

How is a cow like an ethanol production plant?

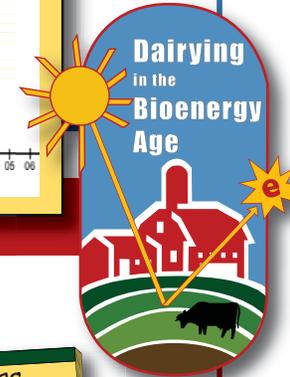
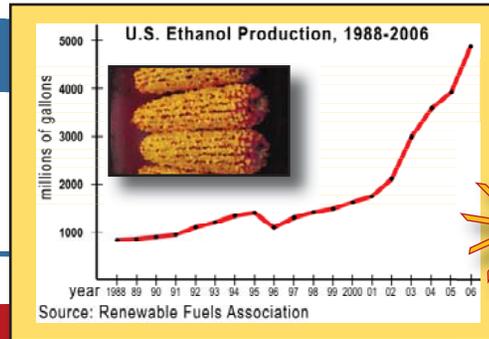
Both utilize fermentation to change plant energy into fuel – milk for the body or ethanol for vehicles.

Both are limited by how well the system breaks down plant cell walls.



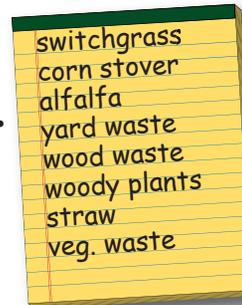
Starch based ethanol:

- **Corn-based ethanol dominates today.**
- **Starch is easily broken down by enzymes, therefore more easily converts to ethanol.**



Cellulose based ethanol:

- **Cellulosic ethanol is needed for future growth in biofuels.**
- **Cellulose is the main component of plant cell walls and is the most common organic compound on earth.**
- **Compared to starch, it is more difficult to break down cellulose to convert it into usable sugars for ethanol production.**
- **Yet, making ethanol from cellulose dramatically expands the types and amount of available material for ethanol production. This includes many materials now regarded as wastes requiring disposal.**



At the U.S. Dairy Forage Research Center, research to improve the digestibility of plant cell walls in dairy cattle is now being applied toward improving the conversion of cellulosic plant materials into ethanol.

Work is also being done to find ways to incorporate more perennial crops, such as alfalfa, into the bioenergy picture – as a beneficial rotation crop with corn and as a feedstock for cellulosic ethanol production.

Alfalfa would be a good biomass crop:

- **Perennial (less erosion).**
- **Nitrogen fixation (lower fertilizer requirement; benefits for next crop).**
- **Established infrastructure (seed, management, harvest equipment).**
- **Valuable co-product (leaf meal as supplemental protein feed for livestock).**
- **Lower energy input costs than corn.**
- **Greater energy ratio than with corn or soybeans.**

Crop yield	Energy Input	Energy Output	Energy Ratio Out:In
MMBTU/acre			
Corn (180 bu/A)	6.0	59.0	8.8
Soybean (40 bu/A)	2.3	18.3	7.1
Alfalfa (6 ton/A)	3.0	78.2	25.0

Source: Russelle, et. al., 2006

Source: Paul Weimer, microbiologist
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