pace of growth in production, these resources have sometimes been strained. Dispensing and storage has also been a challenge for higher ethanol blends such as E85. The pending energy legislation contains a number of programs that would use public money to alleviate the industry's distribution problems. For retail outlets, for example, they include:

- Grants for the installation of renewable fuel infrastructure at retail stations (H.R. 3221, sec. 9301).
- Federal support to ensure standardization of biofuel dispensers (H.R. 3221, 4415).
- A grant program to install refueling infrastructure for E85 and B20. H.R. 3221 (sec. 9301) authorizes up to $ 200 million annually, though it excludes large oil companies as recipients. H.R. 604 would boost the tax credit for E85 refueling property to 75 percent (Sissine *et al.*, September 2007: 21).
- A requirement that the DOE report on the feasibility of *requiring* fuel retailers to install E85 infrastructure (H.R. 3221, sec. 9304).
- A requirement that each federal fleet refueling center have at least one renewable fuel pump by 2010 (H.R. 3221, sec. 9313).

General subsidies to refueling property

The House Energy Bill (H.R. 3221, sec. 12002) would extend and expand the tax credit for alternative fuel vehicle refueling property. The current expiration date of 31 December 2009 would be pushed back a year, and the maximum public cost share would be increased from 30 percent to 50 percent of the cost of installation. The dollar tax credit cap per station would similarly be boosted, from $ 30,000 to $ 50,000 (H.R. 3221, sec. 12002). The tax portion of the 2007 Farm Bill would simply extend the provision one year at the current limits (Joint Committee on Taxation, 2 October 2007a: 46). The JCT has estimated the incremental cost of a similar provision (in H.R. 2766) at roughly $ 40 million per year during the years it would be in effect (Joint Committee on Taxation, 19 June 2007b: 1). Were the provision in effect during the build-up to meet much higher RFS mandates, the costs would be substantially higher than the JCT has modeled.

5.5.2 Expanded eligibility for subsidies to alternative fueled vehicles

The pending bills initiate or expand a number of programs to further subsidize alternative fuel vehicles.

- **Expanded exemption from CAFE standards.** H.R. 3221 (sec. 9317) would allow vehicles capable of operating on B20 to be treated as alternative fuel vehicles eligible for CAFE credits. Although some passenger vehicles are warrantied only to levels of B5, higher blends of B20 could likely be integrated with few modifications to vehicle production. This would make most new diesel passenger cars and light trucks able to earn CAFE credits. A possible outcome of concern would be less stringent requirements for the gasoline fleet, with potential backsliding with respect to actual fleet efficiency. The CRS notes that "[e]xpanding the definition of alternative fuel vehicles to include B20 could make all diesel passenger cars and light trucks eligible for credits under CAFE." (Yacobucci, 21 August 2007: 23) The existing exemptions for FFVs are estimated by the Union of Concerned Scientists to have inflated U.S. oil imports by 80,000 barrels per day (MacKenzie *et al.*: 2005).

  Yacobucci (11 October 2007) notes that the maximum reduction in CAFE standards will already have been reached by most large U.S. manufacturers. However, foreign producers of diesel vehicles (e.g., Volkswagen) could take advantage of reduced mileage requirements on other portions of their fleet. In addition, H.R. 6 (section 506) would allow trading across manufacturers for the first time. With trading, excess credits from foreign producers could be sold to U.S. firms, thus reducing pressure on them to improve their fuel economy.

- **Manufacturing capacity.** The domestic manufacturing conversion grant program would provide federal funding to retool "at-risk" or closed domestic manufacturing capacity to make alternative-fueled vehicles. Run by the U.S. EPA, current law requires grants to domestic manufactures and consumer purchase incentives for efficient hybrid and advanced diesel vehicles. H.R. 3221 (section 9311) would extend this eligibility to FFVs as well.

- **Increasing vehicle market share.** H.R. 6 (sec. 520) would requires the DOT to produce an action plan to ensure that alternative fueled vehicles represent at least 50 percent of new vehicle sales by 2015.

5.5.3 Subsidies for distributional infrastructure

Distribution of liquid biofuels has been a problem, especially for ethanol. Problems with corrosion and cross contamination have precluded the use of existing pipelines to move ethanol. This has greatly increased ethanol's transport costs, with 60 percent of the volume in 2005 moving by rail, 30 percent by truck and only 10 percent by barge. Trucks dominate the shipment of corn to ethanol plants (USDA, September 2007: 6, 8). Build out and expansion of road and rail links to production facilities is a common area of state and county subsidization (though not quantified here). Fuel terminals, blending infrastructure, and retail distribution have been challenges as well. Recent legislation has also begun promoting schemes to ensure feedstock and biofuel security reserves, to cushion against supply disruptions. In all of these areas, federal policy is aiming to help out. Below are some examples:

Cross-modal

- H.R. 3221 (sec. 4403) calls for establishing an R&D program on the effects of biofuels on existing transportation fuel distribution systems.
- H.R. 6 (sec. 121) would provide grants ($ 200 million is authorized) for up to 10 pilots in "infrastructure corridors" to expand ability to ship ethanol (blends >E10 but less than E85) and B10.

- DOE grants to local governments and other entities to develop infrastructure to produce, separate, process and transport biomass to refineries (H.R. 6, sec. 126).
- Mandated study by the National Academy of Sciences on technologies for the production, transportation, and distribution of "advanced biofuels" (H.R. 6, sec. 141).

Rail

- Mandated study by DOE and DOT to assess the adequacy of railroad transport to move domestically-produced renewable fuel (H.R. 3221, sec. 9306; H.R. 6, sec. 521). Section 6032 of the Farm Bill has a similar scope (among other objectives), but is to be coordinated by the USDA and DOT.

Pipeline

- DOE and DOT feasibility study of constructing dedicated ethanol pipelines (H.R. 3221, sec. 9304).

Strategic stockpiles

Although biofuels are touted as a way to boost the United States' energy security, feedstocks for these crops periodically encounter periods of instability, most often from drought, disease, or pestilence. The Competitive Enterprise Institute (CEI, 2007) notes that "[s]ince 1970, six major droughts have dropped corn production typically 20–30 percent from normal weather year production levels. This is an average on drought every six years, mainly occurring in the Midwestern states." Drought would reduce ethanol production by 15–30 percent, an amount CEI claims is difficult to make up via Brazilian imports (at short notice) or increased petroleum-derived gasoline. They estimate that a strategic ethanol reserve, containing fuel rather than feedstock, would cost a some $ 18 billion to create and maintain over the 2008–2022 period, $ 4.3 billion of which would have to be spent during the first five years (2008–12), mainly due to large start-up costs assumed in 2009 (CEI, 2007: 10).

While these cost estimates may prove too high, Congress is indeed worried about the security of biofuel supplies. H.R. 682, introduced in the House of Representatives on 24 January 2007, would add both ethanol and biodiesel to the nation's strategic fuel stockpiles. In addition, as described above, H.R.2419 would establish a series of Biomass Energy Reserves across the country to stabilize cellulosic feedstock supply.

5.5.4 Research on increasing blend ratios

As noted at the beginning of this report, ethanol is at risk of hitting its "blending wall"—the point at which all gasoline has been blended with the full amount of ethanol deemed safe for the existing vehicle fleet. FFV's overcome this constraint, but enter the market slowly as the transport fleet turns over. In the case of biodiesel, cost concerns as well as issues of product performance in colder climates, are inhibiting greater uptake. Yet, in both sectors production capacity is rising quickly. Industry and Congress are looking for alternative solutions, many of which are evident in the pending legislation, which calls for:

- A report on the R&D challenges to boosting biodiesel consumption beyond 2.5 percent of volume (H.R. 3221, sec. 4404) and 5 percent by volume (H.R. 6, sec. 130(a)).
- A study of the potential for using ethanol blends of between 10 and 40 percent (H.R. 3221, sec. 4409 and sec. 9305; H.R. 6, sec. 142).
- A study into whether optimizing vehicles for E85 would increase vehicle fuel efficiency (H.R. 3221, sec. 4410; H.R. 6, sec. 144). FFV engines are normally optimized to burn gasoline.
- Study on the effect of various biodiesel and diesel blends on engine performance and durability (H.R. 3221, 441; H.R. 6, 146).

- A study, to be carried out by the DOE, on the effects of ethanol-blended gasoline on off-road vehicles and recreational boats (H.R. 6, 149). There have been reports of problems with boat fueling systems even at relatively low blend ratios.

5.5.5 End-user demand

A handful of proposals aim to boost the ease of use of biofuels, or to address consumer resistance to them.

- Biodiesel Fuel education program ($ 2 million per year) to fund non-profit organizations to educate governmental units and the public about the benefits of biodiesel (H.R. 3221, sec. 5004; H.R. 2419, sec. 9017). The envisaged increase in funding would double current spending.
- HR6 (sec. 130(c)) requires promulgation of rules to ensure that renewable diesel substitutes comply with applicable ASTM standards. $ 3 million per year for FY08–10. Addresses past quality problems in the biofuel sector.
- DOT outreach and education on FFVs and which vehicles can use E85 (H.R. 3221, sec. 9309).
- DOE/EPA study of the impacts of renewable fuels on energy security, environmental quality, and job creation and agricultural markets (H.R. 3221, sec. 9314; H.R. 6, sec. 162). A similar study is required in section 14002 of H.R. 3221.

6 Conclusions and recommendations

Biofuel subsidies continue to rise and are expected to total more than $ 92 billion for the 2006–12 period

Since the original report was published in October 2006, support for biofuels has continued to be provided at both the state and federal levels. Most of the policies are linked to raw production or consumption levels and are not designed to phase out when oil prices (and biofuels are more competitive) are high, nor once specified production targets are met. As a result, the aggregate level of support has risen, though the subsidies per unit of energy output have remained fairly level. The vast majority of government support goes to corn ethanol; this trend will continue under pending legislation, at least through to 2012.

Despite rising awareness in the local and national media of some of the environmental and economic problems associated with the biofuel build-out, governments around the country continue to significantly expand public subsidization of the industry. This is particularly evident with in respect of planned extensions of the volumetric excise tax credits (with few added controls), and the much higher mandated consumption targets under proposed updates to the Renewable Fuels Standard (RFS). Reaching the RFS, including in some of the pending legislative proposals, will cost more than $ 130 billion per year by 2025, according to estimates by the Energy Information Administration.

Many of the policies currently in place do not appear co-ordinated or well targeted. Rather they are duplicative, with tax credits, grants, and feedstock support added to consumption mandates.

Environmental impacts of biofuels are still peripheral rather than central to policy

Some changes are beginning to enter legislative language to broaden subsidies beyond corn ethanol, and to at least study the impacts that production on biofuels or their feedstocks is having on water and air quality, land use, and other farm sectors. Government funding for R&D and demonstration plants is not going to corn, but primarily to cellulosic technologies. Some production subsidies, such as the USDA's Bioenergy Program, at least for now, also exclude corn starch as a feedstock. In addition, some, though not the majority, of pending legislative efforts include some consideration of the environmental impacts of biofuels, including their lifecycle GHG emissions. However, most are relatively small steps that seem difficult to monitor and enforce.

The core existing programs, and many proposed ones, continue to avoid dealing with the growing environmental concerns associated with both domestic and imported biofuel lifecycle impacts. While directing funding toward cellulosic technologies would be an improvement over many of the existing policy structures, the strategy is missing the primary problems with existing biofuel supports.

Biofuels remain an inefficient way to bolster energy security or reduce greenhouse gas emissions.

Lawmakers are not addressing the core question of whether biofuels are the best tools to deliver on the policy objectives of GHG reductions, energy security or rural development. The October 2006 report, supported by this Update, highlights the availability of cheaper and more effective options for achieving these policy goals.

The average cost to displace petroleum energy during the 2006–12 period is estimated at $ 12–17 per GJ for corn ethanol; $ 16–25 per GJ for biodiesel; and up to $ 19 per GJ for a hypothetical cellulosic case in which existing subsidies are assumed to produce the lower impact cellulosic product. This translates to a public subsidy of $ 1.40–1.70 per gallon gasoline equivalent and $ 2 to $ 2.35 per gallon diesel equivalent—a sizeable percentage of the fuels' retail value.

The cost to displace a metric tonne of CO_2-equivalent via U.S. biofuel subsidy programs remains far higher than the price of displacement in other economic sectors, as measured by the price of these offsets on the Chicago and European Climate Exchanges. Using the most favorable assumptions to estimate how much carbon, ethanol and biodiesel can displace, the minimum subsidy cost (before buying the fuel) per tonne of CO_2-equivalent displaced is $ 295 for corn ethanol, $ 239 for biodiesel, and nearly $ 110 for the hypothetical cellulosic-ethanol case. Simply purchasing carbon offsets on the Chicago Climate Exchange, rather than subsidizing corn ethanol, would buy nearly 90 times the GHG reductions. A similar strategy for biodiesel would buy 75 times the carbon offsets. Even for the hypothetical cellulosic-ethanol scenario, the markets could provide nearly 35 times the reductions for the same price—ignoring the fact that real cellulosic-ethanol plants will require a much higher level of subsidy than corn ethanol to be economically viable.

These are *best-case* scenarios, as estimates for carbon displacement span a far wider range of figures. Many of the published values generate far higher lifecycle GHG emissions for ethanol or biodiesel than used in the above calculations, including some that would imply that large-scale use of biofuels would result in GHG emissions *rising* compared with a gasoline or diesel baseline. If these assessments prove accurate, that would mean that the federal and state governments are, in effect, subsidizing *increased* CO_2–equivalent emissions by hundreds of dollars per metric tonne.

Biofuels should compete head-on with alternative ways to reduce oil demand in the transport sector

Given the inefficiencies that have been identified, combined with the rising environmental costs of biofuel production around the world, there is no reason that this one particular approach aimed at addressing energy security and climate change concerns should be given a free rein. Rather, it should compete directly for public support with alternative strategies, such as improving fleet efficiency, and encouraging hybrid and plug-in hybrid drive trains. While legislative efforts often contain public disbursements in all of these areas, there is no integration and no evaluation of the relative efficiency of the different policies in achieving the desired objectives.

Policy initiatives are adding additional layers of complication and distortion

Congress appears convinced that the way forward is for them to continue to micro-manage the evolution of the market for transport fuels, with specific funding to specific fuels and technologies. There is an unwarranted confidence that they are somehow better placed to choose market winners, rather than focusing instead on establishing a level and transparent playing field on which all suitable strategies can compete.

- By forcing diversification of feedstocks away from corn, farmers and biofuel producers might be compelled to use less economically worthwhile crops (with the consumer or taxpayer paying the additional cost via higher prices or additional cellulosic subsidies). The proposed Biofuel Energy Reserve, which sets up a series of payments to farmers for growing cellulosic crops, is one example.
- Initiatives allowing B20 vehicles to earn CAFE credits will likely compound existing perverse effects associated with Flex Fuel Vehicle exemptions from CAFE. Such exemptions are estimated to boost U.S. oil imports by 80,000 barrels per day. A pending trading system for these credits would enable manufacturers that have reached their allowed reduction in CAFE targets as a result of either FFV or pending B20 rules to sell the credits to other car firms. Implementation of such a system would generate additional losses in the efficiency of the transport fleet.
- A wide array of possible formulations of the Renewable Fuel Standards—addressing targets; special credits for E85, cellulosic, or biomass-fired production facilities; and eligible fuels—all promise a range of unexpected and perverse outcomes that will yield few tangible benefits in terms of energy efficiency, diversification, or GHG mitigation.

Yet, notably absent from the scores of legislative proposals are a simplification of the policy environment, increased competition amongst alternative solutions, and reliance of pricing mechanisms to target research and optimize production. There seems to be no political will to end the excise tax credits, despite their duplication with the RFS mandates. Efforts to reduce or end ethanol tariffs, even though this would also be a cost-effective way to diversify the country's supply of alternative transport fuels, have failed repeatedly.

Rising subsidies have an opportunity cost, not just a financial one

The tens of billions of dollars spent on biofuels rearrange all sorts of economic relationships from land use, cropping patterns, and choice of outlet markets. Public funds spent inefficiently on biofuels are also unavailable to pursue more rapid and cost-efficient solutions to the real issues we face as a society.

The U.S. farm system is already distorted, with wide-ranging subsidies to water use and crop production. The added layer of biofuel subsidies makes it quite likely that the country will squander truly valuable inputs, such as soil fertility and groundwater, to produce non-durable and rapidly consumed biofuels. There are already signs that this is happening, both in the United States and around the world. Restructuring U.S. policy would make a big difference in ameliorating this trend.

This report recommends that:

- funding should be directed towards a broader range of approaches that could achieve the desired policy objectives (notably improving energy efficiency and reducing demand for fuels overall);
- Congress should not be picking winners, but should establish a level basis for competition and for measuring performance against policy objectives;
- any subsidies that are applied should differentiate across production chains so they do not reward environmentally damaging practices; and
- baseline policies, such as carbon constraints, should be implemented to allow markets to rationalize amongst carbon-reducing fuel cycles, rather than assuming that biofuels would automatically win such a contest.

Regarding policies already committed, at a minimum, federal and state policy makers should:

- introduce mechanisms to phase-out subsidies to biofuel manufacturers during times of high oil prices;
- take into account the environmental effects of particular biomass production cycles in the design of any subsidy programs;
- open competition in the transport sector to all methods that can displace carbon and imported oil, including demand reduction; ;
- improve the transparency of information on biofuel subsidies and
- establish an evaluation process that can thoroughly assess the cost-effectiveness of support policies at all levels of government (but particularly the Renewable Fuels Standard) in attaining the key policy objectives behind U.S. biofuel policy.

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Annexes

Annex 1: Understanding subsidies

A basic understanding of core issues regarding subsidy policy is helpful in interpreting this report. The following points provide a useful introduction to subsidy evaluation and address a number of areas of frequent confusion.

Not just cash. Government subsidies are often thought of as cash payments from a government to a private individual or firm. While cash grants are subsidies, there are many other more complex methods that governments use to transfer value to the private sector. These include reduced tax rates; government-provided loans or insurance at below-market rates; guarantees on private loans; special requirements or bans that affect either biofuels or their substitutes; and surcharges or tariffs on competing products. While the details of these approaches can, and do, vary widely, all are used to some degree to subsidize ethanol and biodiesel in the United States.

Time-frame of the analysis. Subsidy values change annually, and can be volatile as one program is phased in or out, or as production levels or interest rates change. For this reason it is useful to show subsidy trends over time. Information for 2006 reflects actual data in most cases; data for future years rely on projections of industry growth developed by the U.S. Energy Information Administration and the Food and Agricultural Policy Research Institute.

Subsidy magnitude—cost to government versus value to recipient. Estimating the size of government subsidies can be complex. Often, estimates must be made against a baseline. For example, the baseline for taxes is that all firms pay income taxes in a particular way, with standard rates across all industries. Baselines for loan programs would be how much the government pays for the credit it uses to make subsidized loans to targeted sectors. The subsidy would be the deviation between standard and preferential tax or credit rates.

Both of the above examples represent one approach to subsidy measurement: the cost of the program to the government. However, there is a second measurement approach that estimates the value to the recipient. The value based approach provides a more accurate metric of the level of distortions the government policies create in biofuel markets. For example, many government tax credits generate special "income" to private industry that is effectively tax-exempt. This generates an incremental subsidy value to the recipient, and is often referred to as the *outlay equivalent*. Similarly, government loans to a small, high-risk energy producer may be made at, or even slightly above, the government's cost of borrowing. However, that rate is still far below what the borrower would have been able to obtain on its own, generating an incremental intermediation value of the government credit support. Loan guarantees can often have quite a high intermediation value to borrowers, as they bring the effective interest rate on high-risk ventures down to the "risk-free" rate of the U.S. Treasury.

Subsidy specificity. A related issue involves subsidy policies that are available to multiple sectors of the economy. If these subsidies support key elements of ethanol production we did include them on a pro-rated basis. From the perspective of trade policy, many of these subsidies are considered "non-specific" and therefore not trade-distorting. Some economists might argue, also, that because these subsidies are offered to many industries, they benefit no single one disproportionately. For a number of reasons, we disagree. First, some of the "general" programs actually contain special terms that do provide disproportionate benefit to liquid biofuels producers (accelerated depreciation, for example). Others, such as many state-level economic development or jobs incentives, are frequently used by the sector. As documented by Greg LeRoy, founder and director of Good Jobs First, these types of local investment incentives can be very lucrative for firms (LeRoy, 2005), in the aggregate affecting their cost structure. Finally, many of the forms of state- and local-government intermediated financing commonly provided to biofuel manufacturers, such as loan guarantees and some tax increment financing instruments, put these governments at financial risk should the operating environment for biofuels change and the borrowers default. Thus, these governments can be expected to take a higher level of interest in maintaining other, especially federal, subsidies to the sector. All of these factors make it quite important to take a holistic view of policy interventions that includes more general, as well as sector-specific, subsidies. Subsidy magnitude—appropriate metrics. The objective of a study such as this is to inform important policy decisions. As such, no single metric tells the entire story. We provide estimates for total expenditures to support the industries, recognizing the many questions regarding fiscal prudence and overall public expenditure. We are also interested in measures of subsidy intensity: how much public subsidy has been spent per unit of output. 5 Government Support for Ethanol and Biodiesel in the United States Depending on the parameter being considered, that output might be a gallon of ethanol or of biodiesel. It can also be for outputs such as petroleum or fossil fuel displacement, or greenhouse gas reduction. In our view, these latter metrics are of great interest when assessing broad policy alternatives related to environmental quality and energy security.

Market impacts. Subsidy magnitude data provide an overview of public transfers to the private sector. The impact that these transfers have on patterns of research, investment or production is a different issue, and one that is far more difficult to ascertain. Economists often build complex partial or general equilibrium models in an effort to answer these questions; we have not done so here. Some subsidies may have predominantly wealth effects, in that they move money from one party to another, but do not particularly affect the structure of markets to such a degree that the energy mix changes. In highly competitive global markets with open borders (which is currently not the case for biofuels), subsidies can affect the mix of suppliers (e.g., domestic versus foreign) without materially affecting the energy mix. Other subsidies can have efficiency effects, in that they do alter market equilibrium in material ways, impeding the most efficient or appropriate diversification of energy suppliers or resources. For individual policies, people (including some reviewers of this study) may hold strong opinions about the impact of a particular subsidy, and whether it affects market efficiency or merely transfers wealth. There are indeed disagreements, and the actual impact is not always self-evident. We do not try to make these evaluations in this report.

Subsidy incidence. Related to this issue of market impacts is the question of which party actually ends up benefiting from a subsidy. There is an inclination to assume that the original recipient (or target) of a subsidy program is the one who benefits. This is not always the case. A new sales tax may be shared partly by the consumer and partly by the supplier, based on their relative market power—even though each would like the other to foot the entire bill. Subsidies are no different. In our tally of transfers, we attribute subsidies to ethanol if the target is the ethanol supply chain, even if, as is often the case with the Volumetric Ethanol Excise Tax Credit, the entity that is paid the funds may be an oil company. In this case, the subsidy encourages the oil company to blend in ethanol rather than another feedstock, but the value of that credit is likely shared between multiple parties in the supply chain. As small, fragmented industries consolidate, power tends to shift to the larger players. Thus, we expect that over time, a higher percentage of all of the subsidies to ethanol and biodiesel will be captured by the larger players.

State and federal interactions. A final complication regarding tax subsidies in particular is the interaction between different tax jurisdictions. Many, though not all, federal tax breaks are accepted at the state level, reducing state taxes as well. The rules regarding what is allowed or disallowed are often state- and provision-specific. Overall, however, this particular interaction increases subsidy magnitude. Working in the opposite direction are state-level subsidies that boost taxable income on federal tax returns. This can reduce the realized benefit from the state provisions and overall tends to reduce the subsidy magnitude. Our estimates do not adjust for either of these factors. However, we estimate their impact, which is partially offsetting, to be on a net basis only a few percentage points on either side of our overall estimates.

Annex 2: Multi-year detail (2006–2016) subsidy estimates

Annex 2. 1 Multi-year detail for ethanol subsidies (millions U.S. $) [1, 2 & 3]

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	Total, 2006–12[4]	Total, 2006–16[4]
Market Price Support (MPS)													
MPS on domestic production	1,310	1,670	2,240	2,790	3,010	3,050	3,090	3,120	3,160	3,220	3,280	17,170	29,950
MPS on imports	80	30	30	30	40	40	40	40	40	40	40	280	440
Output-linked Support													
Volumetric Excise Tax Credit													
Revenue loss estimate (low)	2,810	3,380	4,380	5,420	5,840	5,920	6,000	6,060	6,130	6,260	6,370	33,750	58,570
Outlay equivalent estimate (high)	4,010	4,820	6,260	7,750	8,340	8,460	8,570	8,660	8,760	8,940	9,090	48,220	83,660
Volumetric Excise Tax Credit on Exports	-	-	-	-	-	-	-	-	-	-	-	-	-
USDA Bioenergy Program	80	Program discontinued mid-2006; may be re-implemented in 2007 Farm Bill.										80	80
Reductions in state motor fuel taxes	390	410	440	460	480	500	530	560	580	610	640	3,210	5,600
State production, blender, retailer incentives [5]	120	NQ	NQ	NQ	NQ	NQ	NQ	NQ	NQ	NQ	NQ	120	120
Federal small producer tax credit	110	150	170	170	170	170	170	170	170	170	170	1,100	1,770
Factors of Production – Capital													
Excess of accelerated over cost depreciation	170	220	680	940	620	400	240	210	170	(22)	(193)	3,250	3,410
Expensing of investments in cellulosic plants	-	-	NQ	NQ	NQ	NQ	NQ	NQ	NQ	NQ	NQ	NQ	NQ
Federal grants, demonstration projects, R&D	110	290	350	400	380	290	320	340	350	370	390	2,140	3,590
Credit Subsidies													
Title XVII advanced energy loan guarantees	$2.5 billion in guarantees requested to date by liquid biofuels projects; six projects invited for final round; no awards yet.											-	-
Access to tax-exempt solid waste bonds	110	110	110	130	140	140	140	140	140	150	150	880	1,460
USDA biofuels loan guarantees	NQ	NQ	NQ	NQ	NQ	NQ	NQ	NQ	NQ	NQ	NQ	NQ	NQ
Other tax exempt financing	NQ	NQ	NQ	NQ	NQ	NQ	NQ	NQ	NQ	NQ	NQ	NQ	NQ

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	Total, 2006–12[4]	Total, 2006–16[4]
Deferral of gain on sale of farm refineries to coops	10	20	20	20	20	20	20	20	20	20	20	130	210
Factors of Production – Labor													
Special domestic manufacturing deduction, benefits to biofuels production facilities	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC
Support for Feedstock Producers (pro-rated for biofuels fraction)													
Crop support to corn	490	620	730	760	760	770	770	760	780	780	770	4,900	7,990
Crop support to sorghum	20	20	20	20	20	20	20	20	20	10	10	110	160
Domestic production tax deduction													
Corn	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC
Sorghum	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC
Water	NQ	NQ	NQ	NQ	NQ	NQ	NQ	NQ	NQ	NQ	NQ	NQ	NQ
Consumption													
Credits for clean fuel refueling infrastructure	10	30	20	20	20	20	20	20	20	20	20	140	230
State vehicle purchase incentives	NQ	NQ	NQ	NQ	NQ	NQ	NQ	NQ	NQ	NQ	NQ	NQ	NQ
AFV CAFE loophole	NQ	NQ	NQ	NQ	NQ	NQ	NQ	NQ	NQ	NQ	NQ	NQ	NQ
Total													
Low estimate	5,820	6,940	9,200	11,150	11,490	11,320	11,350	11,450	11,570	11,620	11,670	67,260	113,560
High estimate	7,020	8,390	11,070	13,480	13,990	13,860	13,920	14,050	14,200	14,300	14,390	81,720	138,670

Notes:

(1) NQ - Subsidies exist that were not quantified; NA – Not Applicable; NC – subsidy calculated but not added to total since generally applicable to entire economy.

(2) Policy baseline assumes no new subsidies but continuation of existing ones; existing RFS but not a more stringent one; capital investment slowing way down after 2009

(3) Period of analysis based on availability of projections from either EIA or FAPRI. See report text for more detail on specific line items.

(4) Totals may not add due to rounding.

(5) State–level policy from 2006 study included, but has not been updated for this report or projected forward.

Annex 2. 2 Multi-year subsidy detail for biodiesel (millions U.S. $) [1, 2 & 3]

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	Total, 2006–12[4]	Total, 2006–16[4]
Market Price Support (MPS)													
MPS on domestic production	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
MPS on imports	-	-	-	-	-	-	-	-	-	-	-	-	-
Output-linked Support													
Volumetric Excise Tax Credit													
Revenue loss estimate (low)	250	720	730	440	440	440	430	420	360	360	400	3,440	4,960
Outlay equivalent estimate (high)	350	1,030	1,050	620	620	620	610	600	510	510	560	4,910	7,090
Volumetric Excise Tax Credit on Exports													
Revenue loss estimate (low)	30	90	100	100	100	110	120	120	130	130	140	640	1,160
Outlay equivalent estimate (high)	40	130	140	140	150	160	160	170	180	190	200	920	1,660
Production tax credit (renewable diesel)	-	-	180	250	330	400	480	500	520	550	580	1,630	3,780
USDA Bioenergy Program	20	Program discontinued mid-2006; may be re-implemented in 2007 Farm Bill.										-	-
Reductions in state motor fuel taxes	90	100	100	110	110	120	120	130	140	140	150	750	1,310
State production, blender, retailer incentives [5]	30	NQ	NQ	NQ	NQ	NQ	NQ	NQ	NQ	NQ	NQ	30	30
Federal small producer tax credit	30	170	190	190	190	190	190	190	190	190	190	1,150	1,920
Factors of Production – Capital													
Excess of accelerated over cost depreciation	20	40	160	220	150	100	60	60	50	0	(40)	750	810
Federal grants, demonstration projects, R&D	30	40	50	50	80	80	60	60	60	70	70	380	630
Credit subsidies													
Title XVII advanced energy loan guarantees	$2.5 billion in guarantees requested to date by liquid biofuels projects; six projects invited for final round; no awards yet.											-	-
Access to tax-exempt solid waste bonds	-	-	-	-	-	-	-	-	-	-	-	-	-
USDA biofuels loan guarantees	NQ	NQ	NQ	NQ	NQ	NQ	NQ	NQ	NQ	NQ	NQ	NQ	NQ
Other tax exempt financing	NQ	NQ	NQ	NQ	NQ	NQ	NQ	NQ	NQ	NQ	NQ	NQ	NQ

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	Total, 2006–12[4]	Total, 2006–16[4]
Factors of Production – Labor													
Special domestic manufacturing deduction, benefits to biofuels production facilities	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC
Support for Feedstock Producers (pro-rated for biofuels fraction)													
Crop support to soy	20	20	20	20	20	20	20	20	20	20	20	150	230
Domestic production tax deduction													
Soy	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC
Water	NQ	NQ	NQ	NQ	NQ	NQ	NQ	NQ	NQ	NQ	NQ	NQ	NQ
Consumption													
Credits for clean fuel refueling infrastructure	10	20	10	10	10	10	10	10	10	10	10	80	140
State vehicle purchase incentives	NQ	NQ	NQ	NQ	NQ	NQ	NQ	NQ	NQ	NQ	NQ	NQ	NQ
AFV CAFE loophole	NQ	NQ	NQ	NQ	NQ	NQ	NQ	NQ	NQ	NQ	NQ	NQ	NQ
Total													
Low estimate	530	1,200	1,540	1,380	1,430	1,460	1,490	1,510	1,480	1,470	1,510	9,000	14,970
High estimate	650	1,540	1,890	1,610	1,660	1,700	1,720	1,740	1,690	1,680	1,740	10,750	17,600

Notes:

(1) NQ – Subsidies exist that were not quantified; NA – Not Applicable; NC – subsidy calculated but not added to total since generally applicable to entire economy.

(2) Policy baseline assumes no new subsidies but continuation of existing ones; existing RFS but not a more stringent one; capital investment slowing way down after 2009.

(3) Period of analysis based on availability of projections from either EIA or FAPRI. See report text for more detail on specific line items.

(4) Totals may not add due to rounding.

(5) State-level policy from 2006 study included, but has not been updated for this report or projected forward.

Annex 2. 3 Combined ethanol and biodiesel subsidies (millions U.S. $) [1, 2 & 3]

	Ethanol and biodiesel 2006–12	Ethanol and biodiesel 2006–16
Market Price Support (MPS)		
MPS on domestic production	17,170	29,950
MPS on imports	280	440
Output-linked Support		
Volumetric Excise Tax Credit		
Revenue loss estimate (low)	37,190	63,530
Outlay equivalent estimate (high)	53,120	90,760
Volumetric Excise Tax Credit on Exports		
Revenue loss estimate (low)	640	1,160
Outlay equivalent estimate (high)	920	1,660
Production tax credit (renewable diesel)	1,630	3,780
USDA Bioenergy Program		
Reductions in state motor fuel taxes	3,960	6,910
State production, blender, retailer incentives [4]	160	160
Federal small producer tax credit	2,260	3,690
Factors of Production – Capital		
Excess of accelerated over cost depreciation	4,000	4,220
Expensing of investments in cellulosic plants	NQ	NQ
Federal grants, demonstration projects, R&D	2,520	4,220
Credit subsidies		
Title XVII advanced energy loan guarantees	-	-
Access to tax-exempt solid waste bonds	880	1,460
USDA biofuels loan guarantees	NQ	NQ
Other tax exempt financing	NQ	NQ
Deferral of gain on sale of farm refineries to coops	130	210
Factors of Production – Labor		
Special domestic manufacturing deduction, benefits to biofuels production facilities	NC	NC
Support for Feedstock Producers (pro-rated for biofuels fraction)		
Crop support to corn	4,900	7,990
Crop support to soy	150	230
Crop support to sorghum	110	160
Domestic production tax deduction		
Corn	NC	NC
Soy	NC	NC

	Ethanol and biodiesel 2006–12	Ethanol and biodiesel 2006–16
Sorghum	NC	NC
Water	NQ	NQ
Consumption		
Credits for clean fuel refueling infrastructure	220	360
State vehicle purchase incentives	NQ	NQ
AFV CAFE loophole	NQ	NQ
Total [5]		
Low estimate	76,180	128,460
High estimate	92,390	156,190

Notes:

(1) NQ – Subsidies exist that were not quantified; NA – Not Applicable; NC – subsidy calculated but not added to total since generally applicable to entire economy.

(2) Policy baseline assumes no new subsidies but continuation of existing ones; existing RFS but not a more stringent one; capital investment slowing way down after 2009.

(3) Period of analysis based on availability of projections from either EIA or FAPRI. See report text for more detail on specific line items.

(4) State–level policy from 2006 study included, but has not been updated for this report or projected forward.

(5) Totals may not add due to rounding.

Annex 2. 4 Ethanol subsidy intensity

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	Average, 2006–12	Average, 2006–16
Subsidy Per Gallon of Renewable Fuel (U.S. $)													
Low estimate	1.05	1.05	1.05	1.05	1.00	1.00	0.95	0.95	0.95	0.95	0.95	1.00	1.00
High estimate	1.25	1.25	1.30	1.25	1.20	1.20	1.20	1.20	1.20	1.15	1.15	1.25	1.20
Subsidy per GGE/GDE of Fuel (U.S. $)													
Low estimate	1.45	1.40	1.45	1.40	1.35	1.30	1.30	1.30	1.30	1.30	1.25	1.40	1.35
High estimate	1.75	1.70	1.75	1.70	1.65	1.60	1.60	1.60	1.60	1.60	1.55	1.70	1.65
Subsidy per MMBtu (U.S. $)													
Low estimate	12.50	12.40	12.70	12.40	11.90	11.60	11.40	11.40	11.40	11.20	11.10	12.10	11.80
High estimate	15.10	15.00	15.30	15.00	14.50	14.20	14.00	14.00	14.00	13.80	13.70	14.70	14.40
Subsidy per GJ (U.S. $)													
Low estimate	11.90	11.80	12.00	11.80	11.30	11.00	10.80	10.80	10.80	10.70	10.50	11.50	11.20
High estimate	14.30	14.20	14.50	14.30	13.70	13.40	13.30	13.30	13.30	13.10	13.00	14.00	13.70
Subsidy as share of retail price													
Estimated retail price (U.S.$/ gallon of biofuel)	2.70	2.25	1.95	1.90	1.90	1.85	1.85	1.75	1.75	1.75	1.70	2.05	1.95
Subsidy/market price – low estimate	39%	46%	55%	55%	53%	52%	52%	54%	55%	55%	54%	50%	52%
Subsidy/market price – high estimate	47%	56%	66%	66%	65%	64%	64%	67%	68%	67%	67%	61%	63%

Annex 2. 5 Biodiesel subsidy intensity

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	Average, 2006–12	Average, 2006–16
Subsidy Per Gallon of Renewable Fuel (U.S. $)													
Low estimate	2.10	1.65	1.70	2.00	1.85	1.75	1.65	1.65	1.65	1.60	1.55	1.80	1.75
High estimate	2.60	2.10	2.05	2.30	2.15	2.00	1.90	1.90	1.90	1.85	1.75	2.15	2.05
Subsidy per GGE/GDE of Fuel (U.S. $)													
Low estimate	2.30	1.80	1.85	2.20	2.05	1.90	1.80	1.80	1.80	1.75	1.70	2.00	1.90
High estimate	2.80	2.30	2.25	2.55	2.35	2.20	2.05	2.05	2.05	2.00	1.95	2.35	2.25
Subsidy per MMBtu (U.S. $)													
Low estimate	17.80	13.80	14.20	16.90	15.70	14.70	13.80	13.80	14.00	13.60	13.00	15.30	14.70
High estimate	21.80	17.80	17.40	19.70	18.30	17.00	15.90	15.90	16.00	15.50	15.00	18.30	17.30
Subsidy per GJ (U.S. $)													
Low estimate	16.90	13.10	13.40	16.00	14.90	13.90	13.00	13.10	13.30	12.90	12.30	14.50	13.90
High estimate	20.70	16.90	16.50	18.70	17.30	16.10	15.10	15.10	15.20	14.70	14.20	17.30	16.40
Subsidy as share of retail price													
Estimated retail price (U.S.$/ gallon of biofuel)	3.05	3.00	2.85	2.80	2.80	2.80	2.75	2.75	2.75	2.75	2.75	2.85	2.80
Subsidy/market price – low estimate	69%	54%	59%	71%	66%	62%	59%	59%	61%	59%	56%	63%	61%
Subsidy/market price – high estimate	84%	70%	73%	83%	77%	72%	68%	68%	69%	67%	65%	75%	72%

Annex 2. 6 Subsidy per unit petroleum displaced – ethanol

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	Average 2006–12	Average 2006–16
Subsidy cost per MMBtu petroleum displaced by using biofuels (U.S. $)													
Low estimate	13.00	12.90	13.20	12.90	12.40	12.00	11.90	11.90	11.90	11.70	11.50	12.60	12.30
High estimate	18.50	18.40	18.70	18.40	17.70	17.30	17.20	17.10	17.10	16.90	16.70	18.00	17.60
Cellulosic – hypothetical case – low estimate	13.50	13.40	13.70	13.40	12.80	12.50	12.40	12.30	12.30	12.10	12.00	13.10	12.80
Cellulosic – hypothetical case – high estimate	20.80	20.70	21.00	20.70	19.90	19.50	19.30	19.30	19.30	19.00	18.80	20.30	19.80
Subsidy cost per GJ petroleum displaced by using biofuels (U.S. $)													
Low estimate	12.30	12.20	12.50	12.20	11.70	11.40	11.30	11.20	11.20	11.10	10.90	11.90	11.60
High estimate	17.50	17.40	17.70	17.40	16.80	16.40	16.30	16.30	16.20	16.00	15.90	17.10	16.70
Cellulosic – hypothetical case – low estimate	12.80	12.70	13.00	12.70	12.20	11.80	11.70	11.70	11.70	11.50	11.30	12.40	12.10
Cellulosic – hypothetical case – high estimate	19.70	19.60	19.90	19.60	18.90	18.40	18.30	18.30	18.30	18.00	17.80	19.20	18.80
Petroleum displacement factors													
Displacement factor – worst	82%	82%	82%	82%	82%	82%	82%	82%	82%	82%	82%	82%	82%
Displacement factor – best	96%	96%	96%	96%	96%	96%	96%	96%	96%	96%	96%	96%	96%
Displacement factor – cellulosic, worst	73%	73%	73%	73%	73%	73%	73%	73%	73%	73%	73%	73%	73%
Displacement factor – cellulosic, best	93%	93%	93%	93%	93%	93%	93%	93%	93%	93%	93%	93%	93%

Annex 2. 7 Subsidy per unit petroleum displaced – biodiesel

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	Average 2006–12	Average 2006–16
Subsidy cost per MMBtu petroleum displaced by using biofuels (U.S. $)													
Low estimate	19.50	15.20	15.50	18.60	17.20	16.10	15.10	15.10	15.40	14.90	14.30	16.70	16.10
High estimate	31.90	26.10	25.50	28.80	26.70	24.90	23.30	23.20	23.40	22.70	21.90	26.70	25.30
Subsidy cost per GJ petroleum displaced by using biofuels (U.S. $)													
Low estimate	18.50	14.40	14.70	17.60	16.30	15.20	14.30	14.30	14.60	14.10	13.50	15.90	15.20
High estimate	30.20	24.70	24.20	27.30	25.30	23.60	22.10	22.00	22.20	21.50	20.80	25.30	24.00
Petroleum displacement factors													
Displacement factor – worst	68%	68%	68%	68%	68%	68%	68%	68%	68%	68%	68%	68%	68%
Displacement factor – best	91%	91%	91%	91%	91%	91%	91%	91%	91%	91%	91%	91%	91%

Annex 2. 8 Subsidy per unit fossil fuel displaced – ethanol

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	Average 2006–12	Average 2006–16
Subsidy cost per MMBtu fossil fuel displaced by using biofuels (U.S. $)													
Low estimate	24.20	24.00	24.50	24.00	23.00	22.30	22.10	22.10	22.10	21.70	21.40	23.50	22.90
High estimate	61.50	61.10	62.20	61.10	59.00	57.60	57.10	57.00	57.00	56.30	55.60	59.90	58.70
Cellulosic – hypothetical case – low estimate	13.40	13.30	13.60	13.40	12.80	12.40	12.30	12.30	12.30	12.10	11.90	13.00	12.70
Cellulosic – hypothetical case – high estimate	16.70	16.60	16.90	16.60	16.00	15.60	15.50	15.50	15.50	15.30	15.10	16.30	15.90
Subsidy cost per GJ fossil fuel displaced by using biofuels (U.S. $)													
Low estimate	22.90	22.80	23.20	22.80	21.80	21.20	20.90	20.90	20.90	20.60	20.30	22.20	21.70
High estimate	58.30	57.90	58.90	57.90	55.90	54.60	54.10	54.00	54.00	53.30	52.70	56.80	55.60
Cellulosic – hypothetical case – low estimate	12.70	12.60	12.90	12.70	12.10	11.80	11.60	11.60	11.60	11.40	11.30	12.40	12.00
Cellulosic – hypothetical case – high estimate	15.80	15.70	16.00	15.70	15.20	14.80	14.70	14.70	14.70	14.50	14.30	15.40	15.10
Fossil fuel displacement factors													
Displacement factor – worst	25%	25%	25%	25%	25%	25%	25%	25%	25%	25%	25%	25%	25%
Displacement factor – best	52%	52%	52%	52%	52%	52%	52%	52%	52%	52%	52%	52%	52%
Displacement factor – cellulosic, worst	91%	91%	91%	91%	91%	91%	91%	91%	91%	91%	91%	91%	91%
Displacement factor – cellulosic, best	93%	93%	93%	93%	93%	93%	93%	93%	93%	93%	93%	93%	93%

Annex 2. 9 Subsidy per unit fossil fuel displaced – biodiesel

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	Average, 2006–12	Average, 2006–16
Subsidy cost per MMBtu fossil fuel displaced by using biofuels (U.S. $)													
Low estimate	28.90	22.50	23.10	27.50	25.50	23.80	22.40	22.40	22.80	22.10	21.20	24.80	23.80
High estimate	35.50	29.00	28.40	32.10	29.70	27.60	25.90	25.80	26.00	25.30	24.40	29.70	28.10
Subsidy cost per GJ fossil fuel displaced by using biofuels (U.S. $)													
Low estimate	27.40	21.30	21.90	26.10	24.20	22.60	21.20	21.20	21.60	21.00	20.10	23.50	22.60
High estimate	33.60	27.50	26.90	30.40	28.10	26.20	24.50	24.50	24.70	24.00	23.10	28.20	26.70
Fossil fuel displacement factors													
Displacement factor – worst	62%	62%	62%	62%	62%	62%	62%	62%	62%	62%	62%	62%	62%
Displacement factor – best	62%	62%	62%	62%	62%	62%	62%	62%	62%	62%	62%	62%	62%

Annex 2. 10 Subsidy per unit greenhouse gas displaced – ethanol

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	Average, 2006–12	Average, 2006–16
Subsidy cost per tonne CO_2–equivalent displaced (U.S. $)													
Low estimate	305	302	309	302	289	281	278	278	278	273	270	295	288
High estimate [1]	(600)	(596)	(606)	(596)	(575)	(562)	(557)	(556)	(556)	(549)	(543)	(585)	(572)
Cellulosic – hypothetical case – low	113	112	114	112	107	104	103	103	103	101	100	109	106
Cellulosic – hypothetical case – high	202	200	204	201	193	189	187	187	187	184	182	197	192
GHG displacement factors (percent)													
Displacement factor – worst	(24%)	(24%)	(24%)	(24%)	(24%)	(24%)	(24%)	(24%)	(24%)	(24%)	(24%)	(24%)	(24%)
Displacement factor – best	39%	39%	39%	39%	39%	39%	39%	39%	39%	39%	39%	39%	39%
Displacement factor – cellulosic worst	77%	77%	77%	77%	77%	77%	77%	77%	77%	77%	77%	77%	77%
Displacement factor – cellulosic best	114%	114%	114%	114%	114%	114%	114%	114%	114%	114%	114%	114%	114%
Number of tonnes of carbon offsets subsidies could purchase – ethanol [2]													
ECX – Low	12	11	11	11	10	10	10					11	NA
ECX – High	(24)	(22)	(23)	(22)	(21)	(20)	(19)					(21)	NA
ECX – cellulosic – Low	5	4	4	4	4	4	4					4	NA
ECX– cellulosic – High	8	7	8	7	7	7	6					7	NA
CCX – Low	130	80	81	80	76	73	71					84	NA
CCX – High	(256)	(157)	(160)	(157)	(151)	(145)	(141)					(167)	NA
CCX – cellulosic – Low	48	29	30	30	28	27	26					31	NA
CCX – cellulosic – High	86	53	54	53	51	49	48					56	NA
Cost of CO_2-eq. futures contracts (U.S. $)													
ECX – Average prices paid for settlements during year	24.90	26.70	26.90	27.40	27.90	28.40	28.90					27.30	NA
CCX – Historical average prices paid for settlements during year	2.35	3.80	3.80	3.80	3.80	3.85	3.95					3.60	NA

(1) Values in parentheses are negative. Negative values occur when the specific lifecycle modeling scenarios estimate that GHG emissions from the biofuel production chain exceed those of the conventional gasoline or diesel they are replacing.

(2) Data on tonnes of offsets that could be purchased with the subsidies does not extend past 2012 because the longest ECX futures contracts are for that year. CCX

Annex 2.11 Subsidy per unit greenhouse gas displaced – biodiesel

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	Average, 2006–12	Average, 2006–16
Subsidy cost per metric tonne CO2-eq displaced													
Low estimate	278	216	222	265	246	229	215	215	220	213	204	239	229
High estimate [1]	(861)	(704)	(689)	(779)	(721)	(671)	(629)	(627)	(632)	(614)	(592)	(722)	(684)
GHG displacement factors													
Displacement factor – worst	(33%)	(33%)	(33%)	(33%)	(33%)	(33%)	(33%)	(33%)	(33%)	(33%)	(33%)	(33%)	(30%)
Displacement factor – best	68%	68%	68%	68%	68%	68%	68%	68%	68%	68%	68%	68%	70%
Number of tonnes of carbon offsets subsidies could purchase [2]													
ECX – Low	11	8	8	10	9	8	7					9	NA
ECX – High	(35)	(26)	(26)	(28)	(26)	(24)	(22)					(27)	NA
CCX – Low	119	57	59	70	65	59	55					69	NA
CCX – High	(368)	(185)	(182)	(206)	(190)	(173)	(160)					(209)	NA
Cost of CO_2-eq. futures contracts													
ECX – Average prices paid for settlements during year noted	24.90	26.80	26.90	27.30	27.90	28.50	28.90					27.30	NA
CCX – Historical average prices paid for settlements during year noted	2.35	3.80	3.80	3.80	3.80	3.85	3.95					3.60	NA

(1) Values in parentheses are negative. Negative values occur when the specific lifecycle modeling scenarios estimate that GHG emissions from the biofuel production chain exceed those of the conventional gasoline or diesel they are replacing.

(2) Data on tonnes of offsets that could be purchased with the subsidies does not extend past 2012 because the longest ECX futures contracts are for that year. CCX contracts go only through 2010; values for 2011 and 2012 were estimated by scaling them based on price changes on the ECX contracts.

About the author

Doug Koplow was the author of GSI's original study *Biofuels: At What Cost? Government support for ethanol and biodiesel in the United States*, published in October 2006. He founded Earth Track in 1999 to more effectively integrate information on energy subsidies. For nearly 20 years, Mr. Koplow has written extensively on natural resource subsidies for organizations such as the National Commission on Energy Policy, the Organisation for Economic Co-operation and Development, the United Nations Environment Programme (UNEP), Greenpeace, the Alliance to Save Energy and the U.S. Environmental Protection Agency. He has analyzed scores of government programs and made important developments in subsidy valuation techniques.

His work outside of the subsidy area has included water conservation, wastewater treatment, hazardous waste tracking, recycling and brownfields redevelopment. Working collaboratively with other organizations, Earth Track focuses on ways to more effectively align the incentives of key stakeholder groups and to leverage market forces to help address complex environmental challenges. Mr. Koplow holds an MBA from the Harvard Graduate School of Business Administration, and a BA in economics from Wesleyan University.

The Global Subsidies Initiative (GSI) of the International Institute for Sustainable Development (IISD)

The International Institute for Sustainable Development's Global Subsidies Initiative shines a spotlight on subsidies – transfers of public money to private interests – and the ways in which they can undermine efforts to put the world on a path toward sustainable development.

Subsidies have profound and long-lasting effects on economies, the distribution of income in society, and the environment, both at home and abroad. Subsidies have shaped the pattern and methods of agricultural production, even in countries that now provide few or no farm subsidies. They have encouraged fishing fleets to search farther and deeper than ever before, aggravating the problem of over-fishing. They have fueled unsustainable energy production and wasteful consumption patterns.

While subsidies can play a legitimate role in securing public goods that would otherwise remain beyond reach, they can also be easily subverted. Special interest lobbies and electoral ambitions can hijack public policy. When subsidies result in a fundamentally unfair trading system, and lie at the root of serious environmental degradation, the question has to be asked: Is this how taxpayers want their money spent?

The GSI starts from the premise that full transparency and public accountability for the stated aims of public expenditure must be the cornerstones of any subsidy program. In cooperation with a growing international network of research and media partners, the GSI is endeavouring to lay bare just what good or harm public subsidies are doing; to encourage public debate and awareness of the options that are available; and to help provide policy-makers with the tools they need to secure sustainable outcomes for our societies and our planet.

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