

The Future of Bio-Energy

W.I. Myers Council

By

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October 25, 2007

Agenda

- Background
- Arrival of the bio-energy opportunity
- Challenges
- Opportunities
- Questions



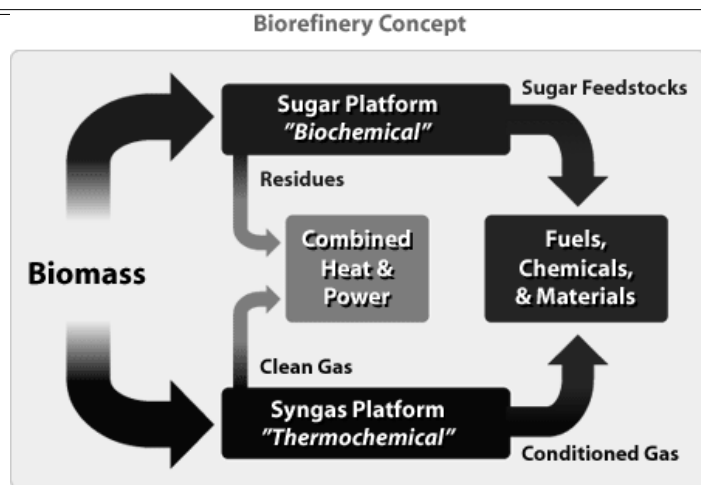
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What is Bio-energy?

- Energy that is produced from organic sources
 - ▣ Wood
 - ▣ Crops/crop residues
 - ▣ Food processing residues
 - ▣ Animal wastes
- Most common current uses
 - ▣ Electricity
 - ▣ Heat/steam
 - ▣ Transport fuels (ethanol and bio-diesel)

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NREL's Biorefinery Concept

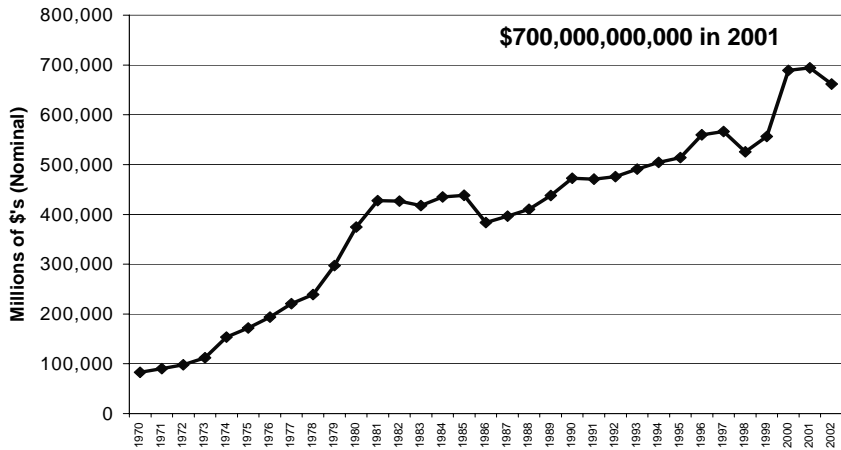


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Source: National Renewable Energy Laboratory
<http://www.nrel.gov/biomass/biorefinery.html>

Energy Markets are Very Large!

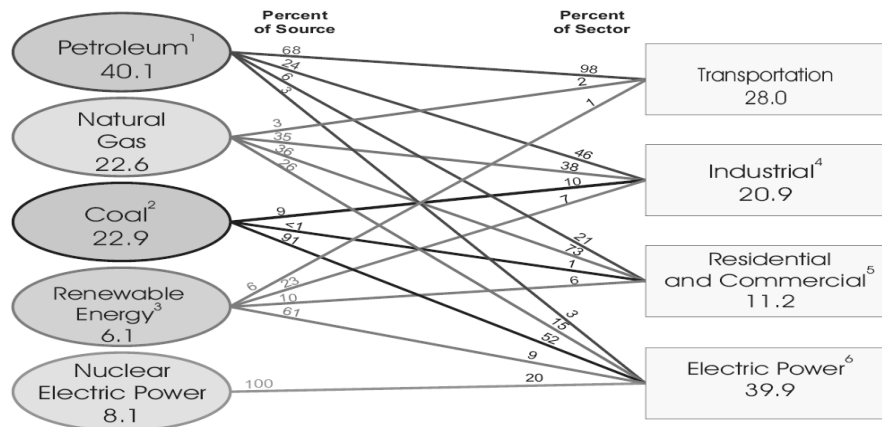
Expenditures on Energy, 1970-2002



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Where does the energy go?

U.S. Primary Energy Consumption by Source and Sector, 2005
(Quadrillion Btu)



Source: Energy Information Administration, U.S. Dept. of Energy

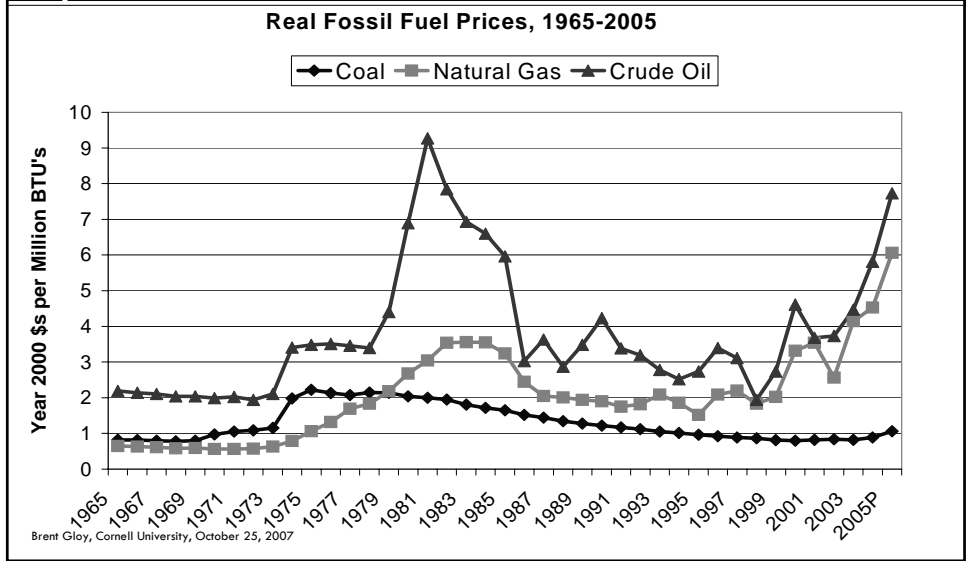
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Arrival of the Opportunity

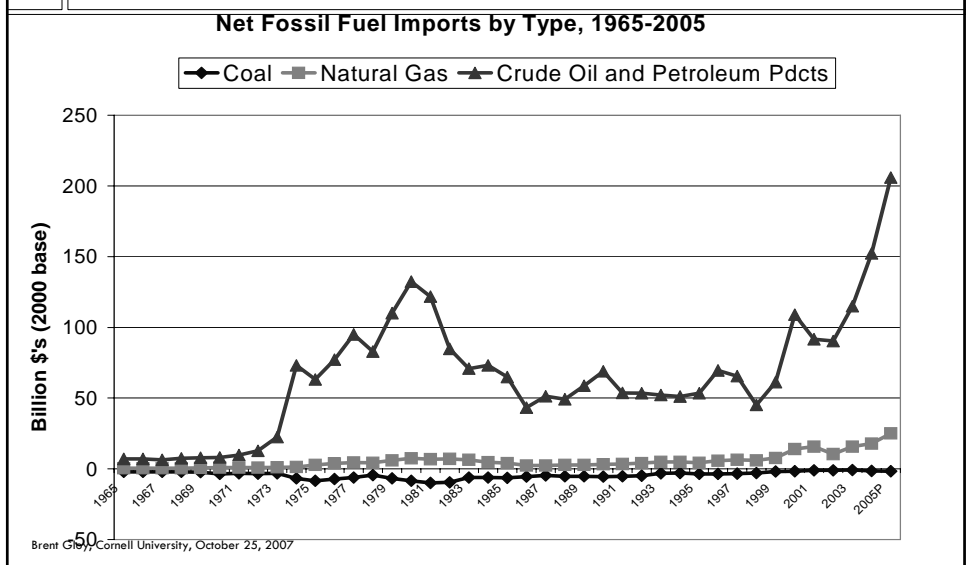
Why the Interest in Bio-Energy

- + (1) Rising energy prices
 - + (2) Increasing concern over the environment
 - + (3) Development of government incentives to jump start the industry
 - + (4) Proven technology and willing capital markets
- = Economic Opportunity

1. Fossil Fuel Prices Have Increased



Spending on Imports has Increased



A Quick Oil Quiz

1. What country is the largest source of petroleum imports?
2. What percent of our imports come from OPEC?

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Bottom Line: Massive Opportunity

- Energy markets are very large
- We are spending more on energy (in real dollars) than in the past
- We are importing more of our energy needs
 - Driven in large part by transportation fuels (crude oil)
 - A significant portion of the imports come from unstable/unfriendly regions
- Result: High and volatile prices

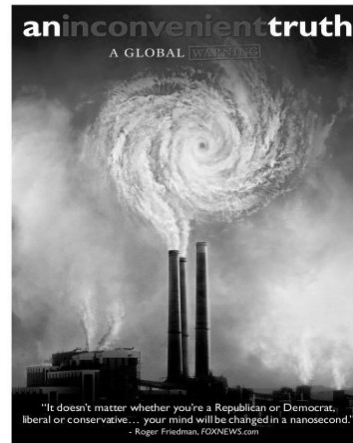
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2. The Environment

- Concern appears to be increasing over impact of green house gas emissions
- Renewable energy is a beneficiary of this concern



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3. Government Incentives

- Transport fuels currently receive more attractive subsidies than most other bio-energy projects
- Key programs
 - Renewable Fuels Standard (RFS)
 - 7.5b gal by 2012
 - 250 m gal of cellulosic ethanol by 2013
 - Blenders credit VEETC
 - \$0.51 per gallon of ethanol
 - \$1.00 per gallon of agri-biodiesel
- Other types
 - Investment tax credits
 - Loan guarantees (critical to waste treatment based systems)
 - Various local incentives

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4. Technology and Lenders

- Turn-key technology solutions developed
- Subsidies provide comfort that product will be marketed brought lenders to the table
 - Farm Credit System an aggressive early lender
 - Equity markets also provided necessary capital



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Challenges and Opportunities for Bio-Fuels

Ethanol and bio-diesel

- The industry will soon meet the RFS
 - Gasoline demand is roughly 142 b gallons/year (EIA)
- Current feedstock availability is limited
- Outputs are not generally produced near demand and currently have issues in transportation
 - Other uses for distillers grains will quickly emerge if they become cheap
- Non-starch technologies exciting but unproven
- Vehicle fleet not easily/quickly converted

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Moving to Bio-Mass Will be a Challenge

- Requires handling massive quantities of bio-mass

Acres required to feed 18,000 dairy cows and produce 20 m gal of corn ethanol

	Units	Yields	Total Acres Required	Acres for Ethanol	Acres for Dairy
Corn	bu/acre	150	86,671	71,429	15,242
Corn Silage*	tons/acre	20	8,905		8,905
Soybeans**	bu/acre	50	11,288		11,288
Hay	tons/acre	7	8,123		8,123
			114,988	71,429	43,560

Estimated at 7.5 bushels per ton

Soybeans required estimated at 44 lbs of meal per bushel of soybeans (60 lbs per bushel)

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Vehicle Fleet Changes a Challenge

- NEVC estimates that there are currently 4.3 million FFV's on the road and 1,133 E85 stations
 - Current U.S. inventory is approx 240 million passenger cars^a
 - Approx. 7.7m passenger cars sold in 2005^a

^a Source: U.S. Dept. of Transportation, Bureau of Transportation Statistics

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Opportunities

- Nearly all of the challenges identified can be addressed
- The potential clearly exists to drastically alter our use of oil
- Should have tremendous benefits for our environment
- Many other areas of bio-energy have great potential
 - Waste to energy applications
 - Biomass to energy

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Bottom Line

- A bright long-term future for bio-energy projects
- The size and outlook of the opportunity is dependent upon the extent to which consumers and the government remain willing to support the environmental and energy security benefits of bio-energy.
 - Coal is and will likely remain the cheapest source of btu's if environmental costs are ignored

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Other Bio-Energy Options

Opportunity for Livestock Operations

- Livestock operations have considerable energy generating potential
 - Biomass is low-cost
 - Collected in one spot
 - Consistently supplied
 - Proven technology to harvest the energy
- Livestock operations can utilize by-products from ethanol production

Anaerobic Digester



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Anaerobic Digestion of Livestock Waste

- Breakdown of organic material in an oxygen free environment (air tight tank)
- Designed to handle high moisture products
- Methanogenic bacteria process organic materials to produce biogas (60-70% methane)
- Gas can be cleaned to be equivalent to natural gas
- Reduces odors in livestock waste
- Creates a compost type fertilizer product

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How Much Energy Can AD Produce?

- Lactating dairy cow – 50,000 btu's/cow/day
- 6,000 cow operation will conservatively produce/run
 - 105,000 MMBTUS per year
 - About 1 MW of electricity generation (400-600 homes)
 - About 900,000 gallons of gasoline equivalents (CNG)
 - Output could easily be doubled with intensive management and inclusion of additional waste streams

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Challenges of Biogas

- Achieving scale necessary to support dedicated management
- Access to waste streams
- Access to energy distribution system
 - Electricity
 - Gas pipeline
 - Industrial user
 - CNG
- Lack of continuing support (blender's credit)

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Key Needs

- Understanding of the science and economics of making bio-energy
 - Cellulosic ethanol
 - Bio-gas (waste to energy and dedicated energy crops)
 - Co-firing biomass
 - Thermo-chemical conversion to energy
 - Other forms of renewable energy

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Key Needs

- Understanding of how to grow, handle, process, and store various forms of biomass
 - What are the best plants for a given region
 - How does one handle the logistical problems associated with moving biomass
 - How does one efficiently harvest biomass
 - What are the energy yields for various types of biomass

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Key Needs

- Understanding of how markets will/can develop for biomass and biomass derived energy
 - What is the best way to coordinate production and processing of biomass
 - What types of standards are needed and how should they be implemented
 - How does one monetize the environmental attributes of biomass derived energy
 - How do/can carbon markets work
 - How to efficiently sell bio-energy in the various energy distribution channels
 - How to speed development when infrastructure plays such a key role – chicken and egg problem

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Key Needs

- Development of sound public policy
 - What are the best policy mechanisms that can be used to influence industry development
 - How to span agricultural, energy, and environmental policy
 - What are the costs of these policies
 - What are the unintended consequences of the policies
 - Articulation of the results of these analyses

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Key Needs

- Understanding of the environmental picture of bio-energy
 - Carbon emissions
 - Nutrient use
 - Land use
 - Water use
 - Willingness of society to pay for environmental attributes

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Key Needs

- And many, many more

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What Do We Hope to Tackle

- Cellulosic Ethanol
 - Economic issues related to feedstocks
 - Handling
 - Selection
 - Sourcing
 - Conversion
 - Public policy
 - Assessment of current and alternative policies
 - Marketing
 - How to best develop and market all of the benefits of cellulosic ethanol

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What Do We Hope to Tackle

- Biogas
 - Key barriers to industry development
 - Markets for energy and environmental benefits
 - Assessment of the potential size of the opportunity
 - Quantification of environmental benefits
 - Assessment of alternative public policies
 - Understanding of the true costs of waste treatment on livestock operations

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Questions