POLICY GAP ANALYSIS: FINDINGS & POLICY RECOMMENDATIONS FOR THE BIOMASS SECTOR

PREPARED FOR: THE BIOMASS R&D
TECHNICAL ADVISORY COMMITTEE'S
POLICY SUBCOMMITTEE

PREPARED BY:
POLICY SUBCOMMITTEE CHAIR JAMES BARBER, CEO METABOLIX
AND BCS, INCORPORATED

February 21, 2007

Introduction

The Biomass Research and Development Initiative (BRDI) is the multi-agency effort to coordinate and accelerate all Federal biobased products and bioenergy research and development in the United States. BRDI is guided by the Biomass Research and Development Act of 2000, passed in June of 2000 (Title III of the Agricultural Risk Protection Act of 2000, P.L. 106-224), and revised by section 937 of the Energy Policy Act of 2005. The Act established the Biomass Research and Development Technical Advisory Committee - a group of 30 individuals from industry, academia, state government – to advise the Secretaries of Energy and Agriculture on the direction of biomass research and development..

The purpose of this paper is to analyze existing policies impacting bioenergy and biobased products and to evaluate their effectiveness. It also is to identify policy gaps which exist, to develop recommendations which will improve biomass-related policies, and to influence biomass policy discussion and decision making, in particular the upcoming discussions regarding the 2007 Farm Bill.

To complete this analysis, the Biomass R&D Technical Advisory Committee surveyed existing policies related to biomass technologies. This included a literature search as well as discussions with experts in the field. Policies were analyzed based on their effectiveness in furthering biofuels, biopower, or biobased products. They also were analyzed in terms of their perceived effectiveness in meeting the Committee's Vision goals.

The status of the role of biofuels, biopower, and biobased products was assessed and major barriers to further market penetration were identified. The effectiveness of relevant policies at affecting market penetration was then evaluated. This analysis is summarized in each of the Biofuels, Biopower, and Biobased Products policy matrices included in this document. From this analysis, Committee members then developed recommendations for improving existing policies. If there were no existing policies promoting the development of biomass technologies in key areas, new policies were recommended.

The paper is organized into three major sections: biofuels, biopower, and bioproducts. Each section lists findings related to a specific policy or key area of biomass technology. Each finding is followed by a policy recommendation. In cases where there is no existing policy, recommendations regarding new policy options are provided. Appendices A-C provide additional information used to develop this analysis. Appendix A contains tables highlighting key bioproducts. Appendix B provides a list of all biomass-related policies, and Appendix C is a proposal submitted by the Committee for the U.S. government to consider which outlines a comprehensive program to promote the increased production of biobased products and bioenergy research and development in the United States.

TABLE OF CONTENTS

I. BIOFUELS

Findings and Recommendations

1 The Federal Renewable Fuels Standard (RFS)

Finding: The RFS in EPAct 2005 mandates 7.5 billion gallons per year of renewable fuels production by 2012. Current renewable fuels production is on track to meet this near term goal. Ethanol from corn is in line to meet goals over the next few years (based on an estimate: one billion gallons per year of sustained growth) although growth of ethanol from corn sugar beyond 15 billion gallons per year targets faces several significant barriers, including agricultural inputs (cost of fuel, fertilizer), scarcity of land (urbanization and lack of arable land), competition with other uses, and lack of feedstocks other than corn (e.g., sugar cane, sugar beet, other crop starches, and cellulosic materials such as switchgrass). Moreover, tax incentives with short term sunset clauses do not provide the investment community the level of comfort needed to make long-term investment.

1.1 *Recommendation: Establish Broader-based RFS*
The Federal Government should establish an even broader-based RFS for the transportation sector, targeting a higher percentage of consumption of biofuels. Moreover, incentives should have longer time horizons to attract the long-term capital investments needed for the development of the production and distribution network required to achieve biofuels goals. Additional funding for future incentives should be targeted at cellulosic biofuels (biochemically or thermochemically produced).

2 Volumetric Ethanol Excise Tax Credit (VEETC)

Finding: In 2004, ethanol and biodiesel constituted approximately 1.5 percent and 0.9 percent of the gasoline and diesel markets, respectively. Ethanol has received sustained federal support through VEETC a $0.51 per gallon tax credit for blenders who blend ethanol with gasoline. Only recently have Federal programs begun to support other biofuel options, such as biodiesel, through the Biodiesel VEETC which provides $0.50 per gallon for biodiesel ($1.00 for agri-biodiesel and renewable biodiesel). VEETC has been one of the most successful biofuels policies to date and can help the market share of biofuels to grow. The current market demand for increased oxygenates is adequate to drive growth of ethanol by one billion gallons per year through 2012 which should reach the RFS of 7.5 billions gallons by 2012.[i] Put in perspective, demand for oxygenates in 2004 was only 1.2 percent of the total 2.1 billion gasoline-equivalent gallons (GGE) of transportation fuels (includes gasoline and diesel).

2.1 *Recommendation: Diversification of Feedstocks*
Diversification of the feedstocks for biofuels will strengthen continued growth of biofuels. Funding for competitive R&D should be expanded by at least an order of magnitude over 2006 levels to be more aligned with the President's Twenty in Ten goal. [ii] *Credits for*

[i] Personal communication from Jeff Cooper, NCGA, in April, 2006. Numbers were still being vetted in final report.
[ii] The President's Twenty In Ten Goal: Increasing The Supply Of Renewable And Alternative Fuels By Setting A Mandatory Fuels Standard To Require 35 Billion Gallons Of Renewable And Alternative Fuels In 2017 – Nearly Five

alternative biofuels should be implemented. Funding should be structured to reduce the cost and lower the barriers to commercialization of cellulosically derived biofuels as well as grain derived biofuels. Cellulosic production methods and technology may deserve disproportionate funding to support a more competitive market price for cellulosically derived biofuel. Grain derived biofuel production technology that reduce production costs should also be pursued. Biofuels should not be separated into different commodities based upon the feedstock they came from.

3 Federal Fleet Requirements (FFR)

Finding: FFR is a mandate which can be met through the use of alternative vehicles and/or fuels.

3.1 *Recommendation: Mandates and Incentives*
FFR is a gateway policy for more widespread use and creates a base market for renewable fuels. Continued development of mandates and incentives, not preferences, must be instituted as federal (and local) policies.

4 The Clean Air Act (CAA)

Finding: CAA requires reformulated gasoline (RFG) be used in non-attainment areas to reduce harmful emissions of ozone. As the phase out of MTBE as a fuel oxygenate nears completion, ethanol has become the primary oxygenate additive increasing ethanol consumption and production.

4.1 *Recommendation: Environmental Programs and Regulations*
Continued application of environmental programs and regulations such Clean Cities, the CAA*, and Regional Environmental Greenhouse Gas agreements will encourage the increased use of biomass for fuels, power, and products.*

5 Multi-agency Panel

Finding: We find that multi-agency panels are an effective tool to analyze and implement policy initiatives which have broad-based implications. We recommend the federal government develop a multi-agency panel to analyze the following potential policy initiatives:

5.1 *Recommendation: Cellulosic Biofuels*
Major new initiatives are needed in support of cellulosic biofuels commercialization efforts (as distinct from R&D). The committee recommends that the federal government analyze the idea of a "Government Biofuels Authority" (see Appendix C), as one such approach.

5.2 *Recommendation: Private Investors*
Potential private investors in biofuels require a stable and predictable policy environment for making long-term capital investment decisions. The government should help create

---

Times The 2012 Target Now In Law. Reforming And Modernizing Corporate Average Fuel Economy (CAFE) Standards For Cars And Extending The Current Light Truck Rule.

this policy environment. The committee recommends that the federal government analyze several approaches for potential implementation, including

5.2.1 Recommendation: A National Carbon Emissions Policy
(See recommendation in Cross Cutting Section).

5.2.2 Recommendation: Setting a Floor Price on Oil
The world market price falling below a prescribed level would trigger government revenues that could be used to help provide incentives for production of biofuels.

Biofuels Policy Matrix

Goals	Status	Gaps	Barriers	Policies	Policy effectiveness[3]
Biofuels Consumption 2010: 8.0 Billion GGE 2015: 13 Billion GGE 2020: 23 Billion GGE 2030: 50 Billion GGE	**Biofuels Consumption** 2004: 2.1 billion GGE renewable fuels consumed in transportation sector. 2005: Ethanol production was 4.3 B gal with 1.7 B gal in planned capacity; 2005: Biodiesel production was 70-75 million gal with 278 million gal in planned new capacity.	Production, distribution, transportation, and storage infrastructure for biofuels is inadequate to meet Vision goals.	Motor gasoline production and distribution infrastructure is mature. Biofuels are not currently allowed access to pipelines even in low level blends, Pipeline infrastructure is not currently available to biofuels.	Production - Clean Fuel Tax Deduction - Ethanol and Biodiesel Tax Credit (VEETC) - Small Ethanol Producer Credit - Small Agri-Biodiesel Producer Credit	 P E P P
				Consumption - The Clean Air Act and Federal RFG Areas - Federal Fleet Requirements - Federal Renewable Fuels Standards - State & Alternative Fuel Provider Rule	 E E N/A
				Distribution/Infrastructure - Alternative Fuel Infrastructure Tax Crédit - Federal CCC Bioenergy Program[4]	 N/A E
	Ethanol Cost Ethanol from corn: $1.10/gal Ethanol from cellulose: $2.25/gal	Significant technical gaps to achieving ethanol from cellulose@ $1.07/gal by 2012.	Petroleum prices historically have been relatively low resulting in a lack of investment in alternative fuels.		
	Feedstock Availability (5/2/06) Corn:$2.11/bushel Soy:$5.39/bushel	Corn production only sufficient to meet 2015 volume target (13-15 B GGE) without impacting food supply.[5]	Perception of food vs. fuel and its impact on food prices.		
	Consumer Acceptance	Consumers are not familiar with biofuels due to low levels of availability.	Consumers must accept biofuels' performance and characteristics. Lack of public knowledge of biofuels.	- Alternative Motor Vehicle Credit - Hybrid Motor Vehicle Credit	E N/A
	Market Prices (4/06)[6] Ethanol & Gasoline Component Spot Market: Ethanol:$2.72/gal, Gasoline:$2.37/gal Biodiesel & Diesel Component Rack Market: Biodiesel:$3.15/gal, Diesel:$2.28/gal		Motor gasoline market and infrastructure is mature: renewables are not. Prior to recent surge in oil prices, gasoline and diesel prices were about 15-25% below biofuels.		

[3] E = effective; P = partially effective; I = ineffective; C = counterproductive

[4] 2006 Farm Bill is being discussed during the summer of 2006 and may include extension of the Commodity Credit Corporation vehicle. This would extend and effective policy for capital investments in biofuels production and sales.

[5] Personal communication from Jeff Cooper, NCGA, in April, 2006. Numbers are still being vetted in final report.

[6] *Fuel Ethanol and Biodiesel Report*. May 1, 2006. OPIS.

II. BIOPRODUCTS

Findings and Recommendations

1 Biobased Products

Finding: Biobased products have the potential to reduce U.S. dependence on chemical products derived from petroleum and natural gas. Many of these chemical products are of strategic importance. The Committee has set a goal of 55,300 million pounds of petroleum-based chemical products displaced by biobased products by 2030. In its current form, despite the hard efforts of the administrators of the program, the USDA BioPreferred Program has had minimal impact towards federal procurement of biobased products. The definition of bioproducts is currently very narrow. Outside of this program, there are no federal policies to promote procurement of biobased products and no incentive programs to promote production or use.

1.1 *Recommendation: Definition of Biobased Products*
Broaden the definition of bioproducts and strengthen the federal mandate for purchasing of bioproducts. This could be tailored after the Federal Fleet requirement incentive for biofuels.

1.2 *Recommendation: Production Incentives*
Provide incentives for the production and use of bioproducts analogous to those in place for biofuels.

1.3 *Recommendation: Construction Incentives*
Provide incentives for the construction of bioproducts infrastructure by reauthorizing and expanding the CCC Bioenergy Program to include biobased products.

1.4 *Recommendation: Certification*
Certification of biobased products methodology and requirements should be modified, to include basic minimum performance criteria.

1.5 *Recommendation: Multi-agency Panel*
The federal government should develop a multi-agency panel to analyze the environmental benefits of biobased products.

1.6 *Recommendation: Review State Incentive Programs*
The Federal government should review state incentive programs for biobased products and determine whether they can be applied to federal programs.

Bioproducts					
Goals	**Status**	**Gaps**	**Barriers**	**Policies**	**Policy effectiveness**[7]
Consumption & Production 2010: 24 B lbs 2015: 26 B lbs 2020: 36 B lbs 2030: 55 B lbs	**Consumption & Production** 2005: 17.6 B lbs biobased products produced. DOE analysis has identified high opportunity products (sub-tables 1-3a&b).	The cost of sugars from cellulosic feedstocks is currently higher than the cost of sugars from corn grain (starch). Reducing the cost of processing to convert sugar streams or lignin streams to products. Lack of technologies to utilize proteins as polymer building blocks.	Cost of incumbent products - petroleum based chemicals and materials are already widely used by the industry and have been relatively inexpensive. Conversion of fabricators and end users to new materials requires extensive certification and testing, re-education and may require added capital cost for new machinery, and material storage.	Federal Biobased Products Preferred Purchasing Program (FB4P) Creates federal purchasing preferences for specific biobased products. (Numbers in () represent percentage of product which must be biobased) • Mobile equipment, hydraulic fluids (44%) • Roof coatings (20%) • Water tank coatings (59%) • Diesel fuel additives (90%) • Penetrating lubricants (68%) • Bedding, bed linens, and towels (12%)	I
	Markets Markets for emerging biobased products remain small with little to no purchasing incentive. Limited early adoption is occurring in some markets such as polylactic acid polymers (corn based), polyurethanes made from soybean oil, and others.	Markets for most biomass extractives, for hemicellulose-derived xylose (beyond as a feedstock for production of xylitol), and for lignocellulosic process residues are largely non-existent.	Test method for industry certification and regulatory compliance designed for petrochemicals are often inappropriate for biobased products leading to increased liability and regulatory burdens.		
	R&D DOE analysis has identified high opportunity products (sub-tables 1-3a&b).	Mixed sugars and other intermediates (and new products) that will be produced in a lignocellulose-based biorefinery are still relatively expensive.			

[7] E = effective; P = partially effective; I = ineffective; C = counterproductive

III. BIOPOWER

Findings and Recommendations

1 Renewable Energy Tariffs

Finding: Electricity Feed Laws and Advanced Renewable Tariffs (ARTs), widely used in Europe, have been successful policy mechanisms for stimulating the rapid development of renewable energy. There are currently eight countries in Europe, and four states in the U.S. which have considered or have introduced programs patterned after Renewable Energy Tariffs.

Advanced Renewable Tariffs: Notable Details
Biomass Tariff: $0.11/kWh, plus $0.0352/kWh for generation on peak
Inflation Adjustment: 20% excluding Solar PV
Term of Contracts: 20 years
Project Size Limit: 10 MW (10,000 kW)
Contracts are Open to All
Simplified Interconnection
No Cap or Limit on the Program
Existing Systems Included
Program Review Every Two Years

2 Renewable Portfolio Standards (RPS)

Finding: RPS and Green Power Purchasing Programs (GP3), implemented at the state level in the U.S., have created markets for renewable energy enabling them to compete with less expensive modes of power production.

2.1 *Recommendation: Biopower Capacity*
Target the development of new biopower capacity so biopower can provide a significant share of renewable electric power as part of a Renewable Portfolio Standard (RPS). Specifically, this recommendation could be supported by Feed Laws providing a clear and consistent purchase price for renewable energy by utilities.

3 Regional Agreements and Cap-and-Trade

Finding: Regional agreements and partnerships have begun cap-and-trade programs and emissions trading systems. These programs (once they enter into force) will mandate companies to lower greenhouse gas emissions in the electric power sector, creating incentives for renewable power such as biopower production.

3.1 *Recommendation: Regional Agreements and Cap-and-Trade*
Continued development of regional agreements for greenhouse gas emissions abatement need to occur. There is already an existing commodities and exchange market for carbon credits. As federal legislation catches up with state and local legislation, power companies will be required to reduce greenhouse gasses and other air pollutants.

Regional Agreements: Reduction in Air Emissions and Greenhouse Gas
Regional Greenhouse Gas Initiative (RGGI)
The Conference of New England Governors and Eastern Canadian Premiers (NEG-ECP)
Western Governor's Association (WGA)
Powering the Plains
West Coast Governors' Initiative
Southwest Climate Change Initiative

4 R&D for Biopower Generation and The Production Tax Credit (PTC)

Finding: There is a clear gap in R&D for biopower generation. The cost (per MWh) must decrease. PTC provides $0.019 per kilowatt-hour (kWh) payment, payable over ten years, to private investors as well as to investor-owned electric utilities for electricity produced from renewable energy sources including closed-loop biomass facilities. Closed loop biomass refers to any crop specifically grown to produce energy. Currently, power projects using "open-loop" biomass receive the PTC at only one half the rate for wind, solar, and geothermal energy projects. The federal distinction between "open loop" and "closed loop" biomass has hampered development of widely available biomass resources, the use of which could contribute significantly to energy production. In addition, the PTC has a sunset (2008) clause which creates a disincentive for capital investments in biopower.

4.1 *Recommendation: Include "sustainable open loop" Biomass and Extend the sunset provisions*
The PTC should include "sustainable open loop" biomass in its definition of renewable energy production. This will create the amounts of feedstocks needed to impact energy production in the United States. In addition, biomass tax credits under the PTC should be equal with those of wind and solar.

5 Education Gap

Finding: There is a gap in education of both the public on the advantages of biopower (or the disadvantages of fossil fuel power) as well as the workforce to utilize biomass feedstocks as sources of power generation.

5.1 *Recommendation: Education*
Develop and implement policies to promote education of the workforce and educate the public.

6 Increase Renewable Electricity Generation

Finding: Increased production will encourage the development of domestic manufacturing capacity of the technologies used in renewable electricity generation. Citing and other community concerns must also be addressed.

6.1 *Recommendation: Renewable Electricity Generation*
America must rapidly increase centralized and decentralized renewable electricity generation, taking advantage of biomass, geothermal, hydropower, landfill gas, biogas from animal operations and other organic waste, solar, and wind, as well as thermal uses.

7 Transmission and Distribution

7.1 *Recommendation: Renewable Electricity Delivery*
To deliver safe, reliable, and affordable renewable electricity to customers, all renewable electricity producers must be allowed fair and nondiscriminatory access to the grid. Both transmission and distribution systems and non-wire approaches must be available to get the electricity from the producer to the market. As with generation, public concerns about increased transmission capacity must be addressed.

8 Building Renewable Electricity Markets

8.1 *Recommendation: Wholesale Markets for Renewable Electricity*
To meet the 25x25 goal, both retail and wholesale markets must be built for renewable electricity. The economic, system, environmental, and social benefits should be incorporated into the overall value of renewable electricity.

Biopower					
Goals	**Status**	**Gaps**	**Barriers**	**Policies**	**Policy effectiveness[8]**
Consumption & Production 2010: 3.1 Quads 2015: 3.2 Quads 2020: 3.4 Quads 2030: 3.8 Quads	**Consumption & Production** - 2004: 2.13 Quads (4% share) of renewable power produced by electric utilities and industrial sector. - Renewable Portfolio Standards exist in 22 states and promote biopower along with other renewables. - $7.25/MMBtus in 2005 (corresponding to 6.86 cents per kWh of electricity)	Reduce syngas cost to $5.25 per million Btus (corresponding to 6.18 cents per kWh of electricity) in FY 2011.	Coal is inexpensive and plentiful in the U.S.	Production Tax Credit (PTC) Feed Laws Regional Air Quality Agreements RPSs at state levels Advanced Renewable Tariffs (ARTs) (Europe)	I E N/A ? E
	Infrastructure	The relatively large scale and capital costs of thermochemical process facilities, including the cost and payback of systems.	Electrical infrastructure is more conducive to large centralized power production facilities, not distributed power generation which is most characteristic of biomass.	Commodity Credit Corporation (CCC) aids producers through loans, purchases, payments, and other operations, and makes available materials and facilities required in the production and marketing of agricultural commodities. DOE released a biorefinery solicitation to design, construct, build and operate an integrated biorefinery employing lignocellulosic feedstocks for the production of combinations of: (i) liquid transportation fuels; (ii) biobased chemicals; (iii) substitutes for petroleum-based feedstocks and products; and (iv) energy in the form of electricity or useful heat.	E
	R&D	Knowledge of how to effectively integrate thermochemical and biochemical (sugars) process technology in biorefinery configurations. Thermochemical conversion of biomass to power needs new clean-up technologies and better, more efficient turbines.			
	Education	Widespread availability of personnel with knowledge of operation and maintenance of thermochemical systems.			

[8] E = effective; P = partially effective; I = ineffective; C = counterproductive

IV. Cross-Cutting

Findings

1 Tax Credits

Finding: Tax credits and tax exemptions are used to promote the use of renewable fuels with the goal of displacing petroleum use in the transportation sector. There are four Federal tax subsidies for the production and use of alcohol transportation fuels: (1) a 5.4 cents-per-gallon excise tax exemption, (2) a 54 cents-per-gallon blender's tax credit, (3) a 10-cents-per-gallon small ethanol production tax credit, and (4) the alterative fuels production tax.

2 Uncertain Regulatory Climate

Finding: The biomass power sector has suffered from an uncertain regulatory climate and lack of a long-term pricing structure. Many facilities have experienced an extended period of a combination of electricity price uncertainty, fuel availability and pricing uncertainties, and in some cases, operational issues that have resulted in economic hardship. Power pricing for most facilities after mid-2006 has yet to be determined.

3 Infrastructure

Finding: There is a need for new policies to modify or create new infrastructure to help reduce transportation costs of biomass. What separates solid biomass from other renewable energy options is the need to collect, transport, and store feedstock. Biomass, with its low energy density compared to fossil fuels, is relatively expensive to transport, limiting most projects (not based on dedicated energy crops) to collection radii of roughly 50 miles. The recent rise in diesel fuel prices (for truck transport of biomass) has had a noticeable impact of biomass power plant viability.

4 Fragmented Bioenergy Industry

Finding: The bioenergy industry is fragmented and composed of biomass providers (i.e., farmers, foresters, agricultural processors, and urban operators), biomass procurers (i.e., companies that collect, process, and transport biomass residues to end users), and biomass users (i.e., power plant operators, landscape companies, and liquid fuel manufacturers). As a result, each segment of the industry has competing interests and faces differing regulations making it difficult for the industry to address common issues or speak in a uniform manner on regulatory issues.

Recommendations

1 Establish stable funding

Recommendation: Establish stable funding for bioenergy programs based on the premise that many of the benefits represent public goods which accrue to all Americans.

2 Leverage Federal (R&D)

Recommendation: Leverage federal research and development (R&D) efforts and improve coordination to realize greater investment in biomass. In specific, target the development of varieties with improved characteristics suitable for biobased products.

3 Conduct Demonstration and Pilot Projects

Recommendation: In conjunction with state collaborations, fund a select number of demonstration and pilot projects designed to prove the commercial readiness of biofuels production technologies that use lignocellulosic feedstocks. Where possible, use existing state or federal facilities.

4 Require Federal Purchasing

Recommendation: Federal agencies should purchase biofuels, bio–based products, and biopower, including combined heat and power where possible, with specific targets for 2010 and 2020. Local governments and public institutions should be encouraged to follow the federal agencies' lead.

5 Biomass Stakeholders

Recommendation: Encourage biomass stakeholders to develop an integrated and coordinated plan to create a favorable regulatory environment for bioenergy development, while maintaining the required oversight of the existing utility, transportation fuel, and waste management industries.

6 Revise Statutory Definitions

Recommendation: The federal government should review and revise statutory definitions which may be preventing the development of environmentally acceptable waste management alternatives known as conversion technologies and seek amendments to existing law to provide diversion credits to local jurisdictions for solid waste processed by eligible conversion technologies meeting environmental standards.

7 Increase Access to Biomass Resources

Recommendation: U.S. Department of Agriculture (USDA), The Food and Drug Administration (FDA), and the U.S. Forest Service (USFS) should develop a plan to determine how to gain better access to biomass resources and continue basic and applied research identifying the highest value use for forest fuel and harvest residues. They should coordinate activities with the Bureau of Land Management (BLM) to ensure criteria for watershed protection, water quality, and fire prevention will be met.

8 Develop carbon cap-and-trade Program

8.1 Recommendation: Bioproducts Should Displace Hydrocarbon Incumbent
The U.S. should establish a carbon cap-and-trade program for bio-products displacing hydrocarbon incumbent, as part of a framework of incentives to promote adoption of bio-products.

8.2 Recommendation: Incentivize Adoption of Biobased Power
The United States should establish carbon cap-and-trade programs to incentivize adoption of bio-based power. R&D is needed to assure the U.S. has a positive LCA / energy balance for the carbon trading.

9 Allow Heavier Loads on the Highway System

Recommendation: To encourage the use of current technology and evaluate the use of future technology that would allow heavier loads on the highway system while respecting the needs for safety standards and infrastructure.

10 Demonstrate the Commercial Readiness of Bioproducts

Recommendation: In conjunction with state collaborations, fund a select number of demonstration and pilot projects designed to prove the commercial readiness of bioproducts production technologies that use renewable feedstocks. Where possible, use existing state or federal facilities.

11 Analyze National Carbon Emissions Policies

11.1 Recommendation: Low-carbon Transportation Fuels Standard (LCFS)
The committee recommends that the federal government analyze national carbon emissions policy options and their potential impact on biomass energy. One option is to analyze a national low-carbon transportation fuels standard (LCFS), along the lines of the one proposed recently for California by Governor Schwarzenegger. Such a mandate may be similar in its impact for bringing renewable biofuels into the market as RPS mandates have been for increasing market share of renewable electricity. A CO_2 cap-and-trade system is another approach that should be analyzed and which would likely have different implications from a LCFS for biofuels development.

12 Establish a Carbon Policy for Biopower and Bioproducts

Recommendation: Similar biofuel carbon policy options should be analyzed for bioproducts and for biopower.

References

Amos, W. A. Bain, R. L. Downing, M. Perlack, R. L. Biopower Technical Assessment: State of Industry and Technology. March, 2003. NREL/TP-510-33123.

Biomass Task Force Report: Clean and Diversified Energy. January 2006. Western Governor's Association.

Burtraw, Dallas. Palmer, Karen. Resources for the Future. *Cost-Effectiveness of Renewable Energy Policies*. 2005

Chum, Helena L. et. al. *Inventory of Federally Funded Bioenergy Research and Development*. April 27, 2000. NREL/TP-570-2825.

Chum, Helena L. Overend, Ralph P. *Biomass and Bioenergy in the United States. Advances in Solar Energy: An annual review of research and development.* Vol 15. American Solar Energy Society. Boulder CO. 2003.

Cooper, Jeff. National Corn Growers Association. April, 2006. Telephone discussion.

Gallagher, Paul. Shapouri, Hosein. *USDA's 2002 Ethanol Cost-of-Production Survey*. July 2005. USDA. Agricultural Economic Report Number: 841.

Greene, Nathanael. Mugica, Yurina. *Bringing Biofuels to the Pump: An Aggressive Plan for Ending America's Oil Dependence*. July 2005. Natural Resources Defense Council.

Haq, Zia. Department of Energy. April, 2006. Telephone discussion.

Inventory of Federally Funded Projects for Biobased Products R, D&D. March 12, 2001. NREL
Office of the Biomass Program

Overend, Ralph. NREL. April, 2006. Telephone discussion.

Schaefer, Larry. Renewable Fuels Association. April, 2006. Telephone discussion.

Pew Center, Global Climate Change, Regional Initiatives, http://www.pewclimate.org/what_s_being_done/in_the_states/regional_initiatives.cfm?preview=1, June 6, 2006

Appendix A: Bioproducts Targeted for Market Impact

Table 1: Vision Biobased Products, Production USA

	Million Pounds	
	2002	2004-2005
Organic Acids	576	987
lactic acid[1]	*114*	*600*
citric acid	*462*	*387*
Ethanol for Industrial Use	1757	1971
Starch[2]	3000	6684
Sorbitol[3]	515	697
Glycerol/Glycerine[4]	410	432
Alkyd resins[5]	550	682
Soy-based Products[6]	654	934
Specialty Oils/Aroma Chemicals[7] *	9	8.9
Spearmint		*1.7*
Peppermint		*7.1*
Forest Chemicals*	2826	2740
Crude Sulfate Turpentine [8]		*1202*
Tall Oil [9]		*1094*
Pine Rosin[10]		*444.6*
Cellulose Polymers	2500	2500
Cellulose fibers	*360*	*** NA*
Cellulose derivatives[11]	*2140*	*696*
TOTAL	**12,797**	**17,635**
% Market share	**5%**	**8%**

Table 1: Biomass R&D Technical Advisory Committee's Vision, DOE & USDA, 2006.

Table 2: Top Value Added Chemicals From Biomass
1,4 succinic, fumaric and malic acids
2,5 furan dicarboxylic acid
3 hydroxy propionic acid
Aspartic acid
Glucaric acid
Glutamic acid
Itaconic acid
Levulinic acid
3-hydroxybutyrolactone
Glycerol
Sorbitol
Xylitol/arabinitol

Table 3a: Low Molecular Weight Lignin Products and Classes Identified in "Top Ten Lignin" Study	
Compound or Class	Product Examples
Simple Aromatics	Biphenyls, styrene, benzene, toluene, xylenes
Quinones	Anthraquinone
Hydroxylated aromatics	Phenol, catechol, propylphenol, eugenol, syringols, aryl ethers, resols/novolaks, alkylated methyl aryl ethers
Aromatic aldehydes	Syringaldehyde, vanillin
Aromatic acids and diacids	terephthalic Acid, vanillic acid
ß-ketoadipic acid, aliphatic acids	New polyesters
Aromatic and aliphatic polyols	Cycohexane diol
Alkanes	cyclohexane

Table 3b: High Molecular Weight Lignin Products and Classes Identified in "Top Ten Lignin" Study
Carbon fiber; Polymer fillers; Polyelectrolytes ; Thermoset resins; copolymers with furfural; wood; adhesives; wood preservatives

Table 2: Top Value Added Chemicals from Biomass, Volume I. PNNL, NREL, August 2004
Table 3a: Top Value Added Chemicals from Biomass, Volume II. PNNL, NREL, July 2005
Table 3b: Top Value Added Chemicals from Biomass, Volume II. PNNL, NREL, July 2005

Appendix B - Biomass Policy Descriptions

Policy Title	Topic Area	Potential Applicants	Originating Legislation	Type	Incentive Amount	Effective Date	Description	Assessment of Effectiveness
Clean Fuel Tax Deduction	Purchase of New clean fuel vehicles, cost of retrofitted clean fuel vehicles, costs of storing and dispensing of alternative fuels	Businesses, personal tax payers, fuel dispensers	EPAct 1992, Working Families Tax Relief Act of 2005, EPAct 2005 § 1348	Tax Deduction	Varies by vehicle type – see below	Ends December 31, 2005	Purchase of New clean fuel vehicles, cost of retrofitted clean fuel vehicles, costs of storing and dispensing of alternative fuels. Maximum allowable deductions are: Buses with seating capacity of 20+ adults: $50,000; Truck or van with GVWR of 26,000+ lb: $50,000; Truck or van with GVWR of 10,000-26,000 lb: $5,000; All other vehicles (excluding off-road): $2,000. The tax deduction will phase out at the end of 2005.	
Alternative Motor Vehicle Credit	Purchase of New dedicated alternative fuel vehicles: light-, medium-, & heavy-duty vehicles; fuel cell; hybrid; dedicated natural gas, propane, & hydrogen; light-duty lean burn diesel vehicles	Consumers; vehicle sellers if purchasers is a non-tax-paying entity	EPAct 2005 § 1341	Tax Credit	50% of incremental cost of vehicle, plus 30% of incremental cost of vehicles with near-zero emissions	January 1, 2006 – December 31, 2010	Purchase of New dedicated alternative fuel vehicles.The tax credit equals 50% of the incremental cost of the vehicle, plus an additional 30% of the incremental cost for vehicles with near-zero emissions (SULEV or Bin 2 for vehicles <14,001 lb GVWR). The following are incremental cost limits for dedicated AFVs: $5,000: 8,500 GVWR or lighter; $10,000: 8,501 - 14,000 GVWR; $25,000: 14,001 - 26,000 GVWR; $40,000: 26,001 GVWR and heavier. The credit expires December 31, 2010.	
Hybrid Motor Vehicle Credit	Purchase of Hybrid vehicles	Consumers	EPAct 1992, EPAct 2005 § 1341	Tax Deduction through December 2006, Tax Credit	Varies by year vehicle purchased	December 2006 – December 31, 2010	Clean Fuel Vehicle Property Tax Deduction through 2006: Purchase Year/Maximum Deduction Per Vehicle - 1992-2003/$2,000; 2004/$1,500; 2005/$1,000; 2006/$500. This tax credit expires December 31, 2010.	
Federal Fleet Requirements	Alternative fuel use in federal fleets	Federal entities with vehicle fleets	EPAct 1992, EPAct 2005, Executive Order 13149 (Greening the Government through Federal Fleet and Transportation Efficiency) EPAct 2005 §	Legislated Requirement	75% of light-duty vehicles in federal fleets must be AFVs & all federal fleets must use alternative fuels in AFVs – or – must receive a waiver from the Secretary of Energy if fuels are not available – or – must choose a petroleum reduction path – and – reduce petroleum use by 20%	No set beginning or end dates	75% of light-duty vehicles in federal fleets must be AFVs & all federal fleets must use alternative fuels in AFVs – or – must receive a waiver from the Secretary of Energy if fuels are not available – or – must choose a petroleum reduction path – and – reduce petroleum use by 20%. No set beginning or end dates.	
State & Alternative Fuel Provider Rule	Alternative fuel use in state fleets; cost of installation of clean-fuel vehicle refueling equipment (includes E85, natural gas, compressed natural gas, liquefied natural gas, liquefied petroleum gas, hydrogen, biodiesel [B20 or higher])	State entities with vehicle fleets; fueling station owners/fuel providers	EPAct 1992, EPAct 2005 § 703	Legislated Requirement, Tax Credit	75% of new light-duty state fleet vehicles must be AFVs; 90% of light-duty alternative fuel providers fleet vehicles must be AFVs – or – must choose a petroleum reduction path – and – fueling stations are eligible for a 30% credit for the cost of installing clean-fuel vehicle refueling equipment	Present – December 31, 2010	75% of new light-duty state fleet vehicles must be AFVs; 90% of light-duty alternative fuel providers fleet vehicles must be AFVs – or – must choose a petroleum reduction path – and – fueling stations are eligible for a 30% credit for the cost of installing clean-fuel vehicle refueling equipment. Present – December 31, 2010	
Ethanol and Biodiesel Tax Credit (VEETC)	Blending, retailing, and producing alcohol, ethanol, and biodiesel fuels	Blenders, retailers, producers	American Jobs Creation Act of 2004, EPAct 2005 § 1344	Tax Credit	Varies by fuel and blend	Ethanol: January 2005 – 2010; Biodiesel: January 2005 – December 2008	$0.51/gallon for ethanol. Expires in 2010 but will most likely be renewed. The credit is given to the blender because corn-to-ethanol is already profitable. The intent is to get more ethanol blended into fuels. Note production costs (excluding capital costs) for ethanol are approximately $1.10/gal and for convential gasoline $1.58/gal in 2005. Sunset for Ethanol: January 2005 – 2010; Biodiesel: January 2005 – December 2008	
Small Ethanol Producer Credit	Ethanol production	Small ethanol producers (less than 60 million gallons/year)	EPAct 2005 § 1347	Tax Credit	$0.10/gallon up to 15 million gallons annually; capped at $1.5 million per year per producer	2005	Ethanol production: $0.10/gallon up to 15 million gallons annually; capped at $1.5 million per year per producer	This tax credit is too small to effect any substantiative volume and isn't included in EIA NEMS model.
Small Agri-Biodiesel Producer Credit	Small agri-biodiesel producers (less than 60 million gallons/year)	EPAct 2005 § 1345	Tax Credit	$0.10/gallon up to 15 million	N/A	2005	Biodiesel production: $0.10/gallon up to 15 million gallons. No sunset date.	N/A
Alternative Fuel Infrastructure Tax Credit	Cost of Alternative Refueling Property: natural gas, propane, hydrogen, E85, biodiesel mixtures above B20	Refueling station owners (business and residential); equipment sellers if refueling business owner is a non-tax-paying entity	EPAct 1992, Working Families Tax Relief Act of 2004, EPAct 2005 § 1342	Tax Credit	30% of the cost of alternative refueling property, up to $30,000 for business, $1000 for residential	Equipment put into service after December 31, 2005, to expire on December 31, 2009	30% of the cost of alternative refueling property, up to $30,000 for business, $1000 for residential. Sunset date: January 1, 2006 – December 31, 2010	
Federal Renewable Fuels Standard	Increasing the production of biofuels		EPAct § 1501	Regulation	N/A	2005	Requires 7.5 million gallons of ethanol produced by 2012.	This requirement based on current productiona nd planned capacity of the ethanol industry, will be met by 2012.
The Clean Air Act and Federal RFG Required Areas	Fuels/Emissions	Cities failing to meet Clean Air Act Standards enforced by EPA	Clean Air Act 1990 § 211	Regulation	N/A	1990	This is a State/Federal issue. EPA designates regions of low air quality and eneacts regulations to meet those requirements. The regions then can meet those regulations however they like. Related to this issue - when ethanol is an additive it increases the octane rating and volitility of the fuel; creating high VOC volumes which lower air quality standards.	

Appendix B - Biomass Policy Descriptions

Policy Title	Topic Area	Potential Applicants	Originating Legislation	Type	Incentive Amount	Effective Date	Description	Assessment of Effectiveness
Renewable Electricity Production Tax Credit (PTC)	Electricity generated from renewable sources (landfill gas, wind, hydroelectric, geothermal, municipal solid waste, refined coal, Indian coal, small hydroelectric, closed- and open-loop biomass, solar energy, small irrigation power)	Commercial and industrial entities	The Working Families Tax Relief Act of 2004, American Jobs Creation Act of 2004, EPAct 2005 § 1301	Corporate Tax Credit	Varies	EPACT 2005 extended credit through 2008	The REPC provides a tax credit of 1.5 cents/kWh, adjusted annually for inflation, for wind, closed-loop biomass and geothermal. The adjusted credit amount for projects in 2005 is 1.9 cents/kWh. Electricity from open-loop biomass, small irrigation hydroelectric, landfill gas, municipal solid waste resources, and hydropower receive half that rate -- currently 0.9 cents/kWh. Sunset 10 yrs	With respect to biomass, this policy is ineffective. The definition of closed loop and open loop disqualifies important biomass feedstocks for energy production.
Renewable Energy Production Incentive (REPI)	Payments for electricity produced and sold by renewable energy generation facilities (solar, wind, geothermal, biomass [except MSW], landfill gas, livestock methane, and ocean)	Tribal Government, Municipal Utility, Rural Electric Cooperative, State/local governments that sell project's electricity, Not-For-Profit Electrical Cooperatives, Public Utility, Commonwealths	EPAct 1992, EPAct 2005	Financial Incentive Payment	1.5 cents/kWh (indexed for inflation)	1992 – FY 2026	The Renewable Energy Production Incentive (REPI) provides financial incentive payments for electricity produced and sold by new qualifying renewable energy generation facilities. Qualifying facilities are eligible for annual incentive payments of 1.5 cents per kilowatt-hour (1993 dollars and indexed for inflation) for the first ten year period of their operation, subject to the availability of annual appropriations in each Federal fiscal year of operation. Sunset 2026	
Feed Laws or Advanced Renewable Tariffs (ARTs)	Biopower prices	Biopower producers	European Union	Financial Incentive Payment			ARTs are rates paid for electricity per kilowatt-hour generated. Below is a summary of ARTs most important elements. * Wind Energy Tariff: $0.11/kWh * Biomass Tariff: $0.11/kWh, plus $0.0352/kWh for generation on peak * Small Hydro Tariff: $0.11/kWh, plus $0.0352/kWh for generation on peak * Solar Photovoltaics Tariff: $0.42/kWh * Inflation Adjustment: 20% excluding Solar PV * Term of Contracts: 20 years * Project Size Limit: 10 MW (10,000 kW) * Contracts are Open to All * Simplified Interconnection * No Cap or Limit on the Program * Existing Systems from January 1, 2000 Included * Contracts Available Fall 2006 * Program Review Every Two Years	ARTs are not yet implemented to the full extent in the U.S.
Regional Greenhouse Gas Initiative (RGGI), The Conference of New England Governors and Eastern Canadian Premiers (NEG-ECP), Western Governor's Association (WGA), Powering the Plains, West Coast Governors' Initiative, Southwest Climate Change Initiative	Carbon dioxide reduction, Cap and trade	All	Various regional agreements	Regulation	N/A	Various	Implementation of a multi-state cap-and-trade program with a market-based emissions trading system. The proposed program will require electric power generators in participating states to reduce carbon dioxide emissions.	Various cap-and-trade programs are being discussed in congress as well as industry initiatives to curb carbon emissions.
Renewable Energy Systems and Energy Efficiency Improvements Program	Energy efficiency		Federal Grant Program					
Tribal Energy Program Grant			Federal Grant Program					

Appendix B - Biomass Policy Descriptions

Policy Title	Topic Area	Potential Applicants	Originating Legislation	Type	Incentive Amount	Effective Date	Description	Assessment of Effectiveness
BioPrefered Program, formerly the Federal Biobased Products Preferred Purchasing Program (FB4P)	Purchasing biobased products	Federal Government Procurement Offices	2002 Farm Bill § 9002	Purchasing	N/A	January, 2006	USDA recently designated 6 items under the FB4P program: • Roof Coatings 20% • Water Tank Coatings - 59% • Diesel Fuel additives - 90% • Penetrating lubricants - 68% • Bedding, bed linens, and towels - 12% • Mobile equipment, hydraulic fluids - 44%	
Federal Commodity Credit Corporation (CCC) Bioenergy Program			2002 Farm Bill § 9002	Tax Credit		2002	To be eligible, ethanol producers must produce and sell ethanol commercially and have authority from the Bureau of Alcohol, Tobacco, Firearms, and Explosives to produce ethanol for fuel or sell denatured ethanol rendered unfit for beverage use. Payments are based on the increase in bioenergy production compared to the previous year's production.	The program is structured to encourage participation by smaller producers. Producers with less than 65 million gallons of annual production capacity are reimbursed on a ratio of one feedstock unit for every 2.5 feedstocks used, while larger facilities are reimbursed on a ratio of one to 3.5. Additionally, a payment limitation restricts the amount of funds any single producer may obtain annually under the program to 5% of the total funds available. The CCC Bioenergy Program has encouraged the increased production of bioenergy and the construction of new production capacity, which has helped the ethanol industry double in size since the creation of the program in 2001. Profitability is difficult in the first year of production for any company, and the margins in the first few years of production for new ethanol and biodiesel facilities are exceedingly tight. The CCC Bioenergy Program provides valuable financial assistance to ensure the success of these new companies.

Appendix C - U.S. GOVERNMENT BIOFUELS AUTHORITY

This memorandum is presented by Hamilton Clark & Co., an investment banking firm that works primarily with energy technology companies. The memorandum outlines the rationale for establishing a U.S. government sponsored "Authority", modeled after the Tennessee Valley Authority, which would develop a large and economically viable cellulosic ethanol industry in the United States by 2015. The Authority would make its technology available to private sector companies and could eventually be privatized. A suggested privatization model is Sasol, Ltd. a publicly traded coal-to-liquids company formed by South Africa in 1950 and privatized in 1979.

The Problem:

1. The U.S. Has a Transportation Fuels Crisis

Most of the American public agrees that U.S. dependence on imported oil has reached untenable levels. In 2005 about 65% of crude oil and petroleum products were supplied by imports, out of which 17% came from the Persian Gulf region. In order to augment our use of petroleum-based fuels, President Bush has proposed a bold strategy to produce biofuels in the U.S.

2. The U.S. Is Not On Track to Meet Our Biofuels Targets – Need for Cellulosic Ethanol

In order to realize a "more balanced and diverse energy portfolio that includes domestic biomass resources" the Biomass R&D Technical Advisory Committee of the DOE and the USDA established it's *Vision for Bioenergy and Biobased Products in the United States.* The Committee established aggressive goals for biofuels, defining market share targets and consumption for 2010, 2020, and 2030, as shown below:

Technical Advisory Committee's Vision Goals for Biofuels

	2000	2004	2010	2015	2020	2030
Market Share (%)	0.7	1.2	4.0	6.0	10.0	20.0
Consumption (billion gasoline equivalent gallons per year	1.1	2.1	8.0	12.9	22.7	51.0
Consumption (million gasoline equivalent barrels per day	0.072	0.14	0.521	0.841	1.480	3.327

Corn ethanol production has the U.S. on track to meet 2010 goals. However, most experts agree that in order to reach 2015 - 2030 targets the U.S. must also develop a large and viable cellulosic ethanol industry to complement corn ethanol. This memorandum suggests that a U.S. government sponsored biofuels Authority focus its efforts only on cellulosic ethanol production.

3. It is Unlikely That the Private Sector Will Develop a Large Cellulosic Ethanol Industry

Based on our discussions with companies, investors and banks, we believe that it is unlikely that financing will be available to build cellulosic plants according to the proposed targets, due to:

- **Price Risk**. Cellulosic ethanol profitability requires that crude oil prices continue to remain above about $60 per barrel. Future price reductions orchestrated by OPEC could make cellulosic ethanol projects uneconomic, similar to what occurred during the energy crisis in the 1970s when government efforts were thwarted by falling crude prices.

- **Technology Risk**. The complexity of *feedstock supply* and *conversion technologies* confuse financiers:

    - Cellulosic ethanol is different than corn ethanol:

        - corn feedstock is generally available to all biorefineries, it is grown to uniform standards, is traded on commodity exchanges and can be contracted for long periods of time by cooperatives or developers

        - conversion technology is relatively simple, available from a number of technology suppliers, and biorefineries are built by a large number of engineering and construction firms willing to accept 100% plant completion liability. Construction is proven at scale of 100+ million gallons per year without technology risk

        - corn ethanol plants are relatively easy to finance, equity and debt guidelines are understood and a number of companies have completed their initial public offerings allowing access to the public equity market

    - Cellulosic ethanol has none of these attributes:

        - cellulosic feedstock is not readily available, competing feedstock suppliers (agriculture residues, woody crops, wood waste, energy crops (switchgrass) and municipal solid waste) confuse financiers as to their proposed qualities and availability. Large biorefineries will require very large acreage devoted to dedicated energy crop feedstock, which has not been thoroughly vetted in the farm community

        - competing conversion technologies confuse financiers because bioprocessing technology experts argue over their proprietary approach to pre-treatment, hydrolysis and fermentation technology; while thermo-chemical experts argue over their proprietary approach to pyrolysis or Fischer-Tropsch syngas technology. There are no engineering and construction firms offering completion guarantees on plant construction

        - because no commercial cellulosic ethanol plant has ever been built, financiers are not willing to accept the technology risk of choosing the wrong feedstock or the wrong conversion technology. Without completion guarantees there will be no debt financing available for cellulosic plants. Equity financing is not available given long project development cycles

The Solution: Develop the Industry, and then Privatize it

1. U.S. Government Biofuels Authority, Like the Tennessee Valley Authority, $4 billion per Year Over Ten Years

Our firm's assessment is that, given current conditions, the best way to develop a cellulosic ethanol industry in the U.S. by 2015, is to establish a U.S. government Authority, like the Tennessee Valley Authority (TVA), that would build, own and operate the first fleet of cellulosic ethanol plants in the U.S. By building the first fleet of commercial-scale plants, price risk and technology risk could be mitigated, allowing the industry to develop in the private sector from 2015 to 2030 on its own merits.

We believe that:

- the goal of this undertaking should be in the range of 500,000 barrels per day (8 billion gallons per year) of cellulosic ethanol production. This could be accomplished by building about 20 biorefineries in various growing regions, each sized at about 25,000 barrels per day (400 million gallons per year). Our research suggests that at targeted yields of 10 tons per acre and 100 gallons per ton, each biorefinery would require about 400,000 acres, and the entire undertaking would require about 8 million growing acres

- biorefineries would use different homogeneous feedstocks (switchgrass, ag residues, woody crops) or heterogeneous feedstocks (combination of energy crops, woody crops, ag residues, wood waste, MSW), grown in various regions of the U.S., in order to determine the best yield per acre for a particular feedstock and a particular region

- biorefineries would utilize different technology solutions both in bioprocessing and thermochemical conversion platforms, in order to determine the best yield per ton for a particular feedstock in a particular region

- at HamiltonClark's estimated capital cost of about $75,000 per daily barrel produced, (like the TVA), we estimate that this strategy would require a U.S. Treasury guarantee of the Authority's bonds equal to approximately $4 billion per year over 10 years

- assuming successful deployment, after 10 years the Authority would be self financing (like the TVA), or it could be privatized

We believe that such a strategy would be successful, and the result would be that:

- a large and viable cellulosic ethanol industry would be developed over the next 10 years and then move on to the private sector

- price risk for the next 10 years could be mitigated by direct government ownership

- technology risk could be reduced or eliminated by figuring out which technology works best at scale with which feedstock in which region of the U.S.

- our nation's biofuels targets could be achieved

- the U.S. Treasury guarantee of the Authority's bonds would eventually be eliminated

2. Tennessee Valley Authority Model

There is a very close comparison between the economic crisis during the Depression and our country's need for cheap electricity during World War II which necessitated development of the TVA; and our current energy crisis with respect to transportation fuels, and our war on terrorism. A short history of the TVA and its goals and objectives (courtesy of the TVA website) is illustrative of these issues and how the TVA model could be adopted to develop a viable cellulosic biofuels industry in the U.S. over the next 10 years:

Background

- President Franklin Roosevelt needed innovative solutions if the New Deal was to lift the nation out of the depths of the Depression. TVA was one of his most innovative ideas. Roosevelt envisioned TVA as a totally different kind of agency. He asked Congress to create "a corporation clothed with the power of government but possessed of the flexibility and initiative of a private enterprise." On May 18, 1933, Congress passed the TVA Act**.**

- Right from the start, TVA established a unique problem-solving approach to fulfilling its mission-integrated resource management. Each issue TVA faced - whether it was power production, navigation, flood control, malaria prevention, reforestation, or erosion control - was studied in its broadest context. TVA weighed each issue in relation to the others. From this beginning, TVA has held fast to its strategy of integrated solutions, even as the issues changed over the years.

1930s

- TVA developed fertilizers, taught farmers how to improve crop yields, and helped replant forests, control forest fires, and improve habitat for wildlife and fish. The most dramatic change in Valley life came from the electricity generated by TVA dams. Electric lights and modern appliances made life easier and farms more productive. Electricity also drew industries into the region, providing desperately needed jobs.

1940s

- During World War II, the United States needed aluminum to build bombs and airplanes, and aluminum plants required electricity. To provide power for such critical war industries, TVA engaged in one of the largest hydropower construction programs ever undertaken in the United States. Early in 1942, when the effort reached its peak, 12 hydroelectric projects and a steam plant were under construction at the same time, and design and construction employment reached a total of 28,000.

1950s and beyond

- These were years of unprecedented economic growth in the Tennessee Valley. Farms and forests were in better shape than they had been in generations. Electric rates were among the nation's lowest and stayed low as TVA brought larger, more efficient generating units into service. Expecting the Valley's electric power needs to continue to grow, TVA began building nuclear plants as a new source of economical power.

- Today, TVA is the nation's largest public power company, with 33,000 megawatts of generating capacity. Through 158 locally owned distributors, TVA provides power to nearly 8.5 million residents of the Tennessee Valley.

TVA's Financing Relationship with the U.S. Treasury

Originally, in the 1930s, TVA issued bonds that were fully guaranteed by the U.S. Treasury. This allowed TVA to immediately launch its mandate with the knowledge that its financing was secure. The U.S. Treasury also had a number of checks and balances which were built into the legislation.

In 1959 this was changed such that TVA currently receives no appropriations from the federal government, is not authorized to issue stock and its bonds are not guaranteed by the U.S. Treasury. Therefore, it must meet its capital requirements through internally generated funds and power program financings. TVA securities may only be issued to provide capital for TVA's power program, including the refunding of existing debt. TVA bonds are backed solely by the net power proceeds of the TVA power system and are neither obligations of nor guaranteed by the U.S. government. The bonds carry a AAA rating.

Financial Summary of the TVA

2005 Financial Results ($ in millions)

Operating revenues	$ 7,794
Operating income	$ 1,291
Net income	$ 85
Total assets	$34,566
Total liabilities (inc. debt)	$32,174
Capital	$ 2,392
Cash provided from operations	$ 1,346

3. Future Privatization, Like Sasol, Ltd.,

Our firm's assessment is that once the cellulosic biofuels Authority is operating at scale, its technology could be licensed to other private companies, and the business could eventually be privatized. A good example of this strategy was how the South Africa government developed Sasol, Ltd., to take advantage of that country's huge coal deposits and lack of any meaningful crude oil production. South Africa has a population of 44 million and consumes about 550,000 barrels per day.

Background

- In 1950 the government of South Africa set up Sasol, Ltd. (South Africa Synthetic Oil Limited), and authorized funding for its first project, a coal-to-liquids facility called Sasolburg in the South African countryside.

- When oil prices increased in the 1970s the South African government decided to lend Sasol $6 billion to build two new facilities at Secunda, SA, each being about 10 times as large as Sasolburg. Sasol had commercialized its coal-to-liquids technology during the 1970s, so in 1979 the government decided to privatize the company, listing it on the Johannesburg Stock Exchange. The stock also trades on the NYSE and the government currently owns a 24% interest, the rest is owned by the public.

- Sasol currently produces 160,000 barrels per day of synthetic crude oil which is further refined into gasoline and diesel fuel. This is about 30% of the country's liquid fuels requirement. Each of their 80,000 barrel per day refineries cost about $6 billion to build ($75,000 per daily barrel produced) at current prices. The learning curve on this technology has driven the breakeven price down to about $30 to $35 per barrel and has allowed Sasol to license its technology to other companies and other countries.

- Sasol currently has about 16,000 employees, the market capitalization of the company is US$22 billion, and it has US$ 2.7 billion of long term debt, about US$ 500 million of cash and an enterprise value of US$24.8 billion. The South African government does not guaranty its debt. For the year ended June 2005 revenues were US$ 9.1 billion, net income was US$ 2.0 billion, EBITDA was $3.4 billion and operating cash flow was US$ 2.5 billion.

- With an enterprise value of US$24.8 billion and 160,000 barrels per day of production, the company is worth about US$155,000 per daily barrel of production.

4. Conclusion

In a joint effort, the DOE and USDA, under the direction of the Biomass Research and Development Technical Advisory Committee, should immediately prepare a plan for their respective Secretaries, to establish a United States Biofuels Authority, modeled after President Roosevelt's TVA, that would build, own and operate up to 500,000 barrels per day of cellulosic ethanol production in various regions of the U.S. by 2015.

Financing of the Authority should be modeled after the early years of the TVA, namely with a full guarantee of the U.S. Treasury, but with checks and balances as to the issuance of bonds by the Authority.

We estimate that a targeted 500,000 barrel per day undertaking would cost about $75,000 per daily barrel produced, or about $40 billion ($4 billion over about 10 years). Assuming that crude prices do not fall and that the technology works at scale, we estimate that, like the TVA, the Authority would eventually be able to repay its government guaranteed bonds, and be self financing.

When the technology has been proven and the cost reduced, the Authority's technology could be transferred to the private sector through privatization and technology transfer. Based on today's enterprise value of Sasol Ltd., and assuming that the Authority was producing at 500,000 barrels per day, the Authority would have an enterprise value in the public markets today of about $77 billion. This suggests that, assuming the business plan is successful, U.S. taxpayers would be obligated to guarantee up to about $40 billion of debt, and in 10 or 15 years might be able to sell the Authority to private investors for a valuation that might be in the range of about $77 billion.