



# THE BIG CORN SELLOUT:

## How National Politics and Ethanol Mandates Are Hurting California's Economy



*The Center For*  
**Regulatory Solutions**

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## Executive Summary

In a country as big and diverse as the United States, the conventional wisdom of national politics is often contradicted by the real-world experiences of states and local communities. And quite often, national policies are hard to overturn even when they are wrong. Poor or failed national policies are staunchly defended by the special interests they serve, and in the face of this pressure, many political figures with national ambitions determine it's more convenient to ignore state and local concerns rather than support reforms.

The federal corn ethanol mandate, also known as the Renewable Fuel Standard (RFS), is one such case study. The policy forces billions of gallons of ethanol to be produced and mixed into gasoline each year, enriching corn-growing states in the Midwest at the expense of consumers, small businesses and farmers across the rest of the country. The RFS survives because of power of the corn ethanol lobby in Congress, and because of the central role that Iowa – a corn-growing state – plays in presidential politics.

The pro-ethanol forces are so strong they have even forced billionaire and environmental activist Tom Steyer – a leading figure in California politics – to back down. In 2010, when Steyer's main focus was California politics and defending the state's global warming laws, he openly [mocked former vice president Al Gore](#)<sup>1</sup> for once supporting ethanol. But a few years later, as Steyer became more involved in national politics, he changed his tune. The RFS is "an important program," Steyer's campaign arm, [NextGen Climate](#),<sup>2</sup> said in 2014. "The RFS supports 73,000 good-paying, clean energy jobs in Iowa and is helping us reduce our dependence on fossil fuels."

This report demonstrates how Steyer and other national political figures – Republican and Democrat – have sold out the California economy by caving to the ethanol lobby. Even worse, their support for the RFS ignored years of warnings from a broad and diverse coalition of Californians, including Democrats, Republicans, environmentalists, organized labor, dairy farmers, academics, environmental regulators and newspaper editorial boards. The findings of the report challenge national political figures to change course and support major reforms to the RFS before California suffers any further from this misguided and failed national policy.

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<sup>1</sup> Shelley DuBois, "Tom Steyer: The jolly green banker," *Forbes*, December 8, 2010, <http://fortune.com/2010/12/08/tom-steyer-the-jolly-green-banker/>.

<sup>2</sup> Laura Barron-Lopez, "Steyer slams Iowa Republican over biofuels," *The Hill*, August 19, 2014, <http://thehill.com/policy/energy-environment/215485-steyer-slams-ernst-over-biofuels>.

## Almost \$42 billion in higher fuel costs

To quantify the impact of the RFS on California's economy, the Center for Regulatory Solutions (CRS) – a project of the Small Business and Entrepreneurship Council (SBE Council) – commissioned an economic analysis of the costs already imposed on California residents since the RFS mandate began in 2005. It also examined future costs over the next decade based on projected ethanol consumption. The analysis found:

- Californians paid \$13.1 billion in higher fuel costs from 2005 to 2014 due to the RFS
- Another \$28.8 billion in higher fuel costs can be expected in California from 2015 to 2024 without RFS reforms
- Therefore, California's corn ethanol bill may total \$41.9 billion between 2005 and 2024.

This is primarily because ethanol provides consumers with only **two-thirds** of the energy content<sup>3</sup> per gallon compared to gasoline, even though the two fuels are priced roughly the same. Therefore, Californians are paying the same price for ethanol as gasoline, but are getting one-third less mileage for each gallon of ethanol they consume. In practical terms, this means the RFS will extract tens of billions of dollars from California consumers and transfer that wealth to corn ethanol producers. Because roughly 90 percent of corn ethanol in California is imported from other states, the wealth transfer outside California is roughly \$37.7 billion over two decades.

## Lost economic opportunity, jobs and farm incomes

This wealth transfer has ripple effects across the California economy, as households and small businesses feel the pinch of these higher fuel costs. According to the CRS analysis, this has already resulted in \$9.9 billion in lost GDP growth since 2005. Looking ahead, California may suffer another \$21.7 billion in lost economic opportunity without RFS reforms. Therefore, in the 20 years from 2005 to 2024, California may suffer \$31.6 billion in lost GDP growth because of the RFS.

The CRS analysis also shows the drag on California's economy will depress employment. RFS-related costs are projected to cut state labor income by almost \$18 billion over 20 years, and reduce labor demand by just over 347,000 job-years over the same period. That is the equivalent of 17,369 lost jobs per year, each and every year, between 2005 and 2024.

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<sup>3</sup> U.S. Department of Energy, "Ethanol," <https://www.fueleconomy.gov/feg/ethanol.shtml>.

For years, California farmers and lawmakers have complained about the “food vs. fuel” competition created by the federal corn ethanol mandate.<sup>4</sup> In fact, recent [research](#)<sup>5</sup> shows the RFS pushed corn prices 40 percent higher than they otherwise would have been. Using this research, the CRS analysis concludes California dairy farmers spent \$598 million more on feed costs in 2012 because of the RFS, and the state’s poultry farmers spent an additional \$126 million.

## Higher carbon emissions and local air pollution

Ever since the RFS was established in 2005, the ethanol industry has [promoted its product](#)<sup>6</sup> as a low-carbon, low-emission alternative to gasoline. In fact, the U.S. Environmental Protection Agency (EPA) is due to set 2014-2016 levels for the ethanol mandate on Nov. 30, the same day the United Nations (U.N.) will convene a highly anticipated summit on climate change in Paris – and ethanol supporters are using the timing to pressure the Obama administration into setting next year’s RFS quotas [as high as possible](#).<sup>7</sup>

But 10 years into the RFS, the facts have never been clearer on whether forcing billions of gallons of corn-derived ethanol into our fuel tanks is an environmental winner: It is not. In fact, a [study](#)<sup>8</sup> published in the *Proceedings of the National Academy of Sciences* last year found that ethanol-fueled vehicles damage air quality up to 80 percent more than vehicles fueled by gasoline. This has serious implications, because environmental mandates from both Washington, D.C. and Sacramento are forcing environmental regulators to monitor and tightly regulate carbon emissions and other pollutants. This task will only become more difficult – and expensive – with the increased emissions that come with ethanol. According to the CRS analysis:

- California corn ethanol consumption has generated an extra 6.3 million metric tons of CO<sub>2</sub>-equivalent (CO<sub>2</sub>e) emissions across the U.S. since 2005
- This is roughly the same as putting 1.3 million more cars on the road for a year
- More than 100,000 tons of smog-forming emissions were released as a result of corn ethanol consumption in California.

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<sup>4</sup> AJR 21, September 12, 2013, [http://www.leginfo.ca.gov/pub/13-14/bill/asm/ab\\_0001-0050/ajr\\_21\\_bill\\_20130927\\_chaptered.html](http://www.leginfo.ca.gov/pub/13-14/bill/asm/ab_0001-0050/ajr_21_bill_20130927_chaptered.html).

<sup>5</sup> Daniel De La Torre Ugarte and Burton English (University of Tennessee, Institute of Agriculture), “10-Year Review of the Renewable Fuels Standard: Impacts to the Environment, the Economy, and Advanced Biofuels Development,” October 14, 2015, [http://beag.ag.utk.edu/pub/TenYrReviewRenewableFuelStandard\\_1015.pdf](http://beag.ag.utk.edu/pub/TenYrReviewRenewableFuelStandard_1015.pdf).

<sup>6</sup> Renewable Fuels Association, “Carbon Footprint,” <http://chooseethanol.com/what-is-ethanol/entry/carbon-footprint/>.

<sup>7</sup> Renewable Fuels Association, “RFA Report Notes 28 COP21 Countries Relying on Biofuels for Carbon Reduction: U.S. Does Not. Huh?” November 5, 2015, <http://www.ethanolrfa.org/2015/11/rfa-report-notes-28-cop21-countries-relying-on-biofuels-for-carbon-reduction-u-s-does-not-huh/>.

<sup>8</sup> Christopher Tessum, Jason Hill, and Julian Marshall, “Life cycle air quality impacts of conventional and alternative light-duty transportation in the United States,” *Proceedings of the National Academy of Sciences of the United States of America* 111 (2014), <http://www.pnas.org/content/111/52/18490.full>.

## Local impacts: San Francisco Bay Area

To illustrate how these impacts are felt at the local level, a separate analysis was prepared for the San Francisco Bay Area (i.e. Alameda, Contra Costa, San Francisco, San Mateo, and Marin counties). It mirrored the statewide analysis, tracking fuel costs, GDP, employment and emissions and how the RFS has impacted these measures in the Bay Area. The CRS analysis found:

- The Bay Area's corn ethanol bill may exceed \$4.3 billion in higher fuel costs between 2005 and 2024
- Lost economic growth may total \$2.74 billion over the same 20-year period
- The RFS may cost the Bay Area \$1.63 billion in lost labor income and more than 1,300 jobs per year
- The Bay Area's corn ethanol consumption has generated an extra 655,000 metric tons of CO<sub>2</sub>e since 2005 – roughly equal to adding 138,000 cars to the road for one year – and produced more than 10,000 tons of smog-forming emissions.

To determine public awareness and attitudes towards ethanol in the Bay Area, CRS commissioned an opinion poll of 600 registered voters in the San Francisco, Oakland and San Jose media market. Well over half (57 percent) of respondents identified as Democrats. Only 28 percent of voters said they were familiar with the RFS, but once they were taken through the arguments for and against, skepticism towards the corn ethanol mandate was high. For example, 75 percent of respondents in the Bay Area said they believe the corn ethanol mandate has a negative effect on the environment, and 72 percent said it's making climate change worse.

## Years of warnings ignored

These economic and environmental impacts are hardly a surprise. In 2007, the editorial board of the [\*Los Angeles Times\*](#)<sup>9</sup> warned "few are considering the environmental and economic effects of a massive, rapid rise in ethanol production." The same year, [\*California Gov. Arnold Schwarzenegger \(R\)\*](#)<sup>10</sup> denounced the combination of ethanol mandates, subsidies and tariffs that favor Midwestern corn ethanol as "crazy." In the years since, other editorial boards representing very different views on most issues have all agreed that corn ethanol is a bad deal for California, including the [\*San Francisco\*](#)

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<sup>9</sup> "Drunk on ethanol," *Los Angeles Times*, August 20, 2007, <http://www.latimes.com/opinion/editorials/la-ed-ethanol20aug20-column.html#page=1>.

<sup>10</sup> Bernie Woodall, "Schwarzenegger attacks ethanol tariffs, subsidies," *Reuters*, May 18, 2007, <http://www.reuters.com/article/2007/05/19/environment-schwarzenegger-fuels-dc-idUSN1821686920070519>.

[Chronicle](#),<sup>11</sup> [Oakland Tribune](#),<sup>12</sup> [San Jose Mercury-News](#),<sup>13</sup> [Modesto Bee](#),<sup>14</sup> [Orange County Register](#)<sup>15</sup> and the [San Diego Union-Tribune](#).<sup>16</sup>

In the state legislature, Democrats and Republicans have united to [abolish state-level funding](#)<sup>17</sup> for corn ethanol, and they have passed a [joint resolution](#)<sup>18</sup> demanding that Congress reform the RFS “to expeditiously transition away” from corn and other “biofuel sources that compete with food production.” The joint resolution, which focused on the RFS driving up corn prices for California’s dairy, livestock and poultry producers, passed through the State Assembly 77-0 and the State Senate 37-0. “Feeding our livestock and our people should take precedence over creating alternative fuels that have proven to be less energy-efficient than gasoline,” the measure’s lead sponsor, [Assemblymember Kristin Olsen \(R-Riverbank\)](#),<sup>19</sup> said afterwards.

The coalition against the federal ethanol mandate is very broad, including environmental groups such as the San Francisco-based Sierra Club. Environmentalists have long opposed the corn-ethanol mandate, largely because of the carbon emissions released when more land is pushed into corn production. For this reason, the [Sierra Club](#) “opposes further deployment of corn-based ethanol based on its extremely dubious net carbon benefits and its unresolved direct and indirect environmental impacts.”<sup>20</sup> For similar reasons, environmental regulators in California have spent years clashing with the ethanol lobby about whether the fuel should be treated as a “low carbon” alternative to gasoline. Corn ethanol “defeats the purpose” of the state’s low-carbon fuel standard “because land now absorbing carbon dioxide would be cleared to produce corn,” the California Environmental Protection Agency [warned in 2009](#).<sup>21</sup>

California’s objections to corn ethanol have spurred [U.S. Sen. Dianne Feinstein \(D-Calif.\)](#)<sup>22</sup> to take a leading role in the battle to reform the RFS in Congress. “The federal mandate for corn ethanol is both unwise and unworkable,” Feinstein said earlier this

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<sup>11</sup> “Ethanol relief vital to state’s cows,” *San Francisco Chronicle*, October 17, 2012, <http://www.sfgate.com/opinion/editorials/article/Ethanol-relief-vital-to-state-s-cows-3958138.php>.

<sup>12</sup> “Editorial: California air board makes good decision to move away from corn-based ethanol,” *Oakland Tribune*, April 24, 2009, [http://www.insidebayarea.com/opinion/ci\\_12210700](http://www.insidebayarea.com/opinion/ci_12210700).

<sup>13</sup> “Editorial: U.S. must move carefully on biofuels policy,” *San Jose Mercury-News*, March 2, 2008, [http://www.mercurynews.com/opinion/ci\\_8426773?nclick\\_check=1](http://www.mercurynews.com/opinion/ci_8426773?nclick_check=1).

<sup>14</sup> “Promising sign No. 2 – ethanol reconsidered,” *Modesto Bee*, November 22, 2013, <http://www.modbee.com/opinion/editorials/article3157109.html>.

<sup>15</sup> “Editorial: Ethanol mandate should be cut, if not killed,” *Orange County Register*, November 14, 2013, <http://www.ocregister.com/articles/ethanol-536782-mandate-corn.html>.

<sup>16</sup> “EDITORIAL: Time to end ethanol mandate,” *San Diego Union-Tribune*, August 14, 2012, <http://www.sandiegouniontribune.com/news/2012/aug/14/editorial-time-to-end-ethanol-mandate/>.

<sup>17</sup> David G. Valadao, “California law eliminates ethanol funding,” *Western Farm Press*, August 29, 2012, <http://westernfarmpress.com/government/california-law-eliminates-ethanol-funding>.

<sup>18</sup> AJR 21.

<sup>19</sup> Kristin Olsen, “Drop corn ethanol mandate to save California dairies,” October 11, 2013, <https://ad12.asmr.org/opinion-editorial/kristin-olsen-drop-corn-ethanol-mandate-save-california-dairies>.

<sup>20</sup> Doris Cellarius, “Sierra Club Guidance on Biofuels,” February 11, 2015, <https://content.sierraclub.org/grassrootsnetwork/team-news/2015/02/sierra-club-guidance-biofuels>.

<sup>21</sup> Jerome R. Corsi, “California EPA to Rule Against Ethanol,” *WND*, April 21, 2009, <http://www.wnd.com/2009/04/95745/>.

<sup>22</sup> Dianne Feinstein, “Feinstein, Toomey Introduce Bill to Repeal Ethanol Mandate,” February 26, 2015, <http://www.feinstein.senate.gov/public/index.cfm/press-releases?ID=61bcf916-1d17-4eba-805d-5b24fcd0a948>.

year, introducing a reform bill with U.S. Sen. Pat Toomey (R-Pa.) – yet another example of political opposites finding common ground on the damaging nature of the RFS. In a similar vein, 12 members of California’s congressional delegation – including U.S. Reps. Jim Costa (D-Calif.) and David Valadao (R-Calif.) – have joined scores of other lawmakers in [demanding](#)<sup>23</sup> that the EPA waive some requirements of the RFS “to help limit the economic and consumer harm this program has already caused.”

## **Conclusion**

To their credit, Californians have been warning of the impacts of the RFS for a long time. But until now, very little analysis has been produced that quantifies in real terms how the national corn ethanol mandates have actually impacted states like California.

This report builds on earlier CRS studies in the six states of New England, and two corn-producing states in the Midwest, Ohio and Indiana. The facts show the federal corn ethanol mandate creates more problems than it solves, inside and outside the Corn Belt, and it’s an unquestionably bad deal for the Golden State.

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<sup>23</sup> Bill Flores and Peter Welch et al., Letter to Gina McCarthy, November 4, 2015, <http://flores.house.gov/uploadedfiles/rfs-letter-to-admin-mccarthy-11-4-2015.pdf>.



## Introduction

On November 30, 2015, the U.S. Environmental Protection Agency (EPA) is **expected**<sup>24</sup> to mandate an increase in the volume of corn ethanol that must be blended into our nation's fuel supply. EPA is acting under the authority of the Renewable Fuel Standard (RFS), which has been a drain on California's economy, siphoning off billions since it was established by Congress in 2005. Since that time, the RFS has transferred billions of dollars out of the California economy, hurting households and small businesses, and shifted that wealth instead to a handful of states known as the "Corn Belt," resulting in high costs but little environmental gain. This has impacted household budgets and small businesses throughout the Golden State. The money drained from California due to the RFS mandate could have been used to grow businesses and jobs, or to invest in better roads, infrastructure and other essential services.

*"One of the reasons I made that mistake is that I paid particular attention to the farmers in my home state of Tennessee, and I had a certain fondness for the farmers in the state of Iowa because I was about to run for president."*<sup>25</sup>

**Former Vice President Al Gore**  
November 22, 2011.

The Center for Regulatory Solutions (CRS), a project of the **Small Business and Entrepreneurship Council**<sup>26</sup> (SBE Council), has long advocated for a reduction in year-by-year RFS targets until it can be phased out completely. In comments to the EPA in 2014, SBE Council and CRS president Karen Kerrigan stated: "Clearly, the RFS mandate makes no sense, especially given the substantial costs imposed on businesses and our economy, the environmental doubts, and the revolutionary changes in the energy position of

the United States."

This report builds on CRS's and SBE Council's previous work and advocacy on the RFS, and examines the economic impact of ethanol mandates on California. The report also takes a closer look at recent scientific research that's been produced specific to the corn ethanol issue that raises needed questions about its previously assumed benefits.

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<sup>24</sup> U.S. Environmental Protection Agency, "Renewable Fuel Standard Program: Standards for 2014, 2015, and 2016 and Biomass-Based Diesel Volume for 2017," June 10, 2015, <https://www.federalregister.gov/articles/2015/06/10/2015-13956/renewable-fuel-standard-program-standards-for-2014-2015-and-2016-and-biomass-based-diesel-volume-for>.

<sup>25</sup> Gerard Wynn, "U.S. corn ethanol 'was not a good policy'-Gore," *Reuters*, November 22, 2011, <http://www.reuters.com/article/2010/11/22/ethanol-gore-idAFLDE6AL0YT20101122>.

<sup>26</sup> Karen Kerrigan, "EPA Comments: Proposal to Reduce Ethanol Blend for Renewable Fuel Standard in 2014," January 27, 2014, <http://www.sbecouncil.org/2014/01/27/comments-to-epa-on-proposal-to-reduce-ethanol-blend-for-renewable-fuel-standard-in-2014/>.

## The RFS: A Bad Deal For The Golden State

To quantify the drag on California's economy created by the RFS, CRS commissioned an analysis of the costs the RFS has already imposed on the region, as well as additional costs projected for the next decade. The analysis shows the RFS has already caused \$13.1 billion in higher fuel costs, and is set to cost another \$28.8 billion over the next 10 years. In other words, the RFS will extract a total of almost \$42 billion from California's economy and transfer that wealth to ethanol producers in the Midwest. As household budgets and businesses big and small adjust, the economic impact – measured in lost GDP opportunity – is estimated at \$31.6 billion over 20 years, with an associated drop in labor demand of 17,369 jobs a year. These serious consequences contradict the claims of RFS proponents, who argue the mandate is an unqualified economic success story.

*"I saw in the paper the other day that Al Gore was saying that maybe he shouldn't have been for ethanol. It's kind of like duh! Did you ever take out your calculator on that one?"<sup>27</sup>*

**Tom Steyer**

Founder, NextGen Climate

Retired hedge-fund billionaire, Dec. 8, 2010

## Fuel Costs

While ethanol and gasoline are priced similarly, ethanol provides consumers with only **two-thirds of the energy content per gallon** compared to gasoline.<sup>28</sup> In other words, Californians are paying the same price for ethanol as gasoline but are getting one-third less mileage for each gallon of ethanol they consume. This translates into an economic loss for motorists. Based on estimated historical consumption (which ranges from 956 million gallons in 2005 to approximately 1.5 billion gallons in 2014), Table 1 illustrates the additional costs corn ethanol mandates have imposed on consumers over the 10-year period between 2005 and 2014. It also projects costs year-over-year from 2015 to 2024 may be incurred without RFS reforms.

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<sup>27</sup> DuBois.

<sup>28</sup> U.S. Department of Energy, "Ethanol."

**Table 1: Additional Fuel Costs in California due to RFS Mandates (millions of 2014 \$)**

	2005-2014	2015-2024	Total
Year 1	1,185.8	2,754.6	
Year 2	2,108.2	2,092.5	
Year 3	1,262.7	3,549.4	
Year 4	1,234.1	3,363.5	
Year 5	998.8	3,233.6	
Year 6	1,174.8	2,886.4	
Year 7	1,784.5	2,901.0	
Year 8	910.6	2,764.4	
Year 9	1,191.6	2,693.7	
Year 10	1,278.2	2,554.7	
<b>Total</b>	<b>13,129.3</b>	<b>28,793.7</b>	<b>41,923.0</b>

*"The federal mandate for corn ethanol is both unwise and unworkable. ... The mandate also pits corn ethanol against other renewable fuels, which has stunted the growth of environmentally-friendly advanced biofuels like biodiesel and cellulosic ethanol. Once the mandate for corn ethanol is gone, the RFS program will be able to focus on those fuels that best reduce greenhouse gas emissions and don't compete with our food supply."*<sup>29</sup>

**U.S. Sen. Dianne Feinstein (D-Calif.)**

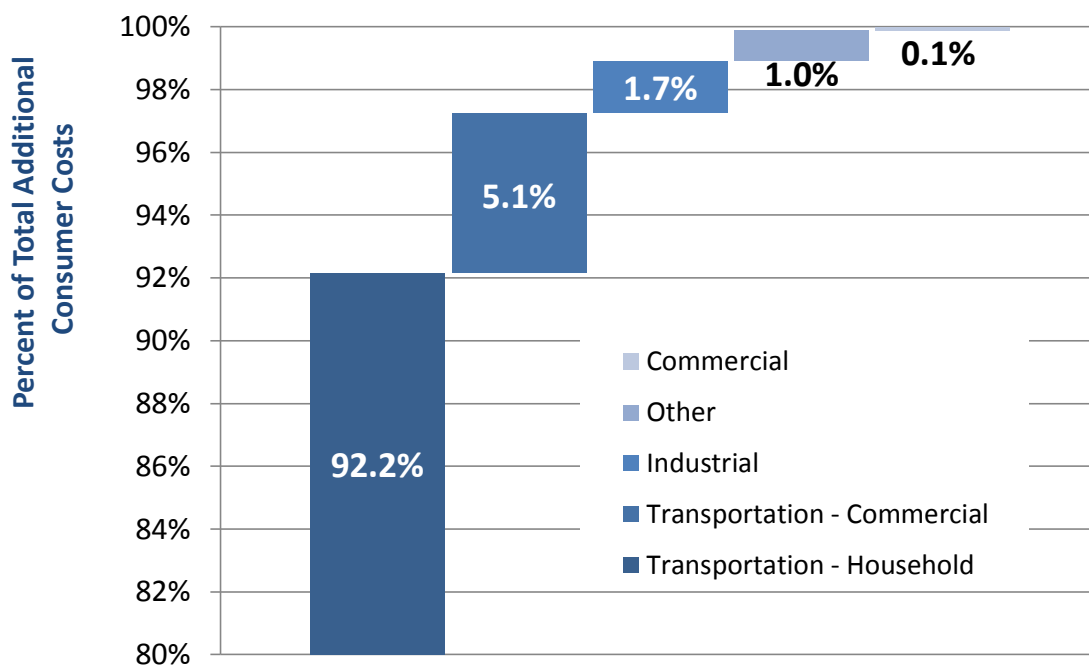
Feb. 26, 2015

<sup>29</sup> Feinstein.

Table 1 shows California consumers have already paid an additional \$13.1 billion for the privilege of using ethanol in their tanks since the RFS was first established in 2005. Based on projected consumption and the ethanol/gasoline price spreads, California consumers can expect to pay another \$28.8 billion in higher fuel costs over the 2015-2024 time period.<sup>30</sup> All told, California consumers can expect to spend over \$41.9 billion to comply with the RFS through 2024.

Not surprisingly, the brunt of the additional cost is felt directly by households, as illustrated by Figure 1, which shows each sector's share of the total direct RFS costs. While consumers bear the brunt of higher fuel costs, other sectors are impacted as well. For example, the commercial and industrial sector in California will pay out more than \$746 million over 20 years in extra fuel costs. This is additional money that could have been used to hire more employees or raise wages, for business-related investments and expansions, or even charitable donations to the local community.

**Figure 1: Share of Additional Consumer Costs (Direct) in California, 2005-2024**



Likewise, the money that consumers lost to higher fuel costs could have been put to better use in myriad ways by households and businesses, or been used to support essential public services.

<sup>30</sup> A discussion of these calculations is included in the Technical Appendix.



For example, the ethanol-related increase in fuel costs can be viewed as a “corn ethanol tax” on consumers. Over 20 years, the ethanol tax averages \$2.1 billion a year. If that amount was redirected towards K-12 teacher [salaries](#),<sup>31</sup> then each of California’s 292,500 teachers could have made an extra \$7,100 last year. But instead of being invested in California, whether by businesses or in public services, this money was lost to the RFS.

## Agriculture Costs

Long before the RFS, corn was – and remains – an important source of animal feed for farmers. Unfortunately for these farmers, the aggressive ethanol quotas of the RFS have driven up demand for corn. The resulting price increases have a significant impact on farmers’ ability to earn an income and stay in business. For farmers in California, just a small increase in corn-related feed prices can translate into millions of dollars in lost income.

*“The [Sierra] Club opposes further deployment of corn-based ethanol based on its extremely dubious net carbon benefits and its unresolved direct and indirect environmental impacts.”<sup>32</sup>*

**Sierra Club**

Feb. 11, 2015

According to the [U.S. Department of Agriculture \(USDA\)](#),<sup>33</sup> the California livestock industry produced \$15.3 billion in sales in 2014. The industry is important to California’s GDP and employment. In 2014, the sector contributed \$6.8 billion in GDP to the California economy, more than 45,000 jobs and \$3.9 billion in labor income, as shown in Table 2.

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<sup>31</sup> National Education Association, “Rankings & Estimates: Rankings of the States 2014 and Estimates of School Statistics 2015,” March 2015, [https://www.nea.org/assets/docs/NEA\\_Rankings\\_And\\_Estimates-2015-03-11a.pdf](https://www.nea.org/assets/docs/NEA_Rankings_And_Estimates-2015-03-11a.pdf)

<sup>32</sup> Cellarius.

<sup>33</sup> U.S. Department of Agriculture, Economic Research Service, “Farm Income and Wealth Statistics,” [http://www.ers.usda.gov/data-products/farm-income-and-wealth-statistics/annual-cash-receipts-by-commodity.aspx#Pf24c6ef0903644f3865fb0aafb9d592\\_2\\_16iT0R0x14](http://www.ers.usda.gov/data-products/farm-income-and-wealth-statistics/annual-cash-receipts-by-commodity.aspx#Pf24c6ef0903644f3865fb0aafb9d592_2_16iT0R0x14).

**Table 2: Livestock sector contribution to California economy in 2014**

	GDP (Value Added)	Employment	Labor income
Dairy cattle and milk production	4,227,156,057	15,894	2,547,741,721
Beef cattle ranching and farming	1,500,488,014	23,317	773,739,740
Poultry and egg production	544,111,014	1,706	298,370,020
Hog farming	32,763,494	290	17,127,305
Miscellaneous animals and products	454,412,483	4,020	237,546,740
<b>Total livestock industry</b>	<b>6,758,931,062</b>	<b>45,226</b>	<b>3,874,525,526</b>

Source: *USDA/ERS Farm Income and Wealth Statistics; IMPLAN.*

Dairy cattle and poultry farmers are the hardest hit players in California's livestock industry when the price corn-based animal feed rises. California is the nation's number one dairy producer, and with more than \$9.3 billion in sales in 2014, it represents almost two-thirds of the state's livestock sector. While somewhat smaller, California's poultry and eggs industry still ranks 8<sup>th</sup> in the nation and produced \$1.7 billion in sales in 2014. Additionally, these two sub-sectors accounted for 39 percent of employment and 73 percent of labor income in California's livestock industry in 2014. As shown in Table 3, the dairy and poultry and eggs sub-sectors also account for the lion's share of feed expenses across the entire livestock industry in California.<sup>34</sup>

**Table 3: California agricultural sectors spending the largest amount on feed in 2012**

	Operating expenses	Feed expenses	Feed expenses as % of operating expenses
Dairy Cattle and Milk Production	6,683,443,000	3,947,009,000	59%
Poultry and Egg Production	1,448,191,000	959,289,000	66%
Beef Cattle Ranching and Farming	1,617,283,000	475,217,000	29%
Cattle feedlots	1,000,314,000	441,146,000	44%
<b>Total</b>	<b>10,749,231,000</b>	<b>5,822,661,000</b>	<b>54%</b>

Source: *2012 Census of Agriculture, USDA.*

<sup>34</sup> U.S. Department of Agriculture, "2012 Census of Agriculture: United States Summary and State Data," May 2014, [http://www.agcensus.usda.gov/Publications/2012/Full\\_Report/Volume\\_1\\_Chapter\\_1\\_US/usv1.pdf](http://www.agcensus.usda.gov/Publications/2012/Full_Report/Volume_1_Chapter_1_US/usv1.pdf).

### Dairy Cattle and Milk Production

Feed is dairy farmers' single biggest production expense, costing California farmers \$3.95 billion in 2012, or roughly 59 percent of their operating expenses.<sup>36</sup> As Table 3 demonstrates, corn purchases accounted for approximately 54 percent of the nutrient component of feed costs for California dairy farmers.<sup>37</sup>

*"[C]orn ethanol is an inefficient fuel source that provides no real environmental benefits and drives up the costs of food and feed."<sup>35</sup>*

### California Dairy Campaign

Jan. 17, 2012

When non-nutrient input costs are accounted for, corn contributes 38 percent to overall feed costs (as shown in Table 4), or \$1.5 billion of feed costs for California dairy farmers in 2012. A recent [University of Tennessee study](#)<sup>38</sup> concluded that without the RFS or a separate subsidy known as the Blender's Tax Credit (BTC), corn crop prices would have been 40% lower on average between 2008 and 2014.<sup>39</sup> This means California dairy farmers spent \$598 million more on feed with the RFS than without the corn ethanol mandate.

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<sup>35</sup> "Dairy Campaign hopes to end corn ethanol subsidies," *Turlock Journal*, January 17, 2012, <http://www.turlockjournal.com/archives/13254/>.

<sup>36</sup> Ibid.

<sup>37</sup> See the Technical Appendix for more information on the formula. The table below shows the calculation of corn's contribution to the feed expense.

<sup>38</sup> De La Torre Ugarte and English.

<sup>39</sup> Ibid, Figure 9, page 9.

**Table 4: Estimate of Corn's Contribution to 2012 Dairy Feed Prices using the Milk Protection Program Feed Price Formula<sup>40</sup>**

	Calculation of contribution to nutrient feed cost (%)				
	2012 average price (USD) [A]	Multiplier [B]	Contribution to nutrient feed cost (USD) [A] x [B]	Contribution to nutrient feed cost (%)	Contribution to total feed cost (%)
					30%
Corn	6.65 per bushel	1.07280	7.14	54%	38%
Soybean meal	439.87 per ton	0.00735	3.23	25%	17%
Alfalfa hay	205.33 per ton	0.01370	2.81	21%	15%
<b>Total</b>			<b>13.18</b>	<b>100%</b>	<b>100%</b>

Source: Corn and alfalfa prices are the average monthly prices published in "[Agricultural Prices](#)," U.S. Department of Agriculture, National Agricultural Statistics Service, published monthly for 2012. Soybean meal price is average of daily 2012 prices from "Soybean Meal, Cent. Ill., rail, ton 54%" price series reported at [www.quandl.com](http://www.quandl.com), a Wall Street Journal database.

*"Unnecessary government interference can have devastating consequences that hurt America's farmers and families. As a dairyman from one of the largest agriculture districts in the United States, I have witnessed firsthand, the negative impact of Renewable Fuel Standard Mandates that are largely fulfilled by corn. These mandates increase feed costs for farmers making it more expensive to raise livestock. These costs are then passed down to the consumer."<sup>41</sup>*

**U.S. Rep. David Valadao (R-Calif.)**

Feb. 26, 2015

<sup>40</sup> This formula derivation is discussed further in the Technical Appendix.

<sup>41</sup> David Valadao, "Bipartisan Group of Legislators Introduce RFS Reform Act," April 11, 2013, <http://valadao.house.gov/news/documentsingle.aspx?DocumentID=333958>.



These results are consistent with general industry trends since the early 2000s. As reported by the USDA, “livestock producers’ expenditure on feed more than doubled from \$24.8 billion in 2001 to \$54.6 billion in 2011.”<sup>42</sup> Furthermore, research from Iowa State University’s Center for Agricultural and Rural Development finds that “the price of corn is the most important factor in determining the cost of feeding livestock.”<sup>43</sup>

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<sup>42</sup> Jayson Beckman, Allison Borchers, and Carol A. Jones (U.S. Department of Agriculture), “Agriculture’s Supply and Demand for Energy and Energy Products,” May 2013, <http://www.card.iastate.edu/publications/dbs/pdf/10pb3.pdf>.

<sup>43</sup> Bruce A. Babcock (Iowa State University), “Impact on Ethanol, Corn, and Livestock from Imminent U.S. Ethanol Policy Decisions,” November 2010, <http://www.card.iastate.edu/publications/dbs/pdf/10pb3.pdf>.

## Poultry and Eggs

Like dairy farmers, the largest expense of poultry farmers is animal feed. In 2012, feed expenses were 66 percent, or \$959 million, of poultry farmers' operating expenses.<sup>44</sup> As demonstrated in Table 5, corn comprises 33 percent, or \$314 million of poultry farmers' feed costs (including non-nutrient input costs) in 2012. Applying the same finding on RFS corn price impacts from the University of Tennessee study, California poultry farmers spent an extra \$126 million more on feed costs in 2012 than they would have without the RFS.<sup>45</sup>

**Table 5: Estimate of the percentage contribution by value of corn to poultry feed costs in 2012**

	Contribution to nutrient feed cost (%)				Contribution to total feed cost (%)
	Broilers	Layers	Turkeys	Population weighted average	
Non-nutrients	N/A	N/A	N/A	N/A	30%
Corn	41%	60%	40%	47%	33%
Soybean	59%	40%	43%	52%	36%
Wheat	0%	0%	17%	1%	1%
Total	100%	100%	100%	100%	100%

Source: See technical appendix for a detailed explanation of the derivation of these figures.

*"The use of corn grown for ethanol to meet a government mandated ethanol requirement has increased cost, and as a result, consumers are paying higher prices for food at the grocery store and family farms are being forced to shut down."<sup>46</sup>*

**U.S. Rep. Jeff Denham (R-Calif.)**

Oct. 7, 2011

<sup>44</sup> U.S. Department of Agriculture, "2012 Census of Agriculture.

<sup>45</sup> This calculation is based on Hill's conclusion that corn prices might have been 40% lower without the RFS in place. De La Torre Ugarte and English, Figure 9, page 9.

<sup>46</sup> Jeff Denham, "Ethanol Subsidies Are Raising Cost of Feed And Killing Jobs In The Valley," October 7, 2011, <http://denham.house.gov/media-center/press-releases/ethanol-subsidies-are-raising-cost-feed-and-killing-jobs-valley>.

## Overall Economic Impacts

After exploring the impact of higher fuel costs on consumers and businesses, and the impact of higher feed prices on farmers, the CRS analysis sought to explore how the RFS has affected the broader California economy. To do that, CRS applied the IMPLAN input-output economic model. The IMPLAN model is licensed by IMPLAN Group LLC, a firm which works with governments, universities and other public and private organizations to assess the impacts of policies and programs across all industry sectors, along with government data and forecasts compiled by the EIA.

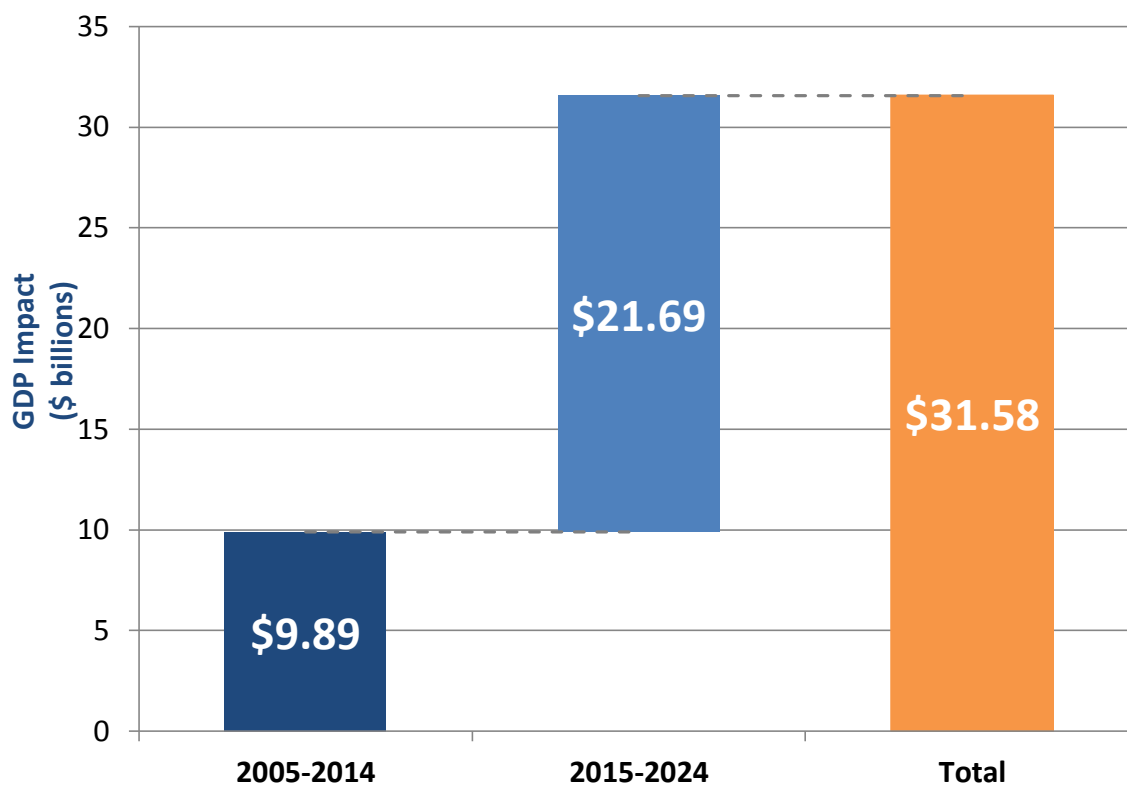
According to the economic modeling conducted by CRS, the cumulative costs of the RFS in California amount to \$31.6 billion in lost GDP opportunity from 2005 to 2024. This is a major economic blow, which results in a loss of \$17.9 billion in labor income and 17,369 jobs annually, as shown in Table 6 below.

**Table 6: Aggregate Economic Impacts due to Reduced Household Spending in California, 2005-2024**

Economic Impact	Aggregate Economic Lost Opportunity
GDP	\$31.58 billion
Labor Income	\$17.95 billion
Annual Employment	17,369 jobs

While some of this economic damage has already occurred, most of pain can still be avoided through major reforms to the RFS. As shown in Figure 2, income losses from higher fuel prices resulted in a \$9.9 billion loss of GDP opportunity during the past 10 years in California. This GDP opportunity loss results from household spending on a fuel that originates outside California instead of goods and services originating inside California, which would have boosted the region's economy. If the federal EPA continues to enforce the RFS mandate, this trend will continue and worsen. Without RFS reform, California the region can look forward to another \$21.7 billion in lost GDP opportunity over the next decade.

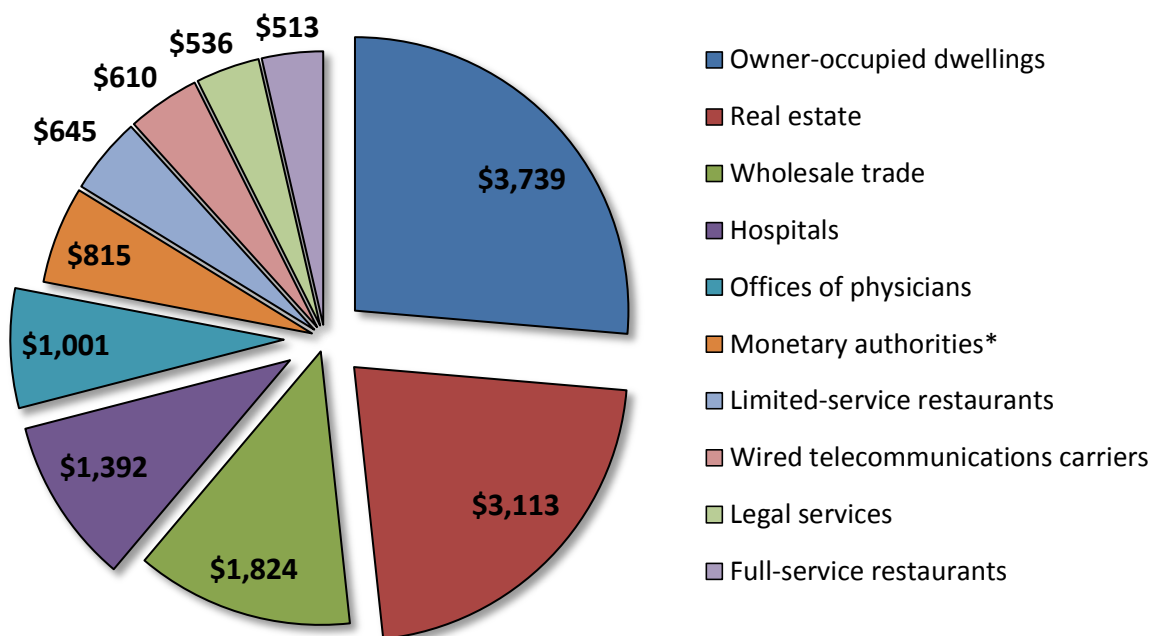
**Figure 2: Cumulative GDP Lost Opportunity in California, 2005-2024**  
(billions of 2014 \$)





Using the IMPLAN model, CRS also examined how these GDP losses would be felt across a number of important industry sectors. Figure 3 shows the top 10 impacted sectors and the GDP lost opportunity each sector will experience between 2005 and 2024. For example, the real estate sector (including owner-occupied dwellings) would sustain a \$6.9 billion hit, while healthcare (hospitals and physician offices of physicians) would lose over \$2.4 billion. In other words, California residents would have spent the money that went towards corn ethanol on local real estate and health care.

**Figure 3: Breakdown of GDP Impact by Industry Sector (Top 10)  
in California from 2005-2024  
(millions of 2014 \$)**

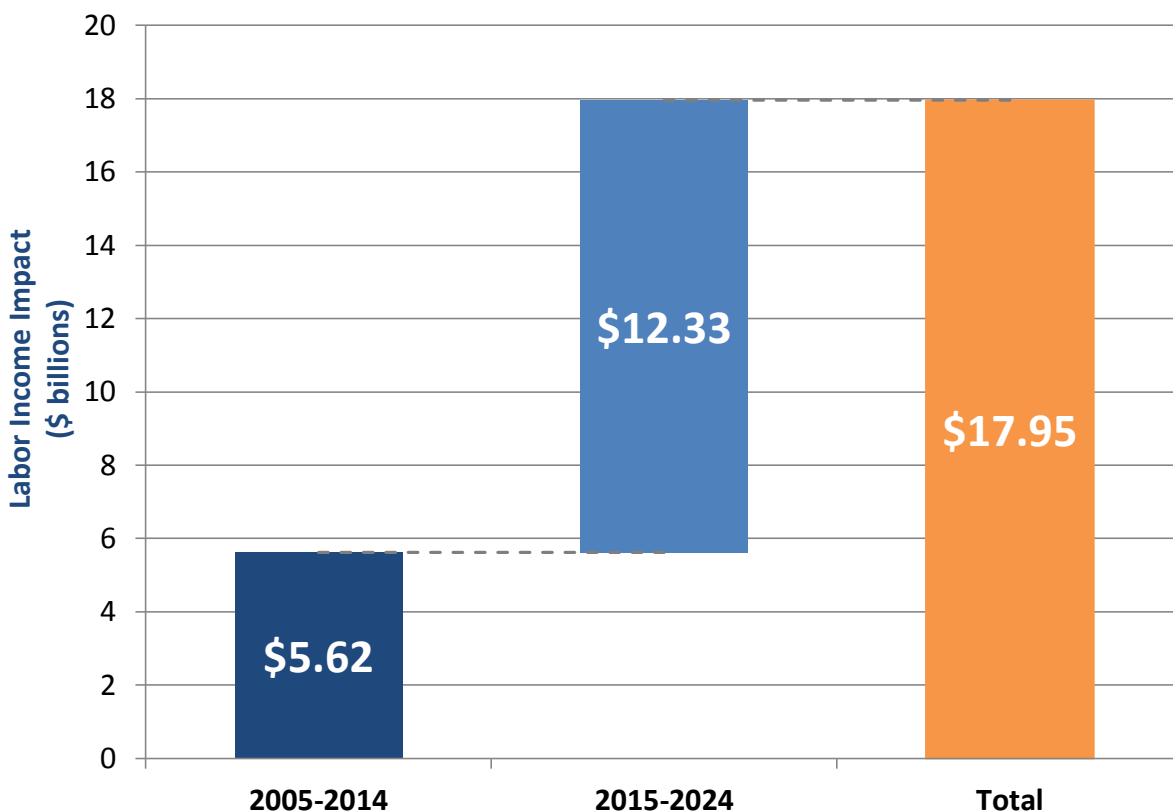


All Other Sectors Total GDP Impact: \$17,390 million

\*Includes depository credit intermediation

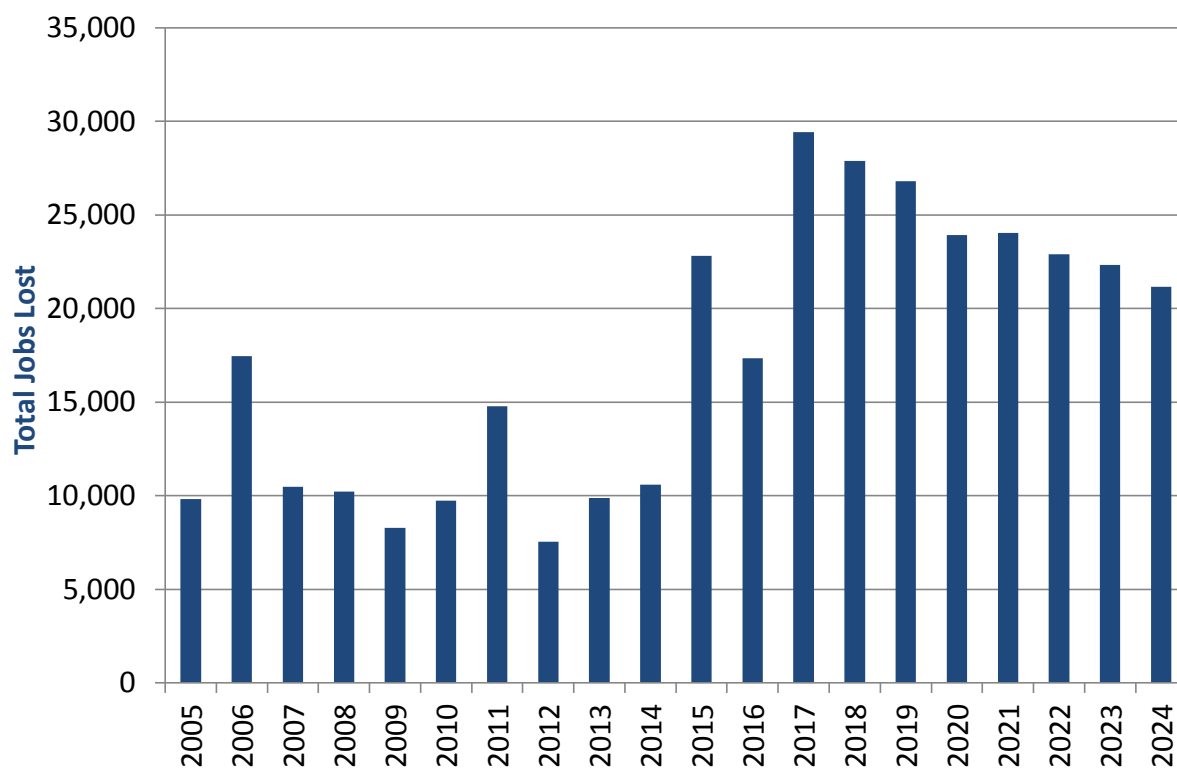
CRS also used the IMPLAN modeling to project the size and distribution of the loss of labor income due to the RFS mandate. The modeling suggests that the RFS resulted in a \$5.6 billion loss in labor income over the last 10 years, and without RFS reform, California will lose an additional \$12.3 billion in labor income. Over 20 years, this grows into an almost \$18 billion loss for California's workers and proprietors, as shown in Figure 4.

**Figure 4: Labor Income Impact in California due to RFS Mandates**  
(billions of 2014 \$)



Repressed economic growth and reduced labor demand translates into lost jobs. Using the IMPLAN model, the CRS analysis found a loss of over 347,000 jobs during the 20-year period between 2005 and 2024. On average, those costs translate roughly into 17,369 lost jobs per year. But, as Figure 5 shows below, the bulk of the job loss impact has yet to be realized – it will spike in 2017 and stay close to 25,000 lost jobs annually thereafter unless the RFS is fundamentally reformed.

**Figure 5: Employment Loss in California due to  
Lost Income from Additional Fuel Costs**



*"It makes absolutely no sense. It's crazy, and it's definitely not in the best interest of the customers."<sup>47</sup>*

**Former Calif. Gov. Arnold Schwarzenegger (R)**

May 18, 2007

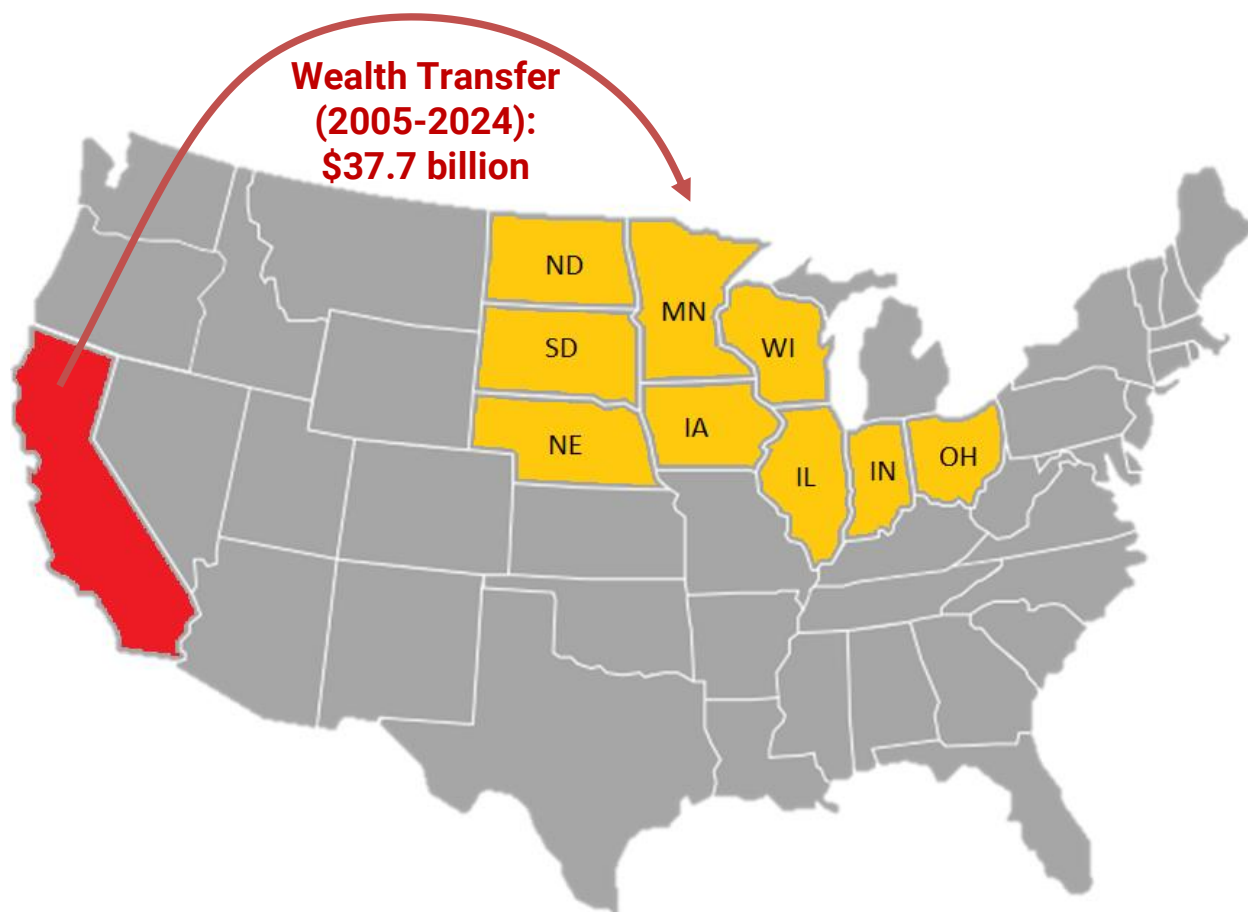
<sup>47</sup> Woodall.



## Wealth Transfer

As the CRS analysis demonstrates, the RFS has assessed major costs on the California economy with very few, if any, benefits. In effect, this has resulted in a huge transfer of wealth from California to the ethanol industry, which is concentrated in the handful of corn states, as illustrated in Figure 6 demonstrates.

Figure 6: Wealth Transfer from California to Corn & Ethanol Producing Regions<sup>48</sup>



Illustrative. Wealth transfer shown going to states with high corn and ethanol production.

<sup>48</sup> While total additional fuel cost to California is roughly \$41.9 billion, corn ethanol production in the state accounts for about 10% of consumption. Therefore, for illustrative purposes, we show the wealth transfer associated with additional fuel costs to be 10% lower.

A [number of studies](#) produced over the past several years have discussed the negative impacts that the RFS has had from an environmental and economic standpoint.<sup>49</sup> A recent [study](#)<sup>50</sup> from the University of Tennessee on the national impacts of the RFS supports the findings of the CRS economic analysis. Using the POLYSYS model, Drs. Daniel De La Torre Ugarte and Burton English estimated the economic impact of the RFS over the past 10 years under various scenarios. The study finds that in 2014 alone, the RFS cost the U.S. economy \$28.4 billion in lost GDP.

Additionally, the same study finds that the RFS pushed corn prices 40 percent higher than they would have otherwise been, and increased wheat and soybean prices by 13 percent. That's great news for the handful of agribusinesses and farmers in the Midwest that produce the overwhelming majority of these commodities but bad news for everyone else.

Despite the perception that the RFS has been an economic savior for the Corn Belt, the corn mandates continue to encounter vocal resistance even in the states that seem to benefit from them most. In Ohio, for example, diverse

constituencies, like those in California, have concluded that corn ethanol mandates are a bad deal. [Ohio Gov. John Kasich \(R\)](#) recently said the RFS "needs to be phased out" and the ethanol industry should "stand on its own."<sup>52</sup> This is stunning because Kasich is running for president and delivered these comments in Iowa, a major corn-producing state. Iowa is also the first, and among the most important, of the battleground states in the Republican presidential nomination process.

*"These wasteful subsidies divert corn into our gas tanks and away from the feedstock our ranchers and dairymen depend on. As a result, food costs have skyrocketed, while livestock and dairy producers are confronting possible feed shortages. Ethanol is one tool in our energy toolbox, but the current policy is unsustainable."*<sup>51</sup>

**U.S. Rep. Jim Costa (D-Calif.)**

Jun. 22, 2011

<sup>49</sup> Center for Regulatory Solutions, "The Lost Decade: How Corn Ethanol Mandates Hurt Ohio's Environment and Economy," November 5, 2015, <http://centerforregulatorysolutions.org/wp-content/uploads/2015/11/The-Lost-Decade-CRS.pdf>.

<sup>50</sup> De La Torre Ugarte and English.

<sup>51</sup> Jim Costa, "Costa Continues Fight to End Corn Ethanol Subsidies," June 22, 2011, <https://costa.house.gov/media-center/press-releases/costa-continues-fight-end-corn-ethanol-subsidies>.

<sup>52</sup> America's Renewable Future, "Gov. John Kasich says RFS 'needs to be phased out'" [video], June 26, 2015, <https://www.youtube.com/watch?v=B8sDul3qpxM>.

Yet even [agricultural officials](#) in Iowa have noted that “high corn prices have encouraged expansion of row crop production to lands which often are at greater risk for soil erosion.”<sup>53</sup>

*“Because the everyday processing of ethanol requires vast amounts of coal and natural gas, and because the energy returned on energy invested is near break-even point, it is simply false to call ethanol a renewable fuel.”<sup>54</sup>*

**[Kamyar Enshayan](#)**

*Director, Center for Energy & Environmental Education,  
University of Northern Iowa, Cedar Falls*

As detailed in an earlier CRS report<sup>55</sup> on the impacts of the RFS in Ohio, [U.S. Rep. Jim Jordan \(R-Ohio\)](#), chairman of the conservative House Freedom Caucus, has said ethanol producers “should be able to stand on their own in the marketplace” and “I just don’t believe the government should be subsidizing any alternative fuels.”<sup>56</sup> On the Democratic side, [U.S. Rep. Marcia Fudge \(D-Ohio\)](#) and the Congressional Black Caucus have called for RFS targets to be eased because they have “resulted in higher prices for corn and higher prices for feed and food.”<sup>57</sup> And as far back as 2007, the [Central Ohio chapter of the Sierra Club](#)

called corn ethanol a “bust” because of the amount of energy needed to produce it, the associated GHG emissions, and the land and water impacts of increased corn production.<sup>58</sup>

A [recent CRS report](#) on ethanol’s environmental performance in Ohio helps explain some of these misgivings.<sup>59</sup> The report shows corn-ethanol mandates have driven a 1.92 million metric ton increase in GHG emissions in Ohio since 2005, significant increases in ozone-forming pollution and more soil erosion, among other major environmental impacts. The RFS has also forced Ohioans to pay \$4 billion in higher fuel costs so far, creating a harmful drag on the economy, small business growth and job creation.

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<sup>53</sup> Iowa Learning Farms, “The Cost of Soil Erosion,” January 2013, [http://www.extension.iastate.edu/ilf/sites/www.extension.iastate.edu/files/ilf/Cost\\_of\\_Eroded\\_Soil.pdf](http://www.extension.iastate.edu/ilf/sites/www.extension.iastate.edu/files/ilf/Cost_of_Eroded_Soil.pdf).

<sup>54</sup> Kamyar Enshayan, “‘Renewable fuel’ a term thrown around loosely,” Des Moines Register, October 28, 2015, <http://www.desmoinesregister.com/story/opinion/readers/2015/10/28/renewable-fuel-term-thrown-around-loosely/74663610/>.

<sup>55</sup> Center for Regulatory Solutions, “New CRS Report: How Corn Ethanol Mandates Have Hurt Ohio’s Environment and Economy,” November 5, 2015, <http://centerforregulatorysolutions.org/new-crs-report-how-corn-ethanol-mandates-have-hurt-ohios-environment-and-economy/>.

<sup>56</sup> Stephen Koff, “Ethanol debate puts conservative, corn-state congressmen in quandry [sic],” *Cleveland.com*, January 17, 2014, [http://www.cleveland.com/open/index.ssf/2014/01/ethanol\\_debate\\_puts\\_conservati\\_1.html](http://www.cleveland.com/open/index.ssf/2014/01/ethanol_debate_puts_conservati_1.html).

<sup>57</sup> Marcia Fudge et al., Letter to Gina McCarthy, January 24, 2014, <http://www.api.org/~media/Files/News/2014/14-April/CBC-RFS-letter-McCarthy.pdf>.

<sup>58</sup> Anita Laurin, “Environmental Organizations Must Fight Bush’s Ethanol Surge,” May/June 2007, [http://www.sierraclubcentralohio.org/2007\\_05\\_Ethanol.asp](http://www.sierraclubcentralohio.org/2007_05_Ethanol.asp).

<sup>59</sup> Center for Regulatory Solutions, “New CRS Report: How Corn Ethanol Mandates Have Hurt Ohio’s Environment and Economy.”

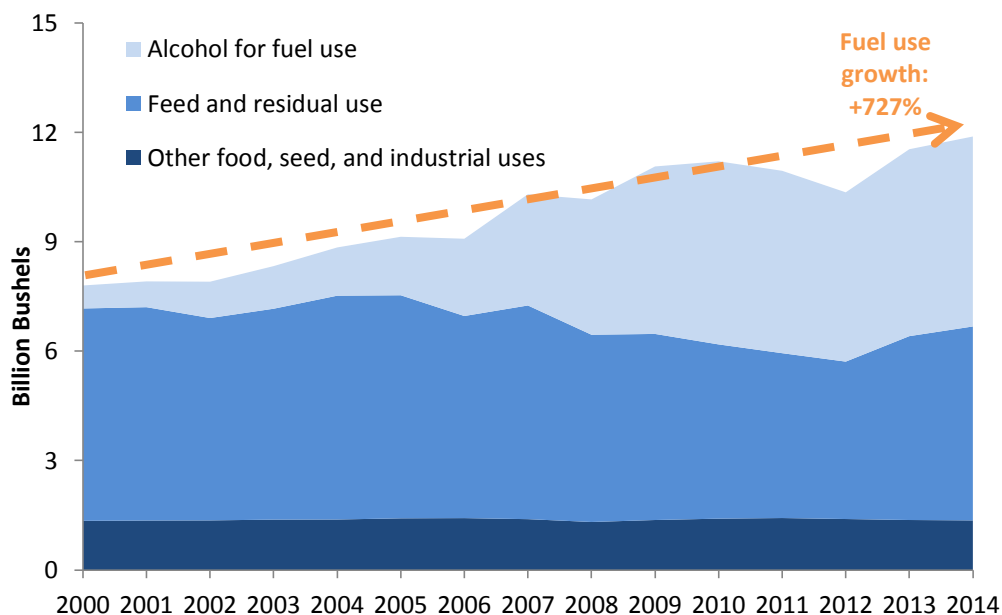
When opposition to corn ethanol mandates is this pronounced in a corn-growing state, it speaks to the program's deep faults and the public's growing understanding of those. Because even in corn-growing Ohio, the RFS clearly benefits a very narrow set of economic interests, while everyone else picks up the tab.

## Historical GHG and Criteria Pollutant Impacts of the RFS

When corn ethanol's emissions profile is accurately and properly calculated, it becomes clear that corn ethanol is worsening – not improving – our environment. A recent University of Tennessee [study](#)<sup>60</sup> found that ethanol's lifecycle greenhouse gas (GHG) emissions actually exceed those of gasoline when land use changes associated with its production are properly measured. In addition, the study found that lifecycle emissions of other pollutants – volatile organic compounds (VOCs), nitrogen oxides (NOx), particulate matter (PM), sulfur dioxide (SOx), and ammonia (NH<sub>3</sub>) – greatly exceed those of gasoline.

In order to better understand corn ethanol's effect on the environment, it's important to consider how the ethanol industry has changed over time. Using USDA [data](#)<sup>61</sup> on domestic corn usage, Figure 7 below shows that corn ethanol production grew from 630 million to 5.2 billion bushels, an increase of 727 percent in the United States over just the past 15 years.

**Figure 7: Corn Usage Across the United States, 2000-2014**



<sup>60</sup> De La Torre Ugarte and English.

<sup>61</sup> U.S. Department of Agriculture, Economic Research Service, "U.S. domestic corn use," <http://www.ers.usda.gov/media/866543/cornusetable.html>.

## Greenhouse Gas and Criteria Pollutant Emissions

When measuring the environmental impacts of expanding total corn ethanol production up to the statutory levels of the RFS (15 billion gallons), a lifecycle approach that encompasses land use changes (LUC) that occur throughout the entire process of ethanol production should be used. LUC is the conversion of land from native habitats or other existing cropland to cropland for corn. There are two types of LUC: direct and indirect. Direct LUC is the conversion of forest and grassland to cropland to provide feedstocks for biofuels production. Indirect LUC includes the price-induced market effects of farmers converting formerly unused areas to cropland for food production.

While there is relatively little corn ethanol production in California, it remains important to understand the full lifecycle impact inside and outside the borders of the Golden State. In terms of GHG emissions, this can be accomplished by applying [research from the University of Minnesota](#)<sup>63</sup> on ethanol and gasoline to historical data on California's consumption of ethanol.

Using this approach, the CRS analysis finds that California corn ethanol consumption has generated an additional 6.3 million metric tons of CO<sub>2</sub>-equivalent (CO<sub>2</sub>e) emissions across the U.S. since 2005.<sup>64</sup> These cumulative emissions are equivalent to the emissions of more than 1.3 million cars in a single year, according to EPA [estimates](#)<sup>65</sup> that show the average car emitting 4.8 metric tons of CO<sub>2</sub> per year.

In addition to GHG emissions relative to gasoline, the ethanol lifecycle also emits other pollutants heavily regulated by EPA, such as VOCs, NO<sub>x</sub>, PM, SO<sub>x</sub>, and NH<sub>3</sub>. The

*"Converting land that is now a 'carbon sink' to farmland producing ethanol also defeats the purpose of the regulations, because land now absorbing carbon dioxide would be cleared to produce corn."<sup>62</sup>*

**Dmitri Stanich**

*Public Information Officer, California Environmental  
Protection Agency*

*Jan. 9, 2014*

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<sup>62</sup> Corsi.

<sup>63</sup> Jason Hill, Stephen Polasky, Erik Nelson et al, "Climate change and health costs of air emissions from biofuels and gasoline," *Proceedings of the National Academy of Sciences of the United States of America* 106 (2009), <http://www.pnas.org/content/106/6/2077.full.pdf?sid=c28dd213-1611-4770-9241-534bf28b6521>.

<sup>64</sup> An in-depth discussion of this calculation is included in the Technical Appendix attached to this report. Note that the Technical Appendix also includes GHG impact estimates using lifecycle impact data from other studies. However, the Hill study provides middle-ground estimates and thus, the results are reported here.

<sup>65</sup> U.S. Environmental Protection Agency, "GHG Equivalencies Calculator – Revision History," <http://www2.epa.gov/energy/ghg-equivalencies-calculator-revision-history>.



emission of these pollutants has increased in California because of RFS-induced corn ethanol production and consumption (as shown in Figure 8). Controlling these pollutants is critical to the state and its counties for meeting EPA's strict clean air standards.

**Figure 8: Cumulative Incremental Lifecycle Pollutant Impacts in the U.S. resulting from Corn Ethanol Consumption in California between 2005 and 2014**

(Calculated using the [Hill Study](#) for incremental emissions and consumption from the [EIA SEDS](#) database)

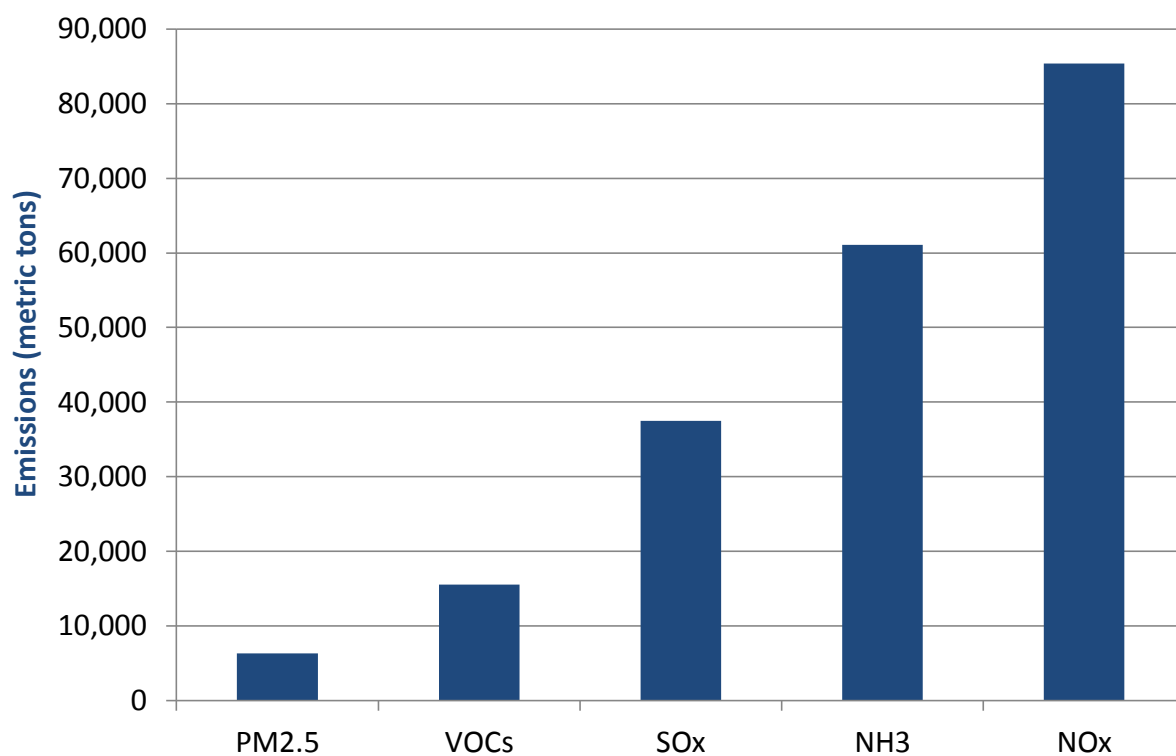


Figure 8 also shows that corn ethanol consumption in California has contributed approximately 15,500 tons of additional VOCs and 85,000 tons of additional NOx during the period of 2005 to 2014 in the U.S. environment.

## **Local Impacts: The San Francisco Bay Area**

To illustrate how the statewide impacts of the RFS can be felt at the local level, CRS sought a separate analysis of the increased fuel costs, economic, employment and environmental impacts of the RFS in the San Francisco Metropolitan Statistical Area (i.e. Alameda, Contra Costa, San Francisco, San Mateo, and Marin counties), more commonly known as the Bay Area. Using the same approach as the California-wide analysis, but with localized inputs, CRS found significant and serious impacts in the Bay Area stemming from the federally mandated consumption of corn ethanol.

### **Fuel costs**

As discussed earlier in this report, ethanol provides consumers with only [two-thirds of the energy content per gallon](#) compared to gasoline.<sup>66</sup> In other words, San Francisco consumers are suffering an economic loss because they are paying the same price for ethanol as gasoline but are getting one-third less mileage for each gallon of ethanol they consume. Based on estimated historical consumption (which ranges from 99 million gallons in 2005 to approximately 159 million gallons in 2014), Table 7 illustrates these additional corn ethanol costs.

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<sup>66</sup> U.S. Department of Energy, "Ethanol."

**Table 7: Additional Fuel Costs in San Francisco MSA  
due to RFS Mandates (millions of 2014 \$)**

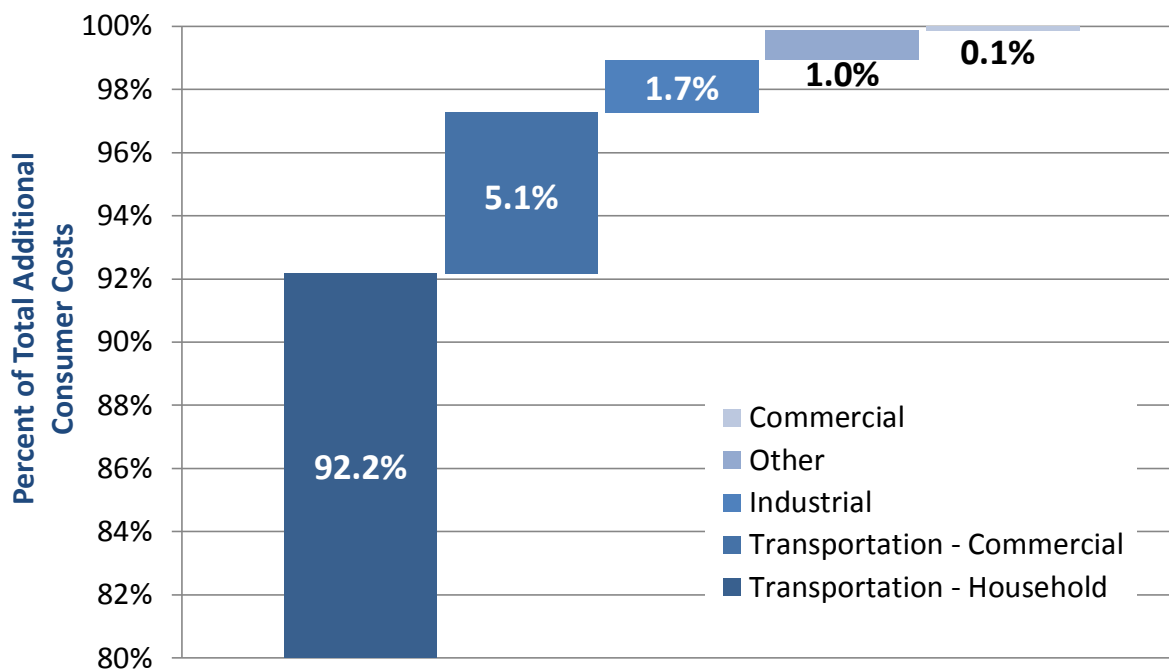
	2005-2014	2015-2024	Total
Year 1	122.8	285.2	
Year 2	218.2	216.6	
Year 3	130.7	367.4	
Year 4	127.8	348.2	
Year 5	103.4	334.7	
Year 6	121.6	298.8	
Year 7	184.7	300.3	
Year 8	94.3	286.2	
Year 9	123.4	278.9	
Year 10	132.3	264.5	
<b>Total</b>	<b>1,359.1</b>	<b>2,980.7</b>	<b>4,339.8</b>

To date, Table 1 shows that San Francisco consumers (Alameda, Contra Costa, San Francisco, San Mateo, and Marin counties) have paid an additional \$1.4 billion to use ethanol in their tanks since the RFS was first implemented in 2005. Based on projected consumption and the ethanol/gasoline price spreads, San Francisco consumers can expect to pay another \$3.0 billion in higher fuel costs over the 2015-2024 time period.<sup>67</sup> All told, San Francisco consumers can expect to spend over \$4.3 billion to comply with the RFS through 2024.

As shown in Figure 9, while consumers bear the brunt of higher fuel costs, other sectors are impacted as well. For example, the commercial and industrial sector in San Francisco will pay out more than \$77 million over 20 years in extra fuel costs. These are resources - money - that could have gone toward hiring more employees or increasing wages, business-related investments and expansions, or charitable donations to the local community.

<sup>67</sup> A discussion of these calculations is included in the Technical Appendix.

**Figure 9: Share of Additional Consumer Costs (Direct) in San Francisco MSA, 2005-2024**



In a similar fashion, the money that consumers lost to higher fuel costs could have been put to better use in myriad ways by households and businesses, or been used to support essential public services.

As discussed in the earlier statewide analysis, the ethanol-related increase in fuel costs can be viewed as a “corn ethanol tax” on consumers. In 2015, the Bay Area’s corn ethanol tax was \$285 million. For perspective, that is more than 50 percent of the [San Francisco Unified School District’s recommended budget](#)<sup>68</sup> for FY 2015-2016. But instead of remaining in the Bay Area, where it could have been put towards K-12 education, this money was transferred to mostly out of state ethanol producers.

<sup>68</sup> San Francisco Unified School District, “San Francisco Unified School District Recommended Budget for Fiscal Year 2015-16,” June 23, 2015, <http://www.sfusd.edu/en/assets/sfusd-staff/about-SFUSD/files/budget/Budget%20Book%20Master%20Vol%20I.pdf>.

### Overall economic impacts

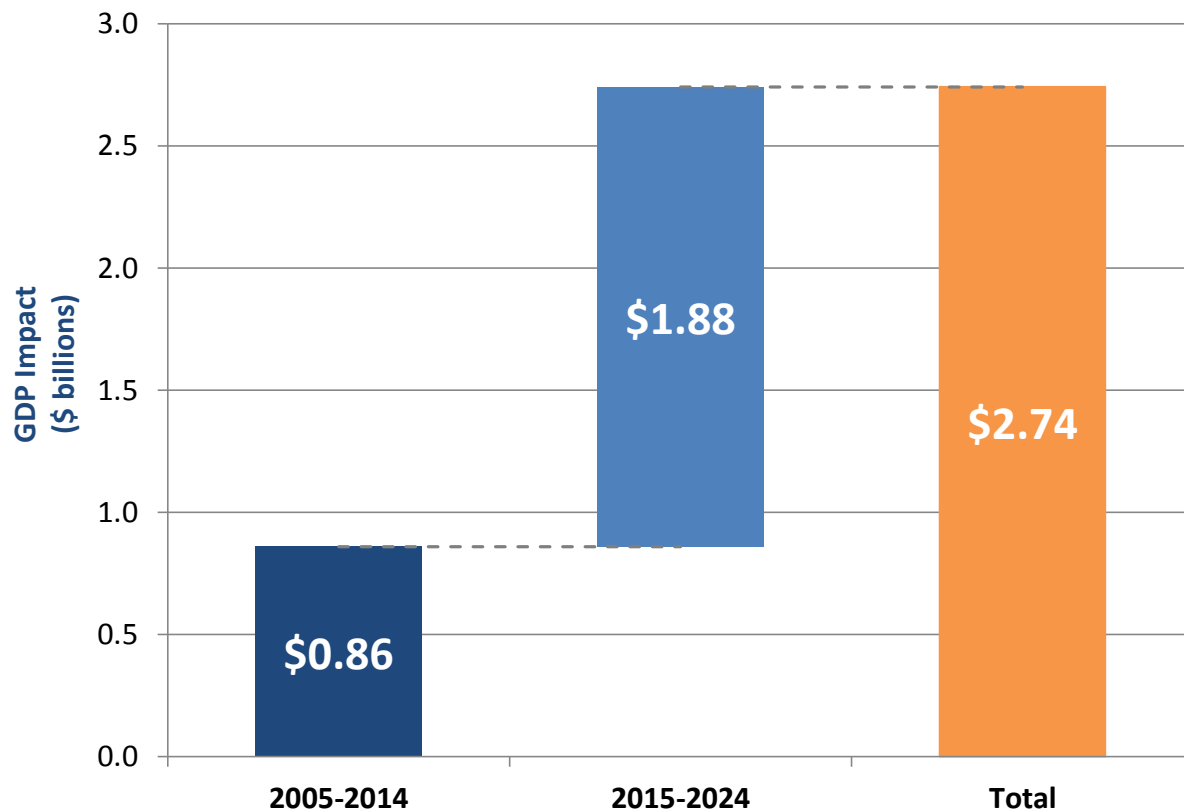
Using the IMPLAN model, it was possible to estimate the broader economic impacts of higher fuel costs in San Francisco due to the federal corn ethanol mandate. CRS found a cumulative cost from the RFS of \$2.74 billion in lost GDP opportunity between 2005 and 2024. This economic blow translates into a loss of \$1.6 billion in labor income and 1,349 jobs annually, as shown in Table 8.

**Table 8: Aggregate Economic Impacts due to  
Reduced Household Spending in San Francisco MSA, 2005-2024**

Economic Impact	Aggregate Economic Lost Opportunity
GDP	\$2.74 billion
Labor Income	\$1.63 billion
Annual Employment	1,349 jobs

As shown in Figure 10, residents of the Bay Area have already experienced a GDP opportunity loss of \$860 million since the RFS was established in 2005. If EPA continues to enforce the RFS without needed reforms, a further \$1.9 billion loss is expected over the next decade.

**Figure 10: Cumulative GDP Lost Opportunity in San Francisco MSA, 2005-2024  
(billions of 2014 \$)**

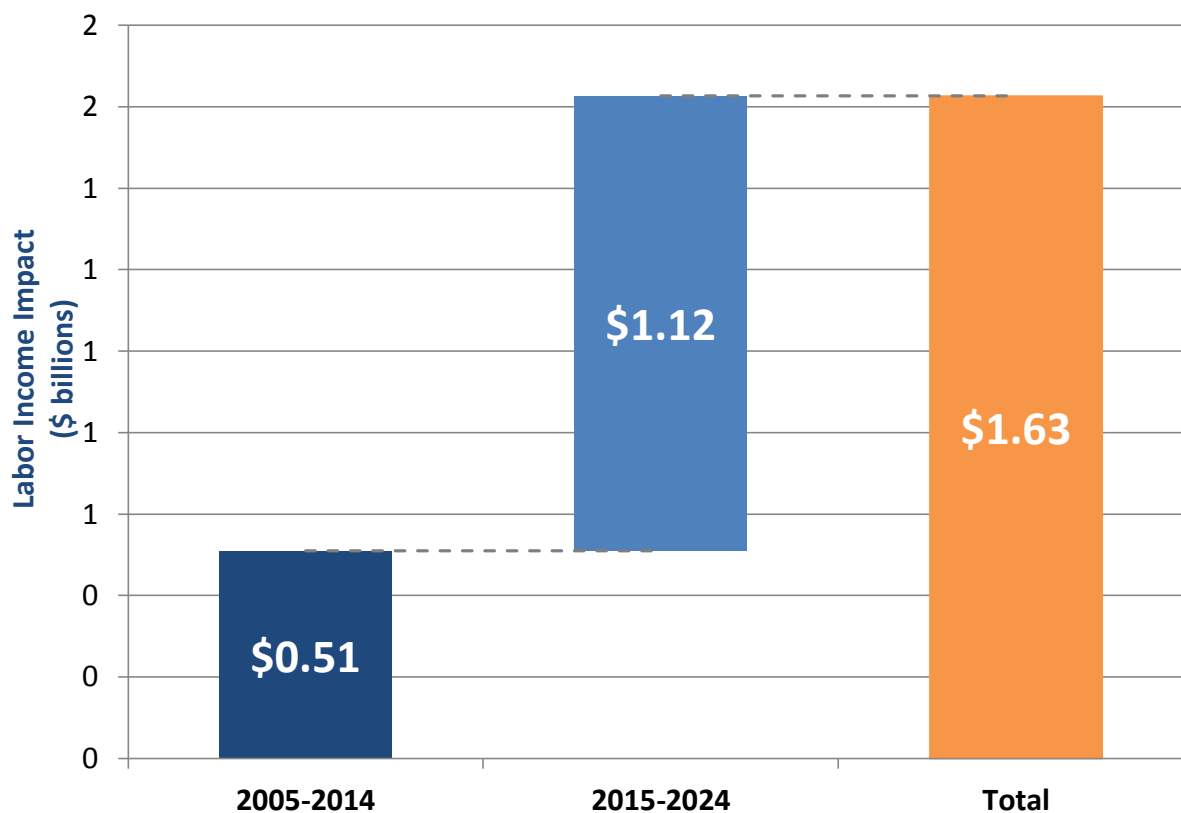




### Labor income and jobs

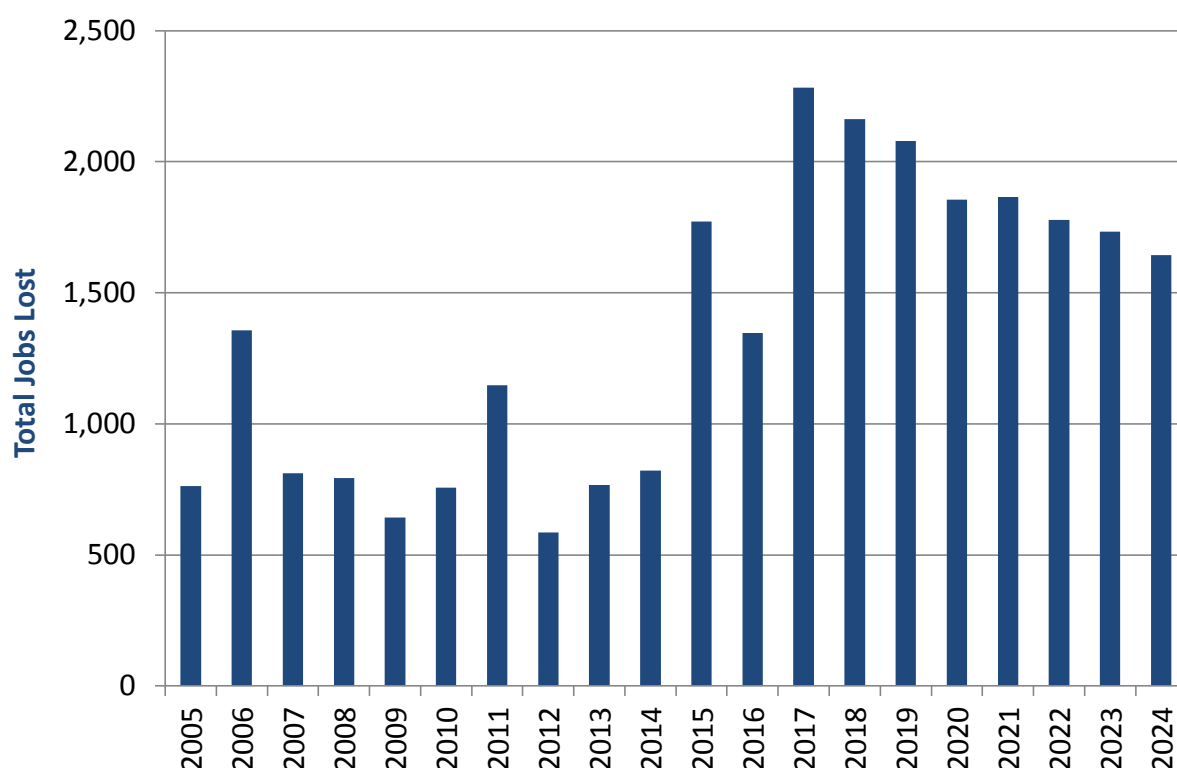
CRS also used the IMPLAN modeling to project the size and distribution of the loss of labor income due to the RFS mandate. The modeling suggests that the RFS resulted in a \$510 million loss in labor income across the Bay Area over the last 10 years, and without RFS reform, the region will lose an additional \$1.1 billion in labor income. Over 20 years, this grows into a \$1.6 billion loss for the region's workers and proprietors, as shown in Figure 11.

**Figure 11: Labor Income Impact in San Francisco MSA due to RFS Mandates  
(billions of 2014 \$)**



Repressed economic growth and reduced labor demand translates into lost jobs. Using the IMPLAN model, the CRS analysis found a loss of over 27,000 jobs in the Bay Area during the 20-year period between 2005 and 2024. On average, those costs translate roughly into 1,349 lost jobs per year. But, as Figure 12 shows, the bulk of the job loss impact has yet to be realized – it will spike in 2017 and stay close to 2,000 lost jobs annually thereafter unless the RFS is fundamentally reformed.

**Figure 12: Employment Loss in San Francisco MSA due to  
Lost Income from Additional Fuel Costs**



### GHG and Criteria Pollutant Impacts of the RFS

Earlier in this report, CRS estimated the GHG emissions and other pollutants tied to corn ethanol consumption in California. Using the same approach, the ethanol-related emissions for the San Francisco Bay Area can also be calculated.

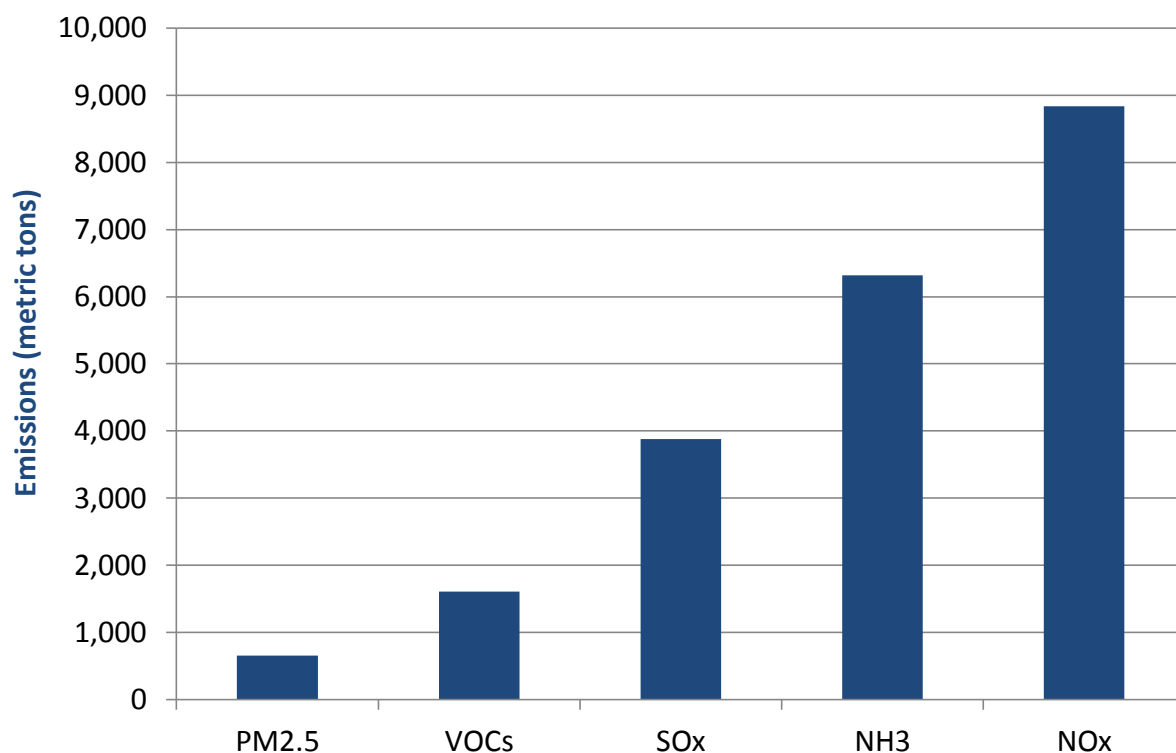
The CRS analysis finds that Bay Area corn ethanol consumption has generated an additional 655,000 metric tons of CO<sub>2</sub>-equivalent (CO<sub>2</sub>e) emissions across the U.S. since

2005.<sup>69</sup> These cumulative emissions are equivalent to the emissions of almost 138,000 million cars in a single year, according to EPA [estimates](#)<sup>70</sup> that show the average car emitting 4.8 metric tons of CO<sub>2</sub> per year.

In addition to GHG emissions relative to gasoline, the ethanol lifecycle also emits other pollutants heavily regulated by EPA, such as VOCs, NO<sub>x</sub>, PM, SO<sub>x</sub>, and NH<sub>3</sub>. The emission of these pollutants has increased because of RFS-induced corn ethanol production and its consumption in the Bay Area (as shown in Figure 13). Controlling these pollutants is critical to the state and its counties for meeting EPA's strict clean air standards.

**Figure 13: Cumulative Incremental Lifecycle Pollutant Impacts in the U.S. resulting from Corn Ethanol Consumption in the San Francisco MSA between 2005 and 2014**

(Calculated using the [Hill Study](#) for incremental emissions and consumption from the [EIA SEDS](#) database)



<sup>69</sup> An in-depth discussion of this calculation is included in the Technical Appendix attached to this report. Note that the Technical Appendix also includes GHG impact estimates using lifecycle impact data from other studies. However, the Hill study provides middle-ground estimates and thus, the results are reported here.

<sup>70</sup> U.S. Environmental Protection Agency, "GHG Equivalencies Calculator – Revision History."

Figure 13 also shows that corn ethanol consumption in the San Francisco Bay Area has contributed approximately 1,600 tons of additional VOCs and 8,800 tons of additional NOx during the period of 2005 to 2014 in the U.S. environment.

## How We Got Here

In July 2005, Congress passed and President Bush signed the bipartisan *Energy Policy Act*, which established the RFS. The RFS created a set of mandates – known as **Renewable Volume Obligations (RVOs)**<sup>71</sup> – that require ever-increasing volumes of ethanol to be added to the nation's fuel supply. Politicians supporting the ethanol mandate **promised**<sup>72</sup> a cleaner environment, enhanced energy security, and greater economic support for domestic farmers and rural communities across the country.

In 2007, after Democrats won control of the U.S. House and U.S. Senate, President Bush found common cause with the new congressional majority and greatly expanded the RFS mandates via passage of the *Energy Independence and Security Act* (EISA). Celebrating the agreement, then-Speaker of the House and California U.S. Representative **Nancy Pelosi** said: "We will send our energy dollars to the Midwest, not the Middle East."<sup>73</sup>

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<sup>71</sup> U.S. Energy Information Administration, "RINs and RVOs are used to implement the Renewable Fuel Standard," June 3, 2013, <http://www.eia.gov/todayinenergy/detail.cfm?id=11511>.

<sup>72</sup> George W. Bush, "President Signs Energy Policy Act," August 8, 2005, <http://georgewbush-whitehouse.archives.gov/news/releases/2005/08/20050808-6.html>.

<sup>73</sup> "House approves boost in auto fuel efficiency," *Oklahoman*, December 6, 2007, <http://newsok.com/house-approves-boost-in-auto-fuel-efficiency/article/3177809>.

In EISA, Congress **mandated**<sup>75</sup> that 100 million gallons of cellulosic ethanol – produced from non-starchy feedstock, such as grass, wood, and crop residues – had to be blended into the fuel supply in 2010, 250 million gallons in 2011, and then, from there,

*“The losers have been net consumers of food, including large numbers of the world's poorest peoples. The cause of this large global redistribution was no perfect storm. Far from being a natural catastrophe, it was the result of new policies to allow and require increased use of grain and oilseed for production of biofuels. Leading this trend were the wealthy countries, initially misinformed about the true global environmental and distributional implications.”<sup>74</sup>*

**Brian Wright**

*Professor of Agricultural and Resource Economics  
University of California, Berkeley, Feb. 5, 2014*

16 billion gallons by 2022. The amount of ethanol derived from corn was capped at 15 billion gallons, starting in year 2015.

However, the targets set by Congress, which included a mandate for the consumption of cellulosic ethanol, have proved imaginary – because converting cellulosic feedstock into usable energy is much more challenging than starch-based crops, like corn.

In fact, commercial volumes of cellulosic ethanol were essentially non-existent in 2010 and 2011, and only 20,000 gallons **were produced in 2012**<sup>76</sup> by a company that subsequently filed for bankruptcy. In 2013, about 230,000 gallons of cellulosic biofuel were **produced by KiOR**,<sup>77</sup> which went **bankrupt in 2014**.<sup>78</sup> In effect, Congress mandated the use of a fuel that did not – and still does not – exist on a commercial scale. In the last few years, production of cellulosic ethanol has increased modestly, but nowhere near the amount mandated by EISA.

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<sup>74</sup> Brian Wright, “Global Biofuels: Key to the Puzzle of Grain Market Behavior,” *Journal of Economic Perspectives* 28(1) (2014), <https://www.aeaweb.org/articles.php?doi=10.1257/jep.28.1.73>.

<sup>75</sup> Randy Schnepf and Brent D. Yacobucci (Congressional Research Service), “Renewable Fuel Standard (RFS): Overview and Issues,” March 14, 2013, <https://www.fas.org/srg/crs/misc/R40155.pdf>.

<sup>76</sup> U.S. Energy Information Administration, “Cellulosic biofuels begin to flow but in lower volumes than foreseen by statutory targets,” February 26, 2013, <http://www.eia.gov/todayinenergy/detail.cfm?id=10131>.

<sup>77</sup> Rob Nikoewski, “Is cellulosic biofuel ready for prime time?” Iowa Watchdog, June 15, 2015, <http://watchdog.org/223693/cellulosic-biofuel-ready/>.

<sup>78</sup> Robert Rapier, “Congress Mandates Cellulosic Ethanol and The EPA Tracks It,” *Energy Trends Insider*, May 20, 2015, <http://www.energytrendsinsider.com/2015/05/20/where-are-the-unicorns/>.

Despite this reality, EPA administrator Gina McCarthy, whose agency is responsible for implementing the RFS, is pledging to get the RFS mandate “[back on track](#)”<sup>79</sup> and eventually align its targets with congressional mandates. Pursuant to this strategy, EPA is proposing to set 2014 cellulosic levels to ones that align with what was actually produced and used as fuel, or 33 million gallons. For 2015 and 2016, EPA is proposing 106 million gallons in 2015 and 206 million gallons in 2016. This would allow set [volumes](#)<sup>80</sup> of corn ethanol to satisfy the total RFS mandate at 13.25 billion gallons, 13.4 billion gallons, and 14 billion gallons for 2014, 2015, and 2016 respectively. EPA is under court order to issue a final decision by November 30, 2015.

Despite the cost imposed on Massachusetts – \$9.337 Billion between 2005 and 2024 – U.S. Sen. Ed Markey (D-Mass.) support the RFS. In a recent [letter](#)<sup>81</sup> to EPA, he and his cosigners argued:

*“The RFS has already proven to be an effective driver of alternative fuels and economic development. It has strengthened agriculture markets and created hundreds of thousands of jobs in the new energy economy, many of which are in rural areas. Setting strong biofuels volume requirements for 2014 and beyond will ensure this progress continues.”*

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<sup>79</sup> Alex Guillen, “McCarthy vows to return to statutory RFS levels,” *Politico*, September 17, 2015, <http://www.governorsbiofuelscoalition.org/?p=14706>.

<sup>80</sup> U.S. Environmental Protection Agency, “EPA Proposes Renewable Fuel Standards for 2014, 2015, and 2016, and the Biomass-Based Diesel Volume for 2017,” May 2015, <http://www2.epa.gov/sites/production/files/2015-08/documents/420f15028.pdf>.

<sup>81</sup> Erin Voegelé, “37 senators issue letter in support of a strong RFS,” *Biomass Magazine*, April 24, 2015, <http://biomassmagazine.com/articles/11860/37-senators-issue-letter-in-support-of-a-strong-rfs>.



His predecessor in the U.S. Senate, John Kerry, initially [rejected](#)<sup>83</sup> federal support for corn ethanol, but then quickly changed his tune when running for president in 2003: “I’m for ethanol, and I think it’s a very important partial ingredient of the overall mix of alternative and renewable fuels we ought to commit to.”<sup>84</sup> In a 2006 [interview](#),<sup>85</sup> Kerry maintained that, “I did vote for ethanol. Every time we’ve had a chance to vote for it on the floor, I vote for ethanol.” Kerry now serves as U.S. Secretary of State.

*“The RFS policy was originally intended to counter rising oil imports and heightened demand for gasoline in the mid-2000s. But an unanticipated boom in domestic energy production, improvements in vehicle fuel economy technologies, unanticipated market failure of some ethanol products, and the weak economy disproved the assumptions that drove energy policies at the time... To make matters worse, higher ethanol fuel blends have less energy content than regular gasoline, delivering lower fuel economy. Ethanol contains 33 percent less energy per gallon than gasoline and that forces Americans to return to the pump more often and spend more money.”<sup>82</sup>*

**Gregory M. Cohen**

*President and CEO of the American Highway Users Alliance*

*“Highway Users Alliance on federal policy affecting I-90 commuters,” Cleveland.com, July 10, 2014.*

Presidential candidate and U.S. Sen. from Vermont Bernie Sanders was historically an ethanol opponent, having [written](#) the EPA in 2007 to “urge [the] Administration to carefully evaluate and respond to unintended public health and safety risks that could result from the increased use of ethanol as a ‘general purpose’ transportation fuel.”<sup>86</sup> And in 2011, Sanders proudly [boasted](#) that he had voted “to end the ethanol subsidy which would save taxpayers \$3 billion for the remainder of this year.”<sup>87</sup> But when asked for his views on the RFS during an [Iowa TV interview](#) earlier in 2015, Sanders sang a

<sup>82</sup> Gregory M. Cohen, “Highway Users Alliance on federal policy affecting I-90 commuters,” *Cleveland Plain Dealer*, July 10, 2014, [http://www.cleveland.com/opinion/index.ssf/2014/07/highway\\_users\\_alliance\\_on\\_fede.html](http://www.cleveland.com/opinion/index.ssf/2014/07/highway_users_alliance_on_fede.html).

<sup>83</sup> “John Kerry’s Flip Flops,” *Free Republic*, April 18, 2004, <http://www.freerepublic.com/focus/news/1119904/posts>.

<sup>84</sup> “Kerry Calls for Suspending Work of Base,” *Free Republic*, September 28, 2004, <http://www.freerepublic.com/focus/f-news/1096620/posts>.

<sup>85</sup> “Exclusive! Sen. John Kerry Enters the ‘No Spin Zone,’” *Fox News*, June 30, 2006, <http://www.foxnews.com/story/2006/06/30/exclusive-sen-john-kerry-enters-no-spin-zone.html>.

<sup>86</sup> U.S. Senate Committee on Environment & Public Works, “Bi-partisan letter urges President to consider health and safety issues that could result from increased use of ethanol as ‘general purpose’ transportation fuel,” December 7, 2007, <http://www.epw.senate.gov/public/index.cfm/press-releases-all?ID=B5C59B38-802A-23AD-4075-AAC3195DF9E8>.

<sup>87</sup> Andrew Schenkel, “Ethanol unites extremes of the Senate,” *Mother Nature Network*, June 17, 2011, <http://www.mnn.com/earth-matters/politics/blogs/ethanol-unites-extremes-of-the-senate>.

very different tune: “Iowa is one of the leaders in the country in wind and biofuels,” he said. “So, I support the Renewable Fuel Standard.”<sup>88</sup>

The rapid rise of San Francisco billionaire Tom Steyer from state-level environmental campaigns to the national political spotlight also tells the story of the ethanol lobby’s tremendous influence.

In 2010, after running a [successful campaign](#)<sup>89</sup> to defend California’s AB32 global warming law, Steyer was opposed to corn ethanol. “I saw in the paper the other day that [former vice president] Al Gore was saying that maybe he shouldn’t have been for ethanol,” Steyer told a reporter with *Forbes*.<sup>90</sup> “It’s kind of like duh! Did you ever take out your calculator on that one?”

But as Steyer’s career as a political activist and major Democratic donor took off, and as he increasingly worked in national political circles, his views on ethanol changed dramatically. In 2014, Steyer’s campaign arm, [NextGen Climate](#),<sup>91</sup> was very active in Iowa and told the news media: “The RFS supports 73,000 good-paying, clean energy jobs in Iowa and is helping us reduce our dependence on fossil fuels.”

More recently, Steyer [hosted a fundraiser](#)<sup>92</sup> for Democratic presidential candidate and former Secretary of State Hillary Clinton, whom the ethanol lobby has [praised](#)<sup>93</sup> for showing “strong and consistent support for the RFS.” Clinton was hardly alone. The pro-ethanol group America’s Renewable Future heaped similar praise on several other candidates, including Sanders, Maryland Gov. Martin O’Malley (D) and Republicans Donald Trump, Mike Huckabee, Rick Santorum, Chris Christie, Lindsey Graham and George Pataki.

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<sup>88</sup> “America’s Renewable Future Commends VT Sen. Bernie Sanders For Renewable Fuel Standard Support,” *Biofuels Journal*, September 15, 2015, [http://www.biofuelsjournal.com/articles/America\\_s\\_Renewable\\_Future\\_Commends\\_VT\\_Sen\\_\\_Bernie\\_Sanders\\_For\\_Renewable\\_Fuel\\_Standard\\_Support-153347.html](http://www.biofuelsjournal.com/articles/America_s_Renewable_Future_Commends_VT_Sen__Bernie_Sanders_For_Renewable_Fuel_Standard_Support-153347.html).

<sup>89</sup> Dana Hull, “Prop. 23 defeat sweet for Tom Steyer,” *San Jose Mercury-News*, November 3, 2010, [http://www.mercurynews.com/breaking-news/ci\\_16515271](http://www.mercurynews.com/breaking-news/ci_16515271).

<sup>90</sup> DuBois.

<sup>91</sup> Barron-Lopez.

<sup>92</sup> Andrew Restuccia and Elana Schor, “Steyer backs Clinton despite Keystone caution,” *Politico*, May 6, 2015, <http://www.politico.com/story/2015/05/tom-steyer-hillary-clinton-keystone-117707>.

<sup>93</sup> Erin Murphy, “Iowa advocacy group grades presidential candidates on ethanol support,” *The Gazette*, November 10, 2015, <http://www.thegazette.com/subject/news/iowa-advocacy-group-grades-presidential-candidates-on-ethanol-support-20151110>.

## Scientists, Experts Separate Fact From Fiction

Notwithstanding perceived political pressure, policy makers are slowly, sometimes reluctantly, coming to grips with the serious environmental costs of the government's corn ethanol mandate. These costs include increased GHG emissions, increased pollution of water and waterways, and increased emissions of ozone precursors.

Unlike politicians, the scientific community began sounding alarms about the RFS almost immediately after the mandate became law. In January 2008, a

[study](#)<sup>95</sup> in the journal *Science* warned that the RFS might undermine GHG reductions if the policy encouraged farmers to plow into untouched grassland or farmland that had been set aside for conservation. Developing this conservation land releases stored carbon dioxide and, therefore, increases GHG emissions. These concerns were [echoed](#)<sup>96</sup> by Dr. Dan Kammen and Dr. Michael O'Hare of the Energy and Resources Group at the University of California, Berkeley [emphasis added]:

*"As farmers rushed to find new places to plant corn, they touched off a cascade of unintended consequences, including the elimination of many acres of conservation land."*<sup>94</sup>

**Associated Press**

*"AP investigation explores hidden cost of ethanol."  
Associated Press, November 6, 2013.*

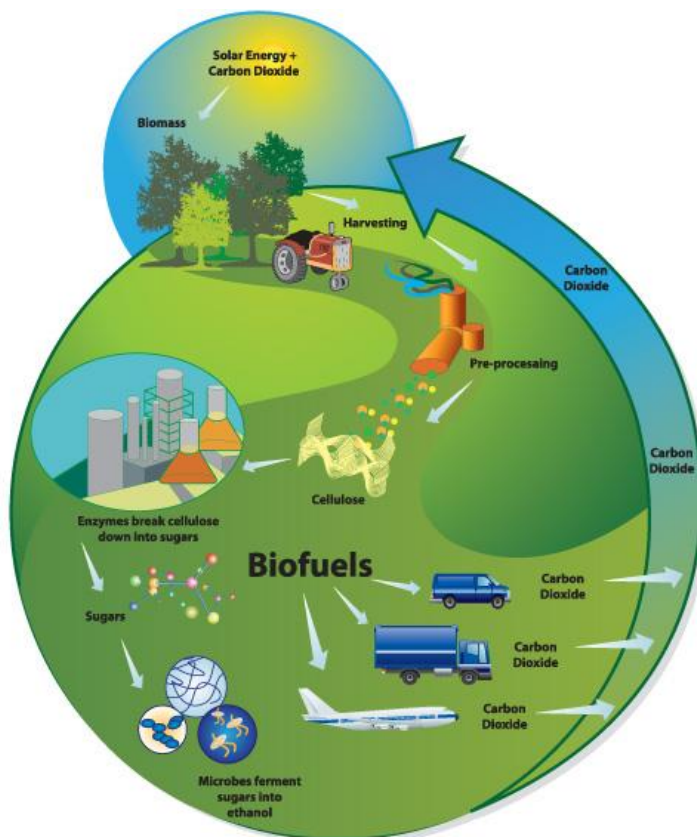
*"Simply said, ethanol production today using U.S. corn contributes to the conversion of grasslands and rainforest to agriculture, causing very large GHG emissions. ... [E]ven if only a small fraction of the emissions calculated in this crude way [through land use change] are added to estimates of direct emissions for corn ethanol, total emissions for corn ethanol are higher than for fossil fuels."*

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<sup>94</sup> "AP investigation explores hidden cost of ethanol," *Associated Press*, November 6, 2013, <http://www.ap.org/Content/Press-Release/2013/AP-investigation-explores-hidden-cost-of-ethanol>.

<sup>95</sup> Jörn P. W. Scharlemann and William F. Laurance, "How Green Are Biofuels?" *Science* 319 (2008), <http://www.sciencemag.org/content/319/5859/43.summary?maxtoshow=&HITS=10&hits=10&RESULTFORMAT=&fulltext=biofuels&searchid=1&FIRSTINDEX=0&resourcetype=HWCIT>.

<sup>96</sup> Alex Farrell and Michael O'Hare (Energy & Resources Group, University of California Berkeley). Memo to John Courtis (California Air Resources Board), January 12, 2008, [http://www.arb.ca.gov/fuels/lcfs/011608ucb\\_luc.pdf](http://www.arb.ca.gov/fuels/lcfs/011608ucb_luc.pdf).



Similarly, a [study](#)<sup>97</sup> produced by researchers from the University of Minnesota found that corn ethanol has a greater impact on climate change than gasoline. In 2011, the National Academy of Sciences (NAS) [reported](#)<sup>98</sup> that the RFS may be an ineffective policy for reducing global GHG emissions because of how biofuels are produced and what land-use or land-cover changes occur in the process. A 2013 [study](#),<sup>99</sup> published in the *Proceedings of the National Academy of Sciences*, used satellite data to confirm that the RFS encourages development of conservation land. The [graphic](#)<sup>100</sup> above shows the GHG lifecycle of ethanol.

In addition to adding to GHG emissions, the ethanol lifecycle emits higher concentrations of ozone precursors relative to gasoline. Nitrogen oxides and volatile organic compounds (VOCs) react in the atmosphere in the presence

<sup>97</sup> Jason Hill, Polasky, Nelson et al.

<sup>98</sup> National Research Council of the National Academies, "Summary" in "Renewable Fuel Standard: Potential Economic and Environmental Effects of U.S. Biofuel Policy," 2011, <http://www.nap.edu/read/13105/chapter/1>.

<sup>99</sup> Christopher Wright and Michael C. Wimberly, "Recent land use change in the Western Corn Belt threatens grasslands and wetlands," *Proceedings of the National Academy of Sciences of the United States of America* 110 (2013), <http://www.pnas.org/content/110/10/4134.full>.

<sup>100</sup> Hong Kong Special Administrative Region Government, Electrical and Mechanical Services Department, "Biomass Energy," <http://www.energyland.emsd.gov.hk/en/energy/renewable/biomass.html>.

*"Any defense of the ethanol policy rests on fallacies, primarily these: that ethanol produced from corn makes the United States less dependent on fossil fuels; that ethanol lowers the price of gasoline; that an increase in the percentage of ethanol blended into gasoline increases the overall supply of gasoline; and that ethanol is environmentally friendly and lowers global carbon dioxide emissions."<sup>101</sup>*

**Colin A. Carter**

University of California, Davis

**Henry I. Miller**

Hoover Institution, July 30, 2012

of sunlight to form ground-level ozone. According to a 2010 [study](#)<sup>102</sup> by Stanford researchers, vehicles running on E85 (a blend of gasoline and ethanol that is 85 percent ethanol) produce different byproducts than gasoline and generate substantially more aldehydes, which are precursors to ozone. The [NAS](#)<sup>103</sup> study also reported that overall production and use of ethanol will result in higher pollutant concentrations for ozone and particulate matter than gasoline on a national scale.

The National Oceanic and Atmospheric Administration ([NOAA](#)<sup>104</sup>) earlier this year confirmed the role that ethanol plays in contributing to higher ozone levels. NOAA found "a pretty substantial increase in ozone production from E85 at cold temperatures, relative to gasoline, when emissions and atmospheric chemistry alone were considered." Moreover, NOAA found that airborne emission levels captured downwind from an ethanol fuel refinery in Decatur, Ill., were 30 times higher than previous government estimates. VOCs were five times higher than inventories estimated, and emissions of ethanol itself, which is also a VOC, were about 30 times higher.

Ethanol production also exacts a heavy toll on water resources, from growing crops to processing those materials into the fuel. The 2011 [NAS study](#)<sup>105</sup> found that the increase in corn production had adverse environmental impacts on surface water and groundwater, including hypoxia, harmful algal blooms and eutrophication. The NAS paper predicted that additional increases in corn production – mandated under the law due to the RFS – would have additional negative environmental consequences.

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<sup>101</sup> Colin A. Carter and Henry I. Miller, "Corn for Food, Not Fuel," *New York Times*, July 30, 2012, [http://www.nytimes.com/2012/07/31/opinion/corn-for-food-not-fuel.html?\\_r=2](http://www.nytimes.com/2012/07/31/opinion/corn-for-food-not-fuel.html?_r=2).

<sup>102</sup> Louis Bergeron, "Stanford researchers: Ethanol results in higher ozone concentrations than gasoline," December 14, 2009, <http://news.stanford.edu/news/2009/december14/ozone-ethanol-health-121409.html>.

<sup>103</sup> National Research Council of the National Academies, "Summary."

<sup>104</sup> National Oceanic and Atmospheric Administration, "Quantifying the emissions from a large ethanol refinery," May 5, 2015, <http://research.noaa.gov/News/NewsArchive/LatestNews/TabId/684/ArtMID/1768/ArticleID/11152/Quantifying-the-emissions-from-a-large-ethanol-refinery.aspx>.

<sup>105</sup> National Research Council of the National Academies, "Summary."

*"[I]t is important to recognize that some of the assumptions underlying the RFS2 have turned out to be wrong, and that has created significant implementation challenges."<sup>106</sup>*

**Alliance of Automobile  
Manufacturers**

July 23, 2013

In light of all these environmental impacts, the EPA Inspector General (IG) recently announced an investigation into EPA's methodology for calculating the GHG benefits associated with the RFS. In a [letter](#)<sup>107</sup> posted on its website, the EPA IG said it "plans to begin preliminary research" to determine whether EPA has properly accounted for the full greenhouse gas emissions of biofuels. The IG indicated that it would be looking more closely at the 2011 NAS study, as well as others, to determine if EPA's analysis with respect to the RFS is properly supported.

## Growing Opposition to the RFS

In light of the serious economic and environmental impact associated with Washington's corn ethanol mandate, there are growing calls for reform. For example, U.S. Sen. Dianne Feinstein (D-Calif.) has co-authored the *Corn Ethanol Mandate Elimination Act of 2015* with U.S. Sen. Pat Toomey, a conservative Republican from Pennsylvania. According to Sen. Feinstein:

*"A significant amount of U.S. corn is currently used for fuel. If the mandate continues to expand toward full implementation, the price of corn will increase. According to the Congressional Budget Office, that would mean as much as \$3.5 billion each year in increased food costs. Americans living on the margins simply can't afford that."<sup>108</sup>*

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<sup>106</sup> Alliance of Automobile Manufacturers, "The alliance testifies before the House Energy and Commerce Committee's Subcommittee on Energy and Power," July 23, 2013, <http://www.autoalliance.org/index.cfm?objectid=DABF5DD0-F3B9-11E2-8898000C296BA163>.

<sup>107</sup> Patrick Gilbride (U.S. Environmental Protection Agency), Memo to Janet McCabe and Thomas Burke, October 15, 2015, [http://www2.epa.gov/sites/production/files/2015-10/documents/newstarts\\_10-15-15\\_rfs.pdf?cm\\_mid=5081307&cm\\_crmid=e7f555c5-d923-e411-becb-6c3be5a81b7c&cm\\_medium=email](http://www2.epa.gov/sites/production/files/2015-10/documents/newstarts_10-15-15_rfs.pdf?cm_mid=5081307&cm_crmid=e7f555c5-d923-e411-becb-6c3be5a81b7c&cm_medium=email).

<sup>108</sup> Feinstein.



Sen. Feinstein also argues that corn-based ethanol “stunted the growth of environmentally-friendly advanced biofuels like biodiesel and cellulosic ethanol,” which

*“Ethanol was always a way to help the corn industry, not the environment. The energy balances have always been terrible.”<sup>109</sup>*

**Bill McKibben**

*Founder, 350.org*

*“How Big Corn Is Killing the Earth,”*

*Yahoo! News. Nov. 15, 2013*

result in fewer emissions and don’t compete with food-based crops. Her concerns were recently **affirmed**<sup>110</sup> by Harvard Professor James H. Stock, who observed, “The current combination of RFS policy uncertainty, the E10 blend wall, high RIN prices, and low investment means that the RFS currently is imposing costs while failing to provide the future benefits associated with domestic, low-greenhouse gas, second-generation advanced biofuels.”

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<sup>109</sup> Steve Holt, “How Big Corn Is Killing the Earth,” *Yahoo! News*, November 15, 2013, <http://news.yahoo.com/big-corn-killing-earth-203905103.html>.

<sup>110</sup> James Stock (Center on Global Energy Policy, Columbia University), “The Renewable Fuel Standard: A Path Forward,” April 2015, [http://energypolicy.columbia.edu/sites/default/files/energy/Renewable%20Fuel%20Standard\\_A%20Path%20Forward\\_April%202015.pdf](http://energypolicy.columbia.edu/sites/default/files/energy/Renewable%20Fuel%20Standard_A%20Path%20Forward_April%202015.pdf).



*"It is not a good policy to have these massive subsidies for (U.S.) first generation ethanol. ... First generation ethanol I think was a mistake. The energy conversion ratios are at best very small. It's hard once such a program is put in place to deal with the lobbies that keep it going. ... The size, the percentage of corn particularly, which is now being (used for) first generation ethanol definitely has an impact on food prices. The competition with food prices is real."*<sup>111</sup>

**Former Vice President Al Gore**

November 22, 2011.

In California, rising opposition to the federal corn ethanol mandate prompted Democrats and Republicans to unite behind a 2012 measure [cutting off state funds](#)<sup>112</sup> for corn ethanol production. The following year, the State Assembly and State Senate unanimously passed a [joint resolution](#)<sup>113</sup> demanding that Congress reform the RFS "to expeditiously transition away" from corn and other "biofuel sources that compete with food production." Producing food for "our livestock and our people should take precedence over creating alternative fuels that have proven to be less energy-efficient than gasoline," the measure's lead sponsor, [Assemblymember Kristin Olsen \(R-Riverbank\)](#),<sup>114</sup> said afterwards.

Both environmentalists and business interests continue to be skeptical of the RFS. For example, Rob Green, the Executive Director of the National Council of Chain Restaurants [said](#)<sup>115</sup> the RFS "affects poultry, beef, pork, other agricultural products. And at a local level ... it costs \$18,000 a year for each restaurant because of the RFS. And if you sell more beef, it can be as high as \$35,000 a year per restaurant." National environmental groups like [Friends of the Earth](#), the [Environmental Working Group](#) (EWG), and the [Natural Resources Defense Council](#) argue that corn ethanol is actually hurting the environment. Environmental opponents of ethanol also include [Bill McKibben](#),<sup>116</sup> founder of the environmental activist group 350.org "Ethanol was always a way to help the corn industry, not the environment," McKibben said in 2013. "The energy balances have always been terrible."

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<sup>111</sup> Wynn.

<sup>112</sup> David G. Valadao, "California law eliminates ethanol funding."

<sup>113</sup> AJR 21.

<sup>114</sup> Olsen.

<sup>115</sup> Rob Green, "Rep. Welch: Ethanol mandate 'killing farmers,'" The Hill, April 10, 2014, <http://thehill.com/policy/energy-environment/203186-rep-welch-ethanol-mandate-h>.

<sup>116</sup> Holt.

Even [former Vice President Al Gore](#)<sup>119</sup> has said that his past support for corn ethanol was a “mistake” and candidly admitted that his position was influenced by his attempts to win votes in Iowa while running for president in 2000.<sup>120</sup> Gore and the environmental movement in general continually battle pro-business groups on a range of policy issues. But in criticizing the RFS, they have found a rare point of agreement.

In California, for example, the backlash against the RFS has brought together groups and individuals from across the political spectrum. San Francisco-based [Sierra Club](#) “opposes further deployment of corn-based ethanol based on its extremely dubious net carbon benefits and its unresolved direct and indirect environmental impacts.”<sup>121</sup> Meanwhile, the [California](#)

*“As a matter of lifecycle calculations, it takes so much energy to produce ethanol, and ethanol is itself such a mediocre fuel that it hardly saves any carbon emissions at all.”<sup>117</sup>*

**[Jonathan Zasloff](#)**

*UCLA School of Law, Aug. 14, 2012*

*“Unfortunately, the EPA has refused to follow even the limited environmental safeguards built into the RFS and as a result, the RFS is causing environmental degradation and making climate change worse. In addition, we are concerned about the impact that increased biofuel production driven by the RFS is having on global food prices. For these reasons, Friends of the Earth believes that the RFS must either be fixed or ditched.”<sup>118</sup>*

**[Friends of the Earth](#)**

[Dairy Campaign](#) argues “corn ethanol is an inefficient fuel source that provides no real environmental benefits and drives up the costs of food and feed.”<sup>122</sup> And the United Food and Commercial Workers Union has called the RFS “irresponsible” because it

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<sup>117</sup> Jonathan Zasloff, “Drive a Stake Through Ethanol’s Heart!” August 14, 2012, <http://legal-planet.org/2012/08/14/drive-a-stake-through-ethanols-heart/>.

<sup>118</sup> Friends of the Earth, “Renewable Fuel Standard,” <http://www.foe.org/projects/climate-and-energy/biofuels/renewable-fuel-standard>.

<sup>119</sup> Wynn.

<sup>120</sup> Ibid.

<sup>121</sup> Cellarius.

<sup>122</sup> “Dairy Campaign hopes to end corn ethanol subsidies.”

“negatively impacts food supplies and price, as well as jeopardizes much needed jobs throughout the Central Valley.”<sup>123</sup>

*“The corn fuel seemed like a good idea when it was invented, but even our immense agricultural industry can't feed us and fuel us at the same time. And some experts doubt that ethanol has any net benefit to air quality anyway, especially when the economic and environmental costs of producing it are factored in.”<sup>124</sup>*

**San Francisco Chronicle Editorial Board**

Oct. 17, 2012

Academics from leading California universities and think tanks have also joined the chorus of RFS opposition over the years. Colin A. Carter of UC Davis and Henry I. Miller of the Hoover

Institution, for example, argue it's simply wrong to claim that “ethanol is environmentally friendly and lowers carbon dioxide emissions.”<sup>125</sup> Jonathan Zasloff, a UCLA law professor, says the amount of energy it takes to produce ethanol from corn makes it “a mediocre fuel” which “hardly saves any carbon emissions at all.”

For similar reasons, environmental regulators in California have spent years clashing with the ethanol lobby about the “low carbon” attributes of ethanol when compared to gasoline. Corn ethanol “defeats the purpose” of the state’s low-carbon fuel standard “because land now absorbing carbon dioxide would be cleared to produce corn,” the California Environmental Protection Agency **warned in 2009**.<sup>126</sup>

Elected officials, donors, strategists and other players in national politics cannot claim they did not know about California’s grave concerns about the federal corn ethanol mandate. In the decade since the RFS was established, the editorial boards of numerous California newspapers have sounded the alarm. In 2007, the **Los Angeles Times**<sup>127</sup> warned “few are considering the environmental and economic effects of a massive, rapid rise in ethanol production [and] unless the mania ends soon, they could far outweigh any gains.” A year later, the **San Jose Mercury-News**<sup>128</sup> said “skeptics are

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<sup>123</sup> California Poultry Federation, “UFCW Joins Poultry and Dairy Industries in Opposition of Subsidies for Corn-Based Ethanol,” *PR Newswire*, April 21, 2011, <http://www.prnewswire.com/news-releases/ufcw-joins-poultry-and-dairy-industries-in-opposition-of-subsidies-for-corn-based-ethanol-120413534.html>.

<sup>124</sup> “Ethanol relief vital to state's cows.”

<sup>125</sup> Emily Cassidy, “Better Biofuels Ahead,” *AgMag Blog*, November 3, 2015, <http://www.ewg.org/agmag/2015/11/better-biofuels-ahead>.

<sup>126</sup> Corsi.

<sup>127</sup> “Drunk on ethanol.”

<sup>128</sup> “Editorial: U.S. must move carefully on biofuels policy.”

right to question the heavy U.S. focus on corn ethanol,” because of the impacts to the environment and food prices.

By 2012, the [San Francisco Chronicle](#)’s editorial board let readers know “some experts doubt that ethanol has any net benefit to air quality anyway, especially when the economic and environmental costs of producing it are factored in.”<sup>130</sup> The same year, the

[San Diego Union-](#)

[Tribune](#)<sup>131</sup> – which has a very different editorial viewpoint than the *Times*, *Mercury-News* or the *Chronicle* – said even a “modest benefit” in cutting emissions would not counterbalance the “significant harm to consumers.” Likewise, the [Orange County Register](#)<sup>132</sup> lamented in 2013 that the power of the “Midwest farm lobby and the renewable-fuels industry” keeps the RFS locked in place. “It certainly isn’t because ethanol is somehow good for the environment,” the *Register* concluded.

*“[T]he primary reason the ethanol mandate remains in place is because of the seeming unlikely coalition of the Midwest farm lobby and the renewable-fuels industry. It certainly isn’t because ethanol is somehow good for the environment.”<sup>129</sup>*

**[Orange County Register Editorial Board](#)**

Nov. 14, 2013

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<sup>129</sup> “Editorial: Ethanol mandate should be cut, if not killed.”

<sup>130</sup> “Ethanol relief vital to state’s cows.”

<sup>131</sup> “EDITORIAL: Time to end ethanol mandate.”

<sup>132</sup> “Editorial: Ethanol mandate should be cut, if not killed.”

## CONCLUSION

President Bush and Congress may have had good intentions when they created the RFS a decade ago. But the facts show those good intentions were misguided, and 10 years later, consumers in California continue to pay a heavy price for them.

The energy security benefits that were promised by ethanol proponents did actually come to pass – but not because of ethanol. Thanks to a domestic energy renaissance that transformed the United States from a huge importer of energy to the world’s largest producer of oil and natural gas, those critical benefits were realized. The promised environmental benefits have not materialized either. In fact, far from cutting GHG emissions, ethanol is staunchly opposed by many environmental groups because of its carbon footprint and other impacts on land and water resources.

Simply put, the RFS did not work and does not work, but Californians are still forced to pay for it. The economic toll for the region has already reached \$13 billion and could rise to \$42 billion over the next decade if nothing is done to fundamentally reform or rescind the program. Higher fuel and agricultural input costs may also destroy the equivalent of 347,000 jobs over 20 years. In effect, the RFS threatens to extract more than \$40 billion from the California consumers and small businesses and transfer the vast majority of that wealth to a narrow set of interests in the corn-growing states of the Midwest.

To be sure, support for the RFS remains strong in pockets of the Midwest where the vast majority of corn production takes place, and especially in Iowa, home of the first-in-the-nation presidential caucuses. Of course, the Corn Belt’s political influence cannot be underestimated – just ask today’s presidential candidates or even Tom Steyer, the billionaire climate activist who made the leap from California politics to the national stage and left all his ethanol worries behind.

But things are changing, and even in the Corn Belt, there is a rising tide of opposition to the RFS. As noted earlier in the study, [Ohio Gov. John Kasich \(R\)](#)<sup>133</sup> recently said the RFS “needs to be phased out” and the ethanol industry should “stand on its own” – to a crowd in Iowa no less. Gov. Kasich is far from alone: Democrats, Republicans, environmentalists and pro-business advocates in the Buckeye State are [criticizing](#) the corn ethanol mandates of the RFS.<sup>134</sup>

The rising level of opposition to corn ethanol mandates in a corn-growing state is demonstrative of the RFS program’s failure. The mandate is an even worse deal for communities outside the Corn Belt, and California’s economy has suffered enough

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<sup>133</sup> America’s Renewable Future, “Gov. John Kasich says RFS ‘needs to be phased out.’”

<sup>134</sup> Center for Regulatory Solutions, “The Lost Decade: How Corn Ethanol Mandates Hurt Ohio’s Environment and Economy.”

damage from this costly and badly conceived program. With corn ethanol interests pressuring the EPA to make the RFS even worse, responsible officials in California should continue their leadership on this issue and demand fundamental reforms before it's too late.

## Technical Appendix

This technical appendix explains the steps and calculations used to estimate the figures within this report. In each section below, we discuss the data, methodology and assumptions used to calculate the effect RFS has had on the California/San Francisco economy.

### Increased Fuel Costs

The calculation of increased fuel costs in California/San Francisco relies on data from the Energy Information Administration (EIA), Bureau of Labor Statistics (BLS), and the USDA Economic Research Service (ERS), and the California Energy Almanac.

The calculation of increased fuel costs are broken down into two periods: 2005-2014 (historical) and 2015-2024 (projected).

#### Historical Analysis:

Historical ethanol consumption data comes from the [EIA SEDS database](#).<sup>135</sup> We downloaded the energy consumption data for each state in the EIA's Pacific Region (CA, HI, OR, and WA),<sup>136</sup> but were only concerned with using the Mnemonic Series Names (MSN) of "ENTCP" and "MGTCP".<sup>137</sup> This data was then converted from thousands of barrels to millions of gallons (multiplying by 42 and dividing by 1,000).

For 2014, state-level ethanol consumption data was not available, so we estimated values by calculating the state's [share of total U.S. 2013 ethanol consumption](#),<sup>138</sup> multiplied by the [total U.S. 2014 ethanol consumption](#).<sup>139</sup> For example, California (1.50 billion gallons) accounted for 11.4% of total 2013 U.S. consumption (13.2 billion gallons). This same percentage was applied to total U.S. 2014 consumption (13.5 billion gallons) to get an estimated 2014 consumption value for California (1.53 billion gallons).

To estimate San Francisco's share of total consumption, we use [gasoline consumption by county](#)<sup>140</sup> provided by the California Energy Almanac. We then calculated the total gasoline consumption in the San Francisco MSA (Alameda, Contra Costa, San Francisco, San Mateo, and Marin counties) and compared this with California total

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<sup>135</sup> U.S. Energy Information Administration, "State Energy Data System (SEDS)," <http://www.eia.gov/state/seds/>.

<sup>136</sup> Note that states other than California are used to calculate state share of the region to be applied to projected consumption levels (which are only regional).

<sup>137</sup> EIA defines "ENTCP" as "Fuel ethanol total consumed" and "MGTCP" as "Motor gasoline total consumed" in thousand barrels. MGTCP is used to generate San Francisco's share of consumption as discussed further in this appendix.

<sup>138</sup> U.S. Energy Information Administration, "Energy Consumption Estimates for Major Energy Sources in Physical Units, 2013," [http://www.eia.gov/state/seds/data.cfm?incfile=/state/seds/sep\\_sum/html/sum\\_use\\_tot.html&sid=US](http://www.eia.gov/state/seds/data.cfm?incfile=/state/seds/sep_sum/html/sum_use_tot.html&sid=US).

<sup>139</sup> U.S. Energy Information Administration, "Frequently Asked Questions," <http://www.eia.gov/tools/faqs/faq.cfm?id=90&t=4>.

<sup>140</sup> California Energy Commission, "Retail Gasoline Sales by County," [http://energyalmanac.ca.gov/gasoline/retail\\_fuel\\_outlet\\_survey/retail\\_gasoline\\_sales\\_by\\_county.html](http://energyalmanac.ca.gov/gasoline/retail_fuel_outlet_survey/retail_gasoline_sales_by_county.html).

consumption between 2008 and 2012. As shown in the table below, San Francisco's share on consumption remained relatively flat over this time period.

**Appendix Table 1: San Francisco MSA Share of Total CA Gasoline Consumption  
(million gallons)**

		SF MSA	CA Gasoline Consumption	SF MSA Share of CA Total
	[a]	[b]	[c]	[d]
[1]	2008	1,593	15,308	10.4%
[2]	2009	1,560	14,982	10.4%
[3]	2010	1,461	14,917	9.8%
[4]	2011	1,507	14,518	10.4%
[5]	2012	1,549	14,367	10.8%
[6]	<b>Total</b>	7,670	74,093	10.4%

Notes:

EIA SEDS for CA consumption.

Next, we use the share calculated in the table above (row [6]) to estimate San Francisco's share of total ethanol consumption for each year in the analysis. This calculation assumes that there is the same ethanol blend in total CA gasoline consumption as there is in San Francisco gasoline consumption.

Once consumption for each year is calculated, we then look at the additional cost associated with ethanol consumption. To do this, we use data from the USDA ERS ([Fuel ethanol, corn and gasoline prices, by month](#)<sup>141</sup>). Ethanol has about one-third less energy content than gasoline. As such, we convert the ethanol price to a dollar per gallon gasoline equivalent and take the difference between this and the gasoline price per gallon for each month. The gasoline and ethanol prices are wholesale prices at Omaha, NE. We assume the same ethanol/gasoline price relationship for California/San Francisco.

Finally, to calculate the total additional fuel cost, we take the average ethanol to gasoline price difference over each year and multiply by the consumption. The ethanol to gasoline price difference is in nominal dollars, so we adjust the final additional costs based on the Consumer Price Index (CPI), provided by the BLS.

<sup>141</sup> U.S. Department of Agriculture, Economic Research Service, "Fuel ethanol, corn and gasoline prices, by month," November 2015, [http://www.ers.usda.gov/datafiles/US\\_Bioenergy/Prices/table14.xls](http://www.ers.usda.gov/datafiles/US_Bioenergy/Prices/table14.xls).



### Projected Analysis:

The projected (2015-2024) additional fuel cost is calculated using consumption data from the EIA's Annual Energy Outlook 2015 (AEO 2015) for Energy Consumption by Sector and Source, Pacific, Reference case. Total ethanol consumption is converted from quadrillion Btu (as shown in the table) to million gallons using the assumption that there are **76,330 Btu's per gallon of ethanol**.<sup>142</sup> The consumption is then allocated based California's share of the 2014 Pacific region total consumption. For example, California's 2014 consumption (1.53 billion gallons) is approximately 80% of the total Pacific region consumption for 2014 (1.92 billion gallons).

For ethanol to gasoline price differences, we use ethanol wholesale price projections from the AEO 2015 Petroleum and Other Liquids Prices, Reference case and wholesale gasoline prices from the AEO 2015 Components of Selected Petroleum Product Prices, United States, Reference case datasets. Both datasets are converted from 2013 dollars per gallon to 2014 dollars per gallon using CPI data from the BLS.

Finally, ethanol prices are converted to a dollar per gallon of gasoline equivalent and the ethanol to gasoline price difference is calculated. We assume the same ethanol/gasoline price relationship for California/San Francisco as in the AEO forecast. The total additional cost in the projected period is calculated by taking this price difference, multiplied by the consumption estimate for each region. As with the historical period, San Francisco's projected consumption is calculated using its share of total California consumption as described above.

### Breakdown by Industry Segment:

In order to break down the additional fuel costs into the various sectors, we use EIA'S AEO 2015 Energy Consumption by Sector and Source, Pacific, Reference case and Transportation Sector Energy Use by Fuel Type within a Mode, Reference case datasets. The first dataset is used to calculate what share of motor gasoline is consumed within the Pacific states and by which sector (e.g., Industrial, Commercial, Transportation, and Other). The relative share of each sector's consumption (weighted average from 2015-2024) is calculated and then applied to the total additional fuel costs, assuming that the motor gasoline used in each sector includes the same proportion of ethanol. The table below shows this calculation.

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<sup>142</sup> U.S. Department of Energy, "Alternative Fuels Data Center – Fuel Properties Comparison," [http://www.afdc.energy.gov/fuels/fuel\\_comparison\\_chart.pdf](http://www.afdc.energy.gov/fuels/fuel_comparison_chart.pdf).

**Appendix Table 2: Sector Shares of Gasoline Consumption**

		<u>Motor Gasoline Consumption (million gallons)</u>				
		Commercial	Industrial	Transportation	Other	Total
	[a]	[b]	[c]	[d]	[e]	[f]
[1]	2015	24.1	332.3	20,121.5	278.3	20,756.2
[2]	2016	23.2	330.3	20,089.3	278.9	20,721.7
[3]	2017	24.5	333.8	20,185.9	225.7	20,769.8
[4]	2018	25.2	336.4	20,196.4	171.0	20,729.0
[5]	2019	25.9	338.5	20,023.2	169.2	20,556.8
[6]	2020	26.5	339.0	19,839.3	167.6	20,372.4
[7]	2021	27.1	338.3	19,641.1	165.6	20,172.1
[8]	2022	27.7	337.2	19,422.9	163.1	19,950.9
[9]	2023	28.3	335.3	19,177.4	160.5	19,701.4
[10]	2024	28.7	333.5	18,917.4	157.8	19,437.5
[11]	2015-2024 Share	0.1%	1.7%	97.3%	1.0%	100.0%

Notes:

EIA data from AEO 2015.

To break out the transportation sector, we calculate household vs. commercial share of motor gasoline consumption (including E85) from the second dataset mentioned above (weighted average over the 2012-2024 period). This dataset includes consumption by Light-duty vehicles, Commercial Light Trucks, Freight Trucks, Bus Transportation, and Recreational Boats (all using motor gasoline). The transportation sector breakdown is calculated using the following shares:

**Appendix Table 3: Sector Shares of Transportation Gasoline Consumption (trillion Btu)**

		<u>Motor Gasoline including E85 Consumption (trillion Btu)</u>		
		Household	Commercial	Total
	[a]	[b]	[c]	[d]
[1]	2012	15,093	807	15,901
[2]	2013	15,208	824	16,032
[3]	2014	15,041	818	15,858
[4]	2015	15,171	833	16,004
[5]	2016	15,146	824	15,969
[6]	2017	15,068	819	15,887
[7]	2018	14,953	819	15,772
[8]	2019	14,788	816	15,604
[9]	2020	14,613	814	15,427
[10]	2021	14,424	809	15,233
[11]	2022	14,212	807	15,019
[12]	2023	13,980	806	14,786
[13]	2024	13,735	804	14,539
[14]	Share of Total	94.8%	5.2%	100.0%

Notes:

EIA data from AEO 2015.

To calculate the California/San Francisco impact, we calculate the aggregate household vs. commercial transportation impact using the relative share of consumption and multiply that by the total additional cost. Thus, the Transportation – Household share of total impacts for San Francisco would be as follows:

*\$4.3 billion total additional transportation fuel costs (San Francisco) x 97% transportation share x 95% household transportation share = \$4.0 billion*

## Economic Impacts

To calculate the economic impacts of the lost household income due to increased fuel prices, we rely on the IMPLAN model. We used the 2014 estimates for lost household income as a result of the RFS and ran IMPLAN for California/San Francisco. The IMPLAN model reports the GDP Impact, Labor Income Loss, and Employment Loss resulting from a change in household income.

To generate results for 2005-2024, we ran the following the steps:

1. Estimate the gasoline expenditure per household income category based on the results of the Bureau of Labor Statistics 2013 consumer expenditures survey.<sup>143</sup>
2. Allocate the overall household income loss to each household income category in proportion to each category's gasoline expenditures.
3. Input into IMPLAN the RFS-associated household income loss into each household category in 2014 dollars for each year from 2005-2024.
4. Generate results for GDP, Labor Income and Employment impacts.

## California Farming Data and Analysis

In order to estimate economic impacts of increased corn prices to California farmers, we rely on various reports and data from the USDA's National Agricultural Statistics Service (NASS). To further break down the size of the California's farming industry, we include the following table.

**Appendix Table 4: Breakdown of Farm Commodity Cash Receipts in 2014 (\$ thousands)**

(USD'000)	Sales	% of total sales	% of livestock sales
<b>All commodities</b>	<b>53,980,108</b>		
<b>Animals and products</b>	<b>15,317,425</b>	<b>28%</b>	
Dairy products, milk	9,358,087	17%	61%
Cattle and calves	3,719,100	7%	24%
Poultry and eggs	1,678,038	3%	11%
Hogs	37,809	0%	0%
Miscellaneous animals and products	524,391	1%	3%

**Source:** USDA ERS Farm Income and Wealth Statistics.

This table shows the following key points:

- In 2014, livestock and related products contributed nearly 30%, or \$15.3 billion, of California's agricultural revenues.
- Dairy cattle and milk production and poultry and eggs (which are particularly impacted by corn based feed price increases) account for 72% of livestock product cash receipts.

<sup>143</sup> U.S. Bureau of Labor Statistics, "Consumer Expenditures in 2013," February 2015, <http://www.bls.gov/cex/csxann13.pdf>.

Feed expenses account for a large share of livestock farmers' operating expenses. In total, feed expenses cost California farmers \$6.1 billion in 2012 alone.<sup>144</sup> However, four agricultural sectors accounted for 96%, or \$5.8 billion, of these feed expenses. On average, feed accounted for 54% of total operating expenses, as shown in the table below.

**Appendix Table 5: Feed Expenses by agricultural sector in 2012 (\$ thousands)**

	Operating expenses	Feed expenses	Feed expenses as % of operating expenses
Dairy Cattle and Milk Production	6,683,443,000	3,947,009,000	59%
Poultry and Egg Production	1,448,191,000	959,289,000	66%
Beef Cattle Ranching and Farming	1,617,283,000	475,217,000	29%
Cattle feedlots	1,000,314,000	441,146,000	44%
<b>Total</b>	<b>10,749,231,000</b>	<b>5,822,661,000</b>	<b>54%</b>

Source: *USDA Census of Agriculture, 2012*.

In estimating the impact of increased corn prices due to ethanol production below, we have not taken into account the price substitution impact of distillers' grain, a co-product of ethanol that to some extent can be used as a feed substitute. For poultry, the ability to digest cellulose from ethanol co-products is reduced because these animals are monogastric (i.e. their stomachs have only one compartment). This limits the benefit that these animals can draw from distillers' grain as substitution feed.<sup>145</sup>

Moreover, this analysis does not take into account the effect of substitution where farmers might have substituted lower cost feed during periods of high corn prices. Additionally, it could be the case that farmers are able to grow their own corn silage to reduce the impact of high corn prices; however, that is not reflected in the estimation.

### Dairy farmers' feed expenses

To calculate corn's contribution to dairy feed costs, we rely on the 2014 U.S. Farm Bill, which introduced a new Dairy Margin Protection Program that calculates the margin over feed cost. The average feed cost is calculated by using the sum of:<sup>146</sup>

<sup>144</sup> U.S. Department of Agriculture, "2012 Census of Agriculture."

<sup>145</sup> Richard Stillman, Mildred Haley, and Kenneth Mathews (U.S. Department of Agriculture, Economic Research Service), "Grain Prices Impact Entire Livestock Production Cycle," March 1, 2009, <http://www.ers.usda.gov/amber-waves/2009-march/grain-prices-impact-entire-livestock-production-cycle.aspx#.VkYd-LerSUI>.

<sup>146</sup> "Agricultural Act of 2014," <http://www.gpo.gov/fdsys/pkg/BILLS-113hr2642enr/pdf/BILLS-113hr2642enr.pdf>.

- 1.0728 times the price of corn per bushel, plus
- 0.00735 times the price of soybean meal per ton, plus
- 0.0137 times the price of alfalfa hay per ton.

The corn and alfalfa hay prices are those reported in the monthly NASS Agricultural Prices report. The price of soybean meal is the Central Illinois soybean meal price delivered by rail as reported in the Agricultural Marketing Service (AMS) Market News-Monthly.<sup>147</sup>

This formula is based on a feed ration that was developed by the National Milk Producers Federation in collaboration with animal nutritionists shown in the table below.<sup>148</sup>

**Appendix Table 6: Daily Quantities of Feed Ingredients for the Entire Herd**

Cow Type	<u>Quantity in Commercial Units (units/day)</u>					
	Proportion of Herd	Dry Matter Consumed (lbs/day)	Shell Corn (bu/day)	Corn Silage (tons/day)	Soybean Meal (tons/day)	Alfalfa Hay (tons/day)
Milking Cows	52.49%	47.1	0.3198	0.0229	0.0032	0.0059
Hospital Cows	1.05%	47.1	0.3198	0.0229	0.0032	0.0059
Dry Cows	8.82%	24.0	0.0249	0.0172	0.0020	0.0042
Replacement Heifers						
To calve within 1 year	18.53%	23.0	0.0239	0.0164	0.0020	0.0041
500 pounds and over	9.55%	15.0	0.0311	0.0107	0.0013	0.0022
Less than 500 pounds	9.55%	7.0	0.0363	0.0045	0.0006	0.0006

Source: "Foundation for the Future - A New Direction for U.S. Dairy Policy", National Milk Producers Federation, June 2010

Using the Dairy Margin Protection Program formula, we calculated the average feed cost per hundredweight of milk using the average 2012 component prices and corn's contribution to nutrient feed cost as shown in the table below.

<sup>147</sup> "U.S. Department of Agriculture, "2014 Farm Bill Factsheet - Margin Protection Program for Dairy (MPP-Dairy)," June 2015, [https://www.fsa.usda.gov/Internet/FSA\\_File/mpp\\_dairy.pdf](https://www.fsa.usda.gov/Internet/FSA_File/mpp_dairy.pdf).

<sup>148</sup> National Milk Producers Federation, "Foundation for the Future - A New Direction for U.S. Dairy Policy," June 2010, <http://www.nmpf.org/files/file/NMPF-FFTF-Narrative-Website-Version-FINAL-092010.pdf>. Marin Bozic (University of Minnesota), "Farm Bill Dairy Margin Formula Explained," August 19, 2013, <http://www.marinbozic.info/blog/?p=316>.

In addition to nutrients, feed costs include other non-nutrient inputs. We calculated the average non-nutrient input to animal feed to be 30% based on IMPLAN's 2013 national data on gross inputs for the "Other animal food manufacturing" sector. To the extent that farmers purchase raw feed directly and mix it themselves the non-nutrient component of feed expenses will be lower and the actual contribution of corn to farmer's feed expenses will be higher.

Accounting for the 30% non-nutrient input component results in a 38% contribution of corn to total feed costs by value:

**Appendix Table 7: Estimate of corn's contribution to 2012 dairy feed prices using the Milk Protection Program feed price formula**

	Calculation of contribution to nutrient feed cost (%)				
	2012 average price (USD) [A]	Multiplier [B]	Contribution to nutrient feed cost (USD) [A] x [B]	Contribution to nutrient feed cost (%)	Contribution to total feed cost (%)
Non-nutrient inputs					30%
Corn	6.65 per bushel	1.07280	7.14	54%	38%
Soybean meal	439.87 per ton	0.00735	3.23	25%	17%
Alfalfa hay	205.33 per ton	0.01370	2.81	21%	15%
<b>Total</b>			<b>13.18</b>	<b>100%</b>	<b>100%</b>

Source: Corn and alfalfa prices are the average monthly prices published in "Agricultural Prices", USDA, published monthly for 2012. Soybean meal price is average of daily 2012 prices from "Soybean Meal, Cent. Ill., rail, ton 48%" price series reported at [www.quandl.com](http://www.quandl.com), a database of the Wall Street Journal.

Note that the application of this result to California assumes that (1) California dairy farmers' feed rations mirror those used to derive the USDA's price formula; and (2) California has the same commodity price relationship as the 2012 average price used.

Finally, to calculate the impact to California, we run the following steps:

1. Multiply dairy farmers' feed costs (\$3.95 billion) by 38% (corn's share of feed costs) which equals \$1.50 billion corn-based feed cost.

2. Calculate the effect of the increased corn price by using the 40% no-RFS price reduction scenario in a recent University of Tennessee study.<sup>149</sup> It's worth noting that other reports have come up with similar conclusion. That is, the RFS and the associated corn ethanol boom have directly increased corn prices anywhere from 22-36%.<sup>150</sup> Multiplying by the \$1.5 billion total corn contribution calculated above for a total of \$598.4 million.

### Poultry farmers' feed expenses

To estimate the contribution of corn to poultry farmers' feed costs we relied on the feed ratios used in the USDA's calculation of the feed price ratios for broilers, layers and turkeys.<sup>151</sup> The USDA assumes rations consisting of approximately 58%, 75% and 51% corn for broilers, layers and turkeys, respectively.

We calculated corn's contribution by value to the feed costs for each of the three populations of poultry (broilers, layers and turkeys). The tables below show the calculation.

**Appendix Table 8: Prices of poultry feed components and the feed composition used the USDA's feed price ratios for broilers, layers and turkeys**

			Price multiplier to calculate feed cost per pound [B]		
	2012 average price (USD) [A]	Price unit	Broilers	Layers	Turkeys
Corn	6.65	per bushel	0.01036	0.0133929	0.0091071
Soybean	13.97	per bushel	0.00700	0.0041667	0.0046667
Wheat	7.55	per bushel			0.0035000

Source: "Agricultural Prices", USDA, published monthly for 2012. Feed contribution by pound of feed relies on USDA feed price ratios. See, for example, "Chapter Four. Parity Prices, Parity Ratio, and Feed Price Ratios", USDA, National Agricultural Statistics Service, page 4-16.

[http://www.nass.usda.gov/Surveys/Guide\\_to\\_NASS\\_Surveys/Prices/Chapter%20Four%20Parity%20and%20Feed%20Price%20Ratios%20v10.pdf](http://www.nass.usda.gov/Surveys/Guide_to_NASS_Surveys/Prices/Chapter%20Four%20Parity%20and%20Feed%20Price%20Ratios%20v10.pdf)

<sup>149</sup> De La Torre Ugarte and English, Figure 9, page 9.

<sup>150</sup> Scott Baier, Mark Clements, Charles Griffiths et al., "Biofuels Impact on Crop and Food Prices: Using an Interactive Spreadsheet," March 2009, <http://www.federalreserve.gov/pubs/ifdp/2009/967/ifdp967.pdf>. Colin Carter, Gordon Rausser, and Aaron Smith, "Commodity Storage and the Market Effects of Biofuel Policies," 2015, [http://arefiles.ucdavis.edu/uploads/filer\\_public/81/ba/81ba961d-fe7b-4629-8511-1b78fdf3b527/carter\\_rausser\\_smith.pdf](http://arefiles.ucdavis.edu/uploads/filer_public/81/ba/81ba961d-fe7b-4629-8511-1b78fdf3b527/carter_rausser_smith.pdf). Bruce A. Babcock (Iowa State University), "Impact on Ethanol, Corn, and Livestock from Imminent U.S. Ethanol Policy Decisions," November 2010, <http://www.card.iastate.edu/publications/dbs/pdf/10pb3.pdf>.

<sup>151</sup> See, for example, U.S. Department of Agriculture, National Agricultural Statistics Service, "Chapter Four. Parity Prices, Parity Ratio, and Feed Price Ratios," [http://www.nass.usda.gov/Surveys/Guide\\_to\\_NASS\\_Surveys/Prices/Chapter%20Four%20Parity%20and%20Feed%20Price%20Ratios%20v10.pdf](http://www.nass.usda.gov/Surveys/Guide_to_NASS_Surveys/Prices/Chapter%20Four%20Parity%20and%20Feed%20Price%20Ratios%20v10.pdf), pgs. 4-16.



**Appendix Table 9: Estimate of the percentage contribution by value of corn to poultry feed costs in 2012**

	Nutrient feed cost per pound [A] x [B]			Contribution to nutrient feed cost (%)		
	Broilers	Layers	Turkeys	Broilers	Layers	Turkeys
Corn	0.07	0.09	0.06	41%	60%	40%
Soybean	0.10	0.06	0.07	59%	40%	43%
Wheat			0.03			17%
<b>Total</b>	<b>0.17</b>	<b>0.15</b>	<b>0.15</b>	<b>100%</b>	<b>100%</b>	<b>100%</b>

Source: Based on figures in preceding table

Using the 2012 Census of Agriculture's poultry population figures for broilers, layers and turkeys we calculate the population-weighted average contribution of corn to nutrient feed costs by value. Adding a 30% non-nutrient input component, corn's contribution by value to total feed costs was about 38%.<sup>152</sup> The table below shows the calculation.

**Appendix Table 10: Estimate of population weighted corn feed contribution by value to poultry feed costs**

	Contribution to nutrient feed cost				Contribution to total feed costs
	Broilers	Layers	Turkeys	Population-weighted average	
Population	42,268,482	19,000,779	4,532,307	N/A	N/A
Non-nutrients	N/A	N/A	N/A	N/A	30%
Corn contribution to feed cost	41%	60%	40%	47%	33%
Soybean contribution to feed cost	59%	40%	43%	52%	36%
Wheat contribution to feed cost	0%	0%	17%	1%	1%

Note: 30% non-nutrient contribution to total feed cost is based on gross inputs for the U.S. "Other animal food manufacturing" sector as recorded in IMPLAN for 2013.

Source: Bird population as per "2012 Census of Agriculture", USDA. The preceding table shows the calculation of the corn feed % by value.

The poultry population calculation excludes pullets for laying flock replacement (4,633,558) and ducks (1,399,187). Ducks are excluded because the USDA does not calculate a feed ratio for ducks and the proportion of the included population is small (about 2%). Pullets are younger chickens that would likely consume less than their adult cousins, the layers. As layers consume relatively more corn by value than the other poultry categories, this is a conservative assumption.

The above calculation assumes that broilers, layers and turkeys consume the same amount of feed per head. As turkeys are larger they are likely to consume more per head than the broilers and layers. However, turkeys only comprise 7% of the calculated

<sup>152</sup> See discussion on dairy feed costs above for a discussion of the 30% non-nutrient input estimate.

population and any impact on the weighted average corn percentage is likely to be offset by the slightly greater number of pullets which consume a higher corn diet and are also excluded from the overall average.

Finally, to calculate the impact to California, we run the following steps:

1. Multiply poultry farmers' feed costs (\$959 million) by 33% (corn's share of feed costs) which equals \$314 million corn-based feed cost.
2. Calculate the effect of the increased corn price by using the 40% no-RFS price reduction scenario from the University of Tennessee study referenced above. We then multiply this reduction by the \$314 million total corn contribution calculated above for a total of \$126 million.

## Environmental Impacts

To estimate the environmental impacts of California/San Francisco's corn ethanol consumption, we rely on data from the Energy Information Administration (EIA) and various lifecycle emissions studies (as discussed further within each section below).

### Greenhouse Gas and Criteria Pollutant Analysis

For the GHG and criteria pollutant emissions analysis, we rely on consumption data provided by EIA. As with the additional fuel cost calculation explained above, the consumption data comes from the [EIA SEDS database](#).<sup>153</sup> This data was then converted from thousands of barrels to millions of gallons (multiplying by 42 and dividing by 1,000).

For 2014, state-level ethanol consumption data was not available, so we estimated values by calculating the state's [share of total U.S. 2013 ethanol consumption](#),<sup>154</sup> multiplied by the [total U.S. 2014 ethanol consumption](#).<sup>155</sup> As California/San Francisco is primarily a consumer of ethanol, we focus on the lifecycle impacts associated with total consumption. San Francisco area consumption was estimated using the methodology explained in the additional fuel costs section above.

Finally, we rely on the lifecycle GHG and criteria pollutant [study results](#)<sup>156</sup> from Dr. Jason Hill's "Climate change and health costs of air emissions from biofuels and gasoline" to provide a baseline of lifecycle emissions values for both GHG and criteria pollutants. Additionally, we also include in this technical appendix a range of GHG impacts using estimates from other lifecycle emissions studies.

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<sup>153</sup> U.S. Energy Information Administration, "State Energy Data System (SEDS)."

<sup>154</sup> U.S. Energy Information Administration, "Energy Consumption Estimates for Major Energy Sources in Physical Units, 2013."

<sup>155</sup> U.S. Energy Information Administration, "Frequently Asked Questions."

<sup>156</sup> Jason Hill, Polasky, Nelson et al.

To calculate GHG emission impacts of California/San Francisco’s corn ethanol consumption, we run the following calculation:

First, we start with California/San Francisco’s historical ethanol consumption for 2005-2014 as described above. Next, we take the difference between Dr. Hill’s estimate of gasoline and ethanol lifecycle emissions (to calculate the ethanol-only impact) as shown below.

**Appendix Table 11: Summary of Lifecycle GHG Emissions Caused by Production and Combustion of an Additional Billion Gallons of Ethanol (Gg of CO2e)**

Fuel	Life-cycle process emissions from biofuel production and combustion (excluding land use)	Loss of soil and root carbon accumulated since land converted to CRP	Carbon opportunity cost of converting land from CRP to bioenergy production	Total
Gasoline	7,520	0	0	7,520
Corn Ethanol (natural gas heat)	5,230	1,010	1,790	8,030
Net Corn Ethanol Emissions (Ethanol less Gasoline)				510

Finally, we calculate the consumption-related GHG impact by multiplying the incremental lifecycle emissions (compared with gasoline) by the state’s ethanol consumption. The table below shows this calculation for San Francisco.

**Appendix Table 12: Cumulative GHG Impact of Ethanol Consumption (metric tons CO2e)**

	Ethanol Consumption (million gallons)	Incremental Lifecycle GHG Emissions from 1 billion gallons of Ethanol Production & Combustion (Gg)	Metric Tons CO2e
[a]	[b]	[c]	[d]
2005	99	510	50,487
2006	98	510	49,884
2007	103	510	52,310
2008	104	510	53,128
2009	103	510	52,348
2010	159	510	81,298
2011	155	510	79,054
2012	150	510	76,559
2013	155	510	79,289
2014	159	510	80,899
Cumulative Impact			655,257

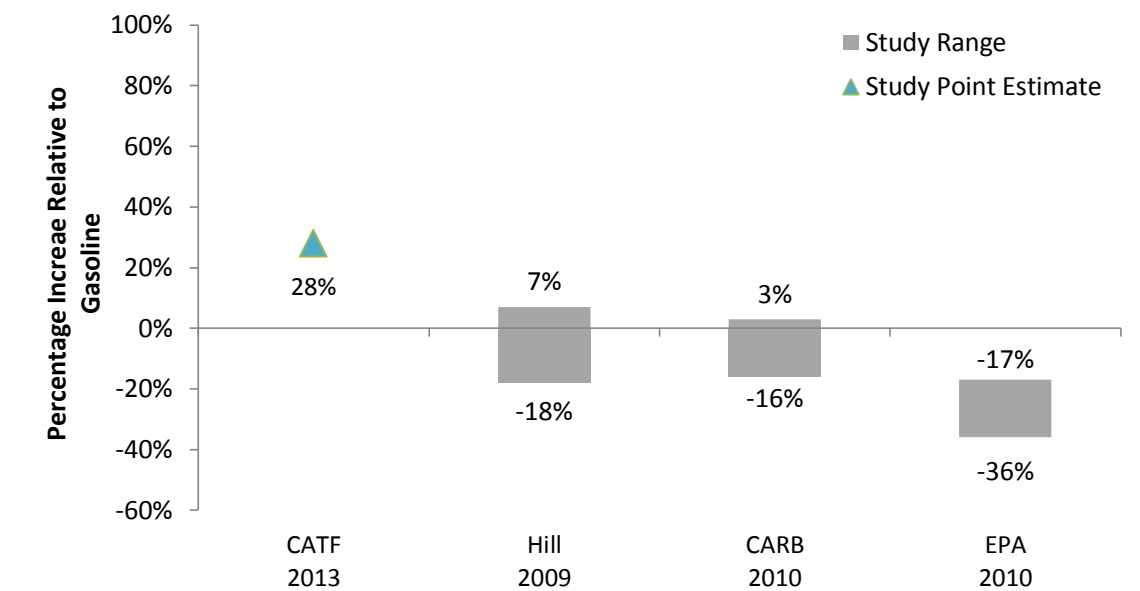
Notes:

2014 consumption figure is estimated based on 2013 share of U.S. total consumption.  
Assumes ethanol production using natural gas heat.

While the report relies on the Hill study, we also calculate the GHG impact using lifecycle emissions estimates from other studies for a basis of comparison. The figure below ([recreated from the University of Tennessee study<sup>157</sup>](#)) displays the range in lifecycle GHG emissions that is used to estimate the impacts in California/San Francisco for our different scenarios.

<sup>157</sup> De La Torre Ugarte and English.

Appendix Figure 1: Corn Ethanol GHG Lifecycle Emissions Increase Relative to Gasoline



As we discuss in the report, recent studies appear to challenge the EPA's estimate of lifecycle GHG emissions associated with corn ethanol production and consumption (as shown in the figure above).

To calculate each scenario, we use the Hill study as a baseline estimate of the volume of emissions and adjust it accordingly based on the scenario. For example, the CATF study states that corn ethanol produces 28% more GHG lifecycle emissions than gasoline. In this scenario, we would increase Dr. Hill's corn ethanol emissions estimates so that they represent a 28% increase over gasoline. We then run the calculation as described above to estimate the total impact. The results of each scenario are shown in the table below. Based on these results, we believe reliance on Dr. Hill's estimates provides a middle-ground estimation of the overall GHG impacts associated with the corn ethanol lifecycle.

**Appendix Table 13: Cumulative GHG Impact Associated with Ethanol Consumption in San Francisco, 2005-2014 (metric tonnes of CO<sub>2</sub>e)**

	CATF	Hill	CARB
<b>Incremental Emissions</b>	<b>2,705,310</b>	<b>655,257</b>	<b>289,855</b>
<b>Equivalent # of Cars in a Year</b>	<b>569,539</b>	<b>137,949</b>	<b>61,022</b>

For criteria pollutant impacts, we also rely on Dr. Hill's estimates as shown in the table below.

**Appendix Table 14: Summary of Lifecycle PM<sub>2.5</sub> Emissions Caused by Production and Combustion of an Additional Billion Gallons of Ethanol (Gg)**

Fuel	VOCs	NOX	PM <sub>2.5</sub>	SOX	NH <sub>3</sub>
Gasoline	4.78	5.78	0.55	1.55	0.79
Corn Ethanol (natural gas heat)	6.03	12.66	1.06	4.57	5.71
Net Corn Ethanol Emissions (Ethanol less Gasoline)	1.25	6.88	0.51	3.02	4.92

We follow the same exact methodology as the GHG impacts described above. Note that for production estimate adjustments, we rely on a separate study by the Argonne National Laboratory.<sup>158</sup> Consumption's share of total emissions range between 12-91% depending on criteria pollutant examined.

<sup>158</sup> Hong Huo, Ye Wu, and Michael Wang, "Total versus Urban: Well-to-Wheels Assessment of Criteria Pollutant Emissions from Various Vehicle/Fuel Systems," *Atmospheric Environment* 43 (2009), <http://www.sciencedirect.com/science/article/pii/S1352231008011588>.

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