Ethanol Supply and Demand Outlook

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Date: April 15, 2008

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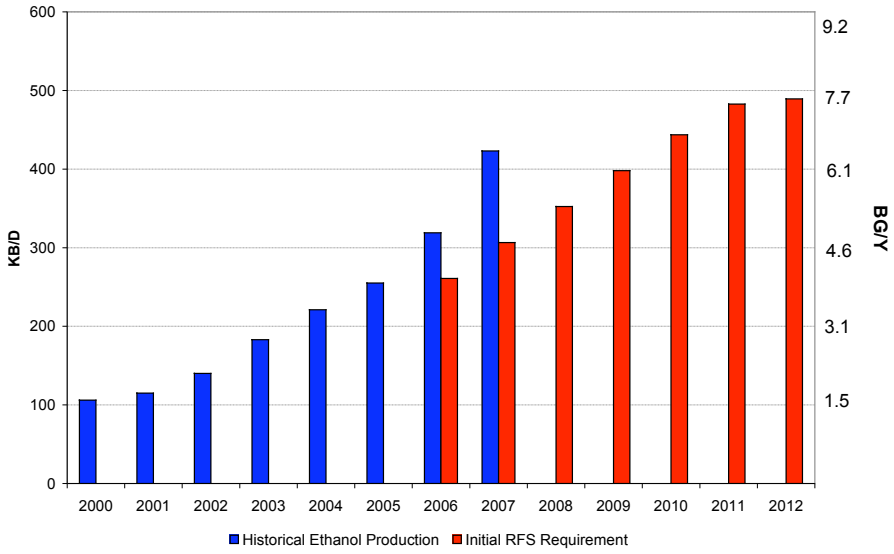
Initial Renewable Fuels Standard (RFS)

- On August 8, 2005, the RFS was passed through the Energy Policy Act of 2005 (Section 1501)
- Required increased usage of renewable fuel, from 4 billion gallons per year in 2006 to 7.5 billion gallons of ethanol and biodiesel by 2012.

Initial Requirements of RFS

Year	Renewable Fuels Required (billions of gallons)
2006	4.00
2007	4.70
2008	5.40
2009	6.10
2010	6.80
2011	7.40
2012	7.50

Source: RFA



Source: RFA & DOE

Enhanced Renewable Fuels Standard

- On December 19, 2007, the Energy Independence and Security Act of 2007 was signed into law, amending the RFS.
- Establishes minimum volumes of renewable fuel for U.S. commerce.
- Applies to refiners, blenders, and importers.
- Sets forth a phase-in for renewable fuel volumes, beginning with 9 billion gallons in 2008 and ending with 36 billion gallons in 2022.

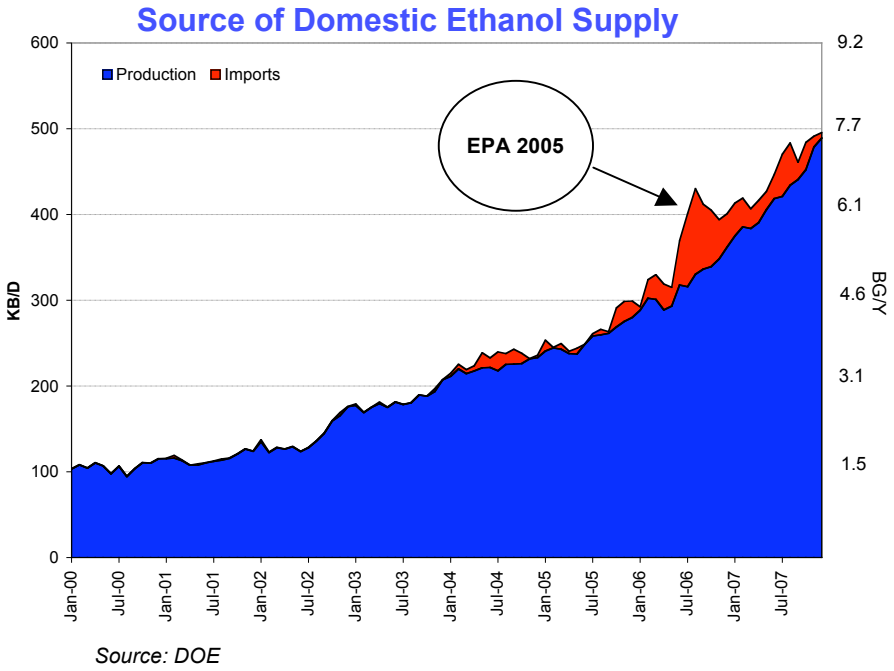
Enhanced Renewable Fuels Requirement (Billions of Gallons)

Year	Renewable Biofuel	Advanced	Cellulosic	Biomass-based Diesel	*Undifferentiated*	Total RFS
2008	9.0	-	-	-	-	**9.0**
2009	10.5	0.6	-	0.5	*0.1*	**11.1**
2010	12.0	1.0	0.1	0.7	*0.2*	**13.0**
2011	12.6	1.4	0.3	0.8	*0.3*	**14.0**
2012	13.2	2.0	0.5	1.0	*0.5*	**15.2**
2013	13.8	2.8	1.0	-	*1.8*	**16.6**
2014	14.4	3.8	1.8	-	*2.0*	**18.2**
2015	15.0	5.5	3.0	-	*2.5*	**20.5**
2016	15.0	7.3	4.3	-	*3.0*	**22.3**
2017	15.0	9.0	5.5	-	*3.5*	**24.0**
2018	15.0	11.0	7.0	-	*4.0*	**26.0**
2019	15.0	13.0	8.5	-	*4.5*	**28.0**
2020	15.0	15.0	10.5	-	*4.5*	**30.0**
2021	15.0	18.0	13.5	-	*4.5*	**33.0**
2022	15.0	21.0	16.0	-	*5.0*	**36.0**

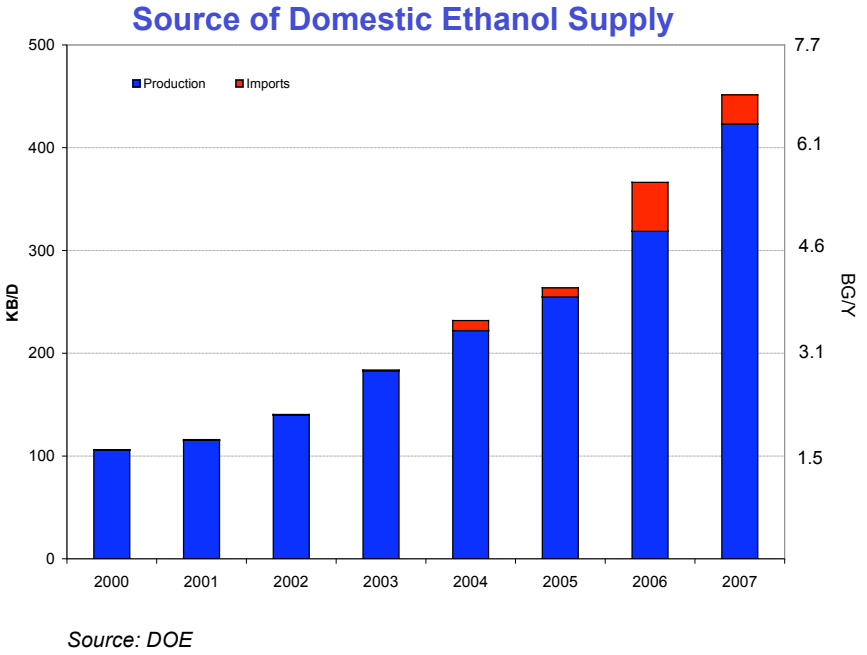
Source: RFA

History of Ethanol Production & Imports

- Domestic production is the primary source of ethanol supply.
- 2007 Domestic production totaled 423kb/d (6.5 billion gallons), in comparison to 2007 imports of 28kb/d (0.43 billion gallons).



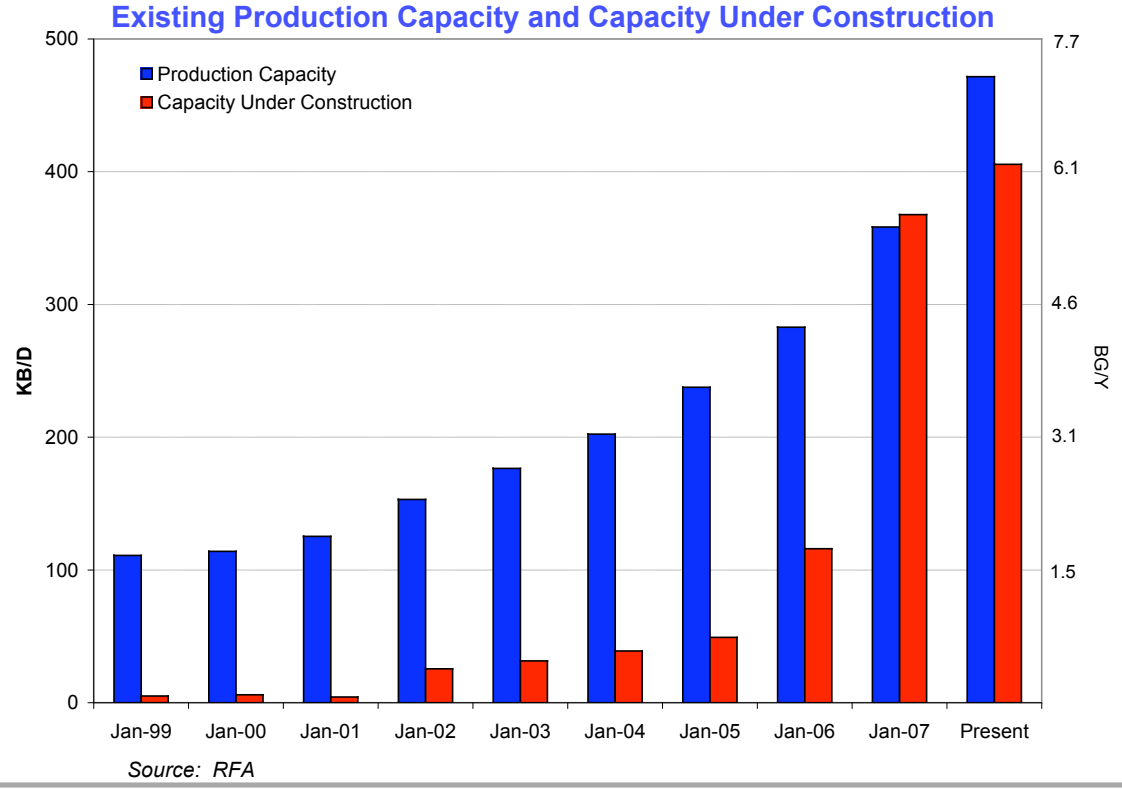
Source: DOE



Source: DOE

Ethanol Plant Construction – Sufficient for 2008 & 2009

- Investment in capacity has increased dramatically as a result of the RFS.
- In 2008, an estimated 4 BGPY will come online from 68 biorefineries.
- Upon completion of all in-process construction, the US ethanol industry is expected to be able to supply over 12 BGPY of ethanol, or just shy of 10% of the nation's gasoline demand.



Source: RFA

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Consumption Opportunity Focused in East

Existing and Maximum Potential Ethanol Demand by Region – Millions of Gallons per Year

2007 Ethanol Demand by Region RFG/OXY vs. Discretionary Blending (Millions of Gallons)				Maximum Ethanol Demand by Region at 10% Blend (Millions of Gallons)		
Region	RFG/OXY	Discretionary	Total	Max 10% Ethanol Blend	Penetration	Incremental Blending Potential
East	1,700	300	2,000	5,800	34%	3,800
Midwest	500	1,600	2,100	3,800	55%	1,700
Gulf	700	40	740	2,200	34%	1,460
Rockies	50	8	58	500	12%	370
West	950	200	1,150	2,400	48%	1,250
Total	3,900	2,220	6,120	14,700	42%	8,580

Existing and Maximum Potential Ethanol Demand by Region – Thousands of Barrels per Day

2007 Ethanol Demand by Region RFG/OXY vs. Discretionary Blending (KB/D)				Maximum Ethanol Demand by Region - at 10% Blend (KB/D)		
Region	RFG/OXY	Discretionary	Total	Max 10% Ethanol Blend	Penetration	Incremental Blending Potential
East	111	20	130	378	34%	248
Midwest	33	104	137	248	55%	111
Gulf	46	3	48	144	34%	95
Rockies	3	1	4	33	12%	24
West	62	13	75	157	48%	82
Total	254.40	144.81	399	959	42%	560

Source: Aventine Renewable Energy & Biofuels Journal

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Demand is Available – If the Price is Right

- Wholesale ethanol infrastructure is relatively low cost and short lead time.
- The industry added significant blending capacity for RFG in anticipation of the implementation of the Energy Policy Act of 2005.
- Marathon Oil expects to complete terminal enhancements to blend E-10 throughout its entire network this summer.
- Delek US has instituted an ethanol blending program and is currently blending ethanol with 67% of gasoline production and selling ethanol blended gasoline at approximately 280 (57%) of its 497 retail outlets.

Generic Ethanol Economics

- There are two commercially-viable ethanol production technologies: **Dry-Mill and Wet-Mill**.
- During 2006, Dry-Mill Production accounted for 82% of ethanol produced.
- Wet-Mill Facilities require greater capital investment, yet provide enhanced product yields.
- Wet-Mill Facilities yield 7 primary products (ethanol, CO2, corn oil, germ cake, condensed solubles, gluten, and bran).
- Dry-Mill Facilities yield 3 primary products (ethanol, distillers grain, and CO2).

Dry-Mill Cost Model

Dry Mill	
Assumptions:	
Plant Size (MMs Gallons/Year)	50,000,000
Capital Cost ($ in MMs)	100,000,000
Capital Cost ($/gallon-yr)	$2.00
Corn Price ($/bushel)	$5.50
Corn Yield (Gallons/Bushel)	2.80
Natural Gas Usage (btus/gal)	30,000
Natural Gas Price ($/Mcf)	$9.50
DDGs ($/ton)	$120.00
Debt %	60%
Equity %	40%
Debt	60,000,000
Equity	$40,000,000
Debt Interest Rate	6.0%
Loan Term (Years)	20
Depreciation (Years)	15.7
Depreciation (per year)	6,369,427
Loan Payment	($5,158,304)
Operating Costs ($/gal)	
Corn Input	$1.96
DDGs	($0.37)
Denaturant	$0.04
Enzymes	$0.07
Chemicals	$0.04
Fuel Cost	$0.29
Transportation	$0.15
Labor	$0.07
Maintenance	$0.05
Other Expenses	$0.05
SG&A	$0.05
Operating Cost Total	$2.40
Depreciation	$0.13
Loan Payment	$0.10
Total Cost	$2.63
Ethanol Price	$2.50
Margin/Gallon	-$0.13

Wet-Mill Cost Model

Wet Mill	
Assumptions:	
Plant Size (MMs Gallons/Year)	100,000,000
Capital Cost ($ in MMs)	225,000,000
Capital Cost ($/gallon-yr)	$2.25
Corn Price ($/bushel)	$5.50
Corn Yield (Gallons/Bushel)	2.60
Natural Gas Usage (btus/gal)	30,000
Natural Gas Price ($/Mcf)	$9.50
Debt %	60%
Equity %	40%
Debt	135,000,000
Equity	$90,000,000
Debt Interest Rate	6.0%
Loan Term (Years)	20
Depreciation (Years)	15.7
Depreciation (per year)	14,331,210
Loan Payment	($11,606,183)
Operating Costs ($/gal)	
Corn Input	$2.12
Coproducts	($0.95)
Denaturant	$0.04
Enzymes	$0.06
Chemicals	$0.05
Fuel Cost	$0.29
Transportation	$0.15
Labor	$0.05
Maintenance	$0.07
Water Treatment	$0.04
Other Expenses	$0.05
SG&A	$0.05
Operating Cost Total	$2.01
Depreciation	$0.14
Loan Payment	$0.12
Total Cost	$2.27
Ethanol Price	$2.50
Margin/Gallon	$0.23

Source: Kansas State University Ethanol Study & SCI Estimates

Dry-Mill Sensitivities

Variable Operating Cost Sensitivity (Ethanol Price - $/Gal)

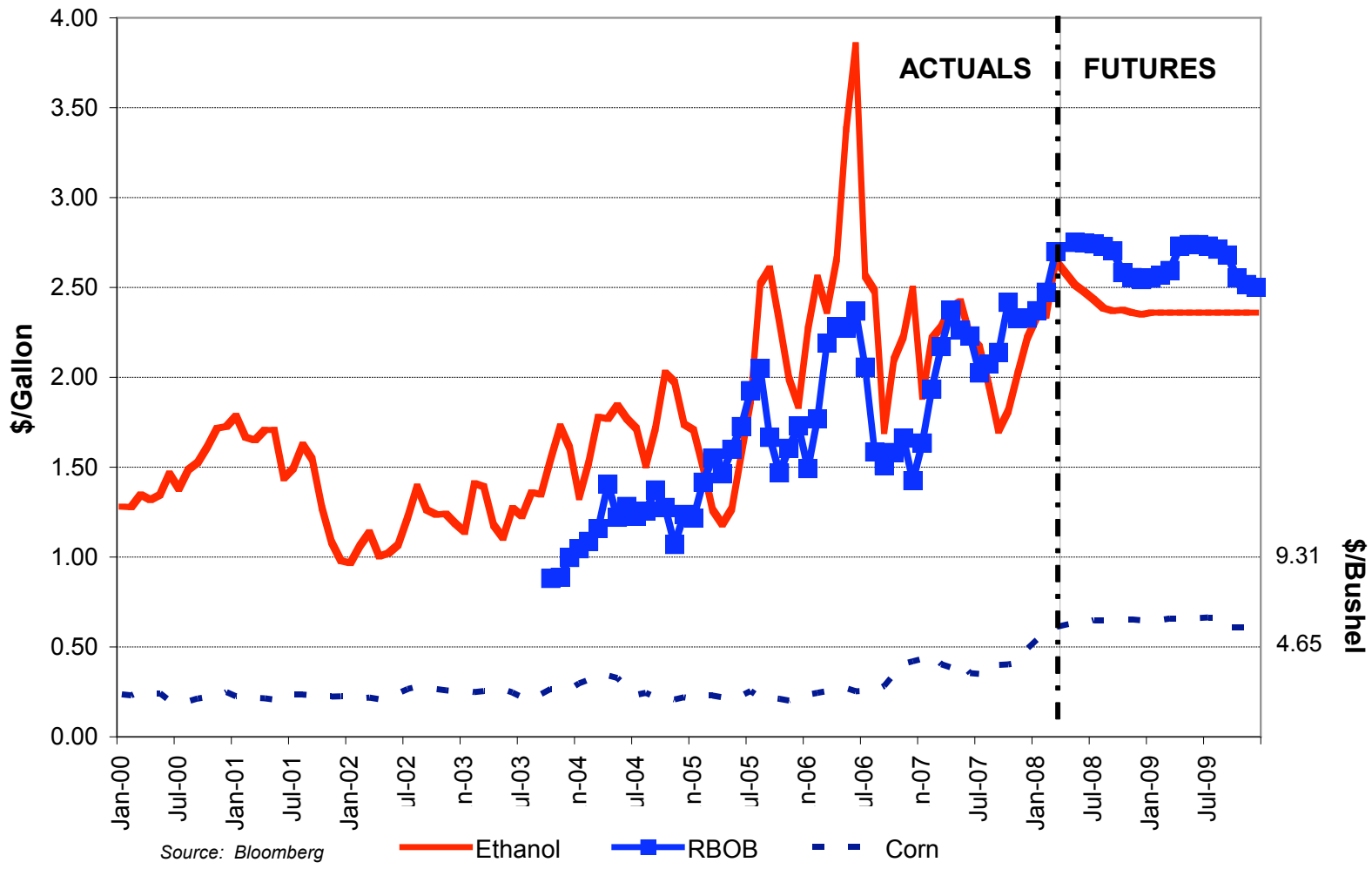
Natural Gas Price ($/Mcf)	Corn Cost ($/bushel)									
	$3.00	**$3.50**	**$4.00**	**$4.50**	**$5.00**	**$5.50**	**$6.00**	**$6.50**	**$7.00**	**$7.50**
$4.00	$1.34	$1.52	$1.70	$1.88	$2.06	$2.24	$2.42	$2.59	$2.77	$2.95
$5.00	$1.37	$1.55	$1.73	$1.91	$2.09	$2.27	$2.45	$2.62	$2.80	$2.98
$6.00	$1.40	$1.58	$1.76	$1.94	$2.12	$2.30	$2.48	$2.65	$2.83	$3.01
$7.00	$1.43	$1.61	$1.79	$1.97	$2.15	$2.33	$2.51	$2.68	$2.86	$3.04
$8.00	$1.46	$1.64	$1.82	$2.00	$2.18	$2.36	$2.54	$2.71	$2.89	$3.07
$9.00	$1.49	$1.67	$1.85	$2.03	$2.21	$2.39	$2.57	$2.74	$2.92	$3.10
$10.00	$1.52	$1.70	$1.88	$2.06	$2.24	$2.42	$2.60	$2.77	$2.95	$3.13
$11.00	$1.55	$1.73	$1.91	$2.09	$2.27	$2.45	$2.63	$2.80	$2.98	$3.16
$12.00	$1.58	$1.76	$1.94	$2.12	$2.30	$2.48	$2.66	$2.83	$3.01	$3.19
$13.00	$1.61	$1.79	$1.97	$2.15	$2.33	$2.51	$2.69	$2.86	$3.04	$3.22
$14.00	$1.64	$1.82	$2.00	$2.18	$2.36	$2.54	$2.72	$2.89	$3.07	$3.25
$15.00	$1.67	$1.85	$2.03	$2.21	$2.39	$2.57	$2.75	$2.92	$3.10	$3.28

Threshold Economic Sensitivity (Ethanol Price - $/Gal)

Natural Gas Price ($/Mcf)	Corn Cost ($/bushel)									
	$3.00	**$3.50**	**$4.00**	**$4.50**	**$5.00**	**$5.50**	**$6.00**	**$6.50**	**$7.00**	**$7.50**
$4.00	$1.57	$1.75	$1.93	$2.11	$2.29	$2.47	$2.65	$2.82	$3.00	$3.18
$5.00	$1.60	$1.78	$1.96	$2.14	$2.32	$2.50	$2.68	$2.85	$3.03	$3.21
$6.00	$1.63	$1.81	$1.99	$2.17	$2.35	$2.53	$2.71	$2.88	$3.06	$3.24
$7.00	$1.66	$1.84	$2.02	$2.20	$2.38	$2.56	$2.74	$2.91	$3.09	$3.27
$8.00	$1.69	$1.87	$2.05	$2.23	$2.41	$2.59	$2.77	$2.94	$3.12	$3.30
$9.00	$1.72	$1.90	$2.08	$2.26	$2.44	$2.62	$2.80	$2.97	$3.15	$3.33
$10.00	$1.75	$1.93	$2.11	$2.29	$2.47	$2.65	$2.83	$3.00	$3.18	$3.36
$11.00	$1.78	$1.96	$2.14	$2.32	$2.50	$2.68	$2.86	$3.03	$3.21	$3.39
$12.00	$1.81	$1.99	$2.17	$2.35	$2.53	$2.71	$2.89	$3.06	$3.24	$3.42
$13.00	$1.84	$2.02	$2.20	$2.38	$2.56	$2.74	$2.92	$3.09	$3.27	$3.45
$14.00	$1.87	$2.05	$2.23	$2.41	$2.59	$2.77	$2.95	$3.12	$3.30	$3.48
$15.00	$1.90	$2.08	$2.26	$2.44	$2.62	$2.80	$2.98	$3.15	$3.33	$3.51

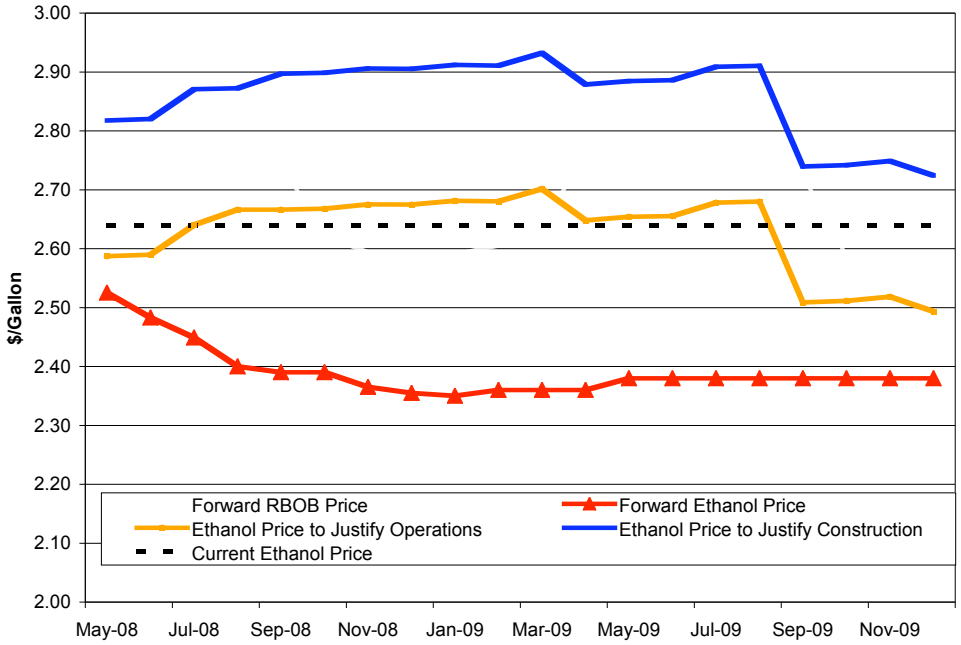
Source: Kansas State University Ethanol Study & SCI Estimates

Forward Curves for Corn, Ethanol, and Gasoline



Ethanol Economics and Forward Pricing

- Forward ethanol prices are below construction economics and variable operating expenses.
- Forward ethanol prices would have to exceed the costs to justify construction (currently ~$2.90/gallon) in order for plant construction to resume.
- However, the ethanol price required to justify construction exceeds forward gasoline prices.
- Ethanol is not an attractive blendstock when priced above gasoline (which would reduce demand and infrastructure development).



Source: Kansas State University Ethanol Study, SCI Estimates, & Bloomberg

Ethanol Economics & Forward Pricing Assumptions

Month	RBOB ($/Gal)	Nat Gas ($/mcf)	Corn ($/Bushel)	Ethanol ($/Gal)	Corn Yield (Gal/Bushel)	Nat Gas Usage (btus/gal)	Operating Cost	Threshold Economics
May-08	2.79	10.40	5.94	2.53	2.80	30,000	$2.59	$2.82
Jun-08	2.79	10.49	5.94	2.48	2.80	30,000	$2.59	$2.82
Jul-08	2.78	10.59	6.08	2.45	2.80	30,000	$2.64	$2.87
Aug-08	2.77	10.64	6.08	2.40	2.80	30,000	$2.67	$2.87
Sep-08	2.74	10.66	6.14	2.39	2.80	30,000	$2.67	$2.90
Oct-08	2.62	10.71	6.14	2.39	2.80	30,000	$2.67	$2.90
Nov-08	2.59	10.96	6.14	2.37	2.80	30,000	$2.68	$2.91
Dec-08	2.58	11.30	6.11	2.36	2.80	30,000	$2.67	$2.91
Jan-09	2.59	11.52	6.11	2.35	2.80	30,000	$2.68	$2.91
Feb-09	2.61	11.48	6.11	2.36	2.80	30,000	$2.68	$2.91
Mar-09	2.63	11.24	6.19	2.36	2.80	30,000	$2.70	$2.93
Apr-09	2.77	9.45	6.19	2.36	2.80	30,000	$2.65	$2.88
May-09	2.78	9.29	6.22	2.38	2.80	30,000	$2.65	$2.88
Jun-09	2.78	9.35	6.22	2.38	2.80	30,000	$2.66	$2.89
Jul-09	2.77	9.42	6.28	2.38	2.80	30,000	$2.68	$2.91
Aug-09	2.75	9.47	6.28	2.38	2.80	30,000	$2.68	$2.91
Sep-09	2.72	9.49	5.80	2.38	2.80	30,000	$2.51	$2.74
Oct-09	2.59	9.57	5.80	2.38	2.80	30,000	$2.51	$2.74
Nov-09	2.56	9.80	5.80	2.38	2.80	30,000	$2.52	$2.75
Dec-09	2.54	10.17	5.70	2.38	2.80	30,000	$2.49	$2.72

Source: Bloomberg, Kansas State University Ethanol Study & SCI Estimates

Conclusions

- **Existing plant capacity plus plants under construction are sufficient to meet 2008-2010 RFS requirements.**

- **Current and future prices make ethanol economically attractive to use as a blendstock and encourage the development of wholesale and retail infrastructure (E-10).**

- **14 BGPY of ethanol (2011 total RFS requirement) represents ~10% of current U.S. gasoline demand and there is no guarantee that gasoline demand will grow. In fact, conservation should be elevated in its importance in energy policy.**

- **Ethanol prices need to hit a tight window. They must exceed construction cost economics to justify construction, but they must be below gasoline prices to be economically attractive as a blending component and justify infrastructure development.**

- **Ethanol consumption above 14 BGPY is significantly more challenging.**

Appendix D

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