

Opportunities for Renewable Energy on Farms

NYSERDA Innovations in Agriculture

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Agenda

- The factors driving renewable energy in agriculture
 - Understanding the system
 - Factors influencing attractiveness
 - Challenges
- Opportunities for farms

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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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Food, Fuel, or Both?

Your view of the agricultural system will likely influence the way it is designed

Is the system?

1. An energy system with feed by-products
2. A food production system with energy by-products
3. An integrated food and energy system

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Understanding the Ag Economy

Opportunity explodes:

- New drivers
 - Energy
 - Sustainability
 - Carbon
 - Conversion
- Old drivers remain important
 - Food demand
 - Environment
 - Population

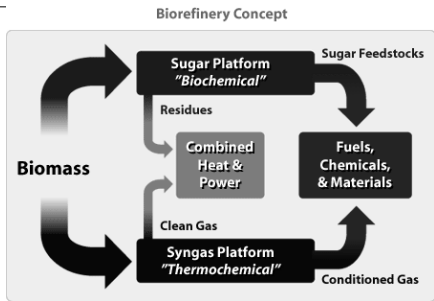
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Understanding the Ag Economy

- Must understand how the pieces of the puzzle fit together for a clear outlook
- Let's start with bio-energy and the well-known bio-refinery concept

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NREL's Biorefinery Concept



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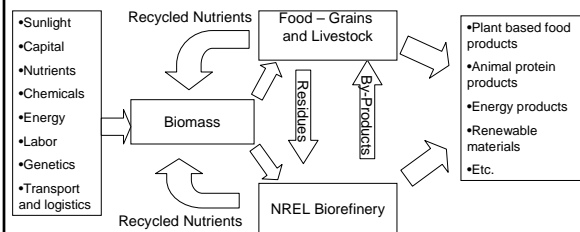
Source: National Renewable Energy Laboratory
<http://www.nrel.gov/biomass/biorefinery.html>

The Total Picture

- The NREL biorefinery is only ***HALF*** of the story
- The complete system includes food/fiber and biomass more generally
 - Bio-energy is dependent upon biomass
 - Biomass has other uses
 - Must consider in the context of larger system

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A More Complete Version of the Biorefinery Concept



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Key Points from Previous Diagram

KEY POINTS:

- Many potential synergies between system components
- Public perception and policy is an important driver of prices – renewable energy contains many non-market goods

Optimal output of the system determined by:

- Relative prices for each input/output
- Costs/technology for conversion of inputs to outputs

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Understanding the System

- The emergence of the energy component has changed the structure of the system
- Let's look at what gave rise to bio-energy developments

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Why the Interest in Bio-Energy

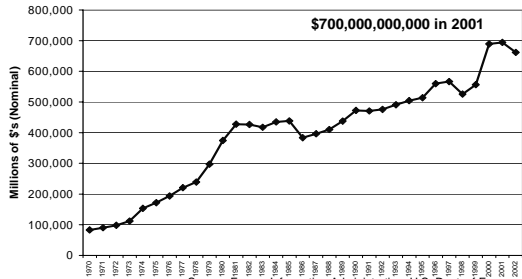
If these change, the economic opportunity changes!

- + (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

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1) Energy Markets are Very Large!

Expenditures on Energy, 1970-2002

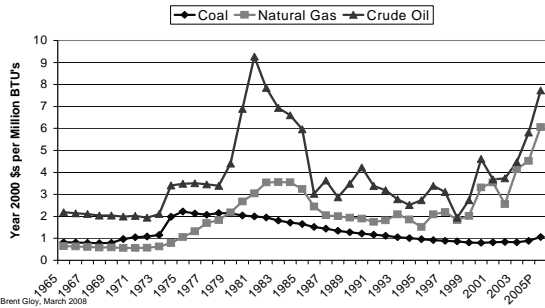


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Source: Energy Information Administration, U.S. Dept. of Energy

1. Fossil Fuel Prices Have Increased

Real Fossil Fuel Prices, 1965-2005



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A Quick Oil Quiz

1. What country is the largest source of petroleum imports?
Canada
2. What percent of our imports come from OPEC?
40%

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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
- Important implications for agriculture

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Green Marketing

- Number of claims will increase
- No consensus on how to regulate or verify
- Will confuse consumers and policy makers

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The Different Attributes of Ethanol

Attributes

- Energy – for whom?
 - Industrial material
 - Environmental good
 - GHG reductions
 - Sustainability
 - Carbon
 - Energy security
- Each market has a different demand and willingness to pay for the product
 - Not all bio-energy is created equal in each of these markets

Causes Tremendous Confusion Among Consumers and POLICY MAKERS!
Viability of Bio-Energy Largely Dependent Upon Non-Market Goods (POLICY)

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Sustainability?

- Does it matter?
- From Google:
 - ethanol and sustainable = 450,000 hits
 - ethanol and green 750,000 hits
 - green biofuels = 2.9 million
 - net energy ethanol 1.8 million
 - Hilary Clinton = 4.9 million hits

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Policy Makers Respond

- Original RFS called for ethanol
- Energy Independence and Security Act of 2007
 - 36 billion gallons of ethanol
 - Conventional biofuels
 - Advanced biofuels (other than corn-starch) 50% GHG emission reduction
 - Cellulosic biofuels (60% GHG reduction)

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4. Technology and Lenders

- Turn-key technology solutions developed
- Subsidies provided comfort that product would have a market and 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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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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Biomass System

■ Challenges

- Risk – supply (weather)
- Demand
 - Access to demand is difficult for non-liquid fuels
- Competitiveness
 - Particularly true for non-liquid fuels

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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 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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Opportunities

- Nearly all of the challenges identified can be addressed
- 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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Opportunities for Farms

- Farms are in the biomass business
- New outputs are emerging
- Opportunities with the best bet solve both environmental and energy problems
 - Waste-to-energy is one such example

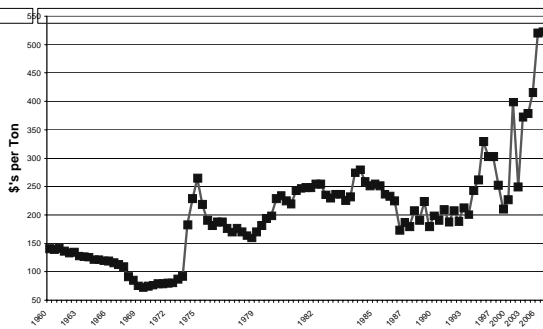
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Consider Manure

- On most farms manure is currently treated as a waste with a negative economic value
- This may soon change
 - Rising energy prices
 - Rising fertilizer prices
 - Improved technology for nutrient and energy recovery
 - Increasing scale of livestock operations
 - Increasing negative public attitudes toward livestock wastes

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Anhydrous Ammonia Prices 1960-2007



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Source: ERS, USDA

The Potential Value of Manure

WARNING: SUBSTANTIAL COSTS ARE REQUIRED TO COLLECT THESE REVENUES

- A 10,000 cow dairy operation produces
 - 259,077 tons of waste per year
 - 35,529 tons of dry waste per year
 - 1,699 tons of N = \$1.02M @ \$600/ton
 - 287 tons of P = \$115k @ \$400/ton
 - 442 tons of K = \$115k @ \$260/ton
 - 176k MMBTU's of renewable energy = \$1.4M @ \$8/MMBTU

Total Potential Revenue = \$2.7 M

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Opportunities for Farms

- Primary driver today remains food production
- Opportunities will continue to emerge for handling by-products of food production
- Efficient nutrient and waste use is key to economics
- With right incentives we can do much more on the energy side

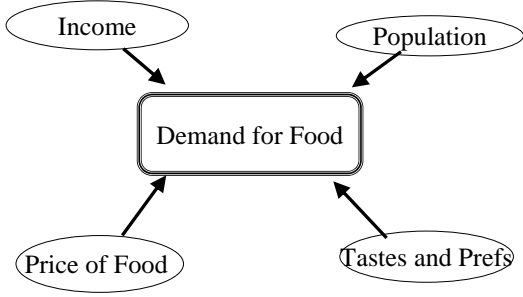
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Don't Forget the Old Drivers

- Food demand is still highest economic use
- Global protein demand will grow with population and income

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1. Four Factors Influencing Demand

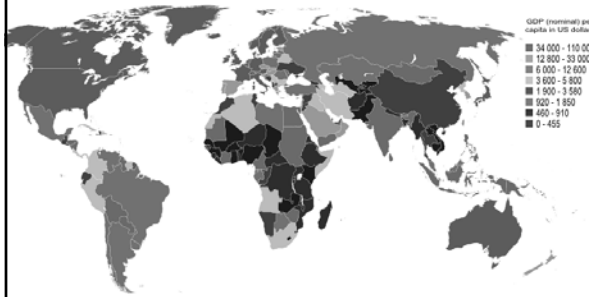


Population by Country



http://en.wikipedia.org/wiki/List_of_countries_by_population
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GDP (Nominal) per Capita, (\$'s), 2006



Source: IMF
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Old Trends

- 37% of world's population is in India and China
- Have a considerable way to go to reach GDP levels of US
- Economic growth is much faster than industrialized world
- Food (protein) demand will increase substantially with economic growth

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Questions

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