Biological feedstocks
What does industry need?

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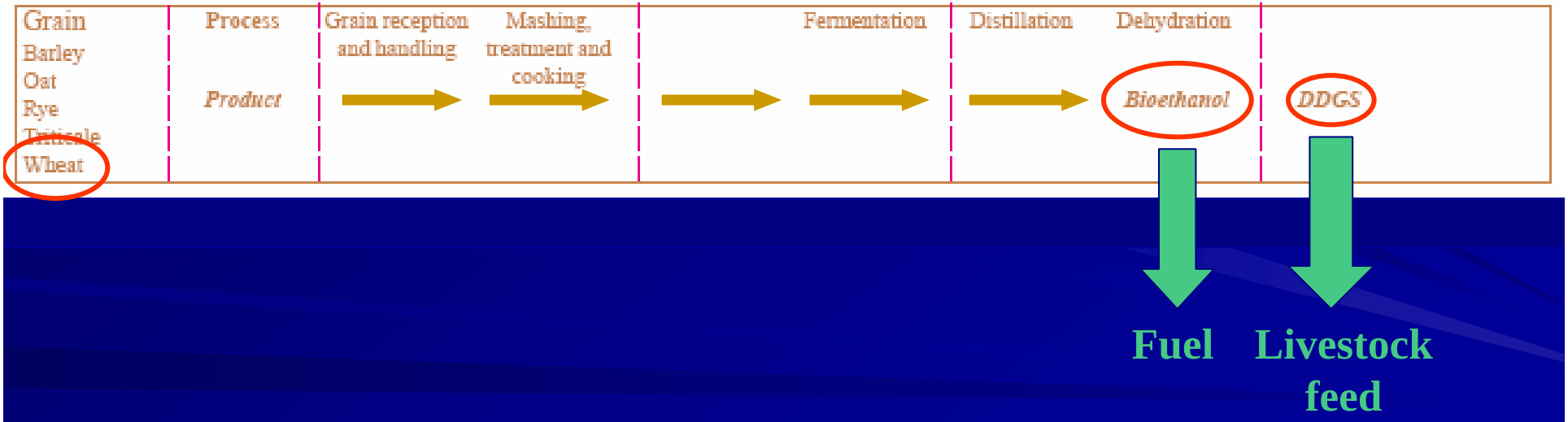
What does industry **want**?

- High yielding, high starch content wheat
- Those profiting primarily from the sale of bioethanol, and the sale DDGS as a by-product, cite these issues exclusively

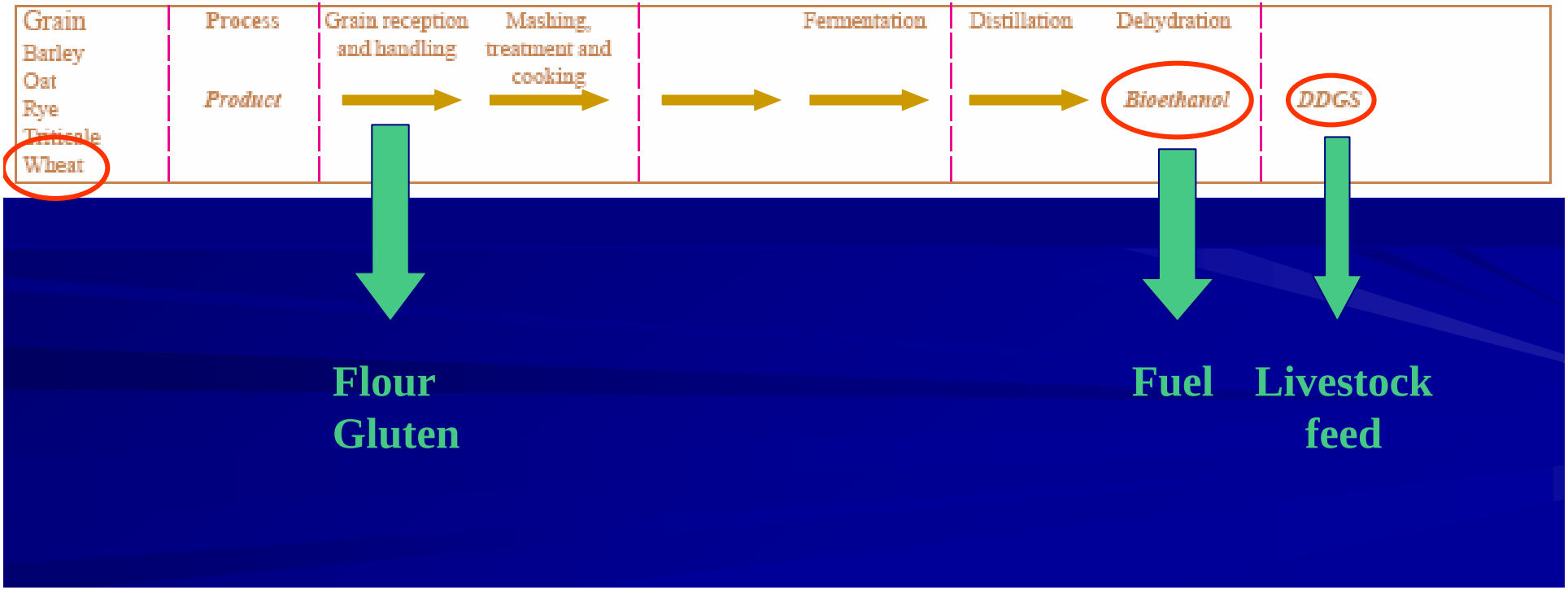
What does industry **need**?

- There has been little discussion around
  - How the industry may evolve and consolidate
  - Whether specific feedstock traits may be of value
  - Whether crops other than wheat may be more suitable as bioethanol feedstocks
  - Value-added propositions

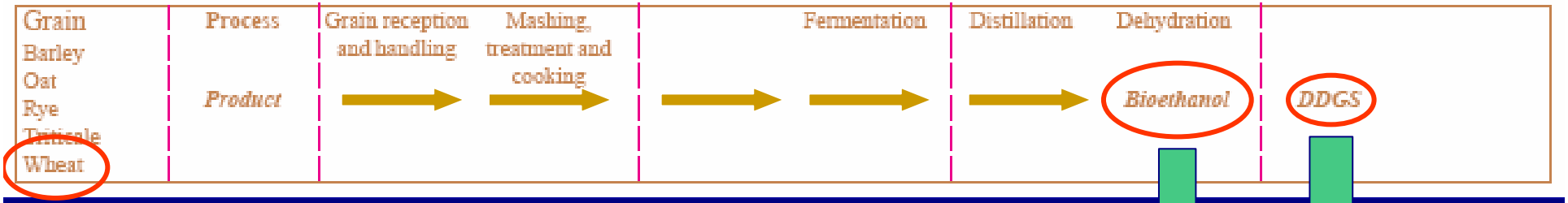
A distillers view of the value chain
The basic model



A distillers view of the value chain
The flour/gluten model



A distillers view of the value chain
The livestock model



Fertilizer

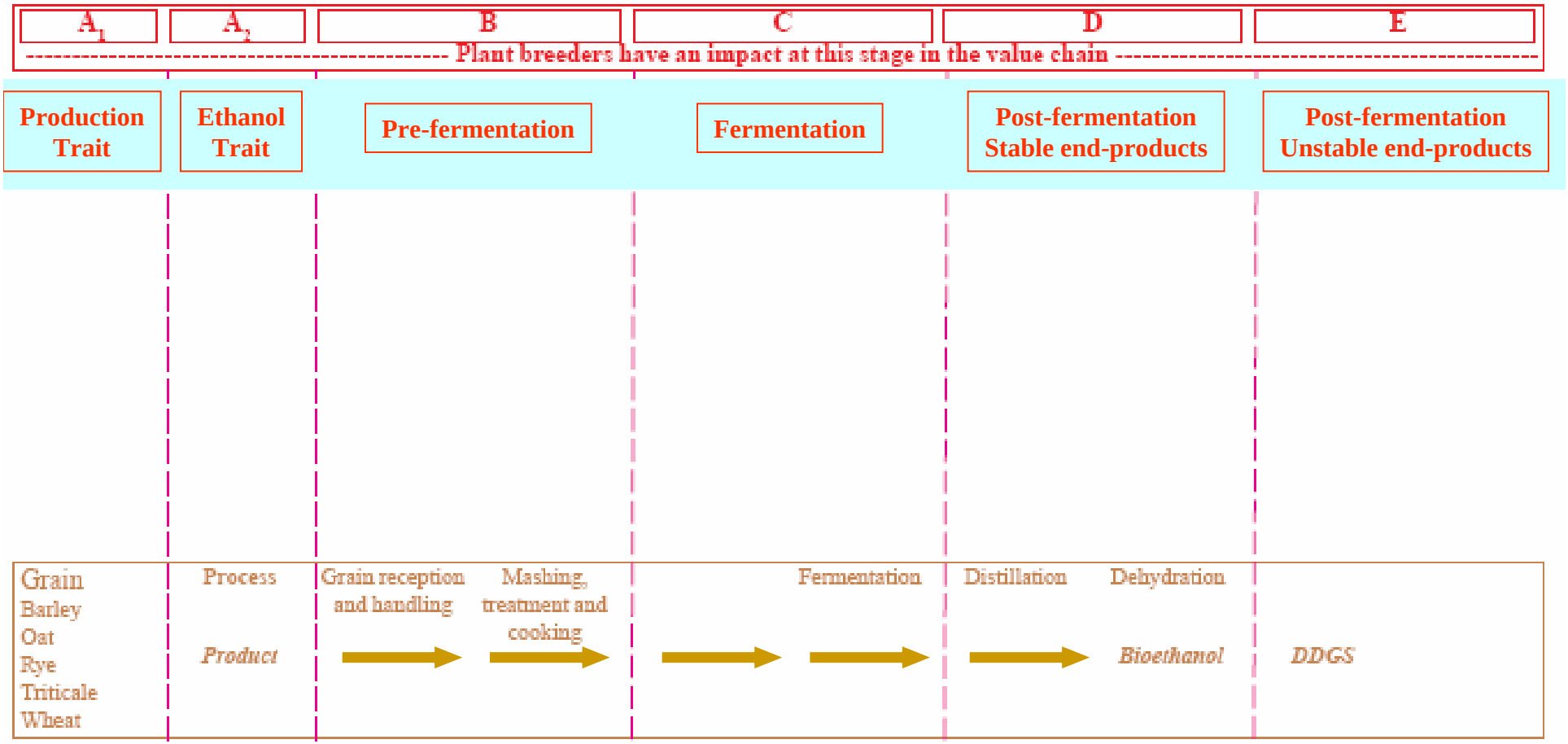
Fuel

Livestock feed

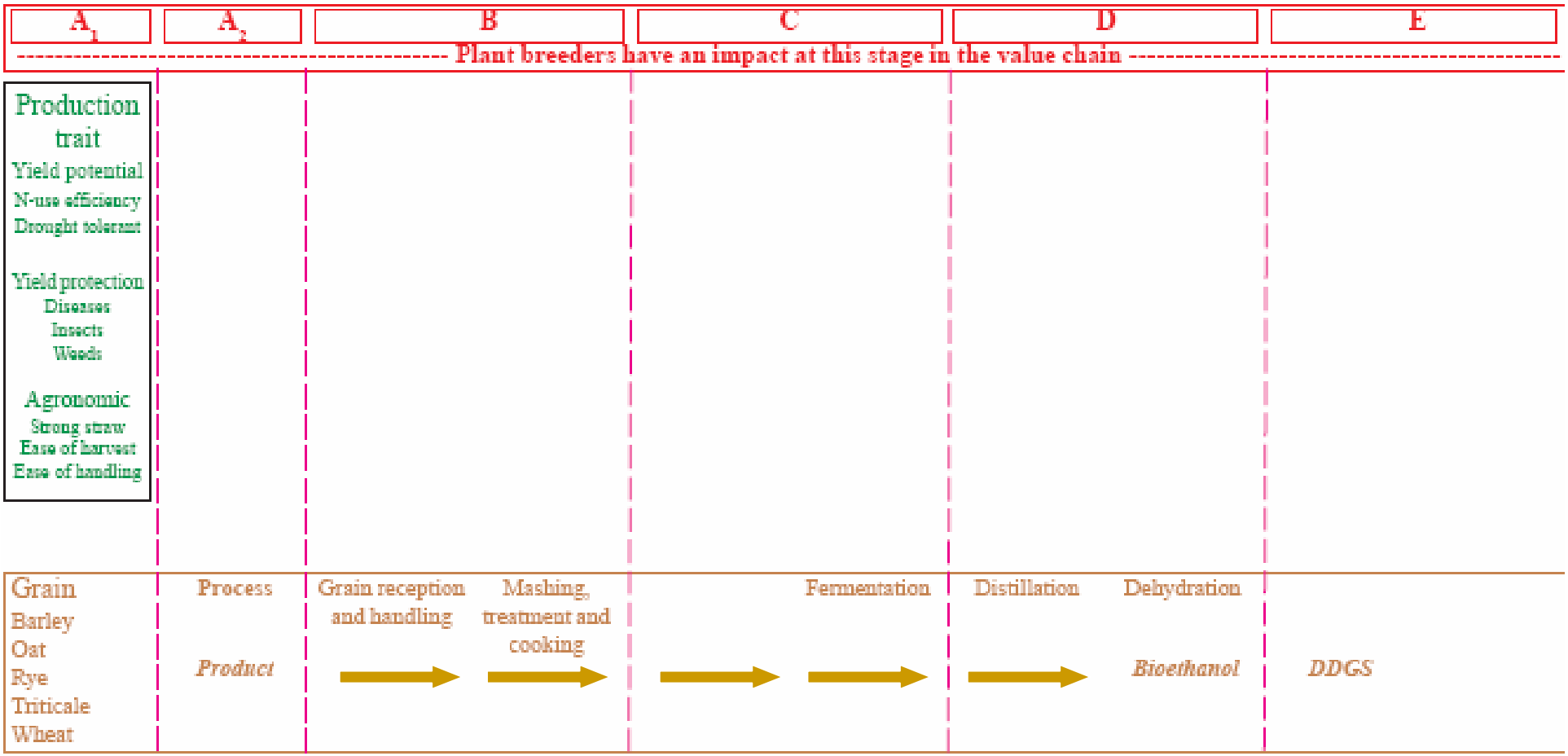
Decomposition

Manure

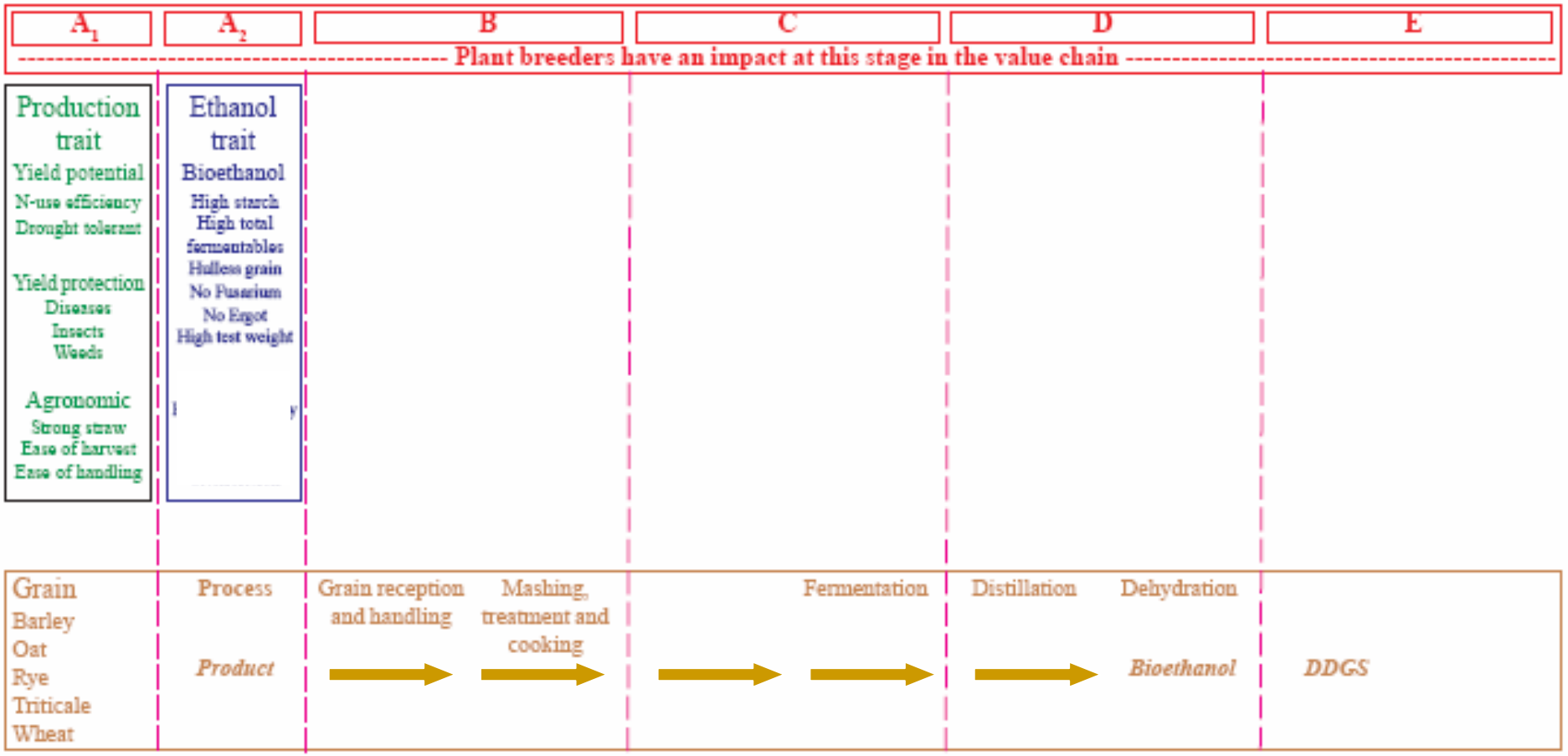
Where can plant breeders add value?



Production trait



Ethanol trait



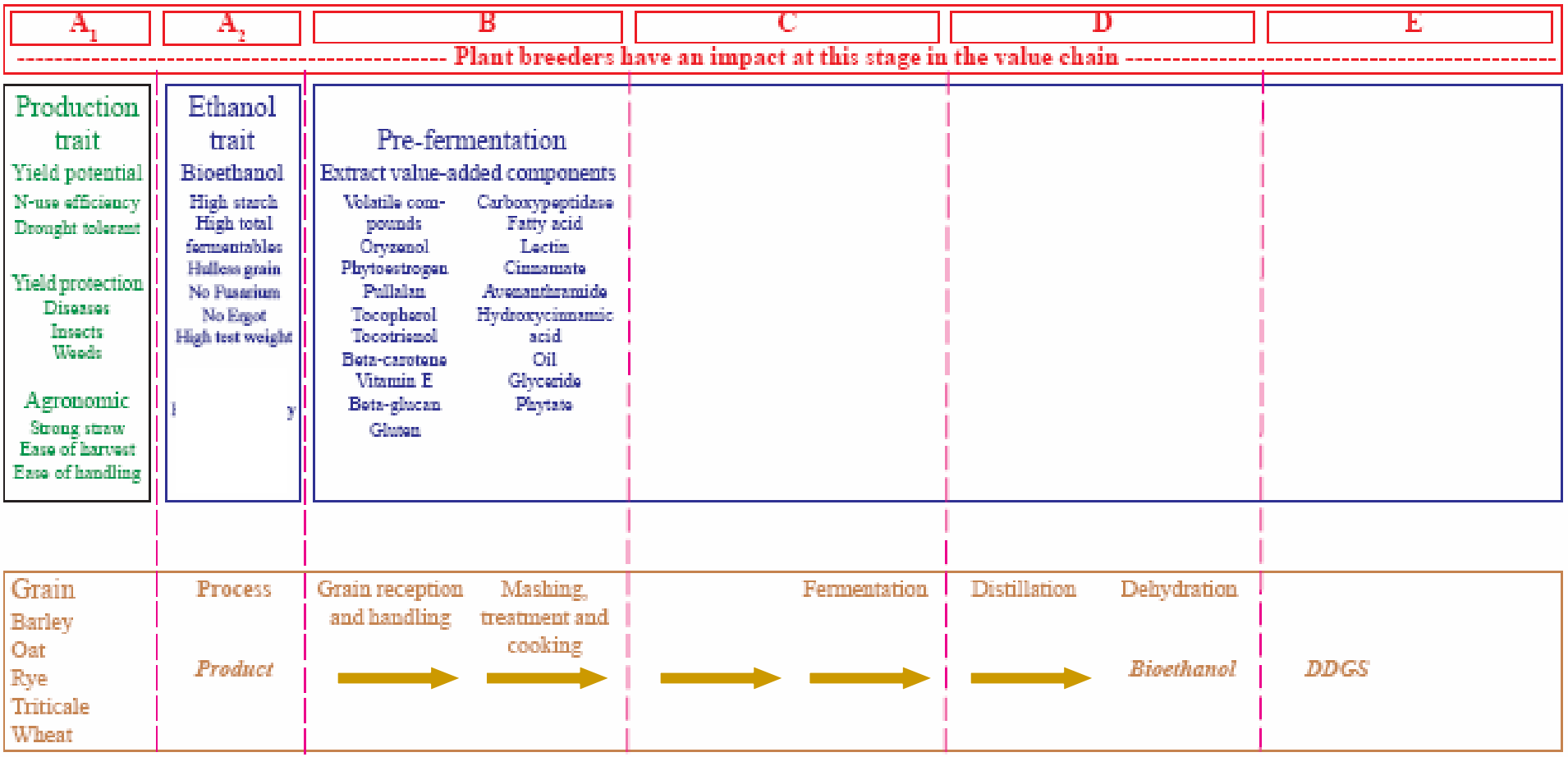
Fractionation

- For bioethanol plants that derive an income stream from a co-product, wheat fractionation may occur before fermentation and distillation, increasing the starch content of the flour
- The fractionation operation concentrates the starch and the starch content of the raw grain is less of an issue

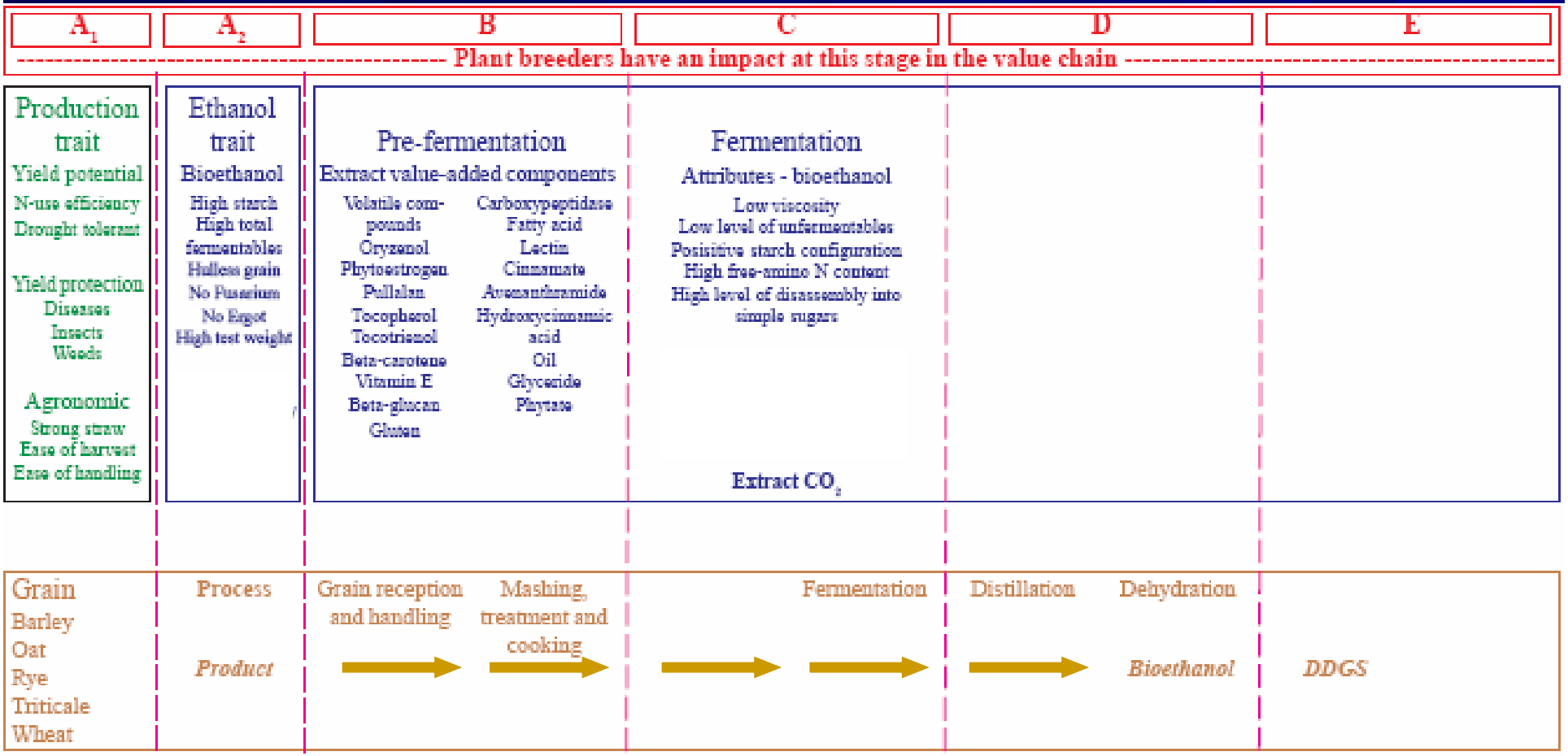
Fractionation and the value of starch content

- How much do we want to invest in raising the starch content of wheat if we could fractionate wheat before distillation?
- Pre-fermentation milling reduces the incidence of fermentation inhibitors and increases starch concentration in the feedstock
  - Increasing efficiency of ethanol production
  - Enhancing the conversion of starch to ethanol
  - Increasing ethanol yield
- Some proprietary processes can
  - Reduce the levels of fermentation inhibitors from 35 to 7 percent
  - Increase the yield of ethanol by 3 percent (corn)
- This milling system could add about $15-16M to the cost of a $130M facility
  - Terra Grain Fuels facility, Belle Plaine, SK.

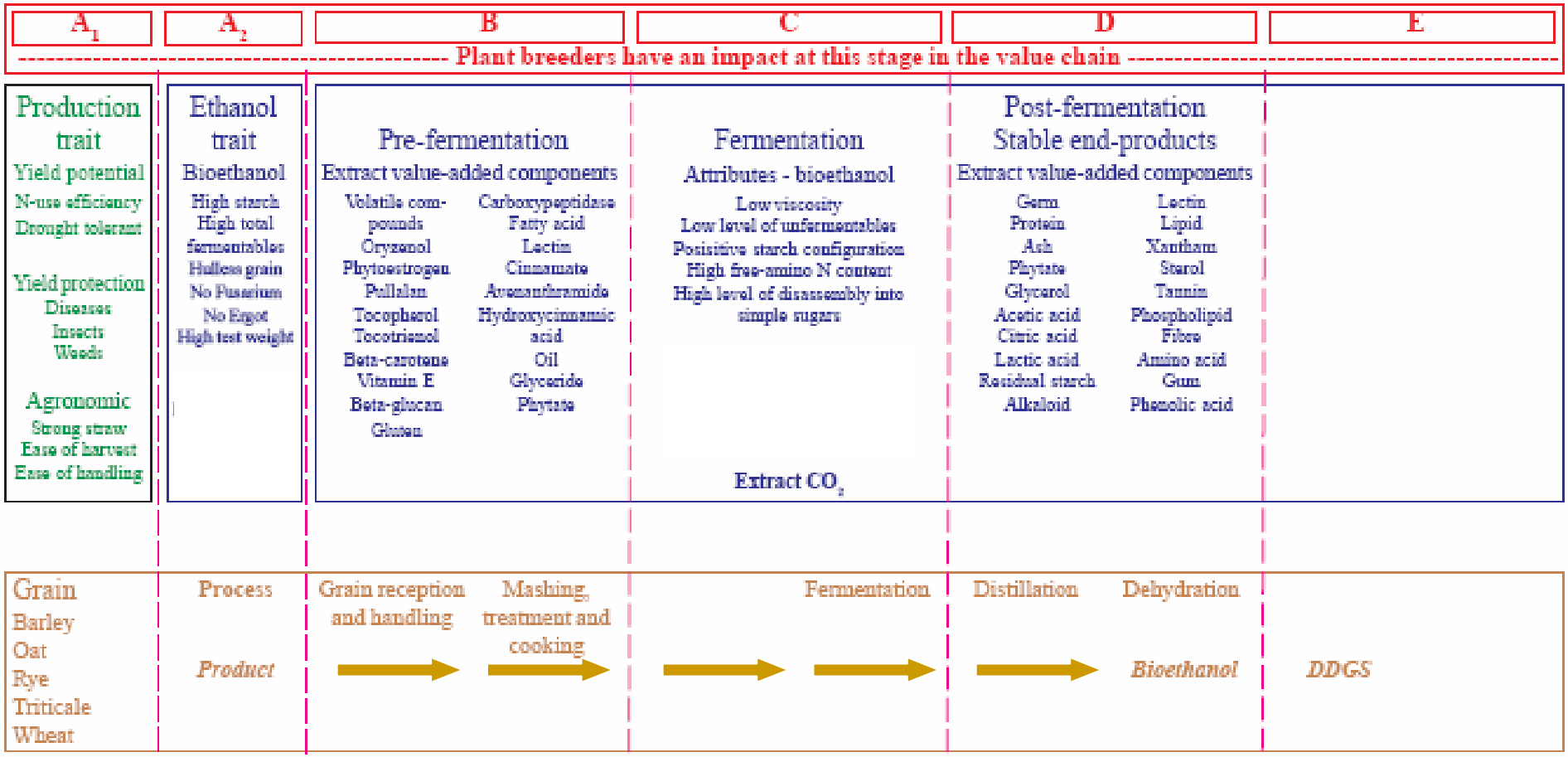
Pre-fermentation



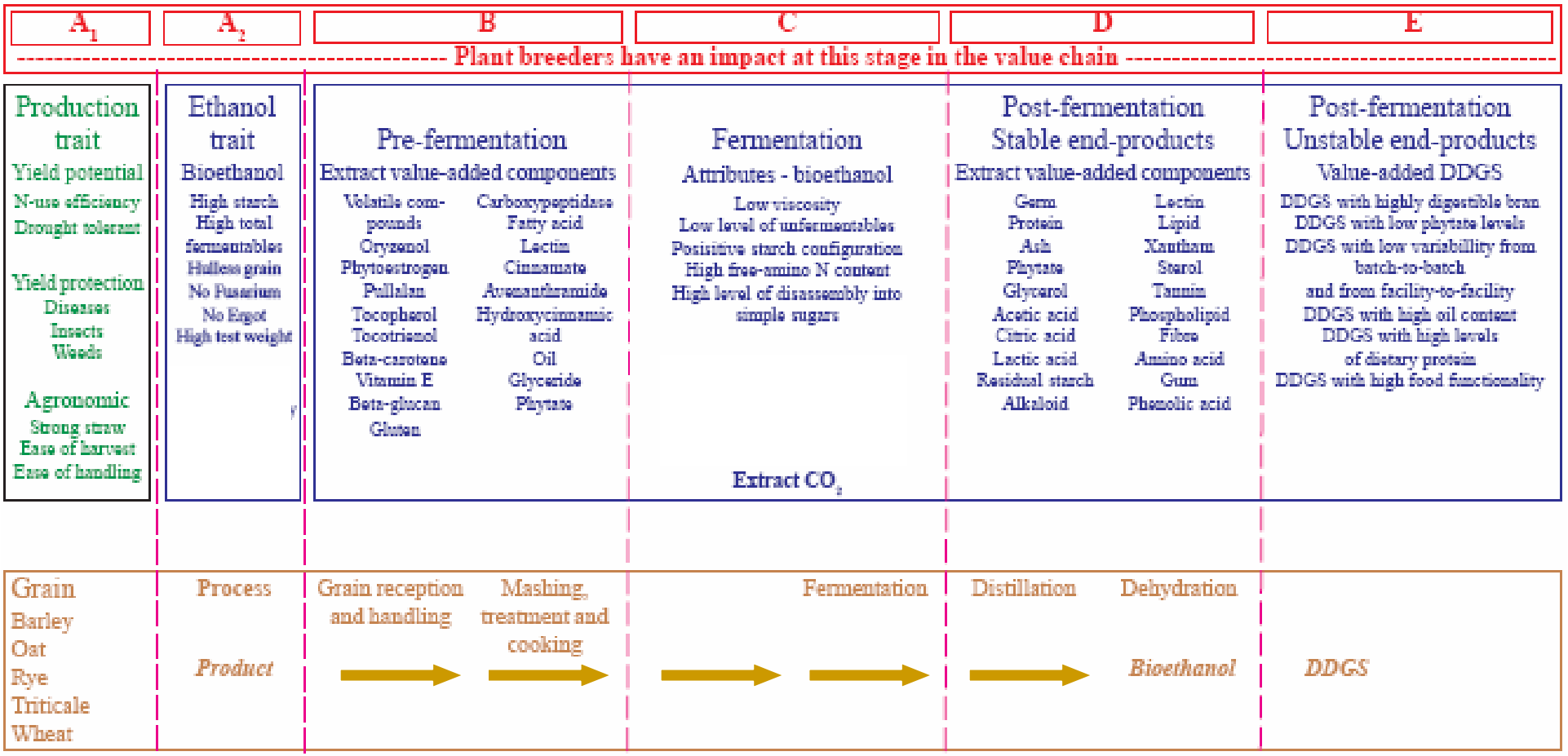
Fermentation



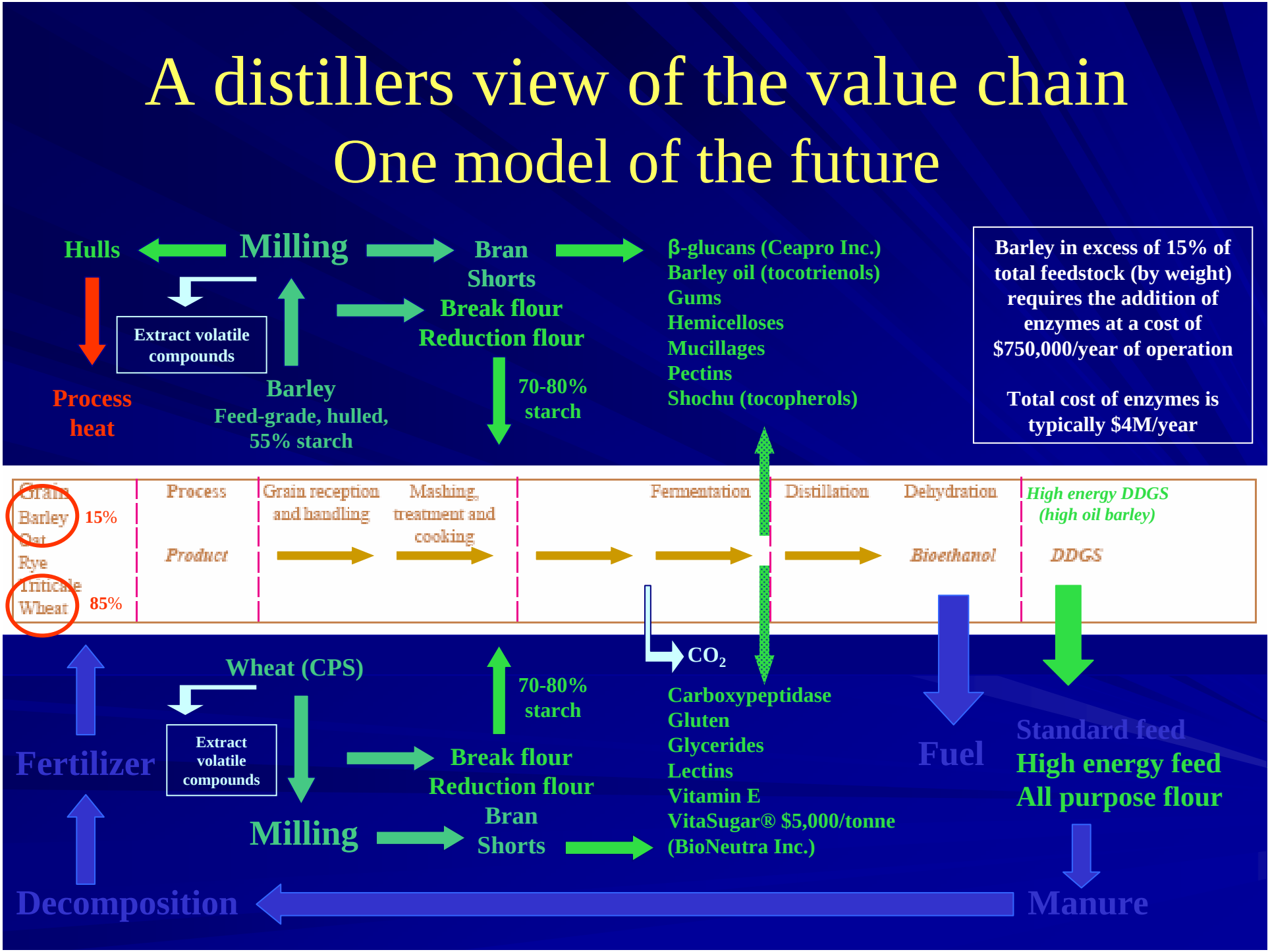
Post-fermentation
Stable end-products



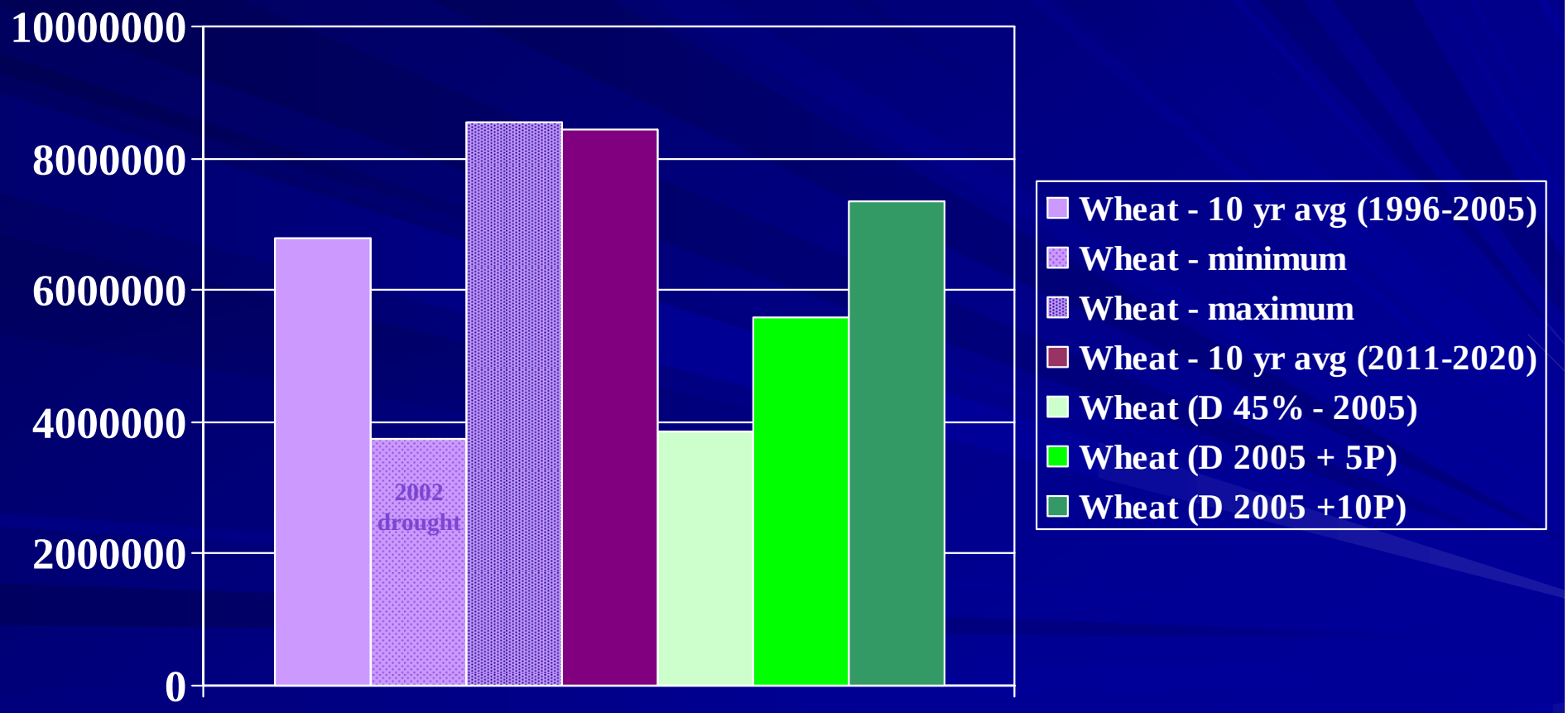
Post-fermentation Unstable end-products



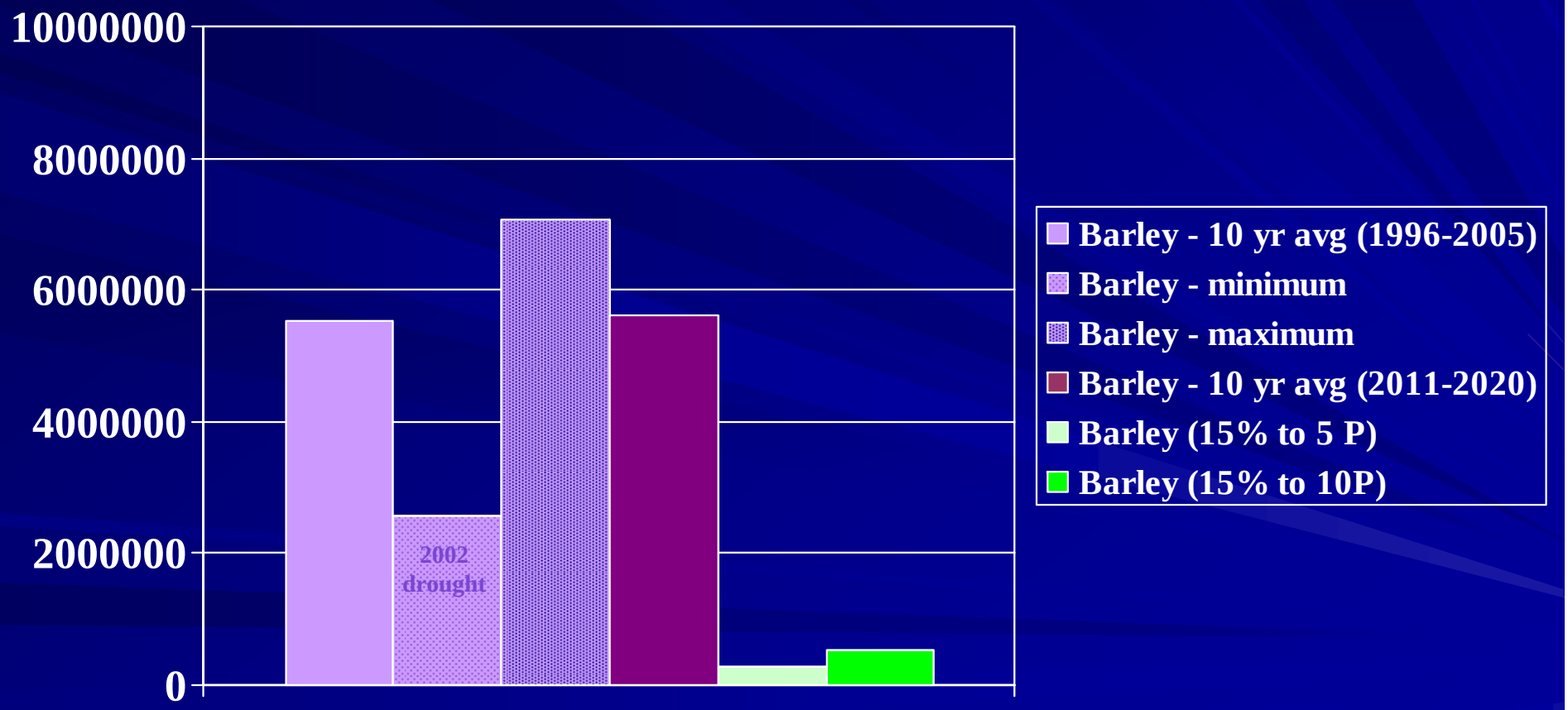
A distillers view of the value chain
One model of the future



Alberta wheat
Production and consumption (tonnes)



Alberta barley
Production and consumption (tonnes)



Alberta canola for biodiesel
Production and consumption (tonnes)