Advanced Biofuels for a Truly Sustainable **Renewable Future**



Advanced Biofuels USA www.AdvancedBiofuelsUSA.org 301-644-1395



Advanced Biofuels USA

501(c)3 Nonprofit Educational Organization

Founded April 2008

Website: www.AdvancedBiofuelsUSA.org

Frederick, MD

Advocates for the adoption of advanced biofuels as an

energy security,
military flexibility,
economic development
climate change mitigation
pollution control

solution.

Feedstock, Process, Product Agnostic

Renewable Fuels' Role in GHG Reduction Most Cost Effective/ Greatest Amount of GHG Reduction/ Shortest Time

Complement to EVs in the GHG Reduction Plan (Legacy, Long Haul, Aviation)

> Not just ethanol; Not just corn

> Benefits

 (Environmental Justice, Focus on High Pollution and Low Income Areas, Sustainability / Policy Considerations / Markets / Jobs)

> Our Proposals

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From Draft Maryland Greenhouse Gas Reduction Act Plan, page 20



Figure 2.3-2: Maryland GHG Projected Emissions by Sector.

Maryland's projected emissions in 2030 (106.04 MMTCO₂E) will represent a slight decline in GHG emission from the 2006 Base Year.

RENEWABLE FUELS: the <u>most cost effective</u> way to <u>reduce the greatest</u> <u>amount of GHG</u> in the <u>shortest amount of time</u> and bring investments and jobs.

Maryland Electric and Hydrogen Fuel Cell Vehicle Sales Projection through 2030 (page 69 GHGA Draft Plan)

Figure 4.3-6 below presents the projected ZEV deployment curve through 2030 based on a 2017 base year. Maryland costs to facilitate this level of deployment includes up to \$1.2 million annually through 2030 for the Electric Vehicle Recharging Equipment Rebate Program and other costs associated with matching federal grants to expand public EV charging infrastructure throughout Maryland.



California Low Carbon Fuel Standard Success of Renewable Fuels Reducing GHG

Cumulative C02 Reductions (million tons)

SOURCE: Califorina Energy Commission, Low Carbon Fuel Standard Dashboard



High octane fuels for high mileage vehicles

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Spot

Using Higher Octane of Alcohols to Increase Mileage

- High Octane = High Compression
- High Compression = Higher Thermal Efficiency
- Higher Thermal Efficiency = More Available Energy from Same Displacement
- Are Technologies Available?

Hydrogen or Ethanol for Fuel Cells

lydrogen Fuel Cell Electric Vehicle



What Are Renewable Fuels Used for Today? • Fueling Cars and Trucks

Heating Fuel

BIO

Diesel

RESS

world energy

• Fueling Aircraft

15% ETHANOL 30% ETHANOL

E-15

E15 De France Control Control

FLEX-FUEL

E485

FLEX-FUEL

E-85

UNITED

eco-skies

0

UNLEADED

inable aviation biofuel

UNLEADED

10% ETHANOL

ADDED

89

Biodiesel Blend

contains less than 5% biomass-based diesel or biodiesel ULTRA LOW-SULFUR HIGHWAY DIESEL FUEL (15 ppm Sulfur Maximum)

Required for use in all highway diesel vehicles and engines.

Recommended for use in all diesel vehicles and engines. **Renewable Fuels' Role in GHG Reduction** Most Cost Effective/ Greatest Amount of GHG Reduction/ Shortest Time

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Not just ethanol Ethanol is <u>a</u> biofuel, <u>not the only biofuel</u>.

Biodiesel Renewable Diesel DME Biogas/Renewable Natural Gas Biojet (Sustainable Aviation Fuel (SAF)) **Biobutanol** Renewable Hydrogen **Drop-in Hydrocarbons BioHeat** ® Cooking Fuel **Rocket Fuel**



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Feedstocks: Not Just Corn

- Algae
- Corn stover
- Corn cobs
- Energy cane
- Sorghum
- Forest waste, residues
- Municipal waste
- Sawdust
- Chicken manure
- Agricultural residues
- Dairy Waste
- Food Processing Waste

- Grasses such as
 - Switchgrass
 - Miscanthus
- Sugar beets/ Energy Beets
- Coffee grounds
- Jatropha
- Camelina, Carinata, Canol
- Cassava
- Paper/pulp mill waste
- Used telephone poles
- Oil seed crops
- Thin air
- Fatbergs
- Halophytes...

Renewable Fuels and Chemicals, Not Just Bio-Based -- Recycling Carbon

Waste Carbon as a Resource for Product Synthesis



- Flue Gas/Industrial Waste Gas
- Recycled Plastic, Tires
- Municipal Waste
- Carbon Capture and Reuse

Some Feedstock Conversion ProcessesBiochemicalThermochemical

- Fermentation
- Anaerobic digestion
- Plant extraction
- Transesterification
- Hydrolysis
- Enzymatic catalysis
- CO2-to-liquid biocatalytic conversion

Gasification
Plasma arc gasification
Pyrolysis
Hydrothermal liquefaction
Thermochemical conversion of sugars

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Energy Beet Projects in Maryland, Florida

Key concepts: NO lignin High yield (2 times corn/acre) Animal feed co-products

Energy Beet Biomass Bestation of Sing





Produced from Energy Beet Biomass

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Proteins for Poultry Feed Energy Beet Biomass After Processing

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Algae Projects in Maryland

Dr. Viji Sitther, Morgan State

EQUIPME

Manta Biofuel, Dr. Ryan Powell

New Brunswic/

Cyanobacteria Wastewater Treatment Agricultural Algae

Dr. Stephanie Lansing, UMD College Park

Process Path: Feedstock-to-Fuels and Products

Graphic by Zina Deretsky, National Science Foundation



Sustainability: Recycling Carbon / Life Cycle Analysis



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Oil Disruption--Geo-Political --1973 Oil Embargo Spurred Development of Home-Grown Fuel



GAS

Sales Limited to

PER CUSTOMER



2006 Ethanol Replaces Carcinogenic MTBE as an oxygenate, serves as a source of octane.

MTBE Cycle—does not breakdown; litigation, banned in multiple states



Ethanol

- Substitute for Carcinogenic Aromatics
- Replaces MTBE in Gasoline -- Urban Air Initiative
- Less Expensive, Less Harmful Octane
 Fuel for Fuel Cells

Biodiesel and Renewable Diesel

- Low Sulfur
- Cleaner Burning
- Fewer Particulates
- Less Maintenance





Why Replacing Fossil-Fuel Oil With Advanced Transportation Biofuels is Important—

> Solutions to Problems

- Reduce carbon footprints
- Erosion control
- Waste water treatment
- Remediation of contaminated soil
- Nutrient management
- Carbon sequestration
- Alternative to carcinogens / Air Qua
- Overflowing landfill relief/plastic recycling
- Burning agricultural waste in fields
- Grease (fatbergs) in sewers
- Contaminated black market used cooking oil

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A Few Types of Jobs Available in Advanced Biofuels from Feedstock Development and Production through Fuel Sales

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- Agronomists
- Farmers / Farm workers
- Farm equipment designers
- Biologists
- Chemists/ Chemical engineers
- Mechanical engineers
- Electrical engineers
- Researchers into bioenergy crop development
- Lab Technicians
- Industrial Engineers
- Plant Operations Managers
- Welders/Boilermakers
- Accountants

- Agriculture/horticulture experts
- Freight railroad operators, engineers, loaders, unloaders
- Equipment operators, technicians
- Farm product purchasers/traders
- Agricultural Inspectors
 - Computer Software Engineers
- Truck drivers
- Equipment operators
- Lawyers
- Office Personnel
- Investors
- Others?

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Renewable Fuels' Role in GHG Reduction

Shortest Time

- Fuel for existing planes, trains, automobiles, equipment
- Fuel for non-EV vehicles that will continue to be bought, especially by:
 Lower income people
 Rural residents
 Those with long commutes (responsible for many vehicle miles traveled)
- Don't have to wait for electricity to be renewable or batteries "fair trade"

Renewable Fuels' Role in GHG Reduction

Most Cost Effective

 People who can't afford EVs can lower carbon footprint of current and future vehicles with less expensive fuel (November 1, 2019, in the US. Fossil gasoline with no ethanol was \$3.09/gallon; with E15, more than 60 cents less (\$2.45) and E85 nearly a dollar less (\$2.14)

Infrastructure change to existing fuel stations; can be part of scheduled equipment replacement

Renewable Fuels' Role in GHG Reduction

Greatest Amount of GHG Reduction

Cumulative C02 Reductions (million tons)

SOURCE: Califorina Energy Commission, Low Carbon Fuel Standard Dashboard Graphic: Diesel Technology Forum



Proposals

- Include Renewable Fuels in GHG Reduction
 Plan
 - Financing Infrastructure and R&D
- Promote Development and Use
- Look at Low Carbon Fuel Standard models to address gaps
- Incorporate into regional Transportation and Climate Initiative (TCI)
- Disappearing Carbon User Fee
 Prioritize funding for renewable fuel infrastructure and use for low income and high pollution areas

Find out more: www.AdvancedBiofuelsUSA.org

For a Truly Sustainable, Renewable Future

Joanne M. Ivancic, Executive Director 301-644-1395 Info@AdvancedBiofuelsUSA.org



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History of Ethanol in US: Federal Policy

2007 Renewable Fuel Standard

Sec. 202 Energy Independence and Security Act of 2007 (Billion Gallons/Year)



Conventional Biofuel (mostly corn) Cellulosic Biofuel

- Biomass-based Diesel*
- Undifferentiated Advanced Biofuel
- After 2022 EPA determines volumes based on six criteria
- * After 2012, the volumes of biomass based diesel are determined by a regulatory process.

