Biomass in the United States Energy Economy

International Biomass Conference and Expo
Dr. Richard Newell, Administrator
May 03, 2011 | St. Louis, Missouri
Overview

- The potential for biomass and biofuels
  - Potential biomass supply chain
  - Biofuel corporate landscape
  - US biomass consumption by sector and type

- Electricity sector
  - Reference case power generation projections
  - Alternative cases

- Liquid fuels sector
  - Current state of industry
  - Reference case biofuel projections
  - Effects of fuel efficiency
  - Sensitivity on E15 penetration

- EIA data available to the public
  - Ethanol
  - Biodiesel & renewable diesel
  - Biomass for electricity
There are many sources and many uses for biomass

**Raw inputs**
- Corn
- Soy
- Other seed crops
- Livestock
- Forestry
- Energy crops
- Municipal solid waste

**Feedstocks**
- Virgin oils
- Starch
- Fiber
- Fat & grease
- Lignocellulose

**Energy products**
- FAME biodiesel
- Renewable diesel
- Ethanol
- Butanol
- Gasoline
- Diesel
- Heat & power

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Corporate landscape for 1\textsuperscript{st} generation biofuels

- **Alcohol production**
  - Vertically integrated majors: Archer Daniels Midland
  - Large refiners: Poet Ethanol (throughout U.S.), Valero Refining (throughout U.S.), Green Plains Renewable Energy (Midwest), Flint Hills Resources, LLC (IA), Abengoa (KS, IL, NM, NE, IN)
  - Medium/small refiners: Big River (East IA, West IL), The Andersons (West OH, IN, South MI), White Energy (TX, KS), Aventine (Central IL, NE), Biofuel Energy (MN, NE)

- **Diesel blendstocks**
  - Vertically integrated majors: Archer Daniels Midland
  - Large refiners: Renewable Energy Group, Renewable Biofuels, Imperium Renewables, Biodiesel of Las Vegas, Green Earth Fuels of Houston, Louis Dreyfus, Delta Biofuels, Inc
Next generation biofuel companies are developing numerous strategic relationships.

**Technology Companies**
- Codexis
- Iogen
- Virent
- Vercipia
- Butamax
- Danisco
- Solazyme
- Zeachem
- Mascoma
- Terrabon
- Solix
- Algenol
- LS9
- Amyris

**Partners**
- Royal Dutch Shell
- BP
- Du Pont
- Chevron
- Valero
- Dow Chemical
- Proctor & Gamble
- Tate & Lyle

**Products and co-products**
- Biofuels: Gasoline, Diesel, Ethanol, Butanol, Biodiesel, Lubricants
- Chemicals: Polymers, Consumer products, Nutraceuticals

**Technology Legend**
- 2nd generation alcohols
- 2nd generation non-alcohol liquids
- Genetics companies
- 3rd generation biofuel producers
EIA projects that consumption of biomass for liquid fuels and power will increase significantly, driven primarily by cellulosic biofuels.

US biomass supply
quadrillion Btu per year

Source: EIA, Annual Energy Outlook 2011
Despite this rapid growth, under current policies, fossil fuels still provide 78% of U.S. energy use in 2035.

Source: EIA, Annual Energy Outlook 2011
Policy and crude oil prices have worked in favor of biofuels

US biofuels consumption
million barrels per day

Source: EIA, Annual Energy Outlook 2007 and 2011
The future market for biofuels depends on the world oil price path, which is highly uncertain.

Annual average price of low sulfur crude oil, real 2009 dollars per barrel.

Source: EIA, Annual Energy Outlook 2011
In EIA projections, cellulosic biomass of three different types is consumed in liquid fuels and for power production

cellulosic biomass consumption
quadrillion Btu per year

Source: EIA, Annual Energy Outlook 2011
Liquid fuels markets and electric power compete for the same biomass supply in EIA projections

- Behind the projection, EIA has a large biomass potential supply over a range of prices
- As crop yields and other farm management practices improve, biomass available in a given year increases
- But the liquid fuel sector does not have access to urban/mill residues and forestry residues from Federal lands, which limits some of the growth
Electricity
Natural gas, wind and other renewables account for the vast majority of capacity additions from 2009 to 2035

**2009 capacity**
- Natural gas: 351 (34%)
- Coal: 313 (30%)
- Nuclear: 101 (10%)
- Hydropower*: 99 (10%)
- Other renewables: 15 (1%)
- Wind: 32 (3%)

**Total capacity: 1,033 gigawatts**

**Capacity additions 2009 to 2035**
- Natural gas: 135 (60%)
- Other renewables: 28 (12%)
- Wind: 25 (11%)
- Hydropower*: 3 (1%)
- Nuclear: 6 (3%)
- Coal: 14 (6%)
- End-use coal: 14 (6%)
- Other fossil: 1 (0.4%)

**Total capacity additions: 223 gigawatts**

* Includes pumped storage

Source: EIA, Annual Energy Outlook 2011
Non-hydro renewable sources grow nearly three-fold, meeting 22% of projected electricity generation growth

non-hydropower renewable generation
billion kilowatthours per year

Source: EIA, Annual Energy Outlook 2011
In the Reference Case, power generation from biomass sources is limited in the electricity sector; main growth in co-generation

Source: EIA, Annual Energy Outlook 2011
When renewable tax credits are extended indefinitely, wind and solar capture market share at the expense of biomass and geothermal.

Total electricity generation
billion kilowatt hours per year

Source: EIA, Annual Energy Outlook 2011
Liquid fuels
The liquid fuels industry landscape has changed rapidly in recent history due to the economy, biofuels, fuel economy, and oil prices.

- Liquid biofuels provide blendable fuels for transportation
- Makes them one of the most straightforward substitutes for petroleum
- But the path has been and remains challenging
The import share of liquids consumption drops over the projection due in part to increased fuel efficiency and biofuel production.

U.S. liquid fuels consumption
million barrels per day

Source: EIA, Annual Energy Outlook 2011

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Domestic biofuels production grows rapidly, displacing 1.25 million barrels per day of gasoline and 360,000 barrels per day of diesel by 2035.

Source: EIA, Annual Energy Outlook 2011
New light duty vehicle fuel economy achieves almost 38 mpg by 2035 in the Reference case, slowing the growth of fuel demand.

Summary of standards:

- **2012-2016:** 34.1 mpg CAFE average (based on NHTSA vehicle footprint sales distribution)
- **2020:** 35 mpg by statute
- **2017-2025:** Reference case *does not* include proposal planned for September 2011

Source: EIA, Annual Energy Outlook 2011
FFVs make up the largest share of unconventional vehicles, which account for 40% of U.S. light-duty vehicle sales in 2035.

Source: EIA, Annual Energy Outlook 2011
E85 infrastructure needs for meeting the RFS depend on the penetration of E15 into the marketplace

Ethanol blending into E85
1000s of stations

Source: EIA, Annual Energy Outlook 2011
Summary and view to the future

- Policy changes and higher oil prices are moving the United States to more use of biofuels

- Uncertainties still lie ahead
  - Land use
  - Infrastructure changes
  - Technology development
  - Political and market uncertainties
For more information

U.S. Energy Information Administration home page | [www.eia.gov](http://www.eia.gov)

Short-Term Energy Outlook | [www.eia.gov/steo](http://www.eia.gov/steo)

Annual Energy Outlook | [www.eia.gov/aeo](http://www.eia.gov/aeo)

International Energy Outlook | [www.eia.gov/ieo](http://www.eia.gov/ieo)

Monthly Energy Review | [www.eia.gov/mer](http://www.eia.gov/mer)

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