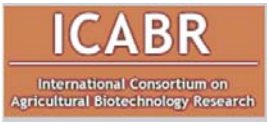
# TARGETS AND MANDATES: LESSONS LEARNED FROM EU AND US BIOFUEL ENFORCEMENT MECHANISMS

**JADWIGA ZIOLKOWSKA**[1], **WILLIAM H. MEYERS**[2], and **SETH MEYER**[2]
[1] Department of Agricultural & Resource Economics, University of California at Berkeley, US
[2] Food and Agricultural Policy Research Institute (FAPRI), Columbia, Missouri, US
ziolkowska@berkeley.edu




**Paper prepared for presentation at the 14th ICABR Conference**
***"Bioeconomy Governance: Policy, Environmental and Health Regulation, and Public Investments in Research"***
**Ravello, Italy, June 16-18, 2010**

Paper to be considered for special issue of AgBioForum: Yes

## Abstract

The US and the EU have taken different paths in the design and implementation of biofuel support and enforcement measures. In the EU, indicative targets have been defined for biofuels, but a strict enforcement mechanism does not exist in practice. Also, mandatory targets have been approved voluntarily by several EU Member States. US biofuel policy has specified targets in absolute quantities rather than in percentages of use, as was done in the EU. Because of this quantitative target and the fact that enforcement is through a mandate rather than a less binding target, enforcement is assured but implementation problems arise (e.g., "blend wall") that may not occur in the EU system.

In this paper, we provide an analytical discussion on lessons learned from the current and previous EU and US biofuel enforcement mechanisms and consider the possibilities, opportunities and challenges for future policy development in both economies.

**Key words**: biofuels, climate change, Common Agricultural Policy, EU targets, US mandates

**JEL codes**: Q18, Q40, Q42, Q48, Q54

## Introduction and Objective of the Paper

In recent years, the question of environmental effects of biofuels production has become relevant for the Common Agricultural Policy (CAP) of the European Union (EU). The discussion is driven by the challenge of adapting the CAP to the progression of climate change policy, thereby facilitating positive effects of biofuels consumption (and therefore of greenhouse gas (GHG) reduction) both in agriculture and in other sectors.

Among the different aspects of biofuels policies, the question of biofuels and climate change targets and mandates has not yet been sufficiently discussed with regard to challenges and

difficulties resulting from their implementation in the EU. However, the wide scope and range of target achievement, the problems with the adaptation of legal rules and monitoring of the implementation processes are crucial for future policy design after 2013. This policy intends to, among others, facilitate environmental protection, meet the challenges of climate change as well as support infrastructure for bioenergy and renewable energy.

The renewable energy sector is acknowledged to be the fastest growing in the EU (EC, 2006b). The production and consumption of biodiesel and ethanol are both rising since 2005. The production of biodiesel amounted to 1,594 million gallons (6,033.3 million liters) in 2009, while ethanol production was 683 million gallons (2,585.2 million liters). From the background of the growing production and consumption of biodiesel and ethanol, the effectiveness of EU biofuels policies in terms of target achievement needs to be evaluated.

The US biofuels industry has also been growing rapidly since 2005, first due to the replacement of MTBE as an oxygenate for motor fuel in urban areas, then due to government policy incentives and rising petroleum prices in the years that followed. US policy is supported by numerous interests, including to reduce dependence on fossil fuels, to reduce GHG emissions and to increase demand for farm commodities. Ethanol production has grown from 3.9 billion gallons (14.8 billion liters) in 2005 to 10.7 billion gallons (40.5 billion liters) in 2009 and biodiesel production has grown from 0.107 billion gallons (0.4 billion liters) to 0.578 billion gallons (2.2 billion liters) in the same period. Also in early 2010 the EPA announced a new Renewable Fuel Standard (RFS2) that implements increased and more complex rules to govern biofuel mandates.

In this paper, we investigate different policy and enforcement approaches in the European Union and the United States that have already been implemented. We discuss the current policies and advantages and disadvantages of the respective policy instruments and enhancement mechanisms, comparing their effectiveness and sustainability.

# I Biofuels Policies and Enforcement Instruments in the European Union

## 1 EU Regulations for Biofuels

The development of the biofuels sector is a major issue in the Renewable Resources Program of the European Union (EU). The aim of the EU Renewable Resources Program is to ensure energy efficiency, to reduce the greenhouse gas (GHG) emissions, to reduce the dependence of the EU Member States on the fossil fuels imported from other countries, to diversify the supply of energy sources, to generate employment in agricultural and rural areas, as well as to promote innovation and technological development (Kraemer and Schlegel, 2007).

Renewable energy is an important target of the European energy policy since 1986 when the European Council announced the promotion of renewable energy sources among its energy objectives. In 1997, the European Commission established a target to increase the total share of renewable energy up to 12% by 2010 (Kraemer and Schlegel, 2007).

The wide support for biofuels policies is indicated by the fact that biofuels are acknowledged as a promising alternative for agricultural production and simultaneously, they are currently the only available renewable fuels for transport. However, biofuels are often more expensive than fossil fuels, which decreases the comparative advantage of biofuels on the market. In order to boost the use of renewable sources in the transport sector, the EU approved several regulations, such as the Directive 2001/77/EC on the promotion of electricity produced from renewable energy sources, and the Biofuels Directive 2003/30 EC establishing an indicative biofuels target (EC, 2003a). The target was set at the level of 2% of biofuels to be used in the transport sector by 2005 and 5.75% by 2010 on the EU level. The objective of 2% by 2005 was not achieved in all EU countries, and the share of biofuels in fuel consumption of transport amounted to 1.06% in 2005 in the EU-27 and to 2.6% in 2007. Only Germany and Sweden

reached the 2005 target with 3.86% and 2.11% biofuels use, respectively, in the total fuel consumption (Eurostat, 2009).

Responding to the challenge faced by almost all EU Member Countries, the EU approved additional instruments supporting the supply and demand for biofuels: Biomass Action Plan and the Strategy for Biofuels. Both regulations have been amended and repealed by the Directive 2009/28/EC, which sets forth the promotion of the use of energy from renewable sources and establishes a common framework for the use of energy from renewable sources. The Directive defined the necessity of National Action Plans (NAP) and procedures for the use of biofuels, with the aim to reduce greenhouse gas emissions and to promote cleaner transport fuels. This directive underlies the commitments constituted by the 2007 Renewable Energy Roadmap and Renewable Energy Directive (2009/29) that established new targets: a) the share of renewable energy in total EU energy consumption is set at 20% by 2020 (including 10% share in the transport sector of each EU Member Country), b) the GHG emissions are scheduled to be reduced by 20% from the 1990 level, and c) the total energy consumption in the EU-27 is expected to be reduced by 20% by 2020 ("20-20-20 Policy" for the post-Kyoto period beyond 2012) (EC, 2008a; Saundry, 2010).

The support for bioenergy in the EU has also been incorporated into the Common Agricultural Policy (CAP) since 1992. The obligation to set aside 15% of cultivation areas to be used, e.g., for bioenergy production, has been implemented and an energy crop premium of 45 €/ha on a maximum of 2.0 Mio ha as a direct output subsidy has been adopted (EC, 2008b). With the 'Health Check' reform from 2007 the earlier adopted energy crop premium and the compulsory set-aside have been abolished from 2009 onward. As a result, no support for bioenergy production is allowed from the first pillar of the CAP. However, within the Rural Development policy (second pillar of the CAP) and through the modulation instrument, several measures supporting bioenergy development have been reinforced, i.e., biogas production, support

for perennial energy crops, processing of agricultural and forest biomass for renewable energy, and investments in infrastructure for renewable energy using biomass (EC, 2008b; EC, 2008c). The available funds for bioenergy support amount to 3.2 billion € in 2010-2013 (EC, 2007a).

Bioenergy production in the EU is mostly based on the national sources. Apart from the legislative measures undertaken at the EU level, the European Commission approaches a combination of domestic production and imports as an important element of increasing the bioenergy use. Thus, the EU biofuels policy is intended to be designed in the future in a way that benefits both European farmers and third countries trading on the biofuels market (Kraemer and Schlegel, 2007).

## 2 EU Target Policy in the Biofuels Sector

The EU policy and its regulations regarding biofuels and renewable energy sector are target-oriented. One of the two principal reasons for adopting targets for renewable energy use in transport, alongside the greenhouse gas benefits in the EU, is security of supply (EC, 2007a). According to the EC (2007a), "targets serve as a public commitment on the part of the government or other authorities to maintain a certain policy stance, which will form the basis of justification for a range of implementing measures". Thus, setting targets for meeting objectives is acknowledged as an element of establishing a policy framework.

Different kinds of targets are to be mentioned in regard to biofuels and renewable resource sectors: *indicative*, *mandatory* and *voluntary* targets. The current EU target framework is mostly based on indicative targets. Mandatory are the Kyoto Protocol targets (where Member States are obliged by the EC legislation to fulfill the commitment), while voluntary targets have

been agreed on in the European Automobile Manufacturers Association (ACEA)[1] agreement on $CO_2$ reductions from cars (EC, 2007a).

In the Electricity Directive (2001/77/EC), the Biofuels Directive (2003/30/EC) and Renewable Energy Sources Directive (EC, 2003a), Member States have been required to set indicative national targets based on the reference values. The targets set by the respective countries are presented in table 1.

[Table 1 here]

While the Electricity Directive requires the Member States to undertake steps to achieve their objectives, the Biofuels Directive does not set a very distinct requirement and only states that Member States should ensure that a minimum level of biofuels is placed on the market in line with their national indicative targets. Since 2006, EU Member States are required to adopt the Energy Services Directive (2006/32/EC) and thus to achieve an overall national indicative energy savings target (EC, 2007a). Due to the fact that the targets set by the Biofuels Directive and the Renewable Energy Roadmap are not binding, nine countries have decided to go beyond the EC Directive and adopted mandatory requirements for the incorporation of biofuels (Table 2).

[Table 2 here]

[1] Fr: Association des Constructeurs Européens d'Automobiles (ACEA).
The agreement was signed in 1998 and set the target of 140 g/km of $CO_2$ to be achieved by 2008 for new passenger vehicles sold by the association's cars in Europe. The target represented a 25% reduction applicable to the 1995 level (equivalent to a fuel economy of 5.8 l/100 km or 5.25 l/100 km for petrol and diesel engines, respectively). The average for the entire car market amounted to 153.7 g/km in 2008, thus, the target has not been achieved. In 2006, the European Commission announced to work out a proposal for legally-binding measures and limits, and reconfirmed the target of $CO_2$ emissions of 140g $CO_2$/km (2008/09) and 120g $CO_2$/km (2012) (EC, 2007b).

## 3 Lessons Learned from the Target System and Recommended Changes for the Future

The share of biofuels that has been established as a target in some EU Member Countries is acknowledged as a mandatory application in other EU countries.

When analyzing the previous process of target achievement, the different forms of targets represented in the EU Member States policies allow comparing the positive aspects of this instrument and also showing weaknesses and challenges for the future.

The challenge of mandatory targets set in the Kyoto Protocol and strengthened by the ETS (Emission Trading Scheme) mobilized the EU Member States to undertake direct measures and actions to meet the goals. The Electricity Directive, requiring concrete actions to achieve the indicative targets, has induced rapid growth in the renewable electricity sector. However, due to the fact, that different actions have been taken to a different degree by the respective EU Member States, the target was not completely reached. In the Biofuels Directive, neither target nor actions are mandatory. As a result, even if there has been some rapid growth in the biofuels sector in some EU Member States, only two countries (Germany and France) have taken sufficient measures and actions to achieve their targets. Referring to the ACEA agreement with the EU, the voluntary targets did help improve $CO_2$ emissions from cars, however, the target has not been reached (EC, 2007a).

Moreover, the mandatory targets established voluntarily by some EU countries have a more binding character than indicative targets; though, this instrument also has other effects. Generally, setting a mandatory obligation (mandate) and thus a fixed market share for an item usually puts an upward pressure on its price. The scale of this impact depends on different factors, e.g., the extent to which the mandate increases consumption above the level that would be achieved otherwise, the degree to which output of the item increases as prices rise, and whether

competition from imports is allowed. As the production costs of biofuels in the EU are significantly higher than of fossil fuels, the mandatory obligation to incorporate biofuels in the market share is expected to increase the consumer price. However, the price rises can be offset with governmental subsidies (i.e., excise tax exemptions). This approach is used in the EU Member States in which biofuel blending is mandatory; Austria, Slovakia and Spain provide full tax exemption for biofuels, while the Netherlands, Slovenia and the United Kingdom offer a partial exemption. In the other countries, tax exemptions for blended fuels have been removed (Kutas et al., 2007).

Different measures have different effects and implications on national markets and policies. The experience with different target instruments in the EU shows, however, that an effective biofuels policy in terms of meeting objectives and reducing $CO_2$ emissions can be realized with mandatory targets.

Another issue discussed in regard to targets in the EU is the question about the choice between the national sectoral targets for 2020 (as in the current system) or a single target for renewable energy for each Member State. The advantage of one single target is that on the market, different technologies and cost-effective instruments can be chosen in order to achieve the goal. Thus, the cheapest and most effective solution can be found, with a benefit for the administration and reducing multiple targets. On the other hand, the experience from the EU Member Countries shows that one target for all sectors and all renewable resources would be too vague and unfocused. The defined target would not be sufficient in terms of its effectiveness. In addition, when promoting the one target policy only, the currently cost-effective technologies would be supported without developing other innovative technologies that could be potentially promising for the future. Thus, short term $CO_2$ reductions could be achieved, however, long term effects would be slowed down (EC, 2007a).

## 4 EU Policy Instruments for Biofuels: Subsidies and Taxation

In order to help the EU Member Countries to achieve the targets set in the Biofuels Directive 2003/30/EC, the European Commission adopted the Directive 2003/96/EC on energy taxation that set up a minimum level of taxation for different fuels and allowed an exemption or reduction of excise taxes (EC, 2003b). The biofuels production in the EU is supported from the EU budget as well as from the national budgets of the EU Member Countries.

Currently, tax relief and obligations to blend are two most common instruments implemented in the EU Member States. The total support for biofuels in the EU-27 amounts to around 3.7 billion € annually. The largest subsidies are those provided through fuel excise tax relief. In total, the subsidies provided for liquid biofuels amounted to about 1.3 billion € for ethanol (0.74 €/liter) and 2.4 billion € for biodiesel (0.50 €/liter) in 2006 (Kutas et al., 2007: 75). As this type of subsidy is directly linked to the biofuels production or consumption, the cost of this measure is expected to rise in future due to the fact that the biofuels production is boosted in the EU to achieve the targets. Responding to this EU policy, the EU Member Countries have adopted additional mandatory blending requirements on the national level in order to complement or replace tax exemptions. The mandatory blending ratios are established on a level to achieve or even exceed the EU target for 2010.

The instruments supporting biofuels production can be implemented in different combinations:

(a) Tax relief (2005-2006) was adopted by the EU Member Countries with little practical experience in the biofuels sector (i.e., Greece, Portugal, Italy); countries with experience of a more directly supported approach through funds (e.g., Poland); and countries with a more cautious approach (e.g., the Netherlands).

(b) Tax exemption and obligation to blend (2005-2006) or adoption of both measures together, replacing a tax relief in order to increase overall effectiveness of these measures in a shorter time (EC, 2007a).

In 2005-2006, all Member States (except Finland) implemented tax exemptions as a main support measure, while obligations to blend were used only by three countries (Austria, France, and Slovakia). Since 2007, other EU Member States (Austria, Cyprus, Czech Republic, France, Germany, Italy, Lithuania, Luxembourg, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, the Netherlands, and United Kingdom) have adopted obligations to blend. In most countries, this obligation was combined with partial level of taxation (i.e., Austria and Greece for ethanol, and Luxembourg and Portugal for biodiesel) or unchanged levels of taxation (i.e. the Netherlands). The obligation to blend combined with the tax exemptions has boosted biofuel growth in many EU Member States (e.g., in the Netherlands the share of biofuels increased from 0.3% in 2006 to 2% in 2007) (EC, 2007a).

Additionally, some countries (Belgium, France, Italy, Ireland, and Portugal) apply a quota mechanism where the amount of biofuels benefiting from the support is shared amongst different suppliers through calls for tender. This mechanism allows national governments to specify the amount of biofuels needed to be supplied each year (EC, 2007a).

In terms of the protection against biofuels imported to the EU from third countries, particularly Brazil, high tariff barriers (0.102 € for denatured ethanol or 0.192 €/liter for undenatured ethanol) have been implemented. In 2006, the tariffs provided the EU producers with the support of 420 million €, simultaneously preventing the EU consumers from the access to cheaper foreign imports (Kutas et al., 2007).

Also, the CAP reform from 2003 and the establishment of energy crop premium of 45 €/ha on a maximum of 2.0 million ha has strengthened the subsidy policy of the EU. Even if

this policy is costly (the EU expenditures for this measure amounted to 25.6 million € in 2005) (Kutas et al., 2007), the response from farmers can be classified as satisfactory. Additionally, some new EU member countries implemented national subsidies for biofuels feedstock production or for manufacturing of biofuels. Moreover, with the research and development projects in the biofuels sector supported from the EU and EU Member Countries, 91 million € have been available from public funds in 2006 only.

Further, in some EU Member States, the distribution and consumption of biofuels are encouraged through national user incentives, e.g., reduced vehicle registration fees and tax credits for flex-fuel vehicles (FFVs), as well as subsidies for E85 pumps. Within this framework in 2006, the support for ethanol on a petrol-equivalent basis was more than twice (0.46 €) as high as ex-tax market price for regular unleaded (RON 91) petrol (Kutas et al., 2007).

Apart from these general market measures, several EU Member Countries have implemented other support measures to specific sectors in 2006-2007, such as:

a) Additional measures for farmers other than set-aside land or energy crop payments in Belgium, Greece, Ireland, Lithuania, and Poland (direct input subsidy for fertilizers, feed, energy, water, transportation, etc.) (OECD, 2008: 27);

b) Additional measures for industry in Cyprus, Czech Republic, Latvia, Lithuania, and Poland in order to reduce the infrastructure costs, e.g., investments in renewable fuel plants;

c) Measures for distribution in the United Kingdom;

d) Measures for purchase and maintenance of cars in Austria, Belgium, Cyprus, Denmark, Estonia, Ireland, Malta, Poland, and Sweden (EC, 2007a).

# II Biofuels Policies and Enforcement Instruments in the US

## 1 US Regulatory System of Subsidies, Tariffs and Mandates

### 1.1 Origin and Evolution of US Biofuel Policies

Biofuel policies in the United States have evolved in steps since the Energy Policy Act (EPAct) of 2005 first established the renewable fuel volume mandate at 7.5 billion gallons (by 2012) and set up the blender's tax credit and the offsetting import tariff on ethanol. It is not clear that an EU-type percentage of fuel target was ever seriously debated, but setting a volumetric mandate rather than a proportional one has implications for the implementation and enforcement of the mandate that will be discussed later. Biofuel policy instruments include a combination of incentives, mandates, escape clauses and enforcement mechanisms. These are outlined separately, then we will discuss the interaction of these under different market conditions, because the relative impact of each policy instrument varies with market situations.

#### 1.1.1 Credits and Tariffs

From 1978 through 2004, the federal government provided the payers of federal excise taxes on motor fuel with a tax credit for the amount of ethanol blended with gasoline. Over the years, the tax credit ranged from $0.40 to $0.60 per gallon ($0.11 to $0.16/liter) of ethanol. Due to concerns about the loss of federal revenue for transportation purposes, the tax credit was replaced in 2005 with a federal tax refund to blenders of motor fuel (OLA, 2009). This was done in the 2005 EPAct, which established a $0.51/gallon ($0.14/liter) ethanol excise tax credit and a $1.00/gallon ($0.26/liter) biodiesel excise tax credit for blenders, as well as a $0.54/gallon ($0.14/liter) import tariff on ethanol to prevent foreign produced ethanol (except from trading partners in the Caribbean Basin Initiative) from gaining the benefit of the domestic ethanol tax credit. A $1.01/gallon ($0.27/liter) tax credit for cellulosic ethanol was introduced and the ethanol tax credit was reduced to $0.45/gallon ($0.12/liter) in the Food, Conservation and Energy Act

(FCEA) of 2008 (the Farm Bill of 2008), apparently as a cost saving measure to meet the budget targets. Because of the different vintages of these provisions, they also expire at different times (Figure 1); biodiesel tax credit expired in December 2009, ethanol tax credit and tariff expire at the end of 2010 and the cellulosic ethanol tax credit at the end of 2012. It is often presumed that such incentives and disincentives will be extended, but it is not automatic; and to prove the point, Congress has not yet managed to find a legislative vehicle to restore the biodiesel tax credit.

[Figure 1 here]

In addition to these Federal policies, some states have additional incentives, such as waiving state taxes (e.g. Iowa and Minnesota) and state mandates (e.g. Missouri and Minnesota) on the use of biofuels. These may increase the use of biofuels in those states but have little or no significant impact on national biofuel markets. An exception to this could be the case of stricter GHG emission standards, such as in California, that will be mentioned in the mandates section below.

### 1.1.2 Mandates

From the beginning with the EPAct of 2005, US biofuel targets were specified as mandates in volumetric terms as part of the Renewable Fuel Standard (RFS) program. In that law, the mandate was set at 4 billion gallons (15.14 billion liters) in 2006 and growing to 7.5 billion gallons (28.39 billion liters) in 2012.[2] The EISA of 2007 expanded the RFS program by adding a biodiesel mandate and expanded the total mandated quantity of renewable fuel to be blended into transport fuel to 9 billion gallons (34.07 billion liters) in 2008 and growing to 36 billion gallons (136.27

[2] A provision of EPAct 2005 that had important short run market effects was the essential ban on use of MTBE as an oxygenate in urban areas of the nation with high levels of smog. The relatively sudden increase in demand for ethanol stimulated rapid increases in profits and investment for ethanol plants during 2006 and 2007.

billion liters) in 2022. These totals were also divided into specific categories, with separate volumes for each and requirements that EPA apply lifecycle GHG performance standards to ensure that each category of renewable fuel emits fewer GHG than the petroleum fuel it replaces. Of the total mandate, conventional (grain based) ethanol cannot be more (but can be less) than 15 billion gallons (56.78 billion liters), which is the difference between the total of 36 and the advanced biofuel total of 21 billion gallons (79.49 billion liters). In April 2010, EPA announced the RFS2, which implements the requirements of the EISA and goes into effect July 1, 2010 (Figure 2).

[Figure 2 here]

The new standards specify minimal lifecycle GHG thresholds by type of biofuel (Table 3). Because several types of biofuel are nested in the "advanced biofuel" mandate, a further explanation of these relationships will be useful. The biofuel mandates established in the Energy Independence and Security Act (EISA) of 2007 are not independent of each other but are hierarchical in nature. A mandate establishes the minimum quantity of use. A mandate is considered 'binding' in the market place if the market would result in use below the mandated quantity in its absence. Similar to its predecessor, the Energy Policy Act of 2005, the EISA establishes a minimum total quantity of biofuel (*T* in figure 3) to be used in a given calendar year (FAPRI, 2010b). However, the new act goes on to specify minimum quantities that must come from specific feedstocks or biofuel types towards meeting that total. Another criterion is greenhouse gas emission reductions.

[Table 3 here]

[Figure 3 here]

Conventional biofuel (*C*) meets the lowest GHG target and counts toward the total mandate. Advanced biofuels (*A*) are biofuels produced from feedstocks that generate greater greenhouse gas emissions savings. Conventional ethanol (*C*) cannot be used to meet the advanced sub-mandate, but advanced biofuels do help to meet the total mandate (*T*). The legislation increases the share of advanced biofuels (*A*) in the mandate total (*T*) over time.

While it is often suggested that there is a corn ethanol mandate, in fact, no such mandate exists. Corn ethanol, a conventional ethanol according to the EISA, can be used to satisfy the difference between the total mandate and the advanced mandate ($T - A = C$) but must compete with all other biofuels, including any production of advanced biofuels in excess of the advanced mandate (*A*). The advanced biofuel mandate is further sub-divided. The two categories outlined are a mandated quantity for ethanol made from cellulosic or agricultural-waste-based feedstocks (*S*) and biodiesel (*B*). The remainder of the advanced ethanol mandate ( $A – S – B = O$) can be met by additional cellulosic production, additional biodiesel production or from another source. Imported sugarcane ethanol, for example, is an advanced biofuel that is neither cellulosic nor biodiesel (thus, type *O*). The mandates only restrict minimum quantities and are nested within each other, creating a hierarchy of biofuel types which can be used for compliance.

Finally, EPA has the authority to waive a mandate if it is technically infeasible or economically not viable for the industry to provide it. This is most applicable to the cellulosic biofuel that is only at the small scale experimental stage of processing.

## 2 Enforcement Mechanisms and the Role of RINS

The mandates, if not waived, are the indicator to biofuel producers what will be the lower limit on the aggregate usage for each particular type. Since this is known well into the future, it is also a signal for investment plans. Of course, biofuel producers are competing with each other for that market. For fuel blenders the mandates are a requirement on what needs to be blended by each based on the blender's share in the total fuel market. A blender is responsible for all four of the mandates even if only one type of fuel is blended in the company. The market mechanism that facilitates market clearing and makes it possible for these markets to reach equilibrium is the issuing and trading of Renewable Identification Numbers (RINs).

Each batch of fuel produced or imported is assigned a RIN, which is a 38 character numeric code that identifies its vintage, volume, and fuel classification (Cellulosic, bio-based diesel, advanced or conventional). These RINS accompany the fuel when it is sold by the producer or importer and becomes the property of the blender who buys the fuel. A blender can accumulate the required volume equivalent of RINs either by buying the exact mix of fuel that was assigned, or more likely by some combination of buying biofuel and trading RINs. For example, a plant that purchases and blends only conventional ethanol needs to buy advanced biofuel RINs from another blender who has more than needed. This market in RINs determines the equilibrium prices of RINs that will clear this market. The exception is when EPA waives or reduces the mandate for cellulosic biofuels, it is required to sell RINs at a fixed price that are not tied to any actual fuel. Verification that each blender has acquired the required quantity and combination of RINs is done by EPA; and in case of non-compliance, there is a daily civil penalty as well as the actual cost of purchasing the lacking RINs (USEPA, 2010).

The value of the RINs, except for the fixed price case mentioned, is determined by supply and demand and are linked to how "binding" the mandates are. If a mandate is not binding, such

as when petroleum prices are high and stimulate higher ethanol prices and production, the value is negligible. However, as the mandate becomes more binding, the RIN value increases. The blender has to drive up the price of ethanol in order to meet the blending mandate, but cannot sell the ethanol at the price paid. Thus, the difference between the blenders selling price of the (blended) ethanol and the buying price is the value of the RIN. The blender passes on this cost to the consumer by increasing the price of gasoline.

Because the mandates are nested, blending above that required to meet the mandate in one mandate category can be used to fulfill a broader mandate (***demotion)*** or carried forward one year to meet up to 20% of next year's obligation ***(rollover)***. The hierarchy of biofuel mandates creates a hierarchy in RIN pricing. Excess RIN production expires if not used for lower level mandates nor rolled forward for next year's obligations. The rollover provision is mechanism that serves to stabilize year to year variation of ethanol and feedstock prices, because blenders can accumulate and dispose of them in the same manner as with commodity stocks.

## 3 Differing Roles of Policy Instruments under Different Market Conditions

Numerous analyses have been conducted to simulate how these markets would behave under differing conditions (Meyer et al., 2009; Westhoff et al., 2008). When petroleum prices are relatively high, mandates are not binding and have little impact on the market outcomes. In this case, prices of petroleum, ethanol and corn are closely linked and the blender's tax credit increases demand for biofuel and translates into higher prices for biofuel and feedstock from which it is produced. When petroleum prices are low and mandates are binding, the mandate is critical to the quantity of transactions, and prices of petroleum and the feedstock are not so closely linked. In fact, the mandates have seldom been binding except in Fall 2008 to Spring 2009 when petroleum prices were so low. These studies have shown and observed market behavior has

demonstrated that the relative impacts of policy instruments differ and market behaviors differ when these different market conditions obtain. The most recent study, done with the FAPRI 2010 baseline (FAPRI, 2010a), showed that without the tax credits and tariff the mandate would lead to lower feedstock prices and more imports. When the mandate is binding, the removal of the tax credit also has the effect of shifting the cost of achieving the mandate from the taxpayers to the fuel consumers.

A new issue has arisen that is related to how the US decided to specify the mandate in volumetric terms. It is called the "blend wall" and refers to the fact that if all gasoline powered motor vehicles were to use a 10% ethanol blend, this alone would not be sufficient to meet the national mandated biofuel usage level. There is a proposal currently under consideration to allow 15% blends to be sold, but even if approved there is no guarantee that consumers would find it acceptable. Meanwhile, there are not enough vehicles or fuel dispensing pumps with E85 capability to overcome this usage barrier.

## 4 Lessons Learned and Prospects for Change in the Future

The new RFS2 was an opportunity to make some changes and indeed some were made. Greater emphasis was placed on measures to ensure that renewable fuel was indeed reducing GHG emissions as it was substituted for fossil fuels. Volumes of mandates were increased and were defined with minimums in specific categories, which somewhat reduced the flexibility of the mandate system.

As mentioned, there is a current debate on resolving the "blend wall" issue by increasing the allowed blend from 10 to 15 percent. Though this would only be a short term solution, there are technical issues to resolve. Even if that can ensure that no damage will be done to vehicles using the blend, it is not a guarantee that it will be accepted by consumer or even by filling

stations. Stations could be concerned about practical or financial issues, such as the number of additional pumps needed or about liability issues if there were a problem with engine damage. Related to this issue is the lack of sufficient flex fuel vehicles and possibly lack of sufficient interest in buying them. Moreover, the cost of E85 fuel is still priced too high in many markets to be attractive relative to its energy value. Short of switching to an EU style percentage mandate as opposed to a volumetric mandate, it is not going to be an easy or quick problem to solve.

Finally, analysis has shown that with a mandate in place, the decision to extend tax credits and the ethanol import tariff is basically a question of who pays. Currently, the program costs are shared by taxpayers and fuel consumers. Eliminating the tax credits and tariff would shift the costs almost entirely to the fuel consumers.

# III Comparative Analysis of EU and US Biofuel Policies

## 1 Differences in Indicative vs. Mandatory Targets and Quantitative vs. % of Total

According to the EC (2007a), the legal strength of a target largely determines its credibility, as stronger targets mean that efforts will be made by governments to achieve the targets. This in turn means that the markets have greater certainty for planning and undertaking investments, which clearly favors the mandatory over indicative targets. Moreover, setting a single target for all sectors gives the market flexibility to choose a cost-effective way of an appropriate technology, while sectoral targets (as in the US) can create the long term confidence for inducing new investments in a broad range of renewable energy sources. This objective is relevant for biofuels policy if Europe plans any reduction in fossil fuel consumption, emissions and import dependency in the transport sector.

The “blend wall” problem in the US already shows the shortcomings of a quantitative target but a similar problem could evolve for any percentage target that seeks to go beyond a 10% replacement of fossil fuels for motor transport.

## 2 Differences in Incentives for Second Generation Biofuels vs. Quantitative Distribution of Mandate by Type

The EU approach of providing higher credit for second generation biofuels provides an incentive for the advanced technology development. The US had such a credit, giving 2.5 times credit to second generation technology, but it was converted to the quantitative categories in the RFS2.

## 3 Differences in Supranational vs. Country Level Strategy

The US-wide approach to biofuel policy would not be possible in the confederate type governance of the EU unless Member Countries agreed to turn over authority and funding biofuel policy to the centralized governance of the Commission as was done with the CAP and Regional Policy. The current decentralized approach of the EU has the advantage of allowing countries to find the most effective means to achieve the targets, which may differ country by country. In the US, it is the RIN market that allows production and distribution to move to the most cost effective facilities and regions. Such a trading of targets or quotas could also be considered in the EU, but there may be concern about the experience with differing enforcement such as in the use of milk quotas in the past.

## 4 Subsidies vs. Mandates

Most acknowledged policy instruments regulating biofuels market in the EU are tax exemptions (subsidies) or mandatory blending. The subsidy system has been successfully implemented,

however, it has caused significant revenue losses for the governments. Another characteristics of tax exemptions is their ability to steer the market by applying different reduction rates to various types of biofuels. Thus, in Germany, only pure biofuels entered the market before 2004, as blends did not profit from tax reductions (Wiesenthal et al., 2009).

With the mandatory obligation to blend, fuel suppliers are obliged to achieve a certain share of biofuels in their total fuel sales. This instrument does not cause any revenue losses to the government since the fuel suppliers and final consumers are carrying the financial burden of this measure. This again might reduce transport demand compared to a tax exemption scheme.

One of the major advantages of the obligation to blend for fuel suppliers is the predictability of the market volumes to be sold in the respective years, as the fuel suppliers are obliged to meet the quota requirements. Therefore, the obligation system sets a long term, predictable framework for biofuel producers, insuring a higher investment security, as compared to tax exemptions that can be revised every year, depending on the government budget. Simultaneously, if the annual targets are set too low, the obligation may not exploit the full potential of biofuels. The average direct cost for each liter of conventional fuel displaced when implementing this instrument, could be expected to be similar to the effect of tax reduction. The main difference would be that the effects on the government budget would be almost neutral (apart from implementation and monitoring costs and second-order effects to the economy).

On the other hand, an obligation system represents several risks, i.e., it sets incentives for fuel suppliers to opt for the lowest cost biofuels and thus creates a risk of not fulfilling the targets (unless additional instruments are employed). As a result, an increase of imports can be expected and would result in lower governmental support to domestic agriculture. Moreover, in case of favoring low-blend fuels, fewer incentives for innovation will be accomplished. The conclusion is therefore that the obligatory system can be efficient when promoting the increase of biofuel

consumption, while it is less suitable for promoting a special type of biofuels (Wiesenthal et al., 2009).

From the point of view of welfare maximization, the blend obligations involve higher fuel prices at the pump, but they raise certainty to investors and industries, as well as they guarantee the achievement of the target. On the contrary, excise tax exemptions are introduced in order to compensate (partially or totally) the extra costs of biofuels, so that the final price at the pump stays unchanged for the consumers.[3] Simultaneously, the tax exemptions reduce budget revenues leading to a lower level of public resources available for transfers and services (EC, 2007a).

According to the EU estimation (EC, 2007a), the most effective combination of political measures supporting biofuels is the obligation to blend and a simultaneous tax relief. Comparing the two enumerated instruments, they would have opposite effects for governments, transport users and consumers, while the same or similar effects for refineries, agricultural sectors, agriculture related sectors, and industry and services. Tax reductions would bring about losses of tax revenue for the government, would not influence transport users and would evoke changes in government spending, as well as an increase in food prices. On the contrary, the obligations would lead to a cost increase for transport users – proportional to blending level, and effects from the reduction of disposable consumer income.

[3] The excise exemptions alone would keep prices at the pump lower, but they would not guarantee the achievement of the desired objectives (both in terms of percentage of blending and reduced $CO_2$ emissions).

# IV Possibilities and Challenges for Policy-Making in the Biofuels Sector in the EU and US: Lessons to Be Learned from Each Other

According to the DG for Agriculture and Rural Development the target of 10% biofuels in the total fuel consumption in the transport sector in the EU-27 can be achieved by 2010. However, many organizations argue that this target cannot be achieved in an environmental and socially sustainable way. Some experts underline the high pressure on feedstock prices that can subsequently impact food prices. Additionally, some scientific research studies show that, depending on the production method and the feedstock used, some biofuels might have no positive impact on $CO_2$ emissions. Finally, the first generation biofuels are sometimes criticized due to the fact that biomass is a more efficient feedstock for bioenergy production (Kutas et al., 2009). Against this background, the challenge for the EU is to guarantee an efficient policy for supporting bioenergy production. The currently acknowledged tax exemptions in most EU Member States, compared with other instruments like obligatory mandates, seem to be insufficient to insure optimal resource allocation as well as environmental and social benefits.

Also with regard to the policy support in the respective EU Member States, the analysis of biofuels policies on the national level shows that different approaches are taken by Member States and the rates of support for biofuels are not uniform across the EU. Additionally, standardized and up-to-date information on the EU biofuels industry is missing, which makes it difficult to estimate the levels of support for the biofuels production. The assessment of the necessary support for biofuels is hindered by the missing information on the amounts of feedstock used for the biofuels production, consumption and trade of biofuels by the respective countries. Therefore, more precise regulatory commitments are necessary in order to insure a more concise and uniform data collection and policy implementation.

Furthermore, subsidies for biofuels production in the EU-27 are likely to grow immensely over the next decade due to the fact that the financial support is linked to the biofuels production or consumption. However, due to the challenging blending targets, the support to biofuels could triple if the current rates of subsidization are not modified. In the Member States implementing exemptions or reductions in fuel-excise tax, the burden on the national budget will rise in proportion to the domestic consumption. However, for such cases, the EU has established criteria that require EU Member States to limit support to the difference between oil prices and biofuels production costs. Thus, given a high increase of petroleum fuels prices, the Member States would be legally required to reduce the amounts of any tax exemptions accordingly.

The trials to change the support policies and to make percentage targets mandatory, and simultaneously phasing out or eliminating excise-tax concessions, gives an impression of reducing support to the industry and simultaneously it transfers the costs of supporting the sector to consumers.

A mitigating and challenging factor in the biodiesel market could be imports from third countries with lower production costs. The relatively low MFN tariff[4] (6.5% ad valorem) on biodiesel means that if the EU biodiesel becomes too expensive, blenders could easily turn to imports. The same possibility does not exist for fuel ethanol. However, it has ascribed a specific-rate tariffs of 0.192 €/liter (for undenatured ethanol) and 0.102 €/liter (for denatured ethanol imported from countries) to which the EU applies its full MFN tariffs (Kutas et al., 2007).

According to EurActiv (2008a), EU ministers distanced themselves from an EU-wide target to boost the use of biofuels in transport, and underlined that the target of 10% by 2020 should be accounted not for biofuels only but for all sources of renewable energy (hydrogen and electric cars). Therefore, in July 2008, the European Parliament's Environment Committee voted

[4] MFN tariff - the tariff level that a member of the GATT/WTO charges on a good to other members

to scale down the proposed EU-wide biofuels target to only 4% by 2015. The major concern about not meeting the targets was exacerbated by the World Bank report that claimed that biofuels support has pushed up food prices worldwide by 75%. Though more careful analyses showed food price effects to be much smaller, the issue remains an important consideration in policy formulation. Also, the Parliament's Industry and Energy Committee approved a report by Luxembourg Green MEP Claude Turmes in September 2008. The report confirmed the 10% target by 2020, setting an interim 5% target for 2015, and specified that at least 20% of the 2015 target and 40% of the 2020 goal must be met from "non-food and feed-competing" second generation biofuels or from cars running on green electricity and hydrogen. The Turmes report also specified that traditional first generation biofuels would only count towards the target if they meet strict sustainability criteria, i.e., social sustainability criteria and an obligation for biofuels to offer at least 45% carbon emission savings compared to fossil fuels, that would rise to 60% in 2015. These numbers are much higher than those proposed by the European Commission (35% saving) and more ambitious than the estimations of national governments. However, the member-state representatives have found a consensus on a two-phased approach initially requiring biofuels to offer a 35% $CO_2$ saving that would then be scaled up to "at least 50%" in 2017, subject to a review in 2014 (Euractiv, 2008b).

Additionally, according to a EU report 2010, the share of biofuels in transport fuel beyond 5.6% could harm the environment, thus suggesting that such a policy and the current targets would not be sustainable. An outcoming EU report on indirect land-use change caused by biofuels is going to measure the extent to which the production of first generation biofuels contributes to emissions by replacing crops grown for food production and accelerating deforestation (Euractiv, 2010). Currently, the EU is discussing the question of possible solutions

such as minimizing the production quotas, and to insure that biofuels production can be sustainable and cost-effective.

The previous section on US biofuel policy indicates that the US has moved in a similar direction in the new RFS2. Indirect land use change was taken into account when calculating the emissions benefits that would obtain from different technologies. Though they apply only to slightly over half the mandated quantities of biofuel, 50% and 60% lifecycle GHG thresholds are the standard in the RFS2; and the lower threshold of 20% applies only to new corn starch facilities or other first generation ethanol feedstocks.

Mandates have been established as the principal mechanism for achieving US biofuel targets and there is little pressure to change that direction. If anything, tax credits, subsidies and tariffs are becoming less critical, since their impact is primarily to alter the consequences for "who pays" rather than what is produced and how. Without tariffs and credits the cost of achieving the mandate shifts almost entirely to the transport fuel consumer rather than being shared by taxpayers and fuel consumers. If in the presence of credits and tariffs there is production above that required by the mandate, the removal of these incentives also reduce production of biofuels and demand for and prices of feedstocks and other commodities linked through market supply and demand interactions (FAPRI, 2010a).

So both the US and the EU have opportunities to improve the efficiency of implementing biofuel policies and both have tradeoffs to consider in determining who gains and losses from policy changes. Experiences on both sides of the Atlantic can inform the other, and there is potential for each to improve the effectiveness of policy design and implementation.

## References:


EC (European Commission) (2003a). Directive 2003/30/EC of the European Parliament and of the Council on the promotion of the use of biofuels or other renewable fuels for transport. *Official Journal of the European Union*, L123, 42-46.

EC (2003b). Council Directive 2003/96/EC of 27 October 2003 restructuring the Community framework for the taxation of energy products and electricity. *Official Journal of the European Union*, L283, 51-70.

EC (2006a). An EU Strategy for Biofuels, Communication from the Commission. COM(2006) 34 final.

EC (2006b). Environment fact sheet: energy for sustainable development. In: http://ec.europa.eu/environment/climat/pdf/energy_fact_sheet.pdf (04/06/2010).

EC (2007a). Commission Staff Working Document. Accompanying document to the Communication from the Commission to the Council and the European Parliament. Renewable Energy Road Map: Renewable energies in the 21st century: building a more sustainable future - Impact Assessment. SEC(2006) 1719.

EC (2007b). Communication from the Commission to the Council and the European Parliament 6 Results of the review of the Community Strategy to reduce $CO_2$ emissions from passenger cars and light-commercial vehicles. COM(2007) 19 final.

EC (2008a). Proposal for a Directive of the European Parliament and of the Council amending Directive 2003/87/EC so as to improve and extend the greenhouse gas emission allowance trading system of the Community, Brussels, 23.1.2008. COM(2008) 16 final, 2008/0013.

EC (2008b). Bioenergy. In: http://ec.europa.eu/agriculture/bioenergy/index_en.htm (04/05/2010).

EC (2008c). Proposal for a Council Regulation establishing common rules for direct support schemes for farmers under the common agricultural policy and establishing certain support schemes for farmers. COM(2008) 306 final.

EurActiv (2008a). Biofuels not an obligation, say EU ministers. In: http://www.euractiv.com/en/transport/biofuels-obligation-eu-ministers/article-173992 (04/29/2010).

EurActiv (2008b). Biofuel-makers denounce target downgrade. In: http://www.euractiv.com/en/transport/biofuel-makers-denounce-target-downgrade/article-175298 (04/29/2010).

Euractiv (2010). EU biofuels target borderline sustainable, report finds. In: http://www.euractiv.com/en/climate-environment/eu-biofuels-target-borderline-sustainable-report-finds-news-382606 (04/29/2010).

Eurostat (2009). Share of biofuels in fuel consumption of transport. Eurostat data base.

FAPRI (2010a). FAPRI U.S. Baseline Briefing Book. *FAPRI-MU Report*, 01-10, FAPRI, University of Missouri, Columbia.

FAPRI (2010b). FAPRI US Biofuel Baseline and Credit and Tariff expiration scenarios. *FAPRI-MU Report*, 04-10. FAPRI, University of Missouri, Columbia.

Kraemer, A.; Schlegel, S. (2007). European Union Policy on Bioenergy. Policy Brief: Economic Policy Program – Biofuels. The German Marshal Fund of the United States: Washington.

Kutas, G.; Lindberg, C.; Steenblik, R. (2007). Biofuels - At what cost? Government support for ethanol and biodiesel in the European Union. International Institute for Sustainable Development: Switzerland.

Meyer, S.; Westhoff, P.; Thompson, W. (2009). Impacts of Selected US Ethanol Policy Options. *FAPRI-MU Report*, 04-09, FAPRI, University of Missouri, Columbia.

OECD (2008). Biofuel support policies. An economic assessment. OECD: Paris.

OLA (2009). Evaluation Report: Biofuel Policies and Programs. Program Evaluation Division, Office of the Legislative Auditor, State of Minnesota.

Saundry, P. (2010). Greenhouse Gas Control Policies in the European Union. In: Encyclopedia of Earth. Eds. Cutler J. Cleveland: Washington, D.C.: Environmental Information Coalition, National Council for Science and the Environment.

USEPA (US Environmental Protection Agency) (2010). National Renewable Fuel Standard Program – Overview. Office of Transportation and Air Quality. USEPA, April 14-15, 2010.

Westoff, P.; Thompson, W.; Meyer, S. (2008). Biofuels: Impact of Selected Farm Bill Provisions and Other Biofuel Policy Options. *FAPRI-MU Report*, 06-08, Food and Agricultural Policy Research Institute, University of Missouri.

Wiesenthal, T.; Leduc, G.; Christidis, P.; Schade, B.; Pelkmans, L.; Govaerts, L.; Georgopoulos, P. (2009). Biofuel support policies in Europe: Lessons learnt for the long way ahead. *Renewable and Sustainable Energy Reviews*, 13, 789-800.

Table 1 Biofuels progress in the EU Member States at national level

| Member State | Market share 2003 | National indicative target for 2005 | Targeted increase, 2003–2005 |
|---|---|---|---|
| AT | 0.06% | 2.5% | +2.44% |
| BE | 0 | 2% | +2% |
| CY | 0 | 1% | +1% |
| CZ | 1.12% | 3.7% (2006) | + 1.72% (assuming linear path) |
| DK | 0 | 0% | +0% |
| EE | 0 | not yet reported | not yet reported |
| FI | 0.1% | 0.1% | +0% |
| FR | 0.68 | 2% | +1.32% |
| DE | 1.18% | 2% | +0.82% |
| GR | 0 | 0.7% | +0.7% |
| HU | 0 | 0.4–0.6% | +0.4–0.6% |
| IE | 0 | 0.06% | +0.06% |
| IT | 0.5% | 1% | +0,5% |
| LA | 0.21% | 2% | +1.79% |
| LI | 0 (assumed) | 2% | +2% |
| LU | 0 (assumed) | not yet reported | not yet reported |
| MT | 0 | 0.3% | +0.3% |
| NL | 0.03% | 2% (2006) | +0% (promotional measures will come into force from January 2006) |
| PL | 0.49% | 0.5% | +0.01% |
| PT | 0 | 2% | +2% |
| SK | 0.14% | 2% | +1.86% |
| SI | 0 (assumed) | not yet reported | not yet reported |
| ES | 0.76% | 2% | +1.24% |
| SV | 1.33% | 3% | +1.67% |
| UK | 0.03% | 0.3% | +0.27% |
| **EU-25** | **0.6%** | **1.4%** | **+0.8%** |

Source: EC (2006a)

Table 2 Mandatory market shares or blending targets for biofuels in the EU (in %)

| Member State | 2006 | 2007 | 2008 | 2009 | 2010 |
|---|---|---|---|---|---|
| Austria | 2.5 | 2.5 | 4.3 | 5.75 | 5.75 |
| Finland | - | - | 2 | 4 | 5.75 |
| Germany | - | diesel: 4.4 | Minimum quota applies also to subsequent years | | |
| | | gasoline: 1.2 | 2 | 2.8 | 3.6 |
| | | - | - | Total quota: 6.25 | Total quota: 6.75 |
| Luxembourg | - | 2 | n.a. | n.a. | n.a. |
| Netherlands | - | 2 | Progressive annual increase | Progressive annual increase | 5.75 |
| Slovakia | 2 | 2 | 2 | 2 | 5.75 |
| Slovenia | 1.2 | 2 | 3 | 4 | 5 |
| Spain | - | - | - | 3.4 | 5.83 |
| United Kingdom | - | - | 2.5 | 3.75 | 5 |

Source: Kutas et al. (2007: 29)

Table 3 Requirements for new standards under RFS2

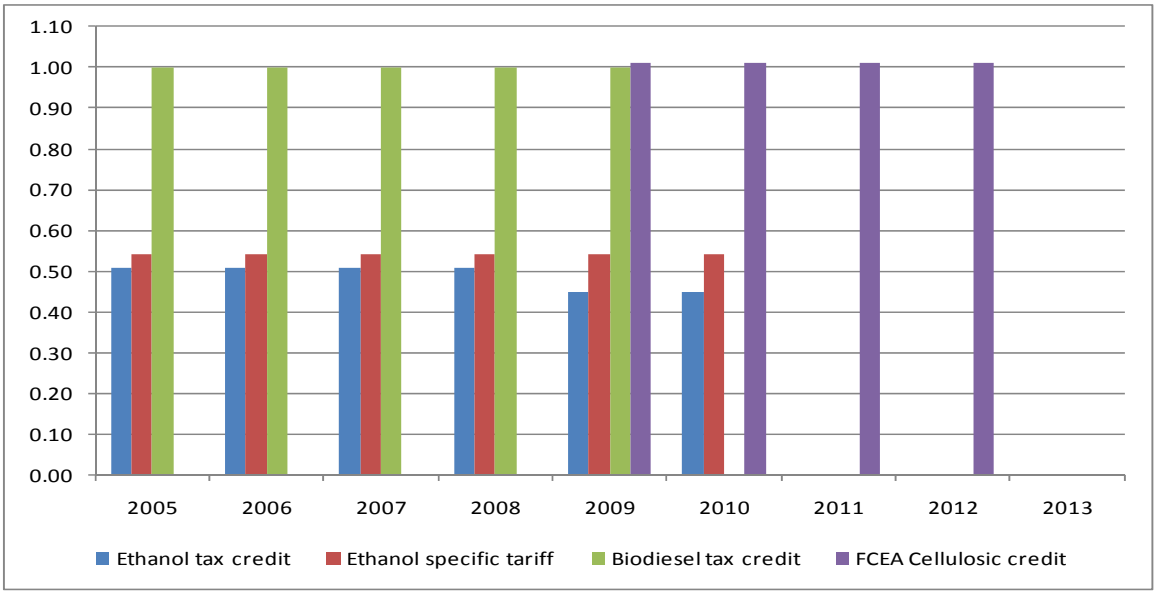
| Type | Volume by 2022 | Lifecycle GHG threshold | Comment |
|---|---|---|---|
| Biodiesel | 1 billion gal (3.79 billion l) | 50% | For 2012 and beyond[5] |
| Cellulosic biofuel | 16 billion gal (60.57 billion l) | 60% | Subject to annual assessments |
| Advanced biofuel | 21 billion gal (79.49 billion l) | 50% | Anything but corn starch, minimum of 4 billion gal additional |
| Renewable biofuel | 36 billion gal (136.27 billion l) | 20%[6] | Minimum of 15 billion gal additional |

Source: USEPA (2010)

[5] Could be increased from 2013 onward

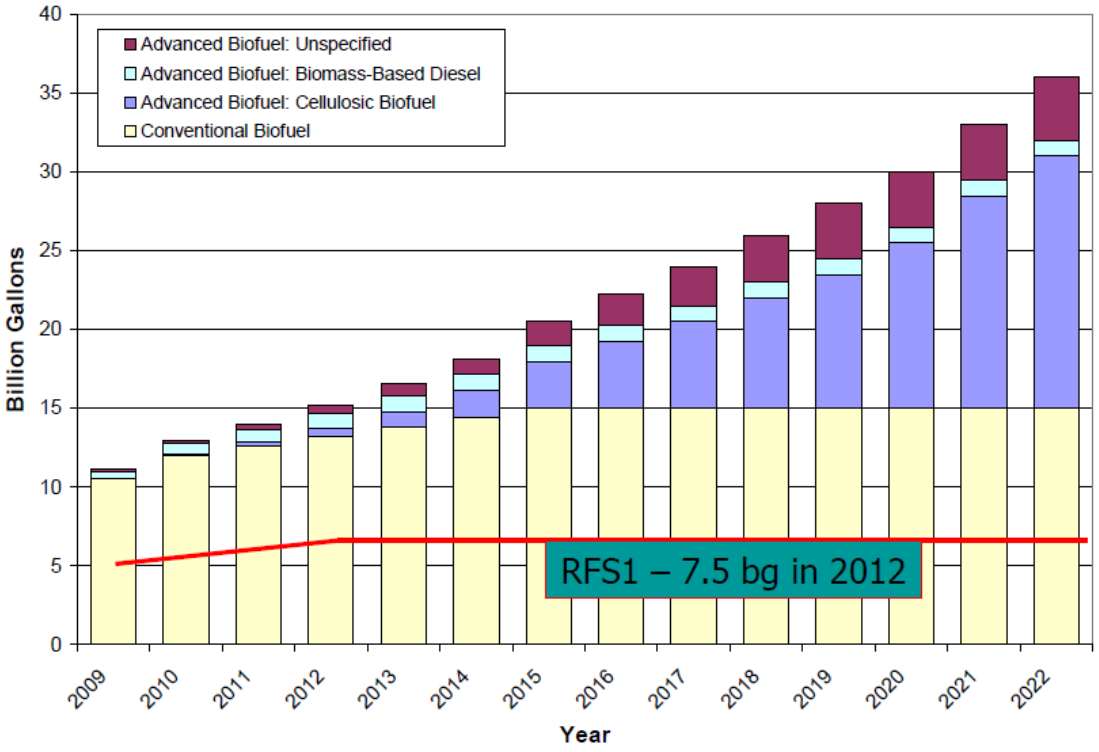
[6] Only applies to fuel from new facilities. "Grandfathered" facilities are those (domestic and foreign) that commenced construction before 31 Dec 2007 and ethanol facilities that commenced construction prior to 31 Deecember 2009 and use natural gas and/or biomass for process heat.

Figure 1 Tax credit by biofuel type and ethanol import tariff 2005-2013, $/gallon



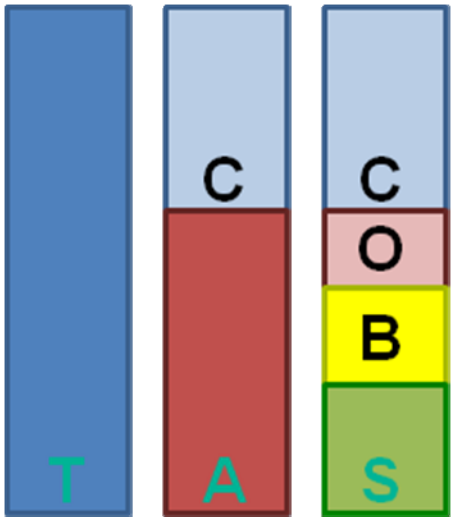

Source: USEPA (2010)

Figure 2 RFS2 volumes by fuel category




Source: USEPA (2010)

Figure 3 Categories of biofuels specified in the RFS2 regulations




Source: FAPRI (2010b)