Ethanol & E85

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U.S. Ethanol Industry Today

- Total production capacity of 13.1 bgy
  - Predicted 2009 production of 10.6 bgy
  - Current capacity utilization of 11.9 bgy (~93%)
- 200 plants operating in 26 states
- There are plants under construction or expanding
- Dozens of next generation facilities in various stages of development

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U.S. Transportation Fuels

- Annual blended gasoline use is ~140 bgy
  - Approximately 160,000 retail stations
- 2009 ethanol production = 8% of gasoline use
- EIA reports that 2007 was peak use of gasoline

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Ethanol as a Fuel & Fuel Additive

1. **E10 (10% ethanol by volume)**
   - Approved for use in all vehicles and engines
   - ~98% of ethanol consumed as E10
   - 80% of U.S. gasoline blended with ethanol

2. **E85 (70-85% ethanol by volume)**
   - For use in flex-fuel vehicles (FFVs) only
   - 8+ million FFVs; ~2,200 retail outlets
   - <2% of ethanol consumed as E85

3. **Mid-level blends (20, 30, 40% ethanol by volume)**
   - For use in FFVs only
   - Dispensed by "blender pumps" (<300 stations)
   - Specifications, BMPs, etc. under development

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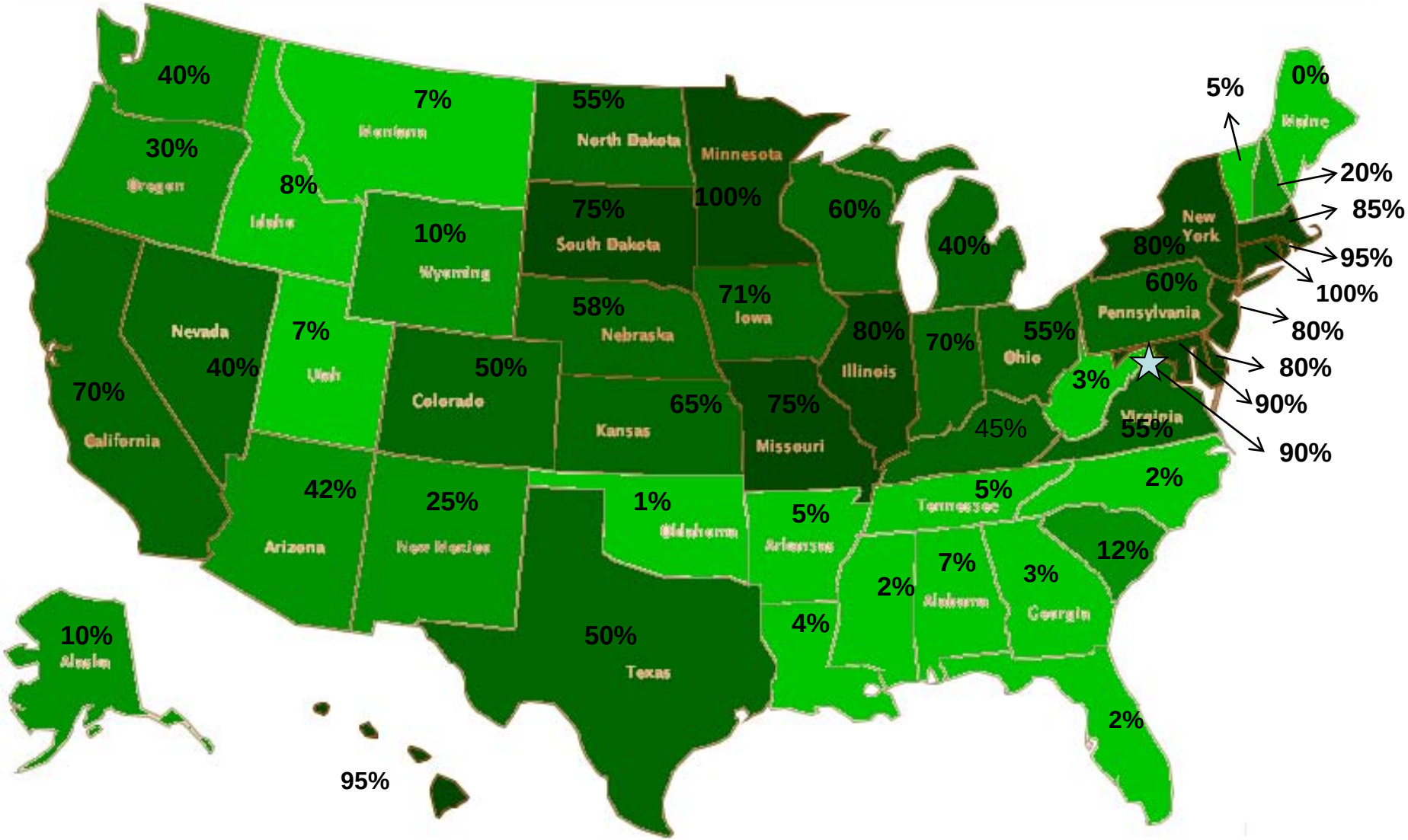

Legend	
Dark Green	75-100%
Med. Green	50-74%
Light Green	10-49%
Bright Green	<10%

E10 Market Estimation 2007

Source: RFA and other resources

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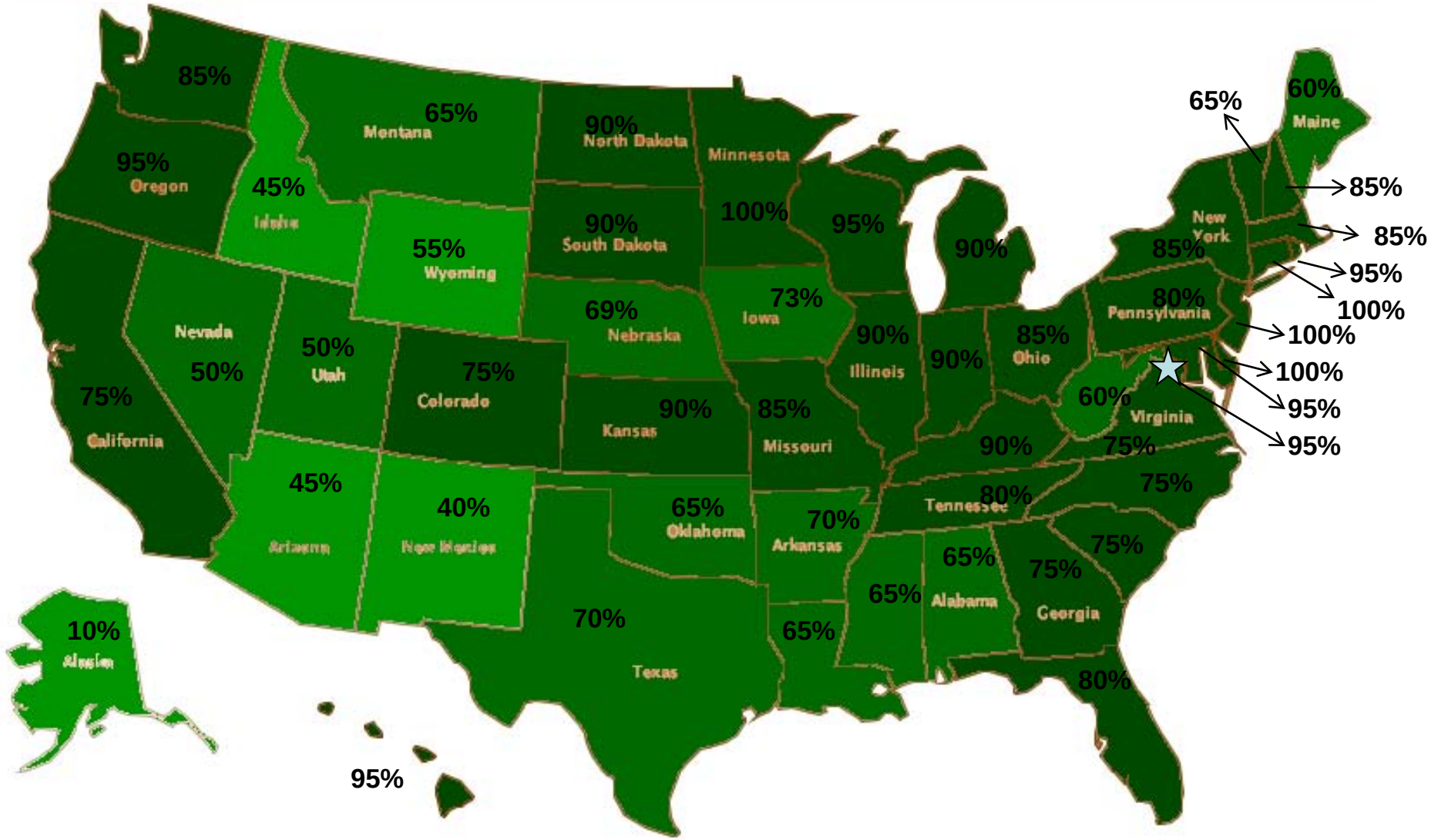

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E10 Market Estimation 2009

Source: RFA and other resources

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E85

- E85 (85% ethanol, 15% gasoline) is considered an alternative fuel under the Energy Policy Act of 1992 (EPAct). It is used to fuel flex-fuel vehicles (FFVs), which are available in a variety of models from U.S. & foreign automakers.
- The 15% gasoline enables FFVs to operate normally under cold conditions.
- Other than lower gas mileage, motorists will see little difference when using E85 versus gasoline. E85 has about 27% less energy per gallon than gasoline. However, this does not translate directly to fuel economy loss. E85 is typically priced lower than gasoline, so the cost per mile is comparable.

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Flex-Fuel Vehicle Features

Engine calibration updates: Fueling and spark advance calibrations directed by vehicle computer to control combustion, enable cold start, and meet emissions requirements

Fuel system electrical connections and wiring: Must be electrically isolated and made of materials designed to handle ethanol's increased conductivity and corrosiveness (if exposed to fuel)

Fuel pump assembly: In-tank components must be made from ethanol-compatible materials and sized to handle the increased fuel flow needed to compensate for ethanol's lower energy density

Internal engine parts: Piston rings, valve seats, valves, and other components must be made of ethanol-compatible materials that are designed to minimize the cleansing effects of alcohol fuels, which can wash lubrication from parts

Fuel filler assembly: Anti-siphon and spark arrestor features are included to handle ethanol's increased conductivity

Fuel identifier system: Automatically senses the composition of the fuel and adjusts engine for varying ethanol-gasoline blends

Fuel injection system: Must be made of ethanol-compatible materials and designed for higher flow to compensate for ethanol's lower energy density

Fuel rail and fuel lines: Must be made of ethanol-compatible materials with seals, gaskets, and rubber fuel hoses rated for ethanol use

Fuel tank: Must be made of ethanol-compatible materials and designed to minimize evaporative emissions from ethanol

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Flex-Fuel Vehicles

- More than 8 million FFVs on the roads today.
- More than 1.5 million annually.
- More than 30 different models.
- No additional cost for vehicle.
- Will never get stranded due to fuel.

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Emissions

- Evaporative
- Tailpipe
- Life-Cycle GHG & Petroleum Use

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Evaporative Emissions

- These emissions enter the air through permeation, fuel tank venting, and fuel or vapor leaks. Permeation vapors are released through fuel-line materials. This type of emission is more of an issue for regular gasoline and gasoline with low levels of ethanol such as E5 (5% ethanol, 95% gasoline) and E10 (10% ethanol, 90% gasoline) than E85.
- Fuel tank venting occurs when fumes escape the tank during refueling and when gasoline vapors expand on warm days. Since model year (MY) 2000, fuel tank venting is controlled by onboard refueling vapor recovery devices installed in all cars running on E85 or gasoline.
- Evaporative emissions also come from fuel or vapor leaks. These emissions are less prevalent in cars running on either type of fuel because of ongoing improvements in leak-resistant materials and fittings.

Tailpipe Emissions

- Tailpipe emissions come from fuel combustion in a vehicle's engine and are emitted from its exhaust system. Most often the emissions of primary concern include hydrocarbons, oxides of nitrogen (NOx), carbon monoxide (CO), air toxics, and carbon dioxide (CO2).
- On average, all regulated emissions either decreased or showed no statistically significant difference with E85 compared with gasoline.

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Life-Cycle GHG & Petroleum Use

- Evaluating life-cycle greenhouse gas (GHG) emissions requires tracking all GHG emissions released to produce and distribute E85, as well as those emitted while driving.
- Researchers at Argonne National Laboratory found that corn-based E85 reduces GHG emissions 17% to 23% below that of regular gasoline on a per-mile basis. They also found that E85 reduces petroleum use by 70%.

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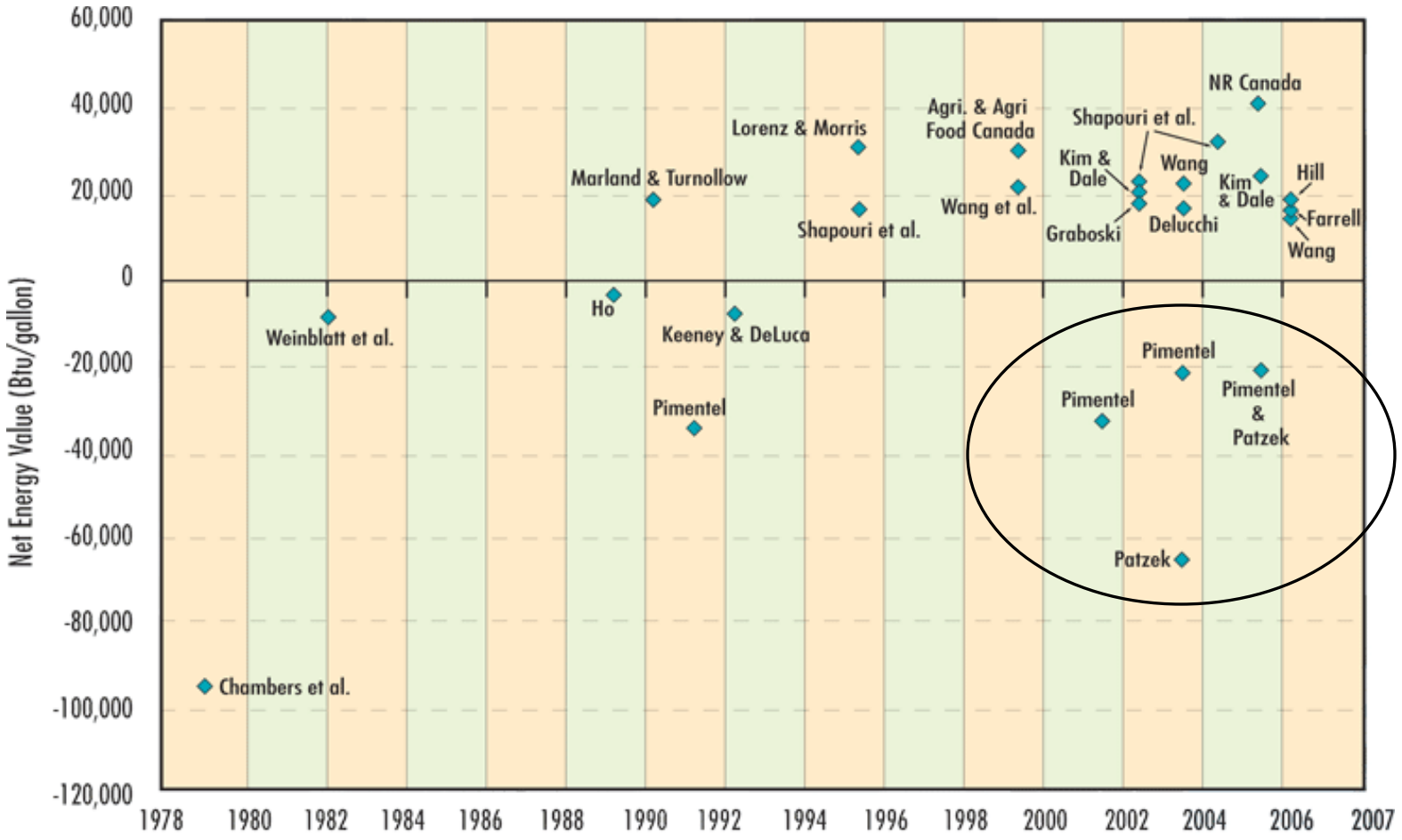
Energy Balance



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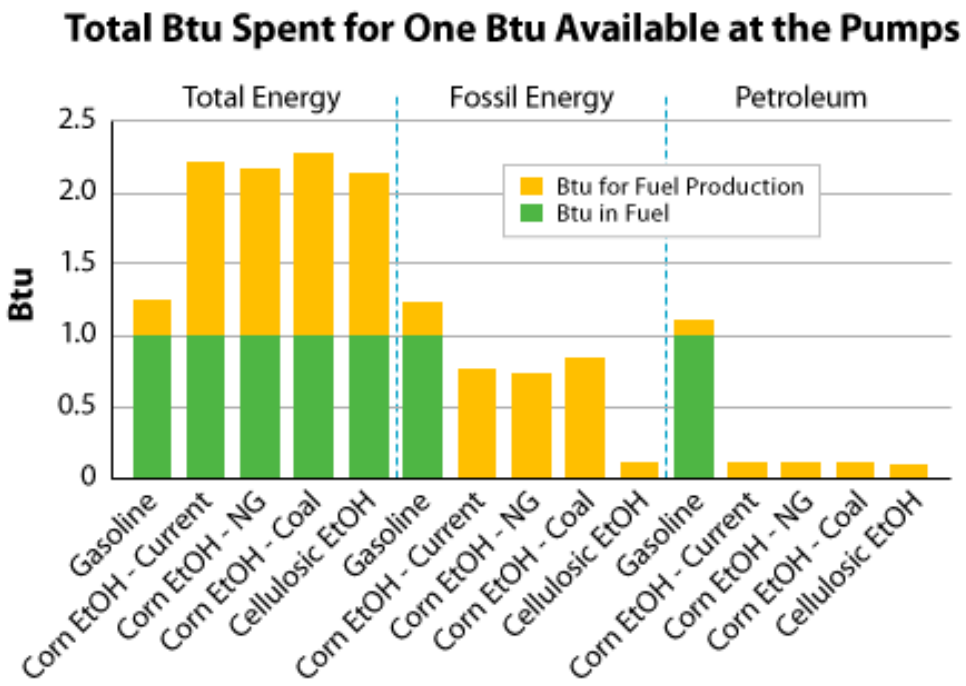
Energy Balance



Source: Updated Energy and Greenhouse Gas Emission Results of Fuel Ethanol. 2005. Report at the 15th International Symposium on Alcohol Fuels.

Fleet Examples

- University of Oklahoma Adopts Variety of Alternative Fuels
- Alternative Fuels Are Key to Airport Transportation in Portland
- University of Illinois-Chicago Fleet Invests in AFVs
- Enterprise Rent-A-Car Responds to Demand for Green Vehicles
- Hoover Municipal Government Runs on Alternative Fuels
- Alabama Police Fleet Boasts 100% AFVs
- Iowa State Patrol Fuels with E85

* More information in packets.

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E85 Fueling Options - Converting

There are three primary concerns for converting existing equipment to E85 fueling. These are described below:

- Condition of existing equipment.
- Compatibility.
- Metering accuracy.

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E85 Fueling Options – New Equipment

- Determine Fueling Specifications
- Decide on Hiring a Project Contractor
- Review Bid Proposals and Select a Contractor
- Create a Project Timeline
- Secure Permits and Adhere to State Requirements
- Install Equipment, Prepare the Site, and Conduct Testing
- Complete Inspection Process
- Ensure Final Walkthrough Meets Expectations

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Sustainability

- 2009:
  - 3.8 billion bushels of corn converted into an estimated 10.6 billion gallons of ethanol and 30.5 million metric tons of the high-value livestock feed, distillers grains and corn gluten feed and meal.
  - Ethanol represented 30% of the gross corn use. But when the contribution of feed co-products is accounted for (1/3 of every bushel of corn used for ethanol is returned to the feed market), the net consumption of corn by U.S. ethanol production is just 21%.
- 2010:
  - USDA projects 4.2 billion bushels will be used on a gross basis to produce approximately 11.75 billion gallons of ethanol and 33 million metric tons of feed in the 2009/2010 marketing year.

Ethanol & Water

- Since 2001, ethanol producers have reduced water requirements by 26%, with many plants requiring less than 3 gallons of water to produce ethanol and distillers' grains.
- Approximately 87% of all corn grown in the U.S. is fed by rainwater. Nearly 97% of all corn used at ethanol biorefineries was not irrigated.
- By comparison, it takes 40 gallons of water to produce one cup of coffee; a pound of hamburgers, 11.6 gallons of water to produce a pound of chicken; 120 million gallons to water a golf course for a year; and 300 million gallons to produce just one day's worth of the newspapers across the country.

(Source: U.S. Geological Survey, National Renewable Energy Laboratory, Waterfootprint.org)

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Questions?

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