Western Governors' Association:
Strategic Development of Biofuels in the Western States

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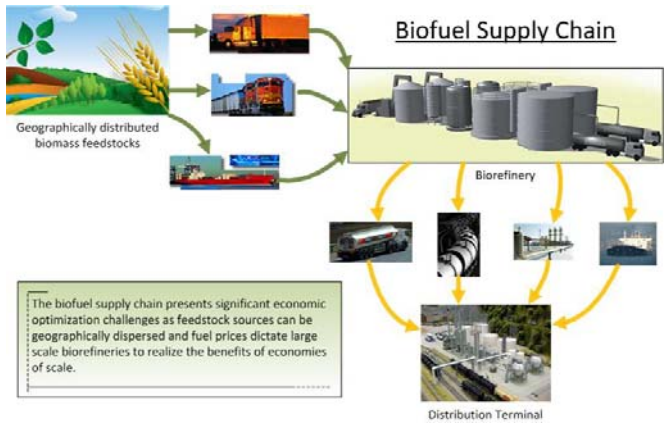
Abstract

The Western U.S. is well positioned to contribute to the nation's bioenergy future. This research examines the West's energy supply potential, the barriers to achieving the full potential, and the policy measures and incentives to enable the transformation to use the supply. The goal of this research is to help the Western governors identify their options for promoting biofuels in their states: feedstock and biofuel development and production.

The analysis investigates the biofuel conversion technologies that are currently available as well as technologies that are currently under development. The latter technologies are those that are far enough along the development path to potentially be available on a commercial basis in the relatively near term.

Geographic Information System modeling was used in conjunction with an infrastructure system cost optimization model to develop biofuel supply curves using biomass feedstocks throughout the Western U.S. Feedstocks considered include agricultural crop residues, beef tallow and yellow grease, forest biomass resources, herbaceous energy crops, orchard and vineyard trimmings, municipal solid waste biomass, and grain and oilseeds. The model estimates gallons of gasoline equivalent of biofuels per year that could be produced at varying prices using technologies and feedstocks that are anticipated available by 2015.



Objectives

• Develop a clear understanding of the contribution that biofuels can make to the transportation fuel requirements of the western United States by 2015.

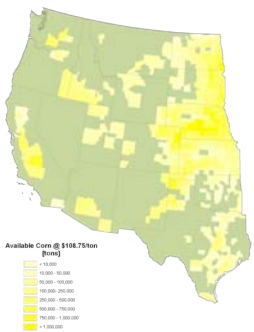
• Identify the regional differences in biomass supply that might affect policy decisions.

• Provide a recommended policy framework to create the environment in which bioenergy projects can appropriately develop.

Biomass Resource Assessment

Feedstock Class	Specific Feedstock	Method of Evaluation
Agricultural Resources		
Residues	Corn stover, small grain straws	Residues not needed for erosion prevention are available
Grains	Corn	FAPRI projections
Herbaceous Energy Crops	Switchgrass	Native grass yields on marginal lands
Oilseed Crops	Soy, canola	FAPRI projections
Forest Resources		
Forest Thinnings	Public and Private lands includes juniper and pinyon pine	Biomass is secondary output of forest management practices
Residues and Byproducts		
Animal Fats & Waste Greases	Beef Tallow, Pork Lard, Yellow Grease	Based on meatpacking industry Assigned by population
Municipal Solid Waste (MSW)	Wood residues, paper, yard waste, etc	Assigned by population from aggregate state statistics
Woody Residues	Orchard and vineyard waste	Yields and acreage

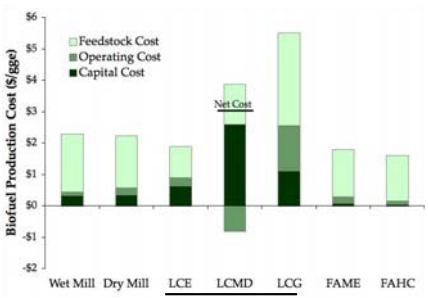
Corn Resources



Conversion Technologies

Current Representative Technologies	
Grain to Ethanol - Dry Mill	Dry Mill
Grain to Ethanol - Wet Mill	Wet Mill
Fatty Acid to Methyl Ester	FAME
Technologies Projected to be Available in 2015	
Lignocellulosics to Ethanol - Fermentation/Hydrolysis	LCE
Lignocellulosics to Middle Distillates - Fischer Tropsch	LCMD
Lignocellulosics to Gasoline - Upgrading/Pyrolysis	LCG
Fatty Acids to Hydrocarbon - Hydrotreatment	FAHC

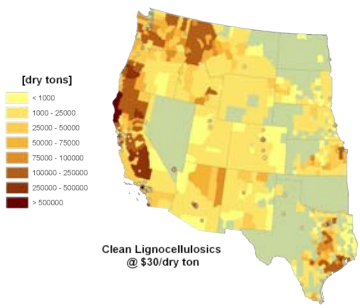
Conversion Cost by Technology

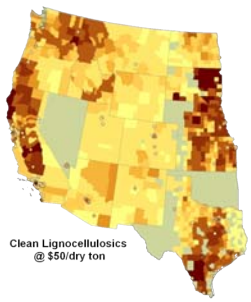


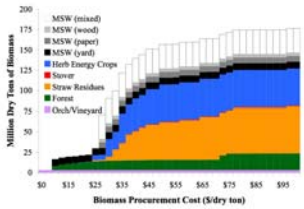
LCBF

Currently conversion of Lignocellulosic Biomass to Ethanol (LCE) is the Lignocellulosic Biofuel (LCBF) technology closest to commercialization and it is used in the study to represent the cost and performance characteristics of future LCBF technology and as the basis of projecting LCBF production capacity by 2015 in the Western States. Other technologies may be in play by 2015 if development is accelerated.

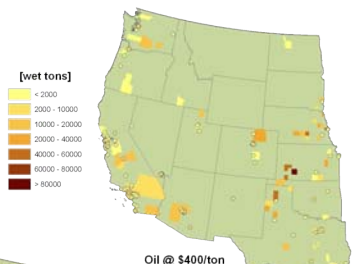
Lignocellulosic Feedstock Resources

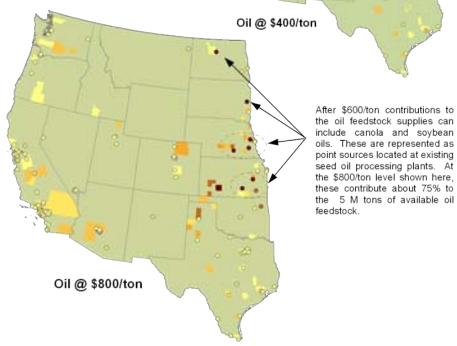


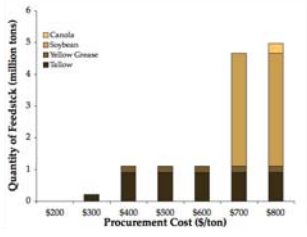




Oil Feedstock Resources







Spatial Supply Optimization Model

The resource assessment and conversion cost models are combined with a geographic transportation cost model in an integrated supply chain optimization model. This model analyzes the supply chain in order to maximize the profitability of producing biofuels at given market prices. In doing so, it chooses:

• Location of the biorefineries

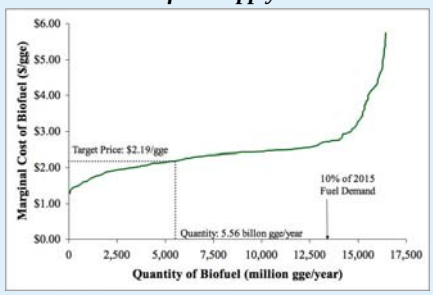
• Conversion technology and size of each biorefinery

• Allocation of resources to biorefineries

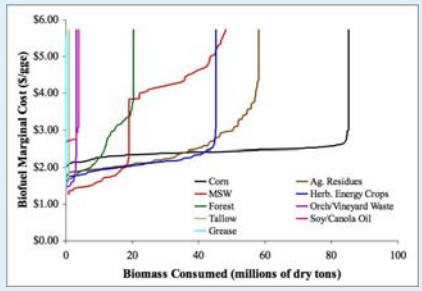
The choice set and costs are defined through a Geographic Information System (GIS) model. The potential sites for biorefineries were chosen using logical criteria including access to transportation infrastructure, access to labor, and distance between potential sites. The transportation cost were calculated over exiting road, rail and marine transportation networks.

Supply Curves for Biofuels in the WGA Region

Biofuel Supply

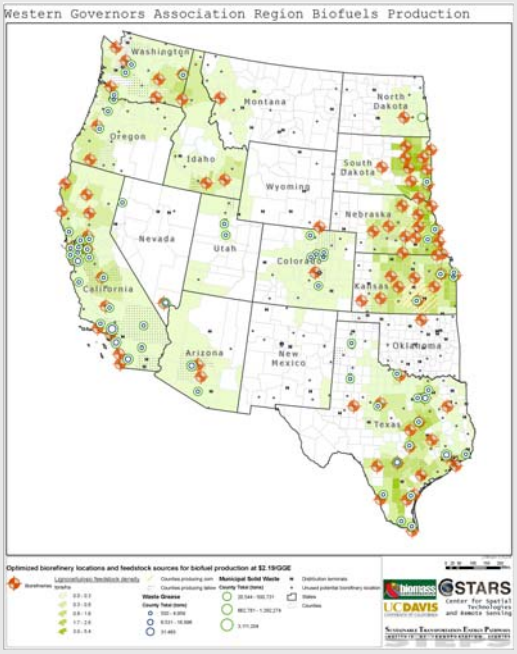


Biomass Resources Consumed

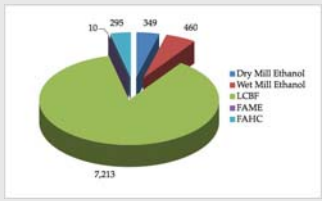


Marginal cost of biofuel includes cost of production and delivery to the nearest distribution terminal. Taxes, local distribution and marketing costs are excluded.

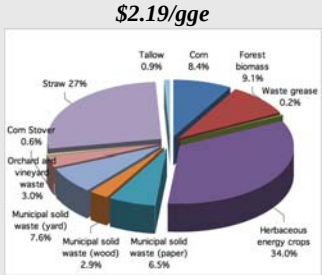
Target Price Biofuel Production System



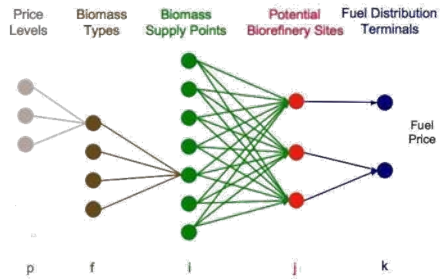
Breakdown of Output Fuel at $2.19/gge



Resource Consumption at $2.19/gge



Model Diagram



Conclusions

The results illustrate the potential to produce substantial quantities of biofuels from western U.S. biomass resources, but they are also subject to substantial uncertainties. In interpreting the supply estimates, unresolved questions remain regarding economic performance of the different conversion technologies and the overall sustainability of many of the biomass resources considered.

The region-wide supply is most sensitive to the following factors.

- The development of low-cost cellulosic ethanol technology or a technology with similar performance to LCE as modeled,
- The availability and yield of herbaceous energy crops from marginal farmland,
- The price and availability of corn for fuel production,
- Acceptability of MSW resources as a biofuel feedstock,
- Access to forest resources.

Policy Recommendations

Based on the Western Governors' policy resolution: 08-02 Transportation Fuels for the West (February 2008), the Transportation Fuels Advisory Committee Report submitted to the Governors: Transportation Fuels for the Future: A Roadmap for the West (February 2008), and the Biofuels Teams Reports to the Western Governors. www.westgov.org

Decisive leadership is needed at the federal and state levels to expand biofuels production and use in ways that deliver sustainable biofuels to consumers at lower prices, more efficiently, and in greater quantities. The necessary policy framework requires: sustained expansion and improved alignment of research, demonstration and technology transfer efforts in the federal, state, and private spheres; innovations and support for biofuel feedstock supply; increases in the biofuels demand floor; [deleted] innovative approaches to catalyzing infrastructure for higher blend ethanol fuels and other biofuels; and increasing attention to sustainability standards ensuring environmental and other intended policy benefits are satisfied.

Priority policy recommendations for action at the federal, state and regional level include:

Research, Demonstration and Technology Transfer

- Fund federal and complementary state biomass research and demonstrations in feedstocks, including yields and production; biomass collection; and sustainability.
- Promote a common fuel life cycle analytic methodology to evaluate greenhouse gases and land, air and water impacts.
- Develop a regional framework for a performance-based greenhouse gas standard for transportation fuels such as a low-carbon fuel standard.

Cellusosic and Other Biofuels Feedstock Supply

- Provide government assistance to implement short- and medium-term burden sharing for producers including low interest loans and other fiscal and economic incentive mechanisms. Expand federal and state technical producer assistance.
- Establish a low-carbon renewable fuels loan guarantee program.

Increasing Demand for Biofuels

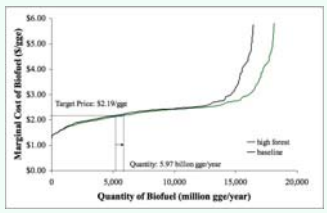
- Promote and support use of E85 and bio/renewable diesel in government fleets and supply contracts.
- Support implementation of the expanded Renewable Fuels Standard.

Production and Infrastructure

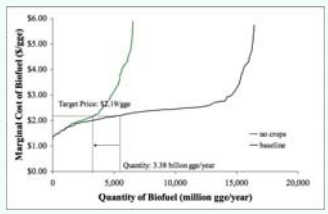
- Support development of infrastructure for an alternative fuels future including feedstock transportation, fuel storage and distribution, and fueling facilities.
- Adopt a city-to-region approach for E85 infrastructure.
- Federally support long-term interest loans for bio/renewable diesel infrastructure, refining, and production agriculture.

Sensitivity Analysis

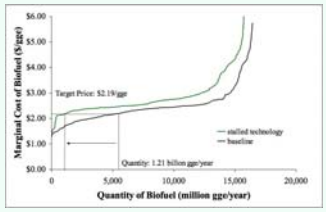
High Forest Resource



No Dedicated Energy Crops



Stalled Technology



Corn Price