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Biofuel Policies: Robbing Peter to Pay Paul

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Policies aimed at reducing carbon emissions from transportation have hit major obstacles in the past few years. In effect, these policies take money from petroleum producers and give it to renewable fuel producers, creating heated political and legal battles but little effect on consumers.

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2015 was the warmest year recorded on earth since at least 1880. Last year, the same statement was true about 2014. The four warmest recorded years since 1880 have occurred since 2010. Alarmed by the scientific consensus that fossil fuels are the main cause of this warming, many governments have enacted policies to promote alternative fuels and penalize fossil fuels.

California drivers are affected by three such policies, one federal and two implemented by the state government. The Federal government requires a certain quantity of biofuels to be used in the country (the Renewable Fuel Standard, or RFS). The California state government requires firms to purchase a certain number of credits for each gallon of fossil fuel they sell (the cap-and-trade program, or CAT). The state also requires firms to achieve prescribed carbon-intensity levels in the fuel delivered to consumers (the Low-Carbon Fuel Standard, or LCFS).

How Do the CAT Program, RFS, and LCFS Work?

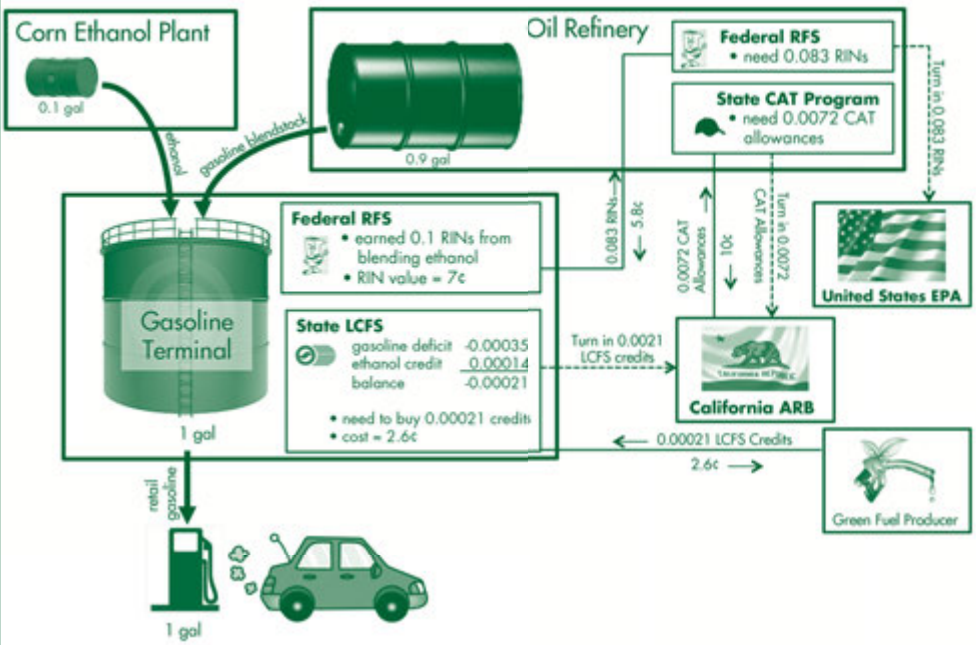
Figure 1 illustrates how the three policies affect a typical gallon of California gasoline. Essentially every gallon of gasoline in the United States is made up of 90% petroleum and 10% ethanol, which is a biofuel made almost exclusively from corn. Gasoline blendstock is produced at an oil refinery, and ethanol is produced at an ethanol plant. These products travel by pipeline, train, or truck to a gasoline terminal in a city near where the fuel will be consumed. The fuel is blended at the terminal and delivered by truck to a gas station.

The CAT program requires that polluting firms, such as electricity generators and producers of gasoline and diesel, purchase emissions allowances. To sell the 0.9 gallons of gasoline blendstock to the terminal, the oil refiner, is required to turn in 0.0072 CAT allowances to the state. The refiner can purchase these allowances from the state at one of the quarterly auctions (as shown in Figure 1), or from another firm that has allowances it doesn't need. Ethanol and other biofuels are exempt from the CAT program.

Since the beginning of 2015, the price of CAT allowances has averaged the equivalent of 10¢ per gallon of gasoline. This charge likely gets passed along to consumers, which creates an incentive to use less gasoline.

Rather than only penalizing fossil fuels, as in the CAT program, the RFS and LCFS aim to promote alternative fuels. Under the RFS, the oil refiner also has to turn in a certain quantity of RFS credits, known as RINs, per gallon of gasoline and diesel it produces. In 2016, it would require 0.083 RINs for the gasoline that goes into our consumer gallon. RINs are created by blending biofuel with petroleum fuel. The gasoline terminal in the figure creates 0.1 of a RIN by blending 0.1gal of ethanol into gasoline. So, the refiner can buy the required RINs from the gasoline terminal. This leaves the terminal with 0.017

Figure 1. The Making of a Typical Gallon of California Gasoline



Notes: Calculations are based on RIN price of 70¢/gal, LCFS credit price of $125/MT, and CAT credit prices of $14/MT. The corn-ethanol CI is 78.83g/MJ, the gasoline blendstock CI is 99.78, and the CI target is 96.5g/MJ. The energy density of gasolineblendstock is 119.53MJ/gal and the energy density of corn ethanol is 81.51 MJ/gal.

surplus RINs, which it could sell to another regulated party. For example, a refiner may want to purchase RINs to cover it for the diesel it produces.

The price of RINs is determined by the extra cost of using biofuel in place of petroleum. The terminal in Figure 1 will use the 7¢ earned from selling RINs to help pay for ethanol (if ethanol is priced higher than gasoline blendstock) or to pay distribution costs (if blended fuel is more costly to deliver to consumers than pure gasoline). Any remaining cost increases will be passed along to consumers, but this amount is likely to be small. The RFS essentially taxes the oil refinery to subsidize biofuel; it transfers money between fuel producers rather than only taxing petroleum. For this reason, the RFS has little effect on gasoline prices, even if RIN prices are high.

The LCFS requires the average gallon of fuel to hit a carbon-intensity (CI) target. It assigns a CI score to each potential fuel based on its estimated emissions. These scores can be used to compute the CI of each gallon of fuel. The CI is a measure of how dirty the fuel is.

The gasoline terminal is the regulated party in the LCFS. In 2016, it has to deliver gasoline with a CI of 96.5 grams of CO_2 per megajoule. The gasoline blendstock exceeds this target. The corn ethanol in this example is below the target, which helps bring down the CI of the blended fuel, but it still doesn't reach the target. There is a deficit of 1.2 in the CI, which translates into 0.00021 LCFS credits. The terminal must buy these credits from an entity that has excess credits, such as another terminal with a cleaner fuel mix or a biogas producer. The terminal would pass the cost of these credits on to consumers. Alternately, the terminal could purchase ethanol with a lower CI, such as corn ethanol from a cleaner plant or ethanol made in Brazil from sugar cane.

The existence of the CAT program potentially curtails the role of the LCFS in reducing carbon emissions from California. The idea behind the CAT program is to set total allowable emissions and let the market determine where those emissions occur. By enacting the LCFS, the state mandates how much of those emissions occur in transportation rather than other sectors such as electricity production, thereby undermining the flexibility of the CAT program. At present, however, there is a surplus of CAT allowances. This means that the CAT program is not actually constraining emissions, which leaves the possibility that the state has lower emissions with the LCFS than without.

Credit prices under the RFS and LCFS have both spiked to eye-popping levels in recent months. The high prices of RFS and LCFS credits arise because it is costly to meet the standard, either because of a lack of fueling infrastructure for renewable fuels or because of the high cost of raw materials. Because these policies effectively take money from petroleum producers and give it to renewable fuel producers, these credit price increases are mostly invisible to consumers. However, the high costs lead firms to mount political and legal challenges.

Technical, Political, and Legal Challenges to the RFS

Until recently, the fuel industry was able meet the RFS mandate without too much difficulty. However, the mandate now requires more biofuel than the fuel industry can easily absorb.

The RFS has hit two barriers. The first, known as the blend wall, is that regular gasoline can contain up to 10% ethanol without affecting engines or fueling infrastructure. The RFS now requires more biofuel than 10% of regular gasoline.

Breaching the blend wall will entail either expanded consumption of biodiesel, which does not face any relevant blend restrictions, or increasing sales of a high-ethanol blend of gasoline known as E85, which contains up to 85% ethanol and can be used in flex-fuel cars. Although about 6% of registered

vehicles in the U.S. have flex-fuel capability, very few gas stations sell E85.

The second barrier is that production of second-generation cellulosic biofuel continues to be close to zero. Cellulosic biofuel is made from the non-food portion of plants and generates much lower greenhouse gas emissions than first-generation biofuels such as corn made from ethanol. The RFS requires large and increasing amounts of cellulosic biofuel to enter the fuel supply.

The EPA, which enforces the RFS, has the authority to set the required biofuel volumes below the mandate if there is insufficient supply. It has used this authority to deal with both barriers. This has been without controversy for the lack of cellulosic production, but has met with stiff opposition when used to deal with the blend wall.

In November 2013, the EPA announced that it intended to waive the above-blend-wall quantities of the ethanol mandate for 2014. This announcement caused a strong reaction from the biofuel industry, and the associated political opposition prevented the EPA from finalizing the required biofuel volumes in a timely fashion. This left the industry in limbo, not knowing how much biofuel it should be using.

In May 2015, the EPA finally proposed a new set of rules, this time for the amount of biofuel to be used in 2014, 2015, and 2016. Because 2014 was history by this time, it set 2014 volumes at actual 2014 production. The proposed volumes for 2015 and 2016 were lower than expected and so would be less costly for the industry to meet. Accordingly, the price of RINs dropped from $0.80 to $0.40. The EPA took feedback on the proposed rule and in November 2015 it announced the final rule. It increased volumes over the proposed rule, which caused an immediate jump in RIN prices to $0.70.

The RFS statute specifies that 22.25bgal (billion gallons) of biofuel be used in 2016, of which no more than 15bgal can be corn ethanol. The blend wall was projected at 13.8bgal in 2016, but is likely to be slightly higher as low gas prices cause people to drive more.

The EPA set the final rule at 18.11bgal of biofuel, of which no more than 14.5bgal can be corn ethanol. The gap between the rule and the blend wall is most likely to be met by increased biodiesel use, but the gap is large enough that some increase in E85 sales may be required. Private market investment in E85 infrastructure has been slow, but in early 2016, the USDA spent $100m to fund the installation of E85 fuel dispensers, with the goal of doubling E85 retail capacity.

The current RIN price of $0.70 means that each gallon of ethanol receives a subsidy of 70 cents and each gallon of gasoline blendstock is taxed at a rate of 6.4 cents. (The 2016 rule specifies that regulated parties turn in 0.0919 RINs for each gallon of gasoline blendstock sold.)

In 2013 when the mandate first hit the blend wall, RIN prices reached $1.40, which at current mandate levels would imply a 12.8 cent tax on gasoline blendstock. The significant political impediments faced by the EPA in setting a rule suggest that the fuel industry views this as a substantial cost. Several ethanol industry groups have petitioned a federal appeals court to hear a challenge to the 2015 final rule. These groups want the EPA to enforce the full mandate. Put another way, they would like a larger subsidy than $0.70.

Technical, Political, and Legal Challenges to the LCFS

The LCFS has faced several lawsuits. It was challenged on the grounds that imposing regulatory costs on out-of-state producers violates the Commerce Clause. The courts rejected this challenge, but in July 2013, the California Court of Appeal held that the California Air Resources Board (CARB) had committed procedural violations when it enacted the LCFS. The court froze the LCFS at 2013 levels until CARB could correct its procedural errors and re-adopt the standard.

The LCFS is highly detailed. The CI for each fuel is estimated from a computer model that accounts for numerous factors that could affect emissions, including oil extraction, oil refining, method of ethanol production, land-use change, and transportation of the fuel, in addition to the final act of burning the fuel. The computer model is transparent (an Excel spreadsheet on the CARB website allows anyone to perform these computations), but the complexity means that small changes in the formula can have large effects on compliance costs.

One particularly contentious issue has been the additional emissions that occur when new agricultural land is brought into production to produce the corn that would be made into ethanol. CARB estimated that these so-called indirect land-use change effects were large, whereas industry groups argued that they were small.

CARB re-adopted the LCFS in September 2015. In addition to correcting its procedural violations, it came up with lower indirect land-use change estimates, tweaked the computer model, and determined a new set of CI targets. Since the re-adoption, LCFS credit prices have jumped from $20 to $125 per metric ton.

Table 1 on page 4 translates the price of LCFS credits into amounts per gallon of fuel for the most commonly used fuels. These amounts vary across fuels. Fuels with a high CI have a positive value because firms must pay for above-mandate emissions from that fuel. Fuels with low CI values are subsidized under the program because they generate LCFS credits. The amount of the tax or subsidy also changes by year because the CI target changes.

The table shows that, at the current price of $125 per ton, gasoline

Table 1: Fuel Taxes Implied by LCFS (Cents per Gallon)

	Final Fuel			Blendstock				
	E10 (Corn Ethanol)	E10 (Sugar Ethanol)	B5 (Soybean Biodiesel)	Gasoline	Corn Ethanol	Sugar Ethanol	Diesel	Soybean Biodiesel
LCFS Credit Price = $125/MT								
2016	2.6	-0.9	-0.1	4.9	-18.0	-52.7	3.4	-85.0
2017	4.8	1.3	0.3	7.1	-16.5	-51.2	6.0	-82.6
2018	6.9	3.4	0.7	9.3	-15.0	-49.7	8.6	-80.2
2019	10.5	7.0	1.4	13.0	-12.5	-47.2	12.9	-76.2
2020	14.0	10.5	2.1	16.7	-10.0	-44.7	17.1	-72.1
LCFS Credit Price = $200/MT								
2016	4.2	-1.4	-0.8	7.8	-28.8	-84.4	5.5	-136.0
2017	7.6	2.0	3.3	11.4	-26.4	-82.0	9.6	-132.1
2018	11.0	5.4	7.4	14.9	-24.0	-79.6	13.7	-128.3
2019	16.7	11.2	14.2	20.8	-20.0	-75.5	20.6	-121.8
2020	22.4	16.9	21.1	26.7	-16.0	-71.5	27.4	-115.4
Carbon Intensity of Each Fuel								
CI	97.69	94.28	99.21	99.78	78.83	44.75	102.01	46.06

Notes: CI standards for gasoline are 96.50, 95.02, 93.55, 91.08, and 88.62 for 2016–2020, respectively. CI standards for diesel are 99.97, 98.44, 96.91, 94.36, and 91.81 for 2016–2020, respectively. MT = metric ton E10 is gasoline that contains 10% ethanol and B5 is diesel that contains 5% biodiesel.

blendstock is taxed 4.9¢ and corn ethanol receives a subsidy of 18¢ per gallon. (The actual ethanol subsidy can vary depending on the ethanol production process and emissions from transporting the fuel to the gasoline terminal, among other things.) As the CI target changes over time, the tax increases 16.7¢ and the subsidy drops to 10¢. These amounts translate into a 2.6¢ tax on retail gasoline in 2016, increasing to 14¢ by 2020. The LCFS credit price cannot go above $200. If it reaches this cap, the magnitudes increase proportionately.

The LCFS tax on diesel is similar to gasoline, but biodiesel receives a much larger subsidy than ethanol. It is 70–85¢, which is a similar magnitude to the subsidy implied by RIN prices in the RFS. This large subsidy means that the net effect on the price of retail diesel containing 5% biodiesel (a common blend) is small. This large subsidy also suggests that, like in the RFS, biodiesel is likely to be an important means of compliance. In fact, re-adoption of the LCFS has caused a massive increase in biodiesel use in California. The latest CARB reporting summary shows that biodiesel reached 9.2% of total diesel in the third quarter of 2015, after being around 5% for the prior two years.

Conclusion

The transportation sector burns too much fossil fuel because motorists do not pay for their effects on the environment. In particular, fossil fuels generate carbon dioxide emissions that contribute to global climate change. There are two levers policymakers can use to mitigate climate change: (i) reduce energy use, and (ii) replace fossil fuel with cleaner fuels.

The most cost effective policies use both levers. The best such policy is to tax each gallon of motor fuel in an amount equal to the marginal emissions damages from using it. This tax raises the cost to consumers, causing them to use less and it makes alternative fuels more competitive in the marketplace. Instead of a tax, policymakers could achieve the same objective through a cap and trade system.

California has a cap-and-trade system that adds a modest 10¢ per gallon to the price of gasoline. In addition, the state LCFS adds another couple of cents and the federal RFS adds a negligible amount. Thus, these policies do not have large effects on consumers at present, which means that the first policy lever is not really being used. The effects on gasoline consumers may increase somewhat in the next few years as the LCFS and RFS become more stringent.

The RFS and LCFS provide significant subsidies to renewable fuel producers paid for by taxes on petroleum. This setup pits the two industries against each other and causes the affected firms to lobby hard to increase their subsidy or reduce their tax.

The structure of the two programs allows such lobbying to occur. Every year, the EPA has to determine the amount of renewable fuel that will be required under the RFS. A move to a longer planning horizon would help reduce the lobbying pressure. Setting a price cap on RINs may also help as it would remove the possibility that the EPA may instead mitigate high RIN prices by reducing the required biofuel volumes. The LCFS is hurt by the complexity of its CI calculations, which opens the door for numerous challenges to the standard. The re-adopted standard is simpler, but still too complicated.

Smith, Aaron. 2016. "Biofuel Policies: Robbing Peter to Pay Paul." *ARE Update* 19(3):1-4. University of California Giannini Foundation of Agricultural Economics. http://giannini.ucop.edu/media/are-update/files/articles/V19N3_1.pdf

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