

Legislating Biofuels in the United States

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Introduction

- **NREL:** U.S. Department of Energy's primary R&D laboratory for energy efficiency, renewable energy technologies
- **NREL Center for Transportation Technologies & Systems (CTTS)**
 - Develop advanced vehicle and fuel technologies, helps to move them from R&D to markets
 - Collaborate on R&D with other agencies, public and private organizations, and industry
- **CTTS Fuels Performance Group**
 - Evaluates fuel chemistry at the fuel-engine interface
 - Examines performance and emissions impacts

Why Legislate Biofuels?

- **Plentiful U.S. biomass resources:** energy crops, agricultural and forestry residues, and others provide a domestic fuel source
- **U.S. “Billion Ton Study”** (2005) estimates 1.3 billion tons of feedstock annually, containing energy equivalent of 3.5 billion barrels of oil
- **Develop a strategy to reduce U.S. petroleum consumption and increase energy security**
- **Reduce greenhouse gas (GHG) emissions**



Background

- **Alternative Fuels Motor Act of 1988:** Calls for demonstrations, provides credits for purchasing alternative-fuel vehicles (AFVs)
- **Energy Policy Acts of 1992 and 2005:** Establishes programs for government fleets, renewable fuels standards, tax incentives
- **Executive Orders (1991-2007):**
Use AFVs in federal fleets, reduce petroleum use, increase alternative fuels use
- **January 2007 Presidential State of the Union Address:**
Reduce gasoline demand by 20% (36 bgy of alternative fuels) by 2017 (“20 in 10”)



New Legislation: EISA

- **Energy Independence and Security Act (EISA) of 2007** signed by President Bush in December 2007; takes effect in January 2009
- **EISA biofuels provisions** include Renewable Fuel Standard:
 - Mandates U.S. increase sales of biofuel to **36 bgy** by 2022 (2006 world production: ~13,500 million gal/yr)
 - Places 15-bgy cap on corn (starch-based) ethanol to meet 2022 target
 - Calls for 21 bgy by 2022 from advanced or cellulosic biofuels (e.g., from corn stover, switchgrass, wood chips, fast-growing trees, other feedstocks)

EISA (continued)

- All new **biofuel production facilities** built in January 2008 and beyond must reduce GHG emissions (compared with a baseline) by
 - 20% for conventional biofuels (e.g., corn ethanol)
 - 50% for advanced biofuels (e.g., sugar ethanol) and biomass-based diesel fuel
 - 60% for cellulosic biofuels made from non-food/feed feedstocks



EISA (continued)

- **To qualify as renewable fuels**, biofuel feedstocks must be grown on land cleared for cultivation before December 2007
- **Bans land-use changes** in the US that are (or could be) detrimental to agriculture, grazing, and/or the environment



EISA (continued)

- Increases corporate average fuel economy (**CAFE**) requirement to 36 mpg (15.3 km/L) by 2020
- Allows **credits** for flex-fuel vehicles, AFVs, and electric vehicle technologies
- Calls for **more federal R&D** in optimized engines, energy storage, and lightweight materials; feasibility studies for E85 and pipelines



EISA (continued)

- U.S. Environmental Protection Agency (EPA) must perform **environmental impact assessments** of biofuels production every 3 years, covering water, soil, air quality, biodiversity, ecosystem health
- EPA has authority to mitigate any **air quality impacts** of renewable fuels (similar to authority for fossil fuels)



EISA Sustainability Issues

- Mandates minimum reductions in life-cycle GHG emissions from renewable fuels
- Discourages use of food and feed crops as feedstocks; encourages use of other feedstocks (e.g., switchgrass)
- Permits use of cultivated land, bars land-use changes in US
- Addresses environmental and food crop issues



Farm Bill Provisions: Biofuels

- U.S. Congress passed new farm bill in May: Food, Conservation and Energy Act of 2008
- Provides for grants of up to 30% of cost to develop and build demonstration biorefineries for advanced (e.g., cellulosic) biofuels
- Establishes new credit for producing cellulosic ethanol of \$1.01/gallon (applies only to fuels produced and used in United States)
- Provides funds for “Rural Energy for America Program”
- Continues Biomass Research and Development Initiative sponsored by Departments of Energy and Agriculture

Where We Are Now

- Almost all of today's U.S. **ethanol** supply (about 6.5-bgy) is produced from corn
- Could reach 12 bgy in a few years, but capped at 15 bgy by EISA
- All U.S. cars can run on gasoline containing 10% ethanol **E10**;
- R&D underway on **E15/E20**
- **Flex-fuel** vehicles can run on **E85** or any mixture of gasoline and ethanol
- **Cellulosic ethanol** is now produced in pilot and start-up plants
- U.S. **biodiesel** production capacity has grown to ~500 mgy (per NBB); EISA mandates 1 bgy by 2012



Where We Want to Be

- To produce 36 bgy of affordable renewable fuels in the United States by 2022, we need to develop the most promising technologies
- The **technologies** can include any or all of these: cellulosic ethanol, biodiesel, green diesel, bio-butanol, syngas liquids, bio-oil derivatives, hydrogen from biomass, diesel and other fuels from microalgae, hydrocarbons from carbohydrates



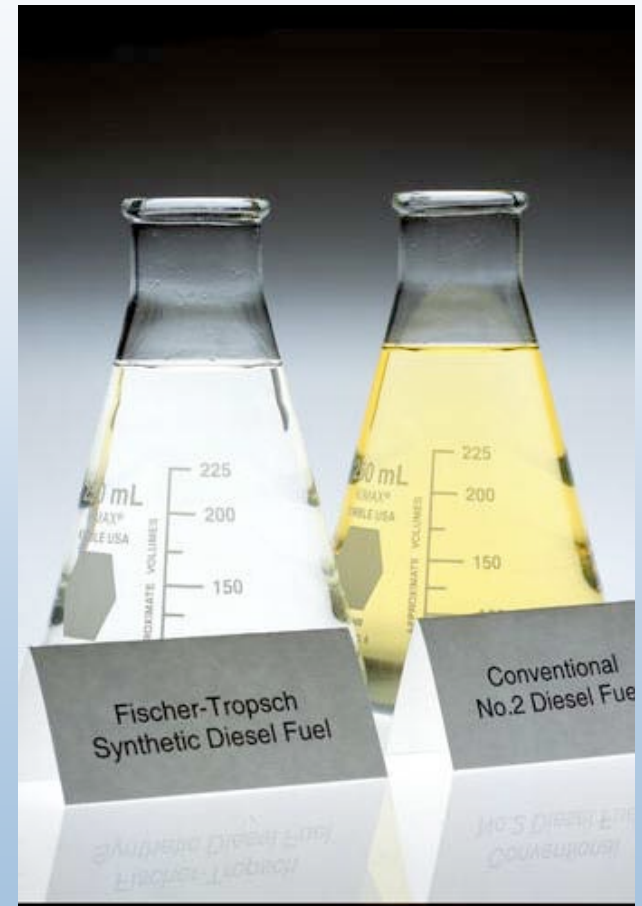
U.S. DOE Activities

- Support R&D in many types and uses of biofuels, often with industry partners
- Call for reducing costs of most efficient and promising options
- Analyze type and quantity of air emissions and seek most environmentally benign choices
- Analyze infrastructure opportunities, options, and issues
- Could also work with EU on standards for uniform product quality



Fuels Research at NREL

- Investigates new fuels and lubricants meeting strict emission standards
- Determines how fuel and lubricant properties affect emission controls
- Investigates fuel property effects on engine durability, performance and emissions/emission controls
- Conducts R&D to expand operating range of high-efficiency, low-emission combustion engines using advanced fuels
- Works to overcome technical barriers to markets for new liquid fuels (e.g., biodiesel, Fischer-Tropsch diesel) and gaseous fuels (e.g., hydrogen)
- Conducts R&D in fuels for advanced combustion concepts in highly efficient, clean engines



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