An Analysis of the Effects of an Expansion in Biofuel Demand on U.S. Agriculture

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EXECUTIVE SUMMARY

This report was done at the request of Senator Saxby Chambliss. Additional specific issues addressed were developed in discussions with Congressional staff. The main purpose of the report is to assess the effects on agriculture of alternative levels of biofuels production from corn and soybean oil. In addition, the potential for expansion of cellulosic ethanol production is reviewed.

Scenarios. Two alternative scenarios of biofuel production are examined for crop years 2007-16 using an econometric model of the U.S. agricultural sector. Under Scenario 1, annual domestic ethanol production increases to 15 billion gallons by 2016, and annual domestic biodiesel production increases to 1 billion gallons. Under Scenario 2, annual domestic ethanol production increases to 20 billion gallons by 2016, and annual domestic biodiesel production increases to 1 billion gallons. The increase in ethanol production is assumed to use corn as the feedstock, and the increase in biodiesel production is assumed to use soybean oil. These scenarios compare with about 12 billion gallons of ethanol production and 700 million gallons of biodiesel production in 2016 in USDA's long-term agricultural projections released in February 2007 (baseline). During 2007-16, domestic ethanol production increases by an average of 2 billion gallons year under Scenario 1 compared with the baseline and by almost 5 billion gallons per year under Scenario 2. Domestic biodiesel production increases by an average of about 200 million gallons per year above the baseline during 2007-16 in both scenarios.

Corn and soybean market effects. The increase ethanol production increases the demand for corn. Corn used in ethanol is estimated at 2.15 billion bushels in 2006 crop year, accounting for 20 percent of corn production. Under Scenario 1, corn used in ethanol rises by an additional 1 billion bushels above the baseline by 2016, to 5.4 billion bushels, accounting for 37 percent of corn production. The increased corn demand attracts more acreage to corn and raises corn prices. Corn area planted rises to over 92 million acres by 2016 under Scenario 1, compared with 90 million acres in the baseline. The season-average farm-level corn price increases to $3.61 per bushel by 2016, $0.31 above the baseline. On average over 2007-16, corn prices rise by 6.3 percent ($0.22 per bushel) above baseline levels. Under the higher corn demand Scenario 2, corn used in ethanol production rises to 7.2 billion bushels, 47 percent of corn production, and area planted to corn increases to 98.5 million acres. Under Scenario 2, corn prices increase to $3.95 per bushel by 2016 and by 15.7 percent ($0.54 per bushel) above baseline levels on average over 2007-16.

Increased demand for soybean oil used to produce biodiesel increases the demand for soybeans. At the same time, the increase in the availability of ethanol coproducts (distillers' dried grains) due to increased ethanol production displaces some soybean meal in feed rations, which lowers the demand for soybeans. The net change in the demand for soybeans of these offsetting effects depends on the relative size of each separate shift in demand for the products. On balance, soybean prices increase less than corn prices, and soybean acreage declines relative to the baseline. On average, soybean prices increase by 3.9 percent ($0.27 per bushel) and 7.5 percent ($0.51 per bushel) above baseline levels over 2007-16 under Scenarios 1 and 2, respectively. Soybean planted area declines to

68.1 and 64.1 million acres, respectively, under Scenarios 1 and 2, by 2016, compared with 68.8 million in the baseline. Smaller acreage declines occur for wheat, cotton, and rice as well.

Higher corn and soybean prices reduce exports of these commodities below baseline levels. The quantity of corn exported declines by 4.8 percent and 12.0 percent, respectively, under Scenarios 1 and 2. Exports of soybeans decline by 2.8 and 5.3 percent under the corresponding scenarios. However, due to generally higher commodity prices, the value of total U.S. agricultural exports increases slightly under both scenarios.

Livestock and livestock product market effects. Overall, livestock production is reduced. However, impacts vary by livestock category because of the unique feeding requirements for each type of animal. Nonetheless, production impacts are small. Cattle can best use ethanol feed co-products compared with other livestock categories. Poultry benefit from lower priced soybean meal. However, hogs and dairy face higher feed costs increases. Consequently, under the higher corn demand Scenario 2, average annual dairy and pork production decline a respective 0.7 and 0.9 percent below baseline production levels over 2007-16. Poultry production declines 0.2 percent, and annual beef production is 0.6 percent higher. The higher feed costs and production declines are transmitted to higher farm and retail, prices. Hogs, milk, and broilers exhibit the largest farm price increases, with average price increases above the baseline of 5.4, 4.8, and 4.4 percent, respectively, over 2007-16 under Scenario 2. Retail prices for pork, dairy products, and poultry increase over the baseline by an average of 2.0, 1.4, and 1.9 percent annually during 2007-16 under Scenario 2.

While higher meat and dairy prices increase the Consumer Price Index (CPI) for all food, the increase is small. The CPI for all food increases by an annual average of 0.5 percent above the baseline during 2007-16 under Scenario 2. The highest annual increases are 0.8-1.0 percent and occur during 2014-16.

Income effects. Cash receipts from farm marketings of crops increase due to higher crop prices and higher aggregate crop demand under both scenarios. Crop cash receipts increase by an annual average of $3.2 and $7.7 billion above baseline levels, respectively, under Scenarios 1 and 2. Higher livestock prices cause livestock receipts to increase, on average, by $1.1 and $4.3 billion above baseline levels under the two scenarios. The increases in cash receipts outweigh increases in production expenses in both scenarios. Net farm income increases above baseline levels by an annual average of $2.6 billion during 2007-16 under Scenario 1 and by an average of $7.1 billion under Scenario 2.

Low yield effects. Generally tight stocks during the analysis period suggest that any production shortfalls, such as those caused by adverse weather, would heighten impacts under both scenarios until markets adjusted. A 10-percent reduction in corn yields was simulated to occur in 2012 to assess the corn price effects of a short crop. As a result of such a yield decline, corn prices rise in 2012 to $4.71 per bushel, $1.02 above the Scenario 1 level, and to $5.51 per bushel under Scenario 2, $1.46 above the Scenario 2 level.

Environmental effects. Regional analysis indicates that along with bringing new land into production, induced changes in crop rotations and tillage practices from increased corn production lead to increases in soil erosion and nutrient loading, particularly in the Corn Belt and Northern Plains, where adjustments are the greatest.

Regional livestock effects. Regional livestock sector analysis suggests no major shifts in livestock production with the advent of higher prices for corn and possibly other feeds driven by increased ethanol demand. The extensive infrastructure in place to support existing production, especially in vertically integrated industries, is a significant factor constraining regional shifts.

Cellulosic ethanol prospects. Cellulosic ethanol production effects were not considered in the analysis of Scenarios 1 and 2. While cellulosic-based ethanol production holds promise in the longer term, more research and development is needed to make the conversion process commercially widely viable. A number of factors will be important in determining which feedstocks will be used in producing cellulosic-based ethanol, including the ability to compete with existing agricultural commodities as well as the costs associated with producing, harvesting, transporting, handling, storing, and processing these various biomass materials. In the near term, agricultural and forest residues appear to be the most commercially viable feedstocks for cellulosic ethanol production.

AN ANALYSIS OF THE EFFECTS OF AN EXPANSION IN BIOFUEL DEMAND ON U.S. AGRICULTURE

The purpose of this analysis is to examine the potential effects on the U.S. agricultural sector of increasing domestic biofuel production above currently projected levels. USDA's long-term projections baseline assumes that by 2016 annual domestic ethanol production will reach 12 billion gallons and that annual domestic biodiesel production will reach 0.7 billion gallons. In this analysis, we examine two alternative scenarios. Under the first scenario, annual domestic ethanol production increases to 15 billion gallons, and annual domestic biodiesel production increases to 1 billion gallons by 2016. Under the second scenario, annual domestic ethanol production increases to 20 billion gallons, and annual domestic biodiesel production increases to 1 billion gallons by 2016. The analysis also examines the effects of a production shortfall in corn under both scenarios.

The USDA Baseline

The Renewable Fuel Program of the Energy Policy Act of 2005 increased the incentives to expand the use of biofuel within the United States. As a result of these and other incentives, including higher gasoline and diesel prices, domestic use of both ethanol and biodiesel has grown in recent years. Furthermore, the latest baseline released by USDA projects that biofuel consumption will continue to increase over the next 10 years.[1]

The USDA baseline assumptions on biofuel production over 2007-16 have a profound effect on the 10-year projections for agricultural commodities. Ethanol production is assumed to increase sharply through the 2009 marketing year. Thereafter, ethanol production is projected to increase at a more moderate rate. USDA is projecting that, by 2016, the United States will be using about 4.3 billion bushels of corn to produce about 12 billion gallons of ethanol per year, accounting for 31 percent of U.S. corn production and representing about 8 percent of gasoline use in the United States (Figure 1).

The USDA baseline also assumes that biodiesel production expands through the 2011 marketing year and then levels off. Our latest long-term projections estimate that, by 2016, the United States will be using about 5.1 billion pounds of soybean oil to produce about 700 million gallons of biodiesel per year, accounting for about 22 percent of U.S. soybean oil production, but less than 2 percent of U.S. highway diesel fuel use (Figure 2).

[1] USDA released two versions of its long-term projections in 2007, each based on a different set of assumptions. Under current law, blenders of biofuels receive tax credits. These credits are scheduled to expire in 2010 for ethanol and in 2008 for biodiesel. In addition, legislation also authorizes import tariffs for ethanol. Authorization for this program expires in 2008. One baseline released by USDA assumes that these programs terminate on their scheduled expiration dates. The alternative baseline used for this analysis assumes that these programs will be reauthorized and extended indefinitely (*USDA Agricultural Projections to 2016*, U.S. Department of Agriculture, Office of the Chief Economist, World Agricultural Outlook Board, OCE-2007-1, February 2007).

The price projections for corn and other commodities reflect these market forces. The season-average farm price of corn is projected to rise until 2009 when it reaches a high of $3.75 per bushel. Afterwards, prices adjust downward, as the rate of expansion in ethanol slackens and producers have time to adjust to the new market environment. By the end of the 10-year projection period, the price of corn is $3.30 per bushel. Prior to 2007, the highest corn price on record was $3.24 per bushel in the mid 1990's, a result of drought-reduced corn production.

As corn prices rise, the incentives to plant corn increase. Consequently, the baseline shows an expansion in area planted to corn. Area planted increases from 86 million acres in 2007 to 90 million acres in 2010. Thereafter, corn acreage remains constant. The area planted to corn has not been above 90 million acres since the 1940's.

The baseline therefore depicts a significant departure from historical price and production levels for corn. Because corn is one of the principal crops grown in the United States and because it is also the principal feed ingredient in livestock production, the baseline projections for corn also have ramifications for all the other major agricultural commodities. Their prices are higher than they would have been in the absence of the expansion in biofuel use.

Assumptions

To implement the scenarios, the increase in domestic biofuel production above baseline levels was assumed to occur gradually over 2007-16. The target levels of domestic production in each scenario are attained only in the final year of the analysis. Because virtually all current ethanol and biodiesel production is derived from corn and soybean oil, we assumed that all of the additional ethanol and biodiesel production implied by the scenarios would be manufactured from corn and soybean oil, respectively.

Tables 1 and 2 indicate the time-path of domestic ethanol and biodiesel production under both scenarios. For purposes of presentation, the 15-billion-gallon scenario is denoted as Scenario 1 and the 20-billion-gallon scenario is denoted as Scenario 2. The results from both scenarios are compared with the current USDA baseline.

The changes in the demand for corn used for ethanol implied by both scenarios are significant (Figure 3; Tables 1 and 2). Under Scenario 1, the annual demand for corn to produce ethanol increases by an additional 1 billion bushels over the USDA baseline by 2016. The increase in corn demand alone represents approximately 7.5 percent of the baseline production of corn in 2016. Under Scenario 2, the demand for corn to produce ethanol increases by an additional 2.85 billion bushels over the USDA baseline by 2016. This increase represents 20 percent of baseline corn production in 2016. In 2016, the total corn used in ethanol accounts for 37 percent of corn production in Scenario 1 and 47 percent in Scenario 2.

The increase in the annual demand for soybean oil used to produce biodiesel reaches 2.2 billion pounds by 2016 under both scenarios (Figure 4; Tables 1 and 2). This increase in soybean oil demand represents approximately 9.3 percent of the baseline soybean oil production in 2016. If biodiesel from soybean oil reached 1 billion gallons per year by 2016, about 31 percent of projected total domestic soybean oil production would be devoted to biodiesel production.

Ethanol can be produced from corn using either a wet milling or dry milling process. Most of the current expansion in ethanol production is based on dry milling. To simplify the analysis, we assume that all of the additional ethanol production from corn is manufactured through a dry milling process. Each additional 56-pound bushel of corn used in this process is assumed to produce 2.8 gallons of ethanol.

When a dry milling process is used to produce ethanol from corn, dried distillers' grains (DDGs) are manufactured as a co-product. The DDGs may be used as an animal feed, and any increase in their supply would displace other feeds used in livestock rations. The assumptions used in the analysis to account for this displacement are consistent with those used to develop the current USDA baseline.[2]

We assumed that 17.5 pounds of DDGs are produced for every bushel of corn used to produce ethanol. Of the additional DDGs entering the market, 75 percent displace other domestic feeds. The remainder is either exported or used for other nonfeed purposes domestically.

Ruminants assimilate the nutritional value of DDGs much more easily than monogastric animals. Consequently, most DDGs are fed to cattle. We assume that, of the DDGs used for feed domestically, 80 percent is used for beef cattle, 10 percent is used for dairy cattle, and 5 percent is used for both hogs and poultry.

The displacement factor of DDGs for corn in the feed ration depends on the type of animal. One pound of DDGs is assumed to displace one pound of corn for beef cattle, 0.45 pound of corn for dairy cattle, 0.85 pound of corn for hogs, and 0.55 pound of corn for poultry.

If we combine all of these assumptions, they imply that each additional bushel of corn used in the production of ethanol decreases the feed use of corn by approximately 0.2 bushel because of displacement by DDGs. The balance of the DDGs used in the domestic feed market displaces soybean meal in the feed rations. Thus, each additional bushel of corn used in ethanol production produces DDGs that displace approximately 1.2 pounds of soybean meal.

The price of DDGs is assumed to be related to the price of corn because DDGs primarily displace corn in the feed rations. As the quantity of DDGs increases, its price in relation to corn is assumed to decline.

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[2] The markets for the co-products of ethanol production have changed significantly in recent years due to the rapid influx of additional quantities of these products available for commercial use. To account for these industry changes, the assumptions used in this analysis differ in many respects from those that have been used in the past to conduct similar studies.

The analysis assumes that 1 gallon of soybean oil is required to produce 1 gallon of biodiesel and that each gallon of soybean oil weighs 7.35 pounds, consistent with the assumptions used in the USDA baseline.

National Level Impacts

National Modeling Framework. To estimate the impacts of greater biofuels production on the agricultural economy at a national level, this study uses the Food and Agricultural Policy Simulator (FAPSIM). FAPSIM is an annual econometric model of the U.S. agricultural sector. Commodities included in FAPSIM are corn, sorghum, barley, oats, wheat, rice, upland cotton, soybeans, cattle, hogs, broilers, turkeys, eggs, and dairy. Each commodity submodel contains equations to estimate production, prices, and the different demand components. The submodels are then linked together through common variables that are important to the different commodities. The model solution computes the market prices that equilibrate supply and demand in all commodity markets simultaneously.

Crop Prices. The increase in the quantity of corn used for ethanol leads to a net increase in the total demand for corn, even though some corn that would have been used for feed is displaced by DDGs. As a result, the price of corn received by farmers increases under both scenarios.[3] Under Scenario 1, corn prices increase by 6.3 percent above baseline levels, on average, over 2007-16. This compares with a 15.7-percent average increase under Scenario 2 (Figure 5; Tables 3 and 4). As would be expected, larger price impacts on corn are associated with larger increases in ethanol demand.

The higher corn prices cause producers to shift land from soybean production to corn. Lower soybean supplies exert upward pressure on farm prices. The net result on soybean prices is determined by the shifts in demand for its co-products.

There are two opposing forces operating on soybean demand. The increase in the availability of DDGs due to increased ethanol production displaces some soybean meal in feed rations. This displacement reduces the demand for soybeans. At the same time, the increased demand for soybean oil used to produce biodiesel increases the demand for soybeans. The net change in the demand for soybeans depends on the relative size of these separate shifts in the demand for the products.

Beef cattle account for 80 percent of the consumption of DDGs, and the cattle feeding industry primarily uses urea as a protein supplement in animal diets. The increase in DDGs used in their feed ration therefore has little effect on soybean meal demand. Of the remaining 20 percent, less than half of the DDGs displace soybean meal in the animal ration. Because the additional DDGs displace only a small portion of soybean meal, the increase in the demand for soybean oil dominates the decrease in the meal under both scenarios.

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[3] USDA publishes a number of different price series for crops. The crop farm prices discussed in this analysis are the season-average prices reported by the National Agricultural Statistics Service.

Because there is a net increase in the demand for soybeans, soybean prices increase under both scenarios. On average, soybean prices increase by 3.9 and 7.5 percent above baseline levels over 2007-16 under Scenarios 1 and 2, respectively (Figure 6, Tables 3 and 4).

Acreage shifts cause the price impacts to be greater under Scenario 2. The increase in the price of corn causes producers to shift land from the production of soybeans into corn. Because corn prices increase more in Scenario 2 than in Scenario 1, the shift in acreage is larger under Scenario 2. As a result, soybean production is lower under Scenario 2, which leads to greater price increases.

The price impacts on the markets for processed soybeans reflect the demand shifts already mentioned. The increased demand for soybean oil increases its price relative to the baseline, and the reduced demand for soybean meal decreases its price. Over 2007-16, soybean oil prices increase on average by 14.4 and 19.1 percent above baseline levels under Scenarios 1 and 2, respectively. The corresponding price declines in soybean meal prices are 5 and 3.9 percent.

Because soybean prices are higher under Scenario 2, the profit margin associated with crushing soybeans to produce meal and oil is lower. As a result, Scenario 2 yields less soybean crush, leading to lower supplies of both meal and oil. Therefore, both soybean oil and soybean meal prices are higher under Scenario 2 than Scenario 1.

Prices for minor feed grains likewise increase under both scenarios. Higher corn prices induce livestock producers to substitute other feed grains for corn in their animal rations, thereby leading to higher demand for these products. As would be expected, the price increases are larger under Scenario 2.

Prices for wheat, upland cotton, and rice also increase under both scenarios. The increases in the prices of corn and soybeans cause producers to shift acreage from wheat, upland cotton, and rice into corn and soybeans. This shift leads to reduced production of wheat, upland cotton, and rice, which causes their prices to increase. In addition, wheat competes with corn as cattle feed. Thus, with higher corn prices, producers substitute wheat for corn, placing additional upward pressure on wheat prices.

Area Planted. The increases in corn prices implied under both scenarios increase the profitability of producing corn versus producing soybeans. Producers respond by shifting land from the production of soybeans into corn. Corn area planted increases by 1.3 and 3.8 million acres, on average, from the baseline over 2007-16 under Scenarios 1 and 2, respectively. Corresponding to these changes, soybean area planted declines by 0.4 and 1.9 million acres from the baseline (Tables 5 and 6).

Because prices for minor feed grains increase under both scenarios, the incentives to plant these crops also increase. Their production increases slightly under both scenarios. Finally, the area planted to wheat, upland cotton, and rice declines somewhat under both scenarios, as producers expand the area planted to feed grains.

Total area planted increases under both scenarios due to the overall increase in profitability in the crop sector. Total area planted increases by 0.9 and 1.9 million acres, on average, under Scenarios 1 and 2, respectively. Thus, the area required to accommodate the expansion in ethanol production is composed of area planted to competing crops and from an overall expansion of area planted.

Other Crop-Sector Adjustments. Stocks and nonindustrial uses also adjust with the expansion in ethanol demand. In response to higher prices, corn export volume declines, on average, by 4.8 and 12 percent below baseline levels over the period of analysis under Scenarios 1 and 2, respectively. Feed use of corn declines for two reasons. First, DDGs are substituted for some corn in feed rations. Second, livestock producers, in aggregate, reduce production in response to higher corn prices. With fewer animals on feed, feed use declines by 5.9 and 13 percent below baseline levels under Scenarios 1 and 2, respectively. Stocks, however, register the largest declines. Stocks are reduced each year of the analysis in response to higher corn prices. Under Scenarios 1 and 2, stocks decline 27.3 and 62.8 percent below baseline levels, respectively (Tables 7 and 8).[4]

The situation is somewhat different for soybeans. The net shifts in demand for corn and soybeans caused by the increase in demand for biofuels are relatively stronger for corn. Consequently, soybean production declines under both scenarios. At the same time, the demand for soybean products also increases. Under Scenario 1, the demand effects are relatively stronger than the supply effects, causing the soybean crush to increase. Under Scenario 2, the reverse is true, and soybean crush declines below baseline levels. In both scenarios, both export and stock levels decline due to higher soybean prices. Exports decline by 2.8 and 5.3 percent below baseline levels, on average, under Scenarios 1 and 2, respectively. These changes correspond with a decline in stock levels of 7.4 and 14.1 percent (Tables 9-14).

Livestock. The livestock production impacts vary by livestock category because of the unique feeding requirements for each type of animal. Poultry producers use relatively more protein in feed rations than do other livestock producers. Thus, although poultry producers experience higher corn prices, they also benefit from lower soybean meal prices. Beef cattle producers also experience higher corn prices, but are able to substitute cheaper DDGs to replace a portion of corn in the feed rations. The analysis also assumes that the price paid by cattle producer for DDGs will be discounted more as the supplies of DDGs increase.

Tables 15 and 16 summarize the production impacts. Because hog and dairy producers experience the greatest increases in feed costs relative to other livestock producers, production of pork and milk declines under both scenarios. The reduction in pork supplies places upward pressure on retail pork prices. As a result, the retail prices of beef

[4] Under Scenario 1, the stock-to-use ratio never falls below 3 percent. Under Scenario 2, however, the stocks-to-use ratio is as low as 1 percent in the final years of the analysis. It is uncertain how low this ratio should be allowed to fall. If the analysis constrained the stocks-to-use ratio to be some value higher than 1 percent, then the price impacts associated with Scenario 2 would be somewhat higher than those described in the text.

and poultry increase as consumers substitute other meats for pork (Tables 17 and 18). This, in turn places upward pressure on farm-level prices of all meats. In addition, farm and retail prices for milk increase due to lower milk production under both scenarios (Tables 19 and 20).

Because of the substitution effects at the retail level, poultry prices rise as feed costs rise. As a result, poultry production changes only slightly under both scenarios. Similarly, beef production is virtually unchanged under Scenario 1. Under Scenario 2, however, the retail substitution effects dominate the feed cost effects and beef production increases somewhat above baseline levels.

Farm Income. Cash receipts from farm marketings of crops increase due to higher crop prices and higher aggregate crop demand under both scenarios. Crop cash receipts increase by $3.2 and $7.7 billion above baseline levels, on average over the projection period, under Scenarios 1 and 2, respectively (Tables 21 and 22). Although aggregate livestock production declines somewhat under both scenarios, livestock prices increase proportionally more. As a result, livestock receipts increase, on average, by $1.1 and $4.3 billion above baseline levels under Scenarios 1 and 2, respectively.

As crop producers expand aggregate production to meet the increased demand for biofuel, they increase input usage. As a consequence, their total expenses increase. In addition, livestock producers must pay more for both feed and for purchased livestock due to higher crop and livestock prices. Production expenses under Scenarios 1 and 2 increase by $1.6 and $4.9 billion on average, respectively.

As would be expected, the increases in cash receipts outweigh the increases in production expenses in the scenarios. Net farm income increases above baseline levels by $2.6 and $7.1 billion, on average over 2007-16, under Scenarios 1 and 2, respectively.

Value of Exports. The price increases for all of the commodities are proportionally larger than the corresponding export volume decreases under both scenarios. As a consequence, the total value of exports increases somewhat for agricultural products. Under Scenario 1, the total value of agricultural exports increases by $0.1 billion, on average, over 2007-16 versus $0.4 billion under Scenario 2 (Tables 23 and 24).

A Production Shortfall for Corn

Two additional scenarios were examined to determine how market prices might respond to a shortfall in the production of corn under the scenarios just discussed. Both scenarios imposed an identical single-year shock to corn yields. The yield per area harvested was reduced 10 percent below its baseline level in 2012.

Although the yield shock applied to both Scenarios 1 and 2 was the same, the yield shock implies somewhat different production shocks between the scenarios because the area harvested is higher under Scenario 2. The decline in corn production is 1,371 million bushels in Scenario 1, as opposed to 1,410 million bushels in Scenario 2. Thus, we would expect a somewhat higher price response in Scenario 2.

However, the difference in the production shocks applied to the scenarios has only a minor influence on the relative size of their price impacts. The key factors influencing the magnitude of the price impacts are the 2012 beginning stock levels under Scenarios 1 and 2.

The stocks-to-use ratio in both Scenarios 1 and 2 was constrained so as not to fall below approximately 1 percent in any year of the analysis. By 2012, the stocks-to-use ratio in Scenario 2 is close to this minimum. This implies that there are few stocks to buffer the market against a production shortfall. The situation in Scenario 1 is less severe. The stocks-to-use ratio in Scenario 1 is above 3 percent in 2012.

The price for corn increases $1.02 per bushel above 2012 baseline level in Scenario 1 with the production shortfall--equivalent to a 27.6-percent increase. The impacts are even larger under Scenario 2 where no buffer stocks exist. The corn price increases $1.46 per bushel above the value attained in Scenario 2, corresponding to a 36-percent increase.

Regional Implications of Increased Corn-Based Ethanol Production in 2016

Regional Modeling Framework. To analyze how the national results break down regionally, the Regional Environmental and Agricultural Programming (REAP) model was used to assess the effects of corn-based ethanol production for the regions shown in table 25. The model contains detailed data at the regional level on crop yields, input requirements, costs and returns, and environmental parameters to simulate long-run equilibrium outcomes from assumptions different from the USDA baseline. REAP explicitly models regional differences in crop rotations, tillage practices, and input use. To evaluate the impact of greater demand for biofuel feedstocks, REAP was run under the two ethanol demand scenarios and the output was compared with the results obtained when using the USDA baseline as a benchmark.

An increase in the demand for biofuel feedstocks will drive adjustments in the crop mix planted in each region of the country. Changes in production practices, expressed as the choice of crop rotations and tillage practice, lead to changes in fertilizer and pesticide use. These changes, in turn, affect soil, water, and air quality. This analysis uses the REAP model to estimate the deviations from the USDA baseline under the two alternative biofuel demand scenarios. The last year in the USDA baseline, 2016, is chosen as the REAP analysis year.

The main conclusion is that along with bringing new land into production, induced changes in crop rotations and tillage practices from increased corn production lead to increases in soil erosion and nutrient loading, particularly in the Corn Belt and Northern Plains, where adjustments are the greatest.

One limitation of the model is that crops not historically grown (as measured by the 1992 Natural Resources Inventory) in a region will not appear in the crop mix in an alternative scenario. Because corn is grown in all regions of the country, corn acreage will adjust in each region to the higher demand for ethanol. However, because soybeans are not grown in some regions (that is, soybean acreage equals zero in the baseline in some regions), soybean acreage will remain zero in those regions regardless of national price signals in this modeling framework.

A significant amount of cropland is allocated by contracts under the Conservation Reserve Program (CRP). This analysis assumes the acreage enrolled in the CRP, which is 39.2 million acres in 2016 under the baseline, remains constant in both scenarios. The actual allocation of CRP acreage among regions will depend on rental payments relative to the value of producing on eligible land.

The same biofuel demand scenarios discussed earlier are examined in the regional component of this study. The results of the two scenarios are compared with the USDA baseline in three areas: 1) the effect on planted acreage, 2) the effect on production practices and input use, and 3) the effect on key environmental indicators. Results are reported regionally with the USDA Farm Production Regions as the geographical units. See table 25 for the states that define the regions. Results are reported as total quantities and as percentage changes from the baseline values.

Regional Land Use Adjustments. Because of regional differences in the mix of crops planted, average yields, and production costs, the redistribution of crops under the biofuel demand scenarios will vary among regions. The increase in demand for corn leads to an increase in corn acres planted in all regions. A total of 2.2 million additional acres of corn are planted above the baseline in Scenario 1 and 8.5 million acres above the baseline in Scenario 2. Figure 7 shows the percentage increase in planted corn acres in each region. In Scenario 1, the increase over the baseline in each region ranges from about 2 percent (Pacific) to 5 percent (Delta). In Scenario 2, the increase ranges from 5 percent (Pacific) to over 30 percent (Delta). While some of the additional corn acreage comes from bringing new land into production, some corn acreage comes from reductions in planting of other crops. Soybean acreage declines in all regions in Scenario 1, except for an increase of 0.7 percent in the Corn Belt (Figure 8). Declines on the order of a half million soybean acres are seen in the Lake States, Northern Plains, and Appalachian regions, with a decline of nearly 2.5 million soybean acres in the Delta. All regions show a decrease in soybean acreage under Scenario 2.

Crop Rotations. As the demand for corn increases, farmers will have incentives to devote more acreage to corn. There are two means to achieve this. One is to bring new land into production. In REAP, idle land can be brought into production if the return is positive for doing so. Another means is to reduce the practice of multi-crop rotations in favor of continuous corn rotations, or to increase the amount of multi-crop rotations that include corn at the expense of crop rotations that do not include corn. The model seeks the allocation of crop acreage and practice such that the marginal returns on each additional acre are equal. If this were not the case for a given rotation, farmers would have an incentive to plant that extra acre, further driving the price down and reducing the marginal return.

The distribution of crop rotations changes under both biofuel demand scenarios in all regions. Because of the large number of crop rotations contained in the model, rotations have been grouped into representative classes: corn only, corn with another (non-soybean crop), corn with soybean, soybean with other crop, and other crops (including single cropping and multi-crop rotations). The distributions for the three largest crop acreage regions (Corn Belt, Northern Plains, and Lake States) are shown in figures 9-11, along with the change in acreage relative to the baseline scenario. In all three regions, the acreage devoted to continuous corn rotations increases, as does acreage in corn/other crop rotations. The acreage under corn/soybean rotation changes very little, in percentage terms. In the Corn Belt under Scenario 1, both continuous corn and corn/soybean acres increase, with a slight reduction in planting of other crops. Corn in rotation with non-soybean crops increases significantly in Scenario 2 in the Lake States and Northern Plains, whereas a modest increase is shown in the Corn Belt.

Tillage Practices. The economics that drives the move toward different crop rotations also drives the choice of tillage practice. Farmers will employ the practice that generates the highest returns and is in compliance with soil conservation requirements. The choice of tillage practice has environmental implications. Tillage may be unmanaged, whereby the soil is turned and weeds and crop residue removed, or a conservation tillage practice may be used. Conservation tillage refers to a number of strategies and techniques for establishing crops in a previous crop’s residues, which are purposely left on the soil surface. The principal benefits of conservation tillage are improved water conservation and reduced soil erosion. Additional benefits include reduced fuel consumption, reduced compaction, planting and harvesting flexibility, and reduced labor requirements. REAP models five tillage practices: two unmanaged practices (conventional and moldboard plowing) and three conservation practices (mulch, ridge till, and no-till).

Figures 12 and 13 show the distribution of tillage practices used in the two major crop-growing regions, the Corn Belt (corn and soybeans) and the Northern Plains (wheat and corn). In the Corn Belt, the increase in crop acreage leads to an increase in use of all tillage types except moldboard. Mulch tillage increases more than conventional tillage. In the Northern Plains, no-till and conventional tillage increase, with mulch tillage use decreasing.

Fertilizer and Pesticide Use. The rotation and tillage practices chosen dictate the fertilizer regimen required for achieving maximum crop yield for a given region. A move away from multi-crop rotations to continuous corn rotation, and away from conservation tillage to conventional tillage, leads to an increase in fertilizer requirements. Tables 26-28 show total nitrogen, phosphorus, and potash fertilizer application regionally and nationally, along with percentage changes from the baseline. Nitrogen fertilizer use increases in every region except for the Pacific region. The percentage increase is at or above the national average in the main corn-growing regions under both scenarios. Phosphorus fertilizer use also increases, but to a lesser extent than for nitrogen fertilizer. Potash fertilizer use increases nationally, but decreases in the Southeast, Delta, Mountain, and Pacific regions. This is mainly a consequence of the shift toward more corn acreage in the traditional corn- producing regions. In Scenario 2, nitrogen fertilizer use increases by over 6 percent nationally. Similar results are seen for pesticide application (table 29), with the largest percentage increases in the Northern Plains and Appalachian regions.

Nutrient Deposition to Groundwater. Nutrients that are applied to the soil and not taken up by crops have the potential to contaminate groundwater through the process of leaching. Table 30 shows the level of nitrogen leaching in each region under the fuel demand scenarios. All regions show an increase in nitrogen leaching in both scenarios, except for the Mountain and the Pacific regions. In these two regions, this result is a consequence of the reduction in conventional tillage used, in combination with a small reduction in crop acreage planted. Similar results are found for phosphorus leaching, the other major nutrient of concern for water quality.

Soil Erosion. Management practice, climate, and geography play a role in soil erosion potential. The move away from conservation tillage toward more soil-intensive conventional tillage leads to an increase in soil erosion. The erosion that occurs in each region is shown in table 31, along with the percentage change from the baseline. The major crop producing regions all show increases in soil erosion, with significantly more erosion in the Northern Plains. The major factor driving this result is the large portion of new acreage planted under conventional tillage.

Ethanol Impacts on Livestock Sectors: Regional Implications

Livestock Production Currently Has Regional Patterns. Cattle feeding is concentrated in the Great Plains and Southwest. Beef cow-calf and feeder calf operations are well represented in the Southeast, Great Plains, and Midwest. Poultry is concentrated in the Southeast and Mississippi Valley, hogs in the Corn Belt and parts of the South, and dairying in the Northeast, Upper Midwest, and West. Additional background material on livestock production is presented in Table 32.

Growth in the ethanol industry has driven corn prices higher and thus raised a major input cost to livestock and poultry producers that is affecting industry “bottom lines.” Substituting DDGs is a way to mitigate the higher corn prices. Several issues related to DDGs result in differing bottom line effects—DDG quality variability, differing capacities of livestock and poultry to make use of the feed, wet versus dry feed types, and shipping and storage.

Smaller operations in vulnerable financial positions are present in all industries and all regions. Such operations are the most likely to feel the effects of higher feed prices, the major input cost component for livestock and poultry producers. In some cases, financially vulnerable producers may be concentrated in a particular region, e.g., dairy production in the Deep South. In other cases, unique regional characteristics may be an advantage, as in drylot dairy production in the West.

We do not anticipate major shifts in livestock production with the advent of higher prices for corn and possibly other feeds driven by increased ethanol demand. The extensive infrastructure in place to support existing production, especially in vertically integrated industries, is a significant factor constraining regional shifts.

Beef Cattle. The fed cattle industry will continue to be located mainly in the Great Plains because of advantageous environmental regulations, grain and forage production, climate, and feeder cattle supplies. Major changes in the infrastructure that has grown up around the industry, the major feedlots, packers, and grain and livestock transport firms would be needed if a major move out of the area were considered. Farmer feeding of cattle will likely increase somewhat in the Midwest, even with higher feed costs (corn/grains about 75-80 percent of cattle rations), despite possible cost offsets due to use of DDGs in rations. Cattle feeders will try to offset the higher costs by bidding lower prices for feeder cattle that will reduce receipts to cow-calf producers, who will also face higher feed costs, but at a reduced proportion (less than 1 percent of total operating costs).

Poultry. There are three industry components—broilers, turkeys, and layers (eggs). Broiler production is concentrated in the Southeast and South Central sections of the country, turkey production is spread throughout the country, and egg production is concentrated mostly in the central portion of the country. Corn constitutes about 65-80 percent of poultry feeds, depending on type. Nutritional requirements of poultry limit use of DDGs in rations to offset higher corn prices. Preference for DDGs, to the extent they can be used, also adds to costs. Poultry production is highly integrated, and the extensive complexes are unlikely to move in response to feed costs.

Hogs. Hog feeding is concentrated in the Corn Belt but is also important in the Southeast and Great Plains. The Southeast is a grain-deficit region, so importing feedstuffs translates into higher feed costs in that region, whether they are co-products of ethanol or corn itself. Nutritional requirements of hogs are similar to poultry in that they limit use of DDGs in rations to offset higher corn prices, as do preferences for DDGs. Hog production is also highly integrated, with an extensive infrastructure, which would tend to keep production in existing areas.

Dairy. Probably the most widely dispersed industry is dairying, but there are concentrations of production in several areas. Milk production growth in the West, where concentrate feed costs are a smaller share of total feed costs, has changed the industry. Forages are the building block of dairy cow rations—if forages are low quality or high priced, milk production can suffer. Significant capital investments also suggest that new dairies and processing plants are not likely to move to major ethanol-producing areas.

Livestock and Poultry Costs of Production (COP). The observed regional patterns of livestock and poultry production lead to the question of whether production costs might also exhibit regional patterns. Regional costs of production are examined for beef (cow-calf), hogs (hogs, feeder-to-finish, farrow-to-finish), and dairy. Only national costs are estimated for poultry (broilers and turkeys) and feedlots (farmer and commercial). All data are for 2005, except turkeys (2003).

Commodity-specific surveys as part of the annual Agricultural Resource Management Survey (ARMS) have been used to collect the data for commodity cost and return estimates since 1996. Each farm sampled in the ARMS represents a known number of farms with similar attributes so that weighting the data for each farm by the number of farms it represents provides a basis for calculating estimates for the target population of each commodity. U.S. and regional cost and return estimates published from the ARMS indicate averages across the different sizes of operations, types of production systems, and farm business arrangements used to produce individual commodities. The costs and returns for individual farms producing each commodity may differ substantially from these averages.

Defining regions for COP data is generally an arbitrary activity that depends on several factors, a major one being the data collection itself. The regions used here for reporting this data are based on those already existing in the REAP modeling framework. The most regions are defined for dairy (seven) and the fewest (two) for hogs. Since we have argued that significant movement among regions is unlikely, it is reasonable to examine those regions where the livestock activities are in operation.

Cost-of-production surveys generally contain relatively detailed information, i.e., several line items. It is also important to be cognizant of the different measures of cost, e.g., cost per cwt (hundredweight) of milk or cost per bred cow. The costs discussed here are aggregates that generally appear in all COP data: operating costs in two categories, feed and non-feed, and allocated overhead costs. Operating costs, particularly the feed category, will be one of the first places producers look to address rising corn and soybean prices driven by ethanol or biodiesel production demands. Appropriate totals are also shown. The order of presentation is from “most” to “fewest” regions.

Dairy. The seven regions defined are, in alphabetical order: Appalachian, Corn Belt, Lake States, Northeast, Southeast, Southern Plains, and West (Pacific and Mountain) (table 33). The total cost of production ranges from about $15.20 per cwt (Southern Plains and West) to approximately $24.00 per cwt (Appalachian and Corn Belt). Feed costs range from $5.24 in the Lake States to $8.82 per cwt in the Corn Belt. The Lake States result offers an interesting insight: it is sometimes argued that higher feed prices are the reason this region’s dairies face financial issues. It appears instead that other operating costs and overhead costs lead to the higher total cost of production in this region.

Beef. Four regions are defined for cow-calf cost of production estimates: Great Plains (Northern and Southern Plains), North Central (Corn Belt, Lake States, and Northeast), South (Southeast, Delta, and Appalachian) and West (table 34). The total production costs do not vary much across regions, ranging from about $1,251 per bred cow in the North Central region to around $1,061 in the West. Total feed costs are highest in the North Central region, followed by the Great Plains, the South, and the West. It is not feed grains or supplemental feeds that contribute most to feed costs; it is forages (including pastures and public grazing), which make up from 82 to 91 percent of the total feed costs. Cow-calf operators will likely face indirect effects of higher feed costs through reduced feeder cattle prices.

The national cost-of-production estimates for farmer feedlots show that over 70 percent of total feed costs are for dry grains, concentrates, and protein supplement feeds (table 35). The relative share of feed costs in commercial feedlots for these three feeds is higher, at almost 90 percent. Feedlot operators are likely to address higher feed costs through adjustments in feeding, including feeding distillers' grains, and other avenues, such as bidding lower prices for feeder cattle.

Hogs. Two regions, North Central/Northern Plains/West and South/Southern Plains, are identified for each of the three hog enterprise types (tables 36-38). Total costs of production are greater in the South/Southern Plains region for hogs by about $4 per cwt gained: $63 versus about $59 in the other region. The same comparison for feeder-to-finish operations shows higher costs again in the South/Southern Plains: about $56 per cwt gained versus $48 in the other region. Farrow-to-finish total production costs are slightly higher in the North Central/Northern Plains/West region, by about $3 per cwt gained. Hog enterprises use mostly complete feed mixes; only in the farrow-to-finish operations are grain feeds of any consequence, and are so in both defined regions.

Poultry. Poultry costs of production present a particular problem. The integrated structure of the industry suggests that producers (growers) may have very little to say in how higher feed costs are addressed. The data provided here are from the perspective of the integrators/processors, so the data lack detail and do not even consider costs that other livestock producers face, such as some of the allocated overhead costs. Integrators reported broiler farm gate production costs of about $0.25 per pound live-weight in 2005 and feed costs (including milling and delivery) of from $0.14 to $0.16 per pound depending on the bird being produced. Farm gate total costs of production in 2003 were reported at about $0.33 per pound live-weight, with feed costs near $0.20 or about two-thirds of the total. Corn and soybeans are major components of poultry feed, so any price effects will be noted—however, there is less room to adjust bird rations to replace these two ingredients than in cattle feeding.

Cellulosic-Based Ethanol

Cellulosic-based ethanol has the potential to play a significant role in the production of renewable fuels. At the levels analyzed earlier in this study, corn would provide 15 to 20 billion gallons of ethanol by 10 years from now, with another 1 billion gallons of biodiesel produced. Thus, cellulosic sources would need to develop and expand to meet higher goals for biofuel production.

A number of studies have examined the potential for cellulosic bioenergy, both from a technical perspective and an economic perspective. These include the "billion ton" study, the "25 by '25" study, and some academic analyses. These studies are summarized in this section to provide some perspectives on the possible magnitudes and feasibility of cellulosic sources of biofuels, as well as to illustrate the challenges and uncertainties faced.[5]

Cellulosic's potential to expand and make a significant contribution to bioenergy reflects, in part, the availability of biomass from crop and forest residues or dedicated energy crops that can be produced from the diverse resource base in the United States. For example, data published by USDA's Economic Research Service shows that almost 1.6 billion acres (1.7 billion acres including Alaska and Hawaii) or 84 percent of the total land area in the 48 States is categorized as cropland, grassland pasture and range, and forest-use land (table 39). Therefore, most of the United States is already producing biomass either as crops, grasses, or trees.

However, the amount of biomass that can be grown on each of the land use categories listed in table 39 varies. For example, with current technologies some portion of 62 million acres in cropland pasture could be planted to energy crops, but at the present time the almost 600 million acres in rangeland and pasture are not used for crop production because of soil conditions or lack of precipitation. However, it is possible through research and development (R&D), scientists could produce genetically modified energy crops that could be produced on rangeland in the future.

Technical Potential. Based on existing land uses, the United States has the potential to produce large amounts of biomass. A report prepared by the U.S. Department of Energy (DOE) and the U.S. Department of Agriculture (USDA), referred to as the "billion-ton" study, found the United States has the resource potential to produce more than one billion tons of biomass materials by the mid 21st century.[6]

The billion-ton study concluded that the land resources of the United States are technically capable of sustainably producing almost 1.4 billion tons of biomass per year that could be used for bioenergy production by the mid 21st century (table 40). The 1.4

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[5] Since many of these studies pre-date the recent expansion of corn-based ethanol production, the grain-to-ethanol estimates are expected to be surpassed.

[6] The study "Biomass as a Feedstock for Bioenergy and Bioproducts Industry: The Technical Feasibility of a Billion-Ton Supply" can be accessed through the internet at the following web site: feedstockreview.ornl.gov/pdf/billion_ton_vision.pdf.

billion tons of biomass materials include forest residues, crop residues, energy crops, manure, and the organic portion of municipal solid waste. Assuming each ton of biomass can be converted to 80 gallons of ethanol, 1.4 billion tons of biomass is equivalent to about 110 billion gallons of ethanol.

As described in table 40, the largest potential sources of biomass include crop residues such as corn stover and wheat straw, perennial crops such as switchgrass, and forestry residues such as residues from logging, land clearing, and fuel treatment to reduce fire hazards as well as unused residues from wood processing mills. The billion-ton study reflects an accounting of different sources of biomass that could be used in the production of ethanol but does not include an economic analysis to identify the economic conditions under which one billion tons of biomass would be produced.

The billion-ton study also found that producing the amounts of biomass described in table 40 would require a "concerted R&D effort to develop technologies to overcome a host of technical, market, and cost barriers". For example, providing almost 1 billion tons of biomass from agricultural lands (crop residues and perennial crops) would require increasing corn, wheat, and other small grain yields by 50 percent; doubling residue-to-grain ratios for soybeans; developing much more efficient residue harvesting equipment; managing active cropland with no-till cultivation; growing dedicated energy perennial crops on 55 million acres of cropland, idle cropland, and cropland pasture; using animal manure in excess of what can be applied on-farm for bioenergy; and using a larger fraction of other secondary and tertiary residues for bioenergy.

Looking only at the almost 1 billion tons of biomass from agriculture, table 41 provides an idea of the necessary technological changes identified in the billion-ton study necessary to meet the goal. The billion-ton study estimated that the agricultural sector could produce 194 million dry tons of biomass per year in a sustainable manner. This includes the amount grain used for biofuels when the study was completed plus recovering 40 percent of corn stover and other crop residues. However, by increasing corn yields by 25 percent and recovering 60 percent of corn stover and other crop residues, the agricultural sector could increase the amount of biomass available by 238 million dry tons per year.

As a point of comparison, USDA's current long-term projections project that corn yields will increase from 151 bushels per acre in 2006/07 to 170 bushels per acre by 2016/17.[7] That change represents a 12.6 percent increase over 10 years, or almost 1.3 percent per year. Therefore, increasing corn yields by 25 percent over the next 20 years is realistic if yields only maintain their historic growth rates.

Higher corn yields and recovering greater amounts of crop residues further increases the amount of biomass available for ethanol production. Increasing corn yields by 50 percent

[7] U.S. Department of Agriculture. Office of the Chief Economist. World Agricultural Outlook Board. "USDA Agricultural Projections to 2016." Long-term Projections Report OCE-2007-1. February 2007. The report is available through the internet at: http://www.ers.usda.gov/briefing/projections/

and recovering 75 percent of corn stover and other crop residues would raise the amount of biomass available by an additional 165 million dry tons per year.

Lastly, growing perennial energy crops on 55 million acres of land would increase the amount of biomass available by about 400 million dry tons per year. Of the 800 million tons of additional biomass production over current levels, half of the increase can be met by increases in crop yields and greater residue recovery on existing cropland with the remainder met by growing perennial grasses for energy crops. In the billion-ton study, the 55 million acres devoted to perennial energy crops came from mainly from reductions in pasture (25 million acres), land enrolled in the Conservation Reserve Program (CRP) (10 million acres), soybean acres (8 million acres), hay (5 million acres), and wheat (5 million acres).

Economic Potential. The U.S. Department of Energy (DOE) expects that research, science, and technological developments can reduce the cost of cellulosic ethanol to be competitive with corn ethanol by 2012. However, it will take time to deploy cellulosic technology through new plant construction and expected retrofitting of existing grain ethanol plants.

A number of factors will be important in determining which feedstocks will be used in producing cellulosic-based ethanol including the costs associated with producing, harvesting, transporting, handling, storing, and processing these various biomass materials as well as the ability to compete with existing agricultural commodities. Because cellulosic-based ethanol is not produced commercially, it is difficult to assess the actual cost of producing biomass feedstocks. Recent studies regarding the economics associated with producing biomass feedstock suggest that increases in the use of no till, improvements in traditional crop yields, and improvements in energy crop yields are necessary to produce biomass at a cost which allows cellulosic-based ethanol to play a significant role in meeting our energy demands.

Researchers at the Iowa State University estimated production costs for switchgrass for seven alternative scenarios and four yield levels per acre (1.5, 3, 4, and 6 tons per acre).[8] In each scenario, the cost to produce each ton of biomass declines as yield per acre increases. In their lowest cost scenario, total yearly production costs excluding land costs range from $121 per acre ($80 per ton) for 1.5 tons per acre yield to $241.16 per acre ($40 per ton) for 6 tons per acre. The average cost over all yield levels was $177.66 per acre ($49 per ton), with an average yield of 3.6 tons per acre.

The University of Nebraska in cooperation with the USDA's Agricultural Research Service also estimated the variable costs of production of switchgrass based on data collected on 10 farms in Nebraska, South Dakota, and North Dakota. The data was collected over five years (2000-05) including one year to establish the switchgrass and four years for full production. A total of 173 acres were planted and the average yield

[8] Duffy, M. and V. Nanhou. "Costs of Producing Switch Grass for Biomass in Southern Iowa." Iowa State University Extension Publication PM 1866. April 2001.

over the four production years was 3.4 tons per acre per year with average production costs excluding land costs of $33 per ton.

The ability to compete with existing commodities is also an important component of the economics of biomass production especially if land is used specifically for dedicated energy crops. For example, under the USDA baseline, net returns per acre (returns over variable costs) are expected to range from $94 per acre for wheat to $334 per acre for corn in 2007. Strong prices for commodities are expected to keep net returns relatively high over the entire forecast period (2007-16). Therefore, assuming biomass yields of 4 tons per acre, farmers would need to be paid an average of $23.40 per ton to compete with wheat and $83.50 per ton compete with corn just to cover the opportunity costs associated with using cropland for dedicated energy crops. These net returns can be considered the minimum returns required to plant energy crops, such as switchgrass, instead of traditional crops.

Adding an additional $23.40 to $83.50 per ton in addition to biomass production costs of $30 to $40 per ton would mean that farmers would need to be paid about $60 per ton to compete with wheat and $120 per ton to compete with corn. The $60 to $120 per ton that is needed to compete with wheat and corn is on land that wheat and corn are currently grown on. These costs could come down on more marginal land assuming biomass yields could be maintained. These estimates are consistent with those Babcock, Gassman, Jha, and Kling of the Center for Agricultural and Rural Development who found that farmers would consider switching from corn to switchgrass if switchgrass prices reached $110 per ton (assuming yields of 4 tons per acre) and $82 per ton (assuming yields reach 6 tons per acre).[9]

As an alternative to dedicated energy crops, researchers at the Oak Ridge National Laboratory estimate there are currently about 60 million tons of corn stover available at a cost of $30 per dry ton.[10] The estimate of available corn stover takes into consideration the need to leave some residue in the field to meet erosion, moisture, and equipment constraints and represents about 30 percent of the total amount of corn stover produced in the United States. If the entire U.S. corn crop is planted to the no tillage system, then about 100 million dry tons of corn stover could be available annually. The $30 per dry ton cost includes the cost of harvesting the stover and the cost of replacing nutrients lost through the removal of the stover but does not include any premium that may need to pay farmers or the cost of transporting the stover to the ethanol plant. It is important to note there are limits to how much crop residue as corn stover can be removed from the land. Crop residues play an important role in reducing soil erosion and runoff and returning organic matter to the soil.

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[9] Babcock, B.A., P.W. Gassman, J. Jha., and C.L. Kling. "Adoption Subsidies and Environmental Impacts of Alternative Energy Crops." Center for Agricultural and Rural Development Briefing Paper 07-BP 50. March 2007.

[10] Graham, R.L., R. Nelson, J. Sheehan, R.D. Perlack, and L.L. Wright. "Current and Potential U.S. Corn Stover Supplies." Agronomy Journal. Vol. 99, January-February 2007.

The cost to transport biomass from the farm gate to the ethanol plant will depend on distance hauled and handling charges. Some experts estimate that transportation and handling would add another $20 per ton to the delivered cost of biomass to the plant. A study by the National Renewable Energy Laboratory (NREL) estimated the delivered cost of corn stover to the plant at $56 per ton.[11]

Corn stover (crop residue) and forest and mill residues appear to be the most likely biomass feedstocks to be used initially. The abundance of corn acres provides ample supplies of corn stover, and the forestry industry has an infrastructure in place for harvest and collection of woody materials and mills are well established.

Dedicated energy crops are likely to take longer to play a significant role as a feedstock for cellulosic-based ethanol because of initially higher production costs and because it takes time to establish the crop. Dedicated energy crops could play a more important role as a feedstock for cellulosic ethanol over time as farmers become more familiar with growing energy crops causing yields to increase, transportation infrastructure issues are overcome, and limits are approached on the availability of lower cost feedstocks such as corn stover and forest and mill residues.

Herbaceous energy crops such as switchgrass will likely be the dominant dedicated energy crops because farmers' existing complement of equipment and machinery, such as mowers and balers used in production and harvesting of alfalfa hay, other hay, and forage could be used in switchgrass production. After one or two years to establish the crop, herbaceous crops are harvested every year and provide the farmer greater flexibility in planting decisions by being able to devote land to an energy crop like switchgrass one year and to switch back to other crops the following year. In contrast, with dedicated woody crops, land is devoted to a specific activity for a longer period of time. For example, hybrid willows are harvested every three years and hybrid poplars every seven to 10 years. In addition, farmers would likely need to invest in a new complement of equipment and machinery to plant, harvest, drag, and chip trees and to remove stumps after the harvest. Capital invested in woody energy crops production could be tied up between three to 10 years.

These results are similar to findings by presented as part of the "25x'25" study.[12] As part of the 25x'25 study, researchers looked at feasibility of two alternative renewable energy scenarios. The 25x'25 study did not estimate how much renewable energy would be produced over time. The study assessed the impacts of alternative levels of renewable

[11] A. Aden, M Ruth, K. Ibsen, J. Jechura, K. Neeves, J. Sheehan, and B. Wallace, Lignocellulosic Biomass to Ethanol Process Design and Economics Utilizing Co-current Dilute Acid Prehydrolysis and Enzymatic Hydrolysis for Corn Stover, National Renewable Energy Lab. (NREL), Technical Report, June 2002, NREL/TP-510-32438.

[12] English, B., D De La Torre Ugarte, K. Jensen, C. Hellwinckel J. Menard, B. Wilson, R. Roberts, and M. Walsh. "25% Renewable Energy for the United States by 2025: Agricultural and Economic Impacts." November 2006. The study can be accessed through the internet at: http://www.agpolicy.org/ppap/REPORT%2025x25.pdf

energy production on the economy and the agricultural sector. Under the "All Energy" or AE scenario, 25 percent of the nation's total energy use in 2025 is required to be produced from renewable sources. Under the AE scenario, ethanol production in the United States increases to 30 billion gallons per year by 2015, 58 billion gallons per year by 2020, and 87 billion gallons per year by 2025. Biodiesel production increases to 450 million gallons per year by 2015, 720 million gallons per year by 2020, and 1.1 billion gallons per year by 2025. The second scenario, referred to as the EPT scenario required that 25 percent of the nation's total electric power and motor vehicle fuels are required to be produced from renewable sources. Under the EPT scenario, ethanol production is slightly higher compared to the AE scenario, increasing to almost 32 billion gallons per year by 2015, 60 billion gallons per year by 2020, and 88 billion gallons per year by 2025. Biodiesel production under the EPT scenario is the same as under the AE scenario.

Figure 14 presents the amounts of biomass used to produce bioenergy under both 25x'25 scenarios. While biofuel production is similar under both 25x'25 scenarios, the AE scenario requires larger amounts of electricity production from biomass compare to the EPT scenario because meeting 25 percent of the nations total energy use (AE scenario) requires more renewable energy than meeting 25 percent of the nation's total electric power and motor vehicle fuels (EPT scenario). Therefore, by 2025, almost 1.3 billion tons of biomass will be required to meet total required bioenergy production under the AE scenario compared to about 1 billion tons of biomass under the EPT scenario.

Initially, wood residues and corn stover are the most likely feedstock to be used to produce cellulosic-based ethanol. However, as the demand for ethanol increases over time, dedicated energy crops play an increasingly important role. By 2025, for example, dedicated energy crops contribute over 50 percent of the total bioenergy feedstock supplies.

The results of the 25x'25 study are also influenced by assumptions regarding the amount of biomass available from crop residues, yield increases in traditional crops, and yields increases for energy crops. The 25x'25 study assumes conventional tillage falls from 60 percent currently to 25 percent by 2021 and the use of no till increases from 20 percent currently to 55 percent by 2021. As in the billion-ton study, the increase in the use of no till increases the amount of biomass available for cellulosic ethanol.

With respect to traditional crops, the 25x'25 study assumes corn yields increase by 1.69 percent per year over time, slightly higher than the 1.3 percent per year increase assumed in the USDA baseline. The effect of the higher yield assumption is that corn yields approach 168 bushels per acre by 2015 and 194 bushels per acre by 2025.

In addition, the 25x'25 study assumes research and technology can increase switchgrass yields over time. Yield increases vary by region of the country, with the greatest annual increases (5 percent per year) assumed for Appalachia, the Southeast, and the Southern Plains and the smallest annual increases (1.5 percent per year) assumed for the North East, Lake States, and Northern Plains. For example, switchgrass yields in the Southern Plains are assumed to increase from 4.3 dry tons per acre to 6.5 dry tons per acre in 10 years and to 8.6 dry tons per acre in 20 years. Harvesting costs also increase by 5 percent for each ton yield increase.

Even with technological advances that increase yields for both conventional and energy crops, biomass prices increase under both 25x'25 scenarios. By 2015, the price of switchgrass ranges from about $36 per dry ton under the EPT scenario to almost $47 per dry ton under the AE scenario. By 2025, however, pressure to increase bioenergy production causes the price of switchgrass to increase to $55 per dry ton under the EPT scenario to almost $82 per dry ton under the AE scenario.

The 25x'25 study also estimates the effects of added bioenergy production on the agricultural economy as well as the economy in general. Under the AE scenario, net farm income is about $15 billion greater than the baseline by 2020 and $37 billion greater than the baseline by 2025. Under the EPT scenario, net farm income is about $8 billion greater than the baseline by 2020 and $18 billion greater than the baseline by 2025.

The impacts on net farm income in the 25x'25 study are modest in relation to the level of added biofuels production. In our corn-based ethanol scenarios presented earlier, increasing biofuel production by 3.3 billion gallons per year (Scenario 1: 3 billion gallons of ethanol and 300 million gallons of biodiesel) in 2016 caused net farm income to increase by $4 billion over the baseline while increasing biofuels production by 8.3 billion gallons per year (Scenario 2) increased net farm income by $14.3 billion over the baseline.

Cellulosic Summary. The United States has the potential to produce a large amount of biomass that could be used to produce biofuels. However, both the billion-ton study and the 25x'25 study note the need for significant technological breakthroughs to convert this technical potential into an economic reality. For example, the billion-ton study found that using a significant amount of this biomass requires a "concerted R&D effort to develop technologies to overcome a host of technical, market, and cost barriers". Similarly, the 25x'25 study noted "To obtain the amount of renewable energy in the goal, two conditions need to be met. First is commercial introduction of the technology for cellulosic-to-ethanol conversion. Second is the development of an energy dedicated crop economy with 105.8 million planted acres." In addition, "To achieve the renewable energy goal at reasonable crop and feedstock prices, investment in research to improve yields of energy feedstock, along with yields of traditional crops, is crucial."

Figure 1: Projected Corn Used for Ethanol Production and Share of Total Domestic Corn Production

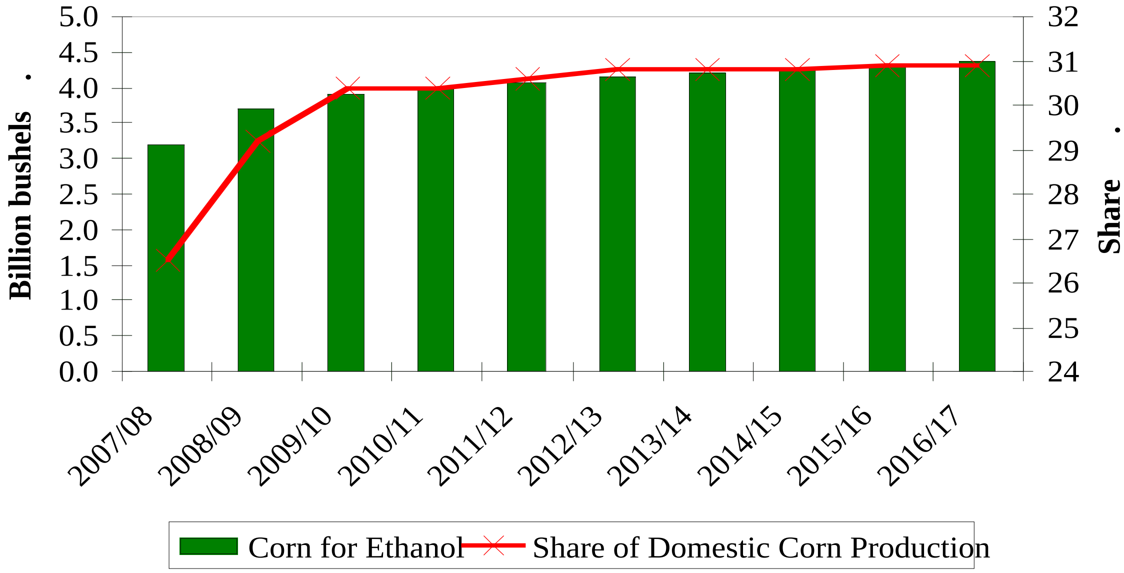


Figure 2: Projected Soybean Oil Used for Biodiesel Production and Share of Total Domestic Soybean Oil Production

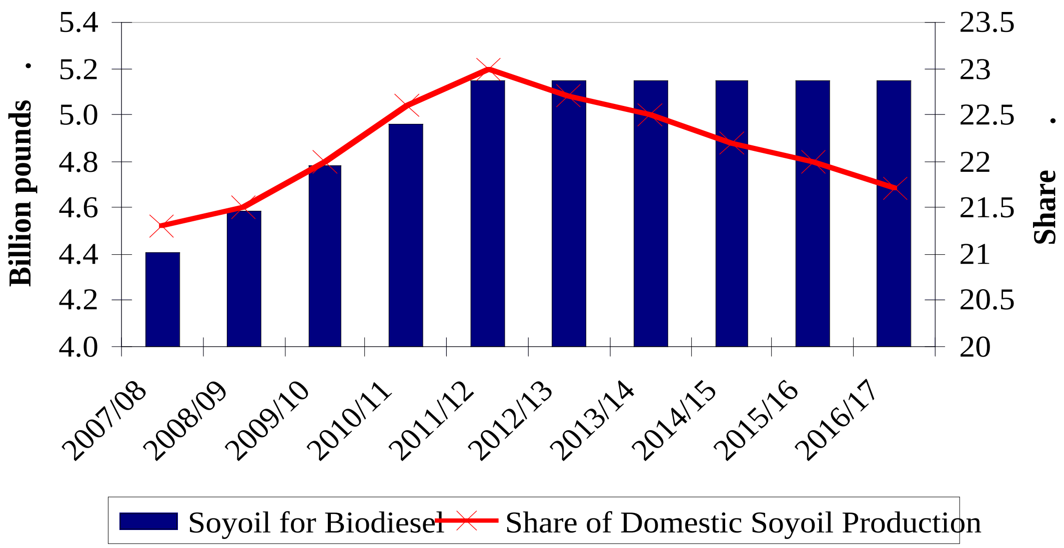


Figure 3. Ethanol production

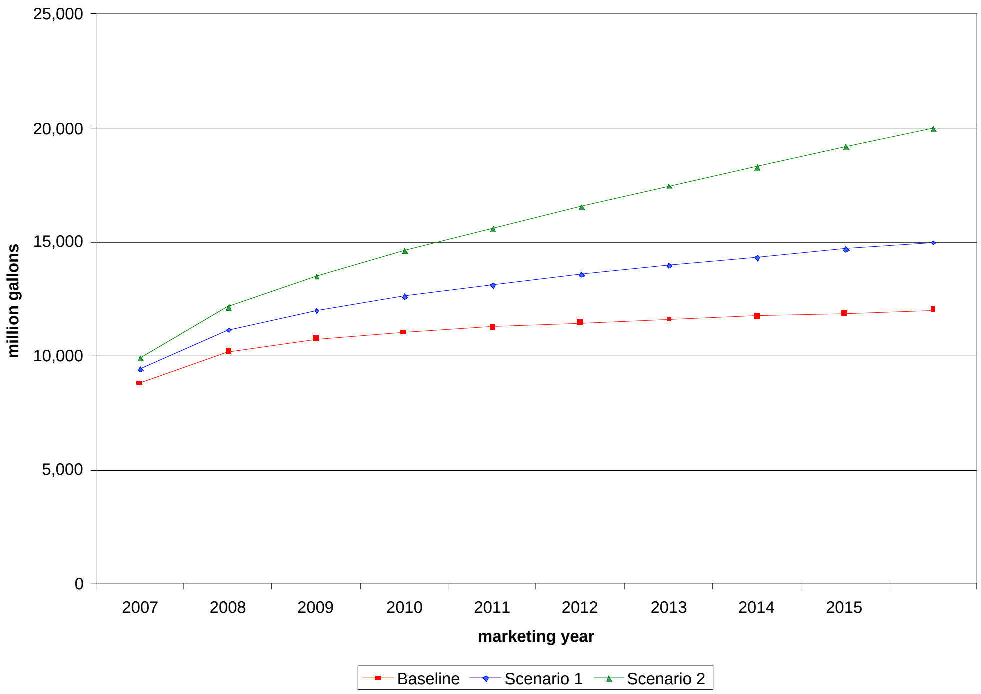


Figure 4. Biodeisel production

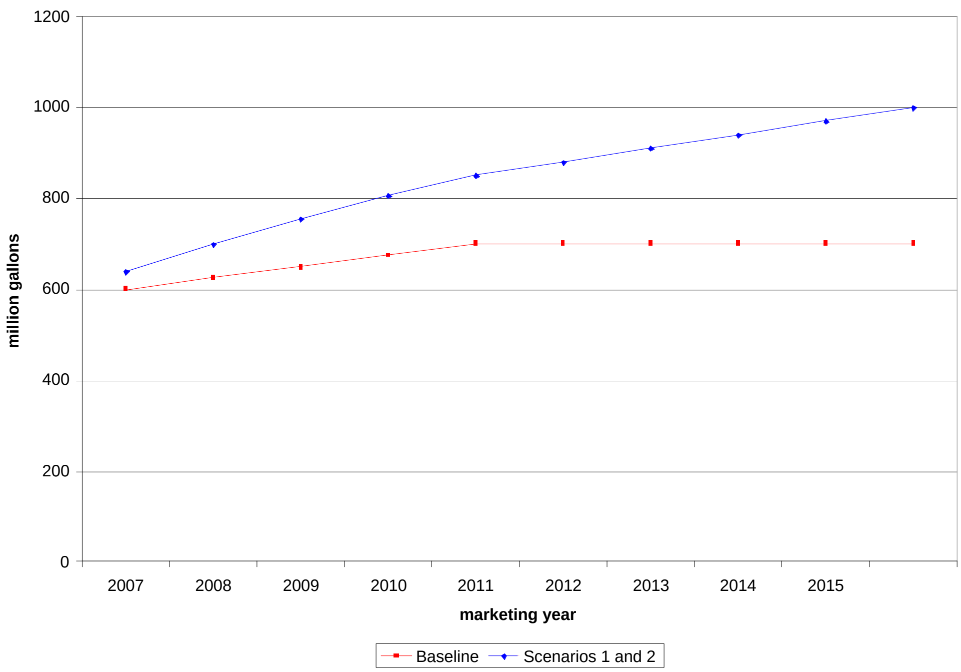


Figure 5: Corn: Season-Average Farm Price

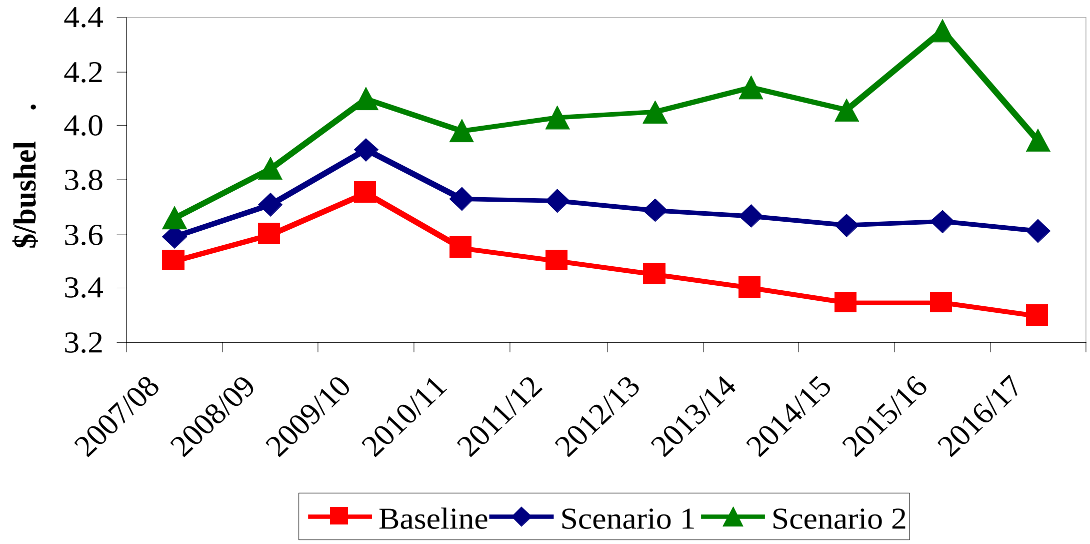


Figure 6: Soybeans: Season-Average Farm Price

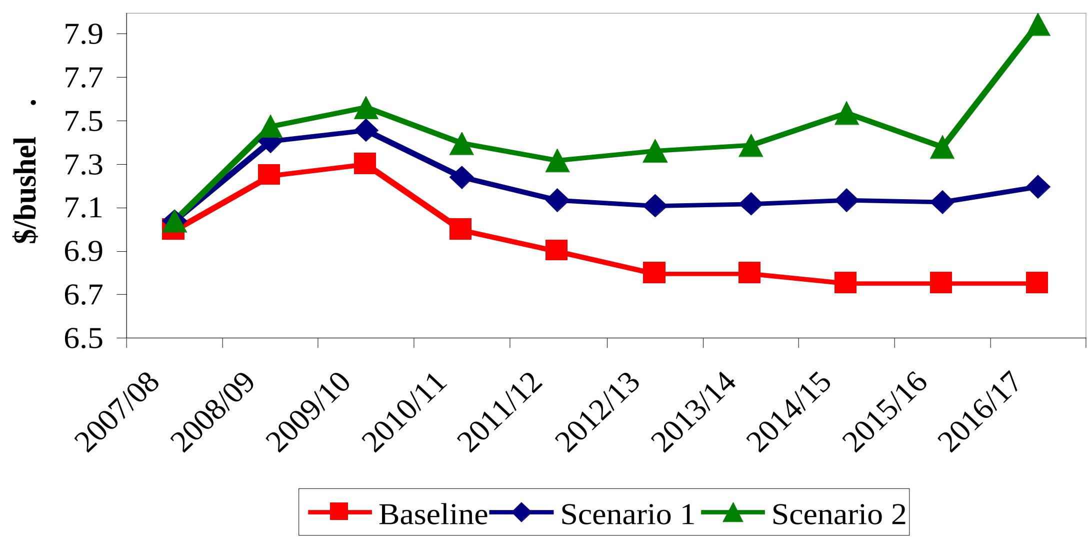
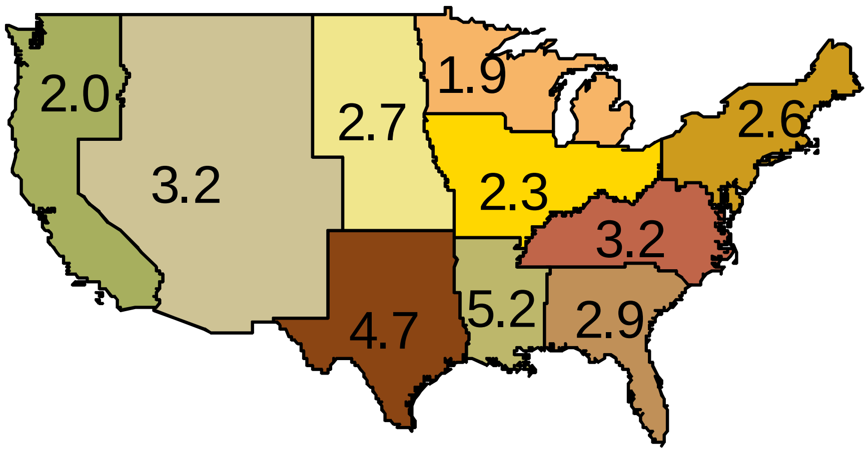


Figure 7: Percent change in corn acreage

15-billion gallon scenario



20-billion gallon scenario

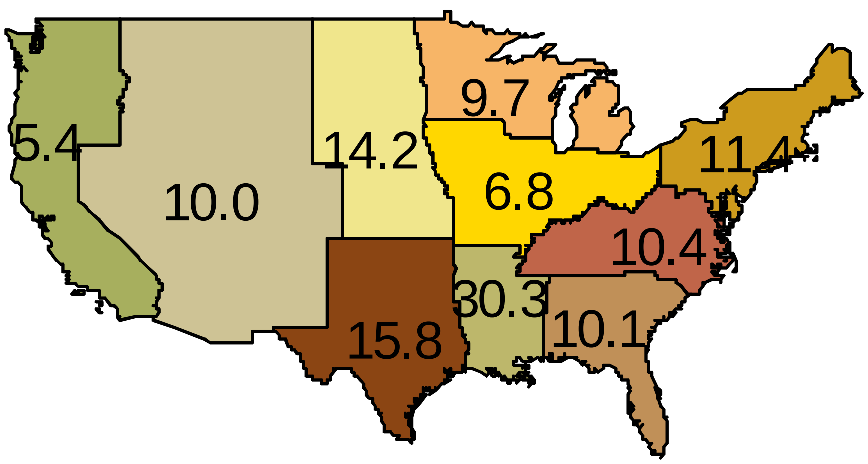
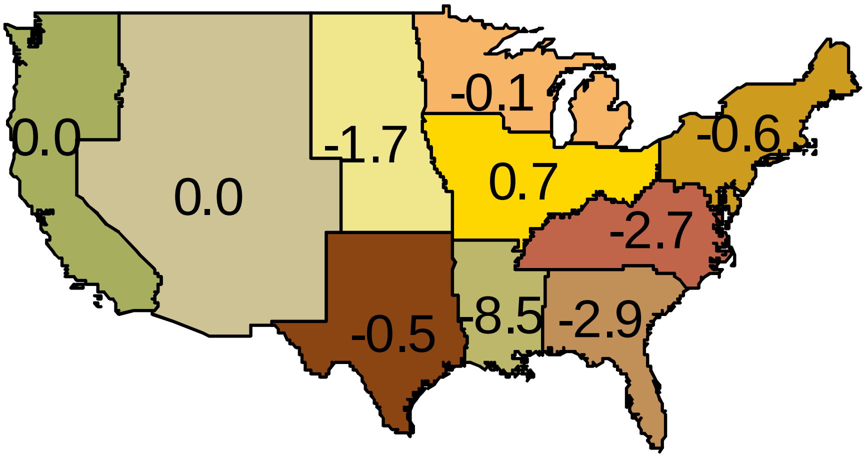


Figure 8: Percent change in soybean acres planted

15-billion gallon scenario



20-billion gallon scenario

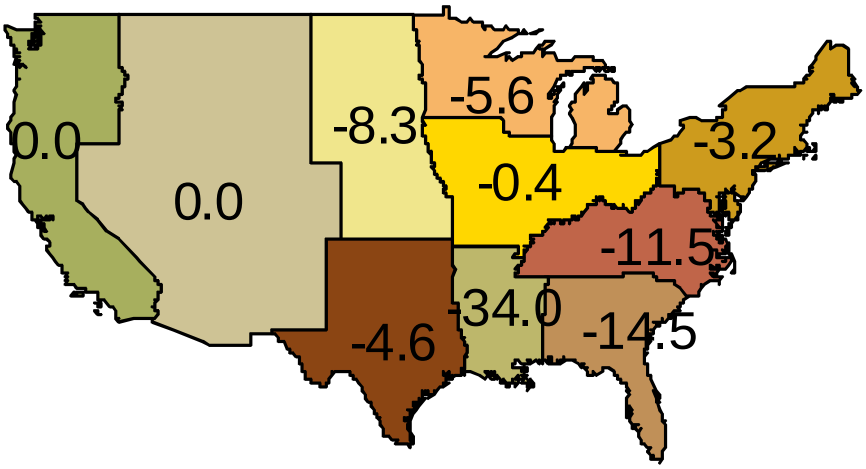


Figure 9: Distribution of crop rotations, Corn Belt, with percentage change from baseline for each rotation

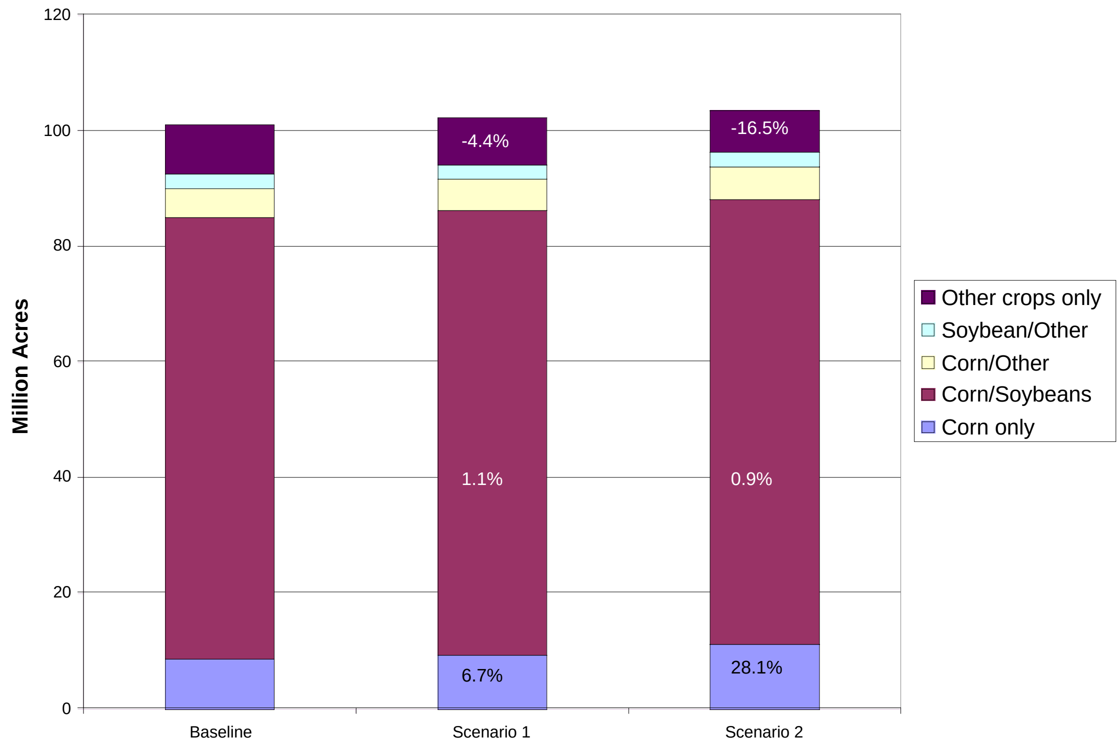


Figure 10: Distribution of crop rotations, Northern Plains, with percentage change from baseline for each rotation

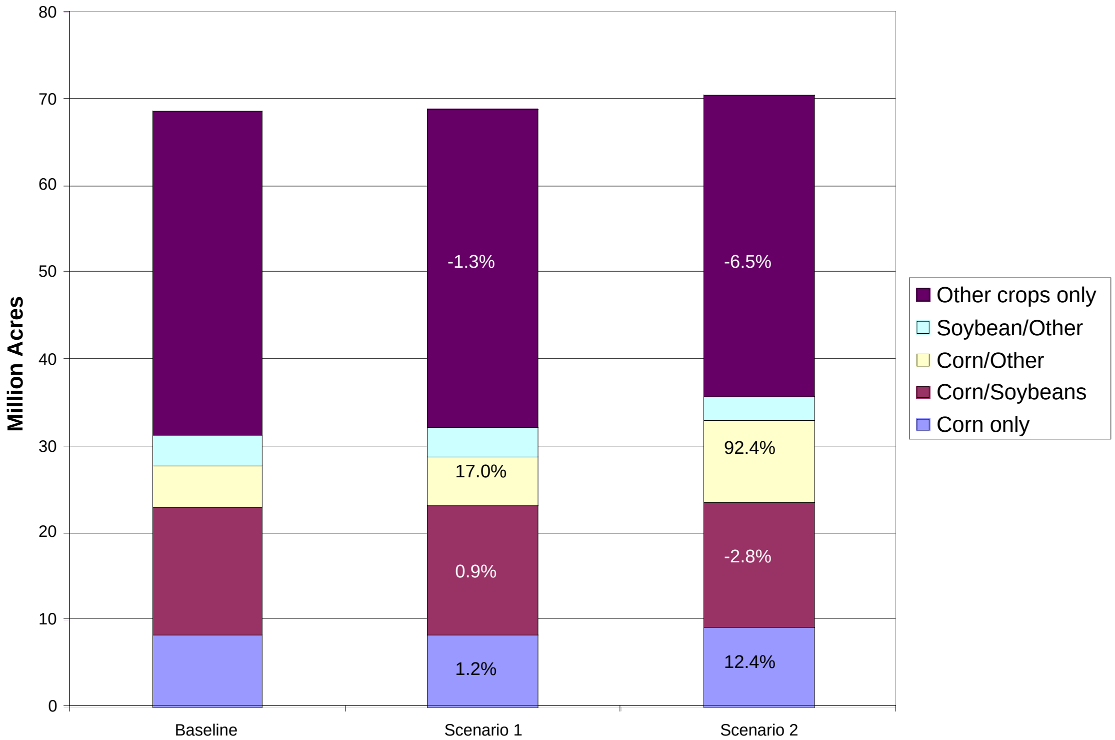


Figure 11: Distribution of crop rotations, Lake States, with percentage change from baseline for each rotation

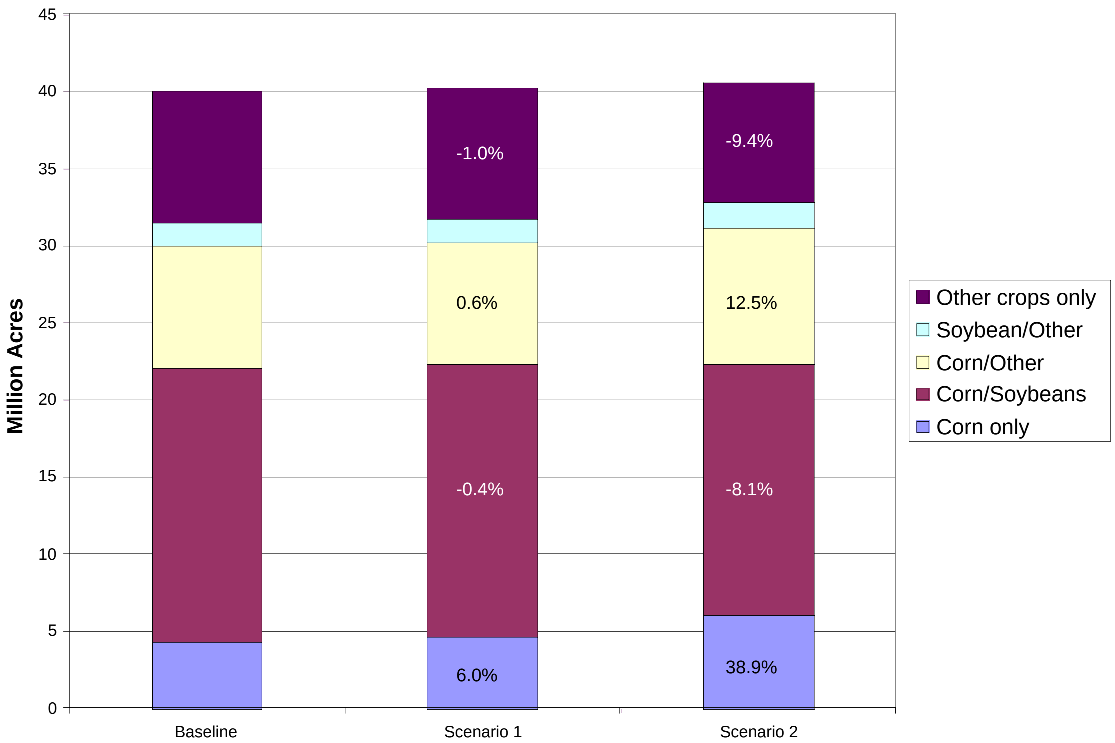


Figure 12: Distribution of tillage practice, Corn Belt, with percentage change from baseline for each tillage practice

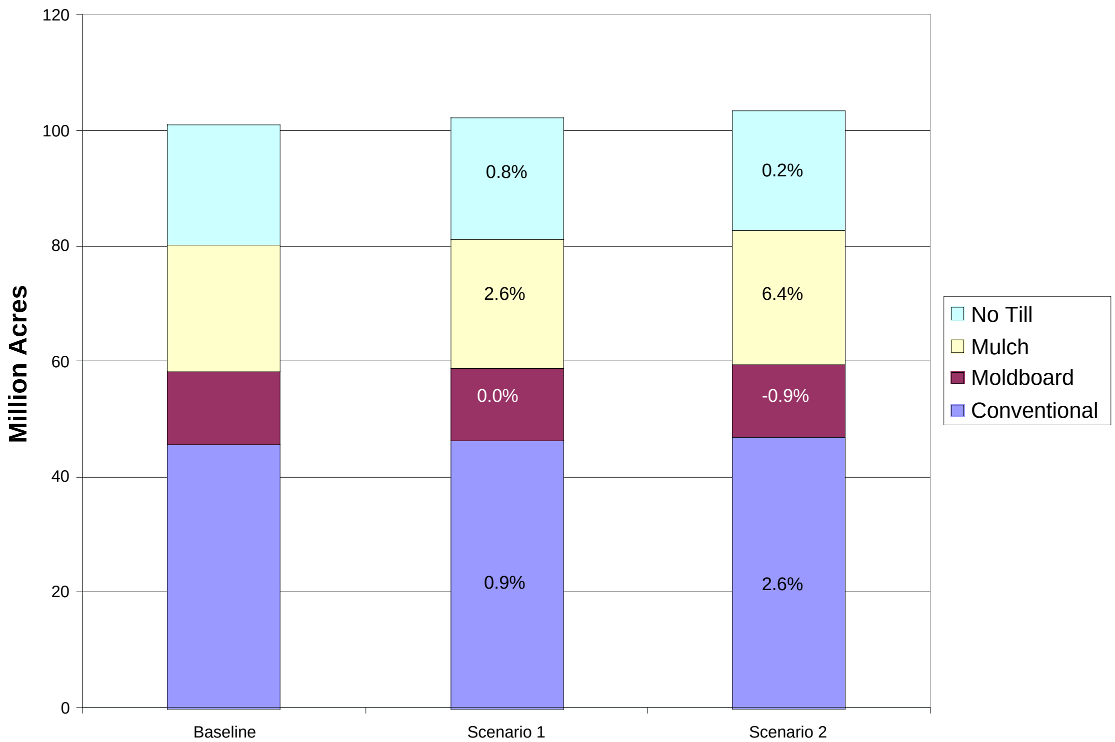


Figure 13: Distribution of tillage practice, Northern Plains, with percentage change from baseline for each tillage practice

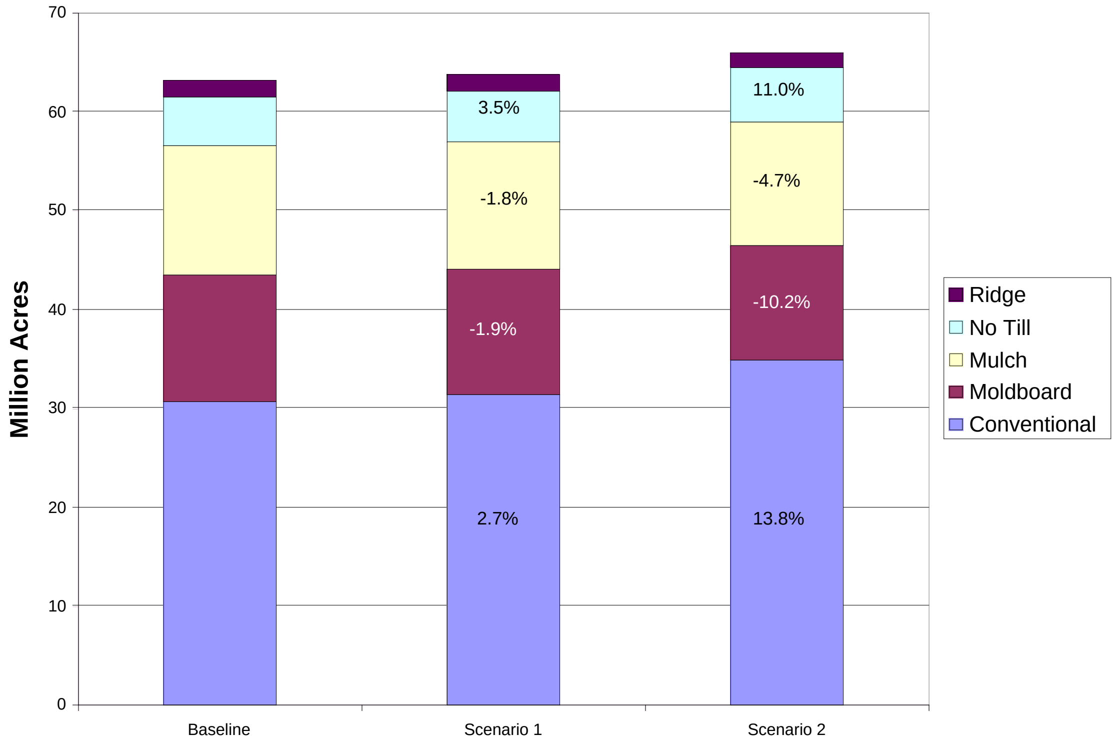
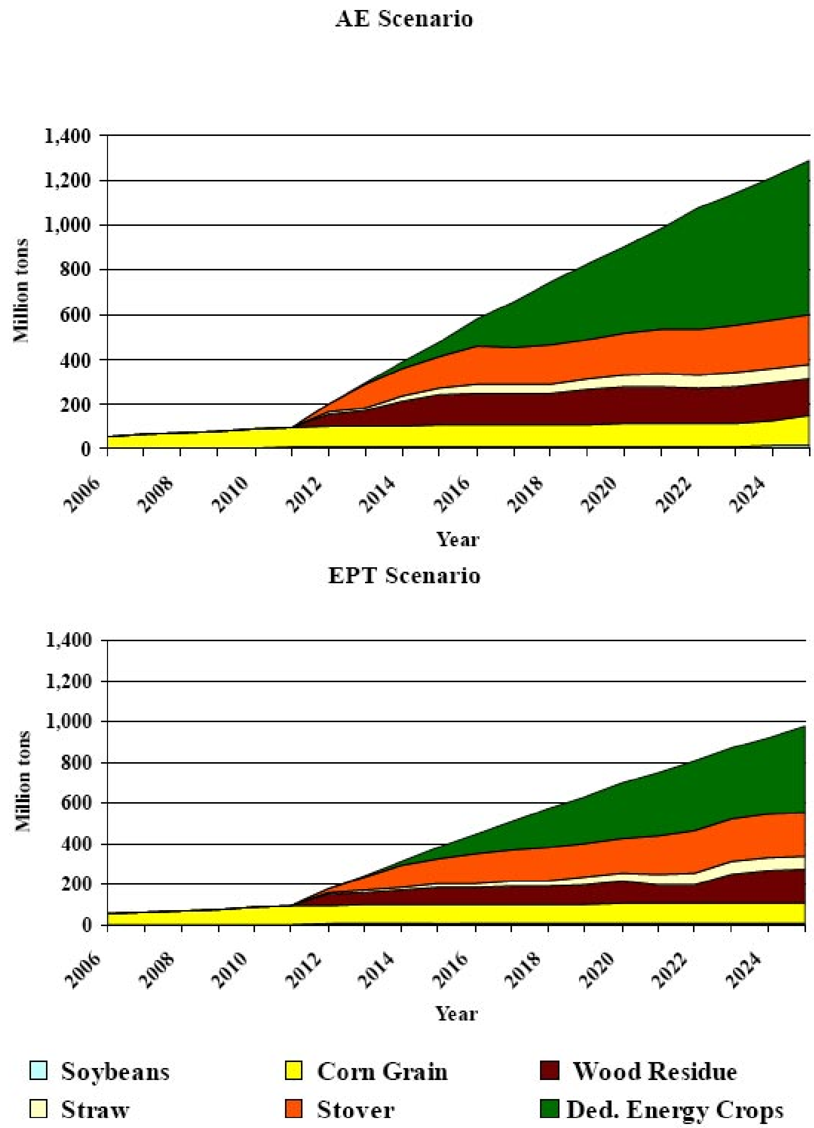


Figure 14. Biomass Feedstocks Over Time



Source: English, B., D De La Torre Ugarte, K. Jensen, C. Hellwinckel, J. Menard, B. Wilson, R. Roberts, and M. Walsh. "25% Renewable Energy for the United States by 2025: Agricultural and Economic Impacts." November 2006.

Table 1. 15-billion gallon scenario: Implied exogenous changes in use

	Units	Marketing year									
		2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Ethanol use											
Scenario	million gallons	9,420	11,160	12,032	12,624	13,125	13,584	13,980	14,348	14,688	15,000
Baseline	million gallons	8,800	10,200	10,760	11,040	11,250	11,460	11,600	11,740	11,880	12,020
Difference from baseline	million gallons	620	960	1,272	1,584	1,875	2,124	2,380	2,608	2,808	2,980
Biodiesel use											
Scenario	million gallons	640	700	755	805	850	880	910	940	970	1,000
Baseline	million gallons	600	625	650	675	700	700	700	700	700	700
Difference from baseline	million gallons	40	75	105	130	150	180	210	240	270	300
Change in use											
Corn used for ethanol	million bushels	221	343	454	566	670	759	850	932	1,003	1,064
Soybean oil used for biodiesel	million pounds	294	551	772	956	1,103	1,323	1,544	1,764	1,985	2,205
Corn displaced by DDG	million bushels	-47	-74	-97	-121	-144	-163	-182	-200	-215	-228
Soybean meal displaced by DDG	thousand tons	-124	-191	-253	-316	-374	-423	-474	-520	-559	-594

Table 2. 20-billion gallon scenario: Implied exogenous changes in use

	Units	Marketing year									
		2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Ethanol use											
Scenario	million gallons	9,920	12,160	13,532	14,624	15,625	16,584	17,480	18,348	19,188	20,000
Baseline	million gallons	8,800	10,200	10,760	11,040	11,250	11,460	11,600	11,740	11,880	12,020
Difference from baseline	million gallons	1,120	1,960	2,772	3,584	4,375	5,124	5,880	6,608	7,308	7,980
Biodiesel use											
Scenario	million gallons	640	700	755	805	850	880	910	940	970	1,000
Baseline	million gallons	600	625	650	675	700	700	700	700	700	700
Difference from baseline	million gallons	40	75	105	130	150	180	210	240	270	300
Change in use											
Corn used for ethanol	million bushels	400	700	990	1,280	1,563	1,830	2,100	2,360	2,610	2,850
Soybean oil used for biodiesel	million pounds	294	551	772	956	1,103	1,323	1,544	1,764	1,985	2,205
Corn displaced by DDG	million bushels	-86	-150	-212	-275	-335	-392	-450	-506	-560	-611
Soybean meal displaced by DDG	thousand tons	-223	-390	-552	-714	-872	-1,021	-1,171	-1,316	-1,456	-1,590

Table 3. 15-billion gallon scenario: Crop prices

	Marketing year										2007-16
	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	Average
Corn, farm price (dol/bu)											
Scenario	3.59	3.71	3.91	3.73	3.72	3.69	3.67	3.63	3.65	3.61	
Baseline	3.50	3.60	3.75	3.55	3.50	3.45	3.40	3.35	3.35	3.30	
Difference for baseline	0.09	0.11	0.16	0.18	0.22	0.24	0.27	0.28	0.30	0.31	0.22
Percentage difference for baseline	2.4	3.2	4.3	5.2	6.3	6.9	7.9	8.4	9.1	9.3	6.3
Sorghum, farm price (dol/bu)											
Scenario	3.36	3.44	3.62	3.44	3.42	3.38	3.36	3.31	3.34	3.28	
Baseline	3.30	3.35	3.50	3.30	3.25	3.20	3.15	3.10	3.10	3.05	
Difference for baseline	0.06	0.09	0.12	0.14	0.17	0.18	0.21	0.21	0.24	0.23	0.17
Percentage difference for baseline	1.8	2.8	3.6	4.2	5.3	5.6	6.7	6.8	7.6	7.7	5.2
Barley, farm price (dol/bu)											
Scenario	3.54	3.56	3.68	3.50	3.37	3.38	3.34	3.31	3.32	3.32	
Baseline	3.50	3.50	3.60	3.40	3.25	3.25	3.20	3.15	3.15	3.15	
Difference for baseline	0.04	0.06	0.08	0.10	0.12	0.13	0.14	0.16	0.17	0.17	0.12
Percentage difference for baseline	1.0	1.8	2.3	2.9	3.6	4.0	4.5	4.9	5.3	5.4	3.6
Oats, farm price (dol/bu)											
Scenario	2.41	2.48	2.54	2.40	2.31	2.27	2.22	2.18	2.19	2.19	
Baseline	2.40	2.45	2.50	2.35	2.25	2.20	2.15	2.10	2.10	2.10	
Difference for baseline	0.01	0.03	0.04	0.05	0.06	0.07	0.07	0.08	0.09	0.09	0.06
Percentage difference for baseline	0.5	1.1	1.6	2.1	2.6	3.0	3.5	3.8	4.2	4.4	2.7
Wheat, farm price (dol/bu)											
Scenario	4.45	4.27	4.27	4.38	4.44	4.50	4.55	4.61	4.61	4.62	
Baseline	4.45	4.25	4.25	4.35	4.40	4.45	4.50	4.55	4.55	4.55	
Difference for baseline	0.00	0.02	0.02	0.03	0.04	0.05	0.05	0.06	0.06	0.07	0.04
Percentage difference for baseline	0.0	0.4	0.6	0.7	0.9	1.1	1.2	1.4	1.4	1.5	0.9
Rice, farm price (dol/cwt)											
Scenario	8.95	8.96	9.23	9.38	9.45	9.47	9.56	9.66	9.77	9.90	
Baseline	8.95	8.95	9.20	9.35	9.41	9.43	9.50	9.60	9.70	9.83	
Difference for baseline	0.00	0.01	0.03	0.03	0.04	0.04	0.06	0.06	0.07	0.07	0.04
Percentage difference for baseline	0.0	0.1	0.3	0.3	0.5	0.5	0.6	0.6	0.7	0.7	0.4
Soybeans, farm price (dol/bu)											
Scenario	7.04	7.41	7.46	7.24	7.14	7.11	7.12	7.14	7.13	7.20	
Baseline	7.00	7.25	7.30	7.00	6.90	6.80	6.80	6.75	6.75	6.75	
Difference for baseline	0.04	0.16	0.16	0.24	0.24	0.31	0.32	0.39	0.38	0.45	0.27
Percentage difference for baseline	0.6	2.2	2.3	3.4	3.4	4.6	4.6	5.7	5.7	6.7	3.9
Soybean meal, Decatur (dol/ton)											
Scenario	196.86	200.39	197.73	187.20	183.52	180.51	177.05	174.29	170.73	169.93	
Baseline	200.00	205.00	205.00	195.00	192.50	190.00	188.50	186.50	185.00	185.00	
Difference for baseline	-3.14	-4.61	-7.27	-7.80	-8.98	-9.49	-11.46	-12.21	-14.27	-15.07	-9.43
Percentage difference for baseline	-1.6	-2.2	-3.5	-4.0	-4.7	-5.0	-6.1	-6.5	-7.7	-8.1	-5.0
Soybean oil, Decatur (cents/lb)											
Scenario	31.15	33.92	35.08	35.22	35.01	35.24	35.78	36.51	37.02	37.74	
Baseline	30.00	31.50	32.00	31.50	31.00	30.50	30.50	30.50	30.50	30.50	
Difference for baseline	1.15	2.42	3.08	3.72	4.01	4.74	5.28	6.01	6.52	7.24	4.42
Percentage difference for baseline	3.8	7.7	9.6	11.8	12.9	15.5	17.3	19.7	21.4	23.7	14.4
Upland cotton, farm price (dol/cwt)											
Scenario	55.02	58.31	59.45	59.56	59.12	58.74	57.75	57.37	57.16	56.86	
Baseline	55.00	58.00	59.00	59.00	58.50	58.00	57.00	56.50	56.00	56.00	
Difference for baseline	0.02	0.31	0.45	0.56	0.62	0.74	0.75	0.87	1.16	0.86	0.64
Percentage difference for baseline	0.0	0.5	0.8	1.0	1.1	1.3	1.3	1.5	2.1	1.5	1.1

Table 4. 20-billion gallon scenario: Crop prices

	Marketing year										2007-16
	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	Average
Corn, farm price (dol/bu)											
Scenario	3.66	3.84	4.10	3.98	4.03	4.05	4.14	4.06	4.35	3.95	
Baseline	3.50	3.60	3.75	3.55	3.50	3.45	3.40	3.35	3.35	3.30	
Difference for baseline	0.16	0.24	0.35	0.43	0.53	0.60	0.74	0.71	1.00	0.65	0.54
Percentage difference for baseline	4.5	6.7	9.4	12.1	15.2	17.4	21.6	21.1	29.7	19.6	15.7
Sorghum, farm price (dol/bu)											
Scenario	3.42	3.54	3.78	3.63	3.67	3.66	3.74	3.63	3.92	3.47	
Baseline	3.30	3.35	3.50	3.30	3.25	3.20	3.15	3.10	3.10	3.05	
Difference for baseline	0.12	0.19	0.28	0.33	0.42	0.46	0.59	0.53	0.82	0.42	0.42
Percentage difference for baseline	3.7	5.6	8.0	10.0	12.9	14.4	18.6	17.0	26.5	13.8	13.0
Barley, farm price (dol/bu)											
Scenario	3.57	3.63	3.79	3.63	3.53	3.58	3.60	3.57	3.68	3.60	
Baseline	3.50	3.50	3.60	3.40	3.25	3.25	3.20	3.15	3.15	3.15	
Difference for baseline	0.07	0.13	0.19	0.23	0.28	0.33	0.40	0.42	0.53	0.45	0.30
Percentage difference for baseline	1.9	3.7	5.2	6.8	8.7	10.2	12.5	13.2	16.8	14.4	9.3
Oats, farm price (dol/bu)											
Scenario	2.42	2.50	2.58	2.46	2.39	2.36	2.38	2.28	2.40	2.34	
Baseline	2.40	2.45	2.50	2.35	2.25	2.20	2.15	2.10	2.10	2.10	
Difference for baseline	0.02	0.05	0.08	0.11	0.14	0.16	0.23	0.18	0.30	0.24	0.15
Percentage difference for baseline	1.0	2.1	3.4	4.7	6.1	7.4	10.5	8.8	14.2	11.3	7.0
Wheat, farm price (dol/bu)											
Scenario	4.45	4.28	4.30	4.42	4.50	4.57	4.64	4.72	4.73	4.78	
Baseline	4.45	4.25	4.25	4.35	4.40	4.45	4.50	4.55	4.55	4.55	
Difference for baseline	0.00	0.03	0.05	0.07	0.10	0.12	0.14	0.17	0.18	0.23	0.11
Percentage difference for baseline	0.1	0.8	1.2	1.7	2.2	2.7	3.1	3.8	3.9	5.1	2.5
Rice, farm price (dol/cwt)											
Scenario	8.95	8.96	9.25	9.40	9.49	9.51	9.61	9.72	9.86	9.96	
Baseline	8.95	8.95	9.20	9.35	9.41	9.43	9.50	9.60	9.70	9.83	
Difference for baseline	0.00	0.01	0.05	0.05	0.08	0.08	0.11	0.12	0.16	0.13	0.08
Percentage difference for baseline	0.0	0.1	0.5	0.5	0.8	0.9	1.2	1.2	1.6	1.3	0.8
Soybeans, farm price (dol/bu)											
Scenario	7.04	7.48	7.56	7.40	7.32	7.36	7.39	7.54	7.38	7.95	
Baseline	7.00	7.25	7.30	7.00	6.90	6.80	6.80	6.75	6.75	6.75	
Difference for baseline	0.04	0.23	0.26	0.40	0.42	0.55	0.59	0.79	0.63	1.20	0.51
Percentage difference for baseline	0.6	3.2	3.5	5.6	6.1	8.2	8.6	11.6	9.4	17.8	7.5
Soybean meal, Decatur (dol/ton)											
Scenario	196.10	200.33	197.49	187.72	184.20	182.12	178.94	178.43	171.86	180.12	
Baseline	200.00	205.00	205.00	195.00	192.50	190.00	188.50	186.50	185.00	185.00	
Difference for baseline	-3.90	-4.67	-7.51	-7.28	-8.30	-7.88	-9.56	-8.07	-13.14	-4.88	-7.52
Percentage difference for baseline	-2.0	-2.3	-3.7	-3.7	-4.3	-4.1	-5.1	-4.3	-7.1	-2.6	-3.9
Soybean oil, Decatur (cents/lb)											
Scenario	31.24	34.40	35.81	36.27	36.25	36.77	37.49	38.76	38.81	41.34	
Baseline	30.00	31.50	32.00	31.50	31.00	30.50	30.50	30.50	30.50	30.50	
Difference for baseline	1.24	2.90	3.81	4.77	5.25	6.27	6.99	8.26	8.31	10.84	5.86
Percentage difference for baseline	4.1	9.2	11.9	15.2	16.9	20.5	22.9	27.1	27.2	35.5	19.1
Upland cotton, farm price (dol/cwt)											
Scenario	55.04	58.62	59.90	60.25	59.95	59.79	58.93	58.95	58.35	59.39	
Baseline	55.00	58.00	59.00	59.00	58.50	58.00	57.00	56.50	56.00	56.00	
Difference for baseline	0.04	0.62	0.90	1.25	1.45	1.79	1.93	2.45	2.35	3.39	1.62
Percentage difference for baseline	0.1	1.1	1.5	2.1	2.5	3.1	3.4	4.3	4.2	6.1	2.8

Table 5. 15-billion gallon scenario: Area planted

	Marketing year										2007-16
	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	Average
	million acres										
Corn											
Scenario	86.1	89.7	89.7	91.2	91.3	91.6	91.7	92.0	92.0	92.2	
Baseline	86.0	89.0	89.0	90.0	90.0	90.0	90.0	90.0	90.0	90.0	
Difference for baseline	0.1	0.7	0.7	1.2	1.3	1.6	1.7	2.0	2.0	2.2	1.3
Percentage difference for baseline	0.1	0.8	0.8	1.3	1.4	1.8	1.8	2.2	2.2	2.5	1.5
Sorghum											
Scenario	6.0	5.9	5.9	6.0	5.9	6.0	5.9	5.9	5.8	5.9	
Baseline	6.0	5.8	5.8	5.8	5.7	5.7	5.6	5.6	5.5	5.5	
Difference for baseline	0.0	0.1	0.1	0.2	0.2	0.3	0.3	0.3	0.3	0.4	0.2
Percentage difference for baseline	0.2	1.7	2.6	3.4	3.8	4.9	4.8	6.0	6.1	6.6	4.0
Barley											
Scenario	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	
Baseline	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	
Difference for baseline	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Percentage difference for baseline	0.0	0.2	0.4	0.6	0.7	0.8	1.0	1.0	1.2	1.2	0.7
Oats											
Scenario	4.1	4.1	4.1	4.1	4.1	4.2	4.2	4.2	4.2	4.2	
Baseline	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1	
Difference for baseline	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.0
Percentage difference for baseline	0.0	0.2	0.5	0.8	1.1	1.3	1.4	1.6	1.8	1.9	1.1
Wheat											
Scenario	60.0	59.3	58.8	58.3	58.3	58.3	58.3	58.2	58.3	58.2	
Baseline	60.0	59.5	59.0	58.5	58.5	58.5	58.5	58.5	58.5	58.5	
Difference for baseline	0.0	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2	-0.3	-0.2	-0.3	-0.2
Percentage difference for baseline	0.0	-0.3	-0.3	-0.3	-0.4	-0.4	-0.4	-0.5	-0.4	-0.5	-0.3
Rice											
Scenario	3.1	3.0	3.0	3.0	3.1	3.1	3.1	3.1	3.1	3.1	
Baseline	3.1	3.0	3.0	3.0	3.1	3.1	3.1	3.1	3.1	3.1	
Difference for baseline	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Percentage difference for baseline	0.0	-0.1	-0.3	-0.2	-0.3	-0.3	-0.4	-0.4	-0.5	-0.5	-0.3
Soybeans											
Scenario	71.0	69.1	68.8	68.5	68.6	68.4	68.5	68.1	68.3	68.1	
Baseline	71.0	69.5	69.0	69.0	69.0	69.0	69.0	68.8	68.8	68.8	
Difference for baseline	0.0	-0.4	-0.2	-0.5	-0.4	-0.6	-0.5	-0.7	-0.5	-0.7	-0.4
Percentage difference for baseline	-0.1	-0.6	-0.3	-0.7	-0.5	-0.9	-0.7	-1.0	-0.7	-1.0	-0.6
Upland cotton											
Scenario	13.7	13.4	13.4	13.5	13.6	13.6	13.7	13.6	13.6	13.6	
Baseline	13.7	13.5	13.5	13.6	13.7	13.7	13.8	13.8	13.8	13.8	
Difference for baseline	0.0	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.2	-0.2	-0.2	-0.1
Percentage difference for baseline	0.0	-0.5	-0.6	-0.7	-0.8	-1.0	-1.0	-1.3	-1.7	-1.2	-0.9
Total											
Scenario	247.4	248.1	247.5	248.2	248.4	248.5	248.8	248.7	248.7	248.9	
Baseline	247.4	247.9	246.9	247.6	247.6	247.6	247.6	247.4	247.3	247.3	
Difference for baseline	0.0	0.2	0.5	0.6	0.9	1.0	1.2	1.3	1.4	1.6	0.9
Percentage difference for baseline	0.0	0.1	0.2	0.3	0.3	0.4	0.5	0.5	0.6	0.6	0.3

Table 6. 20-billion gallon scenario: Area planted

	Marketing year										2007-16
	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	Average
	million acres										
Corn											
Scenario	86.1	90.4	90.8	92.8	93.3	94.2	94.6	95.9	95.3	98.5	
Baseline	86.0	89.0	89.0	90.0	90.0	90.0	90.0	90.0	90.0	90.0	
Difference for baseline	0.1	1.4	1.8	2.8	3.3	4.2	4.6	5.9	5.3	8.5	3.8
Percentage difference for baseline	0.1	1.5	2.0	3.1	3.6	4.7	5.2	6.6	5.9	9.5	4.2
Sorghum											
Scenario	6.0	6.0	6.1	6.3	6.2	6.4	6.3	6.6	6.3	7.0	
Baseline	6.0	5.8	5.8	5.8	5.7	5.7	5.6	5.6	5.5	5.5	
Difference for baseline	0.0	0.2	0.3	0.5	0.5	0.7	0.7	1.0	0.8	1.5	0.6
Percentage difference for baseline	0.3	3.9	5.3	8.1	9.2	12.1	13.1	17.5	14.6	26.6	11.1
Barley											
Scenario	3.5	3.5	3.5	3.5	3.6	3.6	3.6	3.6	3.6	3.6	
Baseline	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	
Difference for baseline	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Percentage difference for baseline	0.0	0.4	0.9	1.3	1.7	2.0	2.5	2.9	3.4	3.7	1.9
Oats											
Scenario	4.1	4.1	4.1	4.2	4.2	4.2	4.2	4.3	4.2	4.4	
Baseline	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1	
Difference for baseline	0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.2	0.1	0.3	0.1
Percentage difference for baseline	0.0	0.3	0.9	1.7	2.3	2.9	3.4	5.3	3.6	6.9	2.7
Wheat											
Scenario	60.0	59.2	58.7	58.1	58.0	57.9	57.9	57.8	58.0	57.4	
Baseline	60.0	59.5	59.0	58.5	58.5	58.5	58.5	58.5	58.5	58.5	
Difference for baseline	0.0	-0.3	-0.3	-0.4	-0.5	-0.6	-0.6	-0.7	-0.5	-1.1	-0.5
Percentage difference for baseline	0.0	-0.5	-0.6	-0.8	-0.8	-0.9	-0.9	-1.3	-0.8	-1.9	-0.9
Rice											
Scenario	3.1	3.0	3.0	3.0	3.0	3.1	3.1	3.1	3.1	3.1	
Baseline	3.1	3.0	3.0	3.0	3.1	3.1	3.1	3.1	3.1	3.1	
Difference for baseline	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Percentage difference for baseline	0.0	-0.1	-0.4	-0.3	-0.6	-0.6	-0.8	-0.8	-1.1	-0.7	-0.5
Soybeans											
Scenario	70.9	68.6	68.2	67.6	67.5	66.9	66.9	65.8	66.8	64.1	
Baseline	71.0	69.5	69.0	69.0	69.0	69.0	69.0	68.8	68.8	68.8	
Difference for baseline	-0.1	-0.9	-0.8	-1.4	-1.5	-2.1	-2.1	-3.0	-2.0	-4.7	-1.9
Percentage difference for baseline	-0.1	-1.3	-1.1	-2.1	-2.1	-3.0	-3.0	-4.3	-2.9	-6.9	-2.7
Upland cotton											
Scenario	13.7	13.4	13.3	13.4	13.4	13.4	13.4	13.3	13.3	13.1	
Baseline	13.7	13.5	13.5	13.6	13.7	13.7	13.8	13.8	13.8	13.8	
Difference for baseline	0.0	-0.1	-0.2	-0.2	-0.3	-0.3	-0.4	-0.5	-0.5	-0.7	-0.3
Percentage difference for baseline	-0.1	-1.0	-1.1	-1.7	-1.9	-2.4	-2.6	-3.5	-3.3	-5.2	-2.3
Total											
Scenario	247.4	248.2	247.8	248.8	249.3	249.7	250.2	250.4	250.8	251.1	
Baseline	247.4	247.9	246.9	247.6	247.6	247.6	247.6	247.4	247.3	247.3	
Difference for baseline	0.0	0.3	0.9	1.2	1.7	2.1	2.6	3.0	3.5	3.8	1.9
Percentage difference for baseline	0.0	0.1	0.4	0.5	0.7	0.8	1.0	1.2	1.4	1.5	0.8

Table 7. 15-billion gallon scenario: Corn supply and use

	Marketing year										2007-16
	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	Average
	million bushels										
Total stocks, Sept 1											
Scenario	929	584	518	438	477	473	489	485	501	494	
Baseline	935	660	620	580	640	670	700	725	750	765	
Difference from baseline	-6	-76	-102	-142	-164	-197	-211	-240	-249	-271	-166
Percentage difference from baseline	-0.7	-11.5	-16.4	-24.6	-25.5	-29.4	-30.1	-33.1	-33.3	-35.4	-24.0
Production											
Scenario	12,074	12,781	12,945	13,325	13,497	13,715	13,878	14,091	14,249	14,454	
Baseline	12,065	12,680	12,835	13,150	13,305	13,465	13,620	13,780	13,935	14,095	
Difference from baseline	9	101	110	175	192	250	258	311	314	359	208
Percentage difference from baseline	0.1	0.8	0.9	1.3	1.4	1.9	1.9	2.3	2.3	2.5	1.5
Imports											
Scenario	15	20	25	20	20	20	20	20	20	20	
Baseline	15	20	25	20	20	20	20	20	20	20	
Difference from baseline	0	0	0	0	0	0	0	0	0	0	0
Percentage difference from baseline	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total supply											
Scenario	13,018	13,385	13,489	13,782	13,993	14,208	14,387	14,596	14,770	14,967	
Baseline	13,015	13,360	13,480	13,750	13,965	14,155	14,340	14,525	14,705	14,880	
Difference from baseline	3	25	9	32	28	53	47	71	65	87	42
Percentage difference from baseline	0.0	0.2	0.1	0.2	0.2	0.4	0.3	0.5	0.4	0.6	0.3

Table 7. 15-billion gallon scenario: Corn supply and use --- continued

	Marketing year										2007-16
	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	Average
	million bushels										
Feed & residual use											
Scenario	5,724	5,615	5,500	5,470	5,439	5,421	5,418	5,426	5,431	5,422	
Baseline	5,825	5,775	5,725	5,750	5,775	5,800	5,850	5,900	5,950	5,975	
Difference from baseline	-101	-160	-225	-280	-336	-379	-432	-474	-519	-553	-346
Percentage difference from baseline	-1.7	-2.8	-3.9	-4.9	-5.8	-6.5	-7.4	-8.0	-8.7	-9.3	-5.9
Food & industrial use											
Scenario	4,804	5,434	5,754	5,975	6,163	6,337	6,487	6,629	6,764	6,886	
Baseline	4,585	5,095	5,305	5,415	5,500	5,585	5,645	5,705	5,770	5,830	
Difference from baseline	219	339	449	560	663	752	842	924	994	1,056	680
Percentage difference from baseline	4.8	6.7	8.5	10.3	12.1	13.5	14.9	16.2	17.2	18.1	12.2
Seed use											
Scenario	20	20	20	20	20	20	21	21	21	21	
Baseline	20	20	20	20	20	20	20	20	20	20	
Difference from baseline	0	0	0	0	0	0	1	1	1	1	0
Percentage difference from baseline	0.9	1.0	1.5	1.6	2.1	2.1	2.5	2.5	2.9	2.8	2.0
Exports											
Scenario	1,886	1,797	1,776	1,840	1,898	1,941	1,976	2,021	2,060	2,108	
Baseline	1,925	1,850	1,850	1,925	2,000	2,050	2,100	2,150	2,200	2,250	
Difference from baseline	-39	-53	-74	-85	-102	-109	-124	-129	-140	-142	-100
Percentage difference from baseline	-2.0	-2.8	-4.0	-4.4	-5.1	-5.3	-5.9	-6.0	-6.4	-6.3	-4.8
Total use											
Scenario	12,434	12,867	13,051	13,306	13,520	13,719	13,902	14,096	14,276	14,436	
Baseline	12,355	12,740	12,900	13,110	13,295	13,455	13,615	13,775	13,940	14,075	
Difference from baseline	79	127	151	196	225	264	287	321	336	361	235
Percentage difference from baseline	0.6	1.0	1.2	1.5	1.7	2.0	2.1	2.3	2.4	2.6	1.7
Total stocks, Aug 31											
Scenario	584	518	438	477	473	489	485	501	494	531	
Baseline	660	620	580	640	670	700	725	750	765	805	
Difference from baseline	-76	-102	-142	-164	-197	-211	-240	-249	-271	-274	-193
Percentage difference from baseline	-11.5	-16.4	-24.6	-25.5	-29.4	-30.1	-33.1	-33.3	-35.4	-34.0	-27.3

Table 8. 20-billion gallon scenario: Corn supply and use

	Marketing year										2007-16
	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	Average
	million bushels										
Total stocks, Sept 1											
Scenario	923	519	405	266	257	197	167	150	150	150	
Baseline	935	660	620	580	640	670	700	725	750	765	
Difference from baseline	-12	-141	-215	-315	-383	-473	-533	-575	-600	-615	-386
Percentage difference from baseline	-1.3	-21.3	-34.7	-54.2	-59.8	-70.5	-76.2	-79.3	-80.0	-80.4	-55.8
Production											
Scenario	12,082	12,877	13,097	13,564	13,799	14,108	14,338	14,711	14,782	15,464	
Baseline	12,065	12,680	12,835	13,150	13,305	13,465	13,620	13,780	13,935	14,095	
Difference from baseline	17	197	262	414	494	643	718	931	847	1,369	589
Percentage difference from baseline	0.1	1.6	2.0	3.1	3.7	4.8	5.3	6.8	6.1	9.7	4.3
Imports											
Scenario	15	20	25	20	20	20	20	20	20	20	
Baseline	15	20	25	20	20	20	20	20	20	20	
Difference from baseline	0	0	0	0	0	0	0	0	0	0	0
Percentage difference from baseline	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total supply											
Scenario	13,020	13,416	13,527	13,850	14,076	14,325	14,525	14,881	14,952	15,634	
Baseline	13,015	13,360	13,480	13,750	13,965	14,155	14,340	14,525	14,705	14,880	
Difference from baseline	5	56	47	100	111	170	185	356	247	754	203
Percentage difference from baseline	0.0	0.4	0.3	0.7	0.8	1.2	1.3	2.4	1.7	5.1	1.4

Table 8. 20-billion gallon scenario: Corn supply and use --- continued

	Marketing year										2007-16
	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	Average
	million bushels										
Feed & residual use											
Scenario	5,648	5,465	5,270	5,163	5,056	4,966	4,869	4,840	4,687	4,771	
Baseline	5,825	5,775	5,725	5,750	5,775	5,800	5,850	5,900	5,950	5,975	
Difference from baseline	-177	-310	-455	-587	-719	-834	-981	-1,060	-1,263	-1,204	-759
Percentage difference from baseline	-3.0	-5.4	-8.0	-10.2	-12.5	-14.4	-16.8	-18.0	-21.2	-20.1	-13.0
Food & industrial use											
Scenario	4,980	5,787	6,284	6,682	7,047	7,397	7,724	8,045	8,352	8,663	
Baseline	4,585	5,095	5,305	5,415	5,500	5,585	5,645	5,705	5,770	5,830	
Difference from baseline	395	692	979	1,267	1,547	1,812	2,079	2,340	2,582	2,833	1,653
Percentage difference from baseline	8.6	13.6	18.5	23.4	28.1	32.5	36.8	41.0	44.7	48.6	29.6
Seed use											
Scenario	20	20	21	21	21	21	22	21	22	21	
Baseline	20	20	20	20	20	20	20	20	20	20	
Difference from baseline	0	0	1	1	1	1	2	1	2	1	1
Percentage difference from baseline	1.7	2.3	3.6	4.2	5.4	6.0	7.6	6.8	10.9	5.2	5.4
Exports											
Scenario	1,852	1,739	1,687	1,727	1,755	1,774	1,761	1,824	1,741	1,951	
Baseline	1,925	1,850	1,850	1,925	2,000	2,050	2,100	2,150	2,200	2,250	
Difference from baseline	-73	-111	-163	-198	-245	-276	-339	-326	-459	-299	-249
Percentage difference from baseline	-3.8	-6.0	-8.8	-10.3	-12.2	-13.5	-16.1	-15.1	-20.9	-13.3	-12.0
Total use											
Scenario	12,501	13,012	13,262	13,593	13,879	14,158	14,375	14,731	14,802	15,406	
Baseline	12,355	12,740	12,900	13,110	13,295	13,455	13,615	13,775	13,940	14,075	
Difference from baseline	146	272	362	482	584	703	760	956	862	1,331	646
Percentage difference from baseline	1.2	2.1	2.8	3.7	4.4	5.2	5.6	6.9	6.2	9.5	4.8
Total stocks, Aug 31											
Scenario	519	405	266	257	197	167	150	150	150	228	
Baseline	660	620	580	640	670	700	725	750	765	805	
Difference from baseline	-141	-215	-315	-383	-473	-533	-575	-600	-615	-577	-443
Percentage difference from baseline	-21.3	-34.7	-54.2	-59.8	-70.5	-76.2	-79.3	-80.0	-80.4	-71.7	-62.8

Table 9. 15-billion gallon scenario: Soybeans supply and use

	Marketing year										2007-16
	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	Average
	million bushels										
Total stocks, Sept 1											
Scenario	565	352	227	224	222	219	212	215	208	204	
Baseline	565	355	237	235	237	234	232	235	233	229	
Difference from baseline	0	-3	-10	-11	-15	-15	-20	-20	-25	-25	-14
Percentage difference from baseline	0.0	-0.8	-4.4	-4.5	-6.5	-6.5	-8.6	-8.7	-10.7	-10.9	-6.2
Production											
Scenario	2,898	2,855	2,875	2,892	2,928	2,946	2,984	3,000	3,037	3,059	
Baseline	2,900	2,871	2,880	2,910	2,940	2,970	3,000	3,026	3,054	3,085	
Difference from baseline	-2	-16	-5	-18	-12	-24	-16	-26	-17	-26	-16
Percentage difference from baseline	-0.1	-0.6	-0.2	-0.6	-0.4	-0.8	-0.5	-0.9	-0.5	-0.8	-0.5
Imports											
Scenario	4	4	4	4	4	4	4	4	4	4	
Baseline	4	4	4	4	4	4	4	4	4	4	
Difference from baseline	0	0	0	0	0	0	0	0	0	0	0
Percentage difference from baseline	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total supply											
Scenario	3,467	3,211	3,106	3,121	3,154	3,169	3,200	3,219	3,249	3,267	
Baseline	3,469	3,230	3,121	3,149	3,181	3,208	3,236	3,265	3,291	3,318	
Difference from baseline	-2	-19	-15	-28	-27	-39	-36	-46	-42	-51	-31
Percentage difference from baseline	-0.1	-0.6	-0.5	-0.9	-0.9	-1.2	-1.1	-1.4	-1.3	-1.5	-0.9

Table 9. 15-billion gallon scenario: Soybeans supply and use --- continued

	Marketing year										2007-16
	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	Average
	million bushels										
Feed, seed & res. use											
Scenario	144	143	145	146	146	150	150	151	151	152	
Baseline	144	143	146	147	147	151	151	152	152	153	
Difference from baseline	0	0	-1	-1	-1	-1	-1	-1	-1	-1	-1
Percentage difference from baseline	-0.3	-0.2	-0.4	-0.4	-0.6	-0.5	-0.7	-0.6	-0.8	-0.6	-0.5
Crushings											
Scenario	1,825	1,876	1,906	1,929	1,960	1,984	2,008	2,029	2,054	2,080	
Baseline	1,820	1,870	1,895	1,920	1,950	1,975	1,995	2,015	2,035	2,060	
Difference from baseline	5	6	11	9	10	9	13	14	19	20	12
Percentage difference from baseline	0.3	0.3	0.6	0.5	0.5	0.5	0.7	0.7	0.9	1.0	0.6
Exports											
Scenario	1,146	966	830	824	829	822	827	831	841	835	
Baseline	1,150	980	845	845	850	850	855	865	875	875	
Difference from baseline	-4	-14	-15	-21	-21	-28	-28	-34	-34	-40	-24
Percentage difference from baseline	-0.3	-1.5	-1.7	-2.5	-2.5	-3.3	-3.3	-4.0	-3.9	-4.6	-2.8
Total use											
Scenario	3,115	2,985	2,881	2,899	2,935	2,957	2,985	3,011	3,045	3,066	
Baseline	3,114	2,993	2,886	2,912	2,947	2,976	3,001	3,032	3,062	3,088	
Difference from baseline	1	-8	-5	-13	-12	-19	-16	-21	-17	-22	-13
Percentage difference from baseline	0.0	-0.3	-0.2	-0.4	-0.4	-0.6	-0.5	-0.7	-0.5	-0.7	-0.4
Total stocks, Aug 31											
Scenario	352	227	224	222	219	212	215	208	204	201	
Baseline	355	237	235	237	234	232	235	233	229	230	
Difference from baseline	-3	-10	-11	-15	-15	-20	-20	-25	-25	-29	-17
Percentage difference from baseline	-0.8	-4.4	-4.5	-6.5	-6.5	-8.6	-8.7	-10.7	-10.9	-12.7	-7.4

Table 10. 20-billion gallon scenario: Soybeans supply and use

	Marketing year										2007-16
	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	Average
	million bushels										
Total stocks, Sept 1											
Scenario	565	352	222	218	211	207	196	197	182	188	
Baseline	565	355	237	235	237	234	232	235	233	229	
Difference form baseline	0	-3	-15	-17	-26	-27	-36	-38	-51	-41	-25
Percentage difference form baseline	0.0	-0.8	-6.3	-7.1	-10.8	-11.6	-15.5	-16.1	-21.8	-17.8	-10.8
Production											
Scenario	2,897	2,835	2,852	2,853	2,883	2,885	2,917	2,904	2,976	2,880	
Baseline	2,900	2,871	2,880	2,910	2,940	2,970	3,000	3,026	3,054	3,085	
Difference form baseline	-3	-36	-28	-57	-57	-85	-83	-122	-78	-205	-75
Percentage difference form baseline	-0.1	-1.3	-1.0	-2.0	-1.9	-2.8	-2.8	-4.0	-2.6	-6.6	-2.5
Imports											
Scenario	4	4	4	4	4	4	4	4	4	4	
Baseline	4	4	4	4	4	4	4	4	4	4	
Difference form baseline	0	0	0	0	0	0	0	0	0	0	0
Percentage difference form baseline	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total supply											
Scenario	3,466	3,191	3,078	3,075	3,099	3,096	3,117	3,105	3,162	3,073	
Baseline	3,469	3,230	3,121	3,149	3,181	3,208	3,236	3,265	3,291	3,318	
Difference form baseline	-3	-39	-43	-74	-82	-112	-119	-160	-129	-245	-101
Percentage difference form baseline	-0.1	-1.2	-1.4	-2.3	-2.6	-3.5	-3.7	-4.9	-3.9	-7.4	-3.1

Table 10. 20-billion gallon scenario: Soybeans supply and use --- continued

	Marketing year										2007-16
	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	Average
	million bushels										
Feed, seed & res. use											
Scenario	143	142	144	145	145	148	147	149	147	152	
Baseline	144	143	146	147	147	151	151	152	152	153	
Difference form baseline	-1	-1	-2	-2	-2	-3	-4	-3	-5	-1	-2
Percentage difference form baseline	-0.6	-0.6	-1.1	-1.2	-1.7	-1.7	-2.3	-1.8	-3.6	-0.7	-1.5
Crushings											
Scenario	1,824	1,868	1,893	1,909	1,935	1,951	1,970	1,979	2,009	2,000	
Baseline	1,820	1,870	1,895	1,920	1,950	1,975	1,995	2,015	2,035	2,060	
Difference form baseline	4	-2	-2	-11	-15	-24	-25	-36	-26	-60	-20
Percentage difference form baseline	0.2	-0.1	-0.1	-0.6	-0.8	-1.2	-1.3	-1.8	-1.3	-2.9	-1.0
Exports											
Scenario	1,146	959	822	810	813	800	803	795	819	768	
Baseline	1,150	980	845	845	850	850	855	865	875	875	
Difference form baseline	-4	-21	-23	-35	-37	-50	-52	-70	-56	-107	-46
Percentage difference form baseline	-0.3	-2.1	-2.7	-4.2	-4.4	-5.8	-6.1	-8.1	-6.4	-12.2	-5.3
Total use											
Scenario	3,113	2,969	2,859	2,864	2,892	2,900	2,920	2,923	2,974	2,920	
Baseline	3,114	2,993	2,886	2,912	2,947	2,976	3,001	3,032	3,062	3,088	
Difference form baseline	-1	-24	-27	-48	-55	-76	-81	-109	-88	-168	-68
Percentage difference form baseline	0.0	-0.8	-0.9	-1.7	-1.9	-2.5	-2.7	-3.6	-2.9	-5.4	-2.2
Total stocks, Aug 31											
Scenario	352	222	218	211	207	196	197	182	188	152	
Baseline	355	237	235	237	234	232	235	233	229	230	
Difference form baseline	-3	-15	-17	-26	-27	-36	-38	-51	-41	-78	-33
Percentage difference form baseline	-0.8	-6.3	-7.1	-10.8	-11.6	-15.5	-16.1	-21.8	-17.8	-33.7	-14.1

Table 11. 15-billion gallon scenario: Soybean meal supply and use

	Marketing year										2007-16
	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	Average
	thousand tons										
Total stocks, Oct 1											
Scenario	300	306	309	314	315	317	318	322	323	327	
Baseline	300	300	300	300	300	300	300	300	300	300	
Difference from baseline	0	6	9	14	15	17	18	22	23	27	15
Percentage difference from baseline	0.0	2.0	2.9	4.6	5.0	5.7	6.1	7.3	7.8	9.1	5.1
Production											
Scenario	43,404	44,673	45,374	45,909	46,654	47,164	47,731	48,317	48,900	49,499	
Baseline	43,285	44,535	45,135	45,710	46,435	46,960	47,435	48,010	48,485	49,060	
Difference from baseline	119	138	239	199	219	204	296	307	415	439	258
Percentage difference from baseline	0.3	0.3	0.5	0.4	0.5	0.4	0.6	0.6	0.9	0.9	0.5
Imports											
Scenario	165	165	165	165	165	165	165	165	165	165	
Baseline	165	165	165	165	165	165	165	165	165	165	
Difference from baseline	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Percentage difference from baseline	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total supply											
Scenario	43,869	45,144	45,847	46,388	47,134	47,647	48,214	48,804	49,389	49,992	
Baseline	43,750	45,000	45,600	46,175	46,900	47,425	47,900	48,475	48,950	49,525	
Difference from baseline	118.8	143.5	247.4	213.1	234.2	221.7	313.9	329.4	438.8	466.5	272.7
Percentage difference from baseline	0.3	0.3	0.5	0.5	0.5	0.5	0.7	0.7	0.9	0.9	0.6
Domestic use											
Scenario	34,463	34,738	35,202	35,624	36,081	36,526	37,027	37,492	38,006	38,482	
Baseline	34,450	34,750	35,200	35,675	36,150	36,625	37,100	37,575	38,050	38,525	
Difference from baseline	12.8	-12.2	1.7	-50.6	-69.5	-99.1	-73.3	-83.4	-43.6	-42.8	-46.0
Percentage difference from baseline	0.0	0.0	0.0	-0.1	-0.2	-0.3	-0.2	-0.2	-0.1	-0.1	-0.1
Exports											
Scenario	9,100	10,097	10,332	10,449	10,736	10,803	10,865	10,989	11,055	11,180	
Baseline	9,000	9,950	10,100	10,200	10,450	10,500	10,500	10,600	10,600	10,700	
Difference from baseline	100	147	232	249	286	303	365	389	455	481	301
Percentage difference from baseline	1.1	1.5	2.3	2.4	2.7	2.9	3.5	3.7	4.3	4.5	2.9
Total use											
Scenario	43,563	44,835	45,533	46,073	46,817	47,328	47,892	48,481	49,061	49,663	
Baseline	43,450	44,700	45,300	45,875	46,600	47,125	47,600	48,175	48,650	49,225	
Difference from baseline	112.8	134.7	233.4	198.2	217.0	203.5	292.0	306.0	411.5	437.7	254.7
Percentage difference from baseline	0.3	0.3	0.5	0.4	0.5	0.4	0.6	0.6	0.8	0.9	0.5
Total stocks, Sept 30											
Scenario	306	309	314	315	317	318	322	323	327	329	
Baseline	300	300	300	300	300	300	300	300	300	300	
Difference from baseline	6	9	14	15	17	18	22	23	27	29	18
Percentage difference from baseline	2.0	2.9	4.6	5.0	5.7	6.1	7.3	7.8	9.1	9.6	6.0

Table 12. 20-billion gallon scenario: Soybean meal supply and use

	Marketing year										2007-16
	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	Average
	thousand tons										
Total stocks, Oct 1											
Scenario	300	307	309	314	314	316	315	318	315	325	
Baseline	300	300	300	300	300	300	300	300	300	300	
Difference from baseline	0	7	9	14	14	16	15	18	15	25	13
Percentage difference from baseline	-0.1	2.5	3.0	4.8	4.6	5.3	5.0	6.1	5.2	8.4	4.5
Production											
Scenario	43,371	44,486	45,089	45,464	46,093	46,435	46,878	47,202	47,902	47,739	
Baseline	43,285	44,535	45,135	45,710	46,435	46,960	47,435	48,010	48,485	49,060	
Difference from baseline	86	-49	-46	-246	-342	-525	-557	-808	-583	-1,321	-439
Percentage difference from baseline	0.2	-0.1	-0.1	-0.5	-0.7	-1.1	-1.2	-1.7	-1.2	-2.7	-0.9
Imports											
Scenario	165	165	165	165	165	165	165	165	165	165	
Baseline	165	165	165	165	165	165	165	165	165	165	
Difference from baseline	0	0	0	0	0	0	0	0	0	0	0
Percentage difference from baseline	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total supply											
Scenario	43,835	44,958	45,563	45,944	46,572	46,916	47,358	47,685	48,382	48,229	
Baseline	43,750	45,000	45,600	46,175	46,900	47,425	47,900	48,475	48,950	49,525	
Difference from baseline	85	-42	-37	-231	-328	-509	-542	-790	-568	-1,296	-426
Percentage difference from baseline	0.2	-0.1	-0.1	-0.5	-0.7	-1.1	-1.1	-1.6	-1.2	-2.6	-0.9
Domestic use											
Scenario	34,404	34,550	34,909	35,198	35,542	35,850	36,235	36,512	37,038	37,064	
Baseline	34,450	34,750	35,200	35,675	36,150	36,625	37,100	37,575	38,050	38,525	
Difference from baseline	-46	-200	-291	-477	-608	-775	-865	-1,063	-1,012	-1,461	-680
Percentage difference from baseline	-0.1	-0.6	-0.8	-1.3	-1.7	-2.1	-2.3	-2.8	-2.7	-3.8	-1.8
Exports											
Scenario	9,124	10,099	10,339	10,432	10,715	10,751	10,805	10,857	11,019	10,856	
Baseline	9,000	9,950	10,100	10,200	10,450	10,500	10,500	10,600	10,600	10,700	
Difference from baseline	124	149	239	232	265	251	305	257	419	156	240
Percentage difference from baseline	1.4	1.5	2.4	2.3	2.5	2.4	2.9	2.4	4.0	1.5	2.3
Total use											
Scenario	43,528	44,649	45,249	45,630	46,256	46,601	47,040	47,370	48,057	47,920	
Baseline	43,450	44,700	45,300	45,875	46,600	47,125	47,600	48,175	48,650	49,225	
Difference from baseline	78	-51	-51	-245	-344	-524	-560	-805	-593	-1,305	-440
Percentage difference from baseline	0.2	-0.1	-0.1	-0.5	-0.7	-1.1	-1.2	-1.7	-1.2	-2.7	-0.9
Total stocks, Sept 30											
Scenario	307	309	314	314	316	315	318	315	325	309	
Baseline	300	300	300	300	300	300	300	300	300	300	
Difference from baseline	7	9	14	14	16	15	18	15	25	9	14
Percentage difference from baseline	2.5	3.0	4.8	4.6	5.3	5.0	6.1	5.2	8.4	3.1	4.8

Table 13. 15-billion gallon scenario: Soybean oil supply and use

	Marketing year										2007-16
	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	Average
	million pounds										
Total stocks, Oct 1											
Scenario	2,688	2,023	1,751	1,703	1,672	1,656	1,635	1,584	1,477	1,369	
Baseline	2,688	2,088	1,888	1,878	1,883	1,883	1,903	1,883	1,818	1,738	
Difference from baseline	0	-65	-137	-175	-211	-227	-268	-299	-341	-369	-209
Percentage difference from baseline	0.0	-3.1	-7.3	-9.3	-11.2	-12.0	-14.1	-15.9	-18.7	-21.3	-11.3
Production											
Scenario	20,811	21,436	21,793	22,078	22,448	22,750	23,048	23,299	23,604	23,927	
Baseline	20,750	21,365	21,670	21,975	22,335	22,645	22,895	23,140	23,390	23,700	
Difference from baseline	61	71	123	103	113	105	153	159	214	227	133
Percentage difference from baseline	0.3	0.3	0.6	0.5	0.5	0.5	0.7	0.7	0.9	1.0	0.6
Imports											
Scenario	125	135	145	155	165	175	185	195	205	215	
Baseline	125	135	145	155	165	175	185	195	205	215	
Difference from baseline	0	0	0	0	0	0	0	0	0	0	0
Percentage difference from baseline	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total supply											
Scenario	23,625	23,594	23,689	23,936	24,285	24,582	24,867	25,077	25,287	25,510	
Baseline	23,563	23,588	23,703	24,008	24,383	24,703	24,983	25,218	25,413	25,653	
Difference from baseline	62	6	-14	-72	-98	-121	-116	-141	-126	-143	-76
Percentage difference from baseline	0.3	0.0	-0.1	-0.3	-0.4	-0.5	-0.5	-0.6	-0.5	-0.6	-0.3
Domestic use											
Scenario	20,716	21,154	21,522	21,850	22,162	22,536	22,915	23,287	23,669	24,048	
Baseline	20,500	20,825	21,125	21,425	21,725	22,025	22,325	22,625	22,925	23,225	
Difference from baseline	216	329	397	425	437	511	590	662	744	823	513
Percentage difference from baseline	1.1	1.6	1.9	2.0	2.0	2.3	2.6	2.9	3.2	3.5	2.3
Exports											
Scenario	886	689	463	414	467	411	369	313	249	169	
Baseline	975	875	700	700	775	775	775	775	750	725	
Difference from baseline	-89	-186	-237	-286	-308	-364	-406	-462	-501	-556	-340
Percentage difference from baseline	-9.1	-21.3	-33.8	-40.9	-39.7	-47.0	-52.4	-59.6	-66.8	-76.7	-44.7
Total use											
Scenario	21,602	21,843	21,985	22,264	22,629	22,947	23,284	23,600	23,918	24,217	
Baseline	21,475	21,700	21,825	22,125	22,500	22,800	23,100	23,400	23,675	23,950	
Difference from baseline	127	143	160	139	129	147	184	200	243	267	174
Percentage difference from baseline	0.6	0.7	0.7	0.6	0.6	0.6	0.8	0.9	1.0	1.1	0.8
Total stocks, Sept 30											
Scenario	2,023	1,751	1,703	1,672	1,656	1,635	1,584	1,477	1,369	1,293	
Baseline	2,088	1,888	1,878	1,883	1,883	1,903	1,883	1,818	1,738	1,703	
Difference from baseline	-65	-137	-175	-211	-227	-268	-299	-341	-369	-410	-250
Percentage difference from baseline	-3.1	-7.3	-9.3	-11.2	-12.0	-14.1	-15.9	-18.7	-21.3	-24.1	-13.7

Table 14. 20-billion gallon scenario: Soybean oil supply and use

	Marketing year										2007-16
	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	Average
	million pounds										
Total stocks, Oct 1											
Scenario	2,689	2,018	1,724	1,662	1,613	1,586	1,548	1,487	1,350	1,267	
Baseline	2,688	2,088	1,888	1,878	1,883	1,883	1,903	1,883	1,818	1,738	
Difference from baseline	1	-70	-164	-216	-270	-297	-355	-396	-468	-471	-271
Percentage difference from baseline	0.0	-3.4	-8.7	-11.5	-14.4	-15.8	-18.7	-21.0	-25.7	-27.1	-14.6
Production											
Scenario	20,794	21,339	21,646	21,848	22,159	22,374	22,608	22,723	23,089	23,018	
Baseline	20,750	21,365	21,670	21,975	22,335	22,645	22,895	23,140	23,390	23,700	
Difference from baseline	44	-26	-24	-127	-176	-271	-287	-417	-301	-682	-227
Percentage difference from baseline	0.2	-0.1	-0.1	-0.6	-0.8	-1.2	-1.3	-1.8	-1.3	-2.9	-1.0
Imports											
Scenario	125	135	145	155	165	175	185	195	205	215	
Baseline	125	135	145	155	165	175	185	195	205	215	
Difference from baseline	0	0	0	0	0	0	0	0	0	0	0
Percentage difference from baseline	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total supply											
Scenario	23,608	23,492	23,515	23,666	23,936	24,135	24,341	24,405	24,644	24,501	
Baseline	23,563	23,588	23,703	24,008	24,383	24,703	24,983	25,218	25,413	25,653	
Difference from baseline	45	-96	-188	-342	-447	-568	-642	-813	-769	-1,152	-497
Percentage difference from baseline	0.2	-0.4	-0.8	-1.4	-1.8	-2.3	-2.6	-3.2	-3.0	-4.5	-2.0
Domestic use											
Scenario	20,710	21,117	21,445	21,720	21,978	22,294	22,616	22,914	23,265	23,520	
Baseline	20,500	20,825	21,125	21,425	21,725	22,025	22,325	22,625	22,925	23,225	
Difference from baseline	210	292	320	295	253	269	291	289	340	295	285
Percentage difference from baseline	1.0	1.4	1.5	1.4	1.2	1.2	1.3	1.3	1.5	1.3	1.3
Exports											
Scenario	880	652	408	333	372	293	238	141	112	22	
Baseline	975	875	700	700	775	775	775	775	750	725	
Difference from baseline	-95	-223	-292	-367	-403	-481	-537	-634	-638	-703	-437
Percentage difference from baseline	-9.8	-25.5	-41.8	-52.4	-52.0	-62.1	-69.3	-81.9	-85.1	-97.0	-57.7
Total use											
Scenario	21,590	21,769	21,852	22,053	22,350	22,587	22,854	23,055	23,377	23,542	
Baseline	21,475	21,700	21,825	22,125	22,500	22,800	23,100	23,400	23,675	23,950	
Difference from baseline	115	69	27	-72	-150	-213	-246	-345	-298	-408	-152
Percentage difference from baseline	0.5	0.3	0.1	-0.3	-0.7	-0.9	-1.1	-1.5	-1.3	-1.7	-0.6
Total stocks, Sept 30											
Scenario	2,018	1,724	1,662	1,613	1,586	1,548	1,487	1,350	1,267	959	
Baseline	2,088	1,888	1,878	1,883	1,883	1,903	1,883	1,818	1,738	1,703	
Difference from baseline	-70	-164	-216	-270	-297	-355	-396	-468	-471	-744	-345
Percentage difference from baseline	-3.4	-8.7	-11.5	-14.4	-15.8	-18.7	-21.0	-25.7	-27.1	-43.7	-19.0

Table 15. 15-billion gallon scenario: Livestock production

	Calendar year										2007-16
	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	Average
Beef (mil lbs)											
Scenario	26,874	26,833	26,572	26,162	26,047	26,157	26,468	27,082	27,668	28,161	
Baseline	26,802	26,846	26,551	26,138	26,050	26,170	26,467	27,079	27,649	28,133	
Difference from baseline	72	-13	21	24	-3	-13	1	3	19	28	14
Percentage difference from baseline	0.3	0.0	0.1	0.1	0.0	-0.1	0.0	0.0	0.1	0.1	0.1
Pork (mil lbs)											
Scenario	21,869	21,412	21,181	21,062	21,101	21,300	21,608	21,984	22,397	22,723	
Baseline	21,870	21,420	21,203	21,106	21,171	21,392	21,719	22,110	22,535	22,868	
Difference from baseline	-1	-7	-22	-44	-70	-92	-111	-126	-138	-145	-76
Percentage difference from baseline	0.0	0.0	-0.1	-0.2	-0.3	-0.4	-0.5	-0.6	-0.6	-0.6	-0.3
Young chickens (mil lbs)											
Scenario	35,929	36,320	36,555	36,679	36,831	37,163	37,684	38,356	38,966	39,531	
Baseline	35,935	36,325	36,560	36,688	36,833	37,162	37,683	38,352	38,960	39,522	
Difference from baseline	-6	-5	-5	-9	-2	0	1	4	7	9	-1
Percentage difference from baseline	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Milk (bil lbs)											
Scenario	183	184	184	184	186	188	189	191	193	195	
Baseline	183	184	184	185	186	188	189	191	193	196	
Difference from baseline	0	0	0	0	0	0	0	-1	-1	-1	0
Percentage difference from baseline	0.0	0.0	-0.1	-0.1	-0.1	-0.2	-0.3	-0.3	-0.3	-0.4	-0.2

Table 16. 20-billion gallon scenario: Livestock production

	Calendar year										2007-16
	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	Average
Beef (mil lbs)											
Scenario	26,935	26,835	26,625	26,236	26,128	26,279	26,653	27,308	28,061	28,502	
Baseline	26,802	26,846	26,551	26,138	26,050	26,170	26,467	27,079	27,649	28,133	
Difference from baseline	132	-10	75	98	78	109	186	229	412	369	168
Percentage difference from baseline	0.5	0.0	0.3	0.4	0.3	0.4	0.7	0.8	1.5	1.3	0.6
Pork (mil lbs)											
Scenario	21,868	21,406	21,160	21,010	21,011	21,172	21,440	21,777	22,150	22,450	
Baseline	21,870	21,420	21,203	21,106	21,171	21,392	21,719	22,110	22,535	22,868	
Difference from baseline	-2	-14	-44	-96	-160	-220	-279	-333	-385	-418	-195
Percentage difference from baseline	0.0	-0.1	-0.2	-0.5	-0.8	-1.0	-1.3	-1.5	-1.7	-1.8	-0.9
Young chickens (mil lbs)											
Scenario	35,924	36,309	36,528	36,633	36,776	37,096	37,605	38,259	38,860	39,401	
Baseline	35,935	36,325	36,560	36,688	36,833	37,162	37,683	38,352	38,960	39,522	
Difference from baseline	-11	-16	-32	-54	-58	-66	-78	-93	-100	-121	-63
Percentage difference from baseline	0.0	0.0	-0.1	-0.1	-0.2	-0.2	-0.2	-0.2	-0.3	-0.3	-0.2
Milk (bil lbs)											
Scenario	183	184	183	184	185	187	188	189	191	193	
Baseline	183	184	184	185	186	188	189	191	193	196	
Difference from baseline	0	0	0	-1	-1	-1	-2	-2	-3	-3	-1
Percentage difference from baseline	0.0	-0.1	-0.2	-0.3	-0.5	-0.7	-0.9	-1.2	-1.4	-1.6	-0.7

Table 17. 15-billion gallon scenario: Consumer price indices

	Calendar year										2007-16
	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	Average
	1982-84 = 100										
All food											
Scenario	198.9	204.5	210.5	216.2	221.6	226.1	230.1	233.9	237.9	242.3	
Baseline	198.9	204.4	210.3	216.0	221.2	225.6	229.5	233.3	237.2	241.6	
Difference from baseline	0.0	0.1	0.2	0.2	0.4	0.5	0.6	0.6	0.7	0.7	0.4
Percentage difference from baseline	0.0	0.1	0.1	0.1	0.2	0.2	0.2	0.3	0.3	0.3	0.2
Beef & veal											
Scenario	200.7	207.9	217.9	226.6	233.7	236.3	236.5	236.6	236.9	238.2	
Baseline	201.0	207.5	217.8	226.5	233.1	235.4	235.5	235.6	235.9	237.3	
Difference from baseline	-0.3	0.4	0.1	0.1	0.6	0.9	1.0	1.0	1.0	0.9	0.6
Percentage difference from baseline	-0.1	0.2	0.0	0.1	0.3	0.4	0.4	0.4	0.4	0.4	0.2
	-0.148										
Pork											
Scenario	173.9	183.0	190.4	197.4	202.1	206.2	208.2	208.5	208.7	210.2	
Baseline	174.0	182.7	190.1	196.8	200.9	204.6	206.3	206.3	206.4	207.8	
Difference from baseline	-0.1	0.3	0.3	0.6	1.2	1.6	1.9	2.2	2.3	2.4	1.3
Percentage difference from baseline	-0.1	0.2	0.2	0.3	0.6	0.8	0.9	1.1	1.1	1.2	0.6
Poultry											
Scenario	183.9	191.5	203.0	215.0	224.9	229.5	230.6	229.5	229.4	231.0	
Baseline	184.0	191.0	202.9	214.7	224.4	228.8	229.8	228.8	228.8	230.5	
Difference from baseline	-0.1	0.5	0.1	0.3	0.5	0.7	0.8	0.7	0.6	0.5	0.5
Percentage difference from baseline	0.0	0.2	0.1	0.1	0.2	0.3	0.3	0.3	0.3	0.2	0.2
Dairy products											
Scenario	185.5	191.8	197.1	201.9	206.0	207.3	207.5	208.2	208.4	209.0	
Baseline	185.5	191.5	196.5	201.1	205.0	206.0	206.0	206.5	206.5	207.0	
Difference from baseline	0.0	0.3	0.6	0.8	1.0	1.3	1.5	1.7	1.9	2.0	1.1
Percentage difference from baseline	0.0	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0	0.6

Table 18. 20-billion gallon scenario: Consumer price indices

	Calendar year										2007-16
	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	Average
	1982-84 = 100										
All Food											
Scenario	198.8	204.6	210.6	216.6	222.1	226.8	231.0	235.2	239.2	244.0	
Baseline	198.9	204.4	210.3	216.0	221.2	225.6	229.5	233.3	237.2	241.6	
Difference from baseline	-0.1	0.2	0.3	0.6	0.9	1.2	1.5	1.9	2.0	2.4	1.1
Percentage difference from baseline	0.0	0.1	0.2	0.3	0.4	0.6	0.7	0.8	0.8	1.0	0.5
Beef & veal											
Scenario	200.5	208.2	218.0	227.0	234.7	237.6	238.1	238.7	238.6	241.0	
Baseline	201.0	207.5	217.8	226.5	233.1	235.4	235.5	235.6	235.9	237.3	
Difference from baseline	-0.5	0.7	0.2	0.5	1.6	2.2	2.6	3.1	2.7	3.7	1.7
Percentage difference from baseline	-0.3	0.3	0.1	0.2	0.7	0.9	1.1	1.3	1.2	1.6	0.7
Pork											
Scenario	173.8	183.3	190.9	198.6	204.2	209.2	212.0	213.3	214.1	216.9	
Baseline	174.0	182.7	190.1	196.8	200.9	204.6	206.3	206.3	206.4	207.8	
Difference from baseline	-0.2	0.6	0.8	1.8	3.3	4.6	5.7	7.0	7.7	9.1	4.1
Percentage difference from baseline	-0.1	0.4	0.4	0.9	1.6	2.2	2.8	3.4	3.7	4.4	2.0
Poultry											
Scenario	183.9	192.1	204.1	217.1	228.1	233.6	235.7	236.0	236.4	240.1	
Baseline	184.0	191.0	202.9	214.7	224.4	228.8	229.8	228.8	228.8	230.5	
Difference from baseline	-0.1	1.1	1.2	2.4	3.7	4.8	5.9	7.2	7.6	9.6	4.3
Percentage difference from baseline	-0.1	0.6	0.6	1.1	1.6	2.1	2.6	3.2	3.3	4.1	1.9
Dairy products											
Scenario	185.6	192.0	197.7	202.8	207.4	209.2	209.9	211.3	211.8	213.3	
Baseline	185.5	191.5	196.5	201.1	205.0	206.0	206.0	206.5	206.5	207.0	
Difference from baseline	0.1	0.5	1.2	1.7	2.4	3.2	3.9	4.8	5.3	6.3	2.9
Percentage difference from baseline	0.0	0.3	0.6	0.8	1.2	1.5	1.9	2.3	2.6	3.0	1.4

Table 19. 15-billion gallon scenario: Livestock prices

	Calendar year										2007-16
	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	Average
Choice steers, Omaha (dol/cwt)											
Solution	83.42	85.14	90.61	93.83	95.59	94.64	93.31	91.97	90.67	89.77	
Baseline	83.66	84.82	90.56	93.74	95.11	93.96	92.55	91.13	89.87	89.03	
Difference from baseline	-0.24	0.32	0.06	0.09	0.48	0.69	0.76	0.84	0.80	0.74	0.45
Percentage difference from baseline	-0.3	0.4	0.1	0.1	0.5	0.7	0.8	0.9	0.9	0.8	0.5
Hogs, farm price (dol/cwt)											
Solution	40.90	47.68	50.66	53.58	55.43	56.59	56.77	56.20	55.49	55.43	
Baseline	40.97	47.44	50.44	53.12	54.58	55.44	55.39	54.63	53.82	53.70	
Difference from baseline	-0.08	0.23	0.22	0.46	0.85	1.15	1.38	1.57	1.67	1.73	0.92
Percentage difference from baseline	-0.2	0.5	0.4	0.9	1.6	2.1	2.5	2.9	3.1	3.2	1.7
Broiler, farm price (cents/lb)											
Solution	39.40	40.81	42.88	45.17	47.09	47.96	48.02	47.73	47.48	47.62	
Baseline	39.42	40.60	42.80	45.00	46.80	47.60	47.60	47.30	47.10	47.30	
Difference from baseline	-0.02	0.21	0.08	0.17	0.29	0.36	0.42	0.43	0.38	0.32	0.26
Percentage difference from baseline	-0.1	0.5	0.2	0.4	0.6	0.8	0.9	0.9	0.8	0.7	0.6
Milk, farm price (dol/cwt)											
Solution	13.80	14.90	15.62	16.26	16.67	16.90	17.07	17.28	17.33	17.39	
Baseline	13.79	14.82	15.47	16.06	16.42	16.57	16.68	16.83	16.83	16.86	
Difference from baseline	0.01	0.08	0.15	0.20	0.26	0.33	0.39	0.45	0.50	0.53	0.29
Percentage difference from baseline	0.1	0.5	1.0	1.2	1.6	2.0	2.4	2.7	3.0	3.2	1.7

Table 20. 20-billion gallon scenario: Livestock prices

	Calendar year										2007-16
	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	Average
Choice steers, Omaha (dol/cwt)											
Scenario	83.22	85.39	90.69	94.12	96.37	95.70	94.61	93.61	92.05	92.03	
Baseline	83.66	84.82	90.56	93.74	95.11	93.96	92.55	91.13	89.87	89.03	
Difference from baseline	-0.44	0.56	0.13	0.38	1.26	1.74	2.06	2.48	2.17	3.00	1.33
Percentage difference from baseline	-0.5	0.7	0.1	0.4	1.3	1.9	2.2	2.7	2.4	3.4	1.5
Hogs, farm price (dol/cwt)											
Scenario	40.83	47.90	51.03	54.43	56.96	58.72	59.54	59.69	59.39	60.25	
Baseline	40.97	47.44	50.44	53.12	54.58	55.44	55.39	54.63	53.82	53.70	
Difference from baseline	-0.14	0.46	0.59	1.32	2.38	3.28	4.14	5.06	5.57	6.55	2.92
Percentage difference from baseline	-0.3	1.0	1.2	2.5	4.4	5.9	7.5	9.3	10.4	12.2	5.4
Broiler, farm price (cents/lb)											
Scenario	39.38	41.10	43.36	46.14	48.55	49.87	50.41	50.75	50.74	51.88	
Baseline	39.42	40.60	42.80	45.00	46.80	47.60	47.60	47.30	47.10	47.30	
Difference from baseline	-0.04	0.50	0.56	1.14	1.75	2.27	2.81	3.46	3.64	4.58	2.07
Percentage difference from baseline	-0.1	1.2	1.3	2.5	3.7	4.8	5.9	7.3	7.7	9.7	4.4
Milk, farm price (dol/cwt)											
Scenario	13.81	14.96	15.77	16.50	17.04	17.41	17.74	18.15	18.30	18.64	
Baseline	13.79	14.82	15.47	16.06	16.42	16.57	16.68	16.83	16.83	16.86	
Difference from baseline	0.01	0.14	0.30	0.44	0.62	0.84	1.06	1.32	1.48	1.78	0.80
Percentage difference from baseline	0.1	0.9	1.9	2.7	3.8	5.1	6.4	7.9	8.8	10.6	4.8

Table 21. 15-billion gallon scenario: Farm income

	Calendar year										2007-16
	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	Average
	billion dollars										
Livestock & products receipts											
Scenario	125.3	129.4	134.8	137.6	140.6	141.9	142.6	143.9	144.7	146.0	
Baseline	125.2	128.9	134.4	137.1	139.6	140.7	141.1	142.1	142.9	144.2	
Difference from baseline	0.1	0.5	0.4	0.5	1.0	1.3	1.6	1.7	1.8	1.8	1.1
Percentage difference from baseline	0.0	0.4	0.3	0.4	0.7	0.9	1.1	1.2	1.3	1.3	0.8
Crops receipts											
Scenario	134.0	143.0	147.8	150.8	152.2	154.5	156.8	159.1	161.7	164.1	
Baseline	133.5	141.5	145.7	148.1	149.1	150.8	152.7	154.6	156.7	158.8	
Difference from baseline	0.5	1.4	2.1	2.6	3.1	3.6	4.1	4.5	4.9	5.3	3.2
Percentage difference from baseline	0.4	1.0	1.4	1.8	2.1	2.4	2.7	2.9	3.1	3.3	2.1
Other income											
Scenario	55.0	53.9	55.2	56.3	57.5	58.7	60.0	61.1	61.3	62.3	
Baseline	55.0	53.8	55.3	56.3	57.6	58.8	60.0	61.2	61.5	62.4	
Difference from baseline	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-0.1	-0.2	-0.1	-0.1
Percentage difference from baseline	0.0	0.0	0.0	-0.1	-0.1	-0.1	-0.1	-0.2	-0.3	-0.1	-0.1
Value of inventory change											
Scenario	4.3	1.6	0.2	0.7	0.6	1.0	1.8	1.9	1.7	1.4	
Baseline	4.3	1.7	0.3	0.8	0.6	1.0	1.8	1.9	1.7	1.3	
Difference from baseline	-0.1	-0.1	-0.1	-0.1	0.0	0.0	0.0	0.0	0.0	0.1	0.0
Percentage difference from baseline	-1.4	-7.4	-31.2	-9.6	-4.2	0.1	0.6	1.7	1.1	5.2	-4.5
Total expenses											
Scenario	251.7	262.6	269.2	274.4	279.6	284.8	290.1	295.3	300.7	305.8	
Baseline	251.3	262.0	268.4	273.3	278.1	283.0	288.0	292.9	297.9	302.7	
Difference from baseline	0.4	0.6	0.8	1.1	1.5	1.8	2.2	2.5	2.7	3.0	1.6
Percentage difference from baseline	0.1	0.2	0.3	0.4	0.5	0.6	0.8	0.8	0.9	1.0	0.6
Net farm income											
Scenario	66.8	65.3	68.8	71.0	71.4	71.3	71.1	70.7	68.8	68.0	
Baseline	66.6	64.0	67.2	69.0	68.8	68.3	67.6	67.0	64.9	63.9	
Difference from baseline	0.1	1.2	1.6	2.0	2.6	3.1	3.4	3.7	3.9	4.1	2.6
Percentage difference from baseline	0.2	1.9	2.3	2.9	3.8	4.5	5.1	5.6	6.0	6.3	3.9

Table 22. 20-billion gallon scenario: Farm income

	Calendar year										2007-16
	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	Average
	billion dollars										
Livestock & products receipts											
Scenario	125.3	129.9	135.6	139.1	143.0	145.2	146.9	149.3	150.9	153.7	
Baseline	125.2	128.9	134.4	137.1	139.6	140.7	141.1	142.1	142.9	144.2	
Difference from baseline	0.1	1.0	1.2	2.0	3.4	4.6	5.8	7.2	8.0	9.6	4.3
Percentage difference from baseline	0.1	0.8	0.9	1.4	2.4	3.2	4.1	5.0	5.6	6.6	3.0
Crops receipts											
Scenario	134.4	144.2	149.9	153.8	156.1	159.3	162.7	166.0	169.6	172.9	
Baseline	133.5	141.5	145.7	148.1	149.1	150.8	152.7	154.6	156.7	158.8	
Difference from baseline	0.9	2.6	4.2	5.6	7.0	8.5	10.0	11.4	12.8	14.1	7.7
Percentage difference from baseline	0.7	1.9	2.9	3.8	4.7	5.6	6.5	7.4	8.2	8.9	5.0
Other income											
Scenario	55.0	53.9	55.2	56.3	57.5	58.7	59.9	61.0	61.2	62.3	
Baseline	55.0	53.8	55.3	56.3	57.6	58.8	60.0	61.2	61.5	62.4	
Difference from baseline	0.0	0.0	0.0	-0.1	-0.1	-0.1	-0.1	-0.2	-0.3	-0.2	-0.1
Percentage difference from baseline	0.0	0.0	-0.1	-0.1	-0.2	-0.2	-0.2	-0.3	-0.5	-0.2	-0.2
Value of inventory change											
Scenario	4.2	1.5	0.1	0.6	0.6	1.0	1.9	2.2	1.7	2.3	
Baseline	4.3	1.7	0.3	0.8	0.6	1.0	1.8	1.9	1.7	1.3	
Difference from baseline	-0.1	-0.2	-0.2	-0.2	-0.1	0.0	0.1	0.3	0.0	1.0	0.1
Percentage difference from baseline	-2.3	-12.7	-68.0	-21.5	-11.4	-1.0	3.6	18.4	-0.5	80.4	-1.5
Total expenses											
Scenario	252.0	263.2	270.4	276.1	282.1	288.1	294.4	300.5	306.9	313.0	
Baseline	251.3	262.0	268.4	273.3	278.1	283.0	288.0	292.9	297.9	302.7	
Difference from baseline	0.7	1.2	2.0	2.8	3.9	5.1	6.4	7.6	9.0	10.3	4.9
Percentage difference from baseline	0.3	0.5	0.7	1.0	1.4	1.8	2.2	2.6	3.0	3.4	1.7
Net farm income											
Scenario	66.8	66.2	70.4	73.6	75.1	76.1	77.0	78.0	76.4	78.2	
Baseline	66.6	64.0	67.2	69.0	68.8	68.3	67.6	67.0	64.9	63.9	
Difference from baseline	0.2	2.2	3.2	4.6	6.3	7.8	9.3	11.1	11.5	14.3	7.1
Percentage difference from baseline	0.3	3.5	4.7	6.6	9.2	11.5	13.8	16.5	17.8	22.4	10.6

Table 23. 15-billion gallon scenario: U.S. agricultural export value

	Fiscal year										2007-16
	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	Average
	billion dollars										
Total agricultural exports											
Scenario	77.0	81.8	81.4	83.7	85.2	87.3	89.1	90.9	92.7	95.1	
Baseline	77.0	81.7	81.3	83.7	85.1	87.2	88.9	90.7	92.5	94.8	
Difference from baseline	0.0	0.1	0.1	0.0	0.1	0.2	0.2	0.2	0.3	0.3	0.1
Percentage difference from baseline	0.0	0.1	0.1	0.0	0.1	0.2	0.2	0.3	0.3	0.3	0.2

Table 24. 20-billion gallon scenario: U.S. agricultural export value

	Fiscal year										2007-16
	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	Average
	billion dollars										
Total agricultural exports											
Scenario	77.0	81.9	81.5	83.8	85.4	87.6	89.5	91.4	93.3	95.7	
Baseline	77.0	81.7	81.3	83.7	85.1	87.2	88.9	90.7	92.5	94.8	
Difference from baseline	0.0	0.1	0.2	0.2	0.3	0.5	0.6	0.7	0.8	0.9	0.4
Percentage difference from baseline	0.0	0.2	0.2	0.2	0.4	0.5	0.7	0.8	0.9	1.0	0.5

Table 25: Composition of Farm Production Regions

Region	States
Northeast	New York, Vermont, New Hampshire, Maine, Connecticut, Rhode Island, Pennsylvania, New Jersey, Maryland, Delaware
Lake States	Minnesota, Wisconsin, Michigan
Corn Belt	Iowa, Illinois, Indiana, Ohio
Northern Plains	North Dakota, South Dakota, Nebraska, Kansas
Appalachian	Kentucky. West Virginia. Virginia. Tennessee, North Carolina
Southeast	Alabama, Georgia, South Carolina, Florida
Delta	Arkansas, Louisiana, Mississippi
Southern Plains	Oklahoma, Texas
Mountain	Idaho, Montana, Wyoming, Nevada, Utah, Colorado, Arizona, New Mexico
Pacific	Washington, Oregon, California

Table 26: Nitrogen fertilizer used, by region (million tons)

	Baseline	Scenario 1	Scenario 2	Percent change from Baseline: Scenario 1	Percent change from Baseline: Scenario 2
Northeast	0.28	0.29	0.30	1.6%	6.1%
Lake States	1.03	1.04	1.09	1.3%	6.6%
Corn Belt	3.58	3.65	3.78	1.9%	5.8%
Northern Plains	1.74	1.78	1.90	2.0%	9.1%
Appalachian	0.53	0.54	0.57	2.6%	8.1%
Southeast	0.22	0.22	0.24	2.9%	9.1%
Delta	0.46	0.47	0.49	2.4%	7.0%
Southern Plains	1.02	1.03	1.07	1.3%	4.9%
Mountain	0.36	0.37	0.37	0.8%	3.3%
Pacific	0.16	0.16	0.15	-2.6%	-8.5%
US	9.37	9.54	9.97	1.8%	6.3%

Table 27: Phosphorus fertilizer used, by region (million tons)

	Baseline	Scenario 1	Scenario 2	Percent change from Baseline: Scenario 1	Percent change from Baseline: Scenario 2
Northeast	0.21	0.21	0.21	0.5%	2.0%
Lake States	0.53	0.54	0.54	0.4%	1.5%
Corn Belt	1.37	1.38	1.40	1.2%	2.5%
Northern Plains	0.91	0.92	0.94	0.5%	3.3%
Appalachian	0.25	0.24	0.24	-0.2%	-1.5%
Southeast	0.10	0.10	0.10	-1.3%	-4.7%
Delta	0.21	0.21	0.18	-3.2%	-13.9%
Southern Plains	0.38	0.38	0.38	0.3%	1.3%
Mountain	0.34	0.34	0.35	0.1%	1.0%
Pacific	0.12	0.12	0.12	-1.1%	-3.4%
US	4.42	4.44	4.46	0.4%	1.0%

Table 28: Potash fertilizer used, by region (million tons)

	Baseline	Scenario 1	Scenario 2	Percent change from Baseline: Scenario 1	Percent change from Baseline: Scenario 2
Northeast	0.46	0.46	0.46	0.3%	1.1%
Lake States	0.90	0.91	0.94	0.6%	3.7%
Corn Belt	2.13	2.15	2.20	1.1%	3.2%
Northern Plains	0.56	0.56	0.59	1.1%	5.8%
Appalachian	0.59	0.59	0.58	0.0%	-0.3%
Southeast	0.24	0.24	0.23	-2.3%	-6.6%
Delta	0.14	0.15	0.15	1.1%	2.1%
Southern Plains	0.08	0.08	0.08	-0.7%	-4.2%
Mountain	0.43	0.43	0.43	-0.2%	-0.7%
Pacific	0.15	0.15	0.15	-0.1%	-0.6%
US	5.69	5.72	5.81	0.5%	2.1%

Table 29: Pesticide applied (million lbs)

	Baseline	Scenario 1	Scenario 2	Percent change from Baseline: Scenario 1	Percent change from Baseline: Scenario 2
Northeast	12.90	13.04	13.41	1.1%	3.9%
Lake States	44.77	45.22	46.58	1.0%	4.0%
Corn Belt	143.18	145.89	150.01	1.9%	4.8%
Northern Plains	47.99	49.30	54.75	2.7%	14.1%
Appalachian	28.32	28.92	30.11	2.1%	6.3%
Southeast	11.87	11.76	11.35	-1.0%	-4.4%
Delta	47.36	47.15	46.33	-0.5%	-2.2%
Southern Plains	15.11	15.31	15.88	1.4%	5.1%
Mountain	8.87	8.90	9.04	0.3%	1.9%
Pacific	8.01	7.73	7.06	-3.5%	-11.9%
US	368.40	373.22	384.51	1.3%	4.4%

Table 30: Nitrogen leached into groundwater (million tons)

	Baseline	Scenario 1	Scenario 2	Percent change from Baseline: Scenario 1	Percent change from Baseline: Scenario 2
Northeast	0.07	0.07	0.07	0.7%	3.8%
Lake States	0.20	0.20	0.22	1.2%	10.6%
Corn Belt	0.14	0.14	0.14	0.9%	2.4%
Northern Plains	0.07	0.07	0.07	-2.0%	5.4%
Appalachian	0.20	0.20	0.20	0.8%	1.5%
Southeast	0.09	0.09	0.09	0.1%	-0.7%
Delta	0.11	0.11	0.11	0.0%	0.9%
Southern Plains	0.03	0.03	0.04	1.9%	8.1%
Mountain	0.02	0.02	0.02	0.4%	2.3%
Pacific	0.02	0.02	0.01	-12.2%	-40.8%
US	0.95	0.96	0.98	0.2%	2.9%

Table 31: Soil erosion (million tons)

	Baseline	Scenario 1	Scenario 2	Percent change from Baseline: Scenario 1	Percent change from Baseline: Scenario 2
Northeast	49.75	50.11	51.09	0.7%	2.7%
Lake States	97.22	97.65	98.68	0.4%	1.5%
Corn Belt	436.62	441.37	448.73	1.1%	2.8%
Northern Plains	147.18	149.86	163.82	1.8%	11.3%
Appalachian	72.01	72.03	71.71	0.0%	-0.4%
Southeast	48.80	48.51	46.96	-0.6%	-3.8%
Delta	83.32	80.06	69.38	-3.9%	-16.7%
Southern Plains	64.95	65.75	68.03	1.2%	4.8%
Mountain	30.21	30.28	30.57	0.2%	1.2%
Pacific	3.92	3.86	3.73	-1.6%	-5.0%
US	1033.98	1039.48	1052.71	0.5%	1.8%

Table 32: Additional industry information on the impact of ethanol on poultry and aquaculture feed costs

Broilers	U.S. broiler liveweight production in 2006 was 48.3 billion pounds. Production is concentrated in the Southeast and South Central sections of the country with Maryland, Virginia, North Carolina, Georgia, Alabama, Mississippi, Arkansas, and Texas accounting for over 70 percent of total broiler production in 2005.The feed conversion ratio for broiler production is approximately 2 pounds of feed per 1 pound of liveweight or approximately 96.6 billion pounds of feed use in 2006. Approximately 68 percent of broiler feed is corn or 66 billion pounds in 2006. Due to nutritional restrictions, broilers feeds can only contain approximately 10 percent DDG's. Most broiler production is not in the same locations as the majority of ethanol production.
Turkeys	U.S. turkey liveweight production in 2006 was 7.2 billion pounds. Turkey production is spread throughout the country with 5 largest producing States being North Carolina, Minnesota, Missouri, Arkansas, and Virginia. These States accounted for 55 percent of total turkey production in 2005. The feed conversion ratio for turkey production is approximately 2.9 pounds of feed per 1 pound of liveweight or approximately 21 billion pounds of feed use in 2006. Approximately 70 percent of turkey feed is corn or 15 billion pounds in 2006. Due to nutritional restrictions, turkey feeds can only contain approximately 10 percent DDG's.
Eggs	U.S. egg production in 2006 was 7.6 billion dozens (table and hatching production). Egg production is concentrated mostly in the central portion of the country with the 5 largest producing States being Iowa, Ohio, Pennsylvania, Indiana, and California. These States accounted for 43 percent of total egg production in 2005. The feed conversion ratio for egg production is approximately 4 pounds of feed per 1 dozen eggs or approximately 30 billion pounds of feed use in 2006. Approximately 80 percent of egg-type feed is corn or 24 billion pounds in 2006. Egg birds (producing shell eggs or hatching eggs) have the same basic nutritional restrictions as broilers and can only use approximately 10 percent DDG's in their rations.
Catfish	U.S. catfish production in 2006 was 570 million pounds. Catfish production is concentrated in four States (Alabama, Mississippi, Louisiana, and Arkansas) with Mississippi being the largest producer. The feed conversion ratio for catfish production is approximately 2 pounds of feed per 1 pound of liveweight of fish at harvested. The National Agricultural Statistics Service estimated that 1.5 billion pounds of catfish feeds were delivered to producers in 2006. Catfish feeds are roughly similar in composition to broiler feeds. Catfish also have similar nutritional restrictions as broilers and can only incorporate a relatively small percentage of DDG's in their rations.

Table 33: Dairy production costs, 2005

Item	West	Southeast	Corn Belt	Lake States	Northeast	Appala-chian	Southern Plains
				dollars per cwt			
Operating costs:							
Feed:							
Feed grains	1.11	0.47	1.21	1.10	0.75	0.78	1.20
Hay and straw	2.32	0.81	3.32	1.24	1.46	1.37	1.63
Complete feed mixes	2.33	3.39	1.43	0.71	1.73	3.36	2.92
Liquid whey and milk replacer	0.06	0.04	0.08	0.24	0.08	0.07	0.01
Silage	0.85	1.12	0.95	0.67	1.20	1.34	0.38
Grazed pasture and cropland	0.13	0.11	0.16	0.07	0.07	0.25	0.08
Other feed items	0.74	1.58	1.67	1.22	2.36	1.04	1.25
Total feed operating costs	7.54	7.52	8.82	5.24	7.64	8.21	7.47
Total non-feed operating costs	2.37	3.93	3.41	2.91	3.84	3.79	2.99
Total operating costs	9.90	11.45	12.23	8.15	11.48	12.00	10.46
Total allocated overhead	5.27	8.66	11.72	12.26	12.15	12.08	4.69
Total economic costs	15.17	20.11	23.95	20.41	23.64	24.07	15.15

Table 34: Cow-calf production costs, 2005

Item	North Central	Great Plains	South	West
		$ per bred cow		
Operating costs:				
Feed:				
Concentrates and other feed	28.36	26.92	25.46	19.42
Supplemental feed	32.35	27.19	12.62	3.13
Harvested forages	183.93	111.56	181.94	116.65
Cropland pasture	15.12	15.52	3.64	4.58
Private pasture	86.52	118.69	67.31	110.91
Public land	0.37	5.94	0.25	1.83
Total feed operating costs	346.65	305.82	291.22	256.53
Total non-feed operating costs	174.00	140.55	128.37	152.86
Total operating costs (Includes purchased cattle for backgrounding)	552.67	523.83	474.30	507.31
Total allocated overhead	698.25	538.31	703.82	553.20
Total economic costs	1,250.92	1,062.14	1,178.12	1,060.51

Table 35: Feedlot costs of production, 2005

Cost category	Farmer feedlot	Commercial feedlot
	$ per cwt final product	
Operating costs:		
Feed--		
Halage	0.37	0.00
Silage	4.51	0.38
Dry grain & concentrates	9.94	9.83
Protein supplement	4.27	3.95
Legume hay	1.20	1.59
Pasture	0.01	0.00
Crop residue	0.00	0.00
Total feed operating costs	20.30	15.75
Total non-feed operating costs	88.62	89.29
Total operating costs (including feeder cattle)	108.91	105.04
Total allocated overhead	14.61	0.85
Total economic costs	123.52	105.89

Table 36: Regional farrow-to-finish production costs, 2005

Cost category	North Central, Northern Plains, and West	South and Southern Plains
	$ per cwt gain	
Operating costs:		
Feed --		
Grain	9.51	5.51
Protein sources	7.64	4.72
Complete mixes	7.66	12.59
Other feed items	0.30	0.23
Total feed operating cost	25.10	23.05
Total other non-feed operating costs	5.24	4.96
Total operating costs	30.34	28.01
Total allocated overhead	24.32	23.94
Total economic costs	54.66	51.95

Table 37: Regional feeder pig-to-finish production costs, 2005

Cost category	North Central, Northern Plains, and West	South and Southern Plains
	$ per cwt gain	
Operating costs:		
Feed --		
Grain	1.87	0.02
Protein sources	1.58	0.01
Complete mixes	15.74	22.68
Other feed items	0.09	0.00
Total feed operating cost	19.28	22.71
Total non-feed operating costs	20.51	25.53
Total, operating costs	39.79	48.24
Total, allocated overhead	8.09	7.33
Total economic costs	47.88	55.57

Table 38: Hog production costs, 2005

Cost category	North Central, Northern Plains, and West	South and Southern Plains
	$ per cwt gain	
Operating costs:		
Feed --		
Grain	3.75	0.47
Protein sources	3.01	0.40
Complete mixes	15.90	21.75
Other feed items	0.20	0.02
Total feed operating cost	22.86	22.64
Total non-feed operating costs	20.44	27.86
Total, operating costs	43.29	50.50
Total allocated overhead	15.42	12.53
Total economic costs	58.72	63.03

Table 39. Major Land Uses in the United States, 2002

Land use	48 States	United States	48 States	United States
	Million acres		Percent of total	
Cropland used for crops	340	340	18.0	15.0
Idle cropland	40	40	2.1	1.8
Cropland used for pasture	62	62	3.3	2.7
Grassland pasture and range	584	587	30.8	25.9
Forest-use land grazed	134	134	7.1	5.9
Forest-use land not grazed	425	517	22.4	22.8
Special uses	153	297	8.1	13.1
Urban	59	60	3.1	2.6
Miscellaneous other land	97	228	5.1	10.1
Total land area	1,894	2,264	100.0	100.0

Source: Lubowski, R., M. Vesterby, S. Bucholtz, A. Baez, and M. Roberts. Major Uses of Land in the United States, 2002. U.S. Department of Agriculture. Economic Research Service. EIB-14. May 2006. The report is available on the internet at: http://www.ers.usda.gov/publications/EIB14/.

Table 40. Estimated Annual Biomass Potential in the United States

	Biomass (million tons)	Ethanol Equivalent (billion gallons)
Grain-to-ethanol *	87	7
Process residues	87	7
Crop residues	446	36
Perennial crops	377	30
Forestry residues	368	29
Total	1,365	109

* The billion-ton study was completed prior to the recent increase in corn-based ethanol production. Therefore, the potential to produce 7 billion gallon per year from grain-to-ethanol is under-estimated. The latest USDA baseline projects corn-based ethanol production of 12 billion gallons per year by marketing year 2016/17.

Assumes 80 gallons of ethanol per dry ton of biomass.

Source: Biomass estimate is from “Biomass as a Feedstock for Bioenergy and Bioproducts Industry: The Technical Feasibility of a Billion-Ton Supply”

Table 41. Sources of Agricultural Biomass Over Time

Scenario	Agricultural Biomass (million dry tons per year)	Change in Biomass (million dry tons per year)
Currently Availability	194	
Moderate crop yield increases without land use change	432	+238
High crop yield increases without land use change	597	+165
High crop yield increases with land use change	998	+401

Source: “Biomass as a Feedstock for Bioenergy and Bioproducts Industry: The Technical Feasibility of a Billion-Ton Supply”