OriginOil®

Solving the Food vs. Fuel Issue

WRA Biofuels 2011 Conference, 6th Annual Meeting

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A BREAKTHROUGH TECHNOLOGY TO EXTRACT OIL FROM ALGAE

This Wasn't Supposed to Happen

- This year, Brazil will *import* 1B liters of ethanol. (Unica)
- Why?
  - Brazil ethanol production down 19% year-on-year
  - Mills chose to produce sugar rather than ethanol due to 30-year record high world sugar prices
  - Demand for sugar in growing economies, weather issues in other sugar growing regions
- Given continued demand for both fuel and food, is this seesaw likely to stop?

Biofuels on a Collision Course with Food

- China's meat consumption since 1995-2007 increased by 112% to 53 kilograms per person per year (25 kilograms in 1995). (Meat vs Fuel: Grain use in the U.S. and China, 1995-2008)
  - Led to increase in livestock grain demand by 200 million tonnes.
- Chinese still 45 percent less than avg. in U.S – If they reach parity with US meat consumption, would require:
  - Additional 250 million tonnes of grain = 60 million acres = 250,000 km2 = 20% of earth's existing arable land.
- Production of one liter of ethanol in regions not using natural rainfall can be water intensive:
  - Irrigated sugarcane in India – requires 3,500 liters of irrigation water
  - Irrigated corn in China – 2,400 liters of irrigation water

Heavy Fertilizer Use in 1st Gen Fuels

- Biofuels production exacerbating nitrogen releases into air and rivers
- U.S. Energy Independence and Security Act of 2007: 54 billion liters (14.3 billion gallons) of ethanol from corn by 2022.
- Meeting that goal could increase the nitrogen flux in the Mississippi by 37 percent. (Corn is especially wasteful of nitrogen.)
- CO2 savings wiped out by higher emissions of nitrous oxide (300x the greenhouse effect of CO2).
- Nitrogen oxide also destroys “good” ozone and fuels production of ground level ozone.

  (Scientific American: Nitrogen Fertilizer: Agricultural Breakthrough--And Environmental Bane)

Second Generation Feedstocks?

- Global biomass potential quite large, could possibly between 30 EJ and 1 500 EJ in 2050, which is between 10% and 300% of current global energy consumption. However:
- Cultivated Energy Crops May Have Limits
  - A high share of land is already cultivated.
  - Steadily increasing population of some countries (e.g. India and Thailand).

  (Sustainable Production of Second-Generation Biofuels – OECD/IEA 2010)
- Can still compete with food production!
  - Low yields on such crops may lead to irrigation and added fertilizer
  - "…if you use marginal land [for jatropha] you'll get marginal yields" (Sun Biofuels)
  - Philippine government has now abandoned jatropha for algae and other advanced fuels. "We want [fuels] that will not compete with food." (Malaya Business Insight, 7 October 2011)

An Unsustainable Competition

- Biofuels from cropland compete with food for…
  - Arable land
  - Fresh water
  - Fertilizers
  - Public acceptance
- In this zero-sum game, there can be only one winner.
- **Conclusion: Food will always win, since biofuels can be replaced by fossil fuels.**

What Doesn't Compete with Food?

- Waste To Energy (WTE)
- Waste from food crops (corn stover, bagasse, forestry waste)
- Can be purchased at its opportunity costs, can form a low-cost feedstock.
- Some Issues:
  - Residues may already be used by rural populations & different industries
  - Possible environmental impact on soil nutrients, carbon & water resources.
  - Large gap to fill: freeing up 10% of global agricultural and forestry residues for second generation biofuel production would amount to just 5% of transport fuels
    (Sustainable Production of Second-Generation Biofuels – OECD/IEA 2010)
- **Conclusion: biofuels from waste can be sustainable, but caloric efficiency can be low, there are still competition issues, and there is a limit to all waste.**

Are Advanced Fuels a Panacea?

- Advanced fuels like algae do not require fresh water, can reclaim fertilizers, and can be grown on any surface including lakes, lagoons and the ocean.
- When the entire biomass is converted to fuel, algae has a high caloric value (presence of lipids, absence of lignin).
- However, scale-up of algae is only now beginning and will take several years.
- Additionally, there may not always be geographical space or adequate insolation for large algae plantations.
- **Conclusion: By themselves, advanced fuels are not yet a viable solution.**

A Potential Solution

- The solution is to pursue a feedstock diversification strategy now:

1. To change the biofuels balance away from food competitors toward a balance of waste biomass and advanced biofuels.
2. To mitigate issues with food crops and eventually replace them.

Examples

1. Cellulosic Waste and Algae
   - Plentiful supplies of forestry waste could be available in a specific region.
   - Combine with high-calorie feedstocks like algae.
   - Result: a balanced and sustainable multi-feedstock refining operation.
2. Ethanol Diversification Using Algae
   - Use of algae to reduce carbon footprint at ethanol plants and to use it as a secondary ethanol feedstock.
   - Eventually, algae can replace wheat and corn as a primary feedstock (see Manildra's algae demonstration announcement.)

DOE: Blendable Multi Feedstocks

- On August 23rd and 24th, Department of Energy (DOE) held a Biomass Preconversion and Densification Workshop at the Idaho National Laboratory (INL).
- Goal to develop feedstock standards and specifications for different formats of bio-energy materials.
- Collaboration to include adding energy content to other feedstocks such as woody and herbaceous materials using algae.
- Combined chemical and energy value of the whole formatted feedstock will be greater than the sum of individual parts.

Conclusions

- There are major security issues for biofuels created from cropland.
- The issues are greater for food crops, but also exist with non-food crops.
- Fuels from waste can be sustainable, but will always have an upward limit.
- Non-cropland feedstocks such as algae are not (yet) a panacea.
- The solution is to start NOW with a feedstock diversification strategy:
  1. Combine advanced fuels with waste based fuels.
  2. Use advanced fuels to mitigate issues with food based fuels and eventually wean away from them.
- We should support feedstock diversification strategies such as the DOE's program.

THANK YOU!

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QUESTIONS?