

Ethanol Fuel Options Exist for Expanding Gasoline Supplies
without processing additional Crude Oil ?

E10 ? E20? E85 ? ETBE ?

Which use of Ethanol in Fuel Provides the Highest Market Value ?

Which use of Ethanol results in the Most Non-Petroleum Fuel ?

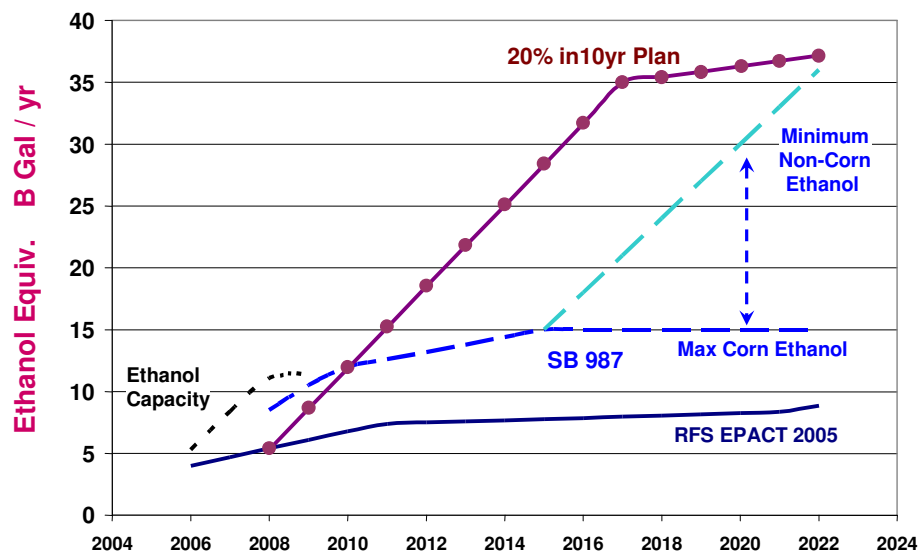
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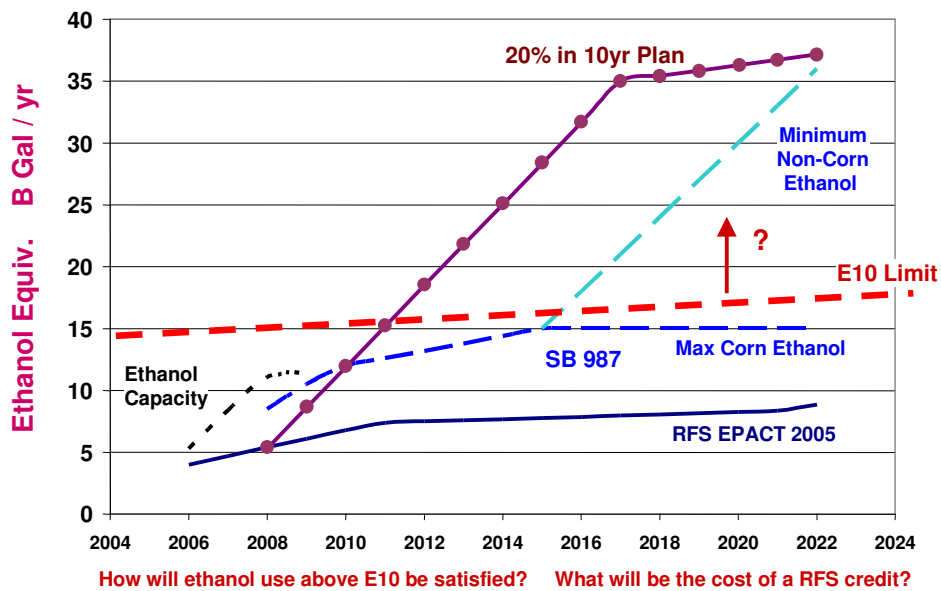
**Potential RFS Volume Requirements Will Grow Substantially
under Government Biofuel Proposals**



Proposed Senate Bills will increase RFS (renewable fuel standard) volumes to 35+ billion gallons per year.

Note: Projected Ethanol Capacity per RFA

Potential RFS Volume Requirements Will Grow Substantially under Government Biofuel Proposals

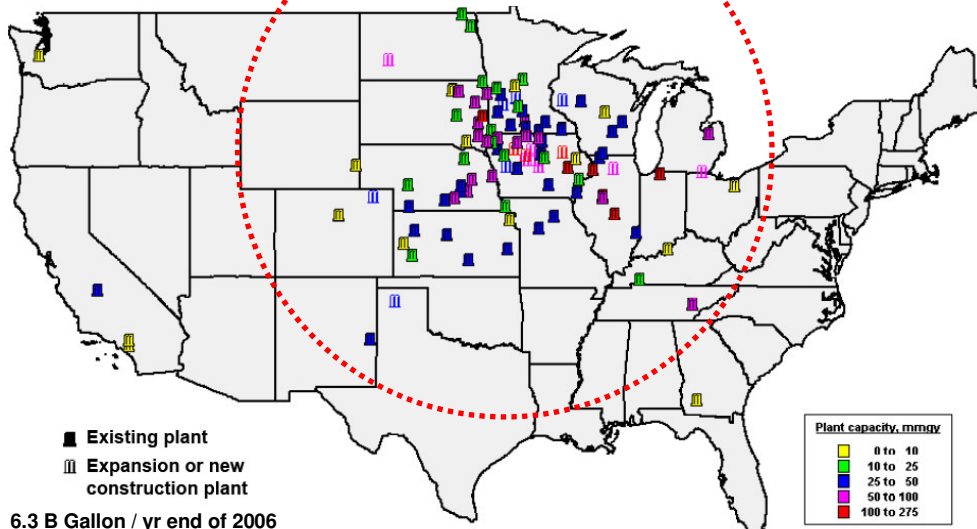


Note: Projected Ethanol Capacity per RFA

Center of Ethanol Production Located Away From US Population Centers Driven by Agriculture Land Economics

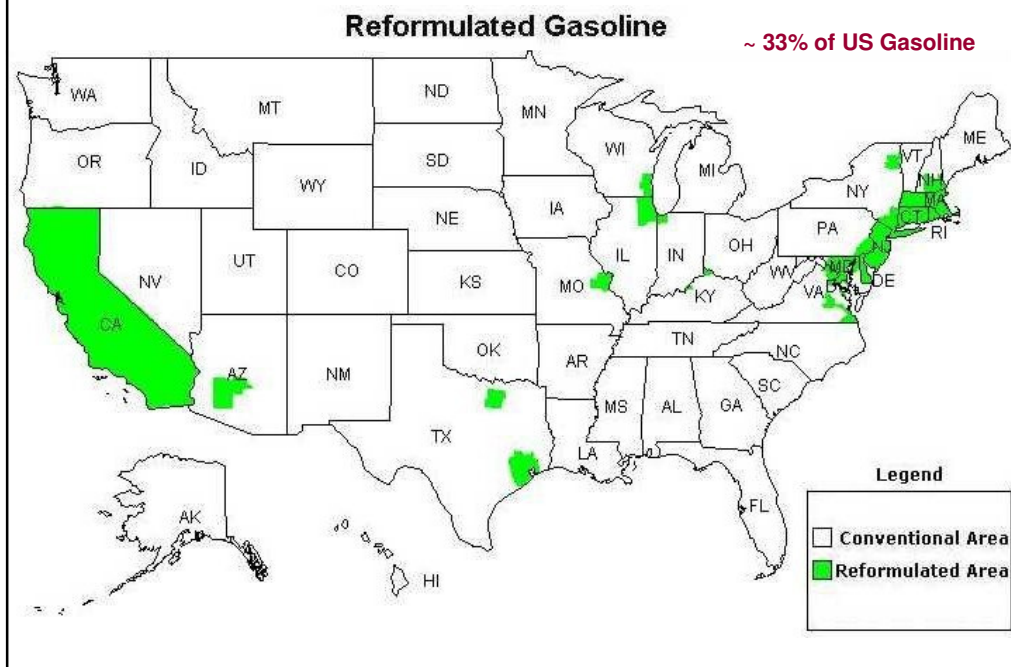
Ethanol Production Plants

1000 Mile Radius

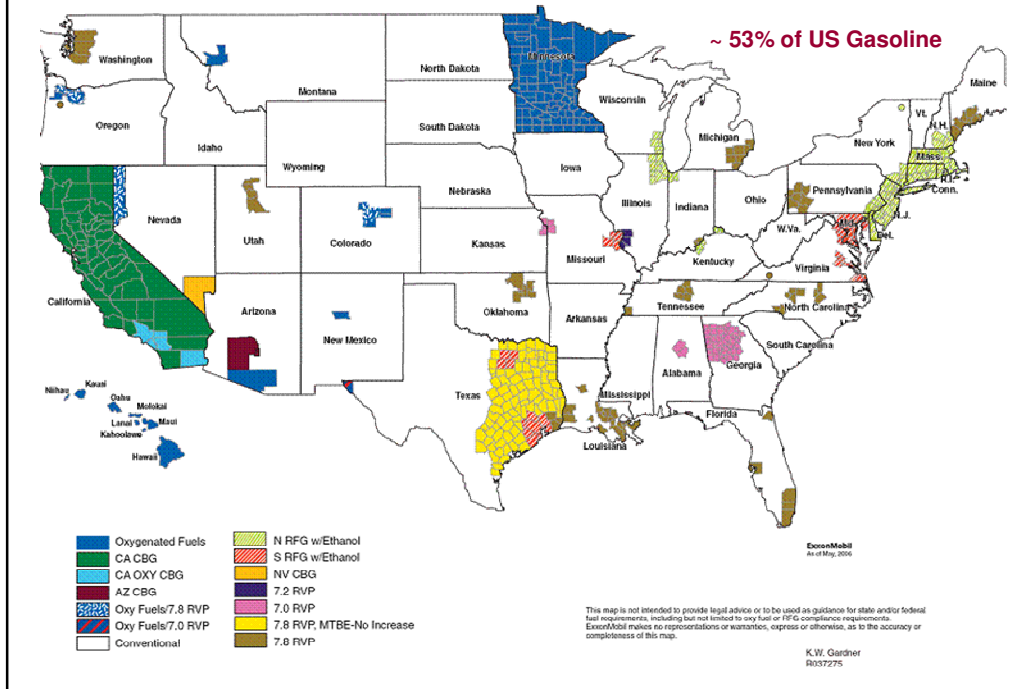


Sources: Renewable Fuels Association (2005a); and Kansas State University

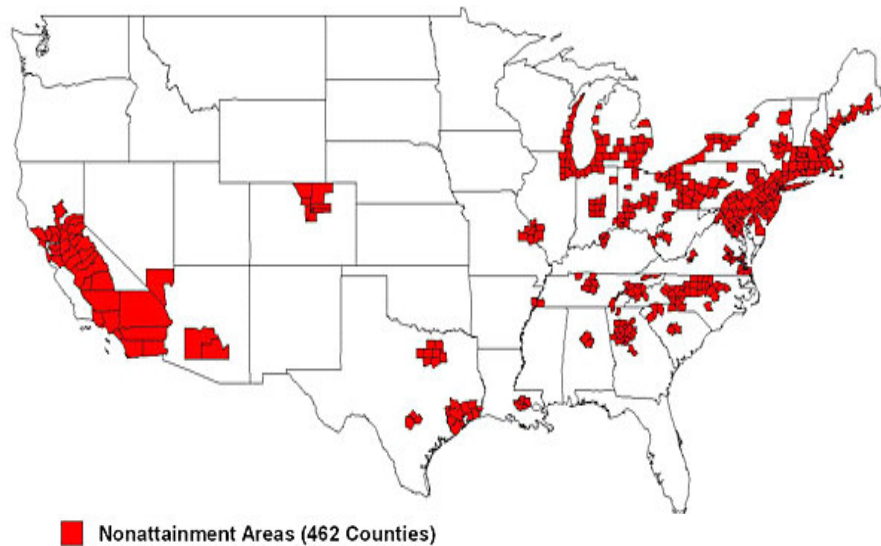
Most Gasoline Demand Located Near US Coastal Population Centers



Federal RFG & State Boutique Low RVP Fuel Programs Lower Ethanol Blending Values



“Lower RVP Fuels” may expand with the increase of Ozone Non-attainment Areas

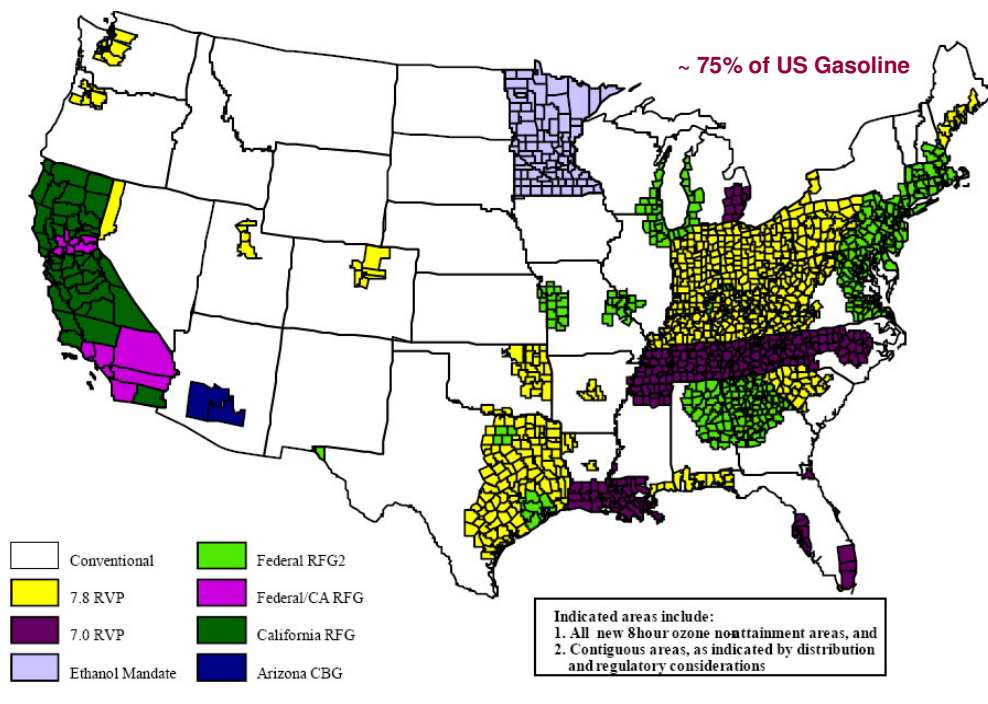


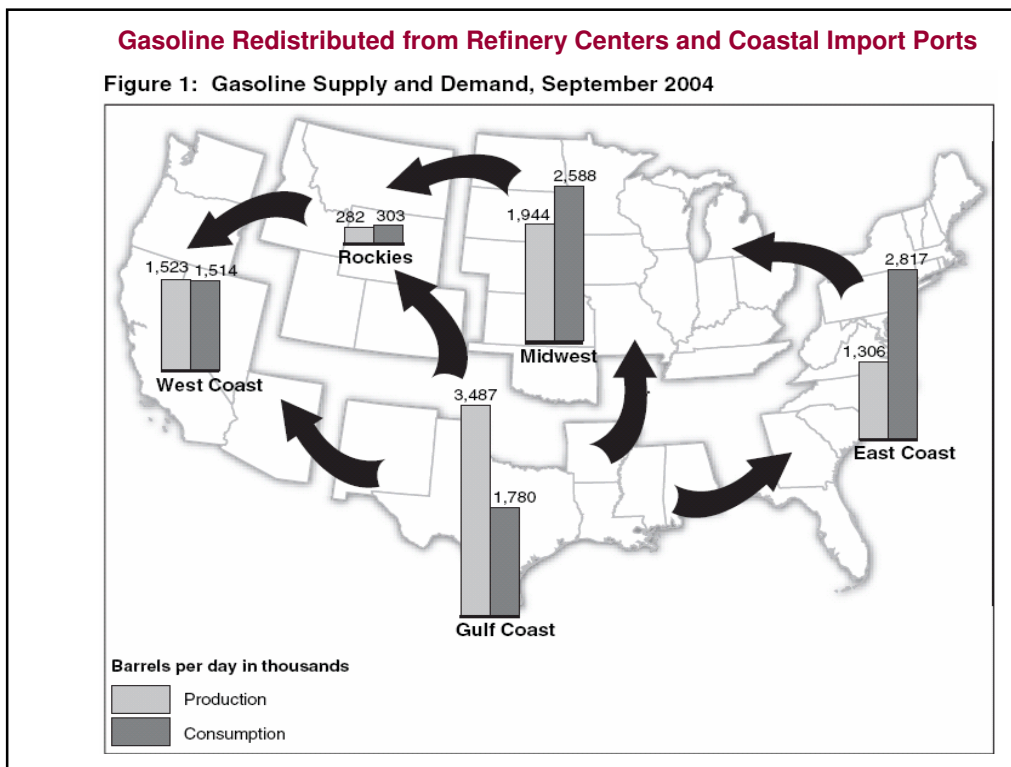
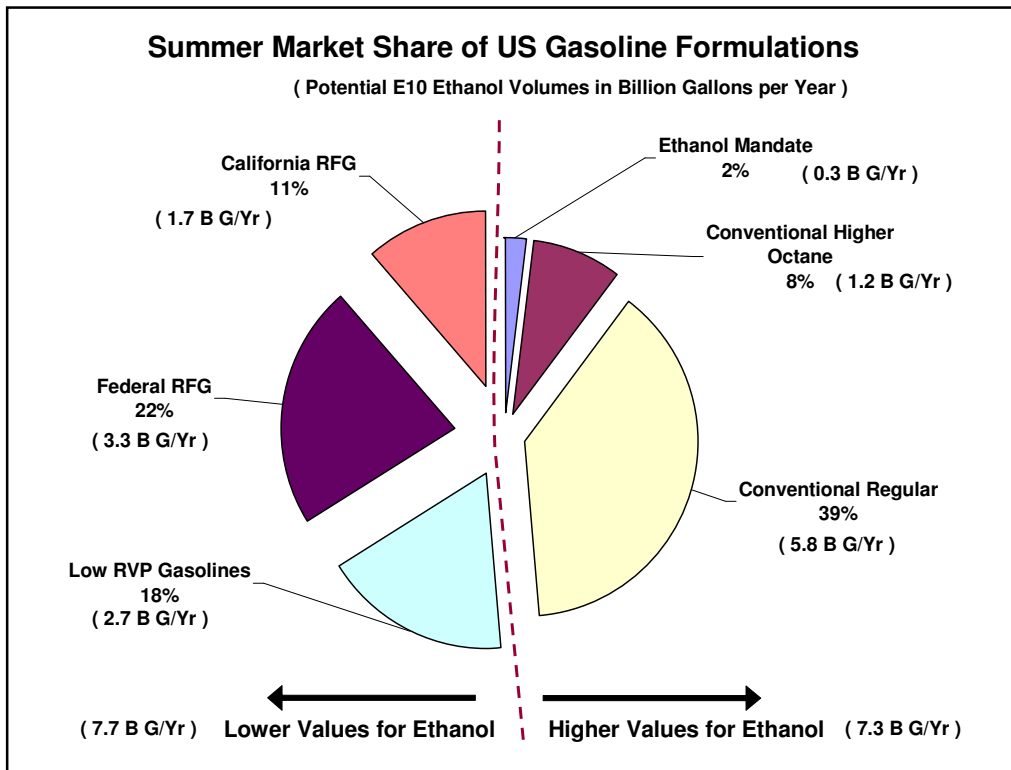
Source: U.S. EPA

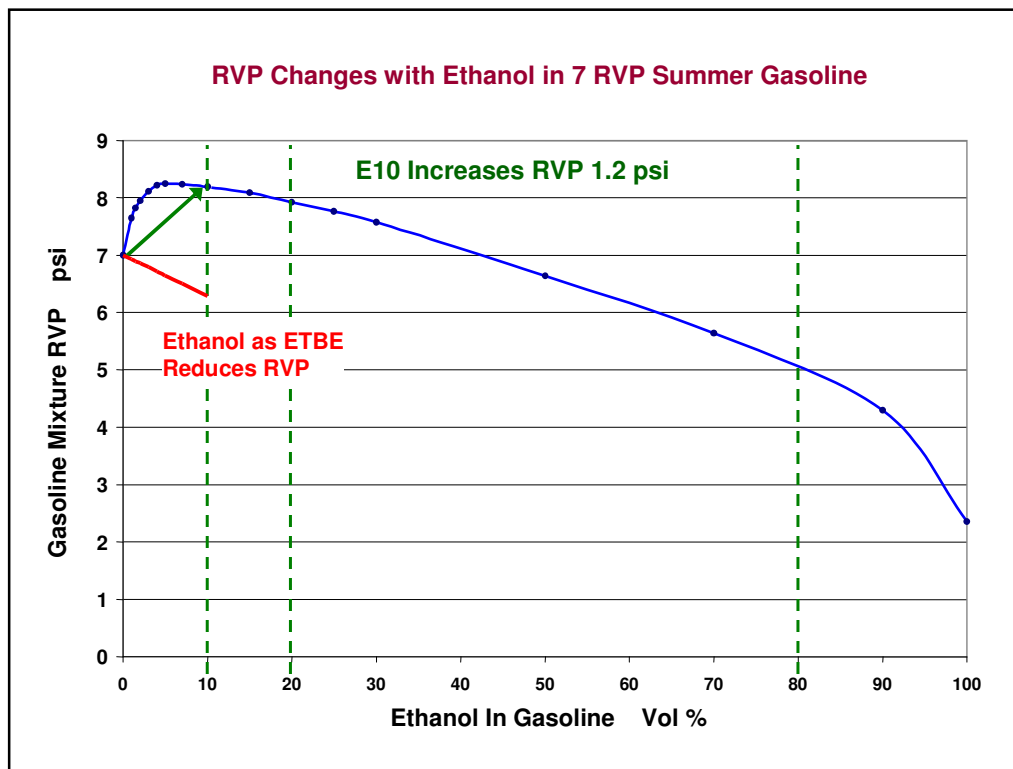
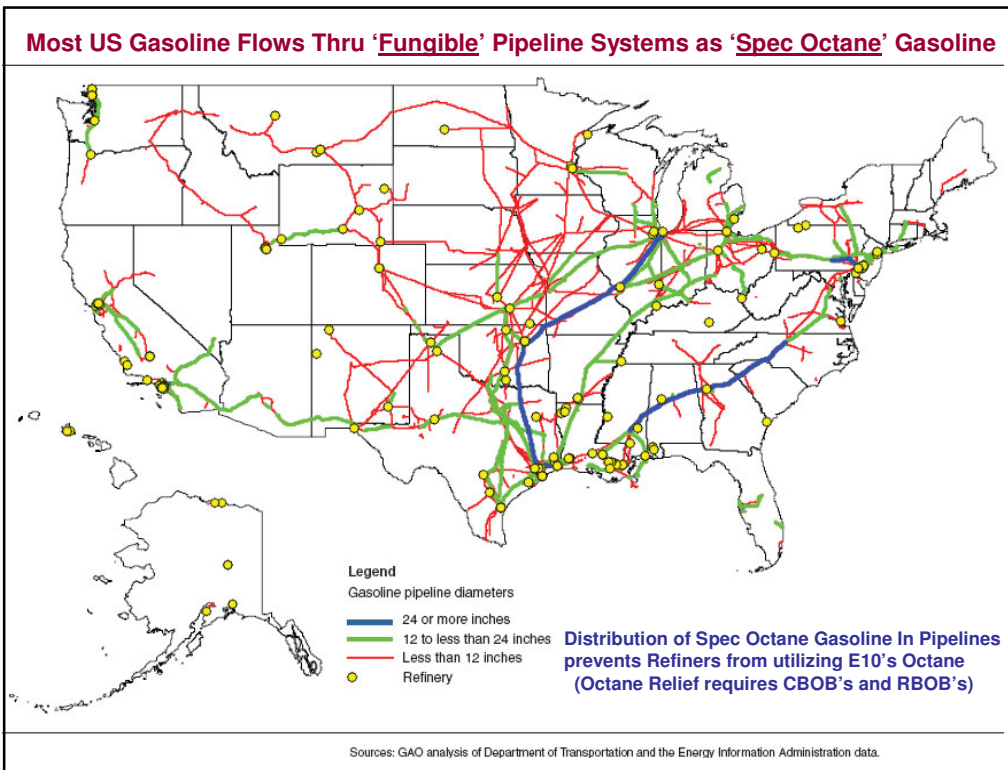
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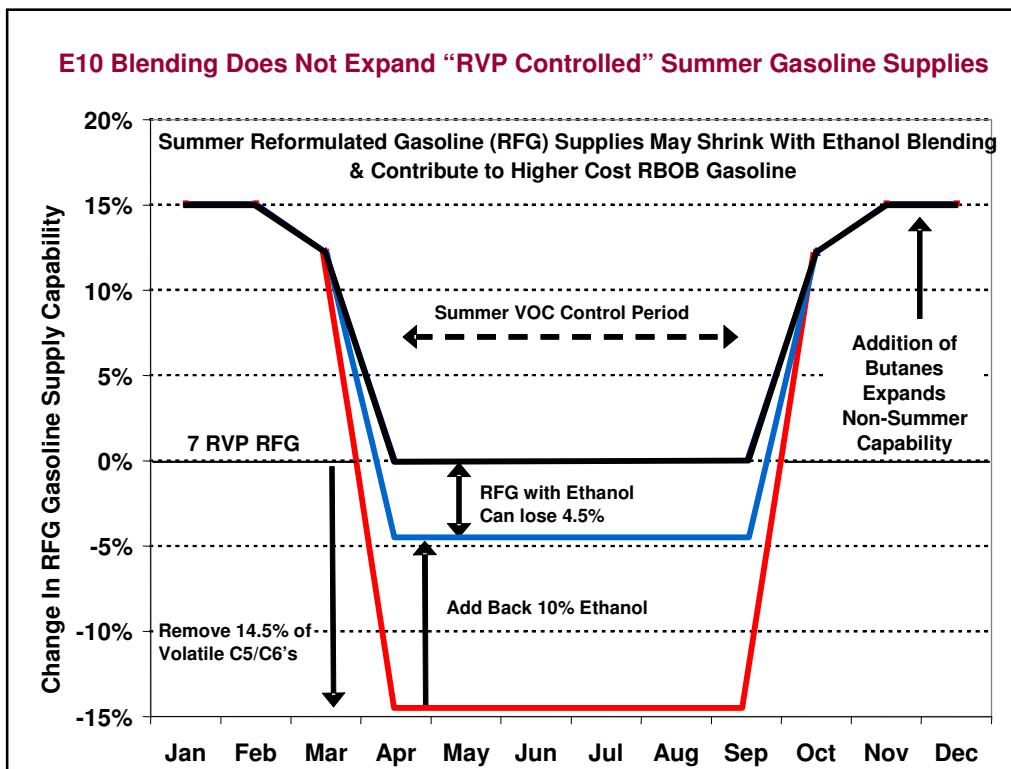
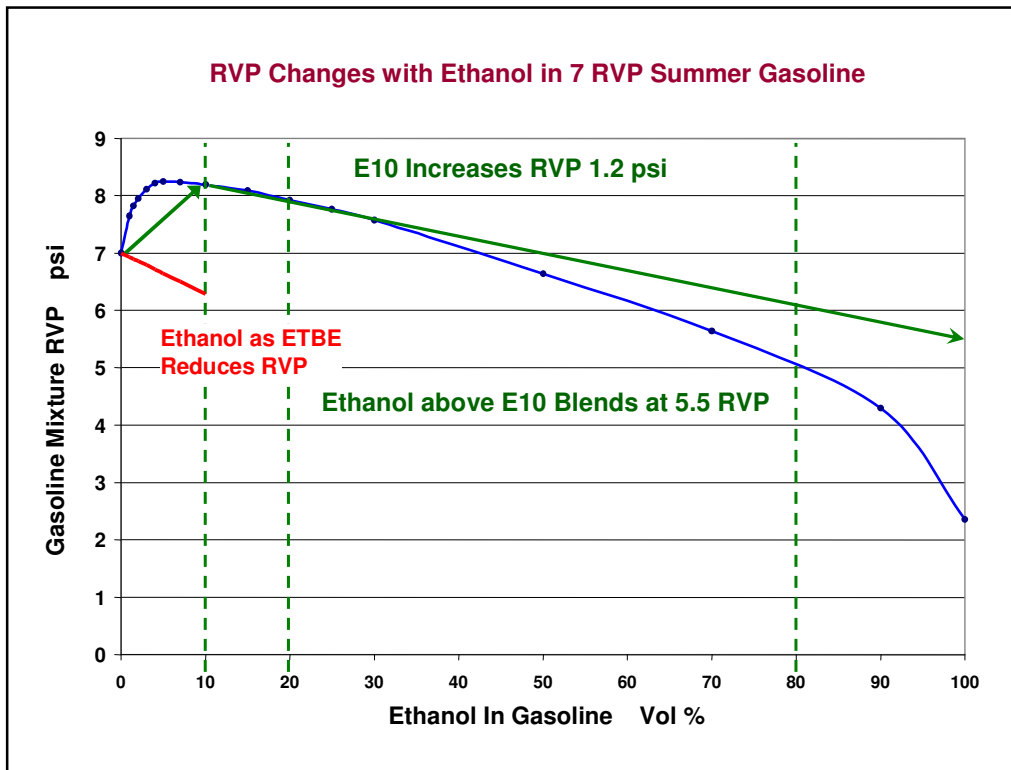
A.S.L. & Associates, Helena, Montana

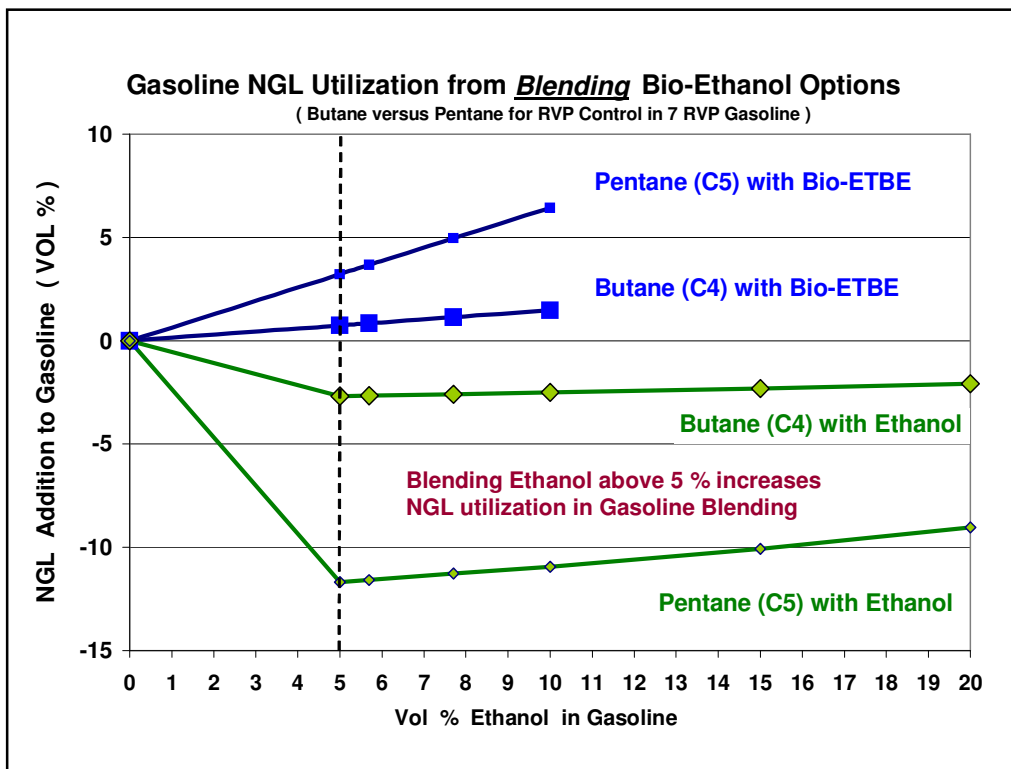
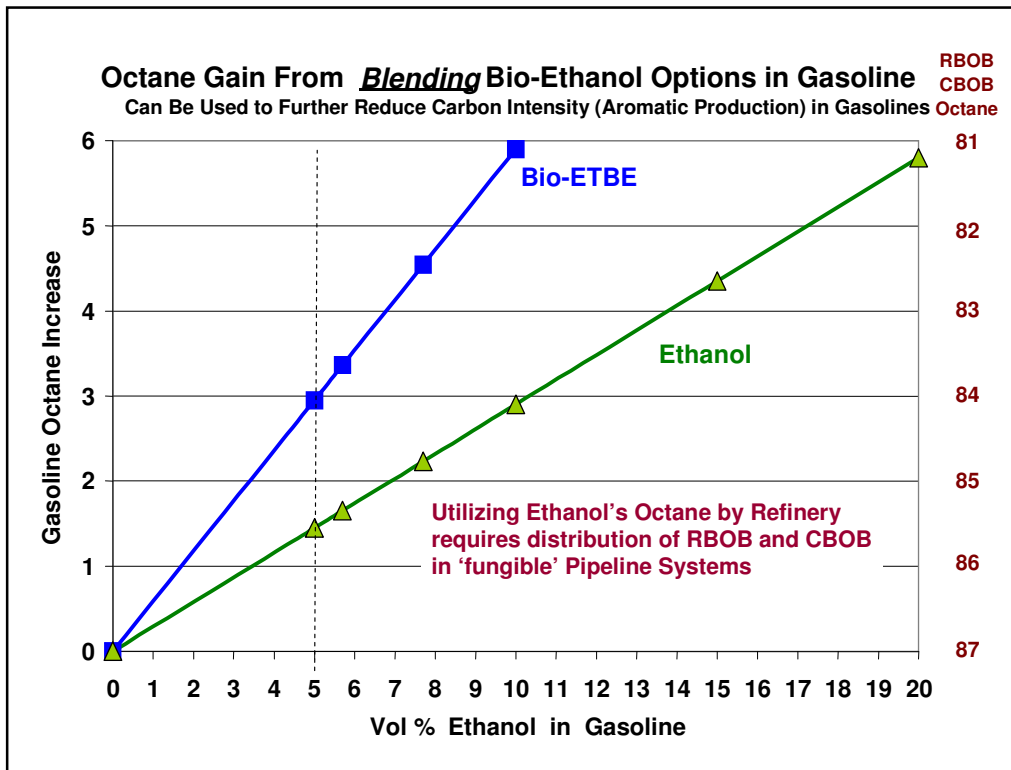
Will Federal RFG & Low Rvp Fuels Expand to All High Ozone Areas ?

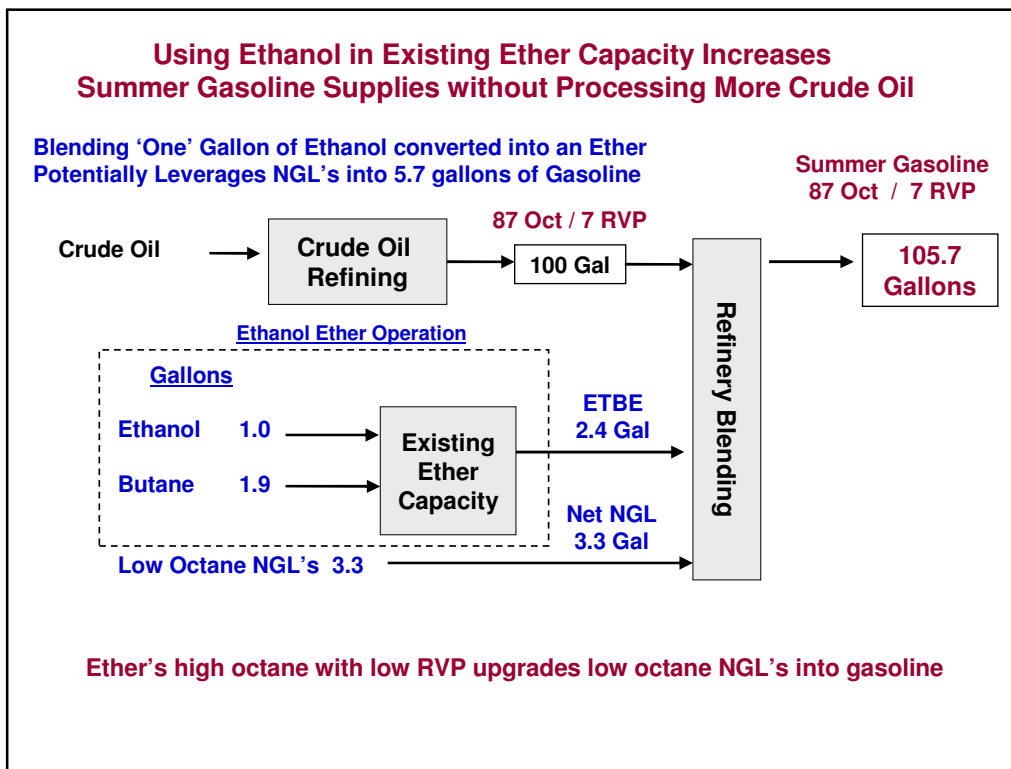
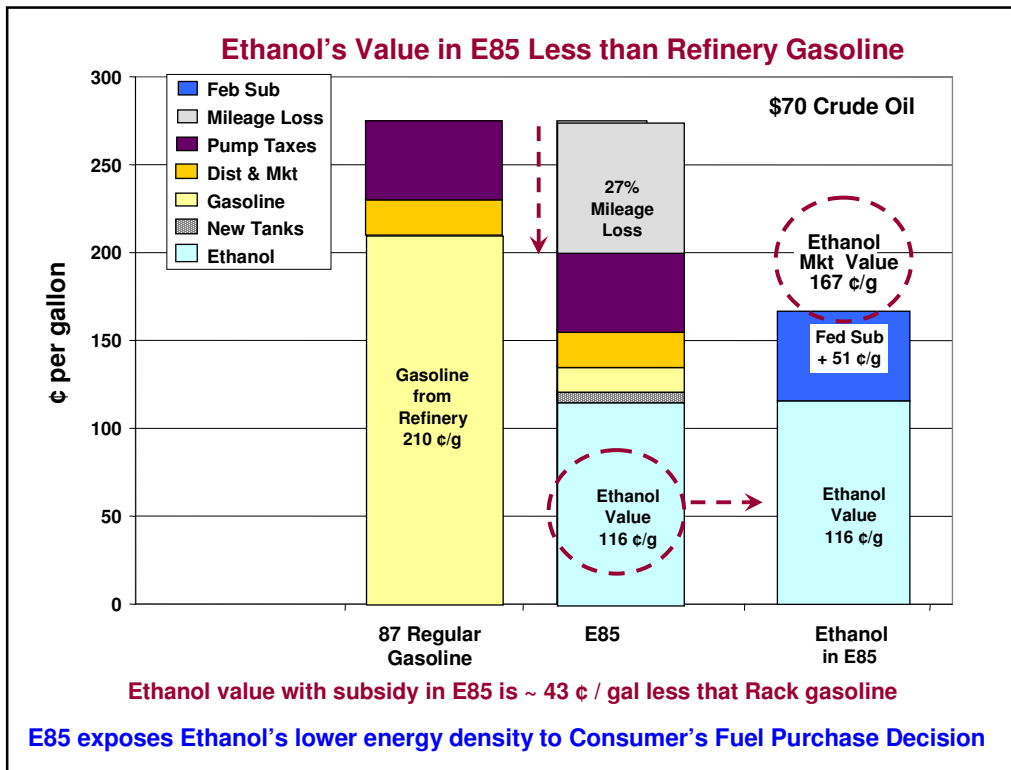








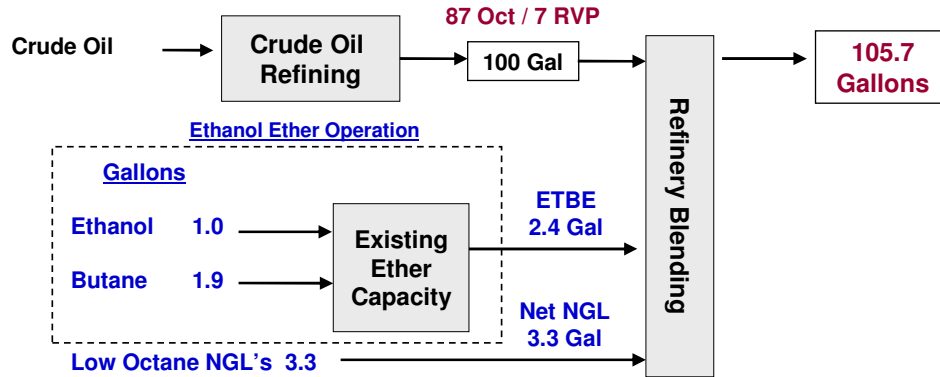




Using Ethanol in Existing Ether Capacity Increases Summer Gasoline Supplies without Processing More Crude Oil

Blending 'One' Gallon of Ethanol converted into an Ether
Potentially Leverages NGL's into 5.7 gallons of Gasoline

Summer Gasoline
87 Oct / 7 RVP



Combining butane and ethanol as ETBE increases their octane and reduces their RVP

<u>Large Octane Gain on Butane</u>			<u>Large RVP Reduction on Butane & Ethanol</u>		
ETBE	Butane	Ethanol	ETBE	Butane	Ethanol
112	92	114	4	55	19 RVP
	+20	-2		-51	-15

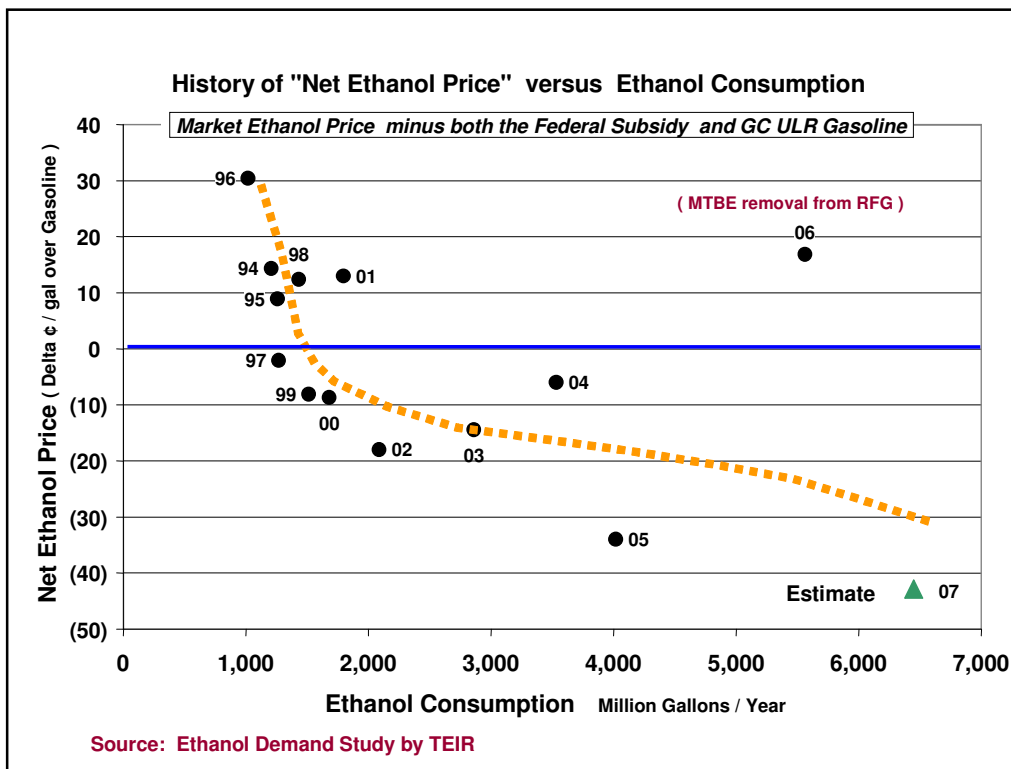
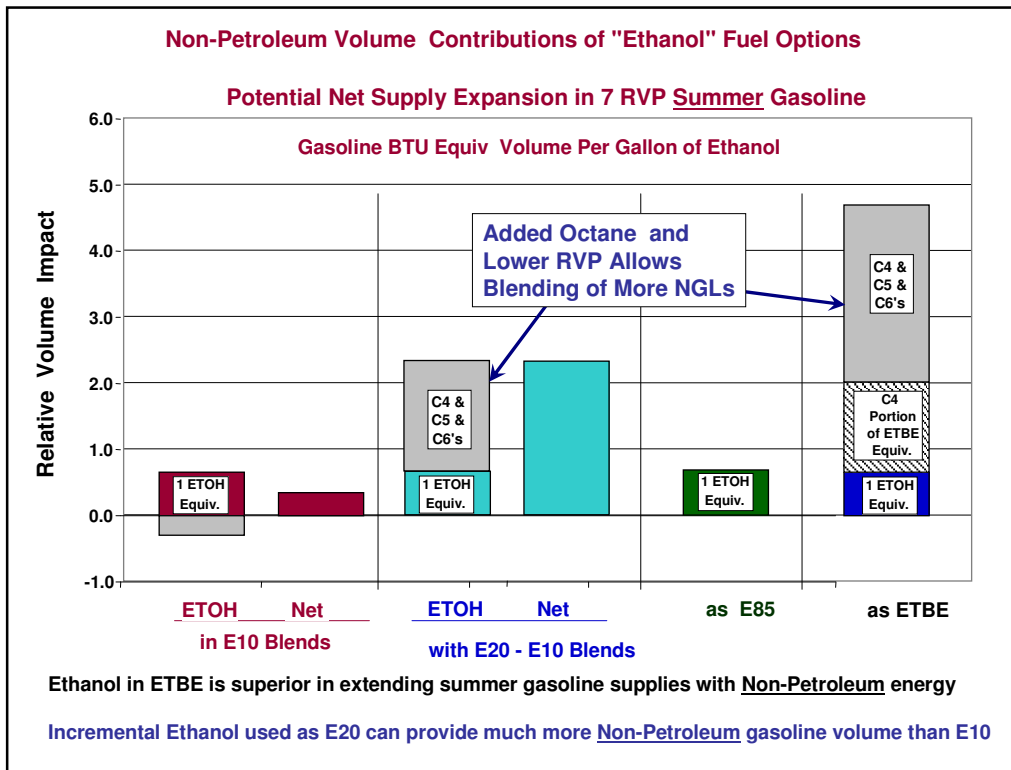
Netback Value Of Ethanol in Various Summer Fuel Options

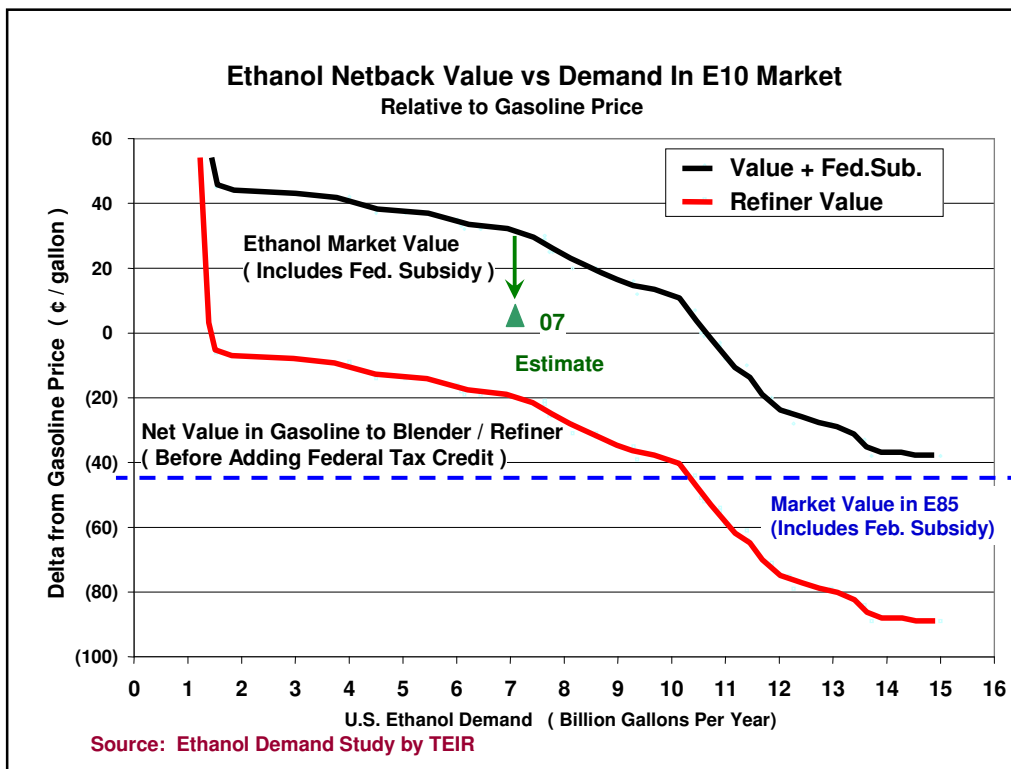
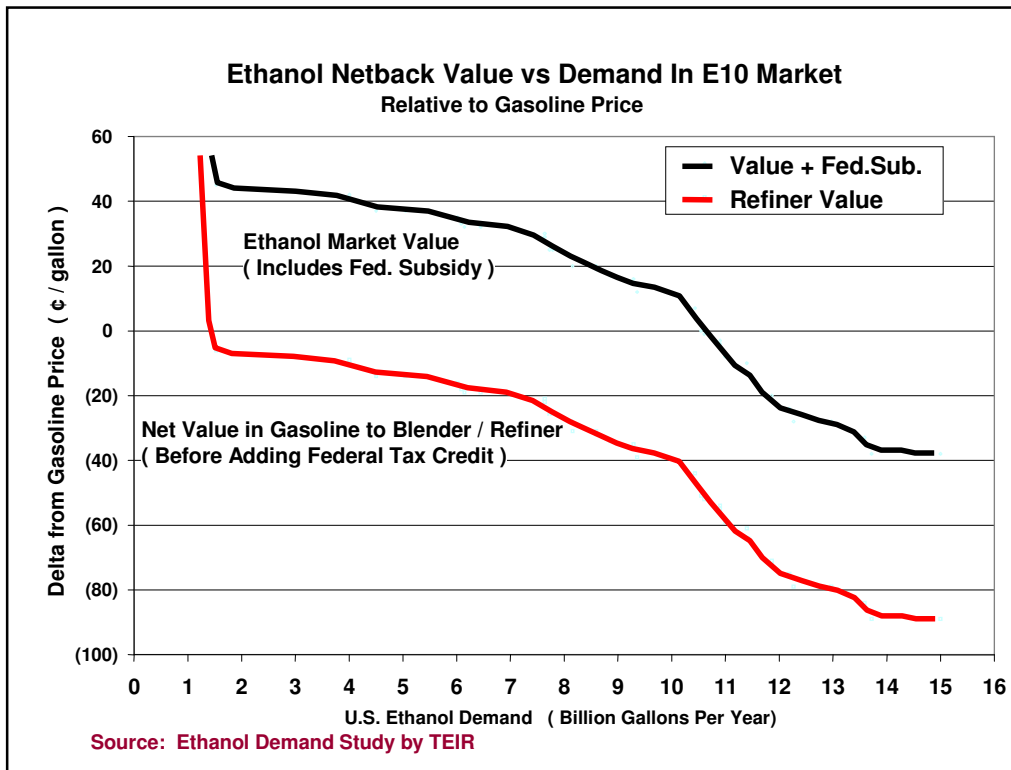
Delta over Refinery Gasoline Price ¢ / gal

Blending Point	E10 Refinery	E10 Terminal	E10 Terminal	E20-10 Terminal	E85 Terminal	ETOH Value in ETBE	ETBE Refinery
Blending Method	Refinery	Splash	CBOB	CBOB	Splash		Refinery
RVP	(49)	0	(49)	5	0		12
Octane	50	0	50	50	0		30
Rail		(10)	(10)	(10)	(10)		
Terminaling		(5)	(5)	(5)	(5)		
Dealer incentive		(10)	(10)		(5)		
Mileage Debit					(94)		
Net Value Delta	1	(25)	(24)	40	(114)	78	42
Subsidy ¢/gal	+51	+51	+51	+51	+51	+51	
Delta ¢/gal Above Refinery Gasoline	52	26	27	91	(63)	129	

High water solubility prevents the refinery from blending E10 for its higher value

Blending ethanol above E10 level as E20 achieves higher market value with RBOB and CBOB made for E20





Potential Increase in Net Summer Gasoline Supply with Ethanol Options

<u>Volume :</u>		E0 » E10	E10 » E20	E85	ETBE *
Ethanol	B G/Yr	15	15	15	1.6
Net Gasoline	B G/Yr	5	36	10	7.0
Potential % Increase		3.3%	24.0%	6.7%	4.8%
<u>Ethanol Value :</u>					
Delta over gasoline (including subsidy)	¢ / Gal	27 ¢	91 ¢	(63 ¢)	129 ¢

* Ethanol to ETBE limited to existing domestic ether capacity

- Incremental Ethanol supply as E20 provides most potential non-petroleum gasoline supply
- Upgrading some existing ethanol to ETBE provides potential quick gasoline supply

Summary Observations

- Ethanol Fuel Options have different impacts on Gasoline Supplies and the value of Ethanol
 - Options- E10, E10 to E20, E85 & ETBE using existing ether capacity
- Expanding E10 to E20 “blending” provides the largest gasoline supply potential, and a higher ethanol value with high octane and low blending RVP
 - Higher value requires utilization of low octane CBOB for ethanol octane value
 - Expanding to E20 blending requires EPA Waiver (& liability shield?)
- Producing domestic ETBE in existing ether capacity can potentially expand gasoline supply by ~ 5% quickly using existing ethanol supplies
 - Provides the highest ethanol value
 - Widely used in Europe and being considered for Japan Biofuel requirement
- E85 exposes ethanol’s lower energy density to consumer’s fuel decision, and also loses the high octane benefit when ‘blending’ ethanol
 - Ethanol value in E85 ~ \$1.50 per gallon less than value of ethanol expanded to E20

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Transportation Energy Information Resources

- 32 years of experience with crude refining and transportation fuels production, economics and fuel quality Issues
- 26 years of market and competitive analysis of transportation fuels and alternative fuels in major world fuel markets
- 20 years of regulatory and legislation experience for transportation fuels such as environmental, energy supply, and alternative fuels
- Current studies are focused on competitive analysis of various biofuels and non-biofuel technologies under various approaches or proposals for regulating transportation fuels.
- Most recent study is on ethanol's incremental market value relative to gasoline and crude oil as a function of demand (supply) for ethanol.
i.e. development of ethanol value versus demand curve.

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Elastomer Volume Swell Curves are Good Predictors of Ethanol Fuel Compatibility

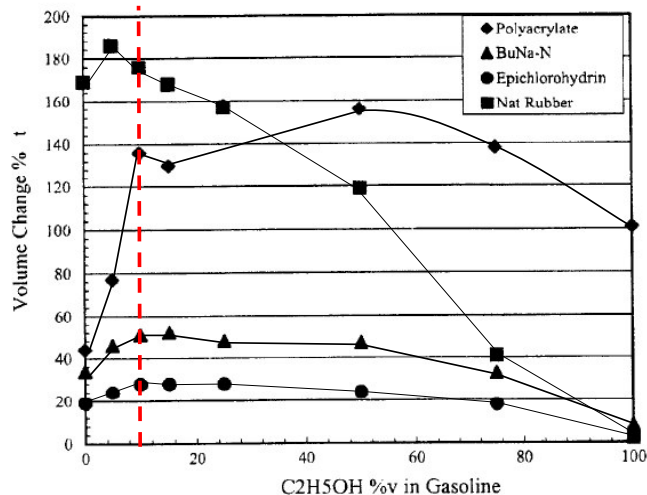


Fig. 12. Swelling of typical elastomers in contact with ethanol-gasoline blends [45].

Maximum Swell for most elastomers occurs with 5 to 10% Ethanol in Fuel which makes it the worse case fuel for most selecting fuel system elastomers

E15 and E20 should be less severe fuels