The Changing Economics of Ethanol Blend Fuels

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President

Scientific Update on Biofuels
Sponsored by the
Environmental and Energy Study Institute
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Team Behind the Analysis
MN Corn Research & Promotion Council Study

Defour Group LLC

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- US FTC from 1982 – 84
- Director of Economics at GM

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- Bachelor in Engineering and MS-Environmental Science
- Director, GM Environmental Activities Staff (EAS)

Other Participants

Tom Darlington
- 9 years at US EPA developing MOBILE emission model
- 5 years at GM EAS
- Founded Air Improvement Resources in 1994

Gary Herwick
- BS in Mechanical Engineering
- Director of Alternative Fuels at GM
- Founded Transportation Fuels Consulting
Ethanol Blend Fundamentals

\[
\text{Benefit of Ethanol in Gasoline} = \text{Cost Per Gallon Benefit} + \text{Octane Boosting Benefit} - \text{Energy Penalty}
\]

**Cost Benefit**

- **Volumetric Price Parity (VPP)**
  - When ethanol and gasoline cost the same per gallon
  - Since 2011, ethanol sells at less than VPP

**Octane Benefit**

- Octane: Measure of Fuel’s Resistance to Pre-ignition
  - Gasoline: low octane
  - Ethanol: high octane
  - Low octane rating limits ability to design high efficiency engines

**Energy Penalty**

- **Energy Price Parity (EPP)**
  - When $1 of ethanol has the same energy as a $1 of gasoline
  - Ethanol vs gasoline:
    - 32% less energy per gallon
    - Costs 19% less
Why Ethanol Now Costs Less Than Gasoline
The Decoupling of Gasoline and Ethanol Prices

Monthly Averages  Source: Nebraska Energy Board

Gasoline

Ethanol

Ethanol Prices Track Gasoline

VEETC and Tariff Expire

Ethanol < Gasoline

Wholesale Price per Gallon, 2013 $:

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Source: Nebraska Energy Board
Ethanol Producer Struggle to Return to Profitability

Ethanol Operating Margins based on futures and Iowa Corn Prices
Center for Agricultural and Rural Development, Iowa State University

Tax Credits and Tariff Protection Expire

Other Operating Costs

Cost of Corn

Capital Costs

Price Per Gallon

02/10 07/10 02/11 07/11 02/12 07/12 02/13 07/13 02/13

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18SEP14 ESI Presentation
Slide 6
Ethanol Gasoline Blends Today
Subsidy Loss Transforms Fuel Ethanol

Ethanol Industry Boosts Productivity

- “new ... processes ... integrated into about 80 percent of U.S. corn ethanol plants...”
- “switching ... plant fuel to lower-carbon sources ...[and] lowering the energy use of their plant”
- “improving the starch-to-ethanol yield through the use of corn [developed] for ethanol production.”

From “Three Routes Forward for Biofuels,” UC Davis, July, 2014

Oil Industry Modifies Processes

- Oil refineries now produce lower octane blendstock
- Blenders add 10% ethanol to boost octane to legal minimum

10% Blend (E10) is New Regular

- Lowest cost per BTU
- Infrastructure now tailored it
- Nearly universal consumer acceptance
Some Recent Studies Based on Pre-2012 Information

API’s NERA Study

“Economic Impacts Resulting from Implementation of RFS2 Program”

- Published October, 2012
- Phase 1 of the Report, “Impact of the Blend Wall Constraint in Complying with the Renewable Fuel Standard” was published November 2, 2011.

CBO Report on RFS

“The Renewable Fuel Standard: Issues for 2014 and Beyond”

- Published June, 2014
- Uses 21 sources published before 2012
Ethanol is the Low Cost Way to Boost the Octane Rating of Gasoline
Ethanol Reduces the Cost of Gasoline

Cost of Octane at the Refinery
- Regular gasoline must have an 87 AKI (anti-knock index) octane rating
- Blendstock has an 84 AKI rating
- Cost to refine blendstock
  - Defour Group: 11 cents/gallon
  - APF Economics: 11 – 17 cents/gallon
  - Hart Energy: 14 cents/gallon

Using Ethanol to Boost Octane
- Fuel ethanol is rated over 110 AKI
- Adding 10% ethanol:
  - Boosts blendstock octane 3 AKI
  - Lowers blendstock price by 5 cents per gallon

Impact on Pump Price to Add 3 AKI to Blendstock
- At refinery: + 11 cents per gallon
- Using ethanol: - 5 cents per gallon

Bottom Line: Even After Adjusting for Ethanol’s Lower Energy, Consumers Save About 6 Cents Per Gallon Because of Ethanol
Octane Benefit Greater Than Energy Loss
E85 is Affordable with Low Octane Blendstock

Natural Gasoline
- A gasoline-like natural gas liquid
- Used to denature fuel ethanol
- Has 90% of the energy in E10
- Costs about 73 cents/gallon less than blendstock
- Rated octane is only 30 – 50 AKI

Ethanol Producers
- Produce their own E85 by mixing in additional natural gasoline
- Sell directly to retailers

E85 Sold Below EPP
- In 2013, E85 needed to sell for $0.72 less than E10 to be at EPP
- Some E85 now $1 a gallon less than E10
- Low octane gasoline could be substituted for natural gasoline
Ethanol May be a Better Value in the Future
Ethanol Reaching Energy Price Parity


Others See EPP in the Near Future

Based on a study of futures prices, CBO predicts “in 2017... [t]he price of ethanol is about the same as that of gasoline per British thermal unit (Btu) of energy content”

Most Cost-Beneficial Use of Ethanol Maximizes Octane Benefit
Ethanol the Key to an Affordable High Octane Fuel

Eco-Performance Fuel (EPF)

- 98 Research Octane Number, or RON (approx. 93 AKI)
- Made from proven components
  - Base is E10 (Also marketed for legacy vehicles)
  - Ethanol added to get to 98 RON
- Improves engine performance by:
  - Allowing higher compression ratios
  - Enhancing combustion

Advanced Vehicles + EPF Would:

- Have equal or better fuel economy
- Produce 2X the engine torque

Than Today’s Vehicles Running on E10
Why Eco-Performance Fuel?

**Cleaner**
- Low CO₂ Emissions
  - Less carbon in fuel =
  - Lower CO₂ tailpipe
- Less Toxic
  - Aromatics linked to cancer use to boost octane in gasoline
  - Ethanol boosts octane w/o adding toxic chemicals

**Cheaper**
- Ethanol Boosts Octane
  - Highest value use
  - Proven with E10
  - Higher concentrations = more savings if vehicle can utilize the octane
  - Savings Over Time
  - Ethanol prices stable (EIA) or falling (U of MO)
  - Gasoline prices rise

Cost Savings Per Gallon EPF vs E10

2017 2035

Cost:
- $0.15
- $0.20
- $0.25
- $0.30
- $0.35
- $0.40
- $0.45
Low-Cost Way to Meet National Energy Goals

Goals

• Reduced oil dependence
• Lower greenhouse gas (GHG) emissions

Programs

• Corporate Average Fuel Economy (CAFE): 1975
• Clean Air Act for GHG emissions: 2007

Cost Effectiveness

• EPF: ($3) to ($9) per ton CO₂
• Tesla: $497 per ton CO₂
Ethanol: The Renewable That Saves Consumers Money

Renewable Share of Energy Supply

- Wind
- Solar
- E10
- EPF*

Cost Per Household of Renewable Use

- Electricity Generated By
- Wind
- Solar

Vehicles Powered By

- E10
- EPF*

* Eco-Performance Fuel, or EPF, has about 30% ethanol

Renewables Can’t Completely Replace Fossil Fuels

- Only Ethanol Both Displaces Fossil Fuel and Saves Consumers Money!

Sources: Brookings Institute, Defour Group, EIA