

# **U.S. Distillers Grains Supply-Use Under E-10, E-12 and E-15**

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This article examines how U.S. corn supply-demand balances are likely to be effected by expanding the proportion of ethanol allowed to be mixed in U.S. fuels from 10% (i.e., E-10), to 12% (E-11) and 15% (E-15) over the next decade. June 2010 USDA World Agricultural Supply-Demand Estimates (WASDE) and 2010 USDA Agricultural Projections of grain and livestock supply, use and agricultural commodity prices for the 2010 through 2019 period are used as a basis for this analysis. United States corn and livestock supply-use projections were taken "as is" from this source with only minor adjustments. Information on 2010 USDA Agricultural Baseline Projections are available online (<http://www.ers.usda.gov/briefing/baseline/>).

Expansion in allowable ethanol fuel blends from E-10 to either E-12 or E-15 is projected to have a marked impact on total supplies and uses of both corn and distillers grains. This analysis combines U.S. corn and distillers dried grain with solubles (DDGS) (in corn equivalents) into one inclusive supply-use balance sheet, showing the projected impact and tradeoffs of expanded grain ethanol production and DDGS.

A key assumption in this analysis is that DDGS substitutes for corn in livestock feed rations on a pound-for-pound or 1-for-1 basis. It is also assumed that domestic uses of total U.S. corn plus DDGS (in corn equivalents) will be maintained over time at the expense of foreign uses (i.e., exports). Another key assumption is that alternative uses of corn and DDGS will be rationed by market forces in such a manner so that ending stocks of U.S. corn will not be drawn down below the 900 million to 1 billion bushel level over the next decade under normal corn production scenarios (i.e., no unforeseen crop production shortfalls). Finally, it is also assumed that all DDGS produced in a particular marketing year are used in that same period, i.e., that ending stocks of DDGS effectively equal zero at the end of each U.S. corn marketing year during the MY 2010-11 through MY 2019-20 period. The assumptions regarding the priority of domestic uses as opposed to export use and of maintaining minimal U.S. corn ending stocks levels are critical determinants of the results of the following analysis.

See the June 2010 AgMRC Renewable Energy and Climate Change newsletter article on "Measuring Supply-Use of Distillers Grains in the United States" for a related article on the issue of combining corn and DDGS together in a single supply-demand balance sheet ([http://www.agmrc.org/renewable\\_energy/agmrc\\_renewable\\_energy\\_newsletter.cfm](http://www.agmrc.org/renewable_energy/agmrc_renewable_energy_newsletter.cfm)) and for an explanation of how the USDA Agricultural Projections for 2010-19 were adopted for use in this analysis.

## **USDA Agricultural Projections for 2010-2019**

As stated by the USDA Economic Research Service (<http://www.ers.usda.gov/briefing/baseline/>), the USDA Agricultural Projections for 2010-19, released in February 2010, provide long run projections for the United States farm sector for the next decade. The following analysis incorporated updated USDA WASDE U.S. corn supply demand report estimates with the original baseline assumptions to examine changes in U.S. bioenergy policy as pertains to U.S. ethanol production and use.

## **U.S. Ethanol & DDGS Production Under Differing Ethanol Use Policy Scenarios**

For each 1% increase of ethanol allowed in U.S. gasoline blends, it is assumed that 1.3 billion gallons more ethanol will be produced each year with requisite increases made in the U.S. Renewable Fuels Standard (RFS). Figure 1 illustrates how increases of 1% in allowable U.S. ethanol use in blended fuels

(i.e., from E-10 to E-11, etc.) would affect U.S. ethanol production in each U.S. corn marketing year through MY 2019-20. Figure 1 likely overstates the ability of the U.S. ethanol industry to quickly increase production capacity to supply the amount of ethanol required to fully supply higher ethanol blends (say, E-14 or E-15) during the early years of adjustment. Total U.S. ethanol production would be projected to increase to as much as 21.36 billion gallons by U.S. corn MY 2015-16 under an E-15 ethanol inclusion policy regime.

Increases in U.S. ethanol production associated with increasing gasoline blend proportions would also bring about increases in DDGS production (Figure 2). For each 1.3 billion gallons of addition ethanol produced (i.e., plus 1% of allowable ethanol in gasoline fuel blends), an additional 464.3 million bushels (mb) of corn is used (1.3 bln. gal ÷ 2.8 gallons of ethanol per bushel). If for each bushel of corn used in ethanol production, 17 pounds of DDGS are produced, then a 1% increase in allowable ethanol mixture in gasoline blends will produce 7,893.9 million pounds of DDGS (3.95 million short tons). Whereas with current U.S. ethanol policy (i.e., E-10), 44.5 million tons of DDGS production from U.S. corn are projected for MY 2015-16, for E-15 an additional 19.7 million tons (i.e., 64.2 million tons) of DDGS would be produced during the same marketing year.

Figure 1. U.S. Ethanol Production from Corn  
Assumed Adjustments from Baseline RFS to E-15

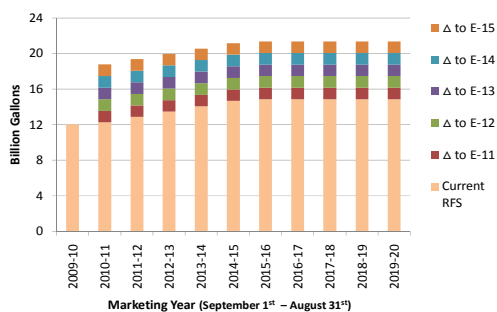
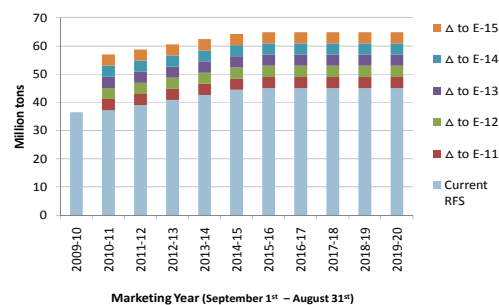


Figure 2. U.S. DDGS Production: Corn Ethanol  
Changes from Baseline RFS to E-15 (17 lb DDGS / bu)



## Baseline E-10 Scenario for U.S. Corn Plus DDGS Supply-Demand

The expanded, combined U.S. corn and DDGS supply-demand balance sheet in Table 1 is patterned after the U.S. corn supply-demand tables provided in monthly USDA WASDE reports (<http://www.usda.gov/oce/commodity/wasde/>). Along with standard WASDE report estimates of corn usage for ethanol production, non-ethanol food, seed and industrial use, exports, and feed and residual use, this table also provides estimates of DDGS production, feed use and exports. A 1 pound of DDGS to 1 pound of corn weight relationship is assumed in this combined table, allowing for DDGS to be represented on the basis of 56 pound or “bushel” equivalent units (i.e., DDGS<sub>cn equiv</sub>). Combined U.S. corn and distillers grains supply-use projections for MY 2010-11 through MY 2019-20 are presented.

Table 1 shows that under the current E-10 ethanol fuel inclusion regulations, U.S. corn ethanol production use, DDGS<sub>cn equiv</sub> production, feed use of corn and DDGS<sub>cn equiv</sub>, and exports of corn and DDGS<sub>cn equiv</sub> are projected to increase until MY 2015-16, but then remain steady through MY 2019-20. Exports of DDGS are assumed to be 21% of annual DDGS production throughout the MY 2010-11 through MY 2019-20 period (see Wisner 2010, <http://www.extension.iastate.edu/agdm/crops/outlook/dgsbalancesheet.pdf>).

This analysis assumes that all DDGS<sub>cn equiv</sub> produced are used in the same marketing year. There is no accumulation of ending stocks of DDGS<sub>cn equiv</sub> because of their bio-degradable properties. Accordingly, only corn ending stocks are assumed to be non-zero in this corn + DDGS<sub>cn equiv</sub> supply-demand table.

Although appreciable ending stocks of U.S. DDGS<sub>cn equiv</sub> are assumed to not exist (equal to zero), DDGS<sub>cn equiv</sub> feed use and exports are accounted for in figuring total use of corn and DDGS<sub>cn equiv</sub>. The % ending

stocks-to-use of corn plus  $DDGS_{cn\ equiv}$  is marginally smaller than for corn alone (i.e., because total use of corn plus  $DDGS_{cn\ equiv}$  is greater than total use of corn alone).

If as assumed in this analysis DDGS are a 1-to-1 substitute for corn in livestock feed rations, then standard U.S. corn supply-demand balance sheets at least marginally misrepresent livestock feed supply-demand balances in the U.S., implying a larger U.S. ending stocks-to-use ratio situation than actual exists when corn plus  $DDGS_{cn\ equiv}$  are accounted for.

**Table 1. E-10 Ethanol Production Scenario – Combined U.S. Corn & Distillers Grains Supply-Demand Projections**

Based on USDA Agricultural Projections for 2010-2019 Marketing Years & the June 10, 2010 USDA WASDE Report

	U.S. Corn Marketing Year (September 1 <sup>st</sup> – August 31 <sup>st</sup> )									
	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19	2019-20
Planted Acres (million acres)	88.0	90.0	89.5	89.5	89.5	89.5	89.5	89.5	89.5	89.0
Harvested Acres (million acres)	81.8	82.8	82.3	82.3	82.3	82.3	82.3	82.3	82.3	81.8
Yields (bushels per acre)	163.5	162.4	164.4	166.4	168.4	170.4	172.4	174.4	176.4	178.4
<b>Supply (million bushels)</b>										
Beginning Stocks: Corn	1,603	1,573	1,570	1,550	1,510	1,479	1,428	1,406	1,414	1,457
Production: Corn	13,370	13,447	13,350	13,695	13,859	14,024	14,189	14,353	14,518	14,593
Production: DDGS <small>corn equivalents</small>	1,484	1,484	1,515	1,576	1,637	1,657	1,657	1,657	1,657	1,657
Imports: Corn	10	15	15	15	15	15	15	15	15	15
<b>Total Supply: Corn + DDGS <small>corn equivalents</small></b>	<b>16,467</b>	<b>16,519</b>	<b>16,629</b>	<b>16,835</b>	<b>17,021</b>	<b>17,175</b>	<b>17,289</b>	<b>17,432</b>	<b>17,604</b>	<b>17,723</b>
<b>Use (million bushels)</b>										
Ethanol Use: Corn	4,700	4,700	4,808	5,022	5,236	5,307	5,307	5,307	5,307	5,307
Non-ethanol FSI: Corn	1,360	1,350	1,350	1,350	1,350	1,350	1,350	1,360	1,365	1,375
Exports: Corn	2,000	2,200	2,250	2,275	2,300	2,325	2,350	2,375	2,400	2,425
Exports: DDGS <small>corn equivalents</small>	300	300	307	320	334	338	338	338	338	338
Feed & Residual: Corn	5,350	5,275	5,300	5,325	5,400	5,500	5,575	5,650	5,725	5,800
Feed & Residual: DDGS <small>corn equivalents</small>	1,127	1,127	1,153	1,204	1,256	1,273	1,273	1,273	1,273	1,273
<b>Total Use: Corn</b>	<b>13,410</b>	<b>13,525</b>	<b>13,708</b>	<b>13,972</b>	<b>14,286</b>	<b>14,482</b>	<b>14,582</b>	<b>14,692</b>	<b>14,797</b>	<b>14,907</b>
<b>Total Use: Corn + DDGS <small>corn equivalents</small></b>	<b>14,537</b>	<b>14,562</b>	<b>14,861</b>	<b>15,176</b>	<b>15,542</b>	<b>15,755</b>	<b>15,855</b>	<b>15,965</b>	<b>16,070</b>	<b>16,180</b>
Ending Stocks: Corn	1,573	1,510	1,407	1,288	1,098	1,036	1,049	1,082	1,150	1,158
Ending Stocks: DDGS <small>corn equivalents</small>	0	0	0	0	0	0	0	0	0	0
<b>Total Ending Stocks Corn + DDGS <small>corn equivalents</small></b>	<b>1,573</b>	<b>1,510</b>	<b>1,407</b>	<b>1,288</b>	<b>1,098</b>	<b>1,036</b>	<b>1,049</b>	<b>1,082</b>	<b>1,150</b>	<b>1,158</b>
%Ending Stocks-to-Use: Corn	11.7%	11.2%	10.3%	9.2%	7.7%	7.2%	7.2%	7.4%	7.8%	7.8%
%Ending Stocks-to-Use: Corn + DDGS <small>corn equivalents</small>	10.8%	10.3%	9.5%	8.5%	7.1%	6.6%	6.6%	6.8%	7.2%	7.2%

## **Impact of E-12 Ethanol Fuel Blends on U.S. Corn + DDGS Supply-Demand**

If the allowable inclusion rate for ethanol in blended fuels in the U.S. were to be raised from 10% (i.e., E-10) to 12% (i.e., E-12), increases are projected in ethanol-related use of corn and DDGS production, feed use and exports (Table 2). Under the assumptions used in this analysis, reductions of approximately 26% in U.S. corn exports and of nearly 14% in U.S. corn ending stocks would occur if E-12 ethanol fuel blending rules were adopted. Key findings in regard to E-12 adoption are as follows:

- Under the assumptions used in this study, decreases in U.S. corn exports of 550-600 million bushels per marketing year would be needed to limit sizable reductions in U.S. corn ending stocks resulting from increased U.S. ethanol production (i.e., to E-12). Decreases of 100-150 million bushels in U.S. corn ending stocks per marketing year would still be projected to occur under the E-12 scenario relative to current E-10 baseline projections.
- For E-12 ethanol fuel blends, annual marketing year increases are projected in corn use for ethanol production of nearly 929 million bushels in comparison to currently allowable E-10 blends. Over the same period, the production and total use of DDGS (measured pound-for-pound as a substitute for corn in terms of “DDGS<sub>cn equiv</sub>”) is projected to increase by 198 million DDGS<sub>cn equiv</sub> “bushels” annually.
- The net result of E-12 adoption in fuel blends is tighter corn supplies than with E-10. Increased DDGS<sub>cn equiv</sub> bushels from E-12 adoption don’t fully offset reduced corn feeding. Part (i.e., 21%) of the increased amount of DDGS that are produced under E-12 adoption are projected to compensate for reduced U.S. corn exports in this analysis.

## **Impact of E-15 Ethanol Fuel Blends on U.S. Corn + DDGS Supply-Demand**

If the allowable inclusion rate for ethanol in blended fuels in the U.S. were to be increased from 10% (i.e., E-10) to 15% (i.e., E-15), major changes are projected to occur in ethanol-related use of corn and DDGS production, feed use and exports (Table 3). Under the assumptions used here, reductions of nearly 69% in U.S. corn exports would occur. Key findings in regard to E-15 adoption are as follows:

- Decreases in U.S. corn exports of approximately 1,550 million bushels per marketing year would be needed to limit extreme reductions in U.S. corn ending stocks over the 10 year period. Decreases of 100-150 million bushels in U.S. corn ending stocks per marketing year would still be projected to occur under this scenario relative to current E-10 baseline projections.
- For E-15 ethanol fuel blends, annual marketing year increases in corn use for ethanol production of nearly 2,321 million bushels are projected in comparison to currently allowable E-10 blends. Over the same period, production and total use of DDGS are projected to increase by 621 million DDGS<sub>cn equiv</sub> “bushels” annually.
- The net result of E-15 adoption in fuel blends would be tighter corn supplies than with E-10. Increased DDGS<sub>cn equiv</sub> bushels don’t fully offset reduced corn feeding. Part of the increased amount of DDGS that would be produced under E-15 adoption are projected to compensate for reduced U.S. corn exports in this analysis.

**Table 2. E-12 Ethanol Production Scenario – Combined U.S. Corn & Distillers Grains Supply-Demand Projections**  
 Based on USDA Agricultural Projections for 2010-2019 Marketing Years & the June 10, 2010 USDA WASDE Report

	U.S. Corn Marketing Year (September 1 <sup>st</sup> – August 31 <sup>st</sup> )									
	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19	2019-20
Planted Acres (million acres)	88.0	90.0	89.5	89.5	89.5	89.5	89.5	89.5	89.5	89.5
Harvested Acres (million acres)	81.8	82.8	82.3	82.3	82.3	82.3	82.3	82.3	82.3	81.8
Yields (bushels per acre)	163.5	162.4	164.4	166.4	168.4	170.4	172.4	174.4	176.4	178.4
<b>Supply (million bushels)</b>										
Beginning Stocks: Corn	1,603	1,573	1,570	1,550	1,510	1,479	1,428	1,406	1,414	1,457
Production: Corn	13,370	13,447	13,350	13,695	13,859	14,024	14,189	14,353	14,518	14,593
Production: DDGS <small>corn equivalents</small>	1,625	1,625	1,656	1,717	1,778	1,798	1,798	1,798	1,798	1,798
Imports: Corn	10	15	15	15	15	15	15	15	15	15
<b>Total Supply: Corn + DDGS <small>corn equivalents</small></b>	<b>16,608</b>	<b>16,659</b>	<b>16,770</b>	<b>16,976</b>	<b>17,162</b>	<b>17,316</b>	<b>17,429</b>	<b>17,573</b>	<b>17,745</b>	<b>17,863</b>
<b>Use (million bushels)</b>										
Ethanol Use: Corn	5,629	5,629	5,737	5,951	6,165	6,236	6,236	6,236	6,236	6,236
Non-ethanol FSI: Corn	1,360	1,350	1,350	1,350	1,350	1,350	1,350	1,360	1,365	1,375
Exports: Corn	1,375	1,575	1,626	1,652	1,677	1,703	1,728	1,753	1,778	1,803
Exports: DDGS <small>corn equivalents</small>	341	341	348	361	373	378	378	378	378	378
Feed & Residual: Corn	5,194	5,119	5,145	5,173	5,251	5,352	5,427	5,502	5,577	5,652
Feed & Residual: DDGS <small>corn equivalents</small>	1,284	1,284	1,308	1,356	1,405	1,421	1,421	1,421	1,421	1,421
<b>Total Use: Corn</b>	<b>13,558</b>	<b>13,673</b>	<b>13,858</b>	<b>14,125</b>	<b>14,443</b>	<b>14,640</b>	<b>14,740</b>	<b>14,850</b>	<b>14,955</b>	<b>15,065</b>
<b>Total Use: Corn + DDGS <small>corn equivalents</small></b>	<b>14,841</b>	<b>14,956</b>	<b>15,165</b>	<b>15,482</b>	<b>15,848</b>	<b>16,061</b>	<b>16,161</b>	<b>16,271</b>	<b>16,376</b>	<b>16,486</b>
Ending Stocks: Corn	1,425	1,362	1,257	1,134	941	877	891	924	992	1,000
Ending Stocks: DDGS <small>corn equivalents</small>	0	0	0	0	0	0	0	0	0	0
<b>Total Ending Stocks Corn + DDGS <small>corn equivalents</small></b>	<b>1,425</b>	<b>1,362</b>	<b>1,257</b>	<b>1,134</b>	<b>941</b>	<b>877</b>	<b>891</b>	<b>924</b>	<b>992</b>	<b>1,000</b>
%Ending Stocks-to-Use: Corn	10.5%	10.0%	9.1%	8.0%	6.5%	6.0%	6.0%	6.2%	6.6%	6.6%
%Ending Stocks-to-Use: Corn + DDGS <small>corn equivalents</small>	9.6%	9.1%	8.3%	7.3%	5.9%	5.5%	5.5%	5.7%	6.1%	6.1%

**Table 3. E-15 Ethanol Production Scenario – Combined U.S. Corn & Distillers Grains Supply-Demand Projections**

Based on USDA Agricultural Projections for 2010-2019 Marketing Years & the June 10, 2010 USDA WASDE Report

	U.S. Corn Marketing Year (September 1 <sup>st</sup> – August 31 <sup>st</sup> )									
	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19	2019-20
Planted Acres (million acres)	88.0	90.0	89.5	89.5	89.5	89.5	89.5	89.5	89.5	89.0
Harvested Acres (million acres)	81.8	82.8	82.3	82.3	82.3	82.3	82.3	82.3	82.3	81.8
Yields (bushels per acre)	163.5	162.4	164.4	166.4	168.4	170.4	172.4	174.4	176.4	178.4
<b>Supply (million bushels)</b>										
Beginning Stocks: Corn	1,603	1,573	1,570	1,550	1,510	1,479	1,428	1,406	1,414	1,457
Production: Corn	13,370	13,447	13,350	13,695	13,859	14,024	14,189	14,353	14,518	14,593
Production: DDGS <small>corn equivalents</small>	2,048	2,048	2,078	2,140	2,201	2,221	2,221	2,221	2,221	2,221
Imports: Corn	10	15	15	15	15	15	15	15	15	15
<b>Total Supply: Corn + DDGS <small>corn equivalents</small></b>	<b>17,031</b>	<b>17,082</b>	<b>17,193</b>	<b>17,399</b>	<b>17,585</b>	<b>17,739</b>	<b>17,852</b>	<b>17,995</b>	<b>18,168</b>	<b>18,286</b>
<b>Use (million bushels)</b>										
Ethanol Use: Corn	7,021	7,021	7,129	7,343	7,557	7,628	7,628	7,628	7,628	7,628
Non-ethanol FSI: Corn	1,360	1,350	1,350	1,350	1,350	1,350	1,350	1,360	1,365	1,375
Exports: Corn	317	517	567	593	619	644	669	694	719	744
Exports: DDGS <small>corn equivalents</small>	430	430	436	449	462	466	466	466	466	466
Feed & Residual: Corn	4,860	4,785	4,811	4,839	4,917	5,018	5,093	5,168	5,243	5,318
Feed & Residual: DDGS <small>corn equivalents</small>	1,618	1,618	1,642	1,690	1,739	1,755	1,755	1,755	1,755	1,755
<b>Total Use: Corn</b>	<b>13,558</b>	<b>13,673</b>	<b>13,858</b>	<b>14,125</b>	<b>14,443</b>	<b>14,640</b>	<b>14,740</b>	<b>14,850</b>	<b>14,955</b>	<b>15,065</b>
<b>Total Use: Corn + DDGS <small>corn equivalents</small></b>	<b>15,175</b>	<b>15,290</b>	<b>15,500</b>	<b>15,816</b>	<b>16,182</b>	<b>16,395</b>	<b>16,495</b>	<b>16,605</b>	<b>16,710</b>	<b>16,820</b>
Ending Stocks: Corn	1,425	1,362	1,257	1,134	941	877	891	924	992	1,000
Ending Stocks: DDGS <small>corn equivalents</small>	0	0	0	0	0	0	0	0	0	0
<b>Total Ending Stocks Corn + DDGS <small>corn equivalents</small></b>	<b>1,425</b>	<b>1,362</b>	<b>1,257</b>	<b>1,134</b>	<b>941</b>	<b>877</b>	<b>891</b>	<b>924</b>	<b>992</b>	<b>1,000</b>
%Ending Stocks-to-Use: Corn	10.5%	10.0%	9.1%	8.0%	6.5%	6.0%	6.0%	6.2%	6.6%	6.6%
%Ending Stocks-to-Use: Corn + DDGS <small>corn equivalents</small>	9.4%	8.9%	8.1%	7.2%	5.8%	5.4%	5.4%	5.6%	5.9%	5.9%

## Conclusions

Expansion in allowable ethanol fuel blends from E-10 to either E-12 or E-15 is projected to have a marked impact on total supply, use and ending stocks of both corn and distillers grains. In this analysis it is assumed that the total cumulative domestic use of corn and DDGS<sub>corn equivalents</sub> for ethanol production, non-ethanol FSI use and livestock feeding would take precedence over the use of U.S. corn for exports (i.e., should domestic uses compete with corn exports). Consequently, U.S. corn exports are projected to be reduced to limit extreme declines in U.S. corn ending stocks. Even under these assumptions, reductions occur in U.S. corn ending stocks and tightening of projected ending stocks-to-use occurs for both U.S. corn alone and cumulative U.S. corn plus DDGS<sub>corn equivalents</sub> for E-12 and E-15 ethanol production scenarios.

The projected tightening of U.S. corn plus DDGS<sub>corn equivalent</sub> ending stocks-to-use would likely result in more volatile U.S. corn prices over time. Potential weather or disease threats to U.S. feedgrain production during the coming decade could cause an extreme tightening of U.S. corn ending stocks and spark sizable corn price volatility events during any particular marketing year – especially during the preharvest summer growing season for U.S. corn.

Declines in U.S. corn exports of the degree projected in this analysis under the E-12 and E-15 scenarios would have marked consequences on the World corn and broader coarse grain export market. In the June 10<sup>th</sup> USDA WASDE report the U.S. was projected to supply 56.5% of World corn exports in MY 2010-11 (i.e., 50.80 mmt of the World total of 89.93 mmt of corn exports). For the broader measure of world coarse grains (including grain sorghum, barley, oats, rye, millet and mixed grains), the U.S. is projected to supply 47.8% of World exports (i.e., 54.63 mmt of total World exports of 114.23 mmt). Reductions in corn exports as projected above for E-15 fuel blends would likely cause sizable and dramatic shifts in the structure World corn and coarse grain export markets and World usage.

More analysis needs to be carried on this topic. Under alternative sets of assumptions different outcomes are certainly possible and likely. The determination of whether domestic or foreign uses of U.S. corn and DDGS are more affected by U.S. energy policy changes in regards to ethanol could have critically important impacts on competitive uses of U.S. corn and on the profitability and sustainability of their associated domestic and/or foreign industries.