Biofuels, Food & Feed Tradeoffs

April 12-13, 2007 St. Louis, Missouri

Farm Foundation

USDA's Office of Energy Policy and New Uses

Rural Development

Food, Bio-energy, and Trade: An Economy–wide Assessment of Renewable Fuels

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Conference on Biofuels, Food, & Feed Tradeoffs

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How NOT to answer questions on Bio-fuels

An answer provided by Donald H. Rumsfeld (former) Secretary of Defense

As we know,
There are known knowns.
There are things we know we know.
We also know
There are known unknowns.
That is to say
We know there are some things
We do not know.
But there are also unknown unknowns,
The ones we don't know
We don't know.

—Source: Department of Defense news briefing

Presentation outline

- **Why? Description and background**
  -One of many ERS projects on bio-fuels research
  -Multiphase long-term project
- **How? Modeling approach and implementation**
  -A CGE model supported by multiple U.S. agencies
  -USDA-ERS responsible for improving the agricultural component
- **What can we learn?**
  Scenarios and their design
  Key results and insights on food, trade, and trade-offs

Current ERS Bio-energy Research Menu

- **Outlook and baseline analysis**
- **Domestic feed and livestock implications**
- **Overview of global bio-energy developments, policies, and implications**
- **Bio-energy policies: an economy-wide perspective**
- **Bio-energy production impacts on natural resources and the environment**
- **Impacts of bio-energy development on rural communities**
- **Effects of higher corn prices on retail food prices**

Why economy-wide analysis ?

- **Determine economic benefits or loses in a consistent framework**
- **The new "agri-bio-energy economy" has multiple interactions that may not be realized in commodity models**
- **U.S. is a large market (as consumer and bio-fuel producer) that energy policy can affect all prices in the rest of the economy or world**
- **Consistency checks -all markets in economy clear simultaneously– track all economic activities (employment, inputs, and their uses)**
- **Flexibility for scenarios e.g. alternative technologies, growth, and changes in fuel standards, independently or together**

The Modeling Framework

- Nicknamed USAGE -U.S. Applied General Equilibrium Model
  -Model’s theoretical origin
  Dixon, P.B. and Rimmer, M.T., Dynamic General Equilibrium Modeling for Forecasting and Policy, North Holland Pub. Co., Amsterdam, 2002.

  -Maintenance support by U.S. government agencies DoC, USDA, ITC (informal consortium)
  -ERS responsible for improving the agricultural component

- Most extensive applications at US-ITC, recently employed for Economic Effects of Significant Import Restraints study
- Large detailed model with 500+ sectors including 18 farm and 51 food processing industries, with additional dry-corn milling for ethanol production

Improving specification of USAGE with USDA data/surveys

- USAGE requires detailed information on value of production, inputs used, and returns to labor, capital, land
- Must apply different value-added concept in USAGE – interpreted as returns to factors of production
- Agricultural Resource Management Survey (ARMS) provides the basis for distributing returns to factors of production by major agricultural activities

Reference and alternative scenarios

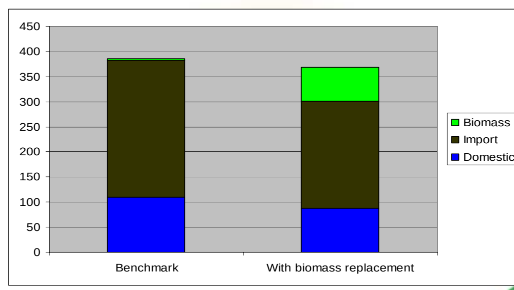
- As reference use scenario by Dixon, Osborne, Rimmer (DOR)
  “The Economy-Wide Effects in the United States of Replacing Crude Petroleum with Biomass, *forthcoming in Energy and Environment, 2007*
- Good study to illustrate potential gains ($74 billion in 2020) from 25% bio-fuel replacement – biomass is derived from feed grain

  “the precise composition of the biomass is not important for our results - what matter are our assumptions about the extent of biomass substitution and biomass competitiveness”

- Composition may not matter for benefits but we ask what about implications for trade in food and agricultural inputs using an alternative biomass?
- Our alternative scenario entails a different biomass composition and inputs depicting alternative biomass source

Less dependency on foreign oil means lower cost for the total crude petroleum bill

$billions (2020)



How do we design scenarios for long-term developments?

- Carefully read USDA’s (2007) Baseline Projections

  -What is plausible in foreseeable future?

  -Total acres (for major crops) nearly constant, expansion from CRP not considered

  -Corn-based ethanol about 8 percent of total gasoline
- For alternative biomass production (not yet in USDA projections)
  -use good judgment and some imagination (a composite-other crops, wastes, forages, grasses)

  -Let model determine trade, market impacts, and potential trade-offs

Key assumptions to permit 25% bio-fuel replacement in 2020
(a best case scenario)

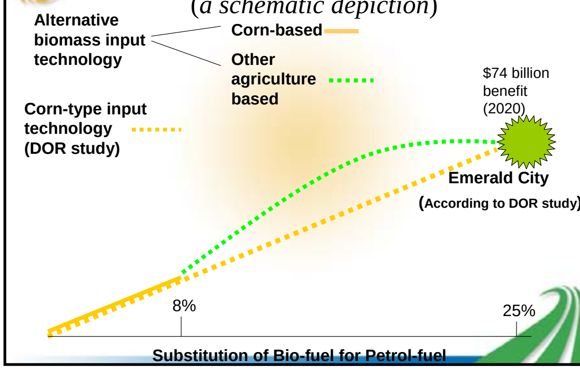
- Not a policy scenario – only used as illustrative experiment
- Research and development reduces cost of biomass-based fuel to be competitive at $2 per gallon gasoline or approximately $40 per barrel oil price
- Subsidy to ethanol no longer needed
- Assume sufficient availability of biomass raw material
- Changes in light vehicle fleet would take place for fully utilizing ethanol for 25 percent of motor fuels
- Required infrastructure costs not included in analysis

What we ask from the model?

- Possible benefits of bio-fuels substitution
- Market impacts for farm and food industries
- Are benefits dependent upon agricultural supply and demand conditions (inputs and commodities) in the rest of the world?

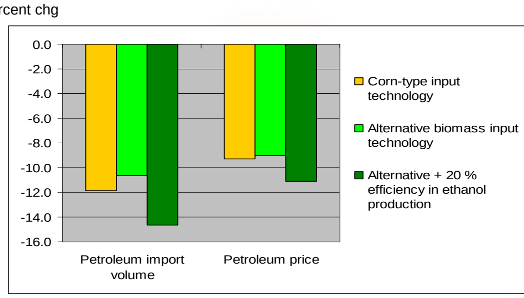
Multiple Paths to Same Destination for Achieving a Bio-fuel Mandate

(a schematic depiction)



A Primary Source of Economic Gains from bio-fuel is lower price and volume of imported petroleum

Percent chg



Source: USAGE model simulation, preliminary estimates USDA-ERS

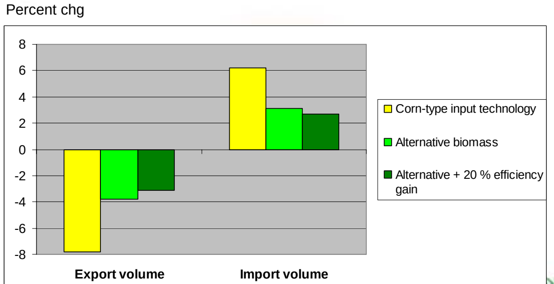
Impacts from bio-fuel replacement on imported oil and farm inputs

	Corn-type input technology (DOR)	Alternative input technology
	Import volume percent chg	Import volume percent chg
Petroleum	-12	-11
Fertilizer (Nitrogen-Phosphorous)	22	3
Chemical Fertilizer	6	2
Pesticide	25	7

Source: USAGE model simulation, preliminary estimates USDA-ERS

Impacts of Bio-fuels substitution on U.S. meat trade

Percent chg



Source: USAGE model simulation, preliminary estimates USDA-ERS

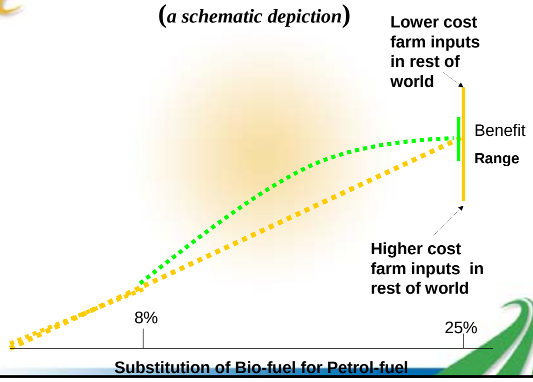
Export impacts from bio-fuel substitution on selected farm and food processing industries

	Corn-type (DOR) input technology	Alternative biomass input technology
	percent chg	percent chg
Live Meat Animals	-10	-4
Feed grains	-18	-6
Cotton	-1.4	-2.2
Food grains	-0.1	-1.7
Oil crops	-1	-2.5
Meat packing	-8	-4
Dairy	-4	-2
Prepared feeds	-5	-3
Corn milling	-8	-2.5

Source: USAGE model simulation, preliminary estimates USDA-ERS

Greater dependency on rest of world for farm resources means higher variability in benefit

(*a schematic depiction*)



Summary: What factors seem to matter?

- **Input requirements for biomass production has important market and trade implications**
- **Cost of farm inputs in rest of world matter more if the U.S. remains corn-intensive**
- **Production of "home grown" inputs for biomass lessens dependency on rest of world**
- **Technological improvements can help mitigate potential negative impacts**

Where do we go from here in project?

- **Improve representation of alternative biomass production**
- **Need better assumptions about the rest of world conditions –connect USAGE to a "real" rest of world**
- **Investigate dynamics of adjustment and cost associated with technological change**
- **Lots of sensitivity analysis – what drives what?**