3.1 Conventional Biofuels

The IEA (2011) classifies biofuels as conventional or advanced according to their stage of technical maturity. Conventional (or first generation) biofuels are produced using technically mature processes that have been proven on a commercial scale. These biofuels include sugar and starch based ethanol, oil crop based biodiesel and straight vegetable oil, as well as biogas derived from anaerobic digestion. The main types of feedstock used to produce conventional biofuels are sugar cane and sugar beet, starch bearing grains like corn and wheat, oil crops like rape (canola), soybean and oil palm and in some cases animal fats and used cooking oils.

Advanced biofuels are produced using technologies that are still in the R&D, pilot or demonstration phase. These are commonly referred to as second or third generation biofuel technologies. This category includes hydrotreated vegetable oil (HVO), which is based on animal fat and plant oil, as well as biofuels based on lignocellulosic biomass such as cellulosic ethanol, biomass to liquids (BtL)-diesel and biosynthetic gas. It also includes novel technologies that are mainly in the R&D or pilot phases such as algae based biofuels and the conversion of sugar into diesel type biofuels using biological or chemical catalysts. This paper will focus on conventional biofuels as they are more widely used across both the US and Indonesia.

Biofuels can be used as an energy source for transport, heating, electricity, and cooking. In the transport sector biofuels are typically blended with gasoline or diesel fuel. Conventional vehicles can accommodate a blend of around 5-15% biofuel but a higher percentage of bioethanol can be used in modified ‘flex fuel’ vehicles (Brown et al., 2011). This paper will focus on the use of conventional biofuels in the transport sector in the US and Indonesia.

3.1.1 Conventional Biofuels in the US

Key findings

- The main impetus for the support extended to biofuels in the US is energy security. The 1973 oil crisis led to subsidies for the sector, while rising oil prices at the turn of the 21^{st} century have prompted further support to reduce US dependence on foreign oil imports. Government agencies have also considered biofuels as a means of helping the US achieve its climate change and energy goals and providing a new source of income for rural America.

- Key policies in support of the biofuels industry include mandates, tax incentives, an import tariff, and loans and grants.

- The analysis of US regulatory practices for the biofuels sector leads to the conclusion that the support that the biofuels sector has received appears to be unsustainable and disproportionate to the purported benefits, such as improved energy security and CO_2 emissions reductions. Furthermore, the industry has the potential to put upward pressure on food prices and infrastructure.

Costs, benefits and promotion

- The fiscal burden from excise tax credits to biofuels producers and blenders has been increasing very rapidly, costing US$ 3 billion in 2006, US$ 3.2 billion in 2008, and US$ 6.1 billion in 2009. Furthermore, if the renewable fuel standards (RFS) targets are met, the federal budget losses are projected to increase from around US$ 6.7 billion in 2010 to a range of US$ 19 billion to US$ 27 billion in 2022.

- Biofuels are an expensive means of abating CO_2 emissions in the US context. Abatement costs per ton of CO_2e of greenhouse gas emissions borne by tax payers are approximately US$ 750 for ethanol and US$ 300 for biodiesel.

Scientific integrity

- There are concerns that not all factors were adequately taken into account in earlier studies when measuring costs and benefits of biofuels, especially with regard to land-use change emissions which can raise doubts on the scientific support of the initial mandates.

Flexibility

- The Renewable Fuel Standard allows for yearly revisions, but recent downward revisions have created investment uncertainty and raised questions over the credibility of the mandate.

- Given agricultural stakeholder positions, the ability to substantially change or discontinue the program is compromised affecting the flexibility of the programs.

Transparency

- The regulatory process is transparent from the point of view of availability of information and stakeholder consultations on the various regulations. However, transparency in the policy formulation stage is limited by political economy considerations, in particular the strength of the influence of lobby groups in the policy formulation process.

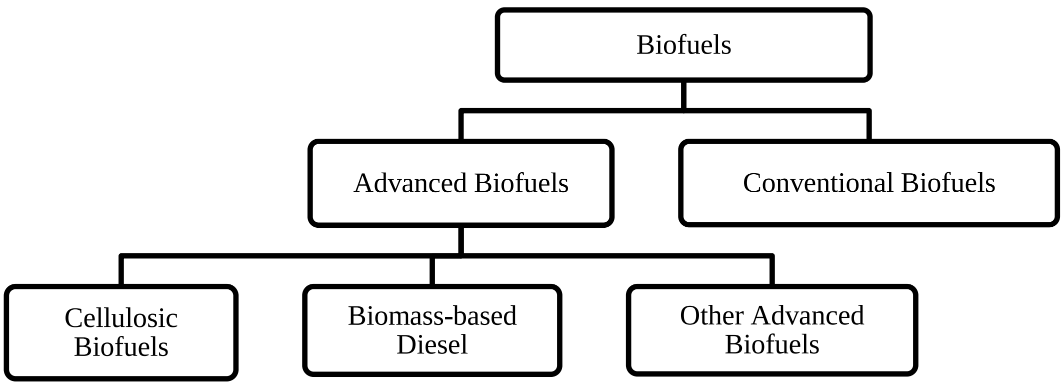
Alignment

- Policy coherence is far from optimal. Several government programs have been created to support virtually every stage of production and consumption relating to ethanol and biodiesel. In many locations, producers have been able to tap into multiple sources of subsidies. Overlapping programs may also carry a high cost for little benefit in terms of energy infrastructure.

A. Size and Significance

In the US, biofuels mostly refer to the liquid biofuels for use in transportation. The most common types of biofuels currently produced and consumed in the United States are fuel ethanol derived from corn grain and biodiesel derived from soybean (Box 3.1.1 depicts the broad classification of biofuels). Fuel ethanol dominates the industry. From 1980, ethanol production has seen a 75-fold increase from 175 million gallons in 1980 to 13,230 million gallons in 2010 at a compound annual growth rate (CAGR) of 24% (see Figure 3.1.1 below). The industry has seen a particularly strong uptake since 2005 with additions in the range of 1 to 2 million gallons per annum. It was also in 2005 that the US surpassed Brazil as the world's largest producer of fuel ethanol (World Bank, 2008).

Box 3.1.1 ***Categories of biofuels***



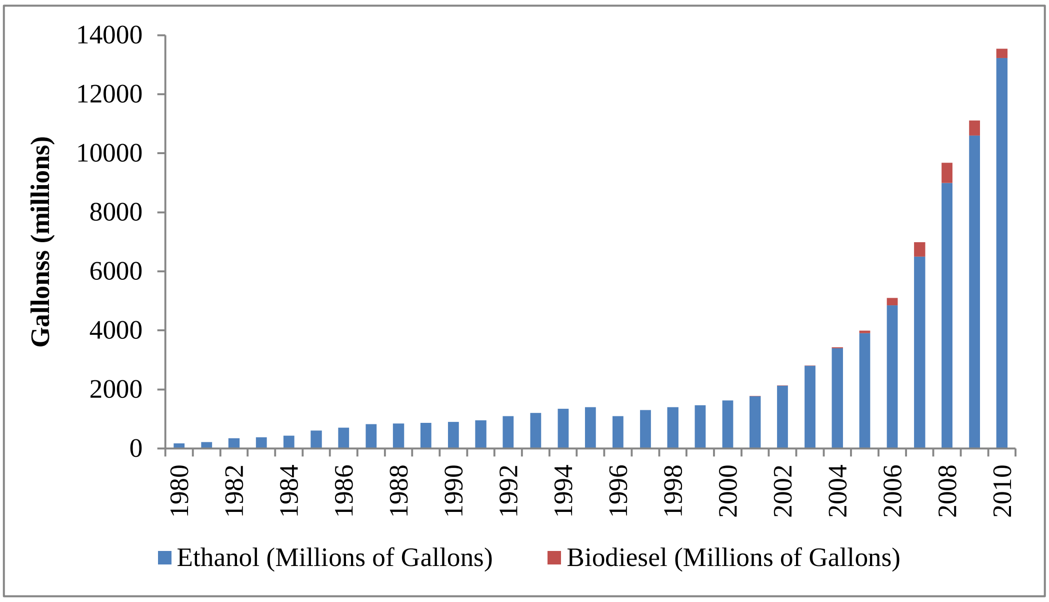
- **Conventional biofuels** in the U.S. comprise of ethanol derived from corn starch. Conventional biofuel produced from facilities that commenced construction after December 19, 2007 would have to achieve a life-cycle greenhouse gas (GHG) threshold of at least a 20% reduction in emissions from the baseline to qualify as a renewable fuel under the Renewable Fuel Standards 2.
- **Advanced biofuels** are defined as renewable fuels, other than ethanol derived from corn starch. These include ethanol derived from cellulose, hemi-cellulose, or lignin, sugar or starch (other than corn starch), waste material (including crop residue, other vegetative waste material, animal waste, food waste and yard waste); biomass-based diesel; biogas (including landfill gas and sewage waste treatment gas); butanol or other alcohols produced through the conversion of organic matter from renewable biomass and other fuel

derived from cellulosic biomass. In the U.S., these fuels must achieve a life-cycle GHG threshold of at least 50% reduction in emissions compared to the baseline petroleum-based gasoline and diesel[123] to qualify as a renewable fuel under the Renewable Fuel Standards 2.

- **Cellulosic biofuels** are renewable fuels derived from any cellulose, hemi-cellulose, or lignin from renewable biomass. This group must achieve a life-cycle GHG threshold of at least 60%.
- **Biomass-based diesel** is biodiesel derived from vegetable oils or animal fats and cellulosic diesel. Examples are biodiesel derived from soybean or algae. The life-cycle GHG threshold for this category is 50%.

Biodiesel, on the other hand, lags significantly behind both in terms of market entry and volume. It is commercially available in most oilseed-producing states. As of 2005, it was more expensive than fossil diesel. Ethanol is blended into gasoline and biodiesel into petroleum diesel. According to the Renewable Fuels Association (2011), over 90% of US gasoline is now blended with ethanol.

Figure 3.1.1 ***Status of biofuels in the US 1980–2010***



Source: Renewable Fuels Association (RFA), Industry Statistics. Available at: http://www.ethanolrfa.org/pages/statistics; EIA (2010), "Annual Energy Review 2009." Available at ftp://ftp.eia.doe.gov/multifuel/038409.pdf

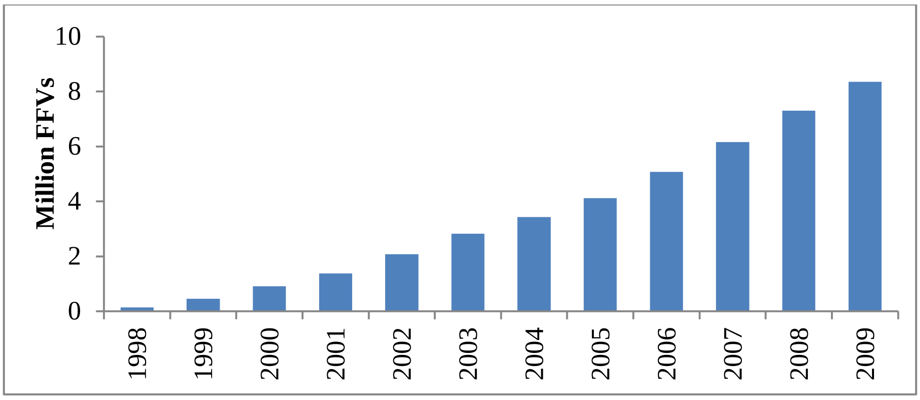
The increase in the production and consumption of biofuels in the US since the turn of the century has come about in part through the increased policy support that the sector has received at both the federal and local levels in the US (Horelik, 2008). In particular, the sales of biofuel/petrol fuel blends that have a low proportion of biofuels in the mix have received encouragement. This is because consumers are unable to distinguish between the performance of a low blend-fuelled vehicle and a pure petrol-fuelled vehicle (GAO, 2007).

Flexible fuel vehicles (FFVs) are those that are designed to handle a wide range of biofuel/gasoline blends. The number of flexible fuel vehicles has also been increasing at a modest pace. Figure 3.1.2 below shows the increase in the number of E85 [124] FFVS from 1998 to 2009 giving

[123] Baseline life-cycle greenhouse gas emission is the average life-cycle greenhouse gas emissions as determined by the Administrator, in this case the US Environmental Protection Agency, for gasoline or diesel (whichever is being displaced by the renewable fuel) sold or distributed as transportation fuel in 2005.
[124] E85 refers to a fuel blend that consists of 85% ethanol and 15% petrol.

a CAGR of 15.5%. The general scarcity of E85 fuel and E85 refueling stations, and low awareness amongst consumers were believed to have contributed to the E85 vehicles being used primarily in localities where the E85s were mandated by law (International Trade Administration, 2007).

Figure 3.1.2 *E85 FFVs in use in the US*



Source: Alternative Fuels Data Center (AFDC)[125]

The majority of the ethanol and biofuel fueling stations are geographically located near the corn and soybean production centers. This has resulted in a high concentration of fueling stations in the US Midwest. The dispersion for both ethanol and biodiesel infrastructure displays this concentration. For instance, as of September 2011, of the 2,442 stations offering E85, nearly half of the fuelling stations were located in only six states: Minnesota (14.7%), Illinois (8.9%), Iowa (6.5%), Indiana (6.3%), Wisconsin (5.7%), and Michigan (4.8%) (AFDC). Similarly for biodiesel, of the 627 fueling stations, six states accounted for half of the fueling stations: North Carolina (22.4%), Tennessee (7.1%), California (6.1%), South Carolina (4.8), Washington (4.8%), and Oregon (4.2%) (AFDC). These refueling stations comprise less than 1% of the US's motor vehicle fueling stations.

B. Policy Formulation

(i) History and Background

The US has a long history of supporting the biofuels industry. The policies enacted in the past two decades are outlined in Table 3.1.1 below. The regulations that directly affect the biofuels industry can be broadly classified into mandates (minimum consumption volumes); fiscal incentives (tax credits, subsidies and import tariffs); and financial incentives (loans, loan guarantees and grants).

In addition to Federal-level policies, the US has many varying state-level policies on consumption mandates and fiscal and financial incentives which make it difficult to determine the overall level of mandates and subsidies in the economy. However, comparing the magnitudes of the federal and state level initiatives, the economic and welfare impacts of the Federal-level programs far outweigh state-level policies.

Biofuels are more expensive relative to traditional fossil fuels. Bioethanol and biodiesel are currently not competitive with gasoline or diesel prices, except in some markets (notably Brazil) where production costs are low (Brown et al., 2011). These costs are largely driven by the cost of the

[125] Please see http://www.afdc.energy.gov/afdc/data/index.html

feedstock which typically make up between 45% and 70% of total production costs (Brown et al., 2011).

Biofuels have been promoted in the US by the various government administrations since Nixon as a means of reducing dependence on foreign oil, providing a new source of income for rural America, and contributing to the economy's climate change goals (Worldwatch Institute, 2009). The notion that increased biofuels production would enhance energy security has been around since the 1970s. In the aftermath of the oil shocks of the 1970s,[126] the US looked to biofuels as one of the means of ensuring security of supply especially in the transportation sector. Energy security and the crisis environment of the oil price shocks were at the root of some of the major attempts to boost the newer energy technologies. Efforts to encourage commercial developments of new energy technologies in the US, the biggest spender on R&D by far, became a key policy focus with President Nixon's "Project Independence," which was continued under President Ford and Carter.

It was especially during the Carter Administration that policy efforts for alternative energy technologies became heavily funded and gained much publicity. The earliest federal mandates in the US for ethanol arose then.[127] Since then, US experiments in commercializing renewable energy since 1973 include synfuels,[128] nuclear fusion,[129] "new generation vehicles" with ultra-low emissions and fuel efficiencies higher than current fleet averages by a factor of over three,[130] and advanced

[126] The 1970s witnessed two large spikes in the price of crude oil. The first spike occurred in 1973 following the Arab oil embargo. This resulted in a quadrupling of the price to nearly US$12 per barrel in 1974. The second spike occurred in 1979 in the wake of the Iranian Revolution. In the year that followed, the price of crude oil rose by approximately 2.6 times to US$39.50 per barrel (Barsky and Kilian, 2004).

[127] Since the late 1970s, U.S. policymakers at both the federal and state levels have enacted a variety of incentives, regulations, and programs to encourage the production and use of agriculture-based energy (Caperhart, 2009). The earliest regulation was introduced through the Energy Tax Act of 1978 (IEA, 2010). The Act constitutes a programme of tax credits for household and businesses purchasing alternative energy equipment including solar wind and geothermal. The bill also created an excise tax exemption of US$ 0.04 per gallon of blended gasoline for alcohol fuels (ethanol and methanol), which was equivalent to the full value of the excise tax at that time. The ethanol excise tax exemption was extended in 1980. The credit was set to expire in 1984 but has been extended several times since at different levels of exemptions.

[128] Synthetic fuels or synfuels refer to unconventional liquid fuels that can be used as petroleum or crude oil substitutes. Synfuels are created by chemical reactions, usually Fischer-Tropsch process, from base resources such as coal, natural gas, oil shale or biomass feedstock (EIA, 2006).

[129] Nuclear fusion is the process by which two or more atomic nuclei join or "fuse" to form a single heavier nucleus (WNA, 2012). This is usually accompanied by the release or absorption of large quantities of energy. With current technology, the reaction most readily feasible is between the nuclei of the two heavy forms (isotopes) of hydrogen – deuterium (D) and tritium (T). Each D-T fusion event releases 17.6 MeV (2.8 x 10-12 joule, compared with 200 MeV for U-235 fission) (WNA, 2012). At present, two main experimental approaches are being studied: magnetic confinement and inertial confinement. The first method uses strong magnetic fields to contain the hot plasma. The second involves compressing a small pellet containing fusion fuel to extremely high densities using strong lasers or particle beams (WNA, 2012).

[130] President Clinton's Clean Car Initiative of 1993 was renamed "Partnership for a New Generation of Vehicles" (PNGV) when the government announced a joint effort with the big three US auto companies GM, Ford and Chrysler. The PNGV Challenge was to build a car with up to 80 miles per gallon at the level of performance, utility and cost of ownership that today's consumers demand (DOE, 2012). Researchers for the Partnership for a New Generation of Vehicles (PNGV) have identified a number of ways to reach 80 mpg including reducing the vehicle weight, increasing engine efficiency, combining gasoline engines and electric motors in hybrid vehicles, implementing regenerative breaking, and switching to high efficiency fuel cell power plants.

conversion of waste or abundant cellulosic materials into biofuels.[131] Thus, a wide variety of policy actions, including taxes on conventional fuels, tax incentives for alternative fuels, financial assistance programs, money for research, and regulations were initiated to encourage conservation and investment in alternative fuels infrastructure (Horelik, 2008).

The 1980s witnessed a massive collapse in crude oil prices.[132] With biofuels positioned as a substitute to fossil-fuels, this fall in crude oil prices reduced the economic attractiveness of biofuels. Nevertheless, in the decades that followed, the industry continued to receive support under various federal and local initiatives. Tax incentives were the most prevalent, supporting various types of biofuels at different rates. Domestic production was protected by imposing an ad-valorem tariff on imported biofuels and an offsetting tariff on imported ethanol. A national consumption mandate was decreed to firm up investor confidence and boost biofuels demand. Various loans and guarantees for biofuels production, supporting infrastructure and research were also made available to support the industry uptake. However, despite these incentives, biofuels did not contribute significantly to the US's energy mix, remaining at less than 1% of energy consumption for transportation in the 1990s and 2000s (Horelik, 2008).

The run up in crude oil prices in the past decade has again brought biofuels back in favor amongst US policymakers. More recently, President Obama's recent State of the Union addresses present renewable energy goals in terms of US economic competitiveness and industrial policy, in addition to stated climate change concerns.[133]

[131] 3rd-generation biofuel is basically advanced algae-based biodiesel while 4th-generation biofuels are created using petroleum-like hydro-processing or advanced biochemistry (Greentechmedia, 2010).

[132] After 1980, reduced demand and overproduction produced a glut on the world market, causing a six-year-long decline in oil prices culminating in a 46 percent price drop in 1986 (Koepp, 1986).

[133] See, for instance, Ellerman (2012).

Table 3.1.1 ***Biofuel policies in the US***

Administering Agency	Program	Description	Expiry date
Mandates			
Environmental Protection Agency	Renewable Fuel Standard	Mandated use of renewable fuel in gasoline: 4.0 billion gallons in 2006, increasing to 36 billion gallons in 2022, out of which 21 billion gallons must be advanced biofuel	None
Tax incentives			
Internal Revenue Service	Volumetric Ethanol Excise Tax Credit	Gasoline suppliers who blend ethanol with gasoline are eligible for a tax credit of 45 cents per gallon of ethanol	End of 2011
	Small Ethanol Producer Credit	An ethanol producer with less than 60 million gallons per year in production capacity may claim a credit of 10 cents per gallon on the first 15 million gallons produced in a year	End of 2011
	Biodiesel Tax Credit	Producers of biodiesel or diesel/biodiesel blends may claim a tax credit of $1.00 per gallon of biodiesel	End of 2011
	Small Agri-Biodiesel Producer Credit	An agri-biodiesel (produced from virgin agricultural products) producer with less than 60 million gallons per year in production capacity may claim a credit of 10 cents per gallon on the first 15 million gallons produced in a year	End of 2011
	Renewable Diesel Tax Credit	Producers of renewable diesel (similar to biodiesel, but produced through a different process) may claim a tax credit of $1.00 per gallon of renewable diesel	End of 2011
	Credit for Production of Cellulosic Biofuel	Producers of cellulosic biofuel may claim a tax credit of $1.01 per gallon. For cellulosic ethanol producers, the value of the production tax credit is reduced by the value of the volumetric ethanol excise tax credit and the small ethanol producer credit—the credit is currently valued at 46 cents per gallon. The credit applies to fuel produced after December 31, 2008.	End of 2012
	Special Depreciation Allowance for Cellulosic Biofuel Plant Property	Plants producing cellulosic biofuels may take a 50% depreciation allowance in the first year of operation, subject to certain restrictions	End of 2012
	Alternative Fueling Station Credit	A credit of up to $30,000 is available for the installation of alternative fuel infrastructure, including E85 (85% ethanol and 15% gasoline) pumps	End of 2011
U.S. Customs and Border Protection	Import Duty for Fuel Ethanol	All imported ethanol is subject to a 2.5% ad valorem tariff; fuel ethanol is also subject to a most-favored nation added duty of 54 cents per gallon (with some exceptions)	End of 2011
Financial Incentives			
Department of Agriculture	Biorefinery Assistance	Loan guarantees and grants for the construction and retrofitting of biorefineries to produce advanced biofuels	End of 2012
	Repowering Assistance	Grants to biorefineries that use renewable biomass to reduce or eliminate fossil fuel use	End of 2012

	Biorefinery Program for Advanced Biofuels	Provides payments to producers to support and expand production of advanced biofuels	End of 2012
	Feedstock Flexibility Program for Producers of Biofuels (Sugar)	Authorizes the use of CCC funds to purchase surplus sugar, to be resold as a biomass feedstock to produce bioenergy	None
	Biomass Crop Assistance Program (BCAP)	Provides financial assistance for biomass crop establishment costs and annual payments for biomass production; also provides payments to assist with costs for biomass collection, harvest, storage, and transportation	End of 2012
Department of Energy	Rural Energy for America Program (REAP)	Loan guarantees and grants for a wide range of rural energy projects, including biofuels.	End of 2012
	Biomass Research and Development	Grants for biomass research, development, and demonstration projects	End of 2015
	Biorefinery Project Grants	Funds cooperative R&D on biomass for fuels, power, chemicals, and other products	None
	Loan Guarantees for Ethanol and Commercial Byproducts from Various Feedstocks	Several programs of loan guarantees to construct facilities that produce ethanol and other commercial products from cellulosic material, municipal solid waste, and/or sugarcane	Varies
	Department of Energy Loan Guarantee Program	Loan guarantees for energy projects that reduce air pollutant and greenhouse gas emissions, including biofuels projects	None
	Cellulosic Ethanol Reserve Auction	Authorizes DOE to provide per-gallon payments to cellulosic biofuel producers	August 8, 2015
Department of Transportation	Flexible Fuel Vehicle Production Incentive	Automakers subject to Corporate Average Fuel Economy (CAFE) standards may accrue credits under that program for the production and sale of alternative fuel vehicles, including ethanol/gasoline flexible fuel vehicles (FFVs)	After model year 2019

Source: Yacobucci, 2011

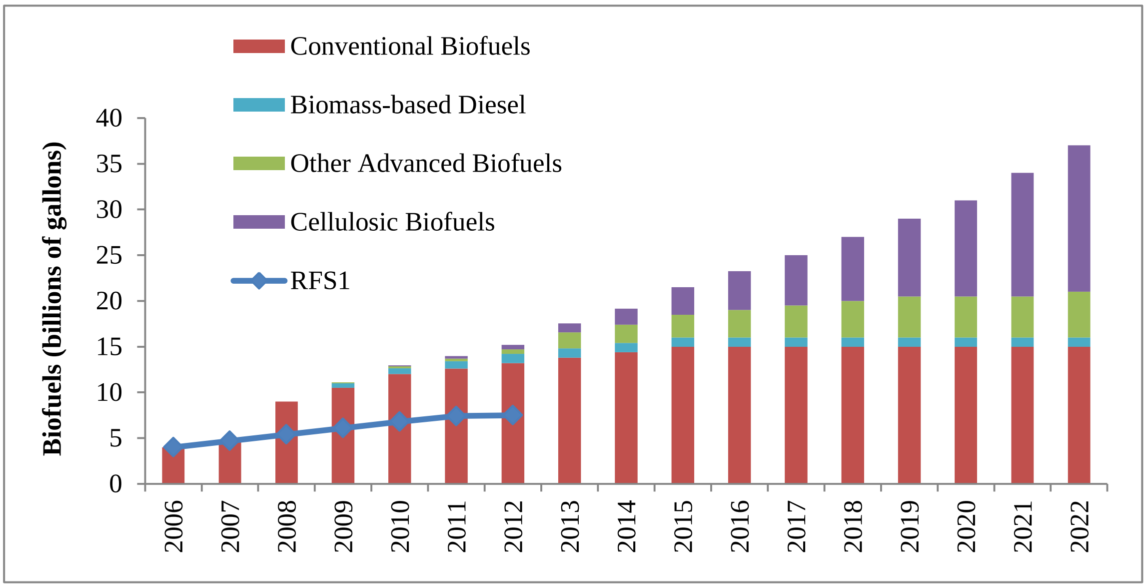
(ii) Policy Description

MANDATES

Renewable Fuel Standard

The original Renewable Fuel Standard (RFS), or RFS1, was established under the Energy Policy Act (EPAct) of 2005. It was the first mandate at the federal level to regulate the use of renewable transportation fuels in the United States. Under the RFS1, a minimum amount of 4.0 billion gallons of biofuels is targeted in 2006 and scheduled to increase to 7.5 billion gallons by 2012. The Energy Independence and Security Act (EISA) of 2007 expanded the RFS1 to encompass a more rigorous standard based on a finer categorization of renewable fuels. This is commonly referred to as the RFS2. Box 3.1.1 above summarizes the categories of biofuels covered under RFS1 and RFS2.

Figure 3.1.3 ***Mandated targets for categories of biofuels under the Renewable Fuel Standard – Energy Independence and Security Act of 2007***



Source: The Energy Policy Act of 2005, §1501; the Energy Independence and Security Act, §202

Note: Volumes of total renewable fuels, total advanced biofuels, cellulosic biofuels, and biomass-based diesel are binding requirements by RFS2. Volume of conventional biofuels is derived by subtracting the total renewable fuels mandate by the total advanced biofuels mandate.

Under the RFS2, the minimum standard volume contributed by all renewable fuels has been revised upwards substantially, almost doubling for every year mandated under the RFS1 and increasing progressively for every year afterwards (see Figure 3.1.3). Starting with a base of 9 billion gallons in 2008, the targets for 2015 and 2022 were set at 20.5 billion gallons and 36 billion gallons respectively, implying a CAGR of 10%. The RFS2 also specifies the minimum volume of total renewable fuels that has to be met by advanced biofuels, and under advanced biofuels, the minimum volume that has to be met by biomass-based diesel and cellulosic biofuels. This effectively puts a cap on the growth of conventional biofuels, underpinning the gradual shift away from corn-based biofuels which has enjoyed rapid expansion and has led to the food-fuel debate.[134]

In order to ensure that the required volumes are met each year, the Energy Protection Agency determines the ratio of biofuels to be used in total transportation fuels. This annual blending percentage obligation is set for the total biofuels as well as each category, and is applicable to all companies that blend gasoline or diesel for transportation. This is referred to as the Renewable Volume Obligation (RVO). To track the volume of biofuels, each gallon qualified under the mandated criteria is issued a unique Renewable Identification Number (RIN). At the end of the year, companies must prove that they have enough RINs to satisfy the RVO.

FISCAL INCENTIVES

Tax Credits

The United States has been providing fiscal support for biofuel production over the last 30 years. The very first tax incentive dated back to 1978 under the Energy Tax Act of 1978, which exempted biofuel producers from the gasoline excise tax of US$ 0.04 per gallon.

In 2004, tax exemption was superseded by several incentives that came in effect under the American Jobs Creation Act of 2004. Under the Act, the federal government granted a Volumetric Ethanol Excise Tax Credit (VEETC) of US$0.51 per gallon of ethanol to gasoline blenders, which was reduced to US$ 0.45 per gallon effective from 1 January 2009 (OECD, 2011b). A Biodiesel Tax Credit (BTC) was also granted to biodiesel blenders, at US$ 1.00 per gallon for biodiesel produced from virgin agricultural products such as soybean or animal fats, and US$ 0.50 per gallon for biodiesel produced from previously used agricultural products such as recycled cooking grease. These incentives are indirect production subsidies, which helped increase the threshold price blenders are willing to pay for ethanol and biodiesel from producers.

Import Duty

To support domestic production, the US imposes a 2.5 percent ad-valorem duty and a US$ 0.54 per gallon tariff on imported ethanol. While Brazilian sugarcane ethanol is more competitive both in terms of production costs and GHG abatement, the tariff reduces imports and supports domestic production. The US, however, maintains free imports for ethanol from the Caribbean Basin on volumes of up to 7% of US domestic consumption in order to promote “a stable political and economic climate in the Caribbean region.” This has created a loophole since there is an incentive for economies where the tariff is effective to process their ethanol in the Caribbean Basin economies and enjoy the zero import duty to the US.

[134] According to some studies, the rise of biofuels production accounted for a major portion of the increase in food prices in the latter half of the last decade, leading to the reconsideration of biofuels policies in the UK, Italy, and other economies (Harrison et al., 2008). In the US, it is generally thought by those in government agencies that biofuels production only accounted for about 3% of the increase (U.S. DOE and USDA, 2008), although this fraction is the subject of intense debate worldwide (Runge et al., 2007). In principle, if corn remains a widely used feedstock then increased demand for ethanol will ensure that corn prices remain high, which would likely affect the rest of the food market by raising prices of other crops. It is precisely for this reason that so much interest is being invested in alternative feedstocks such as cellulosic feedstocks.

FINANCIAL INCENTIVES

Grant programs for R&D have also played a role in developing biofuels technology, although to a lesser extent than mandates and fiscal incentives. In general, these programs have funded researchers working on developing the fundamentals behind biofuels technology, such as enzyme and microbial developments to improve yields.

There are also programs that provide money to industry for demonstrations and pilot plants. These programs, such as the Biomass Research and Development initiative created in 2000 (which funds general R&D as well), allow the government more direct control to bring a greater measure of technological development directly to commercial viability, provided that the demonstrations are successful. Most recently, given the perceived urgency of the movement to non-corn ethanol, government demonstration programs have been investing in cellulosic plants. For example, 9 such biorefinery projects were chosen by the DOE for a cumulative award of US$ 240 million dollars to be distributed between them, with the remainder of the funding for these projects (US$ 495 million) coming from private industry and investors (DOE Press Release, 2008).

C. Regulatory Review

ECONOMIC EFFICIENCY AND EFFECTIVENESS

All government regulations should have clearly defined policy objectives, and alternative regulatory approaches should be judged in relation to those policy objectives. Will they achieve stated policy goals? And will they achieve them at the lowest cost, relative to other alternatives to achieve such goals? The economic efficiency and effectiveness of US biofuel policy thus need to be assessed in relation to the stated goals of energy security, environmental sustainability and economic development.

(i) Costs, Benefits and Promotion

Government support for the US conventional biofuels industry has been the subject of a large literature on the costs and benefits of various aspects of mandates, fiscal and financial policies and regulations over the past several decades. There has been an extensive debate on the costs and benefits of the program to achieve the energy security, environmental and developmental or industrial policy goals that policy makers have identified in support of the program. Given that this literature is now very extensive, our goal is to summarize some of the key findings of the existing research in the context of the objectives of the present study.

The Environmental Protection Agency (EPA) Assessment of the Renewable Fuel Standard 2

The EPA in its 2010 Regulatory Announcement (EPA, 2010a) provides the most recent official estimates of the potential costs and benefits of the increased volume requirements under the RFS2 if standards are met through 2022. Citing reduced dependence on foreign oil and enhanced energy security as a major benefit, the EPA estimates that by 2022, if the RFS2 regulations are in force, approximately 13.6 billion gallons of imported gasoline and diesel fuel (7% of projected annual US transportation fuel consumption in 2022) will be replaced. RFS2 is expected to reduce oil imports by US$ 16 billion. The projected reduction of oil imports under the RFS2 scenario of US$16 billion in 2022 constitutes slightly less than 8% of total projected oil imports of US$ 208 billion (in 2022). The EPA reports increased energy security benefits of US$ 3.7 billion in 2022, citing a study by Oak

Ridge National Laboratory (ORNL) that estimates the security benefit at US$ 12.38/barrel in US $2006 terms (Leiby, 2007).[135]

The EPA also expects that by 2022, the increased use of renewable fuels is expected to decrease gasoline costs by 2.4 US cents per gallon and diesel costs by 12.1 US cents per gallon. The market for agricultural products, especially corn and soybeans, is expected to expand considerably, resulting in an estimated increase of US$ 13 billion in annual net farm income. With respect to climate change as well as local, state-wide and regional environmental goals, the expanded use of biofuels under the RFS is expected to reduce annual greenhouse gas emissions by 138 million metric tons – equivalent to taking about 27 million vehicles off the road by 2022. The impacts of these emissions will be geographically heterogeneous; however, the overall emission changes are projected to lead to increases in population-weighted annual average ambient particulate matter and ozone concentrations. With respects to costs, the EPA identifies the increased cost of food in the United States as a result of using corn for feedstock. By 2022, the RFS2 program is expected to raise the cost of food by about US$ 10 per person by 2022, or over US$ 3 billion for the US.

Economic Impact Assessment of US biofuels policy

Impacts on the Fiscal Budget

An economic analysis of US biofuels policy must consider the 3 key elements at the Federal level that constitute the policy: the consumption mandate, the federal tax credit and the import tariff on ethanol. Given that biofuel prices are higher than gasoline prices, the consumption mandate of RFS2 increases the costs of blended transport fuels, reduces the welfare of fuel consumers and increases the welfare of feedstock and biofuel producers and blenders. The consumption mandate also has an impact on the rest of the economy since it reduces the quantity of resources used in the production of other goods (since more resources are pulled into biofuels production), increasing the relative price of other goods and hence reducing consumer welfare of consumers of other goods.

The tax credit of US$ 0.45/gallon for corn-based ethanol increases the price of ethanol and the quantity produced, and has similar welfare implications as the consumption mandate described above. The tax credit benefits will be shared among biofuel producers, blenders and consumers, depending on market supply and demand elasticities among these groups. But in the case of the tax credit, there is also the impact on Federal fuel tax revenues foregone which will be determined by the size of the tax credit (nominal US$ 0.45/gallon), the quantity of the biofuel that receives the tax credit (number of gallons), and the energy-equivalence of biofuel and gasoline (CBO, 2010).[136] The US Energy Information Administration estimated the Federal government tax expenditure (as foregone revenue from the Federal gasoline excise tax) to be US$ 2.9 billion in 2007, compared to US$920 million in 1999 (EIA, 2008). According to the GAO (2011), the Volumetric Ethanol Excise Tax Credit (VEETC) cost US$ 5.6 billion in revenue in 2010, increasing to some US$ 6.75 billion by 2015 with increased ethanol output under RFS2.

[135] The ORNL study reports the marginal benefits of reducing petroleum imports based on estimates of monopsony premium that the US (as a large importer) could theoretically exercise by imposing tariffs on imports and on the avoided macroeconomic disruption and adjustment costs premium (Leiby, 2007).
[136] A gallon of ethanol is not energy equivalent to a gallon of gasoline, so the displacement of gasoline by biofuels is not one-for-one.

In 2006, the excise tax credits for ethanol and biodiesel alone cost US$ 3 billion (Steenblik, 2007). In 2007, this amount was US$ 3.2 billion (EIA, 2008). In 2009, this increased to US$ 6.1 billion (CBO, 2010). Assuming the tax credits remain at the same rates, if the renewable fuel standards are actually implemented as mandated, the federal budget losses are projected to increase from around US$ 6.7 billion in 2010 to a range of US$ 19 billion to US$ 27 billion in 2022 (Yacobucci, 2010; Steenblik, 2007). Moreover to the extent that a larger proportion of biofuels is slated to come from cellulosic biofuels which are subsidized at a higher rate, the sustainability of the subsidy is in question in the larger context of the recession and massive budget deficits in the US since 2008.

The ethanol import tariff of US$ 0.59/gallon is prohibitive, but imported ethanol also receives the ethanol tax credit of US$ 0.45/gallon, yielding a net tariff of US$ 0.14/gallon. According to the USITC (2009), if the tariff is dropped, imports would be cheaper by 25%, volumes imported would grow annually by over 200% annually and domestic production would be reduced by 2% relative to that under the import tariff. Given all three policies (consumption mandate, ethanol tax credit and the ethanol import tariff) operating together, the result is broadly a function of the mandated consumption quantity and the net price impact of the tax credit and the import tariff (National Academy of Sciences (NAS), 2011).

Several other studies have provided quantitative estimates of the burden that biofuel subsidies have placed on the budgets at the federal and local level. Steenblik (2007) estimated that in 2006, the US spent approximately US$ 5.4 to US$ 6.6 billion, to support 5.8 billion gallons of ethanol and biodiesel. If biofuels production keeps growing at the historical double-digit rate, tax credits would pose a considerable strain on future Federal budgets. Intertemporal budgetary impacts could negatively affect future spending on alternatives that are better aligned to the economy’s stated energy security, environmental and industrial development policy objectives.

Federal tax incentives are used in conjunction with volumetric regulations and mandates in the US. To the extent that these regulations are effective in binding the volume requirements, tax credits are not the main driver for production, but transfer the costs borne by producers (due to the higher prices) to tax payers. Moreover, whilst generous subsidies often help promote technologies, they do so at great cost. Very often, indirect costs are excluded from the calculus. This makes the relative magnitude of the benefits vis-à-vis the costs larger. They also engender unintended consequences. Consider for instance the tax exemptions extended to fuel ethanol production. These helped fuel ethanol production grow 16-fold, from 175 million gallons in 1980 to 2,800 million gallons in 2003 at an average annual growth of 14%.[137] However, this substantially drained the Federal Highway Trust Fund (to which the federal fuel tax is credited), reducing credits available to infrastructure projects.

Impact on Energy Security

The purported energy security benefits of biofuels hinge on the diversification option that they provide. Biofuels do offer a diversification benefit, inasmuch as they may be less vulnerable to the same kinds of disruptions that threaten supplies of petroleum from politically unstable regions of the world.[138] However, the cost per unit of import displacement is very high. Moreover, the feedstocks

[137] RFA Ethanol Industry Statistics. Available at http://www.ethanolrfa.org/pages/statistics

[138] It should be noted however that, given that the world oil market is highly fungible, the impact of supply disruptions from any producing economy will have a similar impact on all importers, whether they buy their oil supplies from the affected areas or not.

from which biofuels are currently derived are also vulnerable to their own set of costly and unpredictable risks, such as adverse weather and crop diseases.

It is also important to note the scale of import displacement that can realistically be expected under the Renewable Fuel Standard 2 (RFS2) implementation scenario. The EPA's projected reduction of oil imports under the RFS2 scenario of US$ 16 billion in 2022 constitutes slightly less than 8% of total projected imports of US$208 billion (in 2022), as already mentioned above. An 8% reduction in oil imports does not alter the picture very much with respect to the US reliance on imports of crude oil and petroleum products. Indeed, far more leveraging to the projected US oil import-export balance are the remarkable development of unconventional oil resources from shale formations.[139]

Impacts on Emission Mitigation

Early life-cycle cost-benefit studies had found that corn ethanol reduced greenhouse gas (GHG) emissions relative to gasoline. An Argonne National Laboratory meta-study which reviewed 22 separate cost-benefit studies between 1979 and 2005 found emission reductions of 20 - 30% for corn-based ethanol. However, more recent studies have either reduced estimates of emission mitigation or found it to be net negative, after taking into account direct and indirect effects of land use change caused by the ethanol support program. The use of nitrogenous fertilizers and the land use change that occurs in switching grasslands and forests to biofuels farming use leads to GHG emissions which can outweigh or drastically reduce the net benefits biofuels might yield in reducing fossil fuel-based emissions. One study published in *Science*, which reviewed six previous studies, estimated GHG emission reductions at 13% (Farrell et al, 2006). Two other studies, both published in 2008, concluded that once emissions that arise from land use change for the purpose of biofuel production are factored in, there is a likely *net increase* in emissions (Fargione et al, 2008; Searchinger et al, 2008).

With respect to the economic effectiveness of biofuels policy for climate change goals, biofuels are an extremely expensive means of GHG abatement. The Congressional Budget Office (CBO, 2010) estimated the costs borne by tax payers to reduce GHG emissions through biofuel tax credits: one metric ton of CO_2e of GHG avoided costs US$ 750 for ethanol, about US$ 300 for biodiesel, and US$ 275 for cellulosic ethanol. Given that the cost of an emissions certificate on the European Union's Emissions Trading Scheme has not crossed US$ 50 per ton of CO_2 since its inception in 2005, the support of the biofuels industry as a means of reducing CO_2 emissions is a very costly one. One recent study found that the range of biofuel crops available for US growers were much less effective for reducing GHG emissions than two alternative policy options: an increase in the gasoline tax and the implementation of energy efficiency improvements (Jaeger and Egelkraut, 2011). The study estimated that US biofuels would cost between 20 and 31 times more than energy efficiency improvements that would reduce gasoline consumption by 1%.

Impact on Food Supply

Another major cost aspect of biofuels relates to its impacts on food resources. The United Nations Environment Program reports "vigorous and contentious debate over economic and environmental merits of biofuels, including questions of direct competition with food resources" (UNEP, 2008).

[139] The "shale gas revolution" of the US of the past few years has been the subject of fundamental revisions in the outlook for US oil trade balances. See Rascoe (2012).

According to the U.S. National Academies of Sciences, even if all the corn and soybeans produced in the US in 2005 had been used for bioethanol production, this would only have replaced 12% of the economy's gasoline demand and 6 % of its diesel demand (cited in UN FAO, 2008). If the whole US corn and soybean production was taken out of the food market and into the biofuel domain, it would have a massive impact on global food prices (UN FAO, 2008). According to the FAO report for 2008 on the state of world food and agriculture, biofuels production has a significant negative impact on global food supply while yielding relatively modest energy savings (UN FAO, 2008).

R&D Expenditure Impacts

In the case of R&D, except in cases where technology transfer programs were successfully carried out, it is difficult to judge the full extent of the effect these programs had in promoting recent growth, if at all. In most cases, such programs are supposed to promote increased fundamental knowledge during the early stages of development, but when the technology becomes commercially viable, it is the companies involved that drive further developments. As a result, R&D programs from the 70s, 80s and 90s may have had some role to play, but the extent to which they did remains unclear.

Assessments of the US's public sector energy R&D investments have not been very encouraging. In 2001, the National Research Council (NRC) completed a Congressionally-mandated assessment of the benefits and costs of DOE energy R&D programs.[140] It found that 0.1% of US$ 13 billion spent on R&D between 1980–2000 accounted for 75% of all estimated benefits of the research programs pursued; the spending of some US$ 9 billion provided "no quantifiable benefit."

In the quarter century since the US government established the Department of Energy (US DOE), federal government subsidies for renewable energy (biomass, waste combustion, geothermal, wind and solar) amounted to US$ 11 billion via investment tax credits, production credits, accelerated depreciation allowances, low interest loans and grants, mandatory purchases of renewable energy at "avoided cost",[141] and publicly funded R&D. The DOE has spent approximately US$ 19 billion since its inception on electricity conservation (US$ 8 billion-US$ 9 billion) and non-hydro renewable (US$ 10.7 billion), in 1996 dollars; at the state level, demand-side management programs added approximately US$ 16 billion more. According to Bradley (1997), the US$ 30 billion to US$ 40 billion cumulative 20-year investment "represents the largest governmental peacetime energy expenditure in U.S. history, outranking the Strategic Petroleum Reserve program to date as well as the cumulative expenditure of the 1974-88 synthetic fuels program."[142] Given this historical trend of high costs without quantifiable benefits, public R&D expenditure on biofuels should be viewed with caution.

[140] See Committee on Prospective Benefits of DOE Energy Efficiency and Fossil Energy R&D Programs, National Research Council, "Energy Research at DOE: Was It Worth It?" (2005). The data reported here is sourced from Fri (2006), "From energy wish lists to technological reality," *Issues in Science and Technology,* Fall 2006.

[141] Avoided cost is the marginal cost for the same amount of energy acquired through another means such as construction of a new production facility or purchase from an alternate supplier. For example, a megawatt-hour's avoided cost is the relative amount it would cost a customer to acquire this energy through the development of a new generating facility or acquisition of a new supplier. Short run avoided cost refers to avoided cost calculated based on energy acquisition costs plus ongoing expenses. Long run avoided cost factors in necessary long-term costs including capital expenditures for facilities and infrastructure upgrades.

[142] Based on US DOE data cited by (Bradley, 1997)

Given the serious concerns of the impact of corn-based ethanol biofuel program on food supply, cellulosic biofuel production has come under intense focus of R&D efforts. To date, cellulosic biofuels are not commercially viable. The National Research Council (2011) estimated that a cellulosic feedstock market would be competitive when oil prices are at or above US$ 191 per barrel or a combination of oil prices at US$ 111 per barrel and carbon price at US$118-US$ 138 per tonne of CO_2e. A subsidy of US$ 1.01 per gallon of cellulosic biofuel is not sufficient to close the price gap at US$ 111 per barrel of oil. This suggests that commercialization of cellulosic ethanol is still uncertain and at best several years down the road.[143] Assuming that technologies are available by 2015, the National Academy of Sciences (2011) estimated that capacity must be built at double the rate at which corn-grain ethanol has grown historically to deliver 16 billion gallons of cellulosic biofuels in 2022. The resources that are needed to make this a possibility are substantial.[144]

Summary of Costs, Benefits and Promotion

The analysis on costs and benefits above leads to the conclusion that the various subsidies that the biofuels sector has received appear to be unsustainable and disproportionate to the benefits achieved. This overall assessment on the US biofuels program is consistent with the studies done for the EU. According to a 2008 study by the European Commission, "the cost disadvantage of biofuels is so great with respect to conventional fuels…that even in the best of cases, they exceed the value of external benefits that can be achieved" (EC, 2008). It estimates the net present value of EU's efforts in biofuels substitution for diesel and gasoline at a negative €35 – 65 billion through 2020.[145]

A significant if often un-noted cost of supporting the biofuels industry is that the billions of dollars of annual subsidies distort investment markets by redirecting venture capital and other investments away from competing alternative energy sources and technologies. Additionally, taxpayers are being asked to finance increasing biofuels subsidies that can have intertemporal effects on future budgetary choices, further constricting future choices in energy sources and technologies. Other costs the industry generates include the potential for social dislocation, the potential to put upward pressure on food prices and infrastructure, and transport bottle necks. Second generation biofuels may help address some of these issues but they are still at the development stage and widespread deployment is uncertain (Brown et al., 2011).

(ii) Scientific Integrity

Biofuels research conducted by congressionally-mandated agencies such as the Environmental Protection Agency or the Energy Information Administration is soon tested and either verified or challenged by a range of independent research institutes and university faculties across the economy. The large technical literature on the biofuels industry is characterized by high quality policy-focused research published by academics and independent think tanks, several of which have been cited above. Scientific integrity and robust research methodologies are the hallmarks of these studies, and provide a source of ready information and policy guidance to US Federal agencies and regulators.

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[143] For instance, the Department of Energy's goal is to make cellulosic biofuels cost-competitive with corn ethanol by 2012. Other groups are less optimistic.

[144] Pressure on public spending created by the size of the budget deficit has become an intensely partisan area of politics, and federal funds for renewable energy are set to face binding constraints. See for instance, "Renewable subsidies to shrink", *Financial Times*, 18 April 2012.

[145] Given the negative findings of a study appointed by the EC, it required a news agency to acquire and report the data by suing on Freedom to Information Act rules. See Harrison, P. "Once hidden EU report reveals damage from biodiesel," Reuters, April 21, 2010.

In the campaigns that created the biofuel mandates and targets in the United States, proponents emphasized the environmental benefits that could come from biofuels use through reduced greenhouse gas (GHG) emissions. Emissions from biofuels and petroleum fuels were compared in a life-cycle approach. Studies have shown that most of the GHG benefits accrue solely through the carbon sequestration potential of biofuel feedstocks.[146] This feedstock carbon uptake credit is large enough to offset net emissions from growing feedstocks, refining, distribution and combustion of biofuels relative to conventional fossil fuels.

These earlier studies, nonetheless, fail to take into account emissions arising from land-use change which can be significant (Fargione et al., 2008). Land use change emissions refer to the release of carbon stored in plants or soils through decomposition or fire when forest and grasslands are cleared in order to grow biofuel feedstock. It is estimated that each hectare of land converted for biofuel crops results in average emissions of 351 metric tons of CO_2e (Searchinger et al., 2008). In the long term, this "carbon debt" will be offset by the feedstock carbon uptake credit, which stands to increase annually as productivity improves. This payback time is estimated to be 167 years for US corn-based ethanol in the case study. In a very optimistic scenario, it would still take more than 30 years to neutralize emissions for corn-based ethanol. Nonetheless, these estimates, similar to any GHG emission calculations for biofuels, are highly sensitive to how the biofuel is processed (using natural gas, coal or biomass), from which feedstock it originated (corn, soybean, sugarcane or waste) and which type of land it replaced. In its life-cycle analysis, the EPA (2009) found that in 30 years, most corn-based ethanol achieve positive GHG reduction.

A similar debate applies to calculating the net energy value (NEV) of biofuels.[147] For example, ethanol made from corn in the US can be seen to have a significantly lower NEV than that made from other feedstocks, such as cellulosic ethanol or ethanol from sugarcane in Brazil (Shapouri et al., 2004). This is because energy input is required for every step of the biofuels chain and different technologies and feedstocks have different efficiencies. Therefore, while the resulting ethanol from two different feedstocks may be chemically identical, the wide-scale adoption of one versus the other can have differing effects on the environment (Fargione et al., 2008).

Ethanol is easily degraded in the environment and human exposure to ethanol itself does not pose considerable health impacts. However, a high blend of ethanol into gasoline will impede the natural attenuation of BTEX (benzene, toluene, ethylbenzene, and xylenes) in groundwater and soil, posing a great risk for human exposure in the event of underground storage tank leaks. The James A. Baker III Institute for Public Policy (2010) also pointed out that increased corn-based ethanol production in the Mid-West could cause detrimental effects to ecosystems and fisheries along the Mississippi River and in the Gulf of Mexico and create water shortages in some areas experiencing significant increases in fuel crop irrigation. In addition, there is concern that the large-scale diversion of agricultural resources to fuel could threaten protected areas such as rainforests, turning it into farmland.

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[146] The carbon sequestration potential arises from the fact that the plant feedstock used in the production of biofuels absorbs carbon dioxide from the atmosphere.

[147] The NEV ratio is determined by the amount of energy available from burning the fuel compared to the amount of energy that went in to producing it. Although these numbers can vary widely depending on the model of analysis, according to a USDA study in 2001, corn ethanol had an NEV of 1.06 without considering co-products, and an NEV of 1.67 considering co-products. Cellulosic ethanol, on the other hand, has an NEV in the range of 5 to 10, depending on the source of biomass used (Shapouri et al. 2004).

In light of the results of research on the environmental impact of biofuels, EPA regulatory policies were revisited and changes were made to ensure environmental soundness. For instance, the Renewable Fuel Standard 2 requires ethanol production and use to emit 20 percent less greenhouse gases than gasoline, and advanced biofuels (made from agricultural waste or crops like switch grass) to release 50 percent less.

(iii) Flexibility

Uncertainties of future cost paths of biofuels technologies and their integration into existing energy systems are the single most important unknown for policy makers. Constantly evolving technological and economic environments together with changing social and institutional norms inevitably lead decision makers and regulators to adjust and change existing policies. The patchwork of state-level biofuel support policies, operating together with Federal regulations, has both advantages and disadvantages. The US Federal-state structure allows for a level of experimentation and diversity in the use of various policy instruments. However, the lack of coordination and the existence of over-lapping regulatory jurisdictions also lead to duplication, redundancy and unintended consequences.

Renewable Fuel Standard (RFS)

The Renewable Fuel Standard allows for revision; however, there is some lag time between review and revision of the standards. The Environment Protection Agency (EPA), which is the appointed administering authority, reserves the right to review and determine the total renewable fuel standards for each calendar year based on gasoline and diesel projections and market analysis from the Energy Information Administration. The finalized standards are announced not later than November 30 of the preceding calendar year.

For any year that EPA feels that “implementation of the requirement would severely harm the economy or environment of a region in the US” or “there is a significant renewable feedstock disruption,” it can reduce the standards for cellulosic biofuel or biomass-based diesel. Similarly, the standards for other advanced biofuels or the total renewable standard can also be revised. In its February 2010 Regulatory Announcement, the EPA set the 2010 cellulosic biofuel standard at 6.5 million ethanol-equivalent gallons as compared to the mandated requirements of 100 million gallons, a downward reduction of nearly 95% (EPA, 2010b). Then, in July 2010, EPA lowered the 2011 RFS for cellulosic biofuels to 6.6 million gallons as compared to the mandate of 250 million gallons (EPA, 2010a). This raises questions over the credibility of the mandate and creates uncertainties which may discourage biofuel investments in the future.

Renewable Volume Obligation (RVO)

Under the Renewable Volume Obligation (RVO), each gallon of transportation fuel that meets the required ratio of biofuels is issued a unique Renewable Identification Number (RIN), and at the end of the year, companies must prove that they have enough RINs to satisfy RVO. RINs, however, afford some degree of flexibility in terms of their lifespan and transferability. A RIN can be used to meet either the current year’s or the following year’s RVO. Furthermore, a market exists for transferring RINs from companies that have met the standard to companies that have not. The flexibility in administering the RINs enhances the probability of fulfilling the renewable fuel standards.

ADMINISTRATIVE AND POLITICAL VIABILITY

The administrative and political viability of US biofuel policy is a function not only of the attributes of the policy instruments used but also of existing institutional and societal norms and practices. The viability of biofuel policy depends on the efficiency of regulations in achieving the stated policy goals, the ease with which it can be amended or reversed (flexibility), and the magnitude and distribution of costs and benefits.

In general, best practice regulations rely on market-based instruments (MBIs) as far as possible. Thus, for efficiently reducing GHG emissions, first best policy instruments include a carbon tax or a system of trading emission certifications. But this is not politically viable in many economies. Similarly, nationwide carbon caps or taxes, though proposed in some legislative initiatives at the Senate and the House, have not been implemented in the US, in part due to powerful opposition by a range of powerful constituencies.[148]

(iv) Transparency

The overall impression that a researcher gets when searching for information on US regulatory policy with regard to stakeholder inclusion or the open government approach encouraged by the best practice guides is that there are well-developed mechanisms to reflect stakeholder views. For instance, with regard to the RFS and all relating acts, information was made available to the public access and the dissemination and regular updating was carried out by the administering agency, in this case, the Environment Protection Agency (EPA). According to Section 202 of the EISAct of 2007, the EPA is appointed as the regulatory authority responsible for promulgating the use of renewable fuels and administering the progress.

Similarly, in the case of biofuels tax incentives, data is made available and transparent to the general public. Information on a specific tax incentive and the applicable rates are accessible through the Internal Revenue Service (IRS) website. Producers who wish to apply for any respective incentive can find all the requirements and forms with ease. Beside the IRS, updates on incentives are well published under other support programs and well-studied by scholars. Examples include the Federal Legislation for Biomass by the US Department of Energy and the Energy Efficiency & Renewable Energy Program.[149]

It must however be recognized that government revenue and expenditure decisions are made in political markets, and the role of political forces in the design of government revenue structure and expenditure allocation should be considered when analyzing issues of regulatory transparency. In the biofuels industry, given the nature of the farm lobby, such an analysis is particularly pertinent. For instance, in studying the link between agriculture and climate-change mitigation, Hornstein (2010)

[148] One study, for instance, found that consumption mandates such as the RFS are 2.5 to 4 times as expensive as cap and trade system, yet such mandates persist despite their evident inefficiency (Holland et al., 2011). Under a cap and trade system, average abatement costs are estimated to be US$ 20/ton CO_2e while consumption mandates such as the RFS cost some US$ 50-80/ton CO_2e. Yet, the political economy of public regulations supports the persistence of inferior policies such as the Renewable Fuel Standard. The skewed distribution of gains and losses, where many states or counties incur small net losses but a few states or counties enjoy large net benefits, support consumption mandates over more efficient market based instruments in the biofuels sector, even if the overall cost-benefit outcome is negative. The Holland et al study supports the private interest theory of regulation, where well organized groups capture rents at the expense of more dispersed groups (see for instance Stigler, 1971).

[149] Available at http://www1.eere.energy.gov/biomass/federal_biomass.html

notes the influence of the farm lobby in the policy formulation process. Skidmore et al (2011) examine the factors that determine the adoption of economic development incentives in the ethanol industry in the US at the local level from 1984–2007. They found that the institution of subsidies/tax credits for ethanol was especially influenced by political considerations.

(v) Alignment

The main US agencies that are involved in the promulgation and implementation of biofuels policy include:

- United States Department of Agriculture (USDA)
- Department of Energy (DOE)
- Environmental Protection Agency (EPA)
- Internal Revenue Service (IRS)
- Department of Transportation (DOT)
- US Customs and Border Protection (CBP).

In general, each agency implements the policy requirements related to it, but there are some significant overlaps in terms of the mechanisms employed. For example, the IRS accommodates tax law changes, the EPA handles mandates through regulations and standards, and CBP enforces tariffs and trade restrictions. When it comes to subsidies, however, the DOE, USDA, DOT, and EPA all play various roles.

The main activities of the DOE have been focused around the theme of research, development, and demonstration. As such they invest in research at federal laboratories and provide grants and loan guarantees for external research and technology demonstrations at companies and universities. The USDA, naturally, has been more focused on agricultural developments, such as the administration of loan guarantees, capital reimbursements, and grants that go to participants in the agricultural sector, both large companies and small farms. Likewise, the EPA also administers specialized funding programs related to air quality, while the DOT focuses on fuel economy standards such as Corporate Average Fuel Economy and other highway initiatives.

With regard to the Renewable Fuel Standard in particular, several regulatory bodies provide inputs into determining the annual level of requirements as well as conducting assessment on the potential environmental and economic impacts of these requirements. The EPA sets the production mandate every year based on the Energy Information Administration’s market analysis and projections. In case which the mandated level is not likely to be met, the EPA, in consultation with the US Department of Agriculture will determine the reduction level.

However, several government programs have been created to support virtually every stage of production and consumption relating to ethanol and biodiesel, from growing the crops that are used for feedstock to the vehicles that consume the biofuels. In many locations, producers have been able to tap into multiple sources of subsidies. Overlapping programs may also carry a high cost for little benefit in terms of energy infrastructure. At the federal level, production is subsidized even though consumption of it is mandated through the RFS. Also, the maintenance of a high tariff on imported ethanol is at odds with the goal of encouraging the substitution of gasoline by ethanol. Coordination failures and far from optimal policy coherence seem to be apparent in some aspects of US biofuels policy.

3.1.2 Conventional Biofuels in Indonesia

Key Findings

- Indonesia first introduced national biofuel policies in 2006 to help protect against falling oil production and rising oil prices.
- To support the biofuels industry, the Indonesian Government has introduced biofuel targets together with subsidies and fiscal incentives.
- Policy support for biofuels has helped bolster its production; however, it appears the Indonesian government's biofuels production targets have not been met. Biofuels remain an expensive alternative to petroleum fuels and the subsidies extended to the industry will add to Indonesia's existing fuel subsidy burden.

Costs, benefits and promotion

- Despite the purported energy security benefits of biofuels in the context of rising oil prices, biofuels remain more expensive than petroleum fuels.
- Biofuel subsidies will add to Indonesia's existing fuel subsidy burden and may not be the most efficient means of achieving social objectives such as helping the poor.
- While biofuels can contribute to greenhouse gas mitigation, they have the potential to cause environmental damage such as deforestation and agricultural pollution. This risk increases if policies to protect the environment are weakly enforced or not enforced at all.

Scientific integrity

- The potential for environmental damage from biofuels does not appear to have been adequately taken into account when biofuel policies were introduced, but recent policy initiatives have sought to make palm oil production sustainable and imposed a moratorium on the clearing of forest areas.

Flexibility

- The target-based approach is not flexible enough to respond automatically to changing circumstances. Initial biofuel targets have not changed substantially.

Transparency

- Indonesia has made progress in promoting transparency in the development of regulations but further efforts are recommended to involve stakeholders and to quantify the true cost of support for the biofuel industry.

Alignment

- More effort is needed as Indonesia does not have adequate structures in place to coordinate policy development among central government agencies and local governments. Indonesia should introduce a coordination mechanism to facilitate policy coherence across central government agencies.

A. Size and Significance

The Indonesian Government began supporting the development of a national biofuel industry in 2006. The main driver for the new policy was a reduction in oil production.[150] A rise in the price of oil put pressure on subsidized fuel prices and caused the government to almost double the price of transport fuel and triple the price of kerosene in 2005 (GSI, 2008). This caused a rethink of Indonesia's broader energy strategy.

In January 2006, the Indonesian Government introduced the National Energy Policy which required the Ministry for Energy and Mineral Resources (MEMR) to develop a National Energy Management Blueprint for the development and exploitation of priority energy sources. This included biofuels which were targeted to make up more than 5% of national energy consumption by 2020. The blueprint provided that Indonesia would develop a biodiesel production capacity of 1.16 billion litres in 2010 and 4.16 billion litres in 2025 (Caroko et al., 2011).

B. Policy Formulation

(i) History and Background

The first step to achieving Indonesia's biofuel targets was to legalize the use of up to 10% bioethanol in petrol and 10% biodiesel in diesel. The Indonesian Government then instructed the State Owned Oil Company, Pertamina, to start selling a 5% blend of biofuel and petroleum products. In July 2006, the Indonesian Government developed the Losari Concept (named after the town in which it was conceived) to support the development of Indonesia's nascent biofuel industry. The plan committed to meet 10% of Indonesia's transport fuel needs from biofuels by 2010 (USDA, 2010). At this time many agricultural commodity prices were relatively low and energy prices relatively high which made biofuels an attractive proposition (GSI, 2008). As a result it was believed that achievement of the Losari targets would help create 3.6 million jobs, reduce the poverty rate by 16% and lower fuel imports by US$5billion (the Indonesian Government also suggested it would reduce fossil fuel subsidies) (GSI, 2008).

To help coordinate Indonesia's approach to biofuel development, the Indonesian Government established a National Team for Biofuel Development (Timnas BBN) in July 2006. Timnas BBN included representatives from government, institutions, corporations and individuals with an interest in biofuels. Timnas BBN developed a roadmap for biofuel development and proposed fiscal and non-fiscal incentives, the creation of special biofuel zones and an increase in the number of energy self-sufficient villages in Indonesia using biofuels (Caroko et al., 2011).

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[150] Indonesia became a net importer of oil in late 2004 (PWC, 2011a)

At the beginning of 2007, the Indonesian Government co-hosted the Joint Initiative for Biofuel Development with industry partners. At this event, 67 contracts for industry development were signed with an estimated value of US$ 12.4 billion. The Indonesian Government also announced another US$ 2.4 billion in interest rates subsidies for the industry to be provided through national banks (USDA, 2007).

However, much of the potential promise of the new announcements was not realized, largely due to a fall in the price of fossil fuels and a rise in the price of Crude Palm Oil (CPO) which made biofuels financially less attractive. This led to a reduction in output or temporary closure of 17 biodiesel companies in late 2007, and a fall in production of 60% in 2008 (Caroko et al 2011). To help reverse the industry decline, the Indonesian Government introduced new biofuel targets in 2008 which legislated the minimum targets for the use of biofuels in the transportation, industry and power sectors out to 2025. The regulation also provided that licensed biofuel entities contributing to the targets may be eligible for fiscal and non-fiscal incentives.

In 2011, the production of biodiesel was expected to reach up to 650 million liters and up to 700 million liters in 2012 (USDA, 2011). Pertamina and PLN had also agreed with state-owned plantation companies to construct three biodiesel power plants with operation to begin in 2012 (USDA, 2011). However, the utilization of Indonesia biodiesel capacity remained low (at 17% in 2011 (USDA, 2011)) and Indonesia’s fuel based bioethanol production had stopped due to a pricing dispute between Pertamina and producers (USDA, 2010).

(ii) Policy Description

MANDATES

Biofuels targets

The Indonesian Government has introduced a number of biofuel targets including the Biofuel blueprint prepared to support the National Energy Policy, the development plans prepared by Timnas BBN and the Losari concept. In 2008, the Indonesian Government introduced mandatory five yearly biofuel targets out to 2025 through MEMR Regulation 32/2008. The targets applied to the household, transport, industrial and power generation sectors (see Table 3.1.2).

Table 3.1.2 ***Indonesian biofuel targets (minimum percentage of biofuel required in fuel)***

	2010	2015	2020	2025
Biodiesel				
Subsidised transport fuel	2.5	5	10	20
Non-subsidised transport fuel	3	7	10	20
Commercial and industry	5	10	15	20
Power plants	1	10	15	20
Bioethanol				
Subsidised transport fuel	3	5	10	15
Non-subsidised transport fuel	7	10	12	15
Commercial and industry	7	10	12	15

Source: USDA, 2009

Environmental regulations

The Indonesian Government has made provisions for the protection of the environment from biofuel development, including the need for an environmental impact assessment or AMDAL as described in Ministry of Environment Regulation 8/2006 (Spitz and Husin, 2009); MEMR Regulation 32/2008 that requires biofuel producers to ensure feedstock sustainability and prove no harm to the environment by way of environmental impact analyses (Kuen and Chalmers, 2010); the 2011 Ministry of Agriculture Indonesian Sustainable Palm Oil standard (Caroko et al., 2011); and the Presidential Decree (10/2011) imposing a two year moratorium on the conversion of forest and development on peat land.

FISCAL INCENTIVES

Subsidies

The Indonesian Government provides the biofuel industry with significant subsidies, including:

- *Fuel subsidies*

  The Indonesian Government provided a biofuel subsidy of IDR 1000 per liter[151] beginning in 2010 in addition to existing petroleum fuel subsidies. This was increased to IDR 2,500 to 3,000 per liter[152] for biodiesel and IDR 3,000 to 3,500 per liter[153] for bioethanol in 2012 (USDA, 2011).

- *Interest rate subsidies*

  In 2006, the Indonesian Government introduced an interest rate subsidy for a period of five years to support plantation development and revitalization, including for biofuel crops (GSI, 2008).

- *Fertilizer subsidies*

  The Indonesian Government provides fertilizer subsidies to the agricultural sector (which reached IDR 15 trillion[154] in 2008 (Osori et al., 2011)). This is important because the cost of fertilizer is a key variable in ensuring the economic viability of biofuel feedstock (Winrock International, 2009).

Other fiscal incentives

The biofuel industry is eligible for a range of fiscal incentives including a reduction in stamp duty, relief from import duties, an investment tax allowance, accelerated depreciation, a loss carry forward facility, a reduced tax on dividends, and an exemption from value added tax for some strategic goods.

[151] This is approximately 11 US cents per liter (assuming that 1 USD = 9000 Indonesian rupiah).
[152] This is approximately 27 to 33 US cents per liter.
[153] This is approximately 33 to 38 US cents per liter
[154] This is approximately 1.7 billion USD.

C. Regulatory Review

ECONOMIC EFFICIENCY AND EFFECTIVENESS

(i) Costs, Benefits and Promotion

Indonesia initially introduced biofuel policies to improve energy security (including affordability) in the face of falling oil production and rising oil prices. It was expected that biofuels could also provide a range of other benefits. Purported benefits included the exploitation of large areas of land that were categorized as forests but considered degraded beyond repair; the promotion of jobs in regional areas, including in Indonesia's crude palm oil sector (which is now the world's largest); the exploitation of land that was not suitable for food crops; and the mitigation of greenhouse gas emissions.

The purported benefits notwithstanding, biofuels are expensive relative to petroleum fuels, which makes them unattractive to Indonesia's largest distributor of petroleum fuels, the state-owned oil company Pertamina. This is because the price at which Pertamina is allowed to sell most of its fuel is regulated by the government at below cost, with the difference made up through government subsidy. Until 2010 no additional subsidy was provided to Pertamina to cover the extra cost of biofuels. This led to large losses for Pertamina (for example it lost US$ 70 million in 2008 (Caroko et al., 2011)). Consequently, Pertamina reduced the supply of biofuels. The state-owned electricity company, PLN, which sells subsidized electricity, has also elected not to use biodiesel for electricity production because it received no additional compensation from the Indonesian Government (USDA, 2008). The biofuel industry has also been costly for private investors, as it is estimated they lost around US$ 2 billion between January and May 2009 (USDA, 2009).

The Indonesian Government's decision (Presidential Regulation 45/2009) to allow the Ministry for Energy and Mineral Resources (MEMR) to determine the price of petroleum and biofuels has also limited the attractiveness of biofuel production for private firms. The price offered by Pertamina for bioethanol is based on a monthly average price of fuel ethanol in Thailand (USDA, 2011). At this price producers prefer to leave production facilities idle or produce industrial ethanol rather than sell fuel ethanol to Pertamina at uneconomical prices (USDA, 2011). A similar issue also faces suppliers of crude palm oil who may be discouraged from selling to the biofuel industry because they can find higher prices for their product in other markets (e.g. for use in cooking).

To address this issue, the Indonesian Government has introduced regulated biofuel targets and provided interest rate subsidies and other fiscal incentives such as a reduction in stamp duty (the biofuel industry is also eligible for fertiliser subsidies) to help achieve those targets. In 2010, the Indonesian Government approved an additional subsidy of IDR 1000 per liter[155] of biofuel sold by Pertamina, to be raised to between IDR 2,500 and IDR 3,500 per liter[156] in 2012. The Indonesian Government is also reported to be considering increasing the price offered to biofuel producers and providing additional incentives for biofuel feedstock suppliers (USDA, 2011). Essentially, the approach has been to provide subsidies to biofuels on top of existing fuel subsidies to improve the uptake of a fuel that is economically unviable for the biofuels producers.

[155] This is approximately 11 US cents per liter (assuming that 1 USD = 9000 Indonesian rupiah).
[156] This is approximately 27 to 39 US cents per liter.

Indonesia's biofuel policies have helped increase the production of biodiesel from 24 million liters from two refineries in 2006 to 650 million liters from 22 refineries in 2011. However, it appears the government's Losari target of meeting 10% of transport fuel needs from biofuels by 2010 (3% from biodiesel and 7% from bioethanol) has not been met. For instance, according to the Directorate of Bioenergy, while the 2010 target for utilization of biodiesel was 1.076 million kilolitres (KL), the actual amount utilized was 0.223 million KL or only 21% of the target. The low price of bioethanol constrained its supply to the extent that 0% of Indonesia's transport fuel needs were met from bioethanol in 2010 (Directorate General of New Renewable Energy and Energy Conservation, 2011).

The promotion of the biofuels industry via subsidies has entailed substantial costs. To help achieve the benefits outlined above, the Indonesian Government allocated US$ 1.6 billion to the biofuel industry between 2006 and 2008. But because the government did not enforce its targets actual spending was estimated to have been US$ 197 million which included training, research and development, Pertamina's losses, and interest rate subsidies (Caroko et al., 2011).[157] These costs are likely to have significantly increased with the introduction of a specific biofuel subsidy in 2010 and will increase even further in 2012 as the subsidy is more than doubled.

Furthermore, biofuel policies have been connected with environmental damage. For example, they may provide an incentive for an expansion of the plantation estate to produce biofuel feedstock. If this expansion occurs on previously forested land or land that contained native vegetation then the production of biofuels is likely to be a net contributor to greenhouse gas emissions (GSI, 2008) and may cause other environmental damage e.g. habitat destruction. Biofuel policies could also contribute to increased agricultural pollution (e.g. from fertiliser and pesticides). They may also contribute to a rise in food prices and thus undermine the purchasing power of the poor.

Further investigation of the unintended consequences of biofuel development including broader environmental and social impacts should be considered. A key issue in this regard is enforcement. Indonesia has already taken steps to address the potential negative impacts of the biofuel industry on the environment, through initiatives such as the AMDAL[158] and the forthcoming roll out of the Indonesian Palm Oil Standard. But there is a suggestion that enforcement is limited (Winrock International, 2009) and many plantation companies tend to neglect what they have promised in their environmental and monitoring plans (Caroko et al., 2011).

A conclusion on the benefits and costs of Indonesia's biofuel subsidies is difficult to reach due to the paucity of data, and because the industry is still relatively small[159]. Many of the benefits and costs are likely to be driven by other factors such as the market price for food grade Crude Palm Oil (CPO) and the market price for timber. However, some general observations can be made.

[157] It is estimated that if the Indonesian Government had enforced its biofuel targets the actual cost to tax payers would have been double the total allocated (GSI, 2008).

[158] AMDAL refers to the provisions made by the Indonesia government for the protection of the environment from biofuel development, including the need for an environmental impact assessment.

[159] It is estimated the only 6% of Crude Palm Oil (CPO) produced in Indonesia is used to produce biofuels (Caroko et al., 2011).

- Biofuels remain more expensive than petroleum fuels and have therefore not helped reduce the cost of meeting the nation's energy needs.

- Biofuel subsidies will add to Indonesia's existing fuel subsidy burden (which was forecast to reach IDR 129.7 trillion[160] in 2011 (Jakarta Post, 2011) which the Indonesian Government has pledged to phase out over the medium term.[161]

- Biofuels have the potential to cause environmental damage, particularly if biofuel targets are met by using extensive forested land or land with native vegetation.

- The contribution of the biofuel industry to social objectives is difficult to determine due to the influence of broader agricultural market and government policies. However, there is evidence that subsidies will not be the most efficient means of helping the poor. For example, the Indonesian Coordinating Ministry of Economic Affairs advised in May 2008 that the wealthiest 40% of families receive 70% of [broader] fuel subsidies while the bottom 40% benefit from only 15% (Mourougane, 2010).[162] There is also some suggestion that the palm oil boom may have benefited large corporations at the expense of Indonesia's poor (GSI, 2008). In addition, increased food prices resulting from biofuel policies have a regressive impact with the poorer households affected the most.

One rationale offered by Indonesia for supporting a mature technology such as biofuels is that it will help internalize the public benefits of production (e.g. greenhouse gas emission reductions). However, in the case of achieving rural development benefits the observations above suggest that the subsidy is poorly targeted. The funds earmarked for biofuel subsidies may have more of an impact if allocated to Indonesia's rural poor through direct transfer mechanisms. Indonesia has a long history with such payments (Mourougane, 2010) but care would need to be taken to ensure it is well targeted. Alternatively the funds could be used to support public services in rural areas.

The least cost approach to achieving Indonesia's objectives of energy security would be through a broad market based mechanism (such as a tax on greenhouse gas emissions) to ensure that biofuels contribute to the social objective by offering a least cost solution. This approach would help promote additional development of the biofuel industry up to the point where the social benefits of doing so justify the costs rather than according to a bureaucratically determined and potentially very costly biofuel target.

(ii) Scientific Integrity

Indonesian biofuel policies were originally introduced to help reduce Indonesia's dependence on imported fossil fuels and improve fuel security. The production of biofuels has been criticized because feedstock plantations may be established on previously forested land or native grass land, thus contributing to deforestation, habitat destruction and greenhouse gas emissions. They could also

[160] This is approximately 14 billion USD (assuming that 1 USD = 9000 Indonesian Rupiah).
[161] G20 Leaders Statement at Pittsburgh Summit: Acting on Our Global Energy and Climate Change Challenges
[162] A similar finding is reported for fertiliser subsidies by Osori et al (2011) who report that public spending to subsidise urea [a fertiliser] is regressive and a large share of the benefits is captured by the larger farmers.

contribute to increased agricultural pollution (e.g. from fertilizers and pesticides). These issues do not appear to have been considered at the time that biofuel policies were introduced.

However, in 2011 the Indonesian Government introduced the Indonesian Sustainable Palm Oil Standard which is designed to make palm oil production sustainable in compliance with Indonesian laws and regulations (Caroko et al., 2011). The Indonesian Government also agreed to a two year moratorium on the issue of licenses for the clearing of forest and development on peat lands except in certain priority areas such as the sugar cane sector.

(iii) Flexibility

Indonesia has adopted a legislated target based approach to the development of its biofuel industry supported more recently by subsidies for transport fuels. A target based approach may be useful for directing attention toward a government priority. It could also reduce industry risks and encourage additional industry investment. However, Indonesia has previously not met targets so they may not encourage additional industry investment.

A target based approach is also not flexible enough to automatically respond to changing market conditions. For example, the target will not respond to changes in the cost of alternative fuels or biofuel feedstock. The lack of in-built flexibility means that if the price of biofuels rises, Indonesia could choose not to meet the targets (as it has done in the past) or end up spending a lot more money than originally anticipated. Nor has the Indonesian government significantly modified its biofuel targets in response to changing economic circumstances. After the target of meeting 10% of transport fuel needs from biofuels by 2010 was set in 2006, falling fossil fuel prices and a rise in the price of Crude Palm Oil (CPO) made biofuels an economically less attractive proposition. However, the new biofuel targets set by Indonesia in 2008 continued to require 10% of transport fuel needs to be met from biofuels by 2010 (with 3% from biodiesel and 7% from bioethanol).[163]

ADMINISTRATIVE AND POLITICAL VIABILITY

(iv) Transparency

Indonesia has established a formal law/regulation making framework through the National Legislation Program (Prolegnas).[164] Stakeholders are required to play an active role in this process. For example, relevant stakeholders such as political and civil society groups, academics, experts and practitioners are invited to help prepare the text to support draft laws and regulations. Public comment is then sought on the draft proposal.

Otsuka et al. (2011) notes that the government has introduced more institutionalized public consultation processes for new policies and strengthened appeal processes, yet many business associations do not have the capacity to effectively critique/discuss government proposals which may limit their influence over government policy (OECD, 2010b).

[163] Refer to Table 3.1.2

[164] The description of the steps involved in policy development is based on (OECD, 2010b)

Evidence on transparency in the development of biofuel policies appears limited. However, there is some suggestion that government performance could be improved. For example, it has been reported that the Timnas BBN blueprint for biofuel development was produced by a few scientists at the Agency for the Assessment and Application of Technology (BPPT) with stakeholder input only sought on the final draft (Caroko et al., 2011). GSI (2008) also reports that the Indonesian Government could be more transparent in the information on biofuel subsidies that it provides to the public.

(v) Alignment

The alignment of policies in Indonesia has been a challenge. One reasons for this is that Indonesia 'does not have a systematic mechanism to develop, monitor and evaluate laws/regulations or a centralized regulatory oversight body with 'whole of government' responsibility for regulatory policy' (OECD, 2010b).

Another reason is that since the fall of Suharto in 1998 Indonesia has pursued a program of decentralization which has led to the sharing of powers between the central and more than 500 local governments (The Asia Foundation, 2010). This approach has provided greater autonomy to the regions but has led to some confusion about the division of responsibility between the levels of government and resulted in the responsibility for some policies resting with local government that did not always have the capacity to establish a regulatory environment conducive to business (OECD, 2010a).

The systems in place to promote alignment of policies in Indonesia are inadequate to coordinate policy among many central government agencies (Winrock International (2009) estimates that 13 were involved in the development of biofuel policy) and potentially hundreds of local governments. At a broad level this has contributed to the development of a large number of laws and regulations which are often overlapping, inconsistent or conflicting. It has also been a problem for the biofuel industry, for example, it has:

- Led to overlap in the national biofuel research agenda (Winrock International, 2009).
- Contributed to the development of overlapping and inconsistent policies. For example, Indonesia wishes to achieve self-sufficiency in edible sugar production but is simultaneously promoting the use of sugar cane for use as a biofuel feedstock (Winrock International, 2009).
- Led to the development of targets that are not supported by broader regulations. For example, there appears to be no link between the oil plantation area that is granted for development and government biofuel targets (Caroko et al., 2011).
- Promoted the objectives of one central government agency over another. For example, the Indonesian Government has agreed to increase the subsidy provided to Pertamina for the biofuel petroleum blends but also wishes to reduce the fuel subsidy paid by the Ministry of Finance (MOF).

To help address this problem the Indonesian Government has cancelled many local regulations that conflict with higher level laws/policies (Otsuka et al., 2011). Some central government agencies have also taken steps to review regulatory policies; and in the 2010 – 2014 Medium Term Development Plan, the

Indonesian Government committed to review and simplify laws and regulations between the central and local governments. This review will be undertaken by the OECD and the National Task Force for Regulatory Reform Review (Indonesian Minister of Finance, 2011). The Task Force will be housed in the MOF and will include several other government agencies and institutions.

3.1.3 Concluding Remarks

The US has had a longer history of policy support for the biofuels industry than Indonesia. The US policy support has come in the form of mandates, tax incentives, import tariff, and loans and grants whereas Indonesia has employed biofuel targets and subsidies to achieve its policy objectives. The economies articulate similar drivers for their support for the biofuels industry, namely improving energy security, achieving environmental objectives and providing income to farmers.

However, the US experience has shown that trying to meet these objectives can be costly. The program to support the US biofuels industry began in the 1970s; however, to date biofuels remain an expensive alternative to conventional fossil fuels.[165] Furthermore, the fiscal burden of subsidies for the industry has been growing rapidly in the past few years. Even where the environment is concerned, biofuels are a costly CO_2 abatement option for the US. Indonesian policymakers ought to take heed of the intertemporal opportunity costs of supporting an industry that is not commercially viable in the US despite the support given for three decades.

For Indonesia, land use change on account of biofuels production is a serious issue that militates against the environmental benefits of biofuels. Indonesia needs to institute a formal mechanism whereby policy decision making is based in cost-benefit analysis. This would allow Indonesia to side step potentially costly energy policy decisions such as those that have been made in the US biofuels context. Cost benefit analysis also serves to reduce the probability of pressure from powerful interest groups in guiding policy making as this raises transparency. That being said, in the US context, cost-benefit analysis has not been able to reduce the influence of the powerful farm lobby.

The US renewable fuels standards are not very flexible as they are updated on a yearly basis. However, Indonesia's target-based approach provides even lower flexibility. Indonesia should reconsider its biofuel subsidy arrangements. The value of the subsidy (if any) should be set to reflect the social value of the biofuel industry (e.g. in terms of energy security or emission reduction benefits) rather than achieve bureaucratically determined biofuel targets. Indonesia should ensure that policies to address the potential negative consequences of biofuel policies, for example, on the environment are adequately enforced. Finally, both the US and Indonesia need to consider increasing the coherence and alignment of policies at the federal and local levels. The overlapping jurisdictions of several authorities raise the cost of regulations.

The analysis of US regulatory practices for the biofuels sector leads to the conclusion that the support that the biofuels sector has received appears to be unsustainable and disproportionate to the realized benefits, such as improved energy security and CO_2 emissions reductions. Indonesia's policy support for biofuels has helped bolster its production; however, it appears the Indonesian government's biofuels production targets have not been met. Biofuels remain an expensive alternative to petroleum fuels and the subsidies extended to the industry will add to Indonesia's existing fuel subsidy burden.

In conclusion, the evidence suggests that policy support extended to the biofuels industry in both economies needs careful reexamination. There is a significant mismatch in the perceived and realized

[165] Brazil is often considered a success story when it comes to biofuels policy. Whilst some experts consider Brazil's biofuels industry to be a model for other economies, others have argued that ethanol production in Brazil is a unique situation and it is not replicable in other economies, particularly the US. See Sperling and Gordan (2009) pp. 95–96.

benefits from biofuels be they expected improvements in energy security, CO_2 emissions reductions, or augmentation of farm incomes.

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