Meeting Fiber Needs for Bioenergy:

The Billion Or More Ton Challenge

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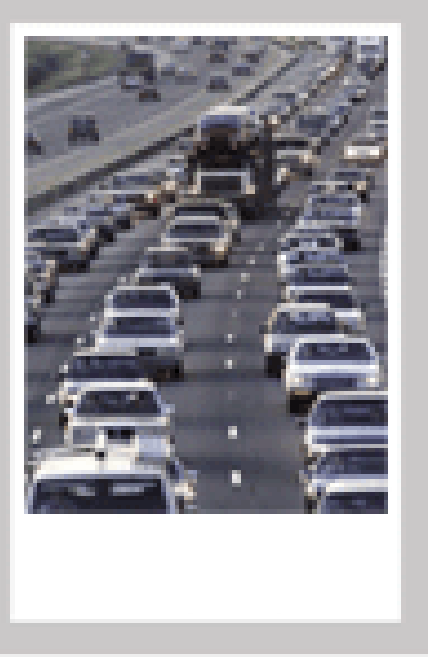

2005 U.S. Fossil Transportation Fuel Consumption
(gallons)

- Gasoline 140,000,000,000
- Diesel 40,000,000,000

Current petroleum imports: 12 million barrels/day

@ $70/barrel, annual oil import bill exceeds

$300 Billion

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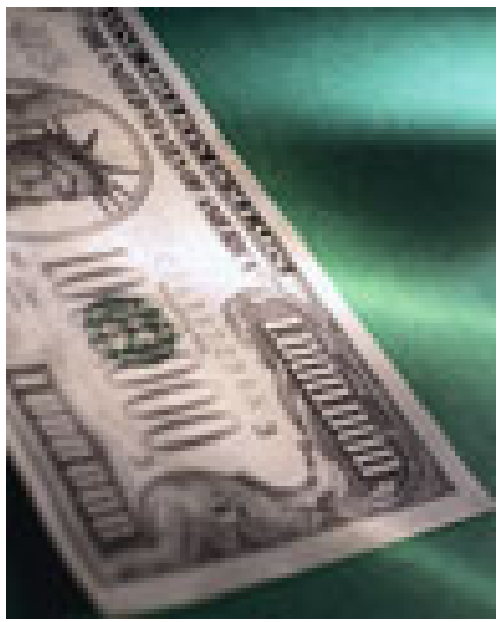
Why Biofuels?

Energy Security

Environment

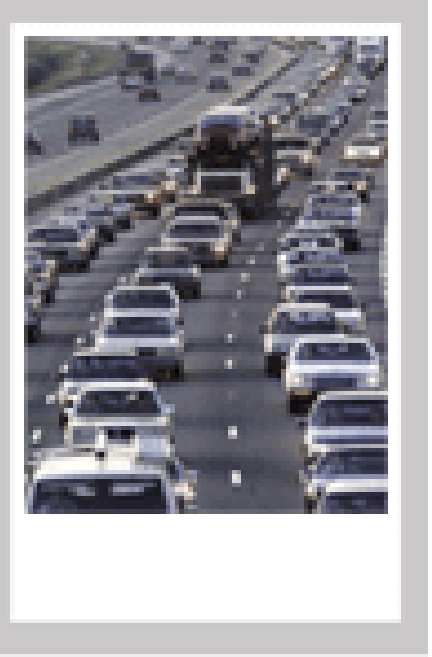
Why Biofuels?



Economy **(Rural Economy)**

Balance of Trade

National Debt



2005 U.S. Liquid Biofuel Consumption for Transportation

(x 10^9 gal)

- Ethanol 3.9
- Biodiesel 0.08

} **2.6 %**

With existing and new capacity, there is a

170 billion gallon opportunity for biofuel

Is Enough Biomass Available?

- Ethanol from corn grain is estimated to provide up to 16 – 18 billion gallons.

- Current amount of oil and fat available could provide about 2 billion gallons of biodiesel

- Suggested that cellulosic ethanol can be sufficient to significantly reduce, or even eliminate, petroleum dependence, but is there enough cellulose?

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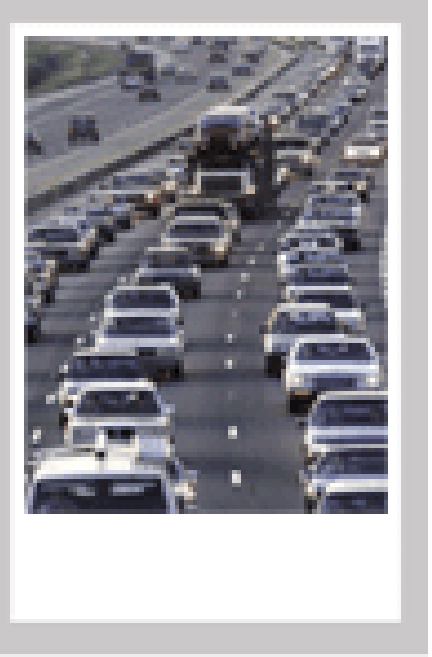


Future U.S. Transportation Fuel Needs?

(x 10^9 gal)

- Ethanol 18
- Biodiesel 2

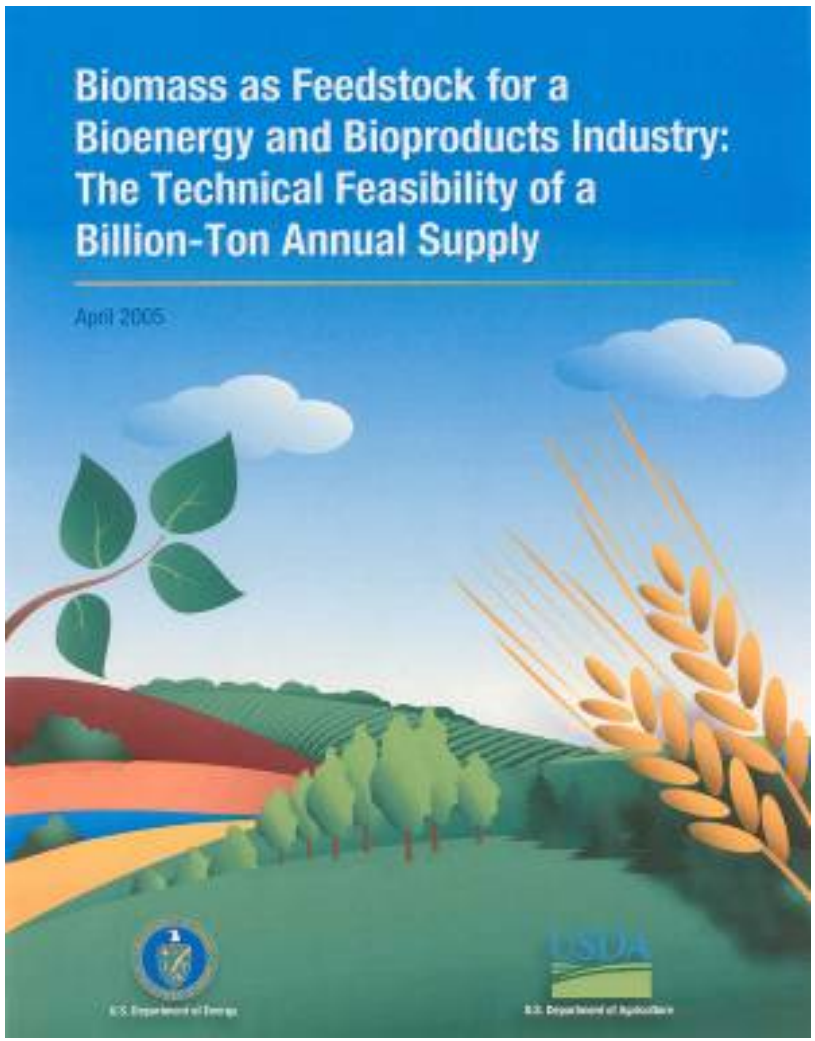
A 160 billion gallon opportunity remains for cellulosics

Cellulosic Potential

The Billion Ton Report

1 1/3 billion dry tons of cellulosic material can be sustainably produced each year.

Agriculture – 998 million dry tons
Forestry – 368 million dry tons



Economic Potential for Agriculture

One billion dry tons @ $40/dry ton = $40 billion

For comparison (November 2005):

- **Corn**
  11 billion bushels @ $1.79/bu = $19.7 Billion
- **Soybean**
  3 billion bushels @ $5.68/bu = <u>$17.0 Billion</u>

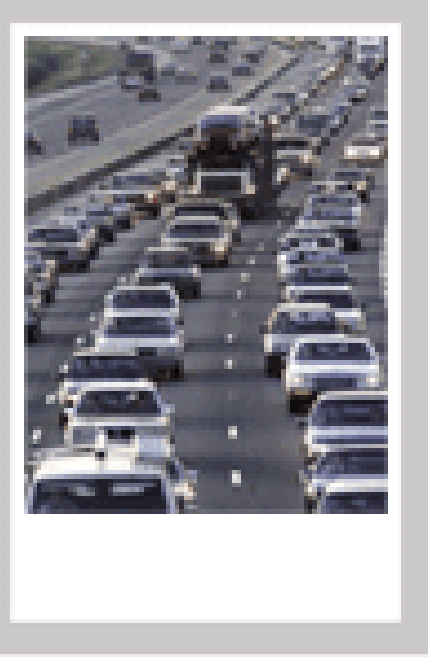
Total = $37 Billion

Cellulosic Potential

1 1/3 billion dry tons can be converted into:

- **80 billion gallons of ethanol**
  (@ 60 gallons of ethanol per dry ton)
- **145 billion gallons of ethanol**
  (@ 110 gallons of ethanol per dry ton)

When adjusted for relative energy content this would provide the equivalent of from 50 to 100 billion gallons of gasoline



Transportation Fuel With "Billion-Ton" projection

(x 10^9 gal)

- Ethanol 118
- Biodiesel 2

Still 60 billion gallons short

Options

- Increase biomass feedstock availability
- Improved feedstock-to-fuel conversion efficiency
- Reduce transportation fuel demand
- Other

The Major Barrier That Must Be Overcome To Commercialize Bioenergy

Cost

- **Feedstock**
- **Conversion**
- **Delivery**

Barriers

- Sustainable Feedstock Production and Delivery
  - Natural Resources
    - Water
  - Ecology
  - Social Acceptability
- Fuel vs. Food and Feed
- Other

-Issues are often raised to support arguments that renewable biofuels are a bad idea.

-However, these issues do need to be addressed.

Technology To Improve Feedstock

- Genetic modification of feedstock plants
- Selection of adapted plants
- Improved production practices
- Match feedstock characteristics with conversion requirements
- Improved logistics

With the overall goal of improving quantity, quality, economics, and sustainability

Raise Energy Crops Adapted to Environment

- Ecoregions – geographic regions for which thermal and moisture (amount and season) determine dominant plant populations.

Is There Enough Cellulosic Biomass?

Yes!

Given policies are enacted that appropriately address both energy demand and feedstock supply

Urgent Need For The Industry to be Born

Need to start the learning curve necessary to develop an effective, efficient industry

- **Need to create a market for cellulosic biomass feedstock. Currently no need to produce or deliver feedstock because there is no market.**
  - **Once industry is functioning, the issues associated with feedstock supply will be resolved.**

To Process a Billion Dry Tons

Would require 1,000 facilities that each can handle 1 million dry tons per year

If each cost $300 Million to construct, the total is $300 Billion

About what it costs to import oil for one year

Another Way For Biofuels To Become Competitive?

A CRISIS