Biofuels: Political/Economic Boondoggle or Energy Salvation for Western States

Doug Young
School of Economic Sciences, Washington State University

2009 WAEA Keynote Address
June 25, 2009, Kauai, Hawaii
Objectives: To Review

1. Comparative disadvantage of western states for crop biofuel feedstocks

2. Brief overview of western states’ cellulosic feedstocks

3. Biofuel incentives at federal level and from selected western states
Objectives: To Review, cont.

4. Rise and fall of the biodiesel and ethanol industries in western states

5. Few remarks on environmental, food versus fuel, and political issues.

6. Few remarks on policy evaluations for biofuels. Will leave most questions of optimal policy design to others.

7. Recommendations for future research priorities
“Today we move away from our dependence on foreign oil... Washington must compete in global markets. The quality of our products is second to none... This bill won’t just help individual farmers. It will help rural communities.”

_____ Washington Governor Christine Gregoire, March 2006
GOALS OF WA’S CURRENT 2% BIOFUEL BLEND MANDATE/GOAL

1. Establish market for alternative fuels in WA
2. Reduce dependence on foreign oil
3. Improve health and quality of life for Washingtonians
4. Create new industry that benefits farmers and rural communities
World and North America Biofuel Crop Feedstocks: An Overview
# World Wide Crop Sources for Ethanol, 2007

<table>
<thead>
<tr>
<th>Crop</th>
<th>Country</th>
<th>Metric Tonnes (Millions)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maize (Corn)</td>
<td>USA</td>
<td>332</td>
</tr>
<tr>
<td></td>
<td>China</td>
<td>152</td>
</tr>
<tr>
<td></td>
<td>Brazil</td>
<td>52</td>
</tr>
<tr>
<td></td>
<td>Mexico</td>
<td>23</td>
</tr>
<tr>
<td>Sugar Cane</td>
<td>Brazil</td>
<td>514</td>
</tr>
<tr>
<td></td>
<td>India</td>
<td>355</td>
</tr>
<tr>
<td></td>
<td>China</td>
<td>106</td>
</tr>
<tr>
<td></td>
<td>Thailand</td>
<td>64</td>
</tr>
<tr>
<td>Sugar Beet</td>
<td>France</td>
<td>32.3</td>
</tr>
<tr>
<td></td>
<td>USA</td>
<td>31.9</td>
</tr>
<tr>
<td></td>
<td>Russian Federation</td>
<td>29</td>
</tr>
<tr>
<td></td>
<td>Germany</td>
<td>26</td>
</tr>
</tbody>
</table>

Source: UN-FAO
## World Wide Crop Sources for Biodiesel, 2007

<table>
<thead>
<tr>
<th>Crop</th>
<th>Country</th>
<th>Metric Tonnes (Millions)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Soybeans</td>
<td>USA</td>
<td>71</td>
</tr>
<tr>
<td></td>
<td>Brazil</td>
<td>58</td>
</tr>
<tr>
<td></td>
<td>Argentina</td>
<td>46</td>
</tr>
<tr>
<td></td>
<td>China</td>
<td>16</td>
</tr>
<tr>
<td>Palm Oil</td>
<td>Indonesia</td>
<td>78</td>
</tr>
<tr>
<td></td>
<td>Malaysia</td>
<td>78</td>
</tr>
<tr>
<td></td>
<td>Nigeria</td>
<td>9</td>
</tr>
<tr>
<td></td>
<td>Thailand</td>
<td>8</td>
</tr>
<tr>
<td>Rapeseed</td>
<td>China</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>Canada</td>
<td>9</td>
</tr>
<tr>
<td></td>
<td>India</td>
<td>7</td>
</tr>
<tr>
<td></td>
<td>Germany</td>
<td>5</td>
</tr>
</tbody>
</table>

Source: UN-FAO
# American Crop Feedstock Production Shares, 2007

<table>
<thead>
<tr>
<th></th>
<th>% North America</th>
<th>% of World</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Canola and Mustard</td>
<td>Soybeans</td>
</tr>
<tr>
<td>Canada</td>
<td>93</td>
<td>4</td>
</tr>
<tr>
<td>United States</td>
<td>7</td>
<td>96</td>
</tr>
</tbody>
</table>

Source: UN-FAO
Crop Feedstock Production for 19 Western States, Av. of 1997, 2002, 2007 Ag. Censuses (% USA)

<table>
<thead>
<tr>
<th>Region</th>
<th>For Ethanol</th>
<th>For Biodiesel</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Field Corn</td>
<td>Sugar Beets</td>
</tr>
<tr>
<td>All 19 States</td>
<td>25</td>
<td>57</td>
</tr>
<tr>
<td>Excluding KS, NE, ND, and SD</td>
<td>5</td>
<td>37</td>
</tr>
</tbody>
</table>
Map of U.S. with field corn production level in western states
Map of U.S. with field canola production level in western states

Canola, Harvested Acres: 2007

0.1
0.8
1.5
1.6
2.4
82.4
0.1
0.1
0.1
0.1
1 Dot = 1,000 Acres

United States Total
1,149,882

07-M184
U.S. Department of Agriculture, National Agricultural Statistics Service
Top 5 Corn Producing States (% USA) & Ethanol Capacity: 2008

<table>
<thead>
<tr>
<th>State</th>
<th>% USA Corn</th>
<th>Ethanol Capacity (MGY)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Iowa</td>
<td>18.1</td>
<td>3,534</td>
</tr>
<tr>
<td>Illinois</td>
<td>17.6</td>
<td>1,223</td>
</tr>
<tr>
<td>Nebraska</td>
<td>11.5</td>
<td>1,666</td>
</tr>
<tr>
<td>Minnesota</td>
<td>9.8</td>
<td>1,102</td>
</tr>
<tr>
<td>Indiana</td>
<td>7.2</td>
<td>1,162</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>64.2</strong></td>
<td><strong>8,687</strong></td>
</tr>
</tbody>
</table>
Western U.S. and Canada Canola Production, 2007

<table>
<thead>
<tr>
<th></th>
<th>Production (mil. lbs)</th>
<th>% US Production</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alberta</td>
<td>6,600</td>
<td>465</td>
</tr>
<tr>
<td>Saskatchewan</td>
<td>9,000</td>
<td>635</td>
</tr>
<tr>
<td>Manitoba</td>
<td>4,300</td>
<td>303</td>
</tr>
<tr>
<td>United States</td>
<td>1,419</td>
<td>100</td>
</tr>
</tbody>
</table>

Canola Growing Regions of Canada and The U.S.
Western states are justly famous for their wheat, vegetables, apples, potatoes, wine grapes, alfalfa hay, and livestock. The West is not the Corn Belt where summer rainfall and warm 24-hour summer temperatures favor corn and soybeans. Nor is the U.S. West the Canadian Prairies where cooler summer temperatures favor oilseeds.
OTHER OILSEEDS

• Soybeans: Main source U.S. biodiesel, 50% of canola’s oil content, but higher yield. Soybeans have other uses and price challenges.
• Mustard, Safflower, Sunflower, Flax Seeds: Minor crops, other uses.
• Camelina: Has been disappointing in Montana.
SUMMARY OF 5-REGION WA LP PROJECTIONS FOR 2008 AND 2010

• Canola and sugarbeets never entered the basis for any region. Projected prices fell short of breakeven levels in product-product competition. Potatoes, apples, grapes, hay, hops, etc. dominated in irrigated regions; wheat, barley, and edible legumes dominated in drylands.

• Projected field corn production was highly variable in competition with small grains. Field corn production low by national standards.
Top 6 of 20 Western States in Biomass Resources (Ag., Forestry, and Municipal Waste)

Washington State Biomass and Bioenergy by Category

IF all potential utilized, could supply up to 49% of power needs.

Source: Frear et al., *Biomass Inventory and Bioenergy Assessment*, WSU/DOE, 2005

http://www.ecy.wa.gov/biblio/0507047.html
### FEDERAL BIOFUEL INCENTIVES

<table>
<thead>
<tr>
<th>Tax Credits/Gallon</th>
<th>Refinery Subsidies</th>
</tr>
</thead>
<tbody>
<tr>
<td>Corn Ethanol (now $0.45)</td>
<td>&lt;= 30% of Cost</td>
</tr>
<tr>
<td>Biodiesel ($1.01)</td>
<td></td>
</tr>
<tr>
<td>Cellulosic ($1.01)</td>
<td>Yr 1 deprec. = 50%, cellulo. Plants</td>
</tr>
<tr>
<td>Year</td>
<td>Bil. Gal/Yr</td>
</tr>
<tr>
<td>------</td>
<td>-------------</td>
</tr>
<tr>
<td>2008</td>
<td>9 conven.*</td>
</tr>
<tr>
<td>2022</td>
<td>15 conven.</td>
</tr>
<tr>
<td></td>
<td>16 cellulos.</td>
</tr>
<tr>
<td></td>
<td>5 other</td>
</tr>
</tbody>
</table>

*conven. = crop feedstocks
WASHINGTON’S BIOFUEL INCENTIVES & GOALS

1. Reductions & exemptions in business, property, and sales taxes

2. Grants and low interest loans for R & D

3. 2% renewable fuel blend goal (currently met with ethanol, not close for biodiesel)

4. 20% blend for state vehicles by 6/1/09; actual 2.1%

5. Goal: Use in-state feedstocks. Virtually all imported

6. Goal: Reduce GHG’s 15% by 2020
OREGON’S BIOFUEL INCENTIVES & GOALS

1. Investment tax credit on refineries: 50% up to $200 million! This influenced Pacific Ethanol’s location at Boardman.

2. Tax credits for Oregon growers of feedstocks used for biofuels

3. Blends of 2% biodiesel & 10% ethanol if local feedstock standards met

4. Consumer tax credit for transport biofuels of $0.50/gal up to $200/yr/registered vehicle
CALIFORNIA’S BIOFUEL INCENTIVES & GOALS


2. Can trade and bank LCFS credits

3. Grants and low interest loans for R & D
BRITISH COLUMBIA’S BIOFUEL POLICY

1. Carbon tax on purchasers of all fuels and combustibles
2. Phased in carbon tax of $0.12/gal gasoline in 2008 to $0.35/gal in 2012
3. Ethanol, biodiesel, biomass, and other renewable are exempt
4. Revenue neutral: Tax collections returned to taxpayers.
Do the Mandates and Subsidies for Biofuels Benefit or Harm Society?

1. Free market economists’ answer: Harm. Markets should be allowed to efficiently allocate resources, not government.

“Competition between alternative energy sources would reveal the most efficient set and allow the United States to meet its policy objectives at least cost... Congress should be neutral to the means by which this is achieved.”

___Bruce Babcock, Iowa State University, Iowa Ag Review, 2007
Single Market Societal Effects of Simple Biofuel Subsidy

Taxpayer Cost = $P_gBCP_c$

“How to measure NME of “Energy Security”??
WHAT HAS BEEN THE OUTCOME OF MARKET TRENDS DESPITE GENEROUS FEDERAL AND STATE SUPPORT FOR U.S. BIOFUEL INDUSTRY?
RISE AND FALL OF PACIFIC ETHANOL

1. Largest ethanol producer in Pacific and Mountain states.

2. 40 Mil. Gal./Yr $100 million ethanol plants at Madera, Stockton, and Calipatria, CA; Boardman, OR; Burley, ID; and Windsor, CO. Imported Midwest corn in unit trains.

3. Stock price fell from $44.50/share in 2006 to $0.20/share in 2009.

4. Filed for bankruptcy 5/18/09.
WIDESPREAD BANKRUPTCIES, PLANT CLOSURES AND DELAYS

1. VeraSun, Sioux Falls, SD, one of largest U.S. ethanol producers, bankrupt 10/31/08 after IPO in 2006. Stock price fell from $17.75 to $0.48 per share. Sold to oil refiner, Valero Energy Co.


4. Similar closures, delays, and bankruptcies in other states.
AUTOPSY OF WESTERN STATES’ BIOFUEL INDUSTRY: A “PERFECT STORM”

1. Plant building binge in 2006-07 in response to govt. incentives and favorable corn prices
2. Competition from petroleum: Price/barrel from $135 in mid-2008 to $69 on 6/19/09
3. Corn/ethanol price ratio still puts ethanol industry in a cost-price squeeze
AUTOPSY continued

5. MPG and engine damage concerns discouraged E-10 consumers

6. EU imposed tariff on exported U.S. biodiesel

7. Federal and CA low carbon fuel standard penalizes biofuels for indirect affects on land use; e.g., clearing rain forests and converting marginal lands to agriculture

8. Industry mgt. based on linear projections of corn prices, ethanol prices & policies
AUTOPSY continued

9. General environmental criticism of use of crop feedstocks

10. Food versus fuel furor

11. State and federal budget deficits moderated subsidy enthusiasm?

12. Economists’ criticisms that biofuel incentives are “social welfare reducing”??
BEACONS OF HOPE FOR BIOFUELS

1. “Second generation” or cellulosic biofuels are new poster child of biofuels-- receiving generous research funding.

2. Small biodiesel plants using recycled greases/oils have been commercially successful.

3. As corn prices have declined, ethanol margins have improved slightly.

4. Industry lobbying and political support will raise blend mandate to 15%?? Will terminate use of indirect land use accounting???
TOP 10 CELLULOSIC FEEDSTOCK CANDIDATES
Based on Number of Articles, *Biofuel Business E-Newsletter*, 7/08-5/09

1. Algae
2. General Biomass
3. Waste, inc. garbage
4. Jatropha
5. Microorganisms
6. Grasses, inc. Switchgrass
7. Wood Fiber
8. Corn fodder
9. Glycerin
10. Pennycress
Promises and Challenges for Cellulosic Feedstocks

• Cellulosic sources are more efficient in reducing GHG’s and potentially in conserving fossil fuels.
• But collection costs are high for forestry residues.
• Cellulosic sources avoid food/energy competition.
• Technical and economic feasibility for cellulosic biofuel production is still uncertain. Additional R&D will take time and money.
• What is optimal cellulosic allocation among fiberboard, electricity, biofuels, feed, and soil building?
Overview: Environmental Effects
Greenhouse Gasses and Biofuels

Feedstocks take up CO2 when they grow
CO2 emitted when feedstocks burned or when energy
product derivatives burned
But Starred areas also emit

Source of underlying graphic: Smith, C.T., L. Biles, D. Cassidy, C.D. Foster, J. Gan, W.G. Hubbard, B.D. Jackson, C. Mayfield and H.M. Rauscher, “Knowledge Products to Inform Rural Communities about Sustainable Forestry for Bioenergy and Biobased Products”, IUFRO Conference on Transfer of Forest Science Knowledge and Technology, Troutdale, Oregon, 10-13 May 2005
Comparing Fuels For CO2
(Before Indirect Land Use Effects)

The Environmental Protection Agency estimates that using liquefied coal as a fuel source instead of petroleum could increase greenhouse gas emissions.

Estimated change in greenhouse gas emissions if petroleum fuel were to be replaced with one of these alternative fuels:

- Cellulosic ethanol: -91%
- Biodiesel: -68%
- Sugar ethanol: -56%
- Electricity: -47%
- Gaseous hydrogen: -41%
- Compressed natural gas: -29%
- Liquified natural gas: -23%
- Liquified petroleum gas: -22%
- Coal-to-liquids: +9%
- Liquid hydrogen: +7%
- Gas to liquid diesel: +4%
- Gas to liquid diesel (With carbon capture and storage): +119%
- Gas to liquid diesel (Without carbon capture and storage): +119%

Note: The estimates include emissions from all parts of the process of making the fuels including fossil extraction, feedstock growth and distribution as well as averaging for the different methods of producing the fuels.

Source: Environmental Protection Agency

The New York Times
N$_2$O release from agro-biofuel production negates global warming reduction by replacing fossil fuels

P. J. Crutzen$^{1,2,3}$, A. R. Mosier$^4$, K. A. Smith$^5$, and W. Winiwarter$^{3,6}$

$^1$Max Planck Institute for Chemistry, Department of Atmospheric Chemistry, Mainz, Germany
$^2$Scripps Institution of Oceanography, University of California, La Jolla, USA
$^3$International Institute for Applied Systems Analysis (IIASA), Laxenburg, Austria
$^4$Mount Pleasant, SC, USA
$^5$School of Geosciences, University of Edinburgh, Edinburgh, UK
$^6$Austrian Research Centers – ARC, Vienna, Austria

Received: 28 June 2007 – Accepted: 19 July 2007 – Published: 1 August 2007

Correspondence to: P. J. Crutzen (crutzen@mpch-mainz.mpg.de)
Beyond CO2: Biofuels Incentives May Also Harm Environment

1. Degrade soil and water by more intensive production on existing cropland

2. Convert rainforest, conservation lands, and marginal lands to cropland to meet feedstock demands

3. EPA decision, 7/09?
Economic Questions
Potential Economic Costs from Biofuel Incentives

1. Raise food prices in poor and rich countries
2. When local feedstocks not competitive, blenders import to meet mandates
3. Boost farmland prices
4. Increase taxes & deficits or reduce govt. services to fund incentives

U.S. Price, 2006-2007 (+%)
- Beef: 6.4
- Poultry: 7.8
- Food: 4.2
- All (CPI): 2.4
- Mexico, Tortillas: +100%
SOCIAL WELFARE ANALYSIS OF BIOFUEL POLICIES

1. Degorter and Just, 2008: Combination of subsidies and mandates increases taxpayer costs with no gains in consumer or producer surpluses.

2. Yoder et al., 2008: Lit. review & CGE model of WA state showed subsidies for biofuel feedstocks outweighed their benefits. Results showed that carbon taxes (as in British Columbia) were most cost-effective for encouraging biofuel use and reducing GHG’s.
Are Politically Popular Biofuel Mandates and Subsidies Bypassing More Socially Efficient Policies?

1. Promote energy conservation and education
2. Promote energy saving technology
3. Promote non-crop feedstocks: Cellulosic sources (trees, straw, switchgrass, etc.)
4. Promote more efficient extraction of fossil fuels
5. Promote cost-effective, clean energy sources (hydro, solar, wind, tidal, methane, etc.)
6. Tax emissions (economists prefer taxes or subsidies to regulations and mandates)
Are Politically Popular Biofuel Mandates and Subsidies Bypassing more Socially Efficient Policies?

7. Tax carbon (like BC)
8. Mandate and enforce energy efficiency standards
9. Remove trade barriers in biofuels

U.S. is promoting some of 1-8 above. What is balance?
Research Agenda

1. Ag Sciences
2. Engineering-Technical
3. Economics
1. Breed adaptive and productive varieties of existing feedstocks and develop new feedstock crops (camelina, switchgrass, peanuts, etc.)

2. Improve energy-gain/energy-used ratio and CO2 savings

3. Consider GMO advances.

4. Improve region-specific management (fertilization, pest control, tillage, planting depth, soil packing, etc)

5. Discover regional niches for oilseed crops.

Crop scientists and biotechnologists are addressing these issues.
Engineering-Technical Research Priorities
(Not Just Biofuels!)

1. Energy-saving technology (electric autos, flores. bulbs, etc.)
2. Improve efficiency of hydro, solar, wind, geothermal energy
3. Improve efficiency and reduce pollution of fossil fuels (oil, coal, tar sands, oil shale, ...)
4. Improve tech. & econ. feasibility of cellulosic biofuels
5. Improve efficiency of traditional biofuels
Economics Research

1. Global economic analysis of alternative energy policies
2. Value environmental effects of energy & bioenergy policies
3. Farm economics of oilseed & other feedstocks with and without subsidies
4. Economics of processing plants by scale, technology and location with and without subsidies.
5. International trade effects of bioenergy policies & cost of trade barriers to consumers and taxpayers (e.g., sugar).
6. Economic efficiency of alternative bioenergy incentives
“Big Questions”
Policy and Economics

- Will we include *worldwide* effects on the environment and on food consumers in benefit-cost analyses of bioenergy policies?
- Will we include full costs to taxpayers?
- Will we support “bypassed” energy options and conservation on a fair and equal basis?

Engineering and Science

- Will we consider all potential technologies and feedstocks for ENERGY production?
- Will we consider all bioenergy alternatives including crops, cellulosics, livestock waste, and recyclables?
- How will we address controversial solutions like GMO’s?
The Future of Biofuels: USDA’s Reasonable Global Perspective

• Global biofuel production tripled between 2000 and 2007, but still accounts for less than 3 percent of the global transportation fuel supply.

• Increased biofuel demand has contributed to higher world food and feed prices.

• Crop-based biofuels will likely be (a small?) part of a portfolio of solutions to high energy prices, including conservation, more efficient energy use, and other alternative fuels.

USDA’s BioFuel Summary, Nov. 2007
FINAL THOUGHTS

The politics of biofuels has outpaced the agricultural science, engineering and economics necessary for sound public decisions.

POLITICAL BOONDOGGLE