RECOMMENDATIONS FOR A BIOENERGY PLAN FOR CALIFORNIA

Prepared for the Bioenergy Interagency Working Group:

Air Resources Board
California Energy Commission
California Environmental Protection Agency
California Resources Agency
California Department of Food & Agriculture
Department of Forestry and Fire Protection
Department of General Services
Integrated Waste Management Board
Public Utilities Commission
Water Resources Control Board

Governor Arnold Schwarzenegger

APRIL 2006
CEC-600-2006-004-F

DEDICATION

Loyd Henry Forrest Jr.
1940-2006

The Interagency Bioenergy Working Group dedicates this report to Loyd Forrest — the quintessential public servant. We gratefully recognize his contribution to California, as a state government executive, and as an early pioneer and advocate of biomass energy technology, and a successful and talented bioenergy consultant and entrepreneur.

Over the course of his long and successful career, governors, legislators, state executives and staff called upon Loyd for his guidance and expertise. He was a person who stood for honesty, integrity and hard work — a man whose word could be trusted.

Loyd was dedicated to issues and programs that mutually improved California's environment and economy. This report honors his commitment and legacy to making California the best that it could be.

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Prepared For:

The Bioenergy Interagency Working Group

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EXECUTIVE SUMMARY

Biomass – biologically-derived renewable materials that can be used to produce heat, electric power, transportation fuels, and other value-added products and chemicals – is found in abundance in California and represents a significant renewable energy resource. As California pursues increases in the use of renewable energy, bioenergy in the form of biomass power (biopower), and biomass-based fuels (biofuels) will be important contributors.

Bioenergy provides a range of strategic energy, economic, and environmental benefits to the people of California. Not only is greater use of bioenergy critical to the state's energy supply and vital to its waste and resource management efforts, it can help achieve the state's petroleum reduction, renewable electricity generation, and climate protection goals. Its use also provides unique state and local economic development benefits. More importantly, biofuels represent one of the only practical near-term renewable energy alternatives to petroleum transportation fuels.

The California Energy Commission retained Navigant Consulting, Inc. (NCI) to review the research and policy developments in biopower and biofuels and assemble a comprehensive set of recommendations for a Bioenergy Action Plan for California. This project leverages the large body of work conducted to date on bioenergy in California and represents a synthesis of ideas from numerous state agencies and other stakeholders.

In developing this proposed Action Plan, NCI reviewed more than 40 research and policy documents[1] and held discussions with representatives of several state agencies, the Bioenergy Interagency Working Group, the California Bioenergy Producers Association, the California Biomass Energy Alliance, and the California Biomass Collaborative. A public workshop was held in Sacramento on March 9, 2006, to solicit input from interested parties, and this input has been taken into consideration in this final document.[2]

California is a national leader in the production of biomass power. In 2005, more than 4 million dry tons (MDT) of solid biomass was used by 28 biomass power plants to generate more than 600 megawatts (MW) of baseload renewable energy. Another 360 MW was generated using landfill gas and biogas from sewage treatment, food processing waste, and animal waste digestion. Combined, these resources meet 2 percent of present total electric demand in the state and can produce as much electricity per year as about 2,500 MW of wind power.

California also leads the nation in the consumption of ethanol, a plant-based renewable transportation fuel, consuming more than 900 million gallons in 2004. This accounted for almost 25 percent of all ethanol produced in the United States in

[1] See the References section for a complete listing.
[2] The workshop was held under CEC docket # 06-BAP-1.

2004. However, California produces less than 5 percent of the ethanol it consumes. California also consumed approximately 5 million gallons of biodiesel, a renewable, clean diesel substitute made from vegetable oils or animal fat in 2004.

California's current use of bioenergy represents a small fraction of what is technically feasible. It is estimated that California has approximately 30 MDT of technically recoverable solid biomass resources each year – enough to power more than 3 million homes or produce enough biofuel to run more than 2 million automobiles at today's efficiencies. These resources are derived mainly from residues associated with agriculture, forestry, and municipal waste, representing a value-added use of materials that would otherwise be considered waste or that pose a significant threat to the California environment, such as the substantial deadfall and fuel overloadings that constitute extreme fire hazards in California's forests and shrub lands.

Despite the many benefits of bioenergy, which are further described in Section 3, California's existing bioenergy industry faces a range of technical, market, and regulatory challenges. For example, the solid-fueled biomass power industry declined by more than 30 percent from its peak capacity in the early 1990s before partially recovering during 2000-2001. The decline has since resumed despite the enactment and implementation of the California Renewable Portfolio Standard (RPS) legislation. A key challenge faced by bioenergy in California (and elsewhere) is that its benefits are not adequately recognized or compensated in the market. Bioenergy development faces a range of other challenges and impediments, many of which can be addressed by state action.

Summary of Recommendations

On August 23, 2005, the Governor expressed his support for the California Biomass Collaborative and asked that the Bioenergy Interagency Working Group, composed of state agencies with important biomass connections, be reinvigorated. He asked the Working Group to develop an integrated and comprehensive state policy on biomass, which includes electricity, natural gas, and petroleum substitution potential. The policy is also required to reflect the substantial potential benefits, such as reducing the amount of municipal solid waste disposed of in landfills.

Consistent with the Governor's direction, the recommendations contained in this Action Plan are intended to create the necessary institutional and regulatory changes that will substantially increase the production and use of bioenergy in California. These recommendations represent near-term first steps that can be taken by state agencies and the Bioenergy Interagency Working Group to invigorate the biopower and biofuels sectors. In some cases, further analysis will be needed, for example, to determine benefit-cost ratio of certain actions.

These recommendations are founded on four broad policy objectives which are consistent with the Governor's direction and the work of the Bioenergy Interagency Working Group. These policy objectives are to:

1. Create a positive environment for bioenergy and create the necessary impetus for investment in new facilities that use California's abundant biomass resources, including the establishment of bioenergy production and consumption targets.

2. Address areas where greater state agency coordination could enhance the opportunities for bioenergy products to contribute to a stable and economically competitive power and fuel supply in California, while preserving other state mandates such as environmental protection and public health.

3. Enhance and accelerate California's existing research, development and demonstration programs to address all aspects of biomass resource production and use, and to capture the benefits of new technologies that use biomass resources more cleanly, efficiently, and economically. Work in partnership with the federal government and the private sector to fund needed research, demonstration, and pilot projects.

4. Promote awareness to inform the general public and policy makers of the importance and benefits of bioenergy.

The following is a summary of high-priority action recommendations for 2006:

1. The Governor should consider issuing an Executive Order establishing statewide goals for bioenergy production and use. This Executive Order should:

    a. Establish a broad-based Renewable Fuel Standard (RFS) for California's transportation sector, targeting consumption of 2 billion gallons of biofuels by 2020 with a minimum of 40 percent produced in California. The RFS should also include interim targets for 2007 and 2010 to spur near-term development and to prevent "backsliding" from current levels. This RFS should be open to the widest possible range of biofuels.

    b. Target the development of 1,500 MW of new biopower capacity by 2020 so that biopower can continue to provide a 20 percent share of in-state renewable electric power as part of the state's accelerated RPS. Establish an interim target of 350 MW of new biopower capacity by 2010.

    c. Direct the Bioenergy Interagency Working Group to develop an integrated and coordinated plan to create a favorable regulatory environment that enhances opportunities for sustainable bioenergy development, yet maintains the required oversight of the existing utility, transportation fuel, and waste management industries, especially with regards to environmental protection.

    d. Request that the California Public Utilities Commission (CPUC) work diligently to preserve the operational status of existing biopower facilities. Further, initiate a proceeding or build upon an existing proceeding to develop

mechanisms that reward biopower for the range of benefits it provides in meeting RPS requirements and other power system needs.

e. Direct the California Energy Commission, in conjunction with the California Biomass Collaborative, the U.S. Department of Energy, and the U.S. Department of Agriculture to fund a selected number of demonstration and pilot projects that are designed to prove the commercial readiness of biofuels production and biomass conversion technologies using lignocellulosic[3] feedstock derived from agricultural, forestry, and municipal wastes.

f. Direct the California Air Resources Board to develop regulations that maximize the flexibility of using biofuels, while preserving the environmental benefits of their use. This effort should build upon the *Rulemaking to Update the Predictive Model and Specifications for Reformulated Gasoline* proceeding that has recently been initiated.

g. Direct the California Integrated Waste Management Board to work to promulgate changes to existing law to develop a regulatory framework for biomass waste conversion facilities, meeting environmental standards, that clearly distinguishes them from disposal, and provides clear permitting pathways for their development, as well as provides diversion credits to local jurisdictions for solid waste processed by these technologies.

h. Direct the California Department of Food and Agriculture and the California Department of Forestry to develop a plan to determine how to gain better access to biomass resources at attractive prices and to continue basic and applied research to identify the highest value use for forest fuel and harvest residues. Coordinate activities with the State Water Resources Control Board to ensure that criteria for watershed protection and water quality are met.

i. Direct state agencies to purchase biofuels, bio-based products, and biopower, including combined heat and power where possible, with specific targets for 2010 and 2020. Encourage local governments and public institutions to follow the state's lead.

j. Direct the California Energy Commission, in consultation with other state agencies, to formulate a plan to disseminate information about the broad-based benefits of bioenergy to the public and to policy makers. This could include a web-based information clearinghouse that contains information on California's bioenergy companies and on the range of state and Federal incentives relevant to bioenergy and bio-based products.

[3] Lignocellulosic biomass, also called cellulosic biomass, is a general term for biomass that is not food or feed, such as woody biomass, perennial grasses, and the non-food components of traditional agricultural crops (e.g., corn stover, rice straw).

2. In addition to the above immediate actions, California needs to coordinate with other states and the federal government. To that end, California agencies should:

    a. Support extension of the Federal Production Tax Credit and advocate for equal tax treatment for biomass relative to other renewable energy resources in federal incentive programs.

    b. Leverage federal research and development (R&D) efforts to realize greater investment of federal research funds in the state.

    c. Work with the National Biomass R&D Initiative and the Western Governors' Association to influence federal funding and policy decisions.

3. To support the above actions, the following key legislative initiatives should be considered, with appropriate input from stakeholders, for 2006:

    a. Revise the existing statutory definition for *transformation* and recommend a new definition for *conversion technology* that facilitates development of environmentally acceptable waste management alternatives. In particular, review definitions of *gasification*, *fermentation*, *pyrolysis*, and *manufacturing*. These revisions are necessary to enable greater use of available biomass waste that otherwise ends up in landfills.

    b. Establish funding mechanisms for bioenergy programs based on the premise that (i) many of the benefits represent public goods that accrue to all Californians, and (ii) predictability and continuity of funding may be just as important as funding amount.

    c. Establish financial incentives to encourage investment and support innovation in bioenergy technologies, and establish mechanisms for supporting bioenergy producers for the multiple benefits they provide.

These high-priority actions are described in more detail in Section 6. In addition to these actions, Section 6 also contains a set of actions that could be undertaken beyond 2006, that could help to resolve more complex or longer-term issues.

By establishing a coordinated policy that is oriented toward actions that enhance the use and production of bioenergy in California, the State can continue to make progress on achieving several of its legislative and policy goals, and take advantage of the benefits provided by bioenergy. This provides a strong rationale for state action. The recommended actions contained in this report are designed to preserve the existing bioenergy base and lay the foundation for sustained, cost-effective, and environmentally sustainable growth of the California bioenergy industry.

SECTION 1: INTRODUCTION

Overview

California has a large, diverse, and widespread biomass resource base that can be used to generate baseload renewable electricity and produce a range of renewable transportation fuels, as well as value-added products and chemicals, to help meet California's energy needs and contribute to a more sustainable future. It is estimated that California has about 30 million dry tons (MDT) per year of technically recoverable biomass resources[4] enough to power more than 3 million homes or produce enough biofuel to run about 2 million automobiles at today's efficiencies[5]

In California today, biomass is used primarily for electric power and thermal energy generation. In 2005, 4-5 million dry tons of solid biomass (about 15 percent of the technical potential) was used by 28 biomass power plants to provide approximately 615 Megawatts (MW) of baseload renewable power[6]. Another 360 MW was generated by landfill gas and biogas from sewage treatment and animal waste digestion[7]. This roughly 1,000 MW of capacity supplies 2 percent of total current electricity demand in the state and can produce as much electrical power per year as about 2,500 MW of wind power.[8]

California is about 95 percent dependent on petroleum for its transportation energy needs.[9] No other sector of the economy is so dependent on a single energy resource. Still, California leads the nation in the consumption of ethanol, a plant based non-petroleum fuel, currently consuming more than 900 million gallons per year, nearly 6 percent of all gasoline on a volume basis.[10] While this accounted for nearly 25 percent of all the ethanol produced in the United States in 2005,[11] California produces less than 5 percent of what it consumes, with the bulk of supply

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[4] California Biomass Collaborative, September 2005, *An Assessment of Biomass Resources in California, 2005,* Draft Report. California Energy Commission, Sacramento, CA.

[5] Calculations assume the following: 30 million dry tons of biomass, converted at 20% efficiency would generate 30 million MWh annually. An additional 4 million MWh was assumed to be available from landfill gas and biogas. Assuming the average home consumes 10,000 kWh per year, this would meet the needs of 3.4 million homes. Similarly, the conversion of 30 million dry tons of biomass to ethanol using cellulosic ethanol technology at a yield of 65 gallons per dry ton would produce 1.95 billion gallons, equivalent to 1.3 billion gallons of gasoline on an energy basis. Assuming automobiles achieve an average 22 miles per gallon and drive 15,000 miles per year, this is enough fuel for 2 million automobiles.

[6] Production figures provided by the California Biomass Energy Association

[7] California Biomass Collaborative, September 2005, *An Assessment of Biomass Resources in California, 2005,* Draft Report. California Energy Commission, Sacramento, CA.

[8] Assumes the average capacity factor for biomass is 85% and for wind power is 35%.

[9] Koyama, Kenneth, California Energy Commission, May 2005, Alternative Fuels Commercialization, California Energy Commission, Sacramento, CA, Publication number CEC-600-2005-020, pg 1.

[10] Ethanol contains one-third less energy per gallon than gasoline, so on an energy basis, ethanol represents about 4 percent of gasoline usage.

[11] In 2005 the U.S. ethanol industry produced nearly 4 billion gallons (see www.ethanolrfa.org)

coming from the "corn belt" states. Most of this ethanol is used in a 5.7 percent blend with gasoline that is consumed throughout the state. There are also approximately 300,000 flexible fuel vehicles (FFVs) on the road that are capable of burning any mixture of gasoline and E85 (a mixture of 85 percent ethanol and 15 percent gasoline), although there is only one retail E85 refueling stations in the state today.

In 2004, California also consumed about 5 million gallons of biodiesel, a substitute for diesel produced from vegetable oils, used cooking oils, or animal fats. By the beginning of 2006 the state had a production capacity of 16 million gallons at four plants.[12]

Project Approach

The objective of this project was to develop recommendations for an Action Plan that addresses the most pressing issues facing the bioenergy industry in California today. The ultimate goal of the Action Plan is to facilitate the increased use of biomass for bioenergy purposes.

Navigant Consulting's (NCI) overall approach is summarized below in Figure 1. This Action Plan represents a synthesis of ideas from numerous state agencies and other stakeholders, and it leverages the large body of work conducted to date on bioenergy in California. In developing this proposed Action Plan, NCI reviewed more than 40 key documents,[13] and held discussions with representatives of several state agencies, the Bioenergy Interagency Working Group, the California Bioenergy Producers Association, the California Biomass Energy Alliance, and the California Biomass Collaborative.

Figure 1: Project Approach

Development of the Bioenergy Action Plan					
Review Reports & Documents	**Create "Bioenergy Value Network" Framework**	**Input BVN Data into "Actions Sorting" matrix**	**Prepare Draft Action Plan**	**Review Draft Plan with Stakeholders**	**Prepare Final Action Plan**
Review past reports for biomass potential, opportunities, and challenges	The Bioenergy Value Network provides a standardized framework for compiling and analyzing the data	Actions Sorting Matrix enables us to measure value of actions using priority criteria	The draft plan incorporated feedback from CEC, BEIWG, and the California Biomass Collaborative	A public workshop was held on March 9, 2006, in Sacramento	Final Action plan to be delivered by 3/31

[12] National Biodiesel Board Website, Fact Sheet January 13, 2006, http://www.biodiesel.org/buyingbiodiesel/producers_marketers/ProducersMap-Existing.pdf.
[13] See the Bibliography section for a complete listing.

Given the tremendous amount of information available on bioenergy and the numerous possible policy actions, NCI developed two tools to sort and prioritize available data and policy actions. The *Bioenergy Value Networks* were created to summarize and organize the information collected. NCI also created an *Actions Sorting Matrix* that allowed for the comparison of various potential actions using several qualitative criteria, such as the magnitude of the expected impact, its benefit, criticality, and size of the energy contribution expected by the action.

A public workshop was held in Sacramento on March 9, 2006, to solicit input from interested parties on a draft Action Plan distributed to the public on March 2, and this input has been taken into consideration in this final document.[14] Some of the comments provided were at a level of detail beyond what was possible to include here. NCI recommends that they be carefully reviewed within the context of developing a detailed implementation plan for bioenergy in California.

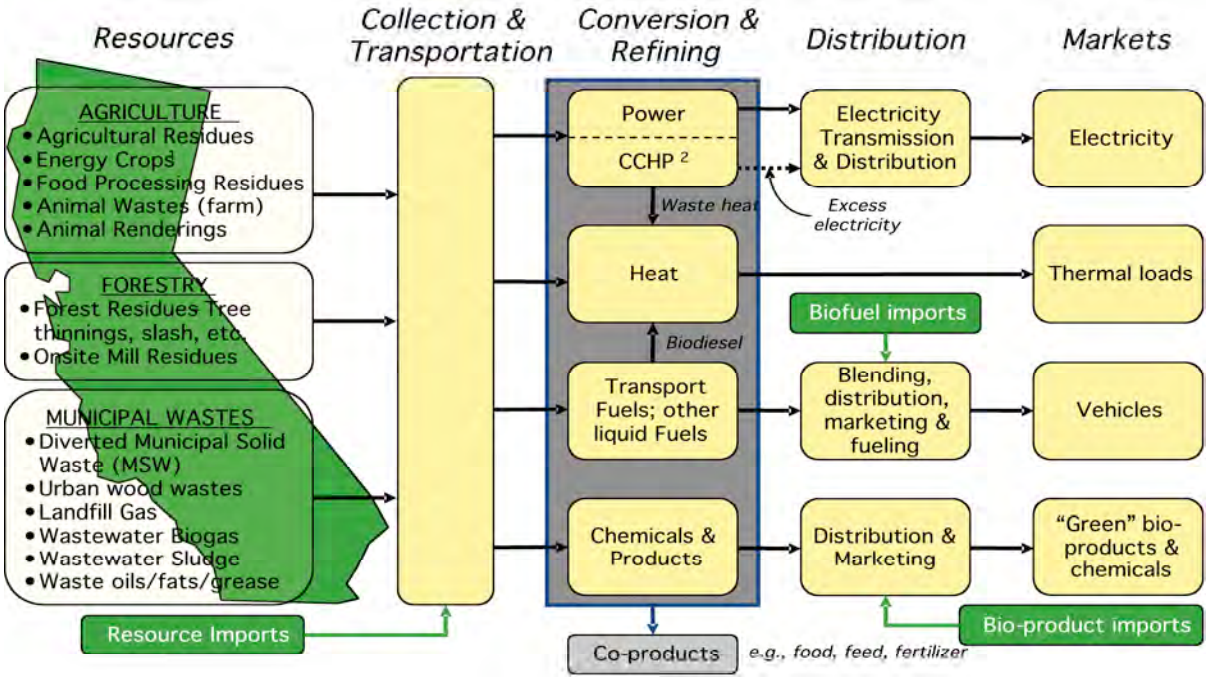
What is Bioenergy?

In the broadest sense, biomass refers to any organic matter, be it vegetable or animal. As a feedstock for energy production, biomass refers to biologically-derived renewable materials that can be used to produce heat, power, transportation fuels, and value-added products and chemicals. Although federal and state statutory definitions can vary widely, for the purposes of this Action Plan, biomass can be thought of as being derived from three principal sources: agriculture, forestry, and municipal wastes.

Figure 2 is a simplified but illustrative depiction of the bioenergy industry structure and puts the biomass resources in context. Additional details on biomass resources can be found in Section 2.

[14] The workshop was held under CEC docket # 06-BAP-1.

Figure 2: Simplified Bioenergy Industry Structure



1. Energy crops include traditional crops such as soybeans and corn, as well as lignocellulosic crops.
2. Combined cooling, heating and power (CCHP) is the simultaneous use of biomass for the production of multiple energy products.

The Benefits of Bioenergy and the Need for State Action

Bioenergy provides multiple benefits that provide a strong rationale for state action to promote its greater use. Not only is greater use of bioenergy critical to the state's energy supply, but it can help achieve the state's existing petroleum reduction, renewable electricity generation, and climate protection goals. Its use also provides unique state and local economic development benefits. More importantly, biofuels represent one of the only practical near-term renewable energy alternatives to petroleum transportation fuels. A more complete list of bioenergy's benefits is found in Section 3.

To fully realize these benefits, California's bioenergy industry must overcome a range of significant technical, market, and regulatory challenges, many of which can be addressed by state action. A key challenge faced by bioenergy in California (and elsewhere) is that the benefits described above are not adequately recognized in the market, for example, in the price paid for biopower in electricity supply contracts. These constraints are more fully described in Section 4.

Section 5 lays out the Role of the State in Bioenergy, and Section 6 is a complete set of Recommended Actions.

SECTION 2: CURRENT PROFILE AND FUTURE BIOENERGY POTENTIAL IN CALIFORNIA

Overview of Bioenergy Resources

California has three principal sources of biomass: agriculture, forestry, and municipal wastes, as summarized in Table 1. Currently, the biomass derived from these sectors is considered a waste product. Statewide, approximately 15 percent of the technically recoverable potential of biomass wastes and residues is being used, suggesting that significant room exists for increased bioenergy use. In the future, additional biomass could also become available from dedicated energy crops.

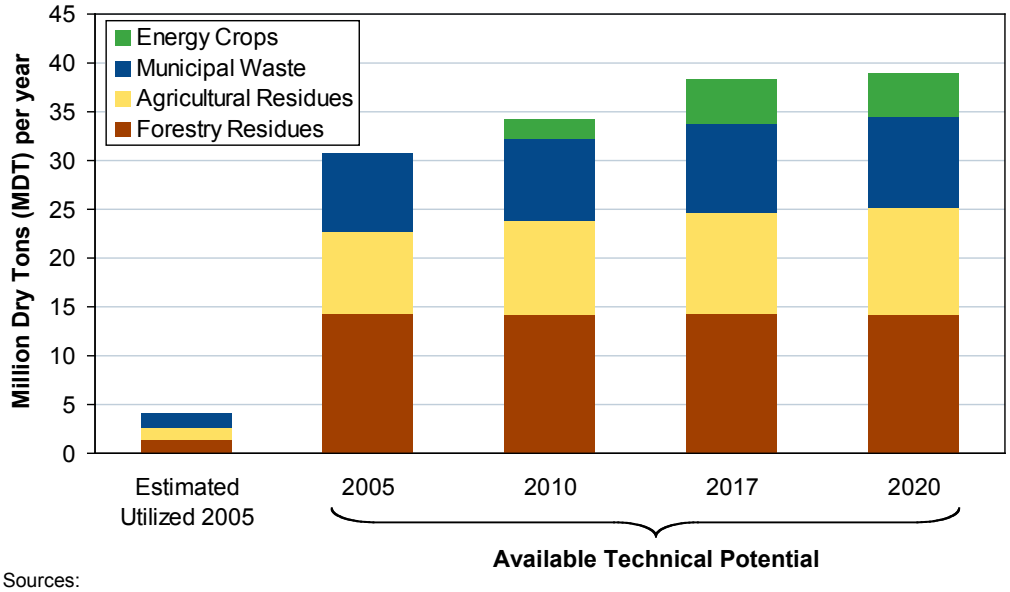
Table 1: California's Bioenergy Resource Types

Biomass Type	Typical Examples
Agricultural	• Agricultural Residues (e.g., orchard trimmings, rice straw) • Energy Crops (e.g., dedicated corn and sugar for ethanol production, safflower and canola for biodiesel, as well as perennial grasses and certain type of fast-growing trees) • Food Processing residues (e.g., hulls, shells, pits, beverage and cheese industry residuals) • Animal Wastes (manure and biogas[1] from manure anaerobic digestion) • Animal Renderings
Forest Residues	• Forest Residues (logging slash, brush, thinnings from fuel treatments, chaparral) • Onsite Mill Residues (sawdust, wood chips, spent pulping liquors, paper mill sludge)
Municipal Wastes	• Diverted Municipal Solid Waste (MSW) (the organic fraction of municipal solid waste) • Urban Wood Waste • Landfill gas[1] • Wastewater Biogas[1] (from wastewater treatment) • Wastewater Sludge (from wastewater treatment) • Waste Oils, Fats, Grease

1. Landfill gas is a mixture of roughly 50:50 methane and carbon dioxide produced by the natural anaerobic decomposition of organic materials in landfills. Biogas is a mixture of roughly 60:40 methane and carbon dioxide produced by the anaerobic digestion of wastes.

The solid biomass resource potential is summarized in Figure 3. In 2005, 4-5 MDT were used, while the potential by 2020 is expected to be approximately 39 MDT.[15] In addition, an estimated 90 BCF per year of landfill gas and biogas are technically available in 2005, which contains as much energy as 3 MDT of additional solid biomass.

Figure 3: Solid Biomass Utilization and Technical Potential in California



Sources:

California Energy Commission, November 2005, *Draft Report An Assessment of Biomass Resources in California, 2005*, California Energy Commission, Sacramento, CA., Contract number 500-01-016. (Table 4.1)

California Energy Commission, April 2005, *Biomass in California, Challenges, Opportunities and Potential for Sustainable Management and Development*, California Energy Commission, Sacramento, CA., Contract number 500-01-016.

Agricultural Biomass Resources

Agricultural sources of biomass include harvesting and production residues, various types of traditional and non-traditional energy crops grown for the dedicated purpose of producing energy, animal wastes, and animal renderings.

Agricultural residues include woody orchard and vineyard prunings, herbaceous field crop residues (such as cereal straws and corn stover), vegetable crop residues, and food processing residues (primarily rice hulls, shells, and pits). Biomass energy crops, or dedicated crops, include sugar and starch crops; oil crops, such as sunflower and safflower; salt and drought tolerant species, including grasses and trees; and aquatic species. In California today, virtually all of the agricultural biomass resources used are residues from orchards, vineyards, seed crops, and other field wastes. There is little use of traditional crops (corn, soybeans) for energy production

[15] The available technical potential is the faction of the theoretical or gross potential that is considered to be recoverable on a sustainable basis. The theoretical potential exceeds 90 million dry tons per year.

(for example, for ethanol or biodiesel) and no production of other dedicated energy crops.

Animal waste includes manure from dairy cows and poultry operations. Dry animal wastes, such as poultry litter and cattle feedlot manure, can be combusted. Waste from dairy and swine operations, however, is typically high in moisture due to the use of water in waste removal. For these high-moisture wastes, anaerobic digestion can be used to reduce the volume of waste, destroy pathogens, and reduce odor. The resulting biosolids can be dried and used as animal bedding or fertilizer. The resulting biogas can be used to produce power and heat or, less commonly, can be purified and used as a substitute for natural gas.

Animal renderings statistics were not readily available and therefore not included in this report, but they represent a smaller potential than other sources of biomass in the market. Nevertheless, use of this resource for energy may provide significant benefits in mitigating the risks associated with various diseases, such as mad cow and avian flu, while creating value from a waste product.

Forestry Residues

Onsite forest residues are those produced as a result of existing forest products activity, such as sawmill operations and pulp and paper (including paper recycling). Sawmill residues were a significant and economic source of biomass fuel in the late 1980s and early 1990s. As much as three MDT was provided annually by sawmill residues alone in 1990-1991. However, the 1990s were a period of decline for sawmilling operations throughout California; and consequently, the contribution of residues from the sawmill industry has declined significantly since that time[16].

Forest residues include forest and shrub land biomass that could be collected specifically for energy conversion and include logging slash, scrub, chaparral, and forest thinning resulting from fuel treatments conducted as part of efforts to mitigate forest fire risk and improve forest health. This last source of biomass could provide an important source of value to forest fire mitigation efforts, as biomass produced from these activities is typically disposed of without generating any additional economic value.

Municipal Wastes

Municipal biomass resources include municipal solid waste (MSW), urban wood waste, landfill gas, waste water treatment plant (WWTP) biogas and the resultant biosolids (sludge), and waste fats, oils, and grease (e.g., yellow grease from

[16] Morris, G., Green Power Institute, July 31, 2003, *The Status of Biomass Power Generation in California July 31, 2003,* National Renewable Energy Laboratory, Golden, CO. Contract No. DE-AC36-99-GO10337

restaurants). MSW includes both high and low moisture content organic materials generated by municipalities, including clean construction waste, paper and cardboard, green wastes, urban tree trimmings, and food wastes. Landfill gas is created from the natural decomposition of the organic fraction of MSW that is disposed of in landfills. WWTP biogas is created from the anaerobic digestion of organic matter in waste water. Waste fats, oils, and grease statistics were not readily available, but their use for biodiesel production represents a value-added activity from this waste product.

Electric Power and Heat from Biomass in California

At present biomass in California is converted to electric power though one of two processes based on the characteristics of the biomass. Two-thirds of California's biomass power capacity is generated by the direct combustion of solid biomass in boiler-steam turbine plants, ranging in size from about 5 to 50 MW. The remainder is generated by the combustion of landfill gas and biogas in a range of power generating equipment including boiler-steam turbine systems, reciprocating engines, and gas turbines. These projects are typically smaller than solid-fueled biomass plants and can be less than 1 MW to about 10 MW, although the largest landfill gas project in California is about 50 MW [17].

Combined, biomass power represents about 2 percent of the electricity supply available to the state and can produce about 7.3 million MWh per year [18,19]. Currently, biomass accounts for about 20 percent of total in-state renewable energy generation, excluding large hydropower[20] making it a critical part of California's renewable energy mix.

Most solid-fueled biomass power plants are currently selling their output under fixed price contracts with an investor-owned utility (IOU). Many also receive revenue for their capacity as well as an Energy Commission subsidy for some or all generation[21]. New biomass projects can compete under the IOU Renewable Portfolio Standard solicitation process. In this case, projects compete against other renewable technologies which are subject to a Market Price Referent (MPR) established by the CPUC, which in 2004 was approximately 5.8 cents per kilowatt-hour. For those facilities that require revenue in excess of the MPR to cover expenses, payments under the California Energy Commission's Supplemental Energy Payment program may be available.

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[17] United States Environmental Protection Agency, *Landfill Methane Outreach Program (LMOP) LMOP Landfill Database, California state operational landfills,* http://www.epa.gov/lmop/proj/xls/lmopdataca.xls

[18] California Biomass Collaborative. 2004. An *Assessment of biomass resources in California.* PIER Consultant Report, California Energy Commission, Sacramento, CA, 2004

[19] Assumes an average 85% capacity factor.

[20] California Energy Commission, 2003 Net system power calculation, Publication 300-04-001R.

[21] Communication from California Biomass Energy Alliance

In some cases, solid biomass and landfill gas are also used for direct heat applications. In certain onsite applications, such as dairies, sewage treatment plants, and forest products mills, biomass and biogas can be used in cogeneration (the simultaneous production of power and useful heat). In such cases, power may or may not be delivered to the grid, depending on whether there is excess power after meeting onsite requirements. At today's high oil and natural gas prices, biomass may provide an economically competitive alternative to conventional sources for space and process heating, as well as for CHP.

Developments in Electricity Generation from Biomass

Due to their relatively small scale, biomass power plants are characterized by high capital and non-fuel operating and maintenance costs, as well as low efficiency (which makes them sensitive to biomass feedstock costs) compared to fossil fuel plants using similar technologies. Technology developments that may help address these issues include gasification of solid biomass for use in gas turbine combined cycle systems. Gasification has the potential to increase electrical generation efficiency which reduces emissions. Biomass co-firing in existing or new coal and natural gas-fired plants would take advantage of the higher overall efficiencies of these plants and also reduce the capital investment required. This represents a significant potential opportunity for bioenergy going forward (although not as much in California which only has a few small coal-fired plants).

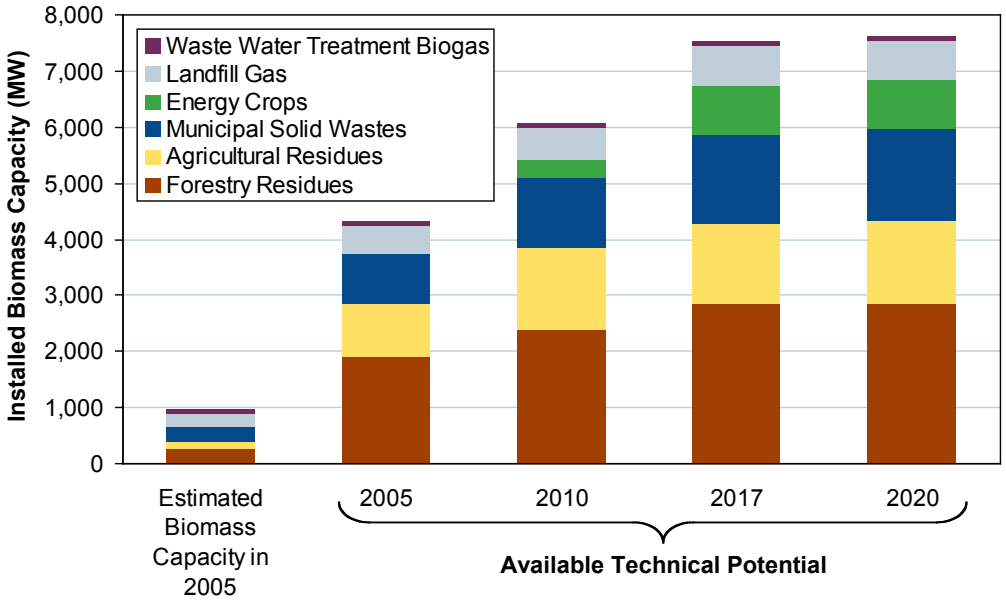
The development of bioreactor landfills – a closed capsule type landfill receiving mostly organic material – could increase the efficiency at which methane is produced and captured from landfills, resulting in higher gas generation rates and more efficient use of limited landfill space. This technology is already being piloted in California.[22]

Biomass Power Potential

If the technical potential described above is fully developed, by 2017[23] electricity from biomass could reach 60,000 gigawatt-hours (GWh) per year, or 18 percent of projected statewide electricity consumption of 334,000 GWh. With conversion efficiency improvements, growth in population, and the use of dedicated energy crops, this corresponds to incremental capacity growth of 7,100 MW by 2017 (see Figure 4). Without improving efficiencies, incremental capacity in 2017 would be closer to 4,800 MW.

[22] The Yolo County Central Landfill was used as a site to demonstrate the bioreactor landfill concept. The project was funded in part by the U.S. EPA and the California Integrated Waste Management Board. See http://www.yolocounty.org/recycle/bioreactor.htm for additional details.
[23] This date was chosen for illustrative purposes because it is the date for achieving the existing RPS targets.

Figure 4: Biomass Power Technical Potential from California Resources



Sources:

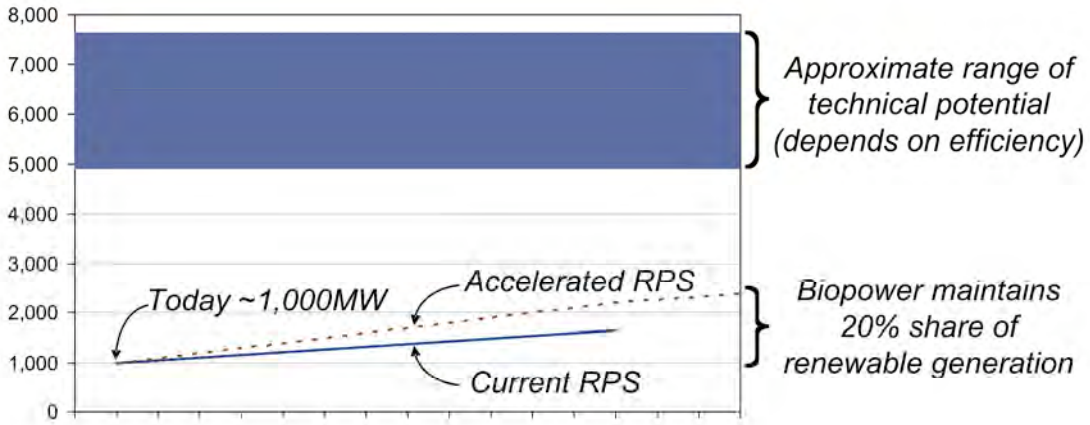
California Energy Commission, November 2005, *Draft Report An Assessment of Biomass Resources in California, 2005*, California Energy Commission, Sacramento, CA., Contract number 500-01-016. (Table 4.1)

California Energy Commission, April 2005, *Biomass in California, Challenges, Opportunities and Potential for Sustainable Management and Development*, California Energy Commission, Sacramento, CA., Contract number 500-01-016.

Note: Agricultural Residues includes biogas from anaerobic digestion.

If in the future biomass were to maintain its 20 percent share of total renewable electricity in California, under the accelerated RPS of 33 percent by 2020, annual additions would need to increase approximately 70-95 MW per year, and net cumulative additions through 2020 would be approximately 1,450 MW for a total of approximately 2,400 MW installed, which is well within the technical potential (see Figure 5)

Figure 5: Biopower Potential and Requirements to Maintain a 20% Share of CA Renewable Power Production



Sources:

- California Energy Commission, November 2005, *Draft Report An Assessment of Biomass Resources in California, 2005*, California Energy Commission, Sacramento, CA., Contract number 500-01-016. (Table 4.1)
- California Energy Commission, April 2005, *Biomass in California, Challenges, Opportunities and Potential for Sustainable Management and Development*, California Energy Commission, Sacramento, CA., Contract number 500-01-016.
- NCI estimates.

Biofuels for Transportation

The current situation for biofuels is considerably different than that for biomass power. California is the leading U.S. market for fuel ethanol, a gasoline additive, having consumed over 900 million gallons in 2004.[24] However, nearly all of this is imported from the "corn belt" states, with only about 35 million gallons per year produced in-state using residual sugars from food processing and imported corn.[25] One other project is currently under construction in California that would add another 35 million gallons per year to California's in-state supply.[26] In addition, several other projects are under consideration that would use a range of feedstocks, including corn, sugarcane, rice straw, and municipal wastes.

Growth in the use of ethanol in California was catalyzed by the banning of methyl tertiary butyl ether (MTBE), a gasoline additive that was contaminating groundwater. As the only practical alternative to MTBE, ethanol is currently blended at a rate of 5.7 percent in virtually all California gasoline. The petroleum industry has invested in

[24] Koyama, Kenneth, California Energy Commission, May 2005, Alternative Fuels Commercialization, California Energy Commission, Sacramento, CA, Publication number CEC-600-2005-020, pg 9.
[25] Parallel Products, Rancho Cucamonga, has been in operation since 1984, producing up to 5 million gal/yr of ethanol from food and beverage industry wastes. Golden Cheese of California, Corona, has been in operation since 1985, producing up to 3.5 million gal/yr of ethanol from cheese processing wastes. Phoenix Bioindustries/Western Milling Co., Goshen, started up a 25 million gal/yr ethanol plant in the fall of 2005.
[26] Pacific Ethanol has a 35 million gallon/year plant under construction in Madera, also to use corn, with operation scheduled for fourth quarter 2006.

the necessary infrastructure to accommodate the shift. California has 70 petroleum product terminals capable of handling ethanol.[27] There is also one E85 retail refueling station and three E85 fleet refueling stations in California, and nearly 300,000 flexible fuel vehicles are on the road in California that are capable of burning any mixture of gasoline and E85, although almost none are using E85 due to the lack of E85 availability.

The only other biofuel used in any significant quantity is biodiesel, a diesel substitute derived from vegetable oils (either virgin oils such as soybean or canola, or used cooking oils) and animal fats. Biodiesel can be used as a neat fuel (B100) in diesel engines, but it is more commonly used in 5 percent (B5) and 20 percent (B20) blends with petroleum diesel. Biodiesel has attractive fuel properties (zero sulfur and aromatic content, high cetane, and high lubricity) and generally results in reduced emissions, although nitrogen oxide (NOx) emissions can increase slightly. Fuel storage and some materials compatibility issues exist, but these are generally manageable and limited to higher blends or B100.

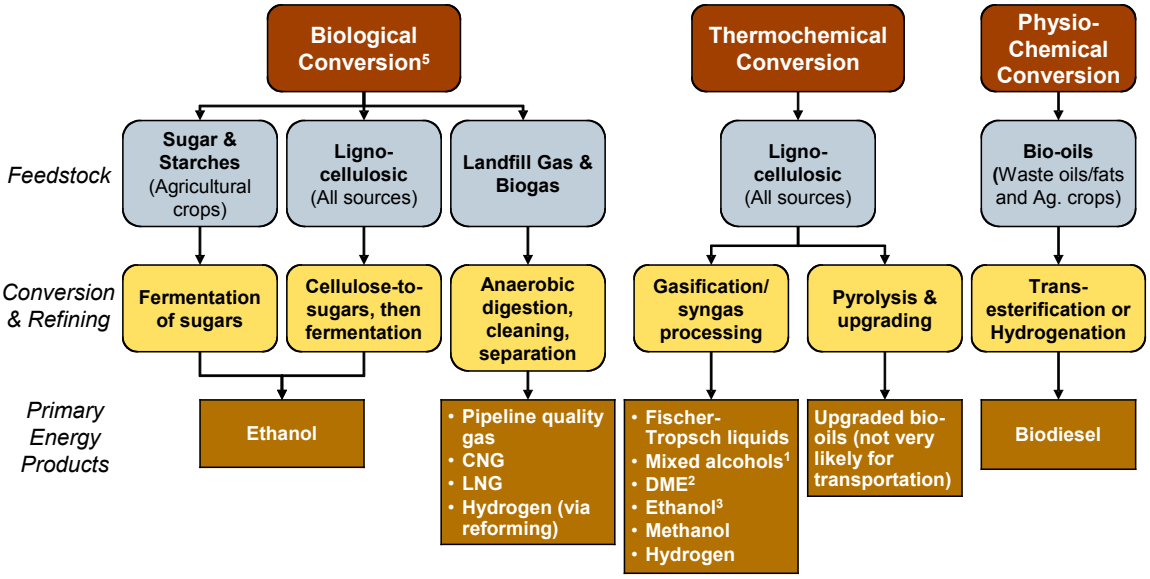
California has four biodiesel production facilities with a combined capacity of approximately 16 million gallons per year. California has 29 biodiesel distributors (primarily petroleum distributors) and 23 retail outlets. In 2004, consumption was about 5 million gallons. Several government and utility fleets in California use biodiesel. Biodiesel and biodiesel blends can also be used as substitutes for distillate fuel, for example, in backup power generation and home heating applications.

From a technology and fuel choice standpoint, the biofuels situation is notably more complex than biopower, which has essentially a single product (electricity). Figure 6 highlights the various technology pathways that are possible for producing biofuels. Given the abundance of lignocellulosic biomass in California relative to sugar/starch and oil crops, those options that use lignocellulosic biomass are more attractive for in-state production. These options are the least technologically mature, however, and will require the commercialization and deployment of new technology, specifically cellulosic ethanol and various options that use gasification followed by catalytic synthesis ("syngas processing") of different fuels such as Fischer-Tropsch liquids (FT, also called biomass-to-liquids)[28] and mixed-alcohols, among others. There are several pilot and demonstration projects underway in the U.S. and Canada that are hoping to confirm the commercial readiness of these technologies.

[27] Fong, Dan, California Energy Commission, July 2005, Options to Reduce Petroleum Fuel Use (Second Edition), California Energy Commission, Sacramento, CA, Publication number CEC-600-2005-024-ED2, Addendum pg AD-2F-3.

[28] Fischer-Tropsch (FT) liquids are high quality substitutes for petroleum fuels. The main product is FT diesel. FT diesel contain no sulfur or aromatic hydrocarbons and has high cetane, making it a clean-burning diesel fuel and a "premium" blendstock for conventional diesel.

Figure 6: Biomass to Fuels Conversion Pathways



1. Via catalytic synthesis. 2. Dimethyl ether. 3. Via syngas fermentation. 4. Pyrolysis oils require substantial upgrading before they can be used for transportation applications (e.g., before they can be processed in a conventional refinery). It is more likely they would undergo more modest upgrading for use as boiler fuel or in a stationary IC engine or gas turbine. 5. Also includes direct microbial conversion of sunlight to hydrogen.

Broadly speaking, advanced renewable diesel fuels are a new group of fuels that differ from traditional biodiesel. These fuels include biomass-to-liquid (BTL) and thermal conversion fuels which are made from a broader range of feedstocks, including vegetable oils, animal wastes, and agricultural residues, which are processed through a more complex refinery process. These advanced processes produce greater volumes and higher quality diesel and naphtha than conventional biodiesel fuel processes. Recent pilot and small scale plants are proving the economic viability of these new processes and promise to enhance traditional biodiesel and petroleum diesel supply. Also, in the long term, biomass may the lowest cost option for producing renewable hydrogen.

Biofuel Potential

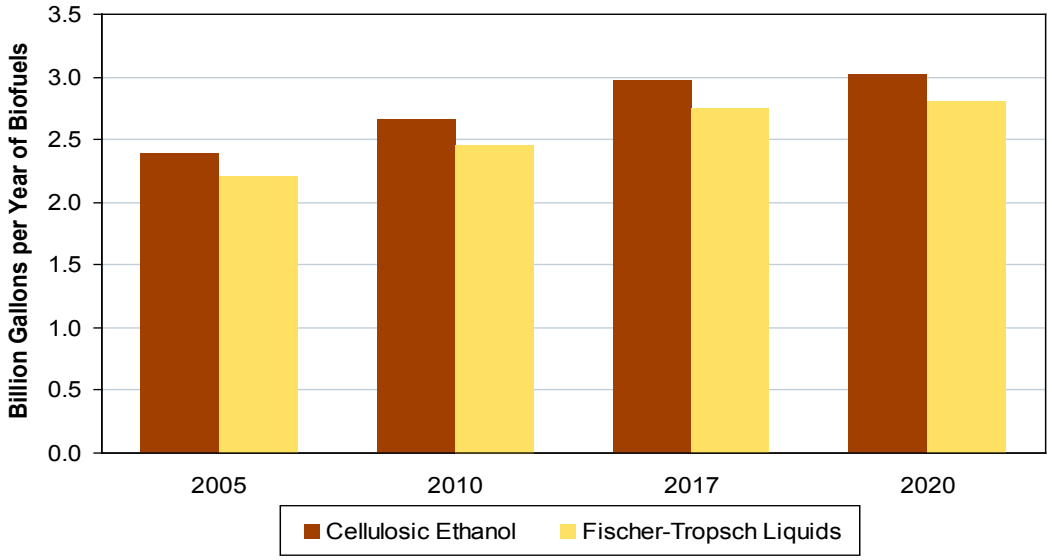
The potential for producing biofuels from California biomass resources depends on the type of biofuel and the conversion technology that is employed. For illustrative purposes, Figure 6 shows the potential for producing ethanol and FT liquids from cellulosic biomass. Based on the technically available cellulosic biomass, and assuming an average yield of 77.5 gallons of ethanol[29] per dry ton and 72 gallons of FT liquids per dry ton, California's cellulosic resource could support production in excess of 2 billion gallons per year, approaching 3 billion gallons by 2020.

In addition to the potential shown in Figure 7, biodiesel can be produced from waste oil or dedicated vegetable oil crops and ethanol could be produced from sugar/starch

[29] This is an average assuming a yield range of 65 to 90 gallons per dry ton.

crops, if these are also grown in the state. Methane from landfill gas and biogas could also be purified, and either liquefied (as LNG) or compressed, and used as an alternative to compressed natural gas in vehicles, or added to the existing natural gas distribution network.

Figure 7: Biofuel Technical Potential from Lignocellulosic Biomass in California



Source:

NCI estimates based on the technical potential described earlier and assuming an average yield, based on a range of 65-90 gallons of ethanol per dry ton of biomass, and 72 gallons per dry ton of Fischer-Tropsch liquids. Actual yields will vary with time as technology matures and on the type of biomass used.

Key Initiatives Underway in California and Elsewhere in the United States

A range of biomass initiatives are underway within various California groups, state agencies, surrounding states, including Oregon and Washington, and others within the western region of the United States. Such initiatives include the California Waste-to-Energy Task Force, Bioenergy Interagency Working Group, the CEC's Public Interest Energy Research Program (PIER) and Renewable Energy Program, California Alternative Fuels Task Force, and the California Biomass Collaborative.

Regional activities include the Western Governors' Association Biomass Task Force, and the West Coast Global Warming Initiative Bio-Fuels Working Group. On the national level, the National Biomass Research and Development (R&D) Initiative has been recently announced by the U.S. Departments' of Energy and Agriculture to coordinate research on renewable transportation fuels, biopower, and bio-based products. These state, regional and federal efforts confirm that biomass is an important resource under careful consideration as a renewable fuel, and help to ensure that biomass issues are given a proper forum for debate, dialogue, and action.

SECTION 3: THE BENEFITS OF BIOENERGY

Bioenergy provides a range of strategic, energy, economic, and environmental benefits to the people of California. Capturing these benefits is the main objective of this Action Plan. Not only is greater use of bioenergy critical to achieving existing regulatory and policy objectives, but it is also consistent with a range of state environmental goals and provides unique economic development benefits relative to other energy options. Biofuels represent one of the only practical near-term renewable energy alternatives to petroleum transportation fuels.

Specific benefits include:

1. Meeting Existing State Goals and Requirements

- **Renewable Portfolio Standard.** Biopower is critical to helping the state reach the accelerated goals of 20 percent of the electricity used coming from renewable resources by 2010 and 33 percent by 2020. With approximately 15 percent of the state's technically available biomass resource currently being used, greater use of biopower represents a significant untapped resource for meeting RPS targets.

- **Resource Adequacy Contribution.** Under policies and rules established by the CPUC in December 2004[30], regulated electric utilities in California have specific minimum levels of power supply resource reserve levels to meet, which are referred to as "resource adequacy" requirements. These requirements were established to help provide power capacity reserves to enhance grid reliability and to help reduce risk of electric price volatility due to possible power supply shortages.

  One of the primary benefits of biomass power generation, especially compared to wind power, is the ability to schedule delivery from such power supplies and their "baseload" (generally operated 24/7) power production capability. As a result, biomass power projects can help contribute to resource adequacy requirements for the electric utilities in amounts that are near their installed capacity, subject to proper power contracting arrangements consistent with CPUC resource adequacy requirements. Use of biomass power facilities for this purpose could help reduce the amount of incremental new gas-fired facilities that would otherwise be required to meet resource adequacy requirements of the utilities.

- **Petroleum Dependency Reduction.** The Joint Report by the California Energy Commission and the Air Resources Board titled *Reducing California's Petroleum*

[30] California Public Utilities Commission, December 20, 2004, *Opinion Adopting Pacific Gas and Electric Company, Southern California Edison Company and San Diego gas & Electric Company's Long-term Procurement Plans, Decision 04-12-048*, California Public Utilities Commission, San Francisco, CA, http://www.cpuc.ca.gov/PUBLISHED/FINAL_DECISION/43224.htm

Dependence has set goals for 20 percent non-petroleum fuel use by 2020 and 30 percent by 2030. Fuels produced from biomass will play an important role in reaching these goals. Developing in-state biofuels production will help to meet these objectives and stimulate the development of new jobs, while contributing to the overall fuel supply for the state.

- **Greenhouse Gas (GHG) Reduction.** Using biomass instead of fossil fuels reduces GHG emissions. Also, conversion of landfill gas to energy and the adoption of animal waste conversion systems can substantially reduce fugitive methane emissions, a powerful greenhouse gas. Finally, improving the use of waste and residues from forests and farms further decreases GHG emissions associated with biomass decomposition. In the long term, advanced bioenergy conversion technologies can also be coupled to carbon dioxide capture and sequestration for additional GHG reductions.

- **Energy Reliability, Security, and Price Stability.** A broadly-diversified energy supply portfolio is increasingly recognized as having value in the market, both as a hedge against price increases and price volatility, and to minimize the impacts of potential energy supply disruptions. There is also value in having a more distributed energy supply system to alleviate transmission system constraints, and bioenergy would naturally contribute to this. Increased biofuels utilization also effectively extends the state's limited refining capacity.

2. Waste Management

- **Landfill Diversion.** The biomass component of municipal solid waste totals approximately 38MDT per year.[31] Biomass conversion technologies have the potential to return a significant portion of this post-recycled fraction of the waste stream to an economic stream in the form of power, fuels, and chemicals. Development of these new industries will enable California not only to meet but substantially exceed its current 50 percent recycling goal while reducing pollution and fostering economic growth.

3. Environmental Quality

- **Air Quality.** Although use of ethanol and biodiesel can result in increases in emissions in some pollutants, such as high oxides of nitrogen and volatile organic compounds from the use of lower level blends (i.e., E6 to E10), biofuels are naturally low in sulfur, aromatics, and other toxic compounds that impact human health. These lower associated toxic emissions, in addition to the lower GHG pollutants noted above, provide significant benefits to air quality.

[31] California Biomass Collaborative, June 2005, *Biomass Challenges, Opportunities, and Potentials for Sustainable Management and Development PIER Collaborative Report*, California Energy Commission, Sacramento, CA.

- **Forest Health and Wildfire Prevention.** California forests contain substantial deadfall and fuel overloading which constitute extreme fire hazards, particularly at the wildland-urban interface. Forest thinning and other improvements in forest health, when coupled with bioenergy production, can create a statewide wildfire prevention strategy that reduces fire suppression costs and enhances the supply of renewable energy.

- **Water Quality and Watershed Protection.** Petroleum-based fuels and chemicals are toxic to the environment and continue to constitute a major source of pollution to surface- and ground-waters. In contrast, biofuels, such as ethanol and biodiesel, are less toxic and are biodegradable. As a result, these fuels result in less environmental impacts from spills and leaks. Watershed protection is also enhanced by integrating forest thinning with bioenergy projects, which preserves forest integrity and reduces the threat of erosion and runoff.

4. Economic Development

- **New Opportunities for Agriculture.** Biomass constitutes new potential opportunities for agriculture, both in terms of improved use of the non-crop portion of current production and in new crops addressing new markets in energy, fuels, chemicals, and bio-based products. In California, opportunities also exist for integrating dedicated biomass crops into remediation programs to repair salt-affected and other contaminated lands.

- **Economic Development.** A significant portion of the fuels and feedstocks used by biomass industries, such as forestry and agricultural wastes and energy crops, originate in rural areas of the state. Creation of a diversified bio-based economy in California will help to revitalize rural communities and the State's agricultural base by creating new value-added markets and new local jobs.

These benefits provide strong motivation for developing a larger, sustainable bioenergy industry. The following section highlights some of the key challenges faced by the industry, many of which can be addressed by state action.

SECTION 4: IMPEDIMENTS AND CHALLENGES

Barriers to biomass energy development are diverse, but can be broadly divided into three areas: policy/regulatory, market, and technical. Some of these – mainly policy/regulatory and market issues – are unique to California, although there are some important federal aspects. Technology issues are largely general in nature.

Policy/Regulatory Impediments

Fragmented State-Level Policies that Do Not Recognize the Full Benefits of Bioenergy

A number of state agencies have jurisdiction over different aspects of biomass management, bioenergy development and use. These various agencies may have unintentionally overlapping and conflicting regulations and policies. Moreover, the state currently lacks a comprehensive system for assessing the overall environmental and health benefits and costs (on a life-cycle basis) of bioenergy options. Tied to that is the lack of a means of remunerating the bioenergy industry for the diverse benefits it provides.

Described below are two specific examples where this coordination is needed:

- Use of ethanol and biodiesel can result in increases in emissions of certain pollutants. However, these fuels offer a range of benefits, especially when considering the well-to-wheel impacts, greenhouse gas emissions, and the strategic value of petroleum displacement. Moreover, recent empirical data has shown that there has not been degradation in air quality with the introduct5ion of ethanol blending n gasoline, although it is not known how ethanol has contributed to this result. In order to chart an appropriate course for greater biofuels utilization, therefore, it is important that California develop a more comprehensive understanding of the air quality and other impacts/benefits of using a range of biofuels. Given the complexity of this undertaking, the process should include peer review.

- Municipal waste is a major potential source of biomass for conversion to energy using advanced, clean technologies. However, there is no statutory definition of *conversion technology* and the existing definition for *transformation* makes it extremely difficult to site and permit projects using these advanced conversion technologies. In addition, a lack of diversion credits for biomass used in such facilities is a further disincentive. This contrasts with the use of biomass as “alternative daily cover” in landfill operations. This material, which provides a beneficial use of biomass, but ends up in the landfill, does qualify for diversion credits. Attempts to clarify and update these definitions have been proposed, but concern remains that current legislative efforts will not be successful or sufficient.

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

Non-optimal Financial Incentives

At the federal level, bioenergy (particularly biopower) has traditionally received second-class treatment relative to other renewable energy options, for example, with the Renewable Energy Production Tax Credit (PTC). The PTC provides roughly one-third of the economic value to a wind power project, but until 2004, most biomass resources were ineligible for the PTC. Currently, power projects using "open-loop" biomass received the PTC at only one half the rate for wind, solar, and geothermal energy projects.[32]

Ethanol has received sustained federal support via the excise tax credit, but only recently have federal programs begun to support other biofuel options with similar incentives. Still, these incentives typically have limited duration and require periodic extensions. This "stop-start" nature of federal renewable energy incentives acts as a barrier to private sector investment.

At the state level, biopower projects have 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, reduced fuel availability and higher pricing, and in some cases, operational issues that have resulted in economic hardship. In fact, ten projects, with a combined capacity of 117 MW, have been shut down since 1999 alone[33]. Power pricing for most facilities after mid-2006 has yet to be determined. Similarly, many projects are dependent on the Energy Commission's subsidy for their operations during certain off-peak time periods, the future of which is also uncertain beyond 2006.

New projects are primarily limited to participating in IOUs RPS solicitation processes. Utilities use a Market Price Referent (MPR) as a proxy for the cost of developing conventional energy sources and as a gauge for determining the competitiveness of renewable pricing proposals. If the MPR does not satisfactorily cover fixed and variable costs, which appears to the case for many biopower facilities, developers must qualify to receive a Supplemental Energy Payment (SEP) from the Energy Commission's Renewable Energy Program. For reasons related to

[32] The updated PTC statute can be found in the U.S. Code: 26 USC 45 (Subtitle A, Chp 1, Subchp A, Part IV, Subpart D, Section 45.
[33] Communications from California Biomass Energy Association

award timing and procedural issues, no disbursements to new projects have occurred under the SEP program, effectively limiting the number of new biopower facilities that have been awarded contracts.

Biomass is also currently not given equal treatment in state net metering programs, which has contributed to the lack of development of smaller biomass facilities.

Complex and Time-Consuming Permitting Process

The costs of dealing with California's time-consuming and complex siting and permitting process can hamper bioenergy project development, especially when one considers the fact that even large biomass energy projects are relatively small compared to their conventional energy counterparts, making the fixed costs associated with permitting a larger fraction of overall project costs. Developers have repeatedly indicated that the challenges faced in navigating the permitting process may be the number one barrier to establishing new facilities. This is exacerbated by the fact that permitting costs are incurred early in the project development process, when capital is most at risk and costly. In the near term, this may also have an impact on California's ability to take advantage of new federal programs and incentives created in the Energy Policy Act of 2005, since other states with less onerous siting and permitting requirements may be more successful.

Although California should not lower its environmental standards, it should consider ways to simplify siting and permitting. As a specific example, as a result of the ban on open-field burning, a significant source of emissions offsets needed in siting facilities in non-attainment areas of the State are no longer available, further constraining bioenergy development. It will be important to engage California's local air quality management districts in this dialogue as they have primary responsibility for permitting biomass projects under 50 MW.

For smaller biomass power projects, such as those located at wastewater treatment plants or dairy farms, the interconnection process is time-consuming and cost uncertain and unfairly burdens smaller projects. Even the simplified onsite generation interconnection standards (under Rule 21) can be costly.

Other siting and permitting challenges include the "not in my backyard" (NIMBY) issue and the unknowns related to emissions for unproven technologies.

Environmental Justice Concerns

The siting of bioenergy facilities is an important issue for low-income and minority communities which may have to bear a disproportionate share of the emissions or discharges located in their communities. As a result, the environmental impacts of converting biomass into energy, which could include increased emissions and foul odor (air quality), toxic leacheate (water quality), noise (transportation), and public

health and safety effects (fire and explosion from methane), all need to be considered, evaluated, and mitigated.

The State of California has made the achievement of environmental justice an integral part of its environmental programs. The California Environmental Protection Agency has directed its regulatory agencies, including the Air Resources Board and the State Water Resources Control Board, to evaluate and mitigate the environmental and health effects on the affected local communities of proposed facilities that produce or use bioenergy. In addition, environmental justice concerns should be included in any public awareness campaign that results from implementation of this proposed Action Plan.

Market Barriers

Cost of Harvesting, Collecting, and Delivering Feedstock

Perhaps what separates solid biomass most from other renewable energy options is the need to collect, process, transport, and store feedstock. Biomass, with its low energy density compared to fossil fuels, is relatively expensive to transport, limiting most projects to collection radii of roughly 50 miles. The recent rise in diesel fuel prices (for truck transport of biomass) has had a noticeable impact on biomass power plant viability.

California currently has insufficient quantities of agricultural crops for more than a few ethanol production facilities. Continuing to import corn from the Midwest is an option, as the production of corn in California for ethanol is generally considered uneconomical. Nevertheless, more comprehensive information is needed on what it would take to develop sufficient supplies of various sugar and starch feedstocks in California, including land, water, and incentive requirements. This situation is similar for oil crops that would be needed for larger-scale biodiesel production. Biodiesel production based on used cooking oil or yellow grease is limited by available feedstocks.

As an alternative or supplement to sugar and starch feedstocks for ethanol production, cellulosic biomass is abundant in California from forest, agriculture, and municipal waste sources, but the technology for converting these feedstocks to biofuels are not yet commercially available. The potential exists for using marginal-production land in California to grow lignocellulosic energy crops, however, large-scale availability is still far off as initial studies and tests are currently being conducted. Nevertheless, a key benefit is that lignocellulosic ethanol has much lower life-cycle greenhouse gas emissions than corn-based ethanol.

Financing Challenges

Significant bioenergy development would require large amounts of capital. Achieving the bioenergy targets (for in-state production) proposed in this action plan would likely require investments totaling several billion dollars. Recent positive announcements by lenders and investors suggest that capital stands ready to support the development of biofuels facilities. However, because of the high capital requirements, investors in this market typically seek long-term commitments from a contracted counterparty. The uncertainty of California's long-term commitment to the bioenergy market makes financing difficult. Also, uncertainties in new technologies, such as power projects based on gasification or ethanol plants based on cellulosic ethanol technology, make financing difficult for promising alternatives to biomass combustion or traditional ethanol production from corn.

For biopower, difficulty in obtaining long-term power purchase agreements to secure financing can be a major obstacle, as can the uncertainty surrounding the Federal Production Tax Credit program for facilities that reach commercial operation after December 31, 2007 (the current expiration date for the PTC).

A unique current challenge for ethanol is the market uncertainty related to California's demand as influenced by the 2005 Federal Energy Policy Act. Although there is demand for ethanol as a blending component in California reformulated gasoline, with the elimination of the federal oxygenate requirement and the lack of a state-specific requirement for ethanol use, the future size of the California ethanol market is uncertain.

Distribution and End Use

The challenges in the area of distribution and end-use relate mainly to the need for new infrastructure for selected biofuels. Specifically, infrastructure is lacking to support an expanded E85 strategy in the state. Currently, only a handful of fueling stations exist, and there is limited capacity for segregating gasoline and E85 in the current fuel distribution network.

Biodiesel blends also present some of their own distribution and end-use issues, such as compatibility issues with seals and gaskets in engines with biodiesel blends higher than B20 in vehicles manufactured before 1994. By comparison, the existing infrastructure and vehicle fleet is already capable of handling low-ethanol blends and could easily accommodate the introduction of FT diesel, either as a blend with conventional diesel or as a neat fuel.

Widespread use of E85 would also require raising awareness among consumers on the availability of FFVs. Although there are over 300,000 FFVs currently in California, almost none operate on E85 due to a lack of E85 availability and lack of publicly convenient fueling stations. As such, many consumers are unaware that they are driving FFVs. Interest among automobile makers appears to be rising, but if

California chooses to make a major push into E85, it will need to work with automakers to increase FFV production beyond the current level of one to two percent of total vehicles in California.

Public Perception

The general public has little knowledge or up-to-date information about the multiple benefits of bioenergy. The public's lingering negative perception of these facilities as "incinerators" does little to enhance biopower's image as a "green" energy source. In fact, biomass is rarely given the attention or accolades of other renewable energy sources such as solar or wind energy, even though it provides many of the same, as well as certain unique, waste management, benefits. Building up a large and successful bioenergy industry will require significant outreach and education to the public and to local and state officials on the broad-based benefits of biopower, biofuels, biochemicals, and other bio-based products. For example, improved public awareness could aid in addressing objections to the siting of new projects.

Need for Cross-Industry Collaboration

Biomass, unlike any other renewable or conventional energy resource, requires unique cooperation and collaboration among a range of industries in order to be widely deployed. These industries include agriculture, forest products, electric power, waste management, chemicals/petrochemicals, oil and gas, and automobile manufacturers. To take biomass to the next level of development may require new partnerships and business models among these industries, and will also likely require government involvement in the near term.

Technical Barriers

Cost Competitiveness of Existing Technology

Mature bioenergy technologies, including the direct combustion of biomass to produce electricity, could benefit from improvements to reduce costs, such as higher efficiency (without incurring higher capital costs) and lower non-fuel operations and maintenance costs. The issue of cost competitiveness is also related to the imbalance in incentives for biomass and other renewable energy sources, most notably wind power.

Conventional ethanol technology (based on sugar or starch crops), although mature, can also benefit from incremental improvements, such as to yields, plant efficiency (power and heat required per gallon of ethanol), and the introduction of technologies to increase value from co-products, such as corn dry fractionation.

Need to Commercialize New Technology

Existing biopower generating technology is well established, and highly reliable. The biopower industry in California is an integral component of the state's waste disposal and renewable energy infrastructure. However, there are a number of emerging technology platforms for both biopower and biofuels, at various stages of development, which have the potential to make bioenergy's future even brighter. These include gasification, pyrolysis, and lignocellulosic ethanol. Broadly speaking, these technologies offer the potential for improved efficiency and reduced emissions relative to current technologies, as well as potential economic benefits.

Biomass gasification, which has been under development for many years, can be used to generate power when coupled to a gas turbine or reciprocating engine, or serve as a front-end to certain biofuels options that are based on catalytic synthesis of syngas. Pyrolysis is a technology with potential for producing a range of products, including bio-oils and bio-based chemicals. The biological conversion of lignocellulosic feedstock into ethanol is not yet a commercial-scale process despite sustained federal and other support for research and development.

In the long-run, bio-refineries – conversion facilities that could combine some or all of the above processes – have not yet been commercially demonstrated. Optimization of biorefinery configurations, finding solutions to a range of scientific and engineering problems, and the need for capital to finance these large projects will require concerted, coordinated effort.

Feedstock Quality

The quality of biomass feedstock can vary by fuel type, source, and season. Improving the quality and consistency and using lower quality biomass resources is equally as important as developing technology that can more easily handle variations in feedstock quality. For example, combustion system fouling is more common with field crops than with woody biomass.

SECTION 5: THE ROLE OF THE STATE IN BIOENERGY

Background

For years, the State of California has played an important role in the development of its biopower industry. Beginning in the 1980s, California's utilities supported the development of biopower facilities through their participation in Standard Offer #4 contracts. This allowed the California biopower industry to establish itself as an important part of the state's electricity supply infrastructure by the latter half of the 1980s. The state continues to support the industry by purchasing the power from biopower facilities, with permitting and siting assistance and financial incentives.

Although several of the early facilities were plagued with operational issues and some ceased to operate, the state now has a well developed solid biomass power industry that produces several hundred MW of baseload and dispatchable power. More importantly, private investment bears the majority of the operational risk for this capacity. Without involvement by state agencies, such as the California Energy Commission, the CPUC, the California Integrated Waste Management Board, and others, millions of tons of biomass waste might not be used in the annual production of energy today. Given the barriers and impediments described in Section 4, the state's continued involvement in future bioenergy activities seems as important as ever.

Perhaps the most important thing the State of California can do with respect to biopower in the immediate term is to ensure the health of the existing industry, while positioning it for growth. This industry has seen a continued loss of operating capacity since its peak in the early 1990s, even as the benefits of biopower have become more widely appreciated. If this trend continues, the State may find itself in the unusual position of endorsing the development of a new bioenergy industry at the same time it is witnessing the steady decline of its existing bioenergy industry. Importantly, continued reliance on solid fuel biopower can prevent the deterioration of the state's solid biomass collection, handling and delivery infrastructure, which is a critical aspect of a vibrant bioenergy industry.

As a national leader in alternative fuel consumption, California is at a crossroads regarding biofuels. The elimination of the federal oxygenated fuel requirements for gasoline and the current lack of rules regarding the new Federal Renewable Fuel Standard (RFS) will likely lead to a decrease in the mandated use of ethanol in California. The State of California should, at a minimum, work to preserve this existing market while addressing emissions issues associated with low level ethanol blends of gasoline. The added benefits from in-state production could further enhance biofuel's contribution to the State's transportation sector.

Statewide Biomass Power and Biofuels Targets

The State of California already has established energy production and use targets and mandates that implicitly include bioenergy, including statewide greenhouse gas reduction targets, petroleum displacement goals for transportation, and an RPS for renewable power generation. It is expected that with the right type of state support, the bioenergy industry can flourish and play a vital role in meeting these strategic energy objectives. To further support these objectives, this Action Plan recommends the establishment of aggressive but achievable targets for increasing the production and use of bioenergy.

Progress on achieving these targets will require a sound implementation plan and allocation of sufficient resources. The State should conduct appropriate analysis and develop the necessary models to understand the economic, environmental and other impacts/benefits of these targets. The State will also need to determine if it is more appropriate to treat the proposed targets as mandates or non-binding targets, as there is precedent for both approaches, both within California and in other states.

The recommendations below assume that the use of solid biomass feedstock increases by an average of 10 percent per year through 2020. This would result in the use of approximately half of the state's technical potential by 2020, or about 19 million dry tons, up from 4-5 million dry tons today. The targets below have also assumed a 50/50 allocation of the feedstock between biopower and biofuels. In conjunction with this target, the recommendations anticipate continued development of landfill gas and biogas to 700 MW, which represents most of its technical potential. If these utilization targets can be met, the following biopower and biofuels production targets should be achievable:

- **BIOPOWER**: Maintain the biomass share within the state RPS at 20 percent of total renewable electricity generation. Under the accelerated RPS targets established by Energy Action Plan II, roughly 1,450 MW of new biomass capacity would be required by 2020. Assuming landfill gas and biogas increases by 350 MW by 2020, this target would require the addition of approximately 1,100 MW of solid biomass capacity by 2020. To reach this target using one-half of the total biomass resource as noted above, the average efficiency of solid biomass power generation would need to increase from approximately 20 percent today to 30 percent by 2020. An interim target of 350 MW of new biopower capacity by 2010 is also proposed, to ensure the long-term target gets the proper focus and attention in the near term.

- **BIOFUELS**: Given the Federal Renewable Fuels Standard created by the Energy Policy Act of 2005, a realistic goal would be to increase total biofuels consumption to 1.2 billion gallons by 2010 and at least 2 billion gallons per year by 2020, with at least 40 percent derived from in-state production by 2020. The remaining one-half of the 19 million tons of biomass is enough to produce approximately 800 million gallons/year of ethanol or 700 million gallons/year of FT fuels from cellulosic biomass by the year 2020. Assuming California's fuel

patterns continue without a marked change in automobile efficiency or consumption, this goal would be enough to meet somewhat less than one-half of the 2020 alternative fuels target.

The significance of these targets can be understood by a simple comparison to wind and solar power. Given the high capacity factor of biomass power relative to wind and solar power, achieving the above targets would be roughly equivalent to adding 3,600 MW of wind power by 2020, or nearly 6,000 MW of solar power. Further, when factoring in the siting process and the need to develop expensive transmission lines to access wind power resources, the benefits of bioenergy and its role in meeting state environmental and energy security objectives become apparent.

Guiding Principles for State Involvement

The state continues to have an important role to play in the evolution of the industry, from one devoted almost exclusively to the production of biopower, to a more technologically-advanced industry that will have the ability to produce a variety of bioenergy and bio-based products.

Several principles are important in guiding the state's involvement in bioenergy. In no order of priority, these are:

- **Reduce market risk to stimulate private investment**. It is expected that private capital will provide the bulk of the investment necessary to sustain and grow California's bioenergy industry. To the extent that the private sector is not investing because the risks (perceived and real) are too high, state actions are needed to help mitigate these risks. For example, perhaps the biggest uncertainty in the bioenergy industry today is associated with the lack of market stability for bioenergy. Although the state has an RPS to increase the use of renewable energy, it has not acknowledged the importance of biomass in meeting this goal.

  California has set ambitious long-term goals for renewable energy and greenhouse gas reductions, as well as non-petroleum fuel use, and the state must now match those goals with programs and policies designed to help achieve them. Reducing the hurdles and investment risks for interested market participants is an important next step. Collaboration via public/private partnerships should also be considered.

- **Encourage and enable coordination among state agencies**. More than any other renewable resource, biomass cuts across virtually all aspects of the economy and of state regulation in both the benefits it provides as well as the regulatory jurisdictions it impacts. A number of state agencies have some role to play in the bioenergy solution, and none can do it alone. Although the regulatory process is compartmentalized by necessity as well as by statute, the State should nevertheless recognize the benefits of a coordinated approach in

achieving its alternative fuel and GHG goals. Of particular concern is the need to address emissions and waste management issues in a coordinated manner. Another challenge is to provide appropriate funding for the implementation of state initiatives that, while they may be strategically important to overall success in reaching state mandates and targets, additional state expenditures may not be easily justifiable under traditional state budgeting rules. Many times, cost effectiveness cannot be accurately or adequately demonstrated in advance of their implementation.

Effective agency coordination can be achieved through the Bioenergy Interagency Working Group that will maximize benefits, mitigate impacts, and remove barriers to biomass energy development and use. The state should also work with other government entities, the local air quality management districts, key stakeholders, and coordinate with other western states through the Western Governors' Association and the National Biomass R&D Initiative.

- **Determine and recognize the full value of the biomass resource.** Biomass energy provides unique benefits that are currently not adequately valued in the market. Recognizing and quantifying the value of these benefits, and remunerating bioenergy project owners for them, should help to create a self-sustaining market. For example, preventing waste from accumulating in California's forests, fields, and landfills provides significant environmental and economic benefits, and that value must be properly allocated. This principle could include, for example, attaching a value to the "netting" of the environmental impacts of bioenergy to recognize areas where biomass improves air quality. Bioenergy also provides economic benefits to rural and agricultural communities.

  For biopower, this principle includes the development of mechanisms to value the resource adequacy component of biopower. Firm and schedulable operation of biopower can meet CPUC resource priorities while adding to the resource adequacy (electric capacity reserves) obligation of utility purchasers or owners, and this value should be captured in power prices.

- **Use the buying power of the state.** Markets for biofuels and biopower are essential. The state could stimulate demand in these markets by using the purchasing power of state government and other public institutions (e.g., universities) to stimulate demand for biopower and biofuels. The state can also play an important role in encouraging other public entities, like local governments, to follow its lead.

- **Accelerate commercialization of leading technology prospects.** Several key technology platforms have been approaching commercialization for years. The State of California has a unique opportunity to push these technologies forward into commercial deployment. Moreover, now is an excellent time to leverage

federal research, development, and demonstration (RD&D) activities as well as several bioenergy provisions in the Energy Policy Act of 2005.[34]

For biopower, this policy could include incentives for the repowering of existing facilities at an appropriate time. The application of advanced technology can significantly reduce power plant emissions and result in higher efficiency, which stretches the available biomass resources. Repowering also leverages prior investments in existing facilities, such as fuel collection, transmission access, and onsite utilities.

For biofuels, this strategy includes the commercialization of technologies for converting lignocellulosic biomass, California's largest biomass resource. These technologies, which use both biological and thermochemical conversion processes, are garnering significant national and international attention and are in the early stages of commercial demonstration. California should provide incentives for commercialization and work collaboratively with the federal government to address key R&D issues.

In the longer term, California could support the creation of integrated biorefineries, that is, facilities that would produce power, fuels, and valued added chemicals and products concurrently. Biorefineries represent a potentially attractive long-term option for large-scale, high-value, high-efficiency use of biomass. Development of biorefineries could be coordinated with efforts to repower aging biopower facilities and to co-locate ethanol plans with existing biomass power plants.

- **Improve availability of biomass resources.** With current use of the technically sustainable biomass resource at only about 15 percent, biomass supply appears to be adequate, at least in the near to medium term. The key issue seems to be gaining access to these resources at reasonable prices. Much of the technically available material is either locked up in forests and agricultural lands or is being buried in landfills. Access to federal forest lands present unique challenges and complexities. A key objective of the Action Plan should also be to increase diversion and use of suitable biomass materials from municipal waste streams to boost fuel supplies.

  If regulations and statutory language can be addressed, an excellent way to avoid collection and handling issues would be to co-locate bioenergy facilities at existing waste management facilities and take advantage of the existing collection infrastructure for biomass in municipal solid waste. Another approach to developing competitive biomass prices would be to develop a plan to grow more biomass for energy on a sustainable basis, while also carefully weighing the cost/benefits of in-state production vs. imports.

[34] See Appendix A for a listing of key Federal bioenergy incentives and programs.

- **Promote public awareness of the importance of bioenergy.** The general public is virtually unaware of the role that biomass plays in California's energy supply. In addition to its investment in the bioenergy industry itself, California must work to increase awareness and acceptance. The State should also encourage support and participation by local and regional public agencies, since many of the biomass resources are within the domain of these entities.

SECTION 6: RECOMMENDATIONS FOR THE CALIFORNIA BIOENERGY ACTION PLAN

Recommendations for the Bioenergy Action Plan are presented in this section. The actions proposed are intended to address the institutional and regulatory challenges that confront the bioenergy industry, as well as to create the stimulus to substantially increase the use of bioenergy in California.

The recommendations are based on four broad policy objectives which are consistent with the Governor's direction and the work of the Bioenergy Interagency Working Group. These policy objectives are to:

1. Create a positive environment for bioenergy and create the necessary impetus for investment in new facilities that use California's abundant biomass resources, including the establishment of bioenergy production and consumption targets.

2. Address areas where greater state agency coordination could enhance the opportunities for bioenergy products to contribute to a stable and economically competitive power and fuel supply in California, while preserving other state mandates, such as environmental protection and public health.

3. Enhance and accelerate California's existing research, development and demonstration programs to address all aspects of biomass resource production and use, and to capture the benefits of new technologies that use biomass resources more cleanly, efficiently, and economically. Work in partnership with the federal government and the private sector to fund needed research, demonstration, and pilot projects.

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4. Promote awareness to inform the general public and policy makers of the importance and benefits of bioenergy.

Achieving these four objectives will help to create clear and consistent state policy that will enable greater development and use of California's biomass resources.

Tier 1: High-Priority 2006 Actions

Tier 1 actions are recommended high-priority, immediate actions that:

- Are needed to clarify and/or change inconsistent rules, regulations and procedures that may be hindering bioenergy development.

- Would allow current levels of bioenergy production and use to be maintained by improving the operating environment for current producers.

- Would improve access to readily available biomass resources, such as agricultural and forest residues, municipal wastes and residues, landfill gas, and biogas.

- Would lay the foundation for growth for large, important undertakings.

- Are of sufficient importance and/or timeliness that they should be undertaken in the very near term.

Recommended Tier 1 Actions for 2006

1. The Governor's Office should consider issuing an Executive Order establishing statewide goals for bioenergy production and utilization. This Executive Order should:

    a. Establish a broad-based Renewable Fuel Standard (RFS) for California's transportation sector, targeting consumption of 2 billion gallons of biofuels by 2020 with a minimum of 40 percent produced in California. The RFS should also include interim targets for 2007 and 2010 to spur near-term development and to prevent "backsliding" from current levels. This RFS should be open to the widest possible range of biofuels.

    b. Target the development of 1,500 MW of new biopower capacity by 2020 so that biopower can continue to provide a 20 percent share of in-state renewable electric power as part of the state's accelerated RPS. Establish an interim target of 350 MW of new biopower capacity by 2010.

    c. Direct the Bioenergy Interagency Working Group to develop an integrated and coordinated plan to create a favorable regulatory environment that enhances opportunities for sustainable bioenergy development, yet maintains the required oversight of the existing utility, transportation fuel, and waste management industries, especially with regards to environmental protection. Near-term, efforts should focus on:

        1) Eliminating unnecessarily or unintentionally conflicting regulations.

        2) Streamlining and consolidating the permitting of biopower and biofuels conversion facilities.

        3) Determining how to evaluate and incorporate the net environmental benefits of bioenergy production and use, including the reduction of greenhouse gas emissions.

4) Exploring “cross-pollutant” or “inter-pollutant” netting, such as offsetting NO_x with emission reductions of volatile organic compounds and non-methane organic compounds, to the extent allowed by state and federal law.

d. Request that the California Public Utilities Commission:

1) Work diligently to preserve the operational status of existing biopower facilities, given the uncertainty in the market after July 2006.

2) Initiate a proceeding or build upon an existing proceeding to develop mechanisms for valuing the range of benefits biopower provides in meeting RPS requirements and other power system needs. A goal should be to provide biopower with long-term power purchase agreements.

e. Direct the California Energy Commission to:

1) In conjunction with the California Biomass Collaborative, the U.S. Department of Energy, and the U.S. Department of Agriculture, fund a selected number of demonstration and pilot projects that are designed to prove the commercial readiness biofuels production and biomass conversion technologies using lignocellulosic feedstocks derived from agricultural, forestry, and municipal wastes.

2) In consultation with other state agencies, formulate a plan to disseminate information about the broad-based benefits of bioenergy to the public and to policy makers. This plan could include selected, high-visibility demonstration projects, highlight the "grown here" aspect of bioenergy, and sponsor public awareness programs (e.g., of flexible fuel vehicle options and resource management benefits).

3) Develop a web-based information clearinghouse that contains information on California’s bioenergy companies and on the range of state and Federal incentives relevant to bioenergy and bio-based products.

f. Direct the Air Resources Board to develop regulations that maximize the flexibility of using biofuels, while concurrently preserving or enhancing the environmental benefits of their use. The effort should build upon the *Rulemaking to Update the Predictive Model and Specifications for Reformulated Gasoline* proceeding that has recently been initiated, and could include:

1) Conducting a comprehensive and peer-reviewed study of the costs, emissions impacts, and fuel supply consequences of low-level ethanol

blends (i.e. E6 to E10), and incorporate the study findings into the rulemaking process.

2) Addressing the emissions performance, fuel supply consequences and cost issues surrounding greater use of E85 in California.

3) Establishing necessary fuel specifications for transportation biofuels used in blends and as neat fuels, including low-ethanol blends with gasoline, the use of mixed-alcohols as a blend with gasoline, E-diesel, B5, B20, and B100.

g. Direct the California Integrated Waste Management Board to:

1) Work to promulgate changes to existing statutes to develop a regulatory framework for biomass waste conversion facilities meeting environmental standards that clearly distinguishes them from disposal, and provides clear permitting pathways for their development, as well as providing diversion credits to local jurisdictions for solid waste processed by these technologies.

h. Direct the California Department of Food and Agriculture and the California Department of Forestry to work to:

1) Develop a plan to determine how to gain better access to available agricultural and forest biomass resources at attractive prices, including regulatory and technology development needs.

2) Continue research to identify the highest value use for forest fuel and harvest residues as a potential source of energy, fuel, chemicals, and other forest products, in coordination with the Energy Commission.

3) Coordinate activities with the State Water Resources Control Board to ensure that criteria for watershed protection and water quality are met.

i. Direct state agencies to purchase biofuels, bio-based products, and biopower, including combined heat and power where possible, with specific targets for 2010 and 2020. Also, encourage local governments and public institutions to follow the state's lead.

2. In addition to the above state-level actions, California should coordinate with other states and the federal government. To that end, California agencies should:

a. Support extension of the Federal Production Tax Credit (PTC) and advocate for equal tax treatment for biomass relative to other renewable energy resources in federal incentive programs.

b. Leverage federal research and development efforts and improve coordination to realize greater investment of federal research funds in the state.

c. Work with the Western Governors' Association and the National Biomass R&D Initiative to influence federal funding decisions.

3. To support the above actions, the following key legislative initiatives should be considered, with appropriate input from stakeholders, for 2006:

   a. Revise the existing statutory definition for *transformation* and recommend a new definition for *conversion technology* that facilitates development of environmentally acceptable waste management alternatives. In particular, review definitions of *gasification*, *fermentation*, *pyrolysis*, and manufacturing. These revisions are necessary to enable greater use of available biomass wastes that otherwise end up in landfills.

   b. Establish funding mechanisms for bioenergy programs based on the premise that (i) many of the benefits represent public goods that accrue to all Californians, but that they are not adequately recognized in the market for bioenergy, and (ii) predictability and continuity of funding sources may be just as important as funding amount. Some of the funding mechanisms the state may want to explore are:

      1) Excise taxes on non-renewable motor fuels with proceeds targeted towards biofuels programs.

      2) An increase in landfill tipping fees or a small surcharge on trash-disposal bills to encourage greater diversion of biomass resources for use in biomass conversion projects.

      3) Carbon taxes, consistent with broader state policy on greenhouse gas reductions, recognizing that there are unique considerations for bioenergy relative to other renewable energy resources.

   c. Establish financial incentives and mechanisms to encourage investment in biopower, biofuels, and bio-products, to reward bioenergy producers for the multiple benefits they provide, and to support innovation and investments in new and emerging technologies. Among the possible financial incentives the state could explore are to:

      1) Expand and coordinate the use of existing state programs, such as the Pollution Control Financing Authority, the Dairy Power Production Program, and the Energy Commission Supplemental Energy Payments program.

2) Consider a range of possible tax credits for biopower and biofuels facilities and delivery infrastructure, including energy production, investment and income tax credits. These credits should be designed to maximize leverage of federal incentives.

3) Consider a range of possible tax exemptions, including biofuel excise tax exemptions and sales and property tax exemptions for fueling infrastructure and other bioenergy investments.

4) Create ways to reduce the cost of technology risk to private sector investors, such as supporting costly premium payments for insurance products (e.g. efficacy insurance).

5) Establish a system of carbon credits, consistent with broader state policy on greenhouse gas reductions, recognizing that there are unique considerations for bioenergy relative to other renewable energy resources.

Tier 2: Actions for 2006 and Beyond

Tier 2 actions are recommendations that are designed to:

- Put in place the mechanisms for coordination and the framework for implementing long-term programs.

- Address more challenging and complex regulatory issues that are not easily resolved by Tier 1 actions.

- Recognizing that there is a limit to the tasks that can be undertaken at any one time, address issues that are viewed as less critical or time sensitive than actions proposed in Tier 1.

Recommended Tier 2 Actions

1. The California Energy Commission should:

   a. Develop and implement a comprehensive RD&D roadmap to guide future activities through the California Biomass Collaborative and other organizations. This roadmap could include the creation of bioenergy and bio-product RD&D centers that leverage the University of California system, as well as the work of the Energy Commission and the California Biomass Collaborative.

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b. Building on the Tier 1 demonstration program, continue to support the commercialization and deployment of new biofuels production technologies that can use California's biomass resources. This could include assisting the California Department of Corrections and Forestry and Fire Protection in the installation of biomass combined heat and power units at its facilities where an identified fuel supply is sustainable for 10 years.

c. Work with the Department of Food and Agriculture and the Air Resources Board on a longer-term plan for developing an E85 refueling network in new and retrofitted service stations in California, using existing regulatory levers and incentives to ensure that the needed infrastructure is built.

d. Investigate ways to increase state and federal collaboration on bioenergy and bio-product research programs and to direct a larger share of federal R&D funding to California to achieve larger scale demonstration of emerging technologies, reduce costs, improve conversion processes, and expand the range of products from biomass.

2. The California Public Utilities Commission should continue to develop a comprehensive, long-term biopower regulatory policy, including the following:

   a. Initiate a proceeding to address net metering opportunities for opportunities for smaller, distributed biomass facilities. This should include: consolidating net metering accounts on a farm, using existing power lines on their properties for grid access, raising net metering limits, and allowing dairy farms net metering based on fully bundled (i.e. including Transmission and Distribution components) electric rates.

   b. Review and adjust, as needed, standardized, simplified interconnection requirements.

3. The California Integrated Waste Management Board should:

   a. Conduct a study to assess the resource potential for waste fats, oils, and grease for biodiesel production and aggressively pursue their collection in a manner that facilitates conversion to biodiesel.

   b. Develop a comprehensive plan for achieving rapid development of viable landfill gas and biogas opportunities. The plan should address the need for new technology (e.g., emissions, permitting, interconnection, cost effectiveness of smaller sites) and create business models and financial incentives to encourage facilities to upgrade with new technology.

4. The California Air Resources Board should improve the review process for the New Source Rule (NSR) for Landfill Gas to Energy (LFGTE) and other biogas power projects. This approach could include developing a state NSR program;

developing a single Best Available Control Technology standard for LFGTE projects; and exploring exemptions for biogas power technologies as Pollution Control Projects, essential public services, and resource recovery projects.

5. The California Department of Food and Agriculture should:

    a. Assess sugar/starch crop potential, cellulosic energy crop potential, and oil crop potential with respect to relative quantities, benefits, and impacts on water and land use. Include an assessment of crops that can be used for soil remediation and assess the impact of salinity on biomass conversion processes.

    b. Conduct RD&D on cropping systems, harvesting, handling, storage, and distribution practices and technology, in coordination with a larger state and federal level R&D effort.

    c. Identify and support development and deployment of bioenergy technologies to address animal disposal and animal health concerns.

6. The California Department of General Services should create rules requiring the evaluation and incorporation of renewable energy, where practical, into any new construction projects carried forward through Capital Outlay Budget Change Proposals, including biomass heating and small biomass combined heat and power systems.

By establishing a coordinated policy that is oriented toward actions that enhance the use and production of bioenergy in California, the State can continue to make progress on achieving several of its legislative and policy goals, and take advantage of the benefits provided by bioenergy. This provides a strong rationale for state action. The recommended actions contained in this report are designed to preserve the existing bioenergy base and lay the foundation for sustained, cost-effective, and environmentally sustainable growth of the California bioenergy industry.

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APPENDIX A: SUMMARY OF KEY U.S. FEDERAL BIOENERGY INCENTIVES AND PROGRAMS

Federal Biopower Incentives						
Name & Responsible Agency	**Type**	**Description**	**Effective Dates**	**Legislation**	**US Code Reference**	**Comments**
Renewable Electricity Production Tax Credit (PTC) **(IRS)**	Income tax credit	1.9¢/kWh for closed-loop biomass; 0.9¢/kWh for open-loop biomass. For open loop biomass, applies to first 10 years of operation for plants placed in service after 8/8/2005 (remains at 5 years for plants placed in service after 10/22/2004 and on or before 8/8/2005)	Thru 12/31/2007	JOBS bill (HR4520, Sec. 710), EPAct 2005 (Sec. 1301)	26 USC 45 (Subtitle A, Chp 1, Subchp A, Part IV, Subpart D, Section 45)	JOBS bill extended (1/1/2006) and expanded to include open-loop biomass. EPAct05 extends (1/1/2008) and clarifies open-loop to include 'nonhazardous lignin waste material'. The American Forest & Paper Association is still seeking clarification so that black liquor can be considered (IRS interprets lignin from pulping process as a byproduct, not waste; AF&PA also wants it clarified that the lignin by product is non-hazardous though it has been chemically processed)
Renewable Energy Production Incentive (REPI) **(Department of Energy)**	Direct Payment	1.51¢/kWh (1993$, indexed to inflation) for the first ten years of operation. Available to public entities (e.g., municipal utilities). Subject to annual appropriations.	Must be in service by 10/1/2016. Appropriation approved thru 2026.	EPAct 1992 and EPAct 2005 (Sec. 202)	42 USC 13317	Requires congressional appropriation. If there are insufficient funds to make full payment, 60% goes to wind, solar, geothermal, ocean and closed-loop biomass, 40% goes to rest.
Federal Renewable Energy Purchase Requirement **(all Federal agencies – DOE is responsible overall)**	Mandate	Requires government agencies to purchase a minimum percent of their electricity from renewable sources, as follows: 3%: 2007-2009; 5%: 2010-2012; 7.5%: 2013 and beyond	See "Description"	EPAct 2005 (Sec. 203)	N/A	Expanded on Executive Order 13123, which went to 2.5%. Credits for compliance are doubled if power is produced onsite, produced on Federal land or produced on Indian Land. DOE provides technical and other assistance via its Federal Energy Management Program (FEMP) and national labs
Clean Renewable Energy Bonds (CREBs) **(IRS and DOE)**	Tax credit bonds	$800 million of tax-credit bonds before December 31, 2007 to support renewable investment by municipal power authorities, rural cooperatives and others.	12/31/2007 (applications due by 4/26/2006)	EPAct 2005	N/A	The buyers of CREBs are compensated via tax credits in lieu of interest payments, effectively making the interest rate 0% for the issuer. Only $500MM of the $800MM can go to governmental agencies.

Federal Biofuels Incentives						
Name & Responsible Agency	**Type**	**Description**	**Effective Dates**	**Legislation**	**US Code Reference**	**Comments**
Volumetric Ethanol Excise Tax Credit (VEETC) **(IRS)**	Excise tax credit	MIXED: Biodiesel - $0.50 / gallon; Alcohol (non-ethanol) $0.60 / gallon; Alcohol (other) $0.51 / gallon	Biodiesel - 12/31/2008; Alcohols - 12/31/2010	JOBS Bill (HR4520) Sec. 301 ; EPACT 2005 Sec. 1344	26 U.S.C. 6427 (Chp 65 Subchp B, Section 6427))	Alcohol: includes methanol and ethanol but does not include— (i) alcohol produced from petroleum, natural gas, or coal (including peat), or (ii) alcohol with a proof of less than 190 (determined without regard to any added denaturants). Such term also includes an alcohol gallon equivalent of ethyl tertiary butyl ether or other ethers produced from such alcohol; Alcohol Fuel Mixture: a mixture of alcohol and a taxable fuel which— (A) is sold by the taxpayer producing such mixture to any person for use as a fuel, or (B) is used as a fuel by the taxpayer producing such mixture.
Volumetric Ethanol Income Tax Credit **(IRS)**	Income tax credit	STRAIGHT: Alcohol, Regular - $0.51 / gallon; Alcohol, Low Proof - $0.3778 / gallon; Biodiesel - $0.50 / gallon; (Agri-Biodiesel - $1.00 / gallon); and Renewable Diesel - $1.00 / gallon; MIXED: Alcohol, Regular - $0.51 / gallon; Alcohol, Low Proof - $0.3778 / gallon; Biodiesel - $0.50 / gallon; (Agri-Biodiesel - $1.00 / gallon); Renewable Diesel - $1.00 / gallon	Other - 12/31/2008; Alcohols - 12/31/2010*	JOBS Bill Sec. 302; EPACT 2005 Sec. 1344	26 U.S.C. 40 and 40A (Chp1, Subchp A, Part IV, Subpart D, Sections 40 and 40A)	Part of the Business Credit against income, 24 U.S.C. 38, which has its own limitations as a package of individual incentives. Provision provides an election to pass through to farer owners via a cooperative. * Does not apply for periods before 1/1/2011 during which the rates of tax under section 4081(a)(2)(A) are $0.043 / gallon. “Renewable Diesel” provisions can be found in Sec. 1346, and provide identical treatment as biodiesel, but at $1/gal instead of $0.50/gal.
Small Ethanol Producer Credit **(IRS)**	Income tax credit	$0.10 / gallon up to 15 million gallons/yr (less than 60 million gallons total capacity)	12/31/2010	JOBS Sec. 313, EPACT 2005 Sec. 1347	26 U.S.C. 40A (Chp1, Subchp A, Part IV, Subpart D, Section 40A)	EPACT 2005 increased producer size limit from 30 to 60 million gallons

Federal Biofuels Incentives						
Name & Responsible Agency	**Type**	**Description**	**Effective Dates**	**Legislation**	**US Code Reference**	**Comments**
Renewable Fuels Standard **(EPA)**	Mandate	• Gasoline sold/ dispensed must contain the applicable volume (billion gallons) of renewable fuel (on annual avg basis) • 2006 - 4.0; 2007 - 4.7; 2008 - 5.4; 2009 - 6.1; 2010 - 6.8; 2011 - 7.4; 2012 - 7.5; • 1 gallon cellulosic biomass or waste derived ethanol = 2.5 gallons of renewable fuel • 2013 onwards – applicable volume determined by EPA; shall have a min of 250 million gallons from cellulosic biomass (specific calculation given); and 2.5-to-1 ratio no longer applies. • If EPA does not issue regs. by 8/2006, applicable amount shall be 2.78% renewable fuel	See "description"	EPACT 2005, Sec. 1501	42 U.S.C. 7545	In 1/2006 EPA released their Notice of Proposed Rulemaking for the implementation of the Renewable Fuel Standard for 2006. Details are: • EPA says they are not likely to meet the 8/2006 deadline given the complexity of the RFS and the fuels industry, need for stakeholder input, and the fact that the EPAct was vague on implementation (e.g., who are the obligated parties? refiners, producers marketers, etc...) • Thus, the default provisions given in EPAct will apply in 2006, i.e., that gasoline contain, on average 2.78% renewable fuel, or about 4 billion gallons. • Given the lack of final rules, the EPA will apply collective responsibility, i.e., as long as the average for gasoline is at least 2.78% in 2006, it will be assumed that all obligations have been met. If the industry falls short, then the shortfall will be carried forward to the 2007 requirement. • EPA expects the industry to exceed the 2.78% target, so "no harm done" in taking more time to get the rules right. • EPA will develop rules such that credit trading will enable fuels not mixed with gasoline to participate in the RFS.

Federal Biofuels Incentives						
Name & Responsible Agency	**Type**	**Description**	**Effective Dates**	**Legislation**	**US Code Reference**	**Comments**
Production Incentives for Cellulosic Biofuels **(DOE in consultation with USDA, DOD and EPA)**	Direct Payment	Secretary to determine per gallon incentive for first 100 million gallons of annual production (or after 3 years). Subsequent incentive determined by "reverse auction."	Recipients get incentive for first 6 years of operation.	EPACT 2005, Sec. 942	N/A	Sets goal of achieving 1 billion gallons of cellulosic biofuels (NOT just ethanol) annual production by 2015.
Credit for Installing alternative fuel refueling equipment **(IRS)**	Tax credit	30% up to 30,000 credit	Through 12/31/2009 and 12/31/2014 for hydrogen	EPAct 2005 , Sec 1342	N/A	

Other Biomass Energy Related Incentives and Programs						
Name & Responsible Agency	**Type**	**Description**	**Effective Dates**	**Legislation**	**US Code Reference**	**Comments**
Qualifying Gasification Project Credit **(IRS)**	Tax credit	Tax credit equal to 20% of the qualified investment. $350MM cap on credit in total.	Tax benefit for one year. Program runs for the 10-year period after October 1, 2005	EPAct 2005, Sec. 1307	N/A	Project must be financially viable without any other Federal funding. Includes biomass gasification and black liquor gasification. The qualified investment refers to eligible property that is part of a gasification project and is "necessary for the gasification technology of such project."
Grants for Beneficial use of Biomass from Fuel treatment projects **(DOE)**	Grant	Grants of up to $20/green ton, with a $500,000 limit per grant. Up to $50MM each year is authorized from 2006-2016	2006-2016	EPACT 2005. Sec. 210	N/A	

Other Biomass Energy Related Incentives and Programs						
Name & Responsible Agency	**Type**	**Description**	**Effective Dates**	**Legislation**	**US Code Reference**	**Comments**
EPACT 2005 RD&D & Commercializati on Program **(DOE)**	RD&D grants	Bioenergy Program ($MM) $213 - 2007 $251 - 2008 $274 - 2009 Of which: Bioerefinery Demo (sec. 932(d)): $100 - 2007 $125 - 2008 $150 - 2009	Request for proposals begin in early 2006.	Title IX, Sec. 931 & 932		• Sec. 932 (d) is for Integrated Biorefinery Demonstration Projects. • Up to $100 M for a single biorefinery demo project. To be eligible, project must demonstrate commercial profitability, once initial construction costs are paid.

Other Relevant Federal Legislation and Initiatives

- 2002 Farm bill, Title 9 - includes biorefinery development grants and a Federal bio-products procurement program
- Biomass Research and Development Act of 2000 – describes the overall Federal program in bioenergy R&D. Authorization for funding extended in EPAct 2005 to $200MM per year through 2015.
- Announced at the State of the Union Address: Advanced Energy Initiative, which provides for a 22% increase in clean-energy research at the Department of Energy (DOE). The Biorefinery Initiative: the President's 2007 Budget will include $150 million – a $59 million increase over FY06 – to help develop bio-based transportation fuels from agricultural waste products, such as wood chips, stalks, or switch grass. Research scientists say that accelerating research into "cellulosic ethanol" can make it cost-competitive by 2012, offering the potential to displace up to 30% of the Nation's current fuel use