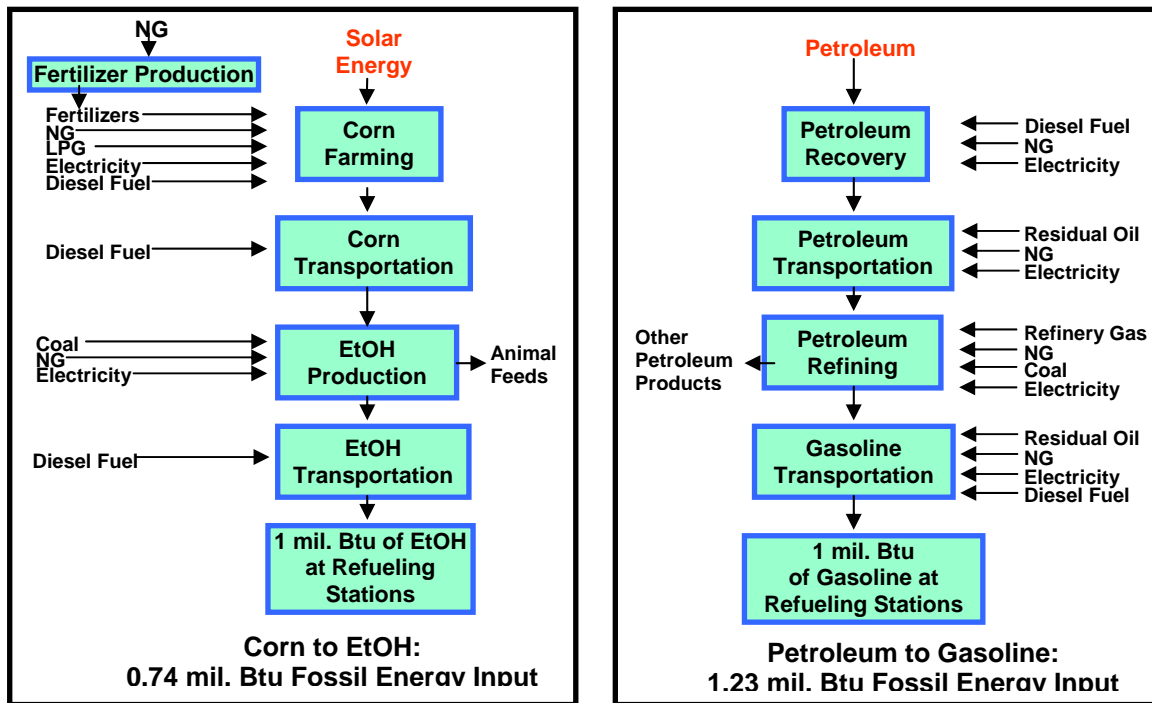


Argonne National Laboratory Ethanol Study: Key points

We believe a recent Argonne National Laboratory study (Michael Wang, Center for Transportation Research, Argonne National Laboratory) has laid to rest some long-held misunderstandings about ethanol and its important role in reducing America’s reliance on imported oil and our greenhouse gas emissions. In terms of key energy and environmental benefits, cornstarch ethanol comes out clearly ahead of petroleum based fuels, and tomorrow’s cellulosic-based ethanol would do even better.

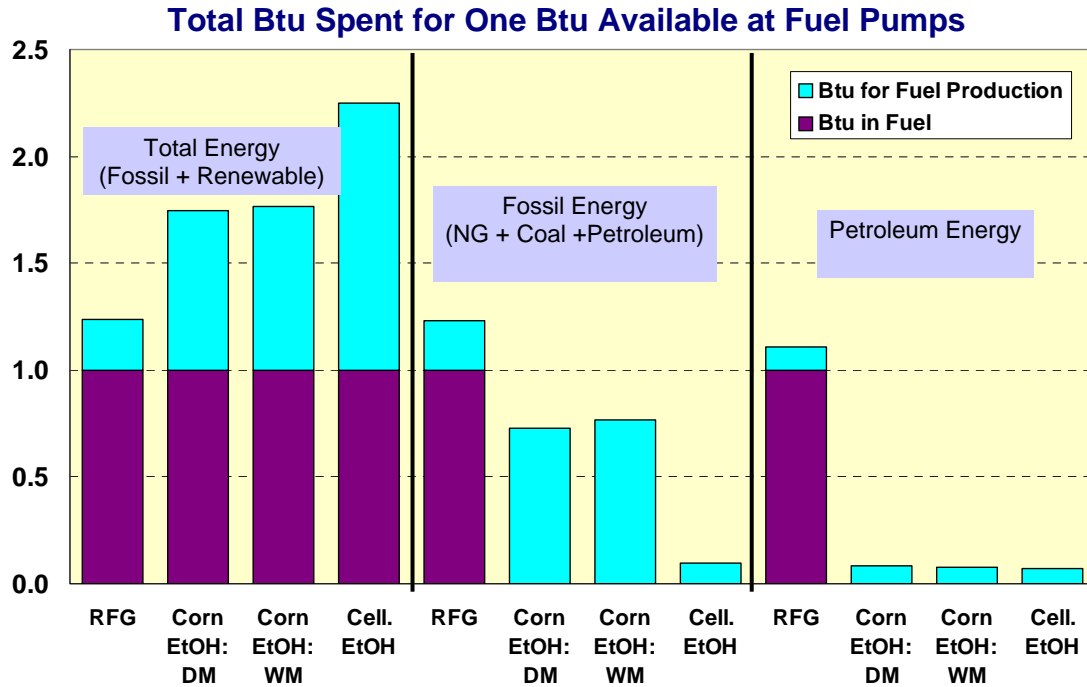
This figure illustrates the energy inputs used to produce and deliver a million British Thermal Units (Btu) of ethanol (EtOH) and petroleum gasoline to a refueling station.



As you can see, the *fossil* energy input per unit of ethanol is lower—0.74 million Btu fossil energy consumed for each 1 million Btu of ethanol delivered, compared to 1.23 million Btu of fossil energy consumed for each million Btu of gasoline delivered.

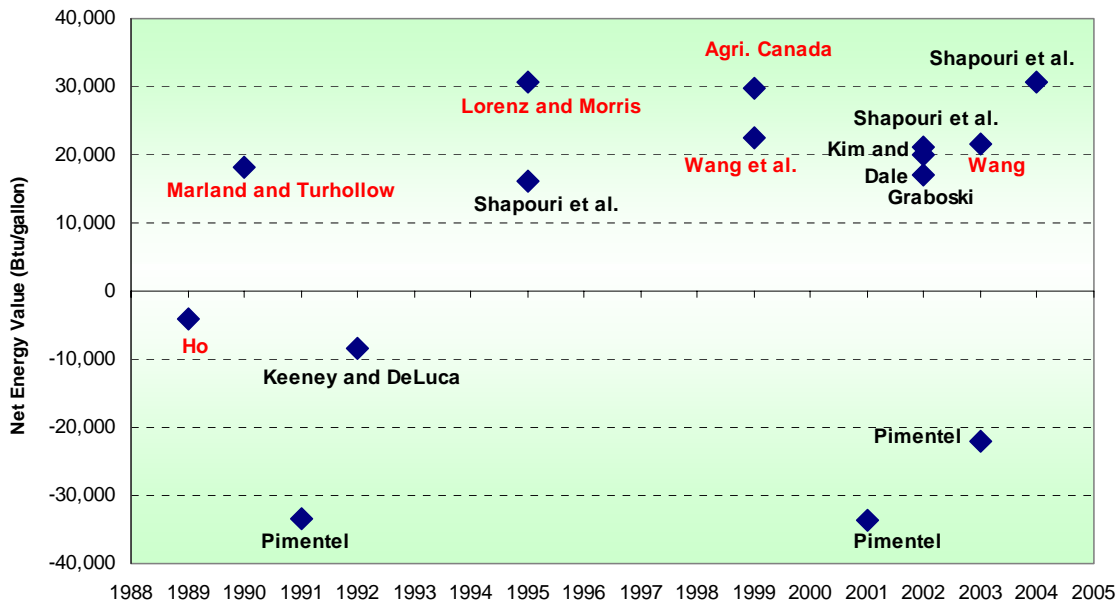
Some of the confusion arises over the fact that some of the *total* (not fossil or petroleum) energy used in the production of ethanol is “free” solar energy used to grow the corn in the first place. Indeed, if you include the solar energy inputs, it is true that you “spend” between 1.5 and 2.0 Btu to produce a Btu of ethanol... but since the solar energy is free, renewable and environmentally benign, we shouldn’t care.

The following graph illustrates that while the *total* energy needed to produce a unit of ethanol is more than the *total* energy needed to produce a unit of gasoline, ethanol comes out way ahead when you are looking at either 1) the amount of *fossil* energy needed or 2) the amount of *petroleum* energy needed.



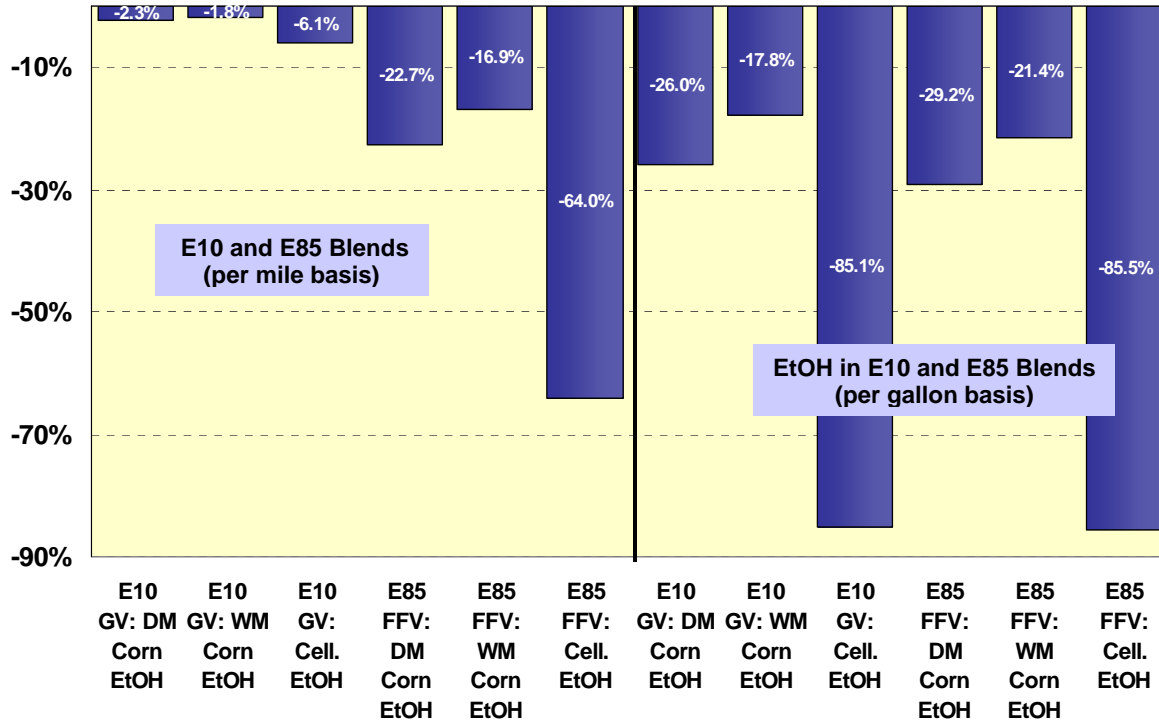
The following chart illustrates the range of studies that have been performed looking at the fossil energy use required to produce ethanol. Studies above the “zero line” found that ethanol had a positive net fossil energy value (that is, less fossil energy is used to produce ethanol than the energy that is available in ethanol). Studies below the “zero line” found that ethanol had a negative fossil energy value. As you can see, most of the studies, and most of the recent studies, show that ethanol has a positive net fossil energy value.

Comparative Results of Corn Ethanol Fossil Energy Balance



Moreover, ethanol has a positive benefit in greenhouse gas (GHG) emissions reduction. On a per gallon basis, corn ethanol reduces GHG emissions by 18% to 29%, while cellulosic ethanol has an even greater benefit with an 85% reduction in GHG emissions.

Corn Ethanol Reduces Greenhouse Gases by 18-29% While Cellulosic Ethanol Can Achieve an 85% Reduction



Guide to abbreviations used:

- BTU British Thermal Units
- Cell. Cellulosic
- DM Dry Mill Process Ethanol
- E10 10% Ethanol blend
- E85 85% Ethanol Blend
- EtOH Ethanol
- FFV Flexible or Flex Fuel Vehicle
- LPG Liquefied Petroleum Gas
- NG Natural Gas
- RFG Reformulated Gasoline
- WM Wet Mill Process Ethanol