

Cellulose for Fuels



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Plant growth is really just a way of capturing the sun's energy that comes to earth and turning that energy into products. Increasing the efficiency of that system or range of products you can derive from that energy will have great value.



Cellulose for Fuels

Biomass is young
oil!



Key Issues

- 1) Starch or Cellulose?
- 2) What technologies will be used in the future?
- 3) What species to focus on?
- 4) What does the future hold?



Cellulose for Fuels

The biomass industry
is in its infancy.



Starch or Cellulose?

- Starch processing much further at this time.
- Starch is ultimately food source and cellulose can be an added value in food production (corn stalks, switchgrass).
- Cellulose gives greater breadth of environments.



Technologies?

Fermentation or Gasification?



Technologies?

Fermentation – Making sugars and then alcohols from plant material.

Strengths – Currently further developed than gasification

Weakness' – Enzyme specific

- Access to fiber

- Contamination can be a problem



Technologies?

Gasification – heating with low oxygen to make gas (instead of burning).

Strengths

- Uses little water
- Fuel flexible
- Tolerant of contamination

Weakness'

- Technologies not as advanced as fermentation

(yes, you can make liquid fuels this way)



Technologies?

Fermentation or Gasification?

- Ultimately specific uses for both, but the fuel flexibility and ability to handle contamination favors gasification.



Technologies

**Logistical issues are just as important as technologies....
harvesting, storing,
transportation, preprocessing,
time of growth, etc.**



Species

Monocultures or Polycultures (mixed)



Species

- Monocultures – Corn stalks, wheat straw, switchgrass, willows, poplars, etc.
- Multiple species (Polycultures) – Prairie, CRP, etc.
- Regionality



Monocultures

Corn and straw residues, switchgrass, willows, poplars, etc.

Strengths

- Ease of management
- Simpler systems
- biorefining

Weakness'

- Risk – Supply, system design
- Inputs



Polycultures

Mixed species – Prairie, CRP, etc.

Strengths

- Perenniality
- Water quality

Weakness'

- Logistics (gophers)
- Biorefining
- System design to meet changing fuel type



Biorefining

Biorefining – Processing materials from plants. In this instance with the end product ultimately being fuel or energy.

The ability to derive a series of higher value products and then produce fuel or energy from what remains may make choice of fermentation or gasification less critical (part of the same system).



The future?

- Clearly the industry is in its infancy and waiting on innovation.
- Potential is huge, where to aim is question.
- Biorefining makes intuitive sense.



The future?

An uninformed opinion: The bridge from here to there may very well be gasification for energy production first, followed by value added front end processing. The gasification plants existence will reduce the front end capital requirement for the value added part until the risk is acceptable.



Summary

It is important to remember that renewable energy is not one thing; it is not just ethanol or just wind or hydrogen and renewable energy is not a one size fits all system. For renewable energy to really command a major part of our nation's energy portfolio, integrated, renewable energy systems that are viable far into the future must be developed. It is about systems that use different technologies to meet different needs and goals.

