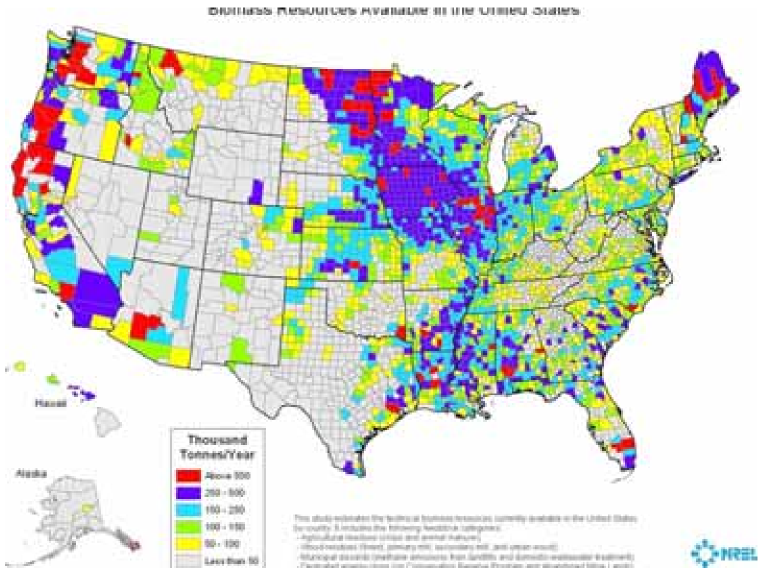
US Policies for Biofuels



Sustainability criteria for biofuels and bio-energy

29 - 30 January 2009
Brussels, Belgium

Richard Nelson
Kansas State University
rnelson@ksu.edu

K-STATE

John Sheehan
SheehanBoyce, LLC
jsheehan303@me.com

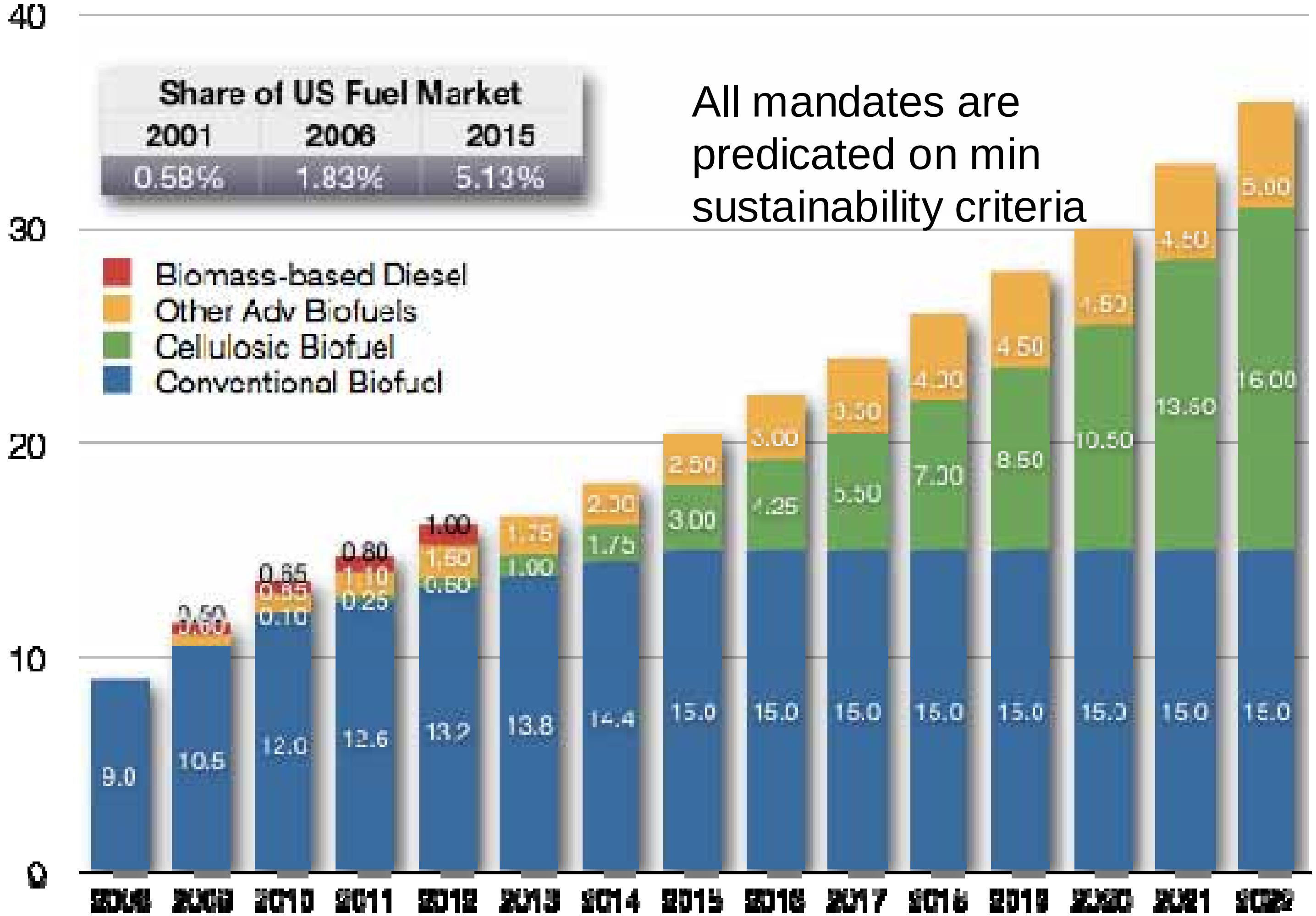
SheehanBoyce, LLC

Today's Presentation

- US Biofuels Policy
  - — US Energy Independence and Security Act
    - Mandates and Sustainability Criteria

- Accounting for Indirect Land Use Change
  - — State of the Art
  - — Controversies and Concerns

Biofuels Mandates in the US



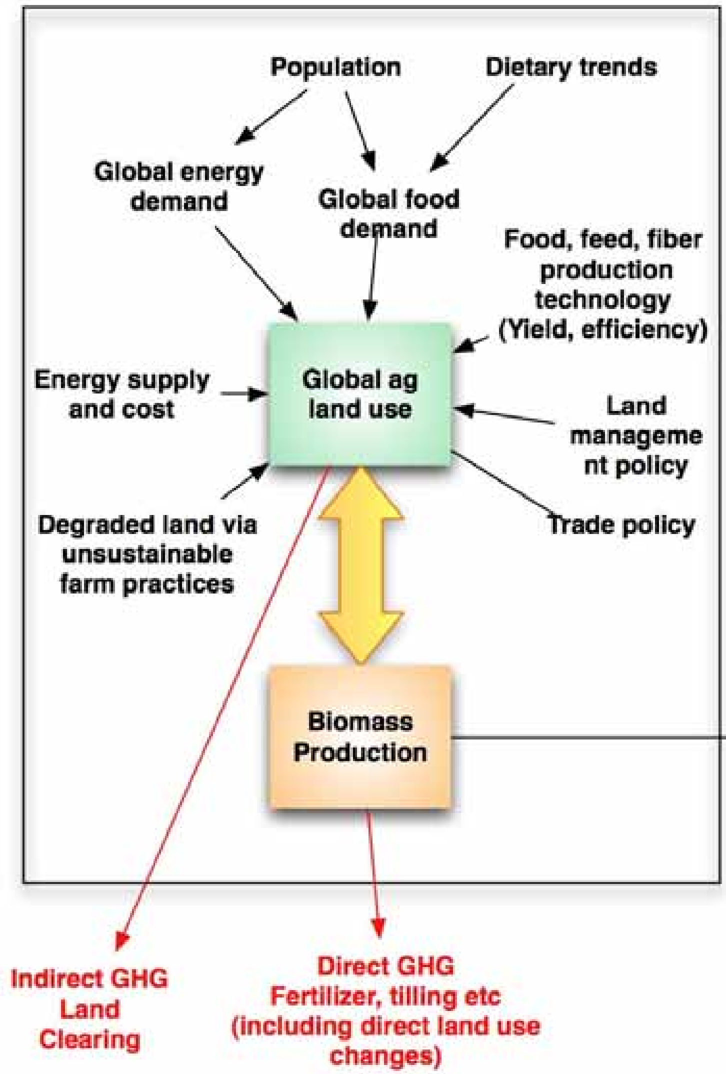
SheehanBoyce, LLC

EISA sustainability criteria

Fuel Type	Sustainability Criterion
Conventional Biofuel Ethanol from Corn Starch	20% lifecycle greenhouse gas emission reduction
Advanced Biofuels Anything but corn ethanol, including the following subcategories	50% lifecycle greenhouse gas emission reduction
Bio-based Diesel A Biomass based diesel fuel substitute	50% lifecycle greenhouse gas emission reduction
Cellulosic Biofuels Renewable fuel produced from cellulose, hemicellulose, or lignin	60% lifecycle greenhouse gas emission reduction

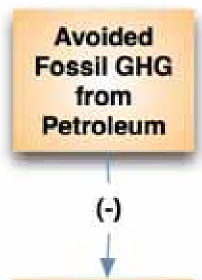
"The term 'lifecycle greenhouse gas emissions' means the aggregate quantity of greenhouse gas emissions (including direct emissions and significant indirect emissions such as significant emissions from land use changes…."

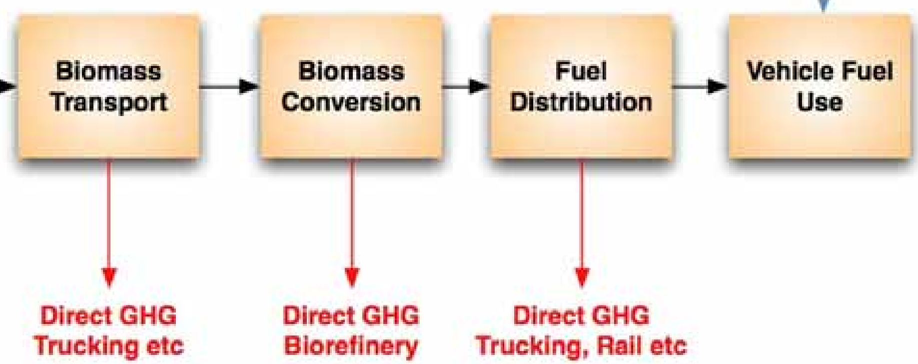
Land Use Change (LUC)



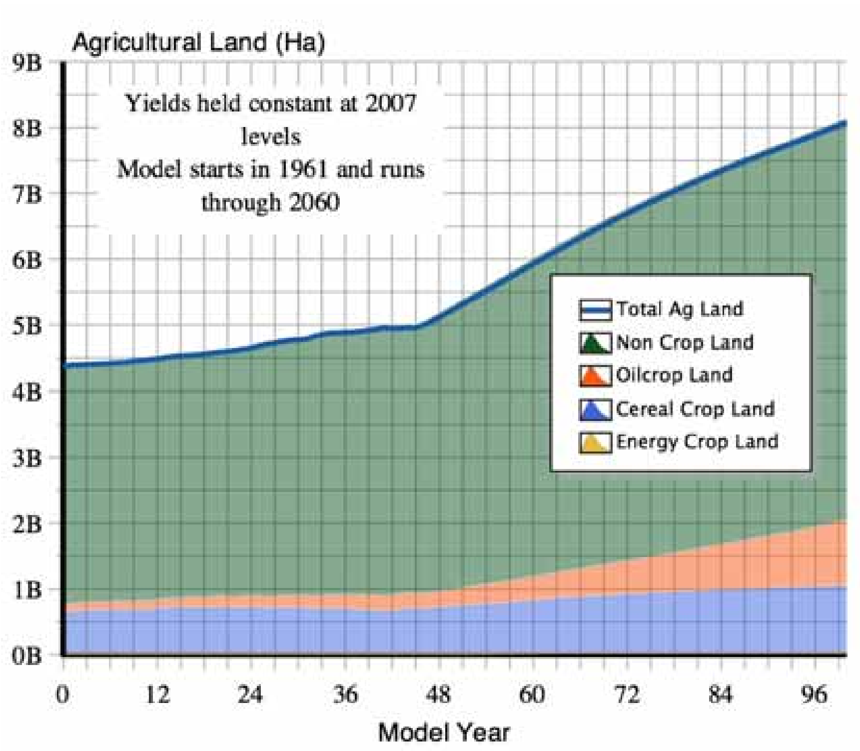
The 1,000 lb (454 kg) gorilla in the room that must be dealt with is indirect land use change.

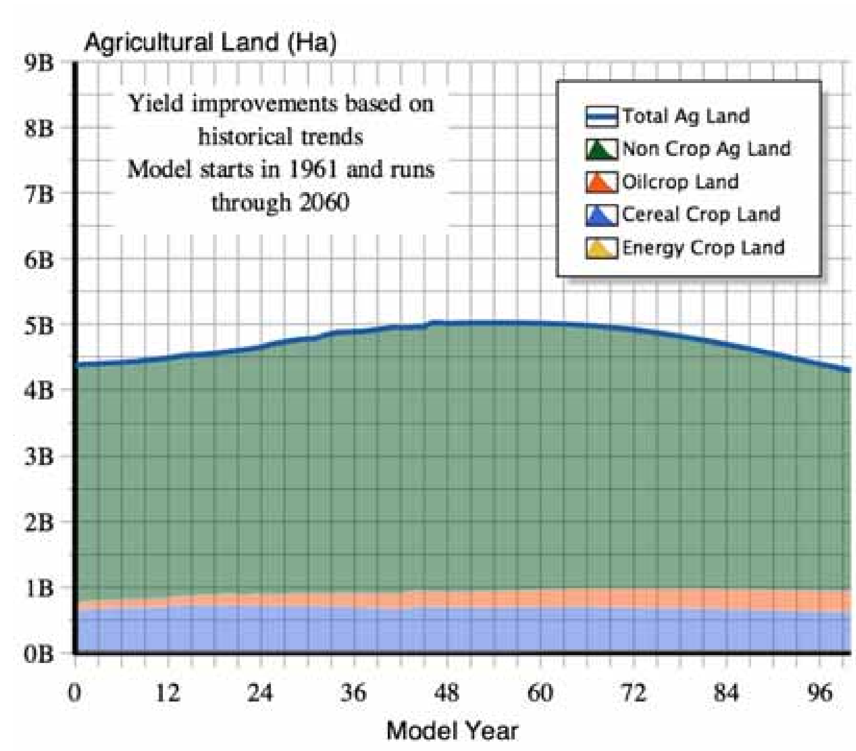
Political and ethical question: should the biofuels lifecycle be burdened with land use changes that are affected by many problems outside the industry's control?





Land surplus or land constraint?





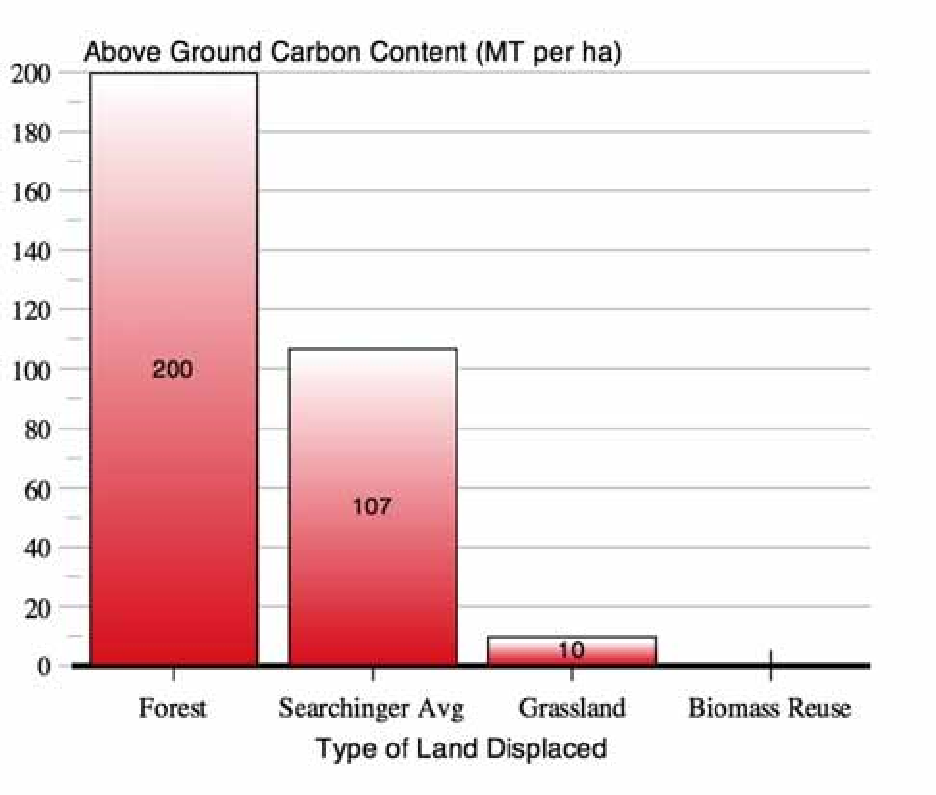
Results of a system dynamics model of global ag land demand. [1] Projections of yield improvement and per capita demand based on historical trends point to a possible decrease in global agricultural land demand. In a future with no further yield improvements, land demand rises rapidly. Why is that important?...

[1]Sheehan (2008) Draft report to NRDC

K-STATE

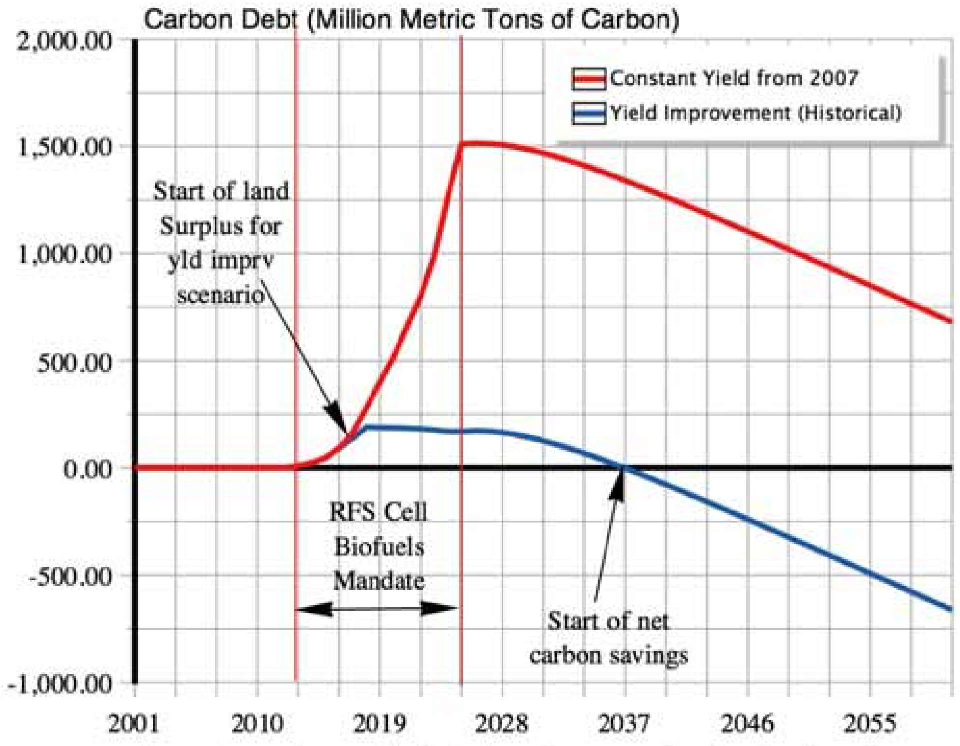
SheehanBoyce, LLC

The carbon debt of land clearing



Depending on the type of land cleared, the above ground carbon release can be substantial. This is the source of the large carbon debts reported by Searchinger et al.

The carbon debt of land clearing



Assumptions: Average land clearing above ground carbon loss based on Searchinger estimate. Bioethanol yield is 90 gallons per US ton. Biomass crop yield is 5 US tons per acre. Carbon debt is calculated as the difference in emissions of carbon from agriculture with and without the cellulosic biofuels RFS

In a future in which agricultural land demand is on the rise, any new demand for biofuels production will add to land clearing pressure. In the yield improvement scenario, carbon debt slows as soon as demand for land drops below available supply

K-STATE

SheehanBoyce, LLC

Resource Assessment & Supply

- Resource Assessment guides:

  1) energy-profit ratio,
  2) environmental quality, and
  3) most definitely, economics (supply = quantity at cost);

- All "land" is not the same, even within sub-classes

  — What are the appropriate land and soil bases and what might be expected yields (Mg/ha)?

  — What are the "driving" forces for sustainable or unsustainable production (climatic and water) and what is their affect on these land bases?

Land Use – South Central Kansas

Reno County, Kansas

	Acres
Open water	15,179
Developed, Open Space	37,580
Developed, Low Intensity	11,938
Developed, Medium Intensity	2,270
Developed, High Intensity	1,111
Barren Land	125
Deciduous Forest	19,712
Evergreen Forest	12
Mixed Forest	1
Scrub/Shrub	175
Grassland/Herbaceous	299,959
Pasture/Hay	2,662
Cultivated Crops	415,871
Woody Wetlands	5,656
Emergent Herbaceous Wetlan	836

# of Acres by Land Capability Class (LCC)

1	2	3	4	5	6	7	8

Increasing "Degradation"

What is the "environmental holding capacity" of these lands for biofuel purposes at each LCC?

Same for renewable energy output

K-STATE

SheehanBoyce, LLC

Conclusions

- Yield improvements will be extremely important
- Many drivers to increased/decreased biofuel production
- Land bases and their “environmental holding capacity” need to be defined more stringently and factored into resource assessments and supply analyses
- If land is constrained for economic and/or environmental reasons, biofuels will probably exacerbate the carbon debt problem