Process Mapping

Module 2: Chemical design, performance, and impacts.

Please sit with your group

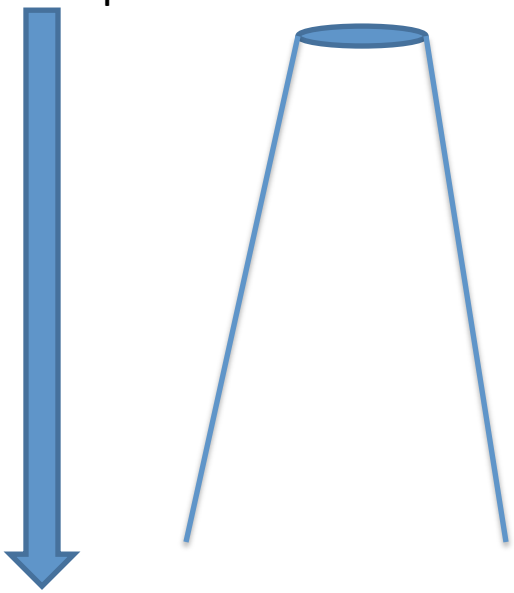
Course Context

1. Introduction – Project proposal (Feb 22nd)
2. Technical performance and heath and environmental impacts – Key figures and explanation. (March 18th)
3. Law and Policy – Summary of barriers and drivers. (April 8th)
4. Business – Scope, development, and available capital in the market and potential partnerships. (April 22nd)
5. Integration and tradeoffs – Conclusions, path forward and rough draft. (May 1st)

Two different ways to write a review

Traditional Academic Approach

Focused Expertise

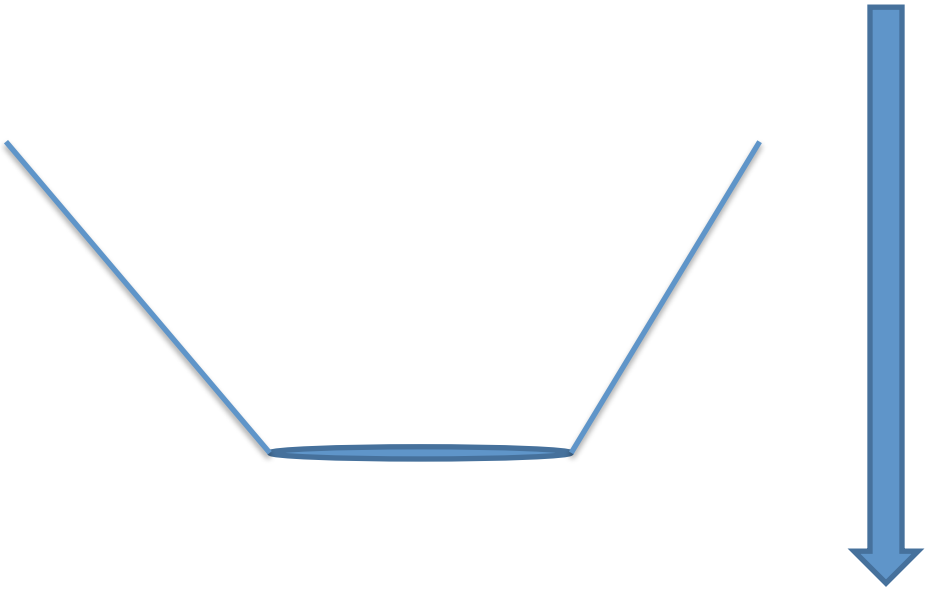


Broader Impacts

Resource Limited

Consulting Approach

Broad Interest and Experience



Focused and Applied Insight

Time Limited

First Assignment Due Friday

Project proposal:

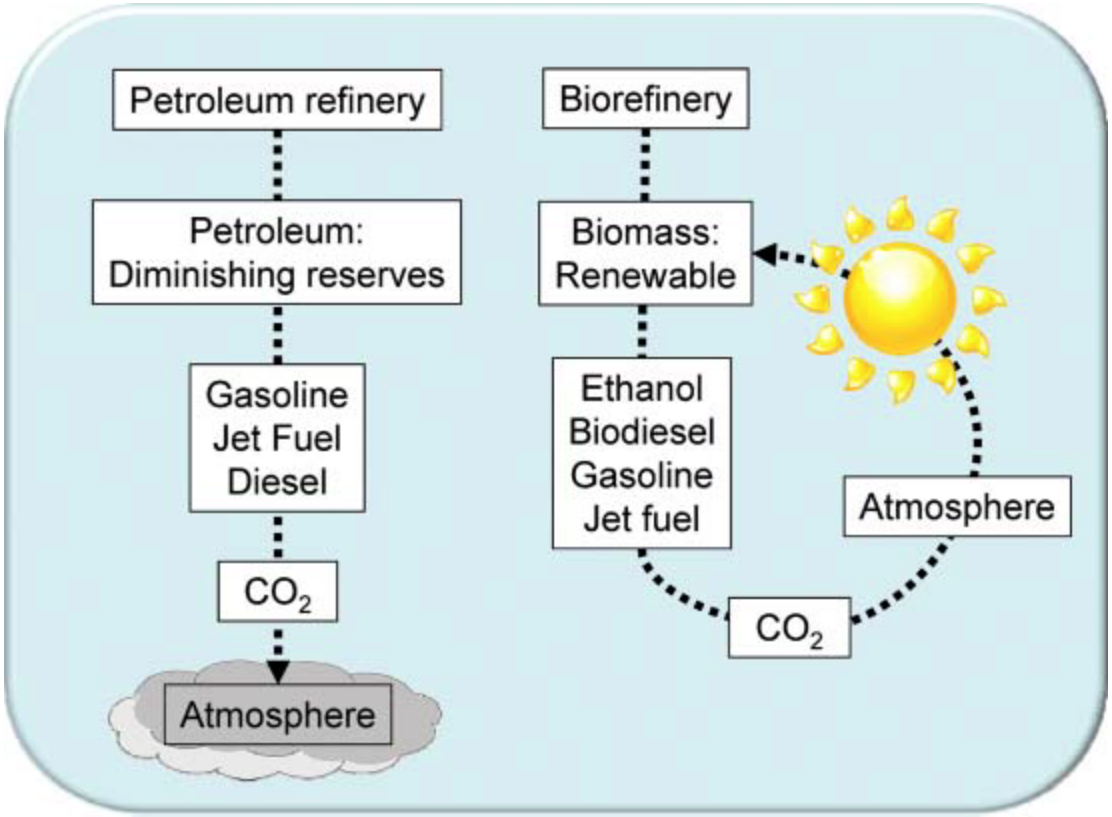
-What BioFuel/energy source?

-Where does it fit with respect to other options?

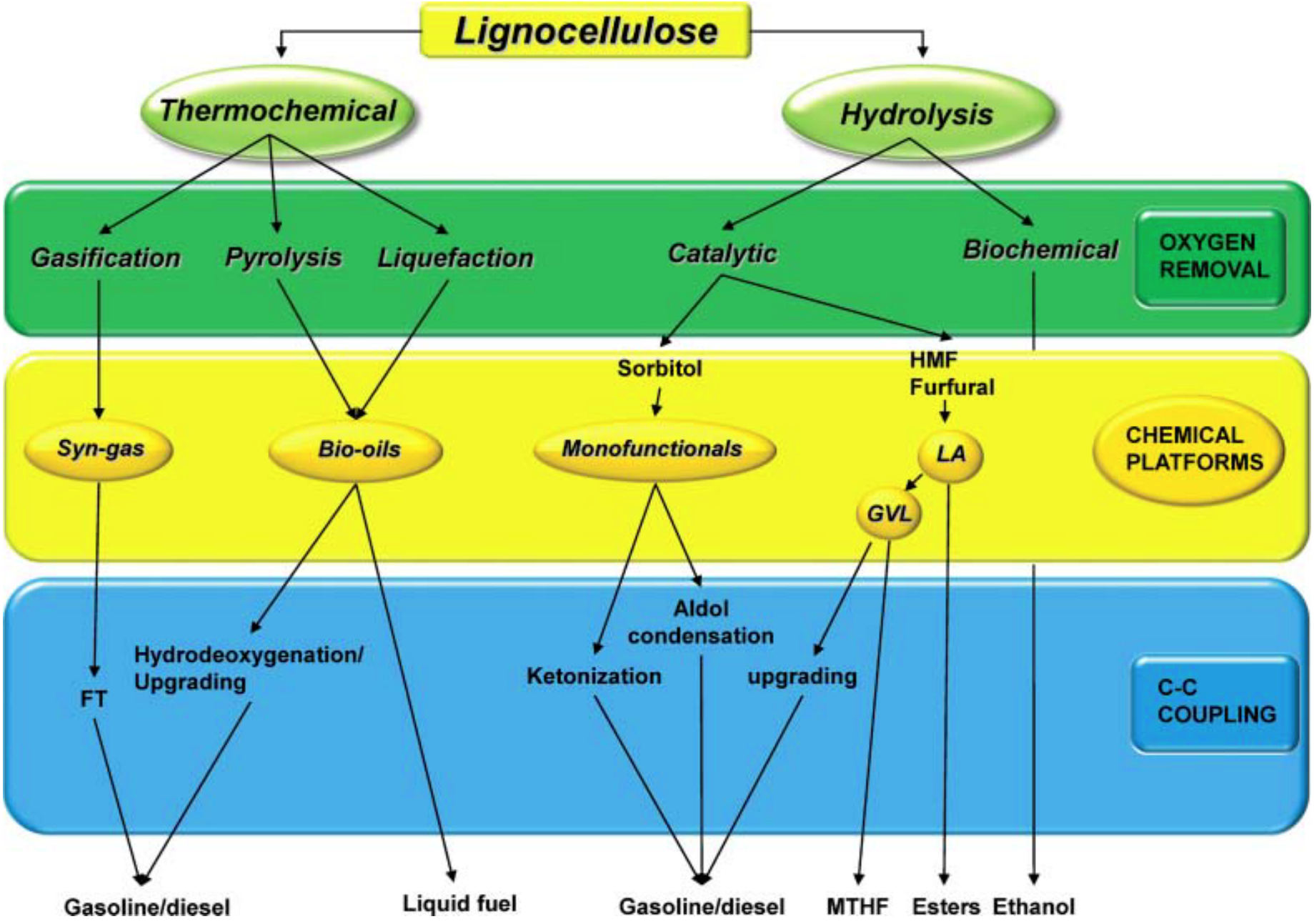
-What make it interesting?

-Show me that you have read both our assigned reading and started researching more broadly

Today's goal is to map the processes and chemicals involved with your chosen biofuel/ energy.



Green Chem., 2010, **12**, 1493–1513



Green Chem., 2010, **12**, 1493–1513

Start with broad categories

Inputs/Procedures

Waste or Output

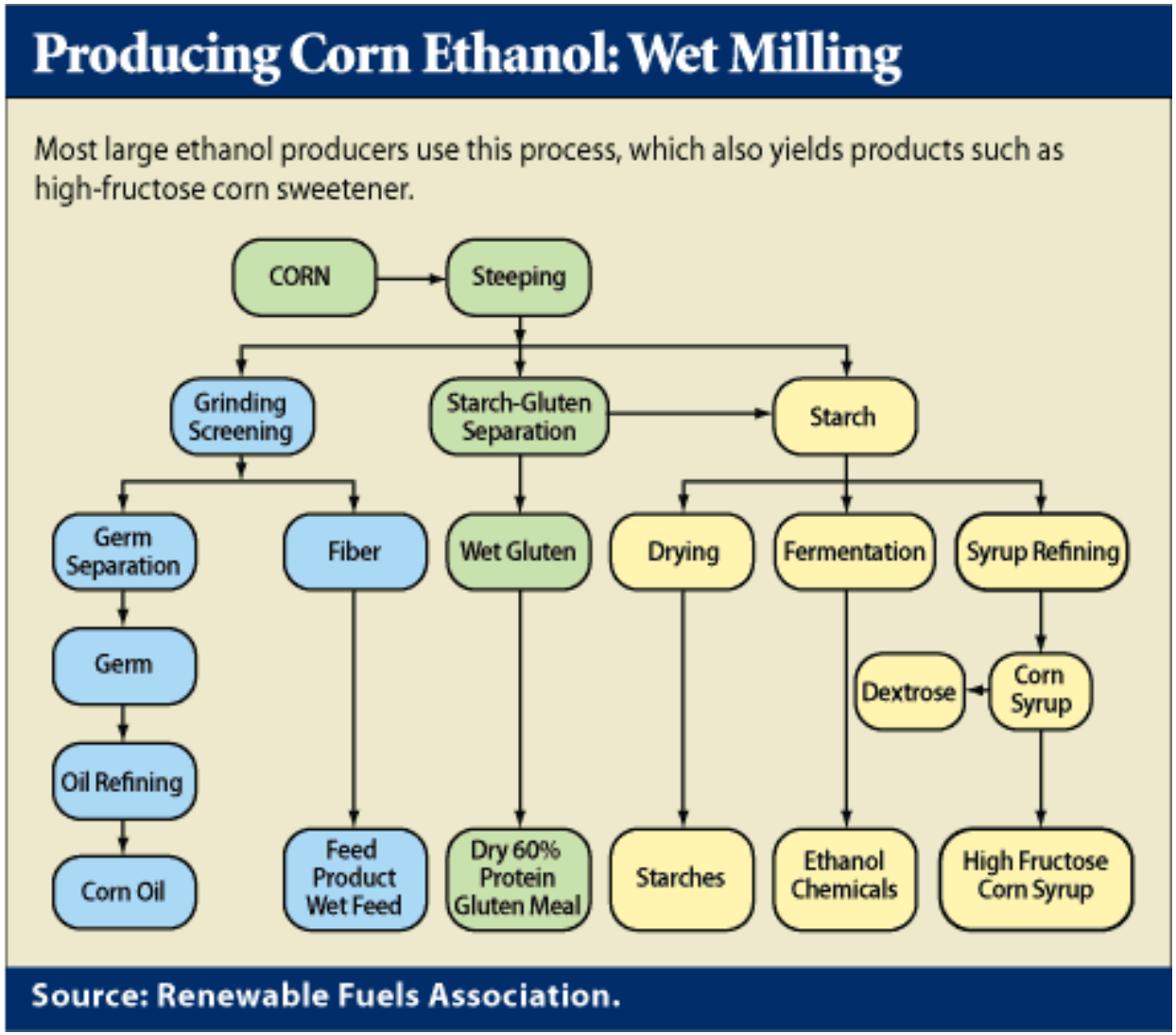
Corn Ethanol

Ten minute timer

Inputs/Procedures		Waste or Output
Fertilizer, pesticides Energy, Land, water, sunlight, CO_2	Corn	Eutrophication, run-off, CO_2,
Wet milling, Hydrolysis (acid, heat, or enzyme), Solid/Liquid separation	Pretreatment	Gypsum, Sugars, wastewater, biomass (lignocellulose, bran, etc.)
Sugar, yeast, water	Fermentation	Ethanol, Other fermentation products, Biomass (lignocellulose, yeast)
Energy	Distillation/blending	CO_2
Ethanol, E10-E85,	Use	Energy, CO_2, Upgraded chemicals (Ethylene, etc.)

Then take a closer looks at each process to characterize products and yields

Pretreatment Products



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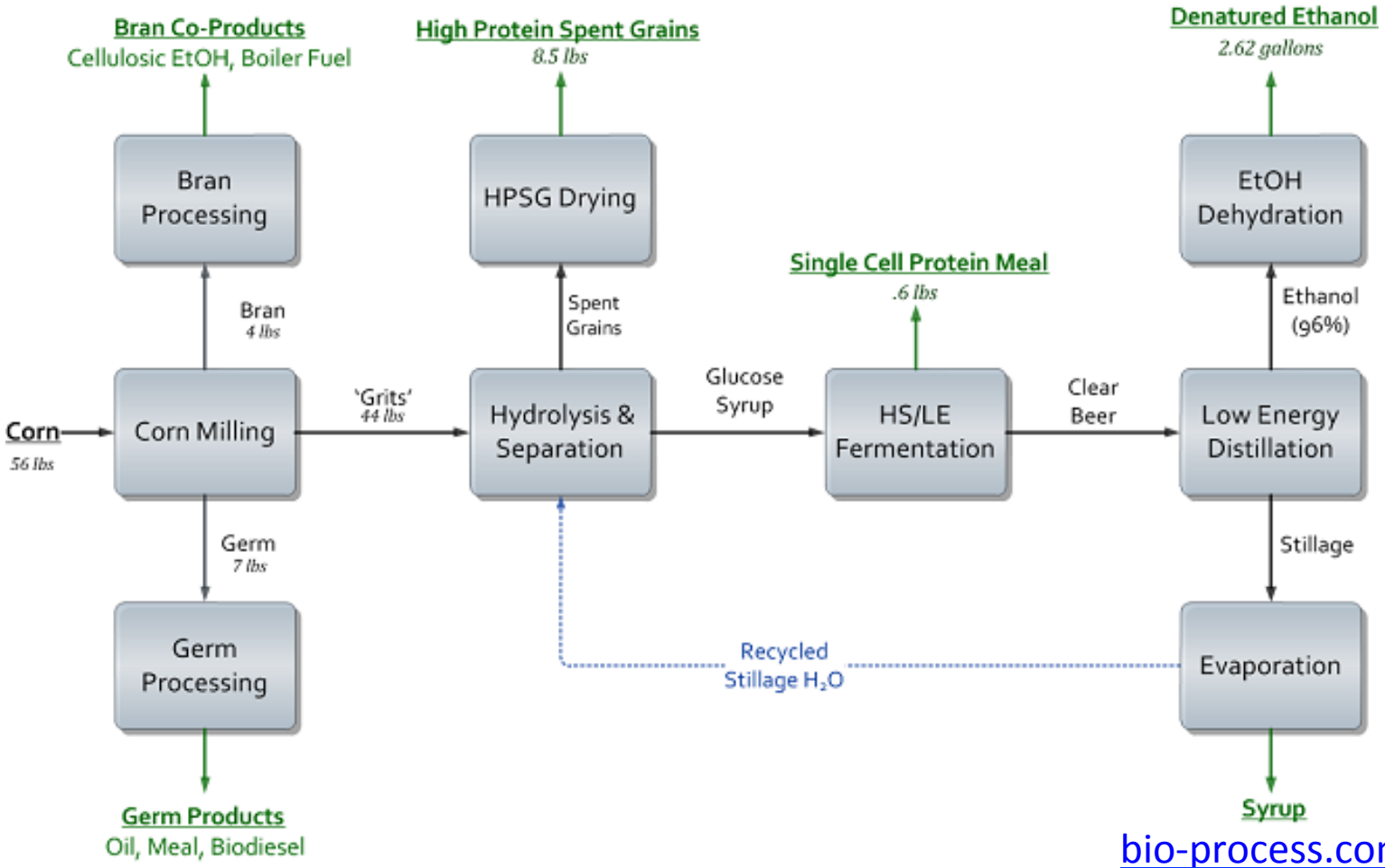
Pretreatment yields

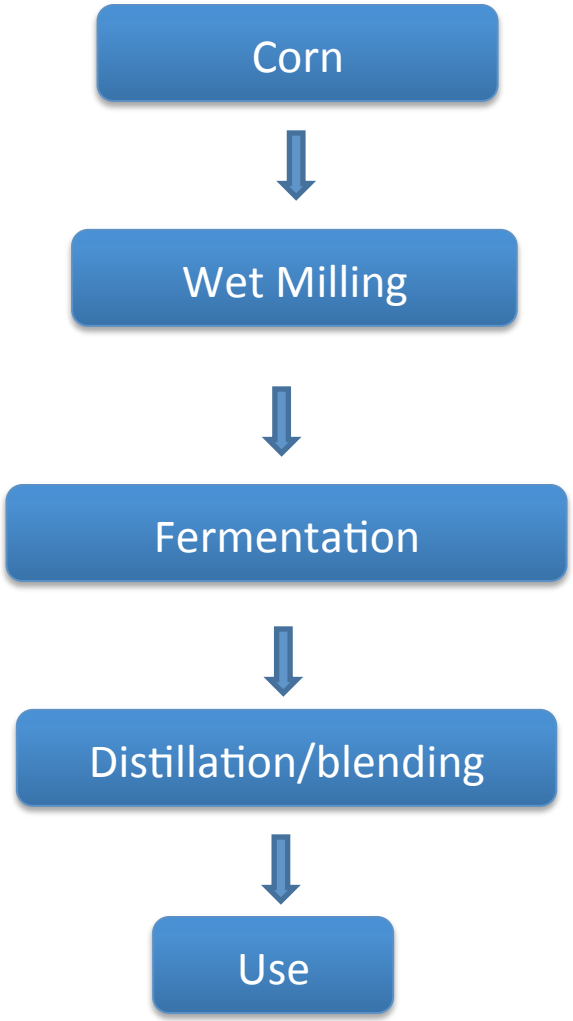


Process Products

Process yields

Note relevant chemical inputs or outputs.

15 minute timer



Pesticides/Herbicides: Atrazine, Phosphonoglycine, Ammonia nitrate and sulfate (Source: Pesticide Action Network http://www.pesticideinfo.org)

Starch, C6 sugars, biomass for other uses, protein, fiber, etc.

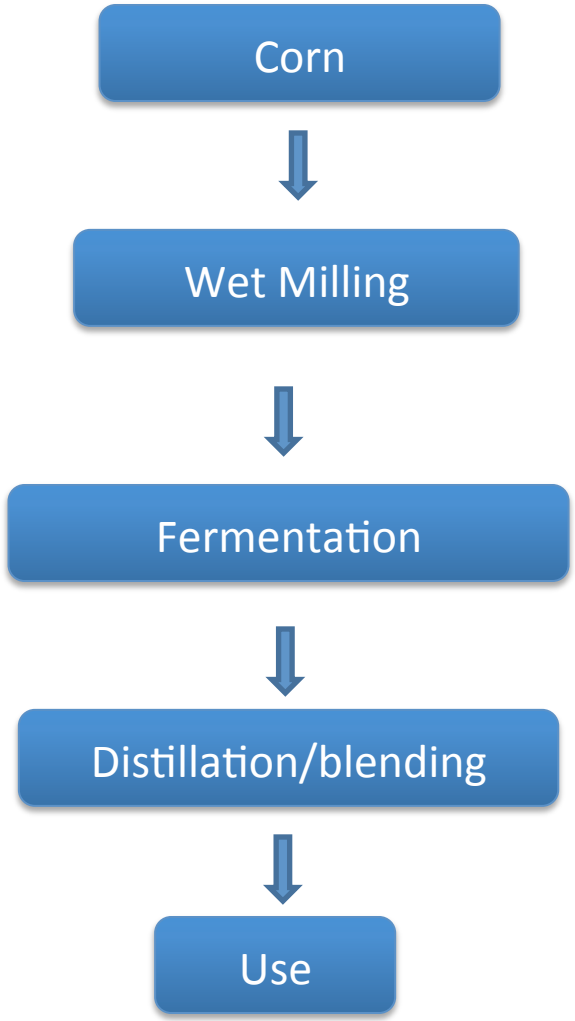
Ethanol major, minor Methanol, acetone, butyl alcohol, etc.

Purification (distillation) Heat, molecular sieves, Gasoline: Gasoline (6-14 Carbon hydrocarbons, aromatics)

Burning: Particulates, NOx, SOx, Ozone, Feedstock: Ethylene, ethylene glycol,

Finally, Summarize Key Findings

Ten minute timer



Typical corn yields are 2000, 2400 lbs/acre in the US.

Most wet milling of corn is done using heat not chemical treatment.

Co-products of Wet milling include: fiber feed, protein feed, some corn oil, as well as other sugar products.

Bushel of Corn (56 lbs.) yeilds ~ 2.5 gallons of 96% EtOH

The energy density of Ethanol is less than gasoline
1.5 L EtOH = 1 L gasoline

From a life cycle perspective there can be upto 10-20% net CO_2 reduction compared to gasoline.