STAFF DRAFT REPORT

2011 Bioenergy Action Plan

Prepared by the California Energy Commission for the
Bioenergy Interagency Working Group:

California Air Resources Board
California Energy Commission
California Environmental Protection Agency
California Department of Food and Agriculture
California Department of Forestry and Fire Protection
California Department of General Services
California Natural Resources Agency
California Public Utilities Commission
California Department of Resources Recycling and Recovery
California Water Resources Control Board
California Biomass Collaborative

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PREFACE

The *2011 Bioenergy Action Plan* identifies actions that state agencies will be taking to implement Executive Order S-06-06. This Executive Order commits California to generating 20 percent of the state's renewable energy from biopower (biomass to electricity) by 2010 and 2020, and producing 20 percent of its biofuels (biomass-based transportation fuels) within the state by 2010, 40 percent by 2020, and 75 percent by 2050. The Executive Order also requires the California Energy Commission to report to the Governor and the Legislature every two years through the *Integrated Energy Policy Report* on progress made to achieve sustainable biomass development in California.

ABSTRACT

California's first *Bioenergy Action Plan* was published in 2006 to implement Executive Order S-06-06. This order set goals for the production and use of electricity and fuels made from biomass, including plant and animal residues produced on farms and in forests, crops grown specifically to produce energy, and urban-derived materials. The *2011 Bioenergy Action Plan* is an update of the *2006 Bioenergy Action Plan*.

The *2011 Bioenergy Action Plan* was prepared by the California Energy Commission with input from a group of state agencies identified as the Bioenergy Interagency Working Group, and with additional assistance from the California Biomass Collaborative. The *2011 Plan* identifies challenges to the development of facilities that generate electricity or produce fuel from biomass and identifies actions that state agencies will take to address those challenges.

Keywords: California Energy Commission, Bioenergy Interagency Working Group, bioenergy, biopower, biofuels, biomass, biorefinery, biogenic, Bioenergy Action Plan

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Introduction

Bioenergy is energy produced from biomass in the form of electricity (biopower), renewable gas (biomethane or synthetic natural gas), or liquid transportation fuels (biofuels). In California, biomass feedstock is generally limited to organic, non-fossil residues from other processes, such as farming, food processing, timber harvesting, wildfire reduction, energy crops, urban wood waste, and other urban processes. Harvesting forest timber for the sole purpose of producing energy is not considered a renewable energy source unless the harvest is part of prescribed wildfire fuel reduction projects.

The increased production and use of sustainable bioenergy can provide a range of economic and environmental benefits. Bioenergy can reduce the state's dependence on foreign oil or imported natural gas, while diversifying the state's energy supply and improving energy security. Bioenergy creates green jobs, enhances rural economic development, and promotes local economic stability. Using biomass from wildfire fuel reduction and agricultural residues can reduce the occurrence of large costly wildfires, protect watersheds and ecosystems, provide an alternative to open field burning, and increase the efficiency and profitability of forestry and farming. More efficient use of these residues has additional lifecycle benefits, including improved local air quality and public health, reduced emissions of greenhouse gases, and reducing the amount of waste buried in landfills.

California is home to aggressive renewable and low-carbon energy goals. The Renewables Portfolio Standard requires retail sellers of electricity to increase the amount of renewable energy they procure each year by at least 1 percent until 20 percent of their retail sales are served with renewable energy by December 31, 2010. Retail sellers include investor-owned utilities, electric service providers, and community choice aggregators. Publicly owned utilities are required to set their own renewable targets. The California Air Resources Board adopted the Renewable Electricity Standard on September 23, 2010, which requires the state's load-serving entities, including both retail sellers and publicly owned utilities, to meet a 33 percent renewable energy target by 2020.

On the biofuels side, the Air Resources Board adopted the Low-Carbon Fuel Standard in 2009, which will reduce greenhouse gas emissions by requiring the reduction of the carbon intensity of transportation fuels used in California by an average of 10 percent by 2020. Low-carbon biofuels, such as compressed biomethane, will play an important role in achieving this target.

Recognizing the contribution that biomass could make to achieve these renewable energy goals, Governor Schwarzenegger signed Executive Order S-06-06 on April 25, 2006. This order committed California to expanding the sustainable use of bioenergy by requiring that:

- The state produce a minimum of 20 percent of its biofuels within California by 2010, 40 percent by 2020, and 75 percent by 2050.
- The state meet a 20 percent target within the established state goals for renewable generation for 2010 and 2020.

Despite aggressive state policies to promote renewable energy, and in particular, bioenergy, progress toward achieving the state's goals has been slow. Between 2006 and 2009, the state

added approximately 130 megawatts (MW) of biopower capacity; however, 60 MW of capacity was forced to shut down for a variety of economic reasons. Also, although the state has seen an increase of about 200 million gallons of gasoline equivalent (gge) per year of ethanol and biodiesel production capacity since 2000, much of this capacity was idle in 2009 due to adverse market conditions. Of the 265 million gge per year of potential production capacity in California, fewer than 50 million gge was produced in 2009.

Purpose

The Bioenergy Interagency Working Group drafted the first plan, *Bioenergy Action Plan for California*, in 2006. This plan identified 63 actions to be undertaken. Of those, progress was made on fewer than 40, and even fewer were completed. In the California Energy Commission's *2009 Integrated Energy Policy Report*, the Energy Commission recommended updating the actions in the *Bioenergy Action Plan* to reflect current challenges facing bioenergy development.

The *2011 Bioenergy Action Plan* describes the current opportunities and challenges that face the bioenergy industry. It also identifies actions that agencies in the Working Group are taking, or will be taking over the next two years, to help achieve the Governor's bioenergy goals. The plan also identifies legislative and regulatory actions that may be needed.

Objectives

To achieve California's bioenergy goals, some existing facilities will need to be retooled or expanded, and new facilities will need to be constructed. The *2011 Plan* identifies five objectives for achieving the bioenergy goals. These five objectives are:

- Increase bioenergy production at existing facilitiesRestarting idle plants, repowering existing facilities, or switching from fossil-based feedstock to biobased feedstocks can cost-effectively increase bioenergy production at existing facilities without developing new projects and land.
    - Continued operation of existing bioenergy facilities will reduce the need to build new facilities.
- Construct new bioenergy facilities.
    - Although the number of bioenergy facilities needed to meet California's bioenergy goals will depend on the production from existing and colocated facilities, to meet the state's bioenergy goals, new projects must be developed. The total biopower generation and biofuel production capacity that can be met with in-state resources depends on the amount of feedstock that is technically available. Of that amount, only a portion will be economically recoverable and requires additional review of site-specific constraints. The California Biomass Collaborative estimates that the amount of biomass feedstock that is potentially available for energy production is 36 million bone dry tons per year (BDT/yr) in 2010 and 40 million BDT/yr in 2020. In terms of power generation, the net technical potential (net of known demand) is 34,300 gigawatt-hours (GWh) in 2010 and 44,300 GWh in 2020. In terms of fuel production, the net technical potential is 1,060 million gge in 2010 and 1,370 million gge in 2020.
    - The Energy Commission estimates that demand for ethanol could increase to more than 3 billion gallons (2 billion gge) per year by 2022, while biodiesel could increase

to more than 200 million gallons (135 gge) per year. In one Low-Carbon Fuel Standard scenario, Air Resources Board staff estimates that 18 cellulosic biorefineries, six corn-ethanol biorefineries, and six new biodiesel or renewable diesel refineries could be needed by 2020 to meet the increased demand for low-carbon biofuels. Total in-state biofuel production could be as high as 1.2 billion gallons (820 gge) in this scenario.

- Integrate bioenergy facilities with biomass collection, processing, and treatment operations, and use multiple fuels in bioenergy plants.
    - Numerous synergistic opportunities exist between biopower and biofuel production and value-added bioproducts across industrial, agricultural, forestry, waste collection, and organic-materials processing activities. Combined or integrated bioenergy facilities hold great promise to increase efficiency and provide a model of how researchers can extract more energy and value from existing biomass resources, altering the current economic relationship to levels that make these relationships both economically viable and of increasing value to society.
- Commercialize next generation conversion technologies.
    - Promotion of next-generation technologies can help California successfully meet a diverse set of goals, including those associated with energy security and diversification, GHG mitigation, rural economic development, and other environmental issues. Next-generation technologies include both thermochemical conversion and biochemical conversion processes that use a wide range of feedstocks. Each technology has unique challenges to commercialization that must be considered. Some of these technologies promise advancements in air quality impact and feedstock compatibility with potential to increase the sustainable use of biomass conversion in California.
- Remove statutory and regulatory hurdles.
    - Numerous utility rules and state and local regulations and policies apply to project developers and operators of bioenergy facilities. Improving consistency between regulations and coordination between regulators and policy makers is important to protect environmental quality and human health and safety, and to encourage investment. A clear permitting process is also needed to promote development of new facilities.

Implementation of the *2011 Bioenergy Action Plan*

There are a large number of challenges facing bioenergy development in the state. For example, existing facilities face economic challenges related to the cost of feedstock collection and transportation versus the price received for energy production, and new project developers must economically meet state and local permitting requirements in a capital-constrained financial market. Given the numerous challenges facing bioenergy, the *2011 Plan* does not attempt to overcome every obstacle to bioenergy development. Instead, the Working Group built on the *2006 Plan* and identified actions that state agencies can feasibly undertake by December 2012, as the next step, leading to a meaningful increase in bioenergy development.

To increase bioenergy development and achieve the *2011 Plan's* objectives and, ultimately, the state's bioenergy goals, additional state actions may be necessary. Following a public workshop scheduled for December 14, 2010, Energy Commission staff will recommend additional actions for the Working Group to consider as resources become available. There are many challenges that are not addressed by the *2011 Plan*. Therefore, the Energy Commission will consider holding a public workshop in 2012 to discuss additional actions and other changes to the *2011 Plan*.

The Energy Commission will lead implementation of the *2011 Bioenergy Action Plan* and will convene the Working Group quarterly to discuss and update the plan's objectives and the status of each agency's actions. The Working Group will include other state agencies, local air districts, stakeholders, and environment groups in the process of implementing this plan.

Energy Commission staff will monitor progress by tracking completion of the actions assigned in the plan. In addition, Energy Commission staff will track the amount of new biopower generation and biofuel production each year. Successful implementation of the plan will require completion of the plan's actions and achievement of the state's bioenergy goals.

CHAPTER 1:
Introduction

Bioenergy is energy produced from biomass. Biomass includes plant or animal residues produced on farms and in forests, crops grown specifically to produce energy (energy crops), and urban-derived materials. Bioenergy comes in many forms, including electricity, heat, gas (methane or synthetic natural gas), and liquid transportation fuels. Biopower electricity generated from biomass is renewable, and supports the current "baseload" or other continuous energy demand; whereas other renewable energy sources like wind and solar are intermittent renewable energy sources that may or may not coincide with periods of peak consumer or industrial demand. Biomethane is gas produced from digested biomass or biogas and can replace natural gas in homes and factories, replace compressed natural gas used in vehicles, or produce renewable hydrogen in fuel cells. Biofuels such as ethanol and biodiesel can be used as alternative transportation fuels.

In California, renewable biomass feedstock (with the exception of energy crops) is generally limited to residues from industrial, agricultural, mill, and forestry projects and other biogenic waste materials. Harvesting forest timber for the sole purpose of producing energy is not considered a sustainable energy source unless the harvest is part of a prescribed wildfire fuel reduction project or an approved timber harvest plan.

The increased production and use of sustainable bioenergy can provide a range of economic and environmental benefits. Bioenergy can reduce the state's dependence on foreign oil and imported natural gas, while diversifying the state's energy supply and improving energy security. Bioenergy creates green jobs, enhances rural economic development, and promotes local economic stability. Using biomass from wildfire fuel reduction activities and agriculture residues can reduce the occurrence of large costly wildfires, protect watershed and ecosystem, provide an alternative to open field burning, and increase the efficiency and profitability of forestry and farming. More efficient use of these residues has additional lifecycle benefits, including improved local air quality and public health, reduced emissions of greenhouse gases, and reducing the amount of waste buried in landfills.

California's Bioenergy Goals

Senate Bill 107, enacted in 2006,[1] requires retail sellers of electricity regulated by the California Public Utilities Commission (such as investor owned utilities) to procure renewable power. SB 107 requires that, by 2010, 20 percent of the total electricity sold by retail sellers in California come from renewable energy resources, such as wind, solar, geothermal, and biomass. The statute also requires publically owned utilities to set their own renewable goals.

Assembly Bill 32, enacted in 2006,[2] directs the California Air Resources Board (ARB) to develop discrete early actions and prepare a scoping plan to reduce greenhouse gases (GHG) to 1990 levels by 2020.

1 Senate Bill 107, Simitian, Chapter 464, Statutes of 2006.

2 Assembly Bill 32, Nuñez, Chapter 488, Statutes of 2006.

Recognizing the contribution that biomass could make to achieve the state's renewable energy and GHG reduction goals, Governor Schwarzenegger signed Executive Order S-06-06 on April 25, 2006. This order committed California to expanding the sustainable use of bioenergy by setting the following state targets:

- The state produce a minimum of 20 percent of its biofuels within California by 2010, 40 percent by 2020, and 75 percent by 2050.
- The state meet a 20 percent target within the established state goals for renewable generation for 2010 and 2020.

In 2008 and 2009, Governor Schwarzenegger signed Executive Order S-14-08 raising the state's overall renewable electricity goal to 33 percent by 2020, and Executive Order S-21-09, directing the ARB to adopt a regulation, requiring the state's load serving entities to meet this target by 2020. The ARB adopted the Renewable Electricity Standard on September 23, 2010, which requires the state's load-serving entities to meet a 33 percent renewable energy target by 2020.

On the biofuels side, the ARB adopted the Low-Carbon Fuel Standard in 2009, which will reduce GHG emissions by reducing the carbon intensity of transportation fuels used in California by an average of 10 percent 2020. Presumably, biofuels will play an important role in achieving this target.

Table 1-1 summarizes the goals established by the Executive Orders.

Table 1-1: Executive Order S-06-06 Bioenergy Goals

Biopower (GWh)[3]		Biofuel Production (million gge)[4]	
2008 Generation	5,800	2009 Production	48
2010 Goal	7,200	2010 Goal	135
2020 Goal	10,000 -13,000	2020 Goal	Up to 820

Source: California Energy Commission

What Is the Bioenergy Action Plan?

California's first *Bioenergy Action Plan for California* (*2006 Plan*) was published in 2006 to implement Executive Order S-06-06. The *2006 Plan* listed 63 actions to be taken by a variety of state agencies to increase the production and use of bioenergy in California. The Bioenergy Interagency Working Group (Working Group) developed the *2006 Plan*. James D. Boyd, Vice Chair of the Energy Commission, chairs the Working Group, which includes representatives from the following state agencies: the California Air Resources Board, California Department of Forestry and Fire Protection (Cal Fire), California Department of Resources Recycling and Recovery (CalRecycle), the California Environmental Protection Agency (CalEPA), the California Department of Food and Agriculture, the Department of General Services, the

3 GWh is gigawatt hours.

4 gge is gallons of gasoline quivalent.

Natural Resources Agency, the California Public Utilities Commission, and the Water Resources Control Board. The California Biomass Collaborative provided *ex-officio* support.

The Energy Commission's *2009 Integrated Energy Policy Report* recommended that "the Governor's Bioenergy Action Plan….be updated in 2010 to address opportunities and "continuing barriers to the development and deployment of bioenergy."[5] In addition, the Energy Commission's *Progress to Plan* found that ". . . progress towards meeting California's ambitious bioenergy goals has been slow, and in some cases, the state is losing ground . . . Without major initiatives to make legislative and regulatory changes, and state and federal financial incentives and policies that recognize the benefits of using 'waste' material for energy, California will fall far short of . . . [its bioenergy] goals . . ."[6]

The *2011 Bioenergy Action Plan*

The *2011 Bioenergy Action Plan* (*2011 Plan*) describes the current opportunities and challenges that face the bioenergy industry. It also identifies actions that agencies in the Working Group are taking, or will be taking, to help achieve the Governor's bioenergy goals and identifies legislative and regulatory actions that may be needed.

The *2011 Plan*:

- Identifies agency and department programs, regulations, policy, and legislative actions to help achieve the goals established by Executive Order S-06-06.
- Identifies expected completion dates of each action.
- Defines the role for the Working Group in overseeing implementation of the *2011 Bioenergy Action Plan* and provides a schedule for its implementation.
- Proposes a continuing process to monitor, measure, and report progress toward California's biopower and biofuel goals.

Each agency in the Working Group has committed to implement actions within its jurisdiction. These actions are designed to address some of the challenges facing developers and operators of bioenergy facilities.

The Working Group will meet quarterly to monitor, measure, and report the progress of member agencies in implementing their individual actions. The Energy Commission will also measure progress toward the state's overall bioenergy goals. As required by the Executive Order, the status of bioenergy development in California will be included in the Energy Commission's *Integrated Energy Policy Report*, and as needed, the *2011 Plan* or its actions will be revised to reflect progress and current conditions.

5 Orta, Jason, Zhiqin Zhang, and et. al. 2010. *2009 Progress to Plan – Bioenergy Action Plan for California.* California Energy Commission. CEC-500-2010-007. Page 233.

6 Ibid. Page 1.

CHAPTER 2:
Status of Bioenergy in California

The Bioenergy Interagency Working Group implemented, completed, or made progress on approximately 40 of the actions assigned in the *2006 Plan*. However, despite partial implementation of the *2006 Plan*, bioenergy development in California still faces many of the same challenges that existed in 2006, such as high cost of development, competition for biomass feedstock, the high cost of fuel delivery, and legal and permitting hurdles. As a result, progress toward meeting the goals in Executive Order S-06-06 has been slow. The *2011 Plan* builds on the *2006 Plan*, reassesses the challenges that bioenergy developers face, and provides a plan for meeting the state's bioenergy goals.

Although development of new projects has been slow, valuable progress has been made to streamline permitting of anaerobic digesters along with the development of state and federal programs to support the development of biofuels.

Status of Biofuels

Biofuel production in California is predominantly ethanol from corn grain derived from Midwest farms, and biodiesel derived from waste grease and tallow and some imported virgin oils, including palm oil; however, other fuels such as biomethane, "drop-in" biomass-derived hydrocarbons (renewable diesel and gasoline components), and renewable hydrogen are being developed by the industry. In 2008, California consumed approximately 1 billion gallons (680 million gge) of biofuel, primarily as ethanol blended in gasoline as an oxygenate (950 million gallons or 640 million gge).[7] To meet California's in-state biofuel production targets in Executive Order S-06-06, the state would need to produce nearly 200 million gallons (135 million gge) of biofuel per year in 2010[8] and up to 1.2 billion gallons (820 million gge) per year in 2020, [9] a range of 3 to 17 times the estimated 48 million gge of biofuels that were produced in 2009.

California has 173 million gge of annual ethanol production capacity, with only 21 million gge produced in 2009. Since 2000, five corn ethanol refineries have been built in California. All five of these plants were idle most of 2009 and 2010 due to adverse market conditions. Only one of these corn ethanol refineries produced fuel in 2010. Total in-state biodiesel capacity is capable of producing 92 million gge per year. However, less than 27 million gge were produced in 2009.Table 2-1 summarizes the biofuel production and capacity in California.

7 Baroody, Leslie, Charles Smith, Michael A. Smith, Charles Mizutani. 2010. 2*010-2011 Investment Plan for the Alternative and Renewable Fuel and Vehicle Technology Program Commission Report.* California Energy Commission, Fuels and Transportation Division. Publication Number: CEC-600-2010-001-CMF. Page 57.

[8] Assuming ethanol demand continues to be the primary source of biofuel demand in California.

9 Under the federal RFS2, California's "fair share" consumption of renewable fuels may be as high as 3 billion gallons per year in 2022. Assuming this is met entirely with first generation and advanced biofuels in 2020, California would need to produce 40 percent (1.2 billion gallons per year) of these fuels in state.

In-state biofuel production will made up just 5.8 percent of California's estimated 1 billion gge biofuel demand in 2009, far below the 2010 biofuel goal of 20 percent (200 million gge).[10]

Table 2-1: Summary of In-State Biofuel Production Capacity

Fuel Type	2009 Production (million gge / yr)	Total Installed Capacity† (million gge / yr)	Proposed Projects (million gge / yr)
Ethanol	21	173	2
Biodiesel	27	92	17
Biomethane‡	n/d	n/d	0.2
Total Biofuels	48	265	20

Source: California Energy Commission
† Includes in-state production capacity that is currently idle.
‡ No data available showing the installed capacity and 2009 production of biomethane.

State and Federal Programs Boost Biofuels

Arguably, the greatest potential impact from the *2006 Plan* will be in the biofuel sector with the adoption of Low-Carbon Fuel Standard (LCFS) and implementation of the *State Alternative Fuels Plan*. The LCFS requires fuel refiners, blenders, producers, and importers to reduce the carbon intensity of the transportation fuels they produce by at least 10 percent by 2020. See Governor's Executive Order S-01-07 dated January 18, 2007.

The ARB adopted the LCFS by regulation on April 23, 2009. Renewable, low-carbon biofuels will play a significant role in meeting greenhouse gas (GHG) reduction targets in the initial years of the LCFS. The LCFS requires fuel suppliers and blenders to produce or secure low-carbon fuels, creating higher demand for biofuels. The LCFS will also support the migration of these facilities toward improved production efficiencies and the use of agricultural and forest-based waste streams and sustainably produced low-carbon bioenergy crops.

Using non-food feedstocks, in-state biofuel production could result in more than an 80 percent reduction in GHG emissions relative to gasoline, measured on a full-fuel-cycle basis. Based on a scenario analysis, ARB staff projects that first generation and advanced biofuels could reduce the total carbon intensity in gasoline by 60 percent to 90 percent by 2020.[11]

Assembly Bill 118 (AB 118), created the Alternative and Renewable Fuel and Vehicle Technology Program.[12] Administered by the Energy Commission, this program is allocated up

10 Baroody, Leslie, Charles Smith, Michael A. Smith, Charles Mizutani. 2010. *2010-2011 Investment Plan for the Alternative and Renewable Fuel and Vehicle Technology Program* Commission Report. California Energy Commission, Fuels and Transportation Division. Publication Number: CEC-600-2010-001-CMF.

11 California Air Resources Board. 2009. *Proposed Regulation to Implement the Low Carbon Fuel Standard; Initial Statement of Reasons*, March 5, 2009, cited in Baroody, Leslie, Charles Smith, Michael A. Smith, Charles Mizutani. 2010. *2010-2011 Investment Plan for the Alternative and Renewable Fuel and Vehicle Technology Program Commission Report*. California Energy Commission, Fuels and Transportation Division. Publication Number: CEC-600-2010-001-CMF. Page 58.

12 Assembly Bill 118 Núñez, Chapter 750, Statutes of 2007.

to $120 million annually to provide grants, loans, or loan guarantees to public agencies, businesses, public-private partnerships, consumers, and academic institutions. The purpose of the program is to develop and deploy innovative technologies that transform California's fuel and vehicle types to help achieve the state's climate change goals.

Recently, in-state production of biofuels has declined, mostly due to poor economics caused by relatively low gas and diesel prices and medium-high corn prices. Lack of capital and debt financing are also impeding biofuel plant development and upgrades. Regulatory uncertainty at the state and national level interact to limit investment. The AB 118 program leverages public and private investment to make price supports and financing more readily available to California's existing and planned biofuel production facilities with the goal of increasing production and achieving California's biofuel production goals.

In the *2008-2009 Investment Plan for the AB 118 Program*, the Energy Commission allocated about $40 million to biofuels, and of that amount, has recommended that $21.5 million be spent on four biomethane projects. These projects are anticipated to displace more than 13 million gallons of gasoline equivalent (gge). The Energy Commission also held an additional funding solicitation with approximately $15 million available for biofuels production in California; the announcement of proposed awardees is currently pending. Additionally, the *2010-2011 Investment Plan for the AB 118 Program* allocates more than $20 million for the production of biofuels as well as $13.5 million for infrastructure to support this production. As the AB 118 program continues to fund projects, program evaluation efforts will take place to determine how funded projects are progressing, to identify key obstacles and challenges, and to make recommendations for future actions.

The federal Renewable Fuel Standard (RFS2) calls for the production of 21 billion gallons of advanced biofuels (from renewable, non-food derived biomass, that is, cellulosic materials, and non corn grain crops, including sugar cane, and crop residues) by 2022. In addition, federal stimulus funds have been awarded to biofuel producers. These federal actions either directly or indirectly help California's biofuel production. The Energy Commission estimates that demand for renewable fuel in California will triple between now and 2022 to meet the Energy Commission's current gasoline demand forecasts and the "fair share" renewable fuel use requirements of the federal RFS2.[13]

Status of Biopower

Biopower in California is predominately generated by solid-fuel biomass and landfill gas facilities. In the *2008 Net System Power Report* (*2008 NSPR*), the Energy Commission reported that the total biopower used to meet in state demand was 6,400 gigawatt hours (GWh), of which 600 GWh represents self-generation.[14] Generation used onsite is not counted toward California's

13 Baroody, Leslie, Charles Smith, Michael A. Smith, Charles Mizutani. 2010. 2*010-2011 Investment Plan for the Alternative and Renewable Fuel and Vehicle Technology Program Commission Report.* California Energy Commission, Fuels and Transportation Division. Publication Number: CEC-600-2010-001-CMF. Page 57.

14 Data includes 5,700 GWh generated in state and 700 GWh imported. Note that renewable definitions in the Net System Power program differ slightly from those in the RPS, and in addition, a small portion of the data presented in the *2008 NSPR* represents estimates of unidentified imported generation. Therefore, this data should be treated as an estimate only. (Nyberg, Michael, 2009. *2008 Net System Power Report.* California Energy Commission. CEC‑200‑2009‑010. Pages A3 – A6.)

renewable goals at this time, so Energy Commission staff uses 5,800 GWh as the total biopower generation in 2008 (2008 Biopower Baseline). The total biopower generated in 2008 (excluding onsite generation) represents 18 percent of total renewable generation reported in the *2008 NSPR* (31,900 GWh).[15]

Table 2-2: Summary of Renewable Energy and Biopower Goals (GWh)

Year	Renewable Goal	Biopower Goal	Existing Biopower (2009)	Additional Biopower Needed
2010	36,000	7,200	5,800	1,400
2020	86,000 – 100,000	17,000 – 20,000	5,800	11,200 – 14,200

Source: California Energy Commission

Energy Commission staff estimates that the total renewable procurement needed to achieve the 2010 renewable procurement target is 36,000 GWh.[16] This assumes that the utilities meet the state's mandate to procure 20 percent of retail sales with renewables by 2012[17] and publicly owned utilities achieve their own renewable energy goals by 2010,[18] the 2010 biopower goal would be 7,200 GWh, or an increase of 1,400 GWh per year to achieve the state's 2010 biopower goal.

Through Executive Orders S-14-08 and S-21-09, Governor Schwarzenegger raised the renewable energy target for most load-serving entities to 33 percent of retail sales by 2020. Energy Commission staff estimates that will require adding between 50,000 and 65,000 GWh of new renewable generation, depending on assumptions for rooftop solar, energy efficiency, and onsite generation. To achieve the state's 2020 biopower goal of 20 percent renewable

15 Nyberg, Michael, 2009. *2008 Net System Power Report.* California Energy Commission. CEC-200-2009-010. Pages A3 – A6 and table 4 on page 10.

32,500 GWh (Total renewables) – 600 GWh (onsite generation) = 31,900 GWh

16 Load-serving entities under the jurisdiction of the CPUC are required to procure 20 percent of their total procurement with renewables by 2010. Publicly owned utilities are not under the jurisdiction of the CPUC and are required to set their own renewable energy targets. Based on *2010 Energy Commission Load Forecast* for each load-serving entity, Energy Commission staff estimates the 2010 renewable procurement goal is 36,000 GWh based on individual utility targets (excluding pumping load).

17 The CPUC developed flexible rules for compliance permitting electrical corporations to apply inadequate procurement in one year to not more than the following three years. Electrical corporations may offset any deficit in 2010 with renewable electricity procured through 2012.

18 "California's Renewables Portfolio Standard law requires certain retail sellers of electricity to increase the amount of renewable energy they procure each year by at least 1 percent until 20 percent of their retail sales are served with renewable energy by 2010, but specifically excludes local publicly owned electric utilities from the definition of 'retail seller.' Instead, local publicly owned electric utilities are required to implement a Renewables Portfolio Standard (RPS) , but are given flexibility in developing utility-specific targets, timelines, and resource eligibility rules." (KEMA. 2008 *The Progress Of California's Publicly Owned Utilities In Implementing Renewables Portfolio Standards*. California Energy Commission. Publication number: CEC-300-2008-005.)

procurement, between 10,000 and 13,000 GWh per year of new biopower must come on-line. Table 2-2 summarizes the renewable and biopower goals for 2010 and 2020.

Since 2006, a total of 22 new facilities were built in California, 15 landfill gas[19] and 7 digester facilities,[20] representing 44 MW of generating capacity. Although no new solid-fuel biomass facilities were constructed, three idle facilities restarted. In addition, an idle coal facility was converted to combust biomass and restarted during the first quarter of 2010. Lastly, two coal facilities began cofiring with biomass and have plans to fully convert to biomass by 2012. Total bioenergy capacity added since 2006 total 88 MW, representing 500 GWh/year.

Table 2-3: Summary of In-State Biopower Capacity

Technology	Operating Capacity (MW)	Idle Capacity (MW)	Proposed Projects (MW)
Solid-Fuel Biomass‡	667	135	172
Landfill Gas**	282	n/d	57
Anaerobic Digester Gas*	3.8	4.6	n/d
Unrecovered MSW§	70	-	n/d
Total Bioenergy	1,049	136	222

‡ Source: Energy Commission

§ Source: Energy Commission. Includes three MSW combustion facilities, of which, only the Stanislaus Resource Recovery facility is eligible for the RPS.

* Source: Air Resources Board

** Source: U.S. EPA

n/d means no data available.

The activity since 2006 was not all positive. Through 2009, two solid-fuel biomass operators have idled their facilities, and one was shut down due to poor economic conditions in the lumber industry and low contract prices for energy. Four additional solid-fuel biomass facilities idled in 2010, one of which restarted operations in the summer of 2010. Seven dairy manure digesters also idled because of financial difficulties and their inability to meet San Joaquin Valley Air Pollution Control District nitrogen oxide (NOx) emission standards. The capacity idled since 2006 is 60 MW,[21] which represents the potential to generate 370 GWh per year[22] of biomass generation.

19 United States Environmental Protection Agency (U.S. EPA) Landfill Methane Outreach Program. www.epa.gov/lmop/documents/xls/opprjslmopdata.xls
www.epa.gov/agstar/pdf/digesters_operational.xls

20 Orta, Jason, Zhiqin Zhang, and et. al. 2010. *2009 Progress to Plan – Bioenergy Action Plan for California.* California Energy Commission. CEC-500-2010-007.

21 Energy Commission. Idle solid-fuel biomass facilities since 2006 include: SPI Loyalton – 20 MW, El Nido – 12.5 MW, Chowchilla – 12.5 MW, SPI Anderson – 1 MW, SPI Sonora – 3 MW, Big Valley Lumber – 5 MW. Idle dairy digesters in the San Joaquin Valley represent 1 MW.

The three largest investor-owned utilities (IOUs) in California have signed contracts with 10 new biopower projects expected to come on-line before 2012. The IOUs estimate that these projects could deliver between 600 and 1,000 GWh per year.[23] California publicly owned utilities have signed contracts with 11 new biopower projects expected to come on-line before 2012. The expected deliveries from these projects total 570 GWh per year.[24] The U.S. Landfill Methane Outreach Program shows an additional 5 projects under construction in 2009. Staff estimates the deliveries from these projects will be 250 GWh per year.

The total statewide-expected deliveries from newly contracted projects are 1,400 – 1,800 GWh. If these projects are successful in coming on-line by 2012, and existing generation remains constant, then the state will remain on track for achieving the near-term biopower goal. Table 2-3 summarizes active, idled, and proposed bioenergy projects in California.

Efforts to Streamline Permitting

To streamline the permitting process for anaerobic digesters, CalRecycle and the Central Valley Regional Water Quality Control Board (Central Valley Water Board) are developing program environmental impact reports (EIR) for anaerobic digestion facilities. The program EIRs are intended to reduce the cost and timeframe needed to permit new anaerobic digester projects in California. Both EIRs are expected to be completed by December 2010.

Currently, there is only one commercial-scale anaerobic digester facility processing organics in California; however, developer interest is growing, and a number of facilities have either been proposed or are under development. CalRecycle anticipates that anaerobic digester facilities will be developed across the state to meet the increasing need to divert organic waste from landfills. CalRecycle is preparing this EIR to assess the potential environmental effects that may result from the development of anaerobic digester facilities throughout California.

The EIR will provide information for future policy considerations related to anaerobic digester facilities and provide background information on anaerobic digester technologies, potential impacts, and mitigation measures. This information will also assist state and local agencies in preparing site-specific environmental documentation that may be required for anaerobic digester facility applications and/or permits submitted to CalRecycle and other state and local regulatory agencies.[25]

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22 Energy Commission. Assumes capacity factor of 85 percent for 49 MW of idle solid fuel biomass, and capacity factor of 60 percent for 1 MW idle dairy digesters.

23 Energy Commission's *Investor Owned Utilities Database of Contracts for Renewable Generation*. Can be downloaded at: www.energy.ca.gov/portfolio/contracts_database.html. Also, the database shows that between 800 GWh to 1100 GWh expected to come on-line by 2014.

24 Energy Commission's *Publicly Owned Utilities Database of Contracts for Renewable Generation*. Can be downloaded at: www.energy.ca.gov/2008publications/CEC-300-2008-005/index.html

25 CalRecycle. *Notice of Preparation of a Draft Statewide Program Environmental Impact Report for Anaerobic Digester Facilities for the Treatment of Municipal Organic Solid Waste.* April 30, 2010. http://www.calrecycle.ca.gov/SWFacilities/Compostables/AnaerobicDig/NOP.pdf

The Central Valley Water Board, with partial funding provided by the Air Resources Board, is also preparing a program EIR to evaluate the environmental effects of dairy manure digesters and codigesters within the Central Valley Region. The EIR is intended to assist developers comply with the California Environmental Quality Act requirements related to water discharge and/or conditional waivers issued by the Central Valley Water Board to owners and operators of such facilities.

These digesters will also require discretionary permits from other state, county, and local agencies and special districts. The program EIR will also be useful to developers in satisfying California Environmental Quality Act requirements. The goal is to reduce the time required for environmental review and other discretionary permitting of digesters at dairies and central facilities throughout the Central Valley.[26] The program EIR is scheduled to be considered for approval at the Central Valley Water Board's December 2010 Board Meeting.

26 Central Valley Water Board. *Central Valley Dairy Digester and Codigester PEIR Notice of Preparation/Initial Study.* March 2010.

CHAPTER 3:
Objectives of the *2011 Bioenergy Action Plan*

To meet the goals of Executive Order S-06-06, some existing facilities will need to be retooled or expanded, and new facilities will need to be constructed. Table 3-1 summarizes the bioenergy goals for 2010 and 2020 and the potential additional bioenergy in each as discussed in each objective. The table includes proposed biopower facilities with contracts approved by the California Public Utilities Commission (CPUC). Even if the total potential in each objective comes on-line, additional new facilities will likely be needed to achieve the 2020 goal.

As part of the *2011 Plan*, Energy Commission staff developed five objectives of the plan building on the lessons learned from the *2006 Plan*. These five objectives are:

- Increase bioenergy production at existing facilities.
- Construct new bioenergy facilities.
- Integrate bioenergy facilities with biomass collection, processing, and treatment operations, and use multiple fuels in bioenergy plants.
- Commercialize next generation conversion technologies.
- Remove statutory and regulatory hurdles.

Table 3-1: Path Toward Meeting California's Bioenergy Goals

E.O. S-06-06 Bioenergy Goals		Baseline	Existing Facilities	New Facilities§	Integrated Facilities	Total Potential plus Baseline
Biopower Goal (GWh)		2008 Generation (GWh)	Potential for Additional Generation (GWh/year)			GWh/yr
2010†	7,200	5,800	2,700-3,600	1,400-1,800	>2,500	12,400-13,700
2020‡	17,000-20,000	5,800	4,600-5,500	1,600-2,000§	>2,500	14,500-15,800
Biofuels Goal (million gge)		2009 Production (million gge)	Potential for Additional Fuel Production (million gge /year)			million gge /yr
2010	135	48	217	20	Unknown	288
2020	Up to 820	48	217	TBD	Unknown	TBD

Source: Energy Commission
† Assumes renewable procurement of 20 percent for IOUs and individual targets for POUs.
‡ Assumes renewable procurement of 33 percent for all load-serving entities regulated by the ARB's Renewable Electricity Standard.
§ Only includes proposed projects expected to come on-line by 2014. This figure does not represent the full feedstock potential throughout the state. A more detailed analysis is required to determine the potential for additional biopower facilities.

Increase Bioenergy Production at Existing Facilities

Restarting idle plants, repowering existing facilities, or switching from fossil-based feedstock to biobased feedstocks can cost-effectively increase bioenergy production at existing facilities. Idled facilities are facilities that have been shut down, but the generation or fuel production equipment remains intact. Idle capacity represents stranded resources. In general, this capacity requires less capital to restart than siting, permitting, and constructing a new facility. For

example, a recent Energy Commission study estimated that the cost of generation for a new solid fuel biomass facility is $2,600 - $3,000 per kilowatt (kW).[27] However, the study also estimated that the cost to retrofit an existing coal facility to cofire using up to 20 percent biomass is about $500/kW.[28] The potential to increase biopower generation and biofuel production capacity at existing facilities is provided in Table 3-2.

Table 3-2: Potential at Existing Bioenergy Facilities

Resource	Potential per year
Restarting Idle Facilities	
Idle solid-fuel biomass facilities in California	900 GWh†
Idle dairy digesters in California	24 GWh§
Idle ethanol biofuel facilities in California	152 million gge
Idle biodiesel facilities in California	66 million gge
Expanding Role of Existing Bioenergy Facilities	
Increase generation at existing solid fuel biomass facilities	650 GWh‡
Increase capture and beneficial use of biomethane currently being flared at wastewater treatment plants and landfills§	Landfills: 700-1,600 GWh WWTP: 400 GWh
Cofiring or fuel switching at existing fossil fuel facilities	100 to 2,000 GWh††
Repowering existing solid-fuel biomass facilities or adding boilers to increase usage of waste heat	Unknown

Source: Energy Commission
† Energy Commission staff estimates based on best available data.
‡ Energy Commission staff estimates assuming existing facilities could increase capacity factor to 85 percent.
§ Energy Commission staff estimates assuming a 60 percent capacity factor.
†† Energy Commission staff estimates assuming 85 percent capacity factor. Minimum range based on cofiring with 5 percent biomass and maximum based on full fuel switch to biomass (100 percent biomass).

Loss of electricity generation or fuel production from existing bioenergy facilities will require development of additional new resources to achieve California's bioenergy goals. Due to the cost and challenges associated with the development of new facilities, the state must ensure existing facilities remain operational. Repowering[29] or retooling existing biomass facilities may be necessary to ensure that they remain operational, meet state, local, and national air quality standards, and use the most efficient or economic technologies. Repowering existing bioenergy facilities can also provide an opportunity for increasing production capacity.

27 O'Donnell, Charles, Pete Baumstark, Valerie Nibler, Karin Corfee, and Kevin Sullivan (KEMA). 2009. *Renewable Energy Cost of Generation Update*, PIER Interim Project Report. California Energy Commission. CEC-500-2009-084. Page 16.

28 Ibid. Page 16.

29 Repowering means replacing a significant portion of the generating equipment at an existing facility. Further restrictions apply to facilities seeking status as a repowered facility in the Renewables Portfolio Standard including, but not limited to, replacement of all prime generating equipment and a capital investment of at least 80 percent of the value of the repowered facility. Please see the *Renewables Portfolio Standard Eligibility Guidebook* for more details.

Solid-fuel biomass facilities currently participating in the Energy Commission's Existing Renewable Facilities Program (ERFP) represent 600 MW of capacity.[30] In 2009, participating facilities generated 3,800 GWh, operating at 70 percent of capacity.[31] Generally, well-maintained solid-fuel biomass facilities can operate at 90 percent capacity averaged over a year (90 percent capacity factor), given sufficient affordable feedstock and an adequate price for energy. Conservatively, Energy Commission staff estimates that existing biomass facilities have the potential to increase generation by 650 GWh per year if they operate at 85 percent capacity, assuming the facilities can overcome feedstock and energy price challenges.

Arguably, one of the most attractive and easily developed renewable energy sources is fuel switching or converting California's in-state coal facilities to biomass. Full-fuel-switching or converting California's in-state coal facilities to biomass is cost-effective because similar technologies can be used to convert coal and biomass to energy. For example, Millennium Energy estimates the cost to complete a retrofit of its 50 MW Mount Poso coal cogeneration facility to a renewable biomass facility will be $1,000/kW. Once completed, the facility will operate as an RPS certified biomass facility.[32]

For facilities that cannot fully convert to biomass, biomass cofiring, where biomass and coal are combusted simultaneously, requires minimal boiler modifications. Cofiring can displace 5 to 30 percent of the fossil fuel.[33] In 2009, KEMA estimated that the cost to cofire with biomass at a coal-fired facility would cost $400-$700/kW.[34]

Comparing cofiring or fuel switching to the cost to construct a new biomass facility ($2,600 - $3,000/kW), cofiring and fuel switching at existing facilities looks very attractive. The potential for cofiring in-state is 15 – 75 MW and up to 290 MW if the facilities undergo a full fuel switch to biomass. In-state coal cofiring and fuel switching represent a potential of 100 – 2,000 GWh/yr.

Although cofiring at out-of-state coal facilities is technically possible, it may not be feasible for a variety of reasons. In 2008, California utilities imported approximately 52,000 GWh of coal-derived power. Despite the potential for cofiring at out-of-state coal facilities, restrictions in California's Emissions Performance Standards would likely preclude any facilities that make plant modifications from securing long-term power purchase agreements (greater than five years) unless the plant's GHG emissions are less than a comparably sized natural gas combined cycle gas turbine.

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30 This capacity is net of on-site load. Many of these facilities service on-site load, such as lumber mill operations. At this time, the on-site generation is not eligible for California's Renewables portfolio Standard, and therefore it is not used to calculate total in-state biopower generation.

31 Energy Commission's Existing Renewable Energy Program.

32 Michael Hawkins, Millennium Energy. *Staff Workshop 2010 Bioenergy Action Plan Transcript*, June 3, 2010, Page 101.

33 O'Donnell, Charles, Pete Baumstark, Valerie Nibler, Karin Corfee, and Kevin Sullivan (KEMA). 2009. *Renewable Energy Cost of Generation Update*, PIER Interim Project Report. California Energy Commission. CEC-500-2009-084. Page 16.

34 Ibid. Page 16.

In addition, restrictions in the Renewables Portfolio Standard do not allow generation from out-of-state facilities to count toward the state's renewable targets unless the facility is new or repowered. Because out-of-state coal facilities are located in semi-arid regions, studies would also be needed to evaluate the feedstock potential available to out-of-state coal facilities and to determine if cofiring at these facilities would be feasible.

Of the seven biorefineries in California, four of the modern corn grain ethanol biorefineries are off-line due to adverse market conditions. As a result, California imports nearly all of the ethanol the state uses each year from large Midwest ethanol producers. Idle capacity represents 152 million gallons of gasoline equivalent (gge) per year.

Of California's 11 biodiesel plants, 6 of these facilities are idle due to biodiesel's inability to compete with petroleum-based diesel prices. Idle capacity represents 66 million gge per year.

Operators of public works projects and landfills must capture and destroy fugitive methane emissions. Due to difficulties obtaining air permits, meeting air quality standards in some California air districts, and the economics of power generation, much of this potential energy resource is flared. While power generation on-site may increase greenhouse gases and other air pollutants when compared to flaring, cleaning and upgrading this gas to meet pipeline or transportation fuel standards would allow this resource to be wheeled to existing facilities or used in large vehicle fleets.

Waste Management operates a landfill gas to liquid natural gas plant in California producing 13,000 gallons per day (about 20,000 gge per day), which they use to fuel their truck fleet.[35] The U.S. EPA estimates that candidate[36] landfills have the potential to generate 720 GWh per year or produce 20 million gge, per year of liquid natural gas with an additional 900 GWh/year, or 30 million gge of liquid natural gas, from other potential LFG to energy sites.[37]

Construct New Bioenergy Facilities

The number of bioenergy facilities needed to meet California's bioenergy goals will depend on the production from existing and colocated facilities. To meet these targets, project developers must site new facilities near sustainable fuel sources or a reliable feedstock transportation network.

California has significant and diverse biomass resources. The full extent to which these resources can be managed for energy production remains somewhat speculative. This is due in

35 Chuck White, Waste Management Waste Management. *Staff Workshop 2010 Bioenergy Action Plan Transcript*, June 3, 2010, Page 146. Data conversion assumes 1.5 gge/gallon LNG.

36 U.S. EPA defines a candidate landfill as one that is accepting waste or has been closed for five years or less, has at least one million tons of waste, and does not have an operational or under-construction project; candidate landfills are also designated based on actual interest or planning. (U.S. EPA Landfill Methane Outreach Program.)

37 U.S. EPA Landfill Methane Outreach Program. Data conversions assume: 300 scf per minute of LFG is available for utilization for every million tons of waste in place; Methane content of LFG is 50 percent; Methane heat content is 1,012 Btu/scf methane; Weighted average heat rate for LFG-fired engines, turbines, and boiler/steam turbines is 11,700 Btu/kWh; and capacity factor of 65 percent. (www.epa.gov/lmop/projects-candidates/interactive.html)

part to uncertainties about the amount of biomass produced in the state every year and the quantity that may be used on a sustainable basis. It is important therefore to estimate how much of these resources may be available for energy production because not all of the biomass produced in the state can or should be used for bioenergy.[38]

The amount of feedstock that is potentially available (that is, technical potential) is defined as the amount of biomass that can be harvested without adversely affecting soil fertility and tilth, or erosion control, and where the biomass is accessible when considering terrain limitations, environmental and ecosystem requirements, collection inefficiencies, and a number of other technical and social constraints. The amount of biomass that is technically available is therefore substantially less than the gross production of biomass. Furthermore, of the amount that is technically available, only a portion is economically recoverable and requires additional review of site-specific constraints.[39]

The California Biomass Collaborative estimates that the technical potential of biomass is 36 million bone dry tons per year (BDT/yr) in 2010, which could be used to generate 40,000 GWh/yr biopower. The collaborative also estimates that resource growth and improvements in conversion efficiencies could increase the technical potential in 2020 to 40 million BDT/yr, enough biomass to generate 50,000 GWh.[40] In 2008, in-state biopower facilities generated 5,700 GWh. Therefore, the net technical potential for new biopower facilities is 34,300 GWh in 2010 and 44,300 GWh in 2020.

Table 3-3: Biomass Technical Potential

Feedstock Source	2010 (GWh)	2020 (GWh)	2010 (million gge)	2020 (million gge)
Agriculture	10,000	10,000	310	310
Forestry	18,000	21,000	560	650
Municipal Waste	10,000	13,000	310	400
Dedicated Crops	2,000	6,000	60	190
Existing Facilities	5,700		180	
Net Technical Potential	34,300	44,300	1,060	1,370

Source: California Biomass Collaborative
Assumed conversion of 32.3 GWh/million gge
Note: Totals may not sum due to rounding
no data available on amount of in-state fuel used by California biofuel producers

Through 2020, the largest potential sources of biomass will be municipal solid waste, in-forest residue, animal manures, landfill gas, orchard and vineyard residues, and some field crop and residues. California's biomass resources are sufficient to supply a substantially larger amount of

38 Williams, R.B. 2008. An Assessment of Biomass Resources in California, 2007. California Biomass Collaborative. CEC-500-2006-094-D.

39Ibid.

40 Ibid.

biopower than is presently generated as well as increasing in-state biofuels production.[41] Table 5 above summarizes the technical potential by resource type.

The Energy Commission estimates that demand for ethanol could increase to more than 3 billion gallons per year by 2022, while biodiesel demand could increase to more than 200 million gallons per year.[42] In one LCFS scenario, ARB staff estimates that 18 cellulosic biorefineries, 6 corn-ethanol biorefineries, and 6 new biodiesel or renewable diesel refineries could be needed by 2020 to meet the increased demand for low-carbon biofuels.[43] Presumably, ethanol and biodiesel will continue to be the primary biofuels, at least in the midterm (2-5 years). Others such as biomethane, renewable hydrocarbons, and renewable hydrogen may also play a role, but commercial development at sufficient scale seems to be many years away. Biomethane as a transportation fuel will be valuable for helping meet the necessary carbon reductions, as it can range from 80 to 87 percent GHG reduction below the gasoline baseline on a full-fuel-cycle basis.

Develop Integrated Bioenergy Facilities

Numerous synergistic opportunities exist between biopower and biofuel production and value added bioproducts across industrial, agricultural, forestry, waste collection, and organic-materials processing activities. The desired outcome of each integrated facility should be to extract maximum value or utility from the biomass material being transformed. Future integrated facilities will focus on employing the byproduct from a process as the source of heat, fuel or feedstock for another. Currently, combined heat and power facilities are employed around the country to provide heat for local buildings or industrial process, but future applications will focus on value-added products (biopolymers, fertilizers, and minerals), reducing feedstock competition and GHG emissions. Combined or integrated bioenergy facilities hold great promise to increase efficiency and provide a model of how researchers can extract more energy and value from existing biomass resources, thereby altering the current economic relationship to levels that make these relationships both economically viable and of increasing value to society.

The following are some examples of integrated bioenergy facilities.

41 Williams, R.B. 2008. An Assessment of Biomass Resources in California, 2007. California Biomass Collaborative. CEC-500-2006-094-D.

42 Baroody, Leslie, Charles Smith, Michael A. Smith, Charles Mizutani. 2010. 2*010-2011 Investment Plan for the Alternative and Renewable Fuel and Vehicle Technology Program Commission Report.* California Energy Commission, Fuels and Transportation Division. Publication Number: CEC-600-2010-001-CMF.

43 California Air Resources Board. 2009. *Proposed Regulation to Implement the Low Carbon Fuel Standard: Initial Statement of Reasons*, March 5, 2009 cited in *Baroody, Leslie, Charles Smith, Michael A. Smith, Charles Mizutani*. 2010. *2010-2011 Investment Plan for the Alternative and Renewable Fuel and Vehicle Technology Program Commission Report.* California Energy Commission, Fuels and Transportation Division. Publication Number: CEC-600-2010-001-CMF.

Colocating Bioenergy Facilities in Forested and Urban Interface Areas With Ongoing Hazard Fuel Reduction Projects.

Communities such as those on the North and South shores of the Tahoe basin and various locations along Sierra Nevada and Cascade mountain ranges require regular hazardous fuel treatments to reduce wildfire risk and support ecosystem function. Disposal of biomass residues to facilities located greater than 100 miles away can nearly double project costs. Locating small bioenergy projects near forest biomass sources can reduce treatment costs by producing energy and other useful byproducts, reduce GHG and particulate emissions from open pile burning, and support stable local employment and energy supplies in rural and forested areas.

Codigesting Fats, Oil, and Grease (FOG), Food Processing Waste, and Dairy Waste at Wastewater Treatment Plants

Many wastewater treatment plants use anaerobic digestion to reduce the volume of biosolids before disposal. The anaerobic digesters produce biogas, which is either flared or used on-site as an energy source. The amount of biogas produced by existing facilities could fuel 125 MW of generation capacity.[44]

Due to the cost and feasibility of siting generation equipment at many of these facilities, much of the biogas produced is flared. A recent Energy Commission study estimated that, using existing infrastructure, codigesting FOG, food processing waste, and dairy waste at existing wastewater treatment plants could increase the biogas yield potential to 450 MW of capacity, representing 2,500 GWh per year.[45]

Wastewater treatment facilities are ideal for accepting diverted food waste because the facilities are often located in urban areas, have experience operating anaerobic digesters, and have existing infrastructure in place to capture biogas.[46] In addition, large treatment facilities could use the electricity and heat onsite.

Additional bioenergy generation potential can be derived by diverting food processing industry wastewater currently discharged on agricultural lands to municipal wastewater sanitary districts. Although the land discharge practice is the least cost option in the Central Valley region, environmental impacts on groundwater quality have shown the need to find alternatives to land disposal.[47] The increased revenue from bioenergy generation could be used to cover the cost of trucking wastewater and solid residues from food processing factories to nearby wastewater districts.

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44 Kulkarni, Pramod. 2009. *Combined Heat and Power Potential at the California Wastewater Treatment Plants.* California Energy Commission. CEC-200-2009-014-SF. Page 13.

45 Ibid. Page 13. Generation estimate assumes 60 percent capacity factor.

46 U.S. EPA, Region 9. *The Benefits of Anaerobic Digestion of Food Waste At Wastewater Treatment Facilities.* Page 2. Can be downloaded at: www.epa.gov/region9/organics/ad/Why-Anaerobic-Digestion.pdf

47 Hilmar Supplemental Environmental Project. http://hgp-inc.net/HilmarSEP/HilmarSEP_ExSumm.html.

Colocating Bioenergy Facilities With Landfills, Material Recovery Facilities, Waste Disposal Sites, and Compost Facilities

The benefits of colocating bioenergy facilities with waste disposal sites include reduced collection and transportation costs, reduced per capita disposal, and reduced GHG emissions. For example, integrating a digester with a compost facility creates the opportunity for compost operations to extract the energy content of their feedstock before composting. In this process, anaerobic digestion of organic waste produces methane, and then the digestate (material remaining after anaerobic digestion) can be used to produce a useable compost product.[48]

Colocating Cellulosic-Ethanol Production Plants With Existing Biomass Combustion (or Other) Facilities

Integrating the processes of biofuel production facilities with existing biomass power generators would exploit synergistic relationships between the processes. For example, fine particles of wood are not suitable for combustion in a biomass boiler; however, this material can be used as a feedstock to produce ethanol. In addition, a by-product of the cellulosic ethanol production process is lignin, which is still carbon-rich and can be used as a feedstock for solid-fuel biomass facilities.

Colocating cellulosic-ethanol production plants with existing biomass combustion (or other) facilities allows these facilities to share the transportation and collection costs of the biomass feedstock, increase the conversion efficiency of biomass-to-energy conversion, and decrease the carbon intensity of the facilities.

Fund Research and Development

Next-generation biomass conversion technologies build upon the successes of the first generation technologies while making significant strides in advancing past their associated economic costs and externalities. Next-generation technologies include both thermochemical conversion and biochemical conversion processes that use a wide range of feedstocks. Each technology has unique challenges to commercialization that must be considered. Some of these technologies promise advancements in air quality impact and feedstock compatibility with potential to increase the sustainable use of biomass conversion in California.

Promotion of next-generation technologies can help California successfully meet a diverse set of goals, including those associated with energy security and diversification, GHG mitigation, rural economic development, and other environmental issues. The policies and actions that the state agencies design and support must be carefully implemented to avoid unwanted delays in commercialization. In addition, the availability of sustainable biomass resources is an area where diverse state and federal rules, laws, and regulatory policies may operate at cross-purposes. Additional research and public outreach is needed by state agencies to define sustainability standards and continue to assess biomass feedstock potential throughout the state.

48 Chuck White, Waste Management. *Staff Workshop 2010 Bioenergy Action Plan Transcript*, June 3, 2010, Page 148.

Remove Statutory and Regulatory Hurdles

Two programs that benefit bioenergy in California will expire in 2012. These are the Energy Commission's Renewable Energy Program, which provides financial support for existing solid-biomass facilities and the Public Interest Energy Research (PIER) Program. The Energy Commission will seek reauthorization of these programs in 2011.

In addition, California state statutes contain restrictive language that limits the use of conversion technologies in the development of waste to energy projects. The *2006 Plan* recommended that these restrictions be removed:

> "Amend existing law to revise existing technology definitions and establish new ones, where needed. In particular, review the definitions of gasification, transformation, fermentation, pyrolysis, and manufacturing. Such statutory clarification would enable the utilization of biomass residues through combustion or non-combustion technology."

Attempting to manage resources and outcomes through technology prescriptions and definitions (that is, gasification, transformation, and so forth), rather than performance-based standards in state statutes inhibited the development of environmentally safe bioenergy resources in the state. State air and water quality standards are established and enforced by state and federal agencies, and California has the strongest environmental and permitting standards in the country.

Another area is the need for uniform pipeline standards for landfill gas usage. Current California law effectively restricts the injection of in state landfill gas into the natural gas pipeline system. However, California utilities can purchase landfill gas from out of state to meet their RPS goals.

The details of recommendations for legislation and regulatory changes will be presented in following chapters.

CHAPTER 4:
Challenges to Bioenergy Development

The challenges to bioenergy have been discussed for many years through workshops and forums held by the California Energy Commission, California Integrated Waste Management Board (now CalRecycle), the California Department of Food and Agriculture, the Department of Forestry and Fire Protection (CalFire), the Air Resources Board, State Water Resources Control Board, the California Biomass Collaborative, U.S. EPA, industry groups and others. These forums have provided developers, stakeholders, and state and federal agencies an opportunity to identify challenges to increased bioenergy development in the state. Some of the challenges identified include:

- Siting, permitting, and state policy challenges.
    - The cost of meeting air quality standards for small projects.
    - The lack of policy and regulatory coordination among local and state agencies.
    - Biogas quality standards and pipeline interconnection.
    - Utility interconnection rules and net metering contracts that show preference for solar and wind technologies.
    - Proposed U.S. EPA Maximum Available Control Technology requirements.
    - U.S. EPA Prevention of Significant Deterioration and Title V Greenhouse Gas Tailoring Rule.
- Sustainable feedstock sourcing and transportation issues.
    - The cost of sustainable solid-fuel biomass collection and processing.
    - Biomass collection and processing issues.
- Economics and financing issues.
    - Contract prices for existing solid-fuel biomass facilities.
    - Competition between biofuels and fossil fuels.
    - Effect of biomass market on project financing.
    - Unrealized net social, economic, and environmental benefits.
- Research and development challenges related to next generation technologies, biomass feedstock sustainability, and feedstock production systems.
    - Biomass-to-biomethane conversion technologies.
    - Low-emission "micro" generation technologies.
    - Biomass-to-biofuels conversion technologies.
    - Air pollution control equipment.
    - Feedstock production systems.
- Statutory and regulatory issues.
    - Sunset of state programs that help fund existing biomass facilities and that fund public interest energy research.
    - Statutory and inaccurate definitions that impede some conversion technologies for energy production, result in non-optimal technology choice, and limit opportunities to develop energy from municipal solid waste.
    - Restrictions and penalties on the injection of landfill gas into the natural gas pipeline.

Siting, Permitting, and State Policy Challenges

Numerous utility rules, state, and local regulations and policies apply to project developers and operators of bioenergy facilities. Improving consistency between regulations and coordination between regulators and policy makers is important to protect environmental quality and human health and safety, and to encourage investment. A clear permitting process is needed to promote development of new facilities.[49]

New projects developers must have sufficient capital on hand to fund projects during the permitting and interconnection stages of development because permit approval and utility interconnection agreements cannot be assured at the onset of project development.[50] The permit process can take months or years and is generally very expensive.[51] Lenders avoid risk associated with permitting or utility interconnection and will generally require project developers to have state and local permits and utility interconnection agreements in hand before agreeing to finance a new project.

Project developers have identified specific siting and permitting challenges that slow project development, such as cost-effectively meeting regional air quality standards with current technology, lack of regulatory and policy coordination, lack of uniform biomethane gas quality standards, and the cost to interconnect small biogas projects to the natural gas pipeline.

The Cost of Meeting Air Quality Standards for Small Projects

According to project developers, a primary obstacle to developing new biopower facilities in California is economically meeting local air quality permit requirements. The Working Group views this as a technical challenge that will require innovative policy actions and technology advances that do not result in lower health protections through regulatory change.

Many air districts in California are designated nonattainment for ozone and particulate matter (soot). California law and federal Clean Air Act require new or modified facilities with an emission increase to comply with the Best Available Control Technology (BACT) or the Lowest Achievable Emission Rate (LAER) standards, depending on a project's expected emissions. The local air quality permits are designed, in part, to implement these regulatory requirements. Therefore, new biomass facilities must install a combination of generation equipment and emissions control equipment to reduce emissions to below the designated limits. In some cases, facilities that meet emissions limits may also be required to purchase emission reduction credits (ERCs).

Purchase of ERCs is particularly difficult in the South Coast Air Quality Management District (SCAQMD) due to the scarcity of credits for soot emissions. A typical 11 MW solid-fuel biomass

49 Williams, R.B. 2008. An Assessment of Biomass Resources in California, 2007. California Biomass Collaborative. CEC-500-2006-094-D. Page 17.

50 Fred Tornatore, TSS Consulting. June 3, 2011 Bioenergy Action Plan Workshop Transcript, pg 56.

51 Williams, R.B. 2008. An Assessment of Biomass Resources in California, 2007. California Biomass Collaborative. CEC-500-2006-094-D. Page 123.

facility emits about 100 pounds per day of soot 10-microns or less in size (PM-10).[52] As part of a new facility's air permit, the developer may be required to offset a portion of these emissions by purchasing ERCs. Although the cost of purchasing PM-10 ERCs has declined since its peak of approximately $350,000 per pound per day in mid-2009,[53] this requirement could make new biomass projects in the SCAQMD economically nonviable.

The air districts do provide offset exemptions under certain circumstances. For example, SCAQMD exempts facilities that emit less than 4 tons per year for each of the nonattainment air pollutants (such as volatile organic compounds, nitrogen oxides, sulfer oxides, and soot) from the emission offset requirements. The exemption is particularly useful for smaller biomass facilities and facilities with enhanced emission controls.

Since the early 2000s, seven dairy producers have installed anaerobic digesters with engines to generate electricity in the San Joaquin Valley, using public funding from the Energy Commission. As of January 2009, these engines were required to demonstrate compliance with new emissions standards adopted by the San Joaquin Valley Air District in 2005, in Rule 4702. Unfortunately, due to a number of economic issues, only four were still operating as of January 2009. The three installations that were shut down tended to be the smaller operations, and represented 0.7 MW of generation capacity. All four of the others, representing 2.6 MW of generation capacity, continue to operate in compliance with Rule 4702.

Biopower facilities seeking to switch to or add a new fuel source must demonstrate to the local air district that the fuel switch will not cause the facility to increase emissions. Otherwise, the modified facility may be subject to the BACT or LAER standards and may even be required to provide emission offsets as discussed above. While agricultural residues have been used as a feedstock in biomass combustion technologies, many agricultural residues have not been tested in thermochemical conversion technologies, and, therefore, emissions data on these feedstock sources is not available. To show that the new fuel or new technology will meet the air emissions limits for the local air district, the project developer may be required to conduct emissions source testing, which could be substantial for small developers.

Air districts that do not meet the national or state ambient air quality standards are under mandate to reduce those pollutants to preserve public health. There are also national emission standards for hazardous air pollutants that may apply to biomass facilities. ARB and the local air districts urge project developers to contact the local air district before starting a project to understand which pollutants must be controlled to what levels so that the costs of complying with air regulations are well understood and factored into business decisions. (See Appendix B for background on California's air quality structure.)

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52 California Air Resources Board, facility details for Burney Mountain Power, available at: www.arb.ca.gov/app/emsinv/facinfo/facdet.php?co_=45&ab_=SV&facid_=42&dis_=SHA&dbyr=2007&dd=.

53 South Coast Air Quality Management District, September 24, 2009, "PM-10 Market Conditions and Offset Availability in SCAQMD," presentation by Mohsen Nazemi, available at: www.energy.ca.gov/2009_energypolicy/documents/2009-09-24_workshop/presentations/06_SCAQMD-Nazemi_Market_Conditions_and_Offset_Availability-092409_Final.pdf.

U.S. EPA MACT Proposed Ruling

The federal Clean Air Act requires the United States Environmental Protection Agency (U.S. EPA) to set national ambient air quality standards (NAAQS) for "criteria" pollutants considered harmful to public health and the environment. The U.S. EPA has proposed stringent new emissions, monitoring, and reporting requirements for broad categories of new and existing non-residential boilers, including those fired by biomass. The U.S. EPA's proposed rule for toxic and hazardous air pollution would require facilities use the Maximum Achievable Control Technology (MACT).[54]

The proposed MACT rule would restrict the allowable levels of carbon monoxide emissions and other hazardous air pollutants to those achieved by the top 12 percent of solid-fuel biomass facilities.[55] Although the U.S. EPA based the proposed MACT standards on the best operating facilities for each pollutant type, it is not likely that any of the existing facilities in the U.S. EPA's background study for the proposed rule would meet the proposed MACT standards for all pollutants at the same time. Due to the cost and other technical issues, existing biomass facilities may not be able to meet the emissions limits, which could result in the closure of existing solid-fuel biomass facilities.[56] However, new solid-fuel biomass may be able to meet this standard.[57]

On August 19, 2010, Governor Schwarzenegger submitted comments to U.S. EPA Administrator Lisa Jackson from the ARB, CalRecyle, and the Energy Commission expressing concern over the potential impacts and unintended consequences of the proposed rules on California's solid-fuel biomass industry, the ability of the state to promote diversion from landfills, and to produce alternative fuels and energy. If the U.S. EPA adopts the proposed MACT rule as drafted, the Governor stated that it could affect electricity production from existing biomass plants, which represents about 2 percent of the state's total in-state generation.

Greenhouse Gas Emissions and Bioenergy

On July 15, 2010, U.S. EPA solicited information on greenhouse gas (GHG) emissions from bioenergy sources as they relate to the Prevention of Significant Deterioration (PSD) and Title V Greenhouse Gas Tailoring Rule (June 3, 2010), which established requirements for obtaining new air quality PSD permits for GHG emissions starting in 2011. U.S. EPA is now considering whether it will treat biogenic emissions as carbon neutral for the purposes of implementing the Tailoring Rule.

The Tailoring Rule sets GHG emissions thresholds that determine which facilities will need GHG emissions permits and will be subject to BACT requirements. If bioenergy emissions are not considered carbon neutral and are thus counted for the purposes of PSD, bioenergy facilities would be subject to new permitting requirements, permit fees, and as yet undeveloped (and thus unknown) control technology. This could deter or delay bioenergy development and

54 www.epa.gov/ttn/atw/112j/112jaypg.html.

55 Ibid.

56 Patrick Holley, Covanta Energy. *Staff Workshop 2010 Bioenergy Action Plan Transcript*, June 3, 2010. Pages 67-69.

57 Ibid.

impede the state's achievement of its RPS goals, and will also adversely affect California's achievement of its GHG reduction goals and climate adaptation objectives.

National GHG inventories and Intergovernmental Panel on Climate Change guidelines consider emissions from biogenic sources (for example, wood waste, agricultural waste, and manure) to be carbon neutral. Carbon emissions from biogenic sources are not counted against the energy sector because they are treated as part of a natural closed carbon loop in which CO2 is sequestered by vegetation growth, released when plants die and decay or are harvested, and captured again as vegetation grows back. Thus, bioenergy does not add new CO2 to the atmosphere, whereas fossil fuels release carbon in permanent storage in the ground.

Using the residue from in-forest fuels reduction to produce energy has many benefits aside from helping to reduce GHG emissions. The controlled disposal of the residues that do not have higher and better uses at bioenergy facilities can reduce the air pollution otherwise emitted during open burning of timber harvest and mill waste, reduce the need for landfills, and reduce the threat of catastrophic wildfires through the controlled disposal of residues.

Furthermore, biomass-to-energy facilities can reduce wildfire suppression costs and offset the cost of in-forest fuels reduction projects. These projects can improve the health of forests, restore fire-resistant conditions by reducing fuels that have built up over nearly a century of fire suppression and help to reduce impacts from climate change-related increases in the number and severity of wildfire (for example, Westerling et. al., 2009, predict up to 100 percent increase in Northern California[58]).

On September 13, 2010, Governor Schwarzenegger's office sent a letter to Administrator Lisa Jackson of the U.S. EPA in response to a Call for Information on approaches to accounting for GHG emissions from bioenergy facilities. The letter was supported by comments from the ARB, Cal Fire, and the Energy Commission. The letter conveyed California's position that "bioenergy can be a 'carbon-neutral,' sustainable energy source" and that "California is counting on the substantial use of bioenergy to meet our GHG reduction goals."

Coordinated Policy Implementation

As noted in the *2006 Roadmap for Development of Biomass in California*,[59] "most new biomass projects will require a land-use permit, conditional-use permit, a zoning or master-plan amendment, or some combination of these. These permits are discretionary and usually require approval by locally elected bodies such as county supervisors or city councils."[60] Greater coordination between state and local permitting agencies can reduce permitting time and ensure that technologies with the highest net environmental benefits are employed. The current

58 Westerling, A. L., B. P. Bryant, H. K. Preisler, T. P. Holmes, H. G. Hidalgo, T. Das, and S. R. Shrestha. 2009. *Climate Change, Growth, and California Wildfire*. August 2009. California Climate Change Center. CEC-500-2009-046-F

59 Jenkins, B. M., et. al. *A Preliminary Roadmap for the Development of Biomass in California*. December 2006. California Energy Commission. CEC-500-2006-095-D.

60 Williams, R.B. 2008. An Assessment of Biomass Resources in California, 2007. California Biomass Collaborative. CEC-500-2006-094-D. Page 123.

approach promotes inefficient use of potential energy resources and, in some cases, pollution shifting from one environmental medium to another.[61]

Historically, proposed bioenergy projects in California have encountered a lengthy permitting process and uncoordinated regulatory requirements. For example, stakeholders have raised the following issues:

- Unlike other states, California does not have a singular state agency responsible for regulatory oversight and coordination. Some believe that this type of agency could provide arbitration when regulations and policies conflict.[62]
- The current regulatory structure leads to "silo" permitting approach, resulting in shifting pollution from one medium to another[63] and conflicting regulations.[64]
- The current regulatory structure disadvantages small developers because obtaining needed permits can be expensive and time-consuming. In addition, the process may be overly complicated and cumbersome to inexperienced developers, discouraging innovation and small-scale generation on farms.

Uncoordinated regulations have limited development of potential renewable energy resources without considering the greatest net environmental benefit. Simplifying and coordinating California's siting and permitting requirements can be done without lowering its environmental standards and can improve communication and education regarding regulatory standards and permitting processes.[65] In addition, uncoordinated regulations can lead to policies that limit technology development by picking preferred technologies or exclude otherwise acceptable feedstock sources.

For example, landfills and wastewater treatment plants are required to collect and destroy fugitive methane emissions. Operators have the option to destroy the gas by flaring the gas or using the gas to generating electricity. Other potential disposal methods include collecting and upgrading the gas to biomethane for pipeline injection or use as a transportation fuel. Obtaining air permits to flare that gas is relatively easy due to provisions in the Health and Safety Code. However, operators choosing to use the gas to generate electricity on-site are required to obtain two air permits, a permit to flare the gas and a permit to generate electricity.

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61 Alan Dusault, Sustainable Conservation. *Staff Workshop 2010 Bioenergy Action Plan Transcript*, June 3, 2010. Page 195.

62 Alan Dusault, Sustainable Conservation. 2011 Bioenergy Action Plan stakeholder workshop written comments. June 11, 2010.

63 For example, restrictions on air pollutants may lead to developers choosing a technology that increases water pollution, or by eliminating a developers ability to employ a technology that could improve water quality because it would increase emissions of air pollutants.

64 Alan Dusault, Sustainable Conservation. *Staff Workshop 2010 Bioenergy Action Plan Transcript*, June 3, 2010. Page 195.

65 Williams, R.B. 2008. An Assessment of Biomass Resources in California, 2007. California Biomass Collaborative. CEC-500-2006-094-D. Page 122.

As mentioned earlier, most small-scale generation projects are nonviable using the types of equipment needed to meet air quality standards. In addition, restrictions in California statute[66] have led to gas utilities refusing to accept injection of biomethane from landfill gas into the California gas pipeline whereas other states, such as Texas, allow upgraded landfill gas injection into the natural gas pipeline.[67] The result is that landfill and wastewater treatment plant operators tend to flare the gas, though some landfills have begun using the resource to fuel landfill trucks and equipment.

Energy Commission staff estimates that landfills flare enough methane to generate 700-1,600 GWh per year.[68]

Although the Energy Commission defines municipal solid waste (MSW) as a renewable fuel for electricity production (even though MSW often contains fossil-derived energetic components such as plastics), current law[69] narrowly defines the environmental and operational parameters that conversion technologies must meet to be eligible for renewable energy credits through the Renewables Portfolio Standard (RPS). To date, one combustion facility, specifically referenced in statute, is eligible for the RPS. No MSW conversion technology has been developed that meets the statutory requirements, particularly the requirement that the conversion process occur without the use of air or oxygen except ambient air to maintain temperature control.[70]

Statutory rules governing MSW facilities and the RPS treat biomass conversion similarly. Neither statute imposes the same restrictions as required by MSW conversion. However, the organic fraction of MSW is treated differently. RPS guidelines do not distinguish between the organic portion and the non-organic portion of the waste stream. Therefore, once organic waste enters the waste stream, it is considered MSW and must meet the statutory requirements for conversion to energy to be eligible for the RPS.

This requirement is not consistent with how CalRecycle defines solid waste and biomass. Because CalRecycle regulates facilities that handle solid waste and not the solid waste itself, CalRecyle does not regulate MSW processed into a product that meets quality standards acceptable to the marketplace. Post-recycled organic material can be sold back to the market place as biomass if it meets the definition in statute.[71]

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66 Because the gas may contain vinyl chloride at unacceptable levels and trigger penalties established by Assembly Bill 4037 (Hayden, Chapter 932, Statutes of 1988).

67 *SMUD to Purchase Green Gas From Texas*. SMUD press release. April 15, 2009.

68 U.S. EPA Landfill Methane Outreach Program. Data conversions assume: 300 Standard cubic feet per minute (scfm) of LFG is available for use for every million tons of waste in place; methane content of LFG is 50 percent; methane heat content is 1,012 British thermal units (BTU) per standard cubic feet (scf) of methane; Weighted average heat rate for LFG-fired engines, turbines, and boiler/steam turbines is 11,700 Btu/kWh; and capacity factor of 65 percent. (www.epa.gov/lmop/projects-candidates/interactive.html)

69 Public Resources Code Section 25741.

70 California Energy Commission, *2009 Integrated Energy Policy Report,* Final Commission Report, December 2009. CEC-100-2009-003-CMF. Pages 74-75.

71 PRC 40106. (a) "Biomass conversion" means the controlled combustion, when separated from other solid waste and used for producing electricity or heat, of the following materials:

The Energy Commission and CalRecycle are working together to resolve the difference between how each program handles organic wastes. CalRecycle estimates that organic material makes up more than 30 percent of MSW.

Biomethane Gas Quality Standards and Pipeline Interconnection

Biogas is produced from anaerobic microbial decomposition of organic matter. Biogas is produced in anaerobic digesters (for example, in sludge digesters at wastewater treatment plants, in manure digesters on farms, at food processing plants, and with solid waste treatment systems), from the degradation of municipal solid waste in landfills, and from the anaerobic decomposition of some wastewaters in ponds or lagoons.[72]

Biogas is principally composed of methane and carbon dioxide. Methane can range from about 40 percent to as high 70 percent by volume of the raw biogas with carbon dioxide accounting for the remainder. Biogas also contains water vapor and often sulfur compounds and siloxanes.[73] Raw biogas must be essentially pure methane stripped of carbon dioxide, moisture, and minor contaminants before it can be used as a compressed natural gas fuel or injected into a utility gas pipeline. The upgraded gas is referred to as biomethane. For use in stationary engines or boilers, only minor contaminants like hydrogen sulfide and siloxanes are removed from the raw biogas, carbon dioxide can remain in the gas.

A number of gas quality standards for pipeline injection are specified by the California utilities in their CPUC-approved tariff rules.[74] Some additional standards are specified in CPUC General

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(1) Agricultural crop residues.
(2) Bark, lawn, yard, and garden clippings.
(3) Leaves, silvicultural residue, and tree and brush pruning.
(4) Wood, wood chips, and wood waste.
(5) Nonrecyclable pulp or nonrecyclable paper materials.

(b) "Biomass conversion" does not include the controlled combustion of recyclable pulp or recyclable paper materials, or materials that contain sewage sludge, industrial sludge, medical waste, hazardous waste, or either high-level or low-level radioactive waste.

(c) For purposes of this section, "nonrecyclable pulp or nonrecyclable paper materials" means either of the following, as determined by the board:

(1) Paper products or fibrous materials that cannot be technically, feasibly, or legally recycled because of the manner in which the product or material has been manufactured, treated, coated, or constructed.

(2) Paper products or fibrous materials that have become soiled or contaminated and as a result cannot be technically, feasibly, or legally recycled.

72 Anaerobic bacteria naturally occur in the environment in anaerobic 'niches' such as marshes, sediments, wetlands ,and in the digestive tract of ruminants and certain species of insects.

73 Rapport, J., R. Zhang, B. M. Jenkins, and R. B. Williams. 2008. *Current Anaerobic Digestion Technologies Used for Treatment of Municipal Organic Solid Waste. Contractor Report to the California Integrated Waste Management Board.* Available: http://www.ciwmb.ca.gov/publications/default.asp?pubid=1275.

74 Utility gas rules can be found at:
www.pge.com/tariffs/tm2/pdf/GAS_RULES_21.pdf
www.sdge.com/tm2/pdf/GAS_GAS-RULES_GRULE30.pdf

Order 58-A.[75] However, not all of the gas quality standards that may be appropriate for biomethane have been specified in the utility rules or in General Order 58-A. This has created different approaches by utilities applying the existing standards for biomethane injected into the natural gas pipeline. For example, Southern California Gas Company has developed a biogas guidance document to complement its natural gas standards, whereas Pacific Gas and Electric (PG&E) has taken a project-by-project approach to applying its quality standards.[76] Southern California Gas said that its interconnection process was designed for large-scale natural gas production and that it is in the process of establishing an appropriate standard that fits biogas.[77]

Currently, rules in the utilities' tariffs require project developers to pay for the costs of the interconnection.[78] Project developers state that uniform and/or clearer gas quality standards would reduce the burden and cost faced by small developers to meet the standards.[79] Although Southern California Gas allows biomethane from dairies to be transported in its pipelines, its Rule 30 dated April 2009 explicitly states that gas from landfills will not be accepted or transported.

Addressing the needs for clearer standards, the Gas Technology Institute (GTI) is preparing a guidance document for the U.S. Department of Transportation, Pipeline and Hazardous Materials Safety Administration (PHMSA). The GTI proposal focuses on the analytical requirements of landfill and wastewater treatment renewable natural gas for safe and proper pipeline introduction into existing natural gas supplies. This effort will be similar to that prepared through the Guidance Document for Dairy Waste Conversion work.

Sustainable Feedstock Sourcing and Transportation

Sustainable and affordable supplies of biomass are critical to the long-term success of bioenergy. A common concern of investors seeking to build new or expanded capacity is the state of feedstock markets and the readiness of suppliers to enter into long-term feedstock contracts. In addition, fuel collection and transportation costs have remained an economic challenge to increasing use of agricultural, forestry, and dedicated crop biomass. Urban-derived biomass, which currently can benefit from tipping fees received by a collection and processing facility, may experience increased competition from soil amendment producers and ranchers,

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www.socalgas.com/regulatory/tariffs/tm2/pdf/30.pdf

75 *Standards for Gas Service in the State of California as Prescribed by the Public Utilities Commission of California General Order No. 58A*. California Public Utilities Commission, December 16, 1992. Available at: docs.cpuc.ca.gov/published/GENERAL_ORDER/54827.PDF

76 Kimberly Kemp, PG&E. *Staff Workshop 2010 Bioenergy Action Plan Transcript*, June 3, 2010. Page 135.

77 Gillian Wright, Director of Commercial and Industrial Services for Southern California Gas Company. *Staff Workshop 2010 Bioenergy Action Plan Transcript*, June 3, 2010. Page 153.

78 Utility gas rules can be found at:
www.pge.com/tariffs/tm2/pdf/GAS_RULES_21.pdf
www.sdge.com/tm2/pdf/GAS_GAS-RULES_GRULE39.pdf
www.socalgas.com/regulatory/tariffs/tm2/pdf/39.pdf

79 Paul Relis, CR&R. *Staff Workshop 2010 Bioenergy Action Plan Transcript*, June 3, 2010, Page 94.

and in the long term, lead to higher prices to the end user.[80] Smaller scale, distributed, or portable conversion facilities may not require long-term fuel contracts, but they still require stable supplies with adequate storage.

Biomass Collection and Transportation Issues

Many biomass resources are dispersed and/or seasonal. For dispersed feedstocks such as forestry residues, the cost of collection and transportation makes much of this material uneconomical. While some biomass such as MSW and landfill gas is available year-round, others such as agriculture and food processing residues are seasonal. Seasonal fuels may require storage facilities or plant downtime or incur additional expense when using alternative feedstocks in the offseason. These challenges make most bioenergy more expensive than the fossil fuels it replaces.[81]

In general, California's biomass sources are residues from activities such as timber harvesting, lumber milling, in-forest fuels reduction, agriculture and dairy operations, food processing, and urban forestry. Most of the feedstock cost is incurred during the collection, transportation, and processing of material. Although the resulting cost in terms of $/million BTU for biomass is often higher than fossil fuel, using in-state biomass for renewable energy has additional benefits. These benefits include reduced waste disposal problems, reduced frequency of catastrophic wildfires, reduced GHG emissions, and fossil fuel displacement.[82] Depending on how the feedstock is harvested, in-state biomass may also reduce water and soil pollution.

Collection of dispersed feedstock, such as forestry residues, is labor-intensive and expensive. However, in-forest fuel reduction activities can improve forest health and reduce the risk of catastrophic wildfires, and is therefore becoming more common. In-forest fuel reduction activities reduce biomass such as dead vegetation, low branches, and small trees. The collected biomass can then be used for energy production. Collaboration among state and federal forestry agencies and the biomass industry is needed to increase sustainable feedstock collection and cost-sharing.

Bioenergy project developers prefer fuel supplies located within 50 to 100 miles of the facility. Beyond this range, transportation costs are generally prohibitive. Although truck transport tends to be the most expensive form of transportation, it provides the greatest flexibility. In addition, truck transportation is often necessary to move biomass from collection points to the final destination or to rail or barge terminals. Generally, the costs of truck transport can range from $0.12 to $0.23 per ton-mile and are heavily dependent on the price of diesel.[83] Densification

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80 Williams, R.B. 2008. An Assessment of Biomass Resources in California, 2007. California Biomass Collaborative. CEC-500-2006-094-D. Page 14.

81 Williams, R.B. 2008. An Assessment of Biomass Resources in California, 2007. California Biomass Collaborative. CEC-500-2006-094-D. Page 25.

82 Orta, Jason, Zhiqin Zhang, and et. al. 2010. *2009 Progress to Plan - Bioenergy Action Plan for California.* California Energy Commission. CEC-500-2010-007. Page 23.

83 KEMA 2009, *Coal to Biomass Fuel Switching - Potential Biomass Contribution to the California RPS.* Unpublished memo to the California Energy Commission. Conversion factor used: 0.907 U.S. tons per. metric ton.

of woody material can reduce the cost of transporting material. However, at this time, densification technologies, including torrefaction[84] and pelletizing[85], add significantly to the feedstock cost. Additional work is needed to evaluate the feasibility of employing these technologies in California.

Transporting biomass over long distances via trains or in barges in locations near large waterways is typically less expensive on a per-mile or per-ton basis. However, additional handling and logistics often make this mode of transportation cost-prohibitive unless very long transport distances are involved.[86]

The California Biomass Collaborative estimates that 36 million tons per year of biomass feedstock are technically available;[87] however, the economically recoverable amount is likely far lower. Increasing the amount of economically recoverable fuel and improving collection and transportation infrastructure can improve the economies of scale for new bioenergy facilities.

Increasing the use of higher moisture organic biomass (such as food processing residues, food waste, and other high moisture organic material) as an energy feedstock will require a different supply chain model as compared to solid-fuel biomass. Supply chain studies using Integrated Analysis Models would help calculate total cost of different biomass materials and the option to site codigestion facilities.

Feedstock Sustainability Concerns

Sustainable resource management can be defined as using a resource to meet current needs while preserving the ability of the resource to meet future needs. Resources should be managed in a way that preserves their ability to continue providing the same level of benefit over time. Moreover, using resources to solve one problem should not create other problems, such as technologies or facilities that rely solely on waste feedstock creating a demand for waste.

In terms of energy, the harvest of "waste" biomass as a feedstock for the production of bioenergy must occur in a manner that protects the productivity and renewable nature of agricultural and forest ecosystems. Sustainable resource management includes reforestation and the replacement of agricultural soil nutrients. Extensive biomass removal may negatively affect soils productivity, carbon and nutrient cycles, biological diversity, wildlife and endangered species habitat, and hydrology, resulting in downstream flooding, stream siltation, and degraded water quality and fisheries.

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84 Torrefaction involves "roasting" woody biomass in a process that resembles roasting coffee beans, removing most the moisture from the wood.

85 Pelletizing consists of grinding woody material into sawdust then compressing it into pellets. Wood pellets are extremely dense. This allows them to be transported at low cost and combusted at a very high efficiency.

86 KEMA 2009, *Coal to Biomass Fuel Switching – Potential Biomass Contribution to the California RPS.* Unpublished memo to the California Energy Commission.

87 Williams, R.B. 2008. An Assessment of Biomass Resources in California, 2007. California Biomass Collaborative. CEC-500-2006-094-D.

Not all agricultural crop or forest management residue should be harvested. For example, some residues are needed to maintain soil fertility and tilth, or for erosion control. It is important to assess whether the economic and environmental costs of collecting and converting biomass to energy outweigh the benefits obtained from using a particular feedstock. This is best performed by comparing the life-cycle performance characteristics of various facilities, technologies, and feedstocks, and evaluating or estimating potential environmental effects.

The Energy Commission is required to "establish sustainability goals to ensure that alternative and renewable fuel and vehicle projects, on a full fuel-cycle assessment basis, will not adversely impact natural resources, especially state and federal lands." [88] In response to this statutory directive, the Energy Commission developed three sustainability goals to identify and promote transportation-related GHG reduction projects that are exemplary in sustainability and environmental performance.[89] These goals are:

1) "[S]ubstantial reduction of life-cycle GHG emissions associated with California's transportation system to help meet California's 2020 and 2050 targets as defined in Health and Safety Code Section 38550 and the Governor's Executive Order S-03-05.
2) . . . [P]rotect the environment, including all natural resources, from the effects of alternative and renewable fuel development and promote the superior environmental performance of alternative and renewable fuels, infrastructure, and vehicle technologies.
3) . . . [E]nhance market and public acceptance of sustainably produced alternative and renewable fuels by developing, promoting, and creating incentives for the production of such fuels in accordance with certified sustainable production practices and standards as established by government agencies, academic institutions, and nongovernmental organizations."[90]

Furthermore, sustainability assessments need to be conducted at the regional level as well as the project level to evaluate the effect of increased bioenergy crop production and integration with existing crop mix on food or animal feed production, agricultural water use, and wastewater discharges. In addition, studies are needed to measure water use and discharge for different types of biofuel production processes and bioenergy crops.[91]

Some stakeholders are concerned that feedstock may not be harvested sustainably. This concern led to the exclusion of forest biomass on national forests and other federal lands from the definition of renewable biomass in the federal Energy Independence and Security Act of 2007. This affects the availability of biomass feedstock for bioenergy. However, some members of Congress have called for an expansion of the definition to include woody biomass from federal

88 Baroody, Leslie, Charles Smith, Michael A. Smith, Charles Mizutani. 2010. 2*010-2011 Investment Plan for the Alternative and Renewable Fuel and Vehicle Technology Program Commission Report.* California Energy Commission, Fuels and Transportation Division. Publication Number: CEC-600-2010-001-CMF. Page 101.

89 Baroody, Leslie, Charles Smith, Michael A. Smith, Charles Mizutani. 2010. 2*010-2011 Investment Plan for the Alternative and Renewable Fuel and Vehicle Technology Program Commission Report.* California Energy Commission, Fuels and Transportation Division. Publication Number: CEC-600-2010-001-CMF. Page 101.

90 Ibid. Page 101.

91 Ibid. Page 103.

forests because this could help to pay for needed fuels reduction projects and other ongoing forest management activities, which is still being debated.

California agencies and stakeholders have been participating in national, regional, and state discussions about sustainability guidelines and principles, which will affect the availability of bioenergy feedstocks. Through the Interagency Forest Work Group, the Climate Action Team has been coordinating discussions, technical workshops and field trips to examine questions about carbon and environmental sustainability of forest biomass for application to the AB 32[92] *Climate Change Scoping Plan*, the Alternative and Renewable Fuel and Vehicle Technology Program, and the Low-Carbon Fuel Standard.

Economics and Financing

Financing bioenergy projects in California carries a high-risk premium to lending institutions. The premium is driven by return on investment uncertainty including the high costs to meet stringent regulatory standards. States like Colorado that have more favorable business environments are developing the type of bioenergy projects that are not occurring in California.

Between 2002 and 2008, biomass generation in the state decreased from 7,140 GWh,[93] to 5,730 GWh,[94] a 25 percent reduction. This demonstrates that the state's economic environment has not been conducive to increased biopower.

Existing Solid-Fuel Biomass Facilities

From an economic standpoint, maintaining California's existing renewable energy facilities is one of the best ways to reduce the cost of achieving the state's renewable energy and climate-change goals. In 2009, more than 12 percent of the state's renewable power and 60 percent of California's biopower was generated by solid-fuel biomass facilities that started operating before 1996. Production from these facilities represents 680 MW and 3,800 GWh in 2009.[95]

Since 1998, the California Energy Commission has offered financial support for these facilities through the Existing Renewable Facilities Program. This program will expire on January 1, 2012, without legislative reauthorization.

Most existing solid-fuel biomass facilities sell their generation under fixed-price contracts with an average annual energy price under $66 per MWh, with contract prices varying from under $25 per MWh to more than $70/MWh.[96] Most of these facilities receive additional payments for

92 Assembly Bill 32, the Global Warming Solutions Act of 2006 (Núñez, Chapter 488, Statutes of 2006).

93 Pan, Adam and Ron Wetherall. 2003. *2002 Net System Power Calculation.* California Energy Commission. CEC-300-03-002

94 Nyberg, Michael, 2009. *2008 Net System Power Report.* California Energy Commission. CEC-200-2009-010.

95 Generation and capacity reported to the California Energy Commission's Existing Renewable Facilities Program in 2009.

96 California Energy Commission's Existing Renewable Facilities Program. Most of the biomass facilities participating in the program are contracted with PG&E at their fixed price for qualifying facilities, which can be downloaded at: www.pge.com/b2b/energysupply/qualifyingfacilities/prices/index.shtml.

capacity during summer peak periods ranging from $30 per MWh to $60 per MWh. Biomass feedstock purchases are a major part of the operating cost of a biomass plant and can range between a third and half of the facility's operating cost, depending on feedstock sources.[97] Because solid-fuel biomass feedstock costs range between $20 and $60 per MWh,[98] without additional revenue, many of these facilities will be economically challenged.

Obtaining Project Financing

New project developers must show that their projects have a sufficient rate of return on investment to obtain financing. In general, higher risk projects require developers to demonstrate a higher rate of return or provide more capital for the project. Risk factors include uncertainty over availability and price of biomass fuel supplies, technology, revenue, and governmental policy and regulatory uncertainty (that is, lack of clear signal regarding price of carbon credits and regulatory and permitting uncertainty).[99]

Generally, lenders will not carry the risk associated with permitting or utility interconnection and will require project developers to have state and local permits and utility interconnection agreements in hand before agreeing to finance the project. This requires the developer to have sufficient capital to permit and interconnect a new project.[100]

Risks associated with revenues include adequacy of the contract price to achieve a desired rate of return and price volatility. For projects pursuing feed-in tariff contracts, the price is statutorily set at the market price referent (MPR).[101] The MPR represents the cost, over a 10-, 15-, 20-, or 25-year period, to own and operate a new combined cycle natural gas facility. The CPUC determines the MPR once utilities complete RPS solicitations. The purpose of the MPR has evolved over the years and is now considered a cost containment mechanism, not a per se reasonableness benchmark for renewable energy contracts

Although contract prices are fixed for the life of the contract (that is, do not change with a new MPR), because the MPR is based on projections of future natural gas prices, which historically have been volatile, project developers pursuing feed-in tariff contracts may not accurately project the future MPR. Failure to accurately predict how the MPR will evolve limits the ability of project developers to accurately determine their rate of return on a future project.

Increasing return-on-investment can improve the financial outlook of many projects. Government programs have attempted to accomplish this through direct monetary incentives for production, fuel subsidies, grants, loans, bonds, and tax credits. However, the use of fluctuating incentives distorts the economics of bioenergy projects and creates uncertainty when public policies shift. Both existing and new bioenergy projects would benefit from greater

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97 Phil Reese, California Biomass Energy Alliance. *Staff Workshop 2010 Bioenergy Action Plan Transcript*, June 3, 2010, page 27.

98 California Energy Commission's Existing Renewable Facilities Program.

99 Ted Kniesche, Fulcrum Energy. *Staff Workshop 2010 Bioenergy Action Plan Transcript*, June 3, 2010, page 187.

100 Ibid. Page 56.

101 The MPR represents the levelized price at which the proxy natural gas combined cycle gas turbine (CCGT) revenues exactly equal the expected proxy CCGT costs on a net-present value basis.

certainty if contract prices directly reflected the public benefits rather than relying on public funding.

Effect of Uncertain Biomass Feedstock Market on Project Financing

Whether looking to restart or expand an existing facility or construct a new facility, bioenergy developers seeking financing must show that the project has long-term access to reliable and affordable feedstock sources. Without long-term feedstock commitments, securing financing is more difficult and less likely.

Lenders are looking for projects with "bankable" feedstock supplies, or sustainable fuel from creditworthy suppliers with long-term contracts.[102] In addition, suppliers must be able to back up their agreements with a "sufficient" balance sheet showing historic fuel supply levels. Unfortunately, most fuel suppliers cannot back up their feedstock supply with a long balance sheet.[103]

Funding for Research and Development

Many existing and emerging challenges to bioenergy will require additional research and development. Research is needed to advance the next generation of bioenergy technologies, to develop economical air pollution control equipment for small-scale generators, to improve performance of small and large scale biopower systems, to develop biomass feedstock sustainability standards, and to measure the carbon benefits of different biomass feedstock used for energy production.

Many of the environmental challenges associated with current bioenergy technologies may be reduced or resolved through the development and commercialization of next generation technologies. These technologies have strong potential to assist California in meeting and exceeding many environmental and energy infrastructure goals. To support this achievement, significant investment from the private and public sectors is needed.

The goal of research and development is to improve performance and advance technologies so that they can be commercialized. While many technologies are being developed to address current challenges, facilities will still require access to sustainable feedstock.

Biomass-to-Methane and SNG Conversion Technologies

Converting biomass and biogas to pipeline quality biomethane provides the opportunity for gas injection into the natural gas pipeline, or compressing or liquefying the gas for use as a compressed or liquid transportation fuel. Biomethane offers an effective way to increase renewable energy usage and displace natural gas. Biomethane can be produced by upgrading biogas from digesters and landfills. It is also possible to make a synthetic natural gas from gasification followed by gas reforming and methane synthesis (though these systems are in the developmental stage).[104]

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102 Kevin Best, Real Energy. *Staff Workshop 2010 Bioenergy Action Plan Transcript*, June 3, 2010, page 136.

103 Stephen Hawkins, Millennium Energy. *Staff Workshop 2010 Bioenergy Action Plan Transcript*, June 3, 2010, page 104.

104 *Advanced Technology to Meet California's Climate Goals: Opportunities, Barriers & Policy Solutions.* ETAAC Advanced Technology Sub-Group. December 14, 2009. Page 4-11.

While anaerobic digestion is commercially available, it is generally limited to high moisture (non-woody) feedstocks such as food processing and dairy residues and certain biodegradable components of the MSW stream. Thermochemical processes are well-suited to convert dry, lignin-rich biomass such as forest residues, straw and orchard prunings, and major portions of the MSW stream. In the United States, gasification and pyrolysis of biomass have been under development for many years but are not yet widely commercialized.

Challenges specific to thermochemical conversion technologies include high capital cost, the need for demonstration facilities, potential emissions, cost and reliability of downstream gas treatment and catalyst systems, and incorrect technology definitions in statute (discussed in the next section).

Low-Emission Microgeneration Technologies

Microgeneration technologies are typically sized less than one megawatt and service on-site combined heat and power (CHP) needs. On-site generation of electricity has many potential benefits including lower fuel costs, limiting transmission congestion, avoiding the need to build new long distance transmission, energy storage, and demand response capability. Dairies, orchards, and food processing facilities are well suited for placement of small-scale generators that use process residues as a fuel source. However, many of these projects cannot economically meet air quality standards using current technology. More research and development are needed to help bring down the cost of low-emission generation technologies such as fuel cells, microturbines, and Stirling engines.

Fuel cells are one of the easiest, but most expensive, microgeneration technologies to site, owing to their quiet operation, low emissions, high efficiencies, and modular design. High-temperature fuel cells may be suited for certain CHP applications. Research is needed to increase fuel flexibility, improve reliability, increase stack life, improve fuel reformer design, reducing size and system complexity, and develop low-cost material alternatives.[105]

Extensive microturbine research and demonstration projects are underway. In recent years, research has focused on using microturbines in CHP applications, focusing on improving microturbine efficiencies and fuel flexibility. Microturbine manufacturers have promised cost reduction with higher rates of production and sales, but to date, significant cost reductions have not materialized. Despite the extensive research to date, additional research is needed into cycle enhancement to address loss of power output and efficiency at higher ambient temperatures and elevation. Further, opportunities exist for improving microturbine efficiency by pairing microturbines with fuel cells.[106]

Another emerging microgeneration technology is the Stirling engine, which is a type of external combustion engine. These engines can achieve lower emissions than reciprocating internal combustion engines. Stirling technology has not undergone a robust research and development phase, which contributes to its lack of proven operation and durability. Further, these engines are manufactured in very low quantities, resulting in a high and variable capital cost – ranging

105 Contreras, Jose Luis, David Walls, Erin Palermo, David Feliciano (Navigant Consulting, Inc.). *Advanced Generation Roadmap Background Paper,* 2009. California Energy Commission, PIER Program. CEC-500-2009-086. Page 24.

106 Ibid. Page 47.

from $2,000 – $50,000 /kW. More research is needed focusing on creating pre-packaged systems and addressing costs and reliability.[107]

Biomass to Biofuels Conversion Technologies

Liquid fuels will continue to be needed to meet California's transportation needs. Due to the Federal Renewable Fuel Standard and California's Low-Carbon Fuel Standard (LCFS), renewable and low-carbon liquid biofuels will play an increasing role in meeting this need. These regulations will require the continued use of current biofuels technologies (sugar, starch fermentation, and vegetable oil transesterification[108]) and increased use of cellulosic and other advanced biofuels. The LCFS has different standards for biofuel use than the federal government, and current biofuels (especially corn grain ethanol) are not useful for meeting LCFS requirements.

A variety of advanced biofuels technologies are being pursued, including both biochemical and thermochemical processes (and sometimes integrating platforms), to produce biomethanol, ethanol, biobutanol, mixed alcohols, biocrude, and "renewable gasoline and diesel," which can be used in existing vehicles without modification as well as in petroleum fuel production and distribution systems. This portfolio of current and advanced gasoline substitute biofuels is the foundation for the strategy to establish increasing use of low-carbon renewable and alternative fuels by the 2020 to 2022 time frame.[109]

At the federal level, the U.S. Department of Energy (DOE), through the national laboratories and a number of universities, is promoting the development of cellulosic ethanol. This development is occurring through broad research and development support for developing more efficient enzymes and ethanol-fermenting organisms, conducting studies to improve technical processes, and cofunding initial demonstration facilities.[110] These efforts are aimed at reducing the cost of processing cellulosic ethanol while ensuring the validity of the technology.

The availability of a significant market is also crucial for cellulosic ethanol to become commercialized in California. For a robust cellulosic ethanol market to develop, government policies promoting price and market stability are needed. Competition with markets such as the highly subsidized and mature Midwest starch-ethanol industry disadvantages the relatively unsubsidized cellulosic ethanol industry.[111]

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107 Contreras, Jose Luis, David Walls, Erin Palermo, David Feliciano (Navigant Consulting, Inc.). *Advanced Generation Roadmap Background Paper,* 2009. California Energy Commission, PIER Program. CEC-500-2009-086.. Page 44.

108 The main reaction for converting oil to biodiesel is called transesterification. The transesterification process reacts an alcohol with the triglyceride oils contained in vegetable oils, animal fats, or recycled greases, forming fatty acid alkyl esters (biodiesel) and glycerin.

109 Baroody, Leslie, Charles Smith, Michael A. Smith, Charles Mizutani. 2010. 2*010-2011 Investment Plan for the Alternative and Renewable Fuel and Vehicle Technology Program Commission Report.* California Energy Commission, Fuels and Transportation Division. Publication Number: CEC-600-2010-001-CMF. Page 55.

110 www1.eere.energy.gov/biomass/pdfs/37092.pdf. Page 1

111 www.library.ca.gov/crb/05/10/05-010.pdf. Page 18.

Today, algal-based production of biofuels is not economical.[112] Commercialization of this technology will require significant research and development to advance a range of technical constraints including strain/biological research, process improvements, production scale, and economic analysis. To advance this research and development, the DOE has provided grants to a number of research institutions including $24 million to UC San Diego,[113] and $9 million to UC Irvine.[114]

Statutory and Regulatory Issues

Financial Incentives for Existing Solid-Fuel Biomass Expire

The biomass industry receives financial assistance from California's Renewable Energy Program. Under this program, production incentives are offered to existing solid-fuel biomass and solar thermal facilities that began commercial operation before September 26, 1996, when market prices are below a specific target price. The authorization for the collection and expenditure of the funding for the Renewable Energy Program—California's public goods charge—is scheduled to end January 1, 2012.[115] While the Energy Commission has deemed other existing renewable technologies competitive, existing solid-fuel biomass facilities continue to struggle in the marketplace. Many biomass facility operators contend that they cannot operate at their current levels without financial assistance.

According to industry representatives, existing biomass cannot compete effectively with other renewables because, unlike other renewables, biomass facilities must procure their fuel and transport it to the facility. Fuel procurement and transportation costs average $20 to $60 per MWh. In addition, wind and solar receive higher federal tax incentives than biomass technologies. The financial challenge facing these plants is evidenced by two more biomass facilities closing in 2009.

The Energy Commission will seek reauthorization of the Renewable Energy Program.

Public Interest Energy Research Expires

Since 1998, the Energy Commission's Public Interest Energy Research Program (PIER) has funded 41 bioenergy research and development projects and studies, and additional research and development initiatives are called for in the *2011 Plan*. Funding for this program is also tied to the collection of public goods charge funds, which expires in 2012. The Energy Commission will seek reauthorization of the PIER Program in 2011.

Municipal Solid Waste Conversion to Renewable Electricity

Although the Energy Commission defines MSW as a renewable feedstock for electricity production (despite containing significant portions of fossil-derived material), current law

112 www1.eere.energy.gov/biomass/pdfs/algalbiofuels.pdf. Page 2.

113 apps1.eere.energy.gov/news/progress_alerts.cfm/pa_id=359.

114 www.universityofcalifornia.edu/news/article/23631.

115 Section 399.8 (c) (1) of the Public Utilities Code states, "The commission (California Public Utilities Commission) shall require each electrical corporation to identify a separate rate component to collect revenues to fund energy efficiency, renewable energy, and research, development and demonstration programs authorized pursuant to this section beginning January 1, 2002, and ending January 1, 2012."

narrowly defines the operational parameters that conversion technologies must meet to be eligible for the RPS. To date, no MSW conversion technology has met these requirements, particularly the requirement that the conversion process occur without the use of air or oxygen except ambient air to maintain temperature control.[116]

Since 2006, the Bioenergy Interagency Working Group has advocated the need to "[a]mend existing law to revise existing technology definitions and establish new ones, where needed. In particular, review the definitions of gasification, transformation, fermentation, pyrolysis, and manufacturing. Such statutory clarification would enable the utilization of biomass residues [from the waste stream for electricity production] through combustion or non-combustion technology."[117] The Working Group recommends statutory clarification as well in the *2011 Plan*.

There have been a number of legislative proposals to change the law; the most recent was AB 222 of the 2009-10 legislative session.[118] This bill sought to repeal statutory restrictions on conversion technologies using MSW feedstocks, requiring instead that implementation of the technologies meet the same public health standards for similar energy production projects. Opponents to the use of MSW as a feedstock for electricity production cite concerns over toxic air pollutants, reductions in recycling and composting programs, and the possibility of creating a "need for waste." Proponents state that there are proven technologies that can meet all of California's air quality standards and do not interfere with recycling goals.

The Energy Commission, ARB, and CalRecycle wrote a letter in support of AB 222. In their support letter, the state agencies stated, "New conversion technologies would assist California in developing local fuel sources as part of the Low Carbon Fuel Standard (LCFS) thereby making better use of resources and providing other [societal and environmental] benefits."

The state agencies also concluded that "AB 222 supports innovation and the introduction of a range of new technologies for production of biofuels and renewable energy from organic wastes that meets California's environmental standards. Additionally, because only post-recycled waste materials will be used, AB 222 would not weaken the state's policy on recycling. In 2008 alone, an estimated 39.7 million tons of municipal waste were deposited into California landfills when this material could instead be used for energy generation and low-carbon fuel production."

Unfortunately, AB 222 did not receive a floor vote in the legislature and was redrafted for an unrelated purpose.

Assembly Bill 2770[119] required the California Integrated Waste Management Board to report on new and emerging conversion technologies and their impacts on recycling and other diversion

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116 California Energy Commission, *2009 Integrated Energy Policy Report*, Final Commission Report, December 2009, CEC-100-2009-003-CMF. Pages 74-75.

117 Bioenergy Interagency Working Group, *Bioenergy Action Plan for California,* July 2006, CEC-600-2006-01. Page 9.

118 Assembly Bill 222, Adams and Ma. Bill significantly amended to remove energy related content. The final bill was subsequently chaptered as a childcare bill as Assembly Bill 222, Adams, Chapter 431, Statutes of 2010.

119 Assembly Bill 2770, Mathews, Chapter 740, Statutes of 2002.

activities.[120] One of the findings of the report was that "there is a projected net positive impact on glass, metal, and plastic recycling under the "base case" conversion technology scenarios in life cycle/market impact study."[121]

Pipeline Injection of Landfill Gas

Injecting biomethane into the pipeline allows the use of this resource without affecting air quality in non-attainment districts. However, pipeline injection of biomethane from landfills is currently prohibited even if the gas is treated to meet health and safety standards.[122] The regulatory hurdles relating to landfill gas injection were imposed by Assembly Bill 4037 (Hayden, Chapter 932, Statutes of 1988),[123] but the implementation is through CPUC regulations. The statute effectively precludes landfill gas from being introduced into the pipeline from in-state sources. However, PG&E has accepted natural gas delivered from interstate pipelines that may include landfill gas supplied from out-of-state sources. Sacramento Municipal Utility District recently published a press release stating that it has a 15-year contract to purchase landfill gas produced in Texas.[124]

Currently, excess landfill gas must be flared, and some estimate that as much as 50 percent of the total amount of methane captured at landfills across the state is flared.[125] According to the U.S. EPA, candidate[126] and potential landfills for power generation could generate up to 1,500 GWh/year if utilized in an efficient combined cycle gas turbine.[127]

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120 *New and Emerging Conversion Technologies Report to the Legislature.* 2007. California Integrated Waste Management Board. Page 6.

121 *New and Emerging Conversion Technologies Report to the Legislature.* 2007. California Integrated Waste Management Board. Page 74.

122 Chuck White, Waste Management. *Staff Workshop 2010 Bioenergy Action Plan Transcript*, June 3, 2010. Page 147. Additionally, gas quality tariff rules of PG&E, SDG&E and SoCalGas explicitly state that they do not accept landfill gas.

123 The statute added Section 25421(a) to the California Health and Safety Code, which states that "no gas producer shall knowingly sell, supply, or transport landfill gas to a gas corporation, and no gas corporation shall knowingly purchase landfill gas, if that gas contains vinyl chloride in a concentration that exceeds the operative no significant risk level set forth in Article 7 (commencing with Section 12701) of Chapter 3 of Division 2 of Title 22 of the California Code of Regulations."

124 *SMUD to Purchase Green Gas from Texas*. SMUD press release. http://www.smud.org/en/news/Documents/09archive/texas-gas-4-15-09.pdf

125 Chuck White, Waste Management. *Staff Workshop 2010 Bioenergy Action Plan Transcript*, June 3, 2010. Page 166.

126 The U.S. EPA's Landfill Methane Outreach Program defines a candidate landfill as one that is accepting waste or has been closed for five years or less, has at least one million tons of waste, and does not have an operational or under-construction project; candidate landfills are also designated based on actual interest or planning.

127 Assumes 300 scfm of LFG is available for utilization for every million tons of WIP. Methane content of LFG is 50 percent. Methane heat content is 1,012 Btu/scf methane. Weighted average heat rate for LFG-fired engines, turbines, and boiler/steam turbines is 11,700 Btu/kWh. Capacity Factor of 60 percent. (www.epa.gov/lmop/projects-candidates/interactive.html)

CHAPTER 5:
A Bioenergy Action Plan for California

As discussed in Chapter 4, there are a large number of challenges facing bioenergy development in the state. For the *2011 Plan*, the Working Group built on the *2006 Plan* and identified actions that state agencies could take as the next step, with the goal of a meaningful increase in bioenergy development. To promote development and meet the *2011 Plan*'s objectives, additional state action may be necessary. Recommendations for additional state actions will be discussed in Chapter 6: Recommendations for Additional State Actions. (Recommendations to be developed following December public workshop.)

This chapter describes the actions developed by the Working Group to address the most significant challenges to bioenergy development.

1. Actions Addressing Siting, Permitting, and Regulation

1.1. Web-Based Portal for Permitting Guidance and Information

Coordination among state and local permitting agencies can streamline the permitting timeframe and reduce developer costs. New biomass projects must acquire various local and state permits, which are critical to obtain project financing. In general, lenders will not consider financing a new project in California until the project has obtained all necessary permits because of the uncertainty and cost of the permitting process. In addition, finding permit information can be a daunting task for both large- and small-scale developers.

To assist new project developers with guidance to obtain permits, the Working Group will form a subcommittee to develop a comprehensive Web-based portal for permitting guidance, links, and contacts to permitting agencies.

Lead Agency: TBD
Desired Outcome: Improve developer access to permitting guidance and contact information.
Related Plan Objective: Construct new bioenergy facilities.
Completion Date: September 30, 2011.

1.2. Address Interconnection Challenges for Bioenergy-Based Distributed Generation

The interconnection process can pose challenges for biopower developers. Some biopower developers may choose not to develop projects due to complications of obtaining utility interconnection for biopower projects. The interconnection process includes both obtaining permission for generation equipment interconnection to the utility grid (determined by each utility's Rule 21 and WDAT tariffs), as well as determining the customer's tariff (such as Net Energy Metering or Feed in Tariff). In some cases, the interconnection review process may require utility interconnection studies and fees, that vary depending on the size of the generator, the unique characteristics of the generating technology, or the utility's distribution system characteristics in that local area. Because of the uncertainties around interconnection, it is challenging for bioenergy developers to know upfront the length of time to interconnect or the total cost of interconnection.

The California Public Utilities Commission (CPUC) will work with the Energy Commission to review the Rule 21 tariff interconnection processes for bioenergy projects. The CPUC has indicated that Rule 21 issues will be handled in Rulemaking (R) 10-05-004. There may be a need to convene stakeholders to discuss the specific interconnection issues that affect bioenergy projects.

Lead Agency: CPUC.
Desired Outcome: Streamline interconnection processes for developers of bioenergy distributed generation projects.
Related Plan Objective: Construct new bioenergy facilities.
Completion Date: December 31, 2012.

1.3. Funding for New Fuel Source Testing

Biopower facilities seeking to switch or add a new fuel source may be required to pay for source testing to show that the new fuel will meet the air emissions limits for the local air district. The cost for this testing can be cost-prohibitive for small developers.

To offset the cost for source testing, the Air Resources Board (ARB), with the Energy Commission, will conduct a stakeholder process to identify "new" biomass feedstocks for conversion technologies and seek funding to support source testing for distributed generators. Source test data would be made available to local air districts.

Lead Agency: ARB.
Desired Outcome: Reduce cost-of-compliance to small developers that use new feedstocks or technologies.
Related Plan Objective: Construct new bioenergy facilities.
Completion Date: June 30, 2012.

1.4. AB 1318 – Wildfire Emissions Offset Credits for PM

Emission reduction credits (ERCs) must be obtained for power plants proposed in areas that do not attain the ambient air quality standards. In the South Coast Air Quality Management District (SCAQMD), ERCs for particulate matter (PM) are very scarce and expensive. In some cases, even the cleanest natural gas-fired power plants have been unable to identify traditional sources of PM ERCs. The avoidance of PM emissions from wildfires that results from forest health and hazardous fuels reduction programs should be evaluated as non-traditional and innovative sources of PM ERCs.

The ARB will work with the Energy Commission, Cal Fire, U.S. Forest Service, and local air pollution control districts to evaluate forest health and hazardous fuels reductions programs as a non-traditional and innovative source of PM ERCs in the SCAQMD and other non-attainment areas of California.

Lead Agency: ARB.
Desired Outcome: Additional PM ERCs in the South Coast AQMD.
Related Plan Objective: Construct new bioenergy facilities.
Completion Date: June 30, 2012.

1.5. Revisit Restrictions on the Injection of Biomethane Derived from Landfill Gas

Pipeline injection of biomethane from landfills is currently prohibited even if the gas is treated to meet health and safety standards.[128] The prohibition on landfill gas injection stretches back to Assembly Bill 4037,[129] which requires landfill gas producers to sample and test landfill gas product gas twice a month. Both the gas producer and the associated gas corporation (gas pipeline operator) are subject to a fine of $2,500 per day for any known failure to meet the specified levels of vinyl chloride in the biomethane delivered by the gas producer to the gas corporation.

The statute effectively precludes landfill gas from being introduced into the pipeline from in-state sources. Currently, excess landfill gas not used to generate electricity on-site must be flared, and there are estimates that as much as 50 percent of the total methane captured at landfills across the state is flared.[130] To increase the beneficial use of landfill gas, the state should revisit the injection of biomethane derived from landfill gas.

The Energy Commission, ARB, CalRecycle, and CPUC will work with California gas utilities through a public process to address and resolve barriers to introducing landfill gas into the California natural gas pipeline.

> **Lead Agency:** Energy Commission.
> **Desired Outcome:** Increased use of landfill gas.
> **Related Plan Objectives:** Increase bioenergy production at existing facilities; construct new bioenergy facilities; development of next generation technologies.
> **Completion Date:** December 31, 2012.

2. Actions Addressing Sustainable Feedstock Challenges

2.1. Sustainability Standards for Biomass Feedstock Sourcing

The Energy Commission, ARB, and Cal Fire will continue to work with the Interagency Forestry Working Group to assess and define sustainability standards for biomass feedstock sourcing.

> **Lead Agency:** Energy Commission.
> **Desired Outcome:** State standards defining sustainability that can be used to identify sustainable sources of biomass feedstock.

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128 Chuck White, Waste Management. *Staff Workshop 2010 Bioenergy Action Plan Transcript*, June 3, 2010. Page 147.

129 Hayden, Chapter 932, Statutes of 1988. The statute added Section 25421(a) to the California Health and Safety Code, which states that "no gas producer shall knowingly sell, supply, or transport landfill gas to a gas corporation, and no gas corporation shall knowingly purchase landfill gas, if that gas contains vinyl chloride in a concentration that exceeds the operative no significant risk level set forth in Article 7 (commencing with Section 12701) of Chapter 3 of Division 2 of Title 22 of the California Code of Regulations."

130 Chuck White, Waste Management. *Staff Workshop 2010 Bioenergy Action Plan Transcript*, June 3, 2010. Page 166.

Related Plan Objectives: Increase bioenergy production at existing facilities; construct new bioenergy facilities by increasing forest biomass feedstocks.
Completion Date: December 31, 2012.

2.2. Increase Use of Forest Biomass Harvested for Wildfire Fuel Reduction

Collection of dispersed feedstock, such as forestry residues, is a labor intensive and expensive process. However, the collection and treatment of these residues have many benefits such as wildfire risk reduction, and improved forest health. Collaboration among state and federal forestry agencies and the biomass industry could increase sustainable feedstock collection and provide an opportunity to share the cost of collection and transportation.

The Board of Forestry and Fire Protection is developing a Modified Timber Harvest Plan (THP) for Fuels Management, which prescribes standards for harvesting forest fuels that landowners can use to facilitate plan preparation and regulatory compliance. Cal Fire administers this THP process. The Board and Cal Fire are developing the Modified THP with input from other agencies, such as the Department of Fish and Game, to ensure that biomass fuel harvest activities protect the environment and are sustainable.

Lead Agency: Board of Forestry and Fire Protection.
Desired Outcome: A modified timber harvest plan that will increased access to affordable and readily available feedstock from wildfire hazard reduction and forest health activities.
Related Plan Objectives: Increase bioenergy production at existing facilities; construct new bioenergy facilities.
Completion Date: December 31, 2011

2.3. Public Education and Outreach

The Board of Forestry and Fire Protection and Cal Fire will provide training workshops for Cal Fire staff to implement the 2010 Strategic Fire Plan to assist communities, local agencies and citizen groups such as Fire Safe Councils in reducing wildfire hazards and damages, including hazardous fuel removal. Trainings will improve identification of priority areas for fuels treatments and education about wood biomass treatments.

Lead Agency: Cal Fire.
Desired Outcome: Increased treatment of priority hazardous fuels which will improve community safety and forest health while generating woody biomass waste materials for energy production.
Related Plan Objectives: Increase bioenergy production at existing facilities; construct new bioenergy facilities.
Completion Date: December 31, 2011.

2.4. Web-Based Database of Biodegradable Waste for Codigestion at Wastewater Treatment Plants

- The Energy Commission's Public Interest Energy Research (PIER) Program will commit research dollars and work with the California Biomass Collaborative, the Department of Food and Agriculture, and industry associations to update and renew an existing Web-based database to provide location, volume, quality, and seasonality of biodegradable waste suitable for codigestion at wastewater treatment plants. The database will include waste from California's agriculture, food processing, and dairy industries.

Lead Agency: Energy Commission.
Desired Outcome: Updated and accessible public data source for regional operators to determine feedstock locations and seasonal variations.
Related Plan Objectives: Construct new bioenergy facilities; increase the development of integrated bioenergy facilities.
Completion Date: December 31, 2012.

- CalRecycle will work with the Energy Commission and the California Biomass Collaborative to integrate locations of post-consumer food waste into the Web-based database.

  Lead Agency: CalRecycle.
  Desired Outcome: Extend the scope of the database to include locations of post-consumer food waste in the data set.
  Related Plan Objectives: Construct new bioenergy facilities; Increase the Development of Integrated Bioenergy facilities.
  Completion Date: 2012.

2.5. Increase Energy Production From Urban Derived Biomass

The RPS does not explicitly differentiate the organic fraction of the waste stream from non-organic materials when considering if energy produced from the feedstock is an eligible renewable resource. Instead, in practical terms, feedstock eligibility for the RPS depends on the path on which the material is taken to the biopower facility. For example, a branch collected from an orchard and transported directly to a biomass facility is an RPS-eligible feedstock for any conversion or combustion process. However, if the branch travels first to a regulated municipal solid waste facility, the branch may be considered MSW. According to the current RPS guidelines and statutory restrictions, if the branch is considered MSW, it may only be converted to energy using a conversion process that meets the strict statutory restrictions for the purposes of the RPS. No thermochemical conversion process has met these restrictions in practice.

- The Energy Commission will work with CalRecycle to determine if urban derived biomass (the organic fraction of solid waste not derived from fossil fuel) separated from municipal solid waste can be considered biomass for the RPS. If necessary, the Energy Commission will clarify biomass eligibility in the *Renewables Portfolio Standard Eligibility Guidebook*.

  Lead Agency: Energy Commission.
  Desired Outcome: Clarify RPS eligibility guidelines that readily identifiable and separable biomass feedstock that may have entered the waste stream is an RPS eligible feedstock.
  Related Plan Objectives: Increase bioenergy production at existing facilities; construct new bioenergy facilities; development of next generation technologies.
  Completion Date: June 30, 2011.

- The Energy Commission will continue to work with CalRecycle to determine if the remaining organic fraction of municipal solid waste should be considered biomass for the purposes of the RPS and, if necessary, identify changes to statute and/or regulation to allow the use in the RPS.

Lead Agency: Energy Commission.
Desired Outcome: Allow the organic fraction of MSW not derived from fossil fuel that is recovered and converted to electricity to be eligible for RPS credits.
Related Plan Objectives: Increase bioenergy production at existing facilities; construct new bioenergy facilities; development of next generation technologies
Completion Date: December 31, 2012.

- The Energy Commission, in partnership with the CalRecycle, and the ARB will provide technical review of proposed legislation that refines or removes the definition of MSW conversion and biomass conversion in statute.

  Lead Agency: Energy Commission, CalRecycle, ARB.
  Desired Outcome: Provide technical review of proposed legislation that will allow technologies that convert post-recycled material into electricity to be eligible for the RPS and eliminate technology restrictions in statute.
  Related Plan Objectives: Increase bioenergy production at existing facilities; construct new bioenergy facilities; development of next generation technologies.
  Completion Date: December 31, 2012.

2.6. Support Deployment of Anaerobic Digestion Projects

CalRecycle has adopted Strategic Directives that support the development of anaerobic digester facilities; one directive seeks to reduce by 50 percent the amount of organic waste disposed in the state's landfills by 2020, and another seeks to promote the in-state development of biofuels and bioenergy. One of CalRecycle's charges under the *AB 32 Climate Change Scoping Plan* is to evaluate and promote the development of anaerobic digestion facilities, with a goal of reducing landfill methane emissions by 2 $MMTCO_2E$ by 2020.

To support the deployment of anaerobic digestion projects in California, the following actions will be taken:

- CalRecycle will prepare a Program Anaerobic Digestion Environmental Impact Report.
- CalRecycle will participate in the Technical Advisory group of the Central Valley Regional Water Quality Control Board's Statewide Program Environmental Impact Report for Anaerobic Digestion facilities.
- CalRecycle will participate in the Advisory Committee for the California Energy Commission's Alternative and Renewable Fuel and Vehicle Technology Program (AB 118).
- CalRecycle will provide technical reviews of relevant anaerobic digester project proposals submitted under the AB 118 program.
- CalRecycle will work with the Air Resources Board to incorporate anaerobic digester into the state's Low Carbon Fuel Standard.
- CalRecycle will work with the California Pollution Control Financing Authority to help anaerobic digestion project proposals obtain funding.
- CalRecycle will work with the California Biomass Collaborative to provide technical support for anaerobic digestion projects.
- CalRecycle will participate on technical workgroups convened by the Climate Action Reserve to develop or modify protocols, such as the Organic Waste Digestion Project Protocol, for projects that divert and digest organic waste that otherwise would have gone to solid waste landfills.

- CalRecycle will update guidance documents that outline how CalRecycle regulations are applied to anaerobic digester and the statutory requirements that CalRecycle and Local Enforcement agencies have regarding anaerobic digester when solid waste is used as a feedstock.

  Lead Agency: CalRecycle
  Desired Outcome: Reduce by the amount of organic waste disposed in the state's landfills by promoting in-state development of biofuels and bioenergy projects.
  Related Plan Objective: Construct new bioenergy facilities; Development of Integrated Bioenergy Facilities; Development of next generation technologies.
  Completion Date: December 31, 2012.

3. Actions Addressing Economics and Financing Challenges

3.1. Ensure Continued Operation of Existing Biomass Facilities After Contract Expiration

Most existing biopower facilities sell their generation under fixed price contracts with an average annual energy price under $66 per MWh, which is applied towards the facility's fixed and variable plant operating costs. Biomass feedstock is a major part of the operating cost of a biomass plant and can range between a third and half of the facility's operating cost.[131] Because solid-fuel biomass feedstock costs range between $20 and $60 per MWh,[132] without additional revenue, many of these facilities will likely shut down.

- The Energy Commission will explore options to ensure that existing biomass facilities continue to operate through the continuation of the Existing Renewable Facilities Program. However, contract renegotiations must be considered as a long-term solution.

  Lead Agency: Energy Commission.
  Desired Outcome: Continued operation and/or increased production at existing solid fuel biomass facilities.
  Related Plan Objective: Increase and/or maintain bioenergy production at existing facilities.
  Completion Date: December 31, 2012.

- The CPUC will work with the utilities and existing solid-fuel biomass facilities to ensure streamlined, quick, and fair processes through which they may renegotiate expiring contracts.

  Lead Agency: CPUC.
  Desired Outcome: Renegotiated contracts that provide for the continued operation and/or increased production at existing solid fuel biomass facilities.
  Related Plan Objective: Increase and/or maintain bioenergy production at existing facilities.
  Completion Date: December 31, 2012.

131 Phil Reese, California Biomass Energy Alliance. *Staff Workshop 2010 Bioenergy Action Plan Transcript*, June 3, 2010. Page 27.

132 California Energy Commission's Existing Renewable Facilities Program.

3.2. Alternative Fuel Investment Plan

Despite clear policies developed to promote biofuel production in California, much of the in-state production capacity is now idle. California biofuel plants supplied 48 million gallons of gasoline equivalent (gge), of California's estimated 680 million gge ethanol demand in 2009, far below the 2010 biofuel goal of 135 million gge per year. In addition, ARB staff estimates that 18 new cellulosic biorefineries, 6 corn ethanol biorefineries, and 6 new biodiesel or renewable diesel refineries could be needed by 2020 to meet the increased demand for low-carbon biofuels.

To promote restarting or retooling existing biofuel plants, and to promote development of new in-state production capacity, the Energy Commission will develop and implement funding programs through the Alternative Fuels Investment Plan.

As part of the Alternative Fuels Investment Plan, the Energy Commission will do the following:

- The Energy Commission will allocate funding through fiscal year 2011 to support feasibility studies for low-carbon cellulosic ethanol feedstock, including feasibility studies of modifications to existing plants.
- The Energy Commission will fund research to improve conversion efficiencies of cellulosic biofuels derived from straw, corn stover, timber processing residues, and the organic fraction of MSW.

Lead Agency: Energy Commission.
Desired Outcome: Research results that will lead to reduce cost and greater efficiencies for advanced biofuel technologies.
Related Plan Objectives: Increase bioenergy production at existing facilities; construct new bioenergy facilities; development of next generation technologies.
Completion Date: December 31, 2012.

3.3. Implementation of Feed-In Tariffs for Renewable Projects

Small bioenergy developers, especially those whose main business is not energy production, could benefit from a simple and streamlined procurement tool that offers a price high enough to provide incentives for new development.

The CPUC will continue to work on implementing and expanding feed-in tariffs for renewable energy projects through implementation of the SB 32 feed-in tariff and the proposed Renewable Auction Mechanism for projects up to 20 MW.

Lead Agency: CPUC.
Desired Outcome: Streamlined procurement mechanism for new and repowered bioenergy facilities.
Related Plan Objectives: Construct new bioenergy facilities; development of next generation technologies.
Completion Date: December 31, 2012.

3.4. Funding for Integrated Biorefineries

The Energy Commission's Public Interest Energy Research Renewable-Based Energy Secure Communities program will provide grants focusing on projects that capitalize on the synergies

of colocating biopower or biofuel refineries with other biomass to energy projects, manufacturing facilities, or waste disposal projects.

Lead Agency: Energy Commission.
Desired Outcome: Leverage public and private funding to reduce the cost of business and industry development and increase development of biomass markets, especially through co-locating bio-based energy facilities with manufacturing, composting, recycling or waste facilities.
Related Plan Objectives: Construct new bioenergy facilities; Development of Integrated Bioenergy Facilities; Development of next generation technologies.
Completion Date: December 31, 2012.

3.5. Funding for Advanced Biofuels and Renewable Energy Facilities

CalRecycle's Recycling Market Development Zones program[133] may provide low interest loans to develop biofuels and renewable electricity using waste materials diverted from landfills.

Lead Agency: CalRecycle
Desired Outcome: Increase the awareness of low-interest loan financing available through CalRecycle.
Related Plan Objectives: Construct new bioenergy facilities; development of integrated bioenergy facilities; development of next generation technologies.
Completion Date: December 31, 2012.

4. Actions Addressing Gas Quality Standards

4.1. Coordinate Efforts to Increase the Beneficial Use of Biogas

Project developers state that uniform and/or clearer gas quality standards for pipeline injection of biomethane would reduce the burden and cost faced by small developers to meet the standards.[134] A number of gas quality standards for pipeline injection are specified by the California utilities in their CPUC-approved tariff rules and some additional standards are specified in CPUC General Order 58-A. However, not all of the gas quality standards that may be appropriate for biomethane have been specified in the utility rules or in General Order 58-A. This has created different approaches by utilities applying the existing standards for biomethane injected into the natural gas pipeline.

The Energy Commission supports the establishment of state rules and requirements regarding transporting biogas and biomethane in California's natural gas pipelines and development of a uniform regulatory standard for pipeline quality.

To increase the beneficial use of biogas, the following actions will be taken:

- The Energy Commission, through the Alternative Fuels Investment Plan, will provide funding for research to reduce the cost of biomethane gas clean up to meet gas quality standards for use as a transportation fuel or injection into the natural gas pipeline.

133 For more information on CalRecycle's Recycling Market Development Zones program, please go to www.calrecycle.ca.gov/rmdz/.

134 Paul Relis, CR&R. *Staff Workshop 2010 Bioenergy Action Plan Transcript*, June 3, 2010, Page 94.

Lead Agency: Energy Commission.
Desired Outcome: A set of policies, procedures and standards for injecting biogas into natural gas pipelines.
Related Plan Objectives: Increase bioenergy production at existing facilities; construct new bioenergy facilities; development of next generation technologies.
Completion Date: December 31, 2012.

- CPUC will work with the Energy Commission to examine whether additional gas quality standards should be adopted for biogas injected into utility natural gas pipelines. Preliminary joint CPUC/Energy Commission investigation into whether additional quality standards are needed and if a formal CPUC proceeding should be undertaken.
- If it is determined that a CPUC proceeding should be initiated and if it begins in 2011, the CPUC proceeding adopting new quality standards based upon preliminary investigation might be completed by the end of 2012.

Lead Agency: CPUC.
Desired Outcome: A set of policies, procedures and standards for injecting biogas into natural gas pipelines.
Related Plan Objectives: Increase bioenergy production at existing facilities; construct new bioenergy facilities; development of next generation technologies.
Completion Date: June 30, 2011 (Preliminary investigation)

4.2. Evaluation of the Public Interest Natural Gas Research and Development Program

In CPUC decision D.04-08-010, the CPUC designated the Energy Commission as the administrator of the public interest natural gas research and development program, which is funded by utility ratepayers. Under D.04-08-010, CPUC staff has recently begun an investigation and evaluation of the program. CPUC staff expects that this effort will result in the CPUC determining whether the program should continue or be modified, what the ongoing budget should be, and whether the Energy Commission should continue as administrator.

Lead Agency: CPUC.
Desired Outcome: Continued research, development and demonstration concerning biogas.
Related Plan Objective: Increase production of biogas.
Completion date: December 31, 2011.

5. Actions Addressing Legislation and Statutory Challenges

5.1. Reauthorization of the California's Renewable Energy Program and the Existing Renewable Facilities Program.

The authorization that allows the Energy Commission to collect and expend funds from the Renewable Resource Trust Fund for the Renewable Energy Program will expire on January 1, 2012. The Renewable Energy Program provides market-based incentives for existing utility-scale solid fuel biomass and solar thermal facilities through the Existing Renewable Facilities Program.

The Energy Commission will introduce or support legislation to extend the expiration dates for the administration of the Renewable Energy Program from 2012 to 2017, in Section 399.8 of the Public Utilities Code and Sections 25740.5 and 25742 of Division 15 of the Public Resource Code.

Lead Agency: Energy Commission.
Desired Outcome: Reauthorization of the Renewable Energy Program and the Existing Renewable Facilities Program to support the continued operation and/or increased production at existing solid fuel biomass facilities.
Related Plan Objective: Increase and/or maintain bioenergy production at existing facilities.
Completion Date: September 15, 2011.

5.2. Reauthorization of the Energy Commission's Public Interest Energy Research Program (PIER).

PIER has funded 41 bioenergy research and development projects and studies, and additional R&D initiatives are called for in this *Action Plan*. The Energy Commission will seek re-authorization of the PIER Program.

Lead Agency: Energy Commission.
Desired Outcome: Reauthorization of the PIER Program.
Related Plan Objective: Development of next generation technologies.
Completion Date: December 31, 2011.

5.3. Support for Legislative Changes to the Statutory Definition of MSW Conversion

The Energy Commission, in partnership with CalRecycle, and ARB, will continue to assess legislation to amend the definition of MSW conversion in statute, providing a technically accurate description of available conversion technologies that meet California's strict air and water quality standards.

Lead Agency: Energy Commission, CalRecycle, ARB.
Desired Outcome: Remove technology restrictions imposed by statute on the eligibility of conversion of MSW to electricity for the RPS.
Related Plan Objectives: Increase bioenergy production at existing facilities; construct new bioenergy facilities; development of next generation technologies.
Completion Date: December 31, 2012.

5.4. Monitor Changes to Federal Bioenergy Policies and Regulations

The Working Group will continue to monitor and comment on state and federal regulatory and legislative proposals that will impact the state's ability to meet its bioenergy goals, including but not limited to:

- Follow-up on the Governor's and state agencies' comment letter dated August 19, 2010, on U.S. EPA's proposed rule on Maximum Available Control Technology (MACT) for biomass facilities and on U.S. EPA's September 2010 request for comment on the carbon neutrality of biomass for EPA's GHG tailoring rule.
- Support federal legislation that allows states to implement feed-in tariffs for renewable energy projects, including bioenergy projects.
- Support federal legislation that allows use of woody biomass feedstock harvested sustainability from California from federal lands be eligible feedstock for biofuels.
- Support extending federal tax credits for existing solid-fuel biomass facilities and new biomass and biogas facilities. The Working Group will also support development of federal tax credits for biogas injected into natural gas pipeline.

Lead Agency: Energy Commission.
Desired Outcome: Continuous monitoring of federal laws and regulations that may impact state bioenergy goals allowing the state to provide timely comments as issues arise.
Related Plan Objectives: Increase bioenergy production at existing facilities; construct new bioenergy facilities; development of next generation technologies.
Completion Date: Continuous.

CHAPTER 6:
Recommendations for Additional State Actions

Recommendations for additional state actions will be added following the December 14, 2010, workshop.

CHAPTER 7:
Implementation of the *2011 Bioenergy Action Plan*

Roles and Responsibilities

Bioenergy Interagency Working Group

The Governor has entrusted the Working Group with the primary responsibility for carrying out his bioenergy policy objectives and meeting the state's targets. The Working Group, chaired by the Energy Commission, will continue to meet as its member agencies carry out their individual and joint responsibilities. These meetings will provide a consistent public forum for the interested stakeholders and members of the public to keep track of the progress being made throughout state government.

The Bioenergy Interagency Working Group will meet quarterly beginning in April 2011 to monitor and share information on the implementation of individual agency actions, to discuss continuing challenges to bioenergy development, and to plan future collaborative efforts aimed at addressing these challenges.

State Agencies

Each member of the state's Bioenergy Interagency Working Group will be responsible for implementing a portion of the *2011 Bioenergy Action Plan*. These agencies have committed to taking actions within their purview to address one or more of the challenges facing bioenergy development. These actions are described in Chapter 5: A Bioenergy Action Plan for California.

California Energy Commission

The Energy Commission will continue to lead, organize, and staff the Bioenergy Interagency Working Group. Staff will provide quarterly reports to the Energy Commission's Renewables Committee starting in June 2011.

Tracking Agency Progress

The Bioenergy Interagency Working Group (BIWG) will meet quarterly starting in April 2011 to track each agency's progress in implementing their actions. The BIWG will hear whether actions are expected to be completed on schedule, and what obstacles, if any, have delayed implementation. These group meetings will provide an opportunity to raise issues of concern and to discuss and solve problems collaboratively. The Energy Commission will document BIWG meetings for planned progress reports.

Measuring Achievement of State Biopower Goals

Energy Commission staff will track the progress of biopower development in June of each year. The following indicators will be used to measure progress toward the biopower goals:

- Year-to-year change in the amount of in-state and out-of-state biopower generation
- The estimated generation from new investor-owned utilities and publicly owned utility contracts involving biomass-to-energy
- Year-to-year change in the amount of generation from existing biomass-to-energy facilities participating in production incentive payment programs

The goals for biopower are defined in terms of the state's renewable energy goals for 2010 and 2020. The RPS targets within the state depend on whether the load serving entity is regulated by the CPUC (such as investor-owned utilities) or publicly owned. Load-serving entities regulated by the CPUC are mandated to procure 20 percent of their retail sales with renewable generation, whereas, publicly owned utilities are required to set their own renewable targets. The Renewable Electricity Standard (RES) adopted by the ARB requires certain regulated entities to procure 33 percent of their retail sales with renewables by 2020. Measuring progress toward achieving these goals can be calculated as follows:

- For 2010 through 2011: the annual biopower (MWh) divided by the estimated statewide renewable purchases (or generation if purchases are not available).
- For 2012 through 2020: the RES biomass and biogas energy (MWh) divided by the verified RES energy (MWh) for all obligated California utilities.

Data Sources

Renewables Portfolio Standard: For 2010, investor-owned utilities, electric service providers, and community choice aggregators are required to procure 20 percent of retail sales of electricity from renewable resources. This program is called the Renewables Portfolio Standard (RPS). The RPS requires that electricity must be delivered to California and meet specified eligibility requirements.[135] Before energy from a renewable energy facility can be claimed for California's RPS program, the Energy Commission must certify that the facility meets RPS eligibility requirements.[136]

Senate Bill 1078[137] requires that the Energy Commission and the CPUC work collaboratively to implement the RPS and assigned specific roles to each agency. Senate Bill 107[138] and Senate Bill 1036[139] amended portions of the law relating to RPS and revised the Energy Commission's roles, which are to:

- Certify eligible renewable resources that meet criteria contained in the bill.
- Design and implement a tracking and verification system to ensure that renewable energy output is counted only once for the purpose of the RPS and for verifying retail product claims in California or other states.

Publicly owned utilities (POUs), such as Los Angeles Department of Water and Power and the Sacramento Municipal Utility District, are required to establish their own RPS goals.[140]

Renewable Electricity Standard: On November 17, 2008, Governor Schwarzenegger signed Executive Order S-14-08, raising California's renewable energy goal to 33 percent by 2020. This

135 www.cpuc.ca.gov/PUC/energy/Renewables/ and www.energy.ca.gov/portfolio/index.html.

136 www.energy.ca.gov/2007publications/CEC-300-2007-006/CEC-300-2007-006-ED3-CMF.PDF.

137 Sher, Chapter 516, Statutes of 2002

138 Simitian and Perata, Chapter 464, Statutes of 2006

139 Perata, Chapter 685, Statutes of 2007

140 www.energy.ca.gov/2009publications/CEC-200-2009-019/CEC-200-2009-019.PDF.

Executive Order directed the ARB to adopt regulations as a way to achieve this goal. The regulations are titled the RES.[141]

RPS and RES Data Collection and Verification: Data on energy claimed through 2007 for the RPS is collected through an interim tracking process comparing procurement claims to generation data.[142] The Energy Commission will use data from the Western Renewable Energy Generation Information System (WREGIS) to verify RPS energy claimed for 2008 and later years. To verify delivery of energy from out of state, the Energy Commission will use data from North American Electricity Reliability Council E-tags. The Energy Commission publishes information on verified procurement and energy deliveries claimed for the RPS.[143]

RPS and RES Compliance Determination: The compliance and penalty mechanisms for the RPS and RES can provide further information regarding the amount of biopower procured as a portion of total RPS and RES energy. The CPUC determines compliance with the RPS for IOUs, ESPs, and CCAs, taking flexible compliance mechanisms into account. The CPUC flexible compliance mechanisms include borrowing from future RPS energy and banking from past RPS energy. The CPUC also determines whether to impose penalties for non-compliance. State law allows penalties up to 5 cents per kWh, up to $25 million per year.[144] POUs determine compliance and penalties for their own RPS programs.

Power Source Disclosure Program: Senate Bill 1305[145] requires retail suppliers of electricity to disclose to consumers "accurate, reliable, and simple-to-understand information on the sources of energy that are (being) used. . ."[146]

The law requires that these suppliers disclose the type of resource used to generate the electricity being provided. The suppliers are required to use a format developed by the California Energy Commission called the *Power Content Label.*

SB 1305 also required electricity generators that report meter data to a system operator to report generation, fuel type, and fuel consumption data to system operators quarterly.

Generators that do not report information to system operators but whose electricity is being claimed as a specific purchase report this data directly to the Energy Commission. System operators must then make the generation and fuel source information available to the Energy Commission for verifying information disclosed to consumers and calculating net system power.

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141 www.arb.ca.gov/energy/res/res.htm.

142 For a summary of the data used for procurement claims and generation, see pp. 13-16, www.energy.ca.gov/2009publications/CEC-300-2009-006/CEC-300-2009-006-CMD.PDF.

143 California Energy Commission, July 2010, Draft Commission *RPS 2006 Verification Report*, www.energy.ca.gov/2009publications/CEC-300-2009-006/CEC-300-2009-006-CMD.PDF, p. 13-20.

144 www.cpuc.ca.gov/PUC/energy/Renewables/compliance.htm.

145 Senate Bill 1305, Sher, Chapter 796, Statutes of 1997.

146 Public Utilities Code Section 398.1(b)

Quarterly Fuels and Energy Reporting Program: All generators that are 1 megawatt or larger in California report actual generation and fuel use to the Energy Commission under the Quarterly Fuels and Energy Reporting requirements.

Measuring Achievement of State Biofuel Goals

ARB requires each regulated party to reduce the average carbon intensity measured as grams carbon dioxide equivalent per megajoule of the fuel it provides for sale in California. For the LCFS, regulated parties are the producers or importers of each transportation fuel, as specified.[147] Regulated parties are required to file quarterly progress reports and annual compliance reports.[148]

The reporting tool for biofuel producers[149] being developed for the LCFS includes information on the type of fuel, volume of fuel in terms of gallons of gasoline equivalent (gge), and physical pathway[150] to California. This information can be used to determine the number of gallons of gasoline equivalent produced from biofuels in California compared to total biofuels consumed in California.

Regarding verification, the LCFS states: "All data and calculations submitted by a regulated party for demonstrating compliance or claiming credit are subject to verification by the Executive Officer or a third party approved by the Executive Officer."[151] Under PIIRA, both fuel producers and major transporters are required to report fuel production and movement to the Energy Commission monthly.

Data Sources

The Energy Commission's *AB 118 Investment Plan* has expressed these goals in terms of gallons of gasoline equivalent: "Increase biofuel use to 1 billon gge [note omitted] by 2010, 1.6 billion gge by 2020, and 2 billion gge by 2050."

Low Carbon Fuel Standard: The California ARB's Low-Carbon Fuel Standard requires a reduction in the full fuel-cycle, carbon intensity of the transportation fuel pool used in California by 10 percent by 2020.[152] As part of the LCFS, ARB is developing a reporting process

147 www.arb.ca.gov/regact/2009/lcfs09/lcfscombofinal.pdf.

148 www.arb.ca.gov/regact/2009/lcfs09/lcfscombofinal.pdf.

149 See the LCFS Reporting Tool Workgroup materials, available at www.arb.ca.gov/fuels/lcfs/workgroups/workgroups.htm.

150 The LCFS defines "physical pathway" as follows: "the applicable combination of actual fuel delivery methods, such as truck routes, rail lines, gas/liquid pipelines, electricity transmission lines, and any other fuel distribution methods, through which the regulated party reasonably expects the fuel to be transported under contract from the entity that generated or produced the fuel, to any intermediate entities, and ending at the fuel blender, producer, importer, or provider in California."

151 www.arb.ca.gov/regact/2009/lcfs09/lcfscombofinal.pdf.

152 California ARB's Low Carbon Fuel Standard regulation is available at www.arb.ca.gov/regact/2009/lcfs09/lcfscombofinal.pdf.

for biofuels.[153] Staff recommends using the ARB's LCFS biofuels data collection, verification, and compliance processes to track progress toward achieving the Governor's biofuel goals. An additional method that could be used to track biofuel production in California is the Petroleum Industry Information Reporting Act (PIIRA). PIIRA was enacted in 1980 to gather information on the transportation fuels industry, enabling the state government to better respond to shortages, address supply disruptions and provide informed analysis of legislation affecting the industry. With the growing need to decrease the state's dependence on foreign oil and reduce the environmental impacts of conventional fuels, the California transportation fuels industry has diversified the fuel types produced and transported throughout the state. To monitor the production and transportation of biofuels, the PIIRA reporting requirements have recently expanded beyond the collection of information on conventional petroleum-based fuels, to also include the production and movement of fuel ethanol, biodiesel, and their associated feedstocks.

Reporting Progress

Executive Order S-06-06 directs the Energy Commission to report on progress toward achieving the bioenergy goals as part of the biennial *Integrated Energy Policy Report*. Since the first Bioenergy Action Plan was issued in 2006, two *Progress to Plans* (progress reports) have been published:

- *Bioenergy Action Plan: Progress to Plan*, published in 2007.[154]
- *2009 Progress to Plan: Bioenergy Action Plan for California*.[155]

In consultation with the Bioenergy Interagency Working Group, the Energy Commission plans to publish the next *Progress to Plan* in late 2011.

153 See the LCFS Reporting Tool Workgroup materials, available at www.arb.ca.gov/fuels/lcfs/workgroups/workgroups.htm.

154 www.energy.ca.gov/2007publications/CEC-100-2007-006/CEC-100-2007-006.PDF.

155 www.energy.ca.gov/2010publications/CEC-500-2010-007/CEC-500-2010-007.PDF.

APPENDIX A: List of Actions by State Agency

Legislative Options	
5.1. Reauthorization of the California's Renewable Energy Program and the Existing Renewable Facilities Program. The authorization that allows the Energy Commission to collect and expend funds from the Renewable Resource Trust Fund for the Renewable Energy Program will expire on January 1, 2012. The REP provides market-based incentives for existing utility-scale solid fuel biomass and solar thermal facilities through the Existing Renewable Facilities Program. The Energy Commission will introduce or support legislation to extend the expiration dates for the administration of the REP from 2012 to 2017, in Section 399.8 of the Public Utilities Code and Sections 25740.5 and 25742 of Division 15 of the Public Resource Code.	**Lead Agency:** Energy Commission. **Desired Outcome:** Reauthorization of the Renewable Energy Program and the Existing Renewable Facilities Program to support the continued operation and/or increased production at existing solid fuel biomass facilities. **Completion Date:** September 15, 2011.
5.2. Reauthorization of the Energy Commission's Public Interest Energy Research Program (PIER). PIER has funded 41 bioenergy research and development projects and studies, and additional R&D initiatives are called for in this *Action Plan.* The Energy Commission will seek re-authorization of the PIER Program.	**Lead Agency:** Energy Commission. **Desired Outcome:** Reauthorization of the PIER Program. **Completion Date:** December 31, 2011.
5.3. Support for Legislative Changes to the Statutory Definition of MSW Conversion The Energy Commission, in partnership with the Department of Resources Recycling and Recovery, and the Air Resources Board, will continue to assess legislation to amend the definition of MSW conversion in statute, providing a technically accurate description of available conversion technologies that meet California's strict air and water quality standards.	**Lead Agency:** Energy Commission, CalRecycle, ARB. **Desired Outcome:** Remove technology restrictions imposed by statute on the eligibility of conversion of MSW to electricity for the RPS. **Completion Date:** December 31, 2012.
Working Group will collaborate to complete the following actions:	
1.1. Web-Based Portal for Permitting Guidance and Information To assist new project developers with guidance to obtain permits, the Working Group will form a subcommittee to develop a comprehensive Web-based portal for permitting guidance, links, and contacts to permitting agencies.	**Lead Agency:** TBD **Desired Outcome:** Improve developer access to permitting guidance and contact information. **Completion Date:** September 30, 2011.
5.4. Monitor Changes to Federal Bioenergy Policies and Regulations The Working Group will continue to monitor and comment on state and federal regulatory and legislative proposals that will impact the state's ability to meet its bioenergy goals, including but not limited to: 5.4.1. Follow-up on the Governor's and state agencies' comment letter dated August 19, 2010 on U.S. EPA's proposed rule on Maximum Available Control Technology (MACT) for biomass facilities and on U.S. EPA's September 2010 request for comment on the carbon neutrality of biomass for EPA's GHG tailoring rule. 5.4.2. Support federal legislation that allows states to implement feed-in tariffs for renewable energy projects, including bioenergy projects. 5.4.3. Support federal legislation that allows use of woody biomass feedstock harvested sustainability from California from federal lands be eligible feedstock for biofuels. 5.4.4. Support extending federal tax credits for existing solid-fuel biomass facilities and new biomass and biogas facilities. The Working Group will also support development of federal tax credits for biogas injected into natural gas pipeline.	**Lead Agency:** Energy Commission. **Desired Outcome:** Continuous monitoring of federal laws and regulations that may impact state bioenergy goals allowing the state to provide timely comments as issues arise. **Completion Date:** Continuous.

Department of Food and Agriculture will provide support for the following action:	
2.4. Web-Based Database of Biodegradable Waste for Codigestion at Wastewater Treatment Plants 2.4.1. The Energy Commission's Public Interest Energy Research (PIER) Program will commit research dollars and work with the California Biomass Collaborative, the Department of Food and Agriculture, and industry associations to update and renew an existing Web-based database to provide location, volume, quality, and seasonality of biodegradable waste suitable for codigestion at wastewater treatment plants. The database will include waste from California's agriculture, food processing, and dairy industries.	**Lead Agency:** Energy Commission. **Desired Outcome:** Updated and accessible public data source for regional operators to determine feedstock locations and seasonal variations. **Completion Date:** December 31, 2012.
CalRecycle will be the lead the following actions:	
2.4. Web-Based Database of Biodegradable Waste for Codigestion at Wastewater Treatment Plants 2.4.2. CalRecycle will work with the Energy Commission and the California Biomass Collaborative to integrate locations of post-consumer food waste into the Web-based database.	**Desired Outcome:** Extend the scope of the database to include locations of post-consumer food waste in the data set. **Completion Date:** 2012.
2.6. Support Deployment of Anaerobic Digestion Projects 2.6.1. CalRecycle will prepare a Program Anaerobic Digestion Environmental Impact Report. 2.6.2. CalRecycle will participate in the Technical Advisory group of the Central Valley Regional Water Quality Control Board's Statewide Program Environmental Impact Report for Anaerobic Digestion facilities. 2.6.3. CalRecycle will participate in the Advisory Committee for the California Energy Commission's Alternative and Renewable Fuel and Vehicle Technology Program (AB 118). 2.6.4. CalRecycle will provide technical reviews of relevant anaerobic digester project proposals submitted under the AB 118 program. 2.6.5. CalRecycle will work with the Air Resources Board to incorporate anaerobic digester into the state's Low Carbon Fuel Standard. 2.6.6. CalRecycle will work with the California Pollution Control Financing Authority to help anaerobic digestion project proposals obtain funding. 2.6.7. CalRecycle will work with the California Biomass Collaborative to provide technical support for anaerobic digestion projects. 2.6.8. CalRecycle will participate on technical workgroups convened by the Climate Action Reserve to develop or modify protocols, such as the Organic Waste Digestion Project Protocol, for projects that divert and digest organic waste that otherwise would have gone to solid waste landfills. 2.6.9. CalRecycle will update guidance documents that outline how CalRecycle regulations are applied to anaerobic digester and the statutory requirements that CalRecycle and Local Enforcement agencies have regarding anaerobic digester when solid waste is used as a feedstock.	**Desired Outcome:** Reduce by the amount of organic waste disposed in the state's landfills by promoting in-state development of biofuels and bioenergy projects. **Completion Date:** December 31, 2012.
3.5. Funding for Advanced Biofuels and Renewable Energy Facilities CalRecycle's Recycling Market Development Zones program may provide low interest loans to develop biofuels and renewable electricity using waste materials diverted from landfills.	**Desired Outcome:** Increase the awareness of low-interest loan financing available through CalRecycle. **Completion Date:** December 31, 2012.
CalRecycle will provide support for the following actions:	
1.5. Revisit Restrictions on the Injection of Biomethane Derived from Landfill Gas The Energy Commission, Air Resources Board, CalRecycle, and Public Utilities Commission will work with California gas utilities through a public process to address and resolve barriers to introducing landfill gas into the California natural gas pipeline.	**Lead Agency:** Energy Commission. **Desired Outcome:** Increased use of landfill gas. **Completion Date:** December 31, 2012.

2.5. Increase Energy Production from Urban Derived Biomass 2.5.1. The Energy Commission will work with CalRecycle to determine if urban derived biomass (the organic fraction of solid waste not derived from fossil fuel) separated from municipal solid waste can be considered biomass for the RPS. If necessary, the Energy Commission will clarify biomass eligibility in the *Renewables Portfolio Standard Eligibility Guidebook*.	**Lead Agency:** Energy Commission. **Desired Outcome:** Clarify RPS eligibility guidelines that readily identifiable and separable biomass feedstock that may have entered the waste stream is an RPS eligible feedstock. **Completion Date:** June 30, 2011.
2.5.2. The Energy Commission will continue to work with CalRecycle to determine if the remaining organic fraction of municipal solid waste should be considered biomass for the purposes of the RPS and, if necessary, identify changes to statute and/or regulation to allow the use in the RPS.	**Lead Agency:** Energy Commission. **Desired Outcome:** Allow the organic fraction of MSW not derived from fossil fuel that is recovered and converted to electricity to be eligible for RPS credits. **Completion Date:** December 31, 2012.
2.5.3. The Energy Commission, in partnership with the Department of Resources Recycling and Recovery, and the Air Resources Board will provide technical review of proposed legislation that refines or removes the definition of MSW conversion and biomass conversion in statute.	**Lead Agencies:** Energy Commission, CalRecycle, ARB. **Desired Outcome:** Provide technical review of proposed legislation that will allow technologies that convert post-recycled material into electricity to be eligible for the RPS and eliminate technology restrictions in statute. **Completion Date:** December 31, 2012.
Air Resources Board will be the lead the following actions:	
1.3. Funding for New Fuel Source Testing To offset the cost for source testing, the Air Resources Board, with the Energy Commission, will conduct a stakeholder process to identify "new" biomass feedstocks for conversion technologies and seek funding to support source testing for distributed generators. Source test data would be made available to local air districts.	**Desired Outcome:** Reduce cost-of-compliance to small developers that use new feedstocks or technologies. **Completion Date:** June 30, 2012.
1.4. AB 1318 – Wildfire Emissions Offset Credits for PM The Air Resources Board will work with the California Energy Commission, Cal Fire, U.S. Forest Service, and local air pollution control districts to evaluate forest health and hazardous fuels reductions programs as a non-traditional and innovative source of PM ERCs in the SCAQMD and other non-attainment areas of California.	**Desired Outcome:** Additional PM ERCs in the South Coast AQMD. **Completion Date:** June 30, 2012.
2.5. Increase Energy Production From Urban Derived Biomass 2.5.3. The Energy Commission, in partnership with the Department of Resources Recycling and Recovery, and the Air Resources Board will provide technical review of proposed legislation that refines or removes the definition of MSW conversion and biomass conversion in statute.	**Lead Agencies:** Energy Commission, CalRecycle, ARB. **Desired Outcome:** Provide technical review of proposed legislation that will allow technologies that convert post-recycled material into electricity to be eligible for the RPS and eliminate technology restrictions in statute. **Completion Date:** December 31, 2012.
Air Resources Board will provide support for the following actions:	
1.5. Revisit Restrictions on the Injection of Biomethane Derived from Landfill Gas The Energy Commission, Air Resources Board, CalRecycle, and Public Utilities Commission will work with California gas utilities through a public process to address and resolve barriers to introducing landfill gas into the California natural gas pipeline.	**Lead Agency:** Energy Commission. **Desired Outcome:** Increased use of landfill gas. **Completion Date:** December 31, 2012.

2.1. Sustainability Standards for Biomass Feedstock Sourcing The Energy Commission, Air Resources Board and Cal Fire will continue to work with the Interagency Forestry Working Group to assess and define sustainability standards for biomass feedstock sourcing.	**Lead Agency:** Energy Commission. **Desired Outcome:** State standards defining sustainability that can be used to identify sustainable sources of biomass feedstock. **Completion Date:** December 31, 2012.
CalFire and the Board of Forestry and Fire Protection will be the lead the following actions:	
2.2. Increase Use of Forest Biomass Harvested for Wildfire Fuel Reduction The Board of Forestry and Fire Protection is developing a Modified Timber Harvest Plan (THP) for Fuels Management, which prescribes standards for harvesting forest fuels that landowners can use to facilitate plan preparation and regulatory compliance. Cal Fire administers this THP process. The Board and Cal Fire are developing the Modified THP with input from other agencies, such as the Department of Fish and Game, to ensure that biomass fuel harvest activities protect the environment and are sustainable.	**Lead Agency:** Board of Forestry and Fire Protection. **Desired Outcome:** A modified timber harvest plan that will increased access to affordable and readily available feedstock from wildfire hazard reduction and forest health activities. **Completion Date:** December 31, 2011
2.3. Public Education and Outreach The Board of Forestry and Fire Protection and Cal Fire will provide training workshops for Cal Fire staff to implement the 2010 Strategic Fire Plan to assist communities, local agencies and citizen groups such as Fire Safe Councils in reducing wildfire hazards and damages, including hazardous fuel removal. Trainings will improve identification of priority areas for fuels treatments and education about wood biomass treatments.	**Lead Agency:** Cal Fire. **Desired Outcome:** Increased treatment of priority hazardous fuels which will improve community safety and forest health while generating woody biomass waste materials for energy production. **Completion Date:** December 31, 2011.
CalFire will provide support for the following actions:	
1.4. AB 1318 – Wildfire Emissions Offset Credits for PM The Air Resources Board will work with the California Energy Commission, Cal Fire, U.S. Forest Service, and local air pollution control districts to evaluate forest health and hazardous fuels reductions programs as a non-traditional and innovative source of PM ERCs in the SCAQMD and other non-attainment areas of California.	**Lead Agency:** Air Resources Board. **Desired Outcome:** Additional PM ERCs in the South Coast AQMD. **Completion Date:** June 30, 2012.
2.1. Sustainability Standards for Biomass Feedstock Sourcing The Energy Commission, Air Resources Board and Cal Fire will continue to work with the Interagency Forestry Working Group to assess and define sustainability standards for biomass feedstock sourcing.	**Lead Agency:** Energy Commission. **Desired Outcome:** State standards defining sustainability that can be used to identify sustainable sources of biomass feedstock. **Completion Date:** December 31, 2012.
CPUC will be the lead the following actions:	
1.2. Address Interconnection Challenges for Bioenergy-Based Distributed Generation The Public Utilities Commission will work with the Energy Commission to review the Rule 21 tariff interconnection processes for bioenergy projects. The Public Utilities Commission has indicated that Rule 21 issues will be handled in Rulemaking (R) 10-05-004. There may be a need to convene stakeholders to discuss the specific interconnection issues that affect bioenergy projects.	**Desired Outcome:** Streamline interconnection processes for developers of bioenergy distributed generation projects. **Completion Date:** December 31, 2012.
3.1. Ensure Continued Operation of Existing Biomass Facilities After Contract Expiration 3.1.2. The Public Utilities Commission will work with the utilities and existing solid-fuel biomass facilities to ensure streamlined, quick, and fair processes through which they may renegotiate expiring contracts.	**Desired Outcome:** Renegotiated contracts that provide for the continued operation and/or increased production at existing solid fuel biomass facilities. **Completion Date:** December 31, 2012.

3.3. Implementation of Feed-In Tariffs for Renewable Projects The Public Utilities Commission will continue to work on implementing and expanding feed-in tariffs for renewable energy projects through implementation of the SB 32 feed-in tariff and the proposed Renewable Auction Mechanism for projects up to 20 MW.	**Desired Outcome:** Streamlined procurement mechanism for new and repowered bioenergy facilities. **Completion Date:** December 31, 2012.
4.1. Coordinate Efforts to Increase the Beneficial Use of Biogas 4.1.2. Public Utilities Commission will work with the Energy Commission to examine whether additional gas quality standards should be adopted for biogas injected into utility natural gas pipelines. Preliminary joint CPUC/Energy Commission investigation into whether additional quality standards are needed and if a formal CPUC proceeding should be undertaken. If it is determined that a CPUC proceeding should be initiated and if it begins in 2011, the CPUC proceeding adopting new quality standards based upon preliminary investigation might be completed by the end of 2012.	**Desired Outcome:** A set of policies, procedures and standards for injecting biogas into natural gas pipelines. **Completion Date:** June 30, 2011 (Preliminary investigation)
4.2. Evaluation of the Public Interest Natural Gas Research and Development Program In CPUC decision (D) 04-08-010, the CPUC designated the Energy Commission as the administrator of the public interest natural gas research and development program, which is funded by utility ratepayers. Under D.04-08-010, CPUC staff has recently begun an investigation and evaluation of the program. CPUC staff expects that this effort will result in the CPUC determining whether the program should continue or be modified, what the ongoing budget should be, and whether the Energy Commission should continue as administrator.	**Desired Outcome:** Continued research, development, and demonstration concerning biogas. **Completion date:** December 31, 2011.
CPUC will provide support for the following actions:	
1.5. Revisit Restrictions on the Injection of Biomethane Derived from Landfill Gas The Energy Commission, Air Resources Board, CalRecycle, and Public Utilities Commission will work with California gas utilities through a public process to address and resolve barriers to introducing landfill gas into the California natural gas pipeline.	**Lead Agency:** Energy Commission. **Desired Outcome:** Increased use of landfill gas. **Completion Date:** December 31, 2012.
Energy Commission will be the lead the following actions:	
1.5. Revisit Restrictions on the Injection of Biomethane Derived from Landfill Gas The Energy Commission, Air Resources Board, CalRecycle, and Public Utilities Commission will work with California gas utilities through a public process to address and resolve barriers to introducing landfill gas into the California natural gas pipeline.	**Desired Outcome:** Increased use of landfill gas. **Completion Date:** December 31, 2012.
2.1. Sustainability Standards for Biomass Feedstock Sourcing The Energy Commission, Air Resources Board and Cal Fire will continue to work with the Interagency Forestry Working Group to assess and define sustainability standards for biomass feedstock sourcing.	**Desired Outcome:** State standards defining sustainability that can be used to identify sustainable sources of biomass feedstock. **Completion Date:** December 31, 2012.
2.4. Web-Based Database of Biodegradable Waste for Codigestion at Wastewater Treatment Plants 2.4.1. The Energy Commission's Public Interest Energy Research (PIER) Program will commit research dollars and work with the California Biomass Collaborative, the Department of Food and Agriculture, and industry associations to update and renew an existing Web-based database to provide location, volume, quality, and seasonality of biodegradable waste suitable for codigestion at wastewater treatment plants. The database will include waste from California's agriculture, food processing, and dairy industries. 2.4.2. CalRecycle will work with the Energy Commission and the California Biomass Collaborative to integrate locations of post-consumer food waste into the Web-based database.	**Desired Outcome:** Updated and accessible public data source for regional operators to determine feedstock locations and seasonal variations. **Completion Date:** December 31, 2012.

2.5. Increase Energy Production From Urban Derived Biomass 2.5.1. The Energy Commission will work with CalRecycle to determine if urban derived biomass (the organic fraction of solid waste not derived from fossil fuel) separated from municipal solid waste can be considered biomass for the RPS. If necessary, the Energy Commission will clarify biomass eligibility in the *Renewables Portfolio Standard Eligibility Guidebook*.	**Desired Outcome:** Clarify RPS eligibility guidelines that readily identifiable and separable biomass feedstock that may have entered the waste stream is an RPS eligible feedstock. **Completion Date:** June 30, 2011.
2.5.2. The Energy Commission will continue to work with CalRecycle to determine if the remaining organic fraction of municipal solid waste should be considered biomass for the purposes of the RPS and, if necessary, identify changes to statute and/or regulation to allow the use in the RPS.	**Desired Outcome:** Allow the organic fraction of MSW not derived from fossil fuel that is recovered and converted to electricity to be eligible for RPS credits. **Completion Date:** December 31, 2012.
2.5.3. The Energy Commission, in partnership with the Department of Resources Recycling and Recovery, and the Air Resources Board will provide technical review of proposed legislation that refines or removes the definition of MSW conversion and biomass conversion in statute.	**Lead Agencies:** Energy Commission, CalRecycle, ARB. **Desired Outcome:** Provide technical review of proposed legislation that will allow technologies that convert post-recycled material into electricity to be eligible for the RPS and eliminate technology restrictions in statute. **Completion Date:** December 31, 2012.
3.1. Ensure Continued Operation of Existing Biomass Facilities After Contract Expiration 3.1.1. The Energy Commission will explore options to ensure that existing biomass facilities continue to operate through the continuation of the Existing Renewable Facilities Program. However, contract renegotiations must be considered as a long-term solution.	**Desired Outcome:** Continued operation and/or increased production at existing solid fuel biomass facilities. **Completion Date:** December 31, 2012.
3.2. Alternative Fuel Investment Plan As part of California's Alternative Fuels Investment Plan, the Energy Commission will do the following: 3.2.1. The Energy Commission will allocate funding through fiscal year 2011 to support feasibility studies for low-carbon cellulosic ethanol feedstock, including feasibility studies of modifications to existing plants. 3.2.2. The Energy Commission will fund research to improve conversion efficiencies of cellulosic biofuels derived from straw, corn stover, timber processing residues, and the organic fraction of MSW.	**Desired Outcome:** Research results that will lead to reduce cost and greater efficiencies for advanced biofuel technologies. **Completion Date:** December 31, 2012.
3.4. Funding for Integrated Biorefineries The Energy Commission's Public Interest Energy Research Renewable-Based Energy Secure Communities program will provide grants focusing on projects that capitalize on the synergies of colocating biopower or biofuel refineries with other biomass to energy projects, manufacturing facilities, or waste disposal projects.	**Desired Outcome:** Leverage public and private funding to reduce the cost of business and industry development and increase development of biomass markets, especially through co-locating bio-based energy facilities with manufacturing, composting, recycling or waste facilities. **Completion Date:** December 31, 2012.
4.1. Coordinate Efforts to Increase the Beneficial Use of Biogas 4.1.1. The Energy Commission, through the Alternative Fuels Investment Plan, will provide funding for research to reduce the cost of biomethane gas clean up to meet gas quality standards for use as a transportation fuel or injection into the natural gas pipeline.	**Desired Outcome:** A set of policies, procedures and standards for injecting biogas into natural gas pipelines. **Completion Date:** December 31, 2012.

Energy Commission will provide support for the following actions:	
1.3. Funding for New Fuel Source Testing In order to offset the cost for source testing, the Air Resources Board, in collaboration with the Energy Commission, will conduct a stakeholder process to identify "new" biomass feedstocks for conversion technologies and seek funding to support source testing for distributed generators. Source test data would be made available to local air districts.	**Lead Agency:** Air Resources Board. **Desired Outcome:** Reduce cost-of-compliance to small developers that use new feedstocks or technologies. **Completion Date:** June 30, 2012.
1.4. AB 1318 – Wildfire Emissions Offset Credits for PM The Air Resources Board will work with the California Energy Commission, Cal Fire, U.S. Forest Service, and local air pollution control districts to evaluate forest health and hazardous fuels reductions programs as a non-traditional and innovative source of PM ERCs in the SCAQMD and other non-attainment areas of California.	**Lead Agency:** Air Resources Board. **Desired Outcome:** Additional PM ERCs in the South Coast AQMD. **Completion Date:** June 30, 2012.

APPENDIX B: California's Air Regulatory Structure

ARB has established health-based ambient air quality standards to identify outdoor pollutant levels considered safe for the public. State law requires ARB to designate areas as attainment, nonattainment, nonattainment-transitional, or unclassified for each state standard, indicating the healthfulness of the air quality in each area. The federal Clean Air Act requires states to directly regulate sources of air pollution through a state implementation plan to provide for implementation, maintenance, and enforcement of national ambient air quality standards.

In California, responsibility for attaining and maintaining ambient air quality standards is divided among ARB and the 35 independent local air pollution control and air quality management districts (districts). California is also geographically divided into 15 air basins for managing the air resources of the State. The responsibility for controlling pollution from stationary sources, such as power plants, lies with the districts. This responsibility includes developing region-specific rules, permitting, enforcement, collecting data associated with emissions inventory, and preparing local air quality plans.

District rules define the procedure and criteria that districts must use in permitting stationary sources. Although district specific rules vary in scope and level of stringency depending on its area designation, the general procedure for permitting new and expanding sources is the same throughout the State. Pollutant-emitting sources must first obtain an authority to construct (or permit to construct) before beginning construction, and a permit to operate after the completed facility demonstrates compliance with district rules and the facility's permit conditions.

District requirements for stationary sources generally fit into two categories. The first category, the New Source Review (NSR) program, applies to the construction and operation of new and modified (or expanding) stationary sources. The second category, commonly referred to as prohibitory rules, is requirements that new and existing sources must meet.

The California NSR program allows industrial growth to continue in polluted areas while not increasing emissions of non-attainment pollutants or their precursors. This is accomplished through two major requirements in each district NSR rule: 1) best available control technology (BACT)[156] and 2) offsets.

Depending on the quantity of air pollutants that will be emitted from the source and the area designation for that pollutant, the new or modified source may be required to install BACT. BACT is triggered on a pollutant-by-pollutant basis and on an emission unit basis (generally an individual piece of equipment or an integrated process consisting of several pieces of equipment).

BACT requires use of the cleanest, state-of-the-art technology to achieve the greatest feasible emission reductions. To identify BACT for a specific piece of equipment or process, district staff conducts a comprehensive case-by-case evaluation of the cost and effectiveness of technologies or strategies. This includes obtaining testing results or similar proof that the emission levels have been achieved in practice. District staff also conducts a broad search (internationally, in some instances) for technologies or strategies that have demonstrated (through testing on

156 In California, BACT is synonymous with the federal term Lowest Achievable Emission Rate (LAER) for nonattainment area permit requirements.

similar categories of stationary sources) a reduction in emissions to the lowest levels. The cost of the identified technologies is compared to the district BACT cost-effectiveness threshold. If the cost is lower than the threshold, then the technology or strategy can be designated as BACT for that category of stationary source. District staff does not consider cost for technologies or strategies that are already deemed achieved in practice.

In addition to BACT requirements, owners of new or modified sources may be required to mitigate, or offset, the increased emissions that result after installation of BACT. Offsetting is the use of emission reductions from existing sources to offset emission increases from new or expanding sources. This may be done by purchasing emission reduction credits (ERC) from another company and/or cleaning up the existing facility (or a source owned by another company) beyond what is required by law. The amount of offsets required depends on the distance between the source of offsets and the new or modified source.

Offsets are generally required at a greater than 1-to-1 ratio so that when the new or modified facility begins operation, more emissions are reduced than are increased. If a source obtains emission offsets outside the local area (that is, interbasin), or if one type of pollutant is offset against another type (that is, interpollutant), the source must use air quality modeling to show that these offsets will result in a net benefit. Some districts have pre-established ratios for interpollutant offsets in their rules. While BACT is triggered on an emission unit basis, offsets are triggered on a project basis.

Each district has prohibitory rules aimed at limiting emissions from new and existing stationary sources. In most cases where BACT is required for a particular pollutant, the required control technology and corresponding emission level will be more stringent than what is required by the prohibitory rule. The developer of a new or expanding source will have to demonstrate compliance with both NSR and prohibitory rule requirements in any permit application submitted to the district.

APPENDIX C: Acronyms

Abbreviation	Meaning
AD	anaerobic digester
ARB	Air Resources Board
BACT	Best Available Control Technology
BDT	bone dry tons
BIWG	Bioenergy Interagency Working Group
Btu	British thermal unit
CalEPA	California Environmental Protection Agency
CCAs	Community Choice Aggregators
CCGT	combined cycle gas turbine
CHP	combined heat and power
CPUC	California Public Utilities Commission
DOE	U.S. Department of Energy
EIR	environmental impact report
EPA	Environmental Protection Agency
ERCs	emission reduction credits
ERFP	Existing Renewable Facilities Program
ESPs	Electricity Service Providers
FOG	fats, oil, and grease
gge	gallons of gasoline equivalent
GHG	greenhouse gas
GTI	Gas Technology Institute
GWh	gigawatt-hour
IEPR	*Integrated Energy Policy Report*
IOU	investor-owned utility
kW	kilowatt
LAER	Lowest Achievable Emission Rate
LCFS	Low-Carbon Fuel Standard
LFG	landfill gas
MACT	Maximum Achievable Control Technology
MPR	market price referent
MSW	municipal solid waste
MW	megawatt
NAAQS	national ambient air quality standards
NOx	nitrogen oxide
NSPR	Net System Power Report
NSR	New Source Review
PHMSA	U.S. Department of Transportation, Pipeline and Hazardous Materials Safety Administration
PIER	Public Interest Energy Research Program
PIIRA	Petroleum Industry Information Reporting Act

PM-10	particulate matter 10-microns or less in size
POU	publicly owned utility
PSD	Prevention of Significant Deterioration
RES	Renewable Electricity Standard
RPS	Renewables Portfolio Standard
SCAQMD	South Coast Air Quality Management District
scf	standard cubic feet
scfm	standard cubic feet per minute
THP	Timber Harvest Plan
WREGIS	Western Renewable Energy Generation Information System