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Subcontractor Report

The Status of Biomass Power Generation in California, July 31, 2003

G. Morris
Green Power Institute
Pacific Institute for Studies in Development, Environment, and Security
Oakland, California

National Renewable Energy Laboratory

1617 Cole Boulevard
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Introduction

California has the largest and most diverse biomass energy industry in the world. More than sixty solid-fuel fired biomass power generating facilities have been built in the state since 1980, with a combined generating capacity of almost 1,000 MW. The California biomass power plants are fueled by a combination of sawmill residues, in-forest residues, agricultural residues, and wood residues diverted from disposal in the state's sanitary landfills. In all cases, energy production from these materials provides a disposal option that is environmentally superior to the alternatives, which include open burning and landfill burial.

At its peak, the California biomass energy industry produced almost 4.5 billion kWhs per year of electricity, and provided a beneficial use outlet for more than ten million tons per year of the state's solid wastes. The peak, however, occurred during the early 1990s. During the middle 1990s, when California launched the national movement to deregulate the electric utility industry, one-quarter of the operating biomass energy facilities in the state agreed to buyouts of their power sales contracts and terminated operations. In addition, some of the facilities that remained in operation reduced their production levels during off-peak hours. By 1996, biomass power generation in California stabilized at approximately 3.2 billion kWhs per year, and the enterprise provided a disposal outlet for slightly less than six million tons per year of the state's solid waste.

Electric utility deregulation was originally focused exclusively on reducing the costs of power generation, but as the process proceeded, the renewable energy industries, in cooperation with environmentalists and consumer advocates, were able to put environmental concerns on the agenda. By the time deregulation went into effect in 1998, a program had been developed to assist the various renewable power producers in making the transition to a competitive power-generation market. Biomass generators who were not operating under old fixed-price energy provisions were eligible to claim a production credit of up to 1.5 ¢/kWh for power produced during the first two years of the program. This supplement provided the incentive necessary to encourage the generators that were still operating to operate at a higher overall capacity factor, but it was not enough to allow any of the idled facilities in the state to resume operations. By the end of the 1990s biomass power generation in California had increased to 3.5 billion kWh/yr, and fuel use to a level of 6.4 million tons per year.

The dawn of the new century brought a nasty electricity crisis to California. Supplies of natural gas and electricity were short, and wholesale prices shot through the roof. The crisis stimulated ten of the state's idle biomass power generators to initiate restart

investigations, with five eventually achieving restart, although one of the five only operated for a few months and then shut down again. As of mid 2003, the California biomass power industry was producing 4.2 billion kWh/yr of electricity, and was providing a beneficial use disposal outlet for 8.0 million tons per year of biomass residue.

This report describes the development of the biomass power industry in California over the past quarter century, and examines its future outlook. Much of the industry history has been published before (see, for example, Morris 2000, Morris 2002a), but is included here to allow this to be a stand alone report. The development of a state biomass policy, which has been under discussion in California for the better part of the past decade, has never gotten off the ground, but a number of smaller initiatives have helped to keep the biomass power industry afloat and have promoted the use of some targeted types of residues. In this report we will analyze the prospects for policy development and the application of new biomass technologies in California

The 1980s: Decade of Growth

The early 1980s mark the nascent period for the modern California biomass energy industry. Prior to 1980 a handful of biomass power plants operated in conjunction with lumber or pulp mills in the state, and mostly supplied power for on-site uses. During the early 1980s several pioneering biomass energy-generating facilities were built and placed into service. The early facilities tended to be small; generally in the size range of 2 - 10 MW, and most were associated with sawmills or food-processing operations that were looking for beneficial-use outlets for their wastes. Figure 1 shows a map of the state's operating biomass energy facilities at the end of 1985.

The early 1980s were also the period when the California electric utility companies developed standard-offer contracts for power purchases from independent generators. These contracts had particularly favorable provisions for renewable energy projects. A great deal of biomass project development activity was initiated during this period, which led to an explosion of new facility openings during the second half of the decade.

During the later 1980s the California biomass energy industry established itself as an important part of the state's electricity supply infrastructure, as well as its waste-disposal infrastructure. The incentives for renewable energy development that were offered during the first half of the decade led to the opening of 33 new biomass generating facilities between 1985 and 1990. A few of the pioneering facilities were shut down during this period, but the state's total operating biomass energy capacity grew by more than 650 MW. The average size of the facilities brought on-line during this period was about 17.5 MW, with the largest facilities producing as much as 50 MW. The explosive growth of biomass generating capacity in California culminated in 1990, when 11 new facilities were commissioned in a single year, adding 232 MW of biomass generating capacity to the state's electricity supply. Figure 2 illustrates graphically the development of the biomass energy generating industry in California from 1980 to the present. Figure 1 shows a map of the state's installed biomass power infrastructure at the end of 1990.

Many of the facilities that entered service during the late 1980s had Interim Standard Offer No. 4 (SO#4) power purchase agreements with the state's two major electric utility companies, Pacific Gas and Electric Co. (PG&E), and Southern California Edison (SCE) Co. The most significant feature of the SO#4s was an option for energy sales from electricity generated from renewable resources to be based on a forecasted schedule of energy prices for the first ten years of facility operations, rather than being subject to fluctuating, short-term prices. These schedules were based on the high avoided cost rates that were in effect when the contracts were signed (5 – 6 ¢ per kWh), and an expectation that rates would grow from there throughout the terms of the agreements. At the completion of the ten-year fixed price period generators were to be compensated based on the then current market price.

The second half of the 1980s was also significant for a major reversal in world oil markets. World oil prices, which had remained high since the price explosions of the 1970s, collapsed during the period 1985-1986. Short-run avoided cost rates in California fell by 50% over an 18 month period. Most of the biomass power plants, however, were immune to the decline in SRAC rates during this period, because they were receiving fixed-schedule rates under their contracts based on early 1980s energy prices.

Instead, the attention of the biomass generating facilities was focused on a looming crisis in the biomass fuels market. Because the state's installed biomass-generating capacity grew rapidly during the later half of the 1980s, the demand for fuel soon overwhelmed the readily available supply. Virtually all of the sawmill and food processing residues in the state that did not have higher-value uses were being sold into the fuel market, yet there was a significant deficit between supply and demand for biomass fuels. A variety of efforts were under way to develop technologies to produce biomass fuels from new sources, such as agricultural prunings, agricultural field residues, forestry residues, and urban waste wood, with rising fuel prices providing the incentive, as illustrated in Figure 3. The state's biomass fuels crisis peaked in 1990 with average prices topping $40 per bdt[1] of fuel, and spot prices reaching upwards of $60 per bdt. Moreover, several major new facilities were approaching completion at this time, and there was a fear that biomass fuel prices might continue to rise.

The 1990s: Maturity, Consolidation, Deregulation

At the end of 1990 more than 770 MW of biomass energy generating capacity were operating in California, and an additional 100 MW of capacity were in advanced stages of construction. The next several years saw the state's biomass energy industry stabilize at a level of about 750 MW of operating capacity (see Figure 2). During this period the startup of the last of the SO#4 facilities was balanced by the retirement of several of the pre-SO#4 facilities, some of which had serious design flaws or chronic operational

[1] bdt = bone-dry ton equivalent, a unit of measurement used for biomass fuels. A bdt refers to an amount of material that contains a ton of moisture-free biomass fiber. Generally, one bdt is equivalent to 1.5 – 2.2 actual, or green tons of biomass. In this paper the term "ton" used alone refers to green tons of biomass, and bdt refers to bone-dry ton equivalents of biomass.

problems. The year 1993 saw the first retirement and dismantling of a facility with a SO#4 contract. This was a facility that had been beset with technical and operational problems that prevented its profitable operation.

The California biomass fuels market also stabilized during the early 1990s, with average market prices settling at about $37.50 per bdt, at an average statewide consumption level of approximately nine million tons per year. This stability was reached despite the beginning, in 1990, of a long-term decline in the state's commercial wood-products industry. This is significant because wood processing residues are the lowest-cost biomass fuels in the state, and their supply was declining, as shown in Figure 4. Figure 5 shows how fuel pricing had reached equilibrium among fuel types in the early 1990s. By the end of 1993 the biomass energy industry in California appeared to have attained a level of maturity, and a workable equilibrium between fuel supply and fuel demand had been established. While there had been winners and losers, the California biomass energy industry as a whole appeared to have successfully weathered the storm of the fuel crisis that marked the beginning of the decade.

The stability, however, was short lived. In April of 1994 the California Public Utilities Commission (CPUC) issued its landmark *Blue Book* proposal for restructuring the state's regulated electric utility industry (CPUC 1994). The *Blue Book* provided for competition among generating sources on the basis of price alone, without regard to non-market factors such as resource diversity and environmental impact. This represented a major threat to the future of biomass energy generation. For a number of reasons, the cost of power production from biomass is inherently higher than the cost of power generation using natural gas. Competition based on price factors alone would not favor biomass energy generation.

The most immediate effect of the *Blue Book* restructuring proposal for the biomass energy industry was that it provided an incentive for the state's regulated electric utility companies to buy out the SO#4 PPAs held by the biomass generators in their service territories. Many of the biomass generators were receptive to these offers because of their concern about their own long-term liabilities to the utility companies in connection with the firm-capacity obligations in their contracts. Over the next three years 17 biomass facilities, rated collectively at more than 215 MW, accepted buyout offers and shut down.[2] Unlike in earlier years, when only marginal facilities were closed, most of the facilities that shut down in the mid-1990s were first-rate facilities that had been operating efficiently and profitably until the buyouts of their PPAs.

Annual biomass fuel use in the state shrank by 37% during the two years following the appearance of the *Blue Book* proposal (see Figure 6). More than three million tons per year of biomass residues that were being used for energy production in the early 1990s were again burned and landfilled for disposal. In addition, at its peak the state's biomass industry was supporting forest treatment operations on approximately 60,000 acres per

[2] One of the seventeen facilities was sold and restarted during this period. This facility was purchased by a buyer who operated it at about one-half of its rated capacity, supplying steam and electricity to an over-the-fence industrial customer.

year of forest land that was not otherwise being commercially harvested or treated. These treatments reduced the risk of destructive wildfires, and improved the health and productivity of the thinned forest. With the retraction in the demand for biomass fuels, forest-treatment activities in the state declined dramatically.

The CPUC's original restructuring proposal underwent a process of refinement that lasted for more than two years. By the summer of 1996 the CPUC had acknowledged the desirability of incorporating environmental factors into the choice of energy sources for the state, and embraced the concept of a minimum purchase requirement for renewable energy sources. A working group made up of the utility companies, independent power generators, and public interest groups were working on formulating a consensus proposal to the CPUC for the implementation of a minimum renewables purchase requirement for California's regulated electric utility sector (Morris et. al., 1996). The biomass industry, which pioneered the concept of a renewables portfolio standard, played a key role in this process.

In late August of 1996, just before the end of the session, the California legislature formulated its own electric utility restructuring program, superceding the efforts of the CPUC. The legislation that emerged, AB 1890, included a program of short-term support for renewable energy during the four-year transition period (1998-2001) between initiation and full implementation. However, no long-term support program for renewables was included. AB 1890 explicitly recognized the special waste-disposal benefits associated with biomass energy in California. The legislation directed the California Environmental Protection Agency (Cal/EPA) to study policies that would shift some of the costs of biomass energy production away from the electric ratepayer, and onto the beneficiaries of the waste-disposal services.

The legislature made an additional attempt to develop the background necessary for biomass support policies in California. In 1998, AB 2273 was passed and signed into law. AB 2273 directs the Cal/EPA to report annually to the legislature on progress being made to develop biomass cost shifting policies in the state. The California Integrated Waste Management Board is assigned the lead role in developing reports under this legislation.

Despite the cloud of uncertainty over the future viability of biomass energy production in California, the state's biomass energy industry operated with relative stability during the latter half of the 1990s. Following the shutdowns of 1994-1996, a total of twenty-seven biomass facilities, representing 540 MW of generating capacity, remained in operation. Twenty of the facilities were operating intact under SO#4s. The other seven had special circumstances, such as a captive fuel supply, or an ability to earn retail-offset for most or all of their electricity output, that allowed them to continue operating. The fixed-price periods in the SO#4 PPAs were coming to an end, but the renewables transition fund created by AB 1890 offered biomass generators a supplementary payment of 1.5 ¢/kWh for facilities that were not receiving SO#4 fixed-scheduled prices for their sales of electricity.

The operating biomass energy generating capacity in California actually increased slightly at the end of the 1990s, to a level of almost 600 MW. This was mainly because two, twenty-five MW facilities that had accepted contract buyouts and shutdown operations in 1994 had provisions in their buyouts that provided for restarting the facilities at the end of their fixed-price periods. Biomass fuel use increased by 15% over its lowest point following the 1994-1996 shutdowns, but it was still more than 30% lower than the peak level achieved during the early part of the decade. Figure 7 shows maps of California's biomass energy facilities as of 1995 and 2000.

The close of the 1990s saw a renewal of interest in PPA buyouts. One small biomass facility, which was already operating beyond its fixed-price period, accepted a buyout agreement for its remaining capacity obligation and shutdown. One of the state's largest biomass facilities accepted a buyout of its contract and remained in operation as a merchant power facility. The industry was concerned because the transition support payment for biomass energy was scheduled to drop to 1.0 ¢/kWh in 2000, and no tangible progress had been made on implementing cost-shifting measures.

The 2000s: Energy Crisis and Consequences

The Crisis of 2000 – 2001

Natural gas prices in California, which had been stable throughout the 1990s, abruptly shot upwards during the winter of 2000. Electricity prices in San Diego, where deregulation was already in effect, immediately doubled. Prices for customers of PG&E and SCE held steady, due to continuing regulatory control. The staggering increase in gas prices, combined with rapidly growing electricity demand fueled by the booming high tech industries in California, a drought-caused decrease in hydroelectric production in the Pacific Northwest, and increasingly brazen manipulation of the market by major gas and electric producers and marketers, led to electricity supply shortages across California.

Wholesale electricity prices, which had remained within a penny of three cents per kWh for more than 15 years, broke through the four-cent barrier in May of 2000. In June, they hit double digits. By August prices at the state power exchange were averaging more than 15 ¢/kWh. Figure 8 shows the explosion of wholesale electricity prices in California during 2000 and 2001. Suddenly, California was engulfed in a full-fledged energy crisis. The Governor resolved to hold the line on consumer electricity prices, but FERC declined to impose wholesale price controls. Caught in the middle, the utilities' saw their cash reserves vanish virtually overnight.

Biomass power generators in the state responded quickly to what was a considerable opportunity. Each of the operating biomass facilities looked to expand its fuel purchasing, and pushed its facility to maximize output around the clock. All of the facilities that were eligible opted to convert to power exchange pricing in order to take advantage of the higher prices available there. Ten of the biomass facilities in California that had been shut down during the 1990s, representing 130 MW of generating capacity, began

investigations to see whether they could profitably resume operations. The ten facilities, many of which are located near the state's Central Valley region, are shown in Table 1. The state support payments to the biomass generators were suspended because market prices exceed the target level. By the end of the year biomass fuel prices were on the rise, but few of the generators were complaining.

Table 1
Idle California Biomass Facilities that Began Re-Start Investigations in 2000

Auberry Energy, Auberry	7.5 MW	restart abandoned
Blue Lake Energy, Blue Lake	10.0 MW	restart abandoned
Capitol Power, Ione	18.0 MW	restart abandoned
Chow II, Chowchilla	10.0 MW	restart abandoned
Dinuba Biomass, Dinuba	11.5 MW	started up in 2001
El Nido, Chowchilla	10.0 MW	restart abandoned
EPI Madera, Madera	25.0 MW	started up in 2001
Primary Power, Brawley	15.0 MW	started 2001, shut 2002
Sierra Forest Products, Terra Bella	9.5 MW	started up in 2001
Soledad Energy, Soledad	13.5 MW	started up in 2001

The complaints started in December 2000, when the utility companies stopped paying power producers for energy. Six months of unprecedented wholesale energy prices had mortally wounded the utility companies, and they were teetering on the verge of bankruptcy. Additionally, prices at the power exchange suddenly shot up again in December, averaging more than 35 ¢/kWh during the month. They remained at that level into January 2001, when the power exchange itself was shut down. The electricity market in California was in chaos, and the state's investor-owned electric utility companies were crippled.

California's biomass power producers were faced with a mind-boggling irony. At the very time that they were earning unprecedented profits, on paper, they were facing insolvency at the bank. With their revenues suspended, fuel prices elevated, and the state demanding that they produce as much power as they could, their short-term cash positions were precarious. Many biomass operators talked openly of giving up and shutting down for good.

In spite of the troubles faced by the operating biomass facilities, the efforts to restart ten of the state's idled biomass facilities were proceeding at full-speed. Wholesale electricity prices had never been higher, actual operations for these facilities were months away, and it was reasonable to assume that something would be done to get the flow of money moving again before they would be ready to operate. In fact in some ways, it appeared at

the beginning of 2001 that the idled facilities that were trying to restart would enjoy a couple of distinct advantages over the operating facilities. They would not be hobbled by enduring a prolonged period of operating without receiving revenues, and they would not be saddled by old power purchase contracts that now were paying below-market prices.

An emergency session of the state legislature was convened in January 2001 to deal with the still burgeoning energy crisis. Many commentators predicted that a long, hot summer of brownouts and blackouts lay ahead. The governor was negotiating bailout deals with the utility companies that would allow them to sell their entire transmission systems to the state for prices that were well above book value. In March the CPUC, for the first time since the energy crisis hit, granted the utility companies across-the-board rate increases of 10%. Nevertheless, negotiations with PG&E broke down and the utility company declared bankruptcy. Negotiations with SCE eventually broke down too, although SCE avoided bankruptcy.

The state's electricity generators were desperately searching for a way to get the utility companies to pay them. A deal was struck in late March at the CPUC that allowed the utility companies to resume payments to the power generators on a going-forward basis, with the matter of payments for past due bills left unresolved. None of the thirty operating biomass facilities had been forced to shutdown, although many were severely stretched. Short-run avoided cost rates hovered in the neighborhood of 10 ¢/kWh through the Spring of 2001, well below their unbelievable levels of December and January, but still some three times higher than historical levels.

With the collapse of the state power exchange and the crippled financial status of the utility companies, the state legislature passed legislation that allowed the state to begin buying electricity on behalf of the state's utility consumers. The Department of Water Resources (DWR) immediately set up a trading unit and created a power exchange for short-term energy purchases. In addition to purchasing energy on a short-term basis, the DWR embarked on a program of negotiating long-term energy contracts at prices below the then prevailing rates, but above historical levels. Many of the state's generators were eager to join the negotiations, and the state began to deal.

The ten idled biomass generating facilities in the state that had initiated startup preparations during late 2000 and early 2001 looked at long-term contracts with DWR as the obvious way to go. At first they were rebuffed. DWR's initial request for proposals specified a minimum generating unit size of 50 MW. This excluded all of the candidate biomass facilities that were trying to restart.

In parallel with the state's efforts to negotiate long-term contracts with large generators, the CPUC developed a program to allow biomass facilities operating under old standard offer PPAs to select a five-year fixed price payment of 5.37 ¢/kWh, instead of being paid at variable short-term market rates. Many, but not all, of the biomass facilities operating under standard offer contracts accepted this offer, and began receiving the fixed price payments beginning in July 2001.

At this point the biomass power plants in California could be divided into two functional groups based on their power sales arrangements. The first group, which included most of the facilities operating under the old standard offer PPAs, had fixed price agreements that would cover the next five years, with prices that were high enough to ensure their continued ability to operate throughout this period. The second group, which included a few of the facilities that had operated continuously during the 1990s, and most of the facilities that were in various stages of restarting, were stuck without long-term PPAs. The operating facilities in this group were selling their output on the short-term market, where prices were in the neighborhood of 10 ¢/kWh during the spring of 2001. Many of the facilities in this group were actively trying to negotiate long-term contracts (five years or more) with the DWR. A few were content to remain players in the short-term market.

Available power supplies for the California grid remained at very low levels during the spring of 2001, as unusually large numbers of the state's fossil fuel-fired power plants seemed to be out of operation for servicing, many for prolonged periods of time. Rolling blackouts of two or three hours duration each were imposed on many PG&E customers, despite the fact that spring is traditionally a period of low electrical demand in the state. Rumors and charges began to surface that some of the state's largest generators were manipulating their production units to game the market. The state was pleading with FERC to impose price controls on the wholesale market, but the FERC still refused to respond. The situation was rapidly coming to a boiling point.

By the beginning of the summer of 2001, the DWR had signed about forty long-term contracts with generators for more than 10,000 MW of power. Although the contracts were not made public, prices were rumored to be in the range of 7 - 10 ¢/kWh, with terms ranging from 2 - 10 years. One re-starting biomass power plant was among the recipients of the first set of DWR contracts, and was already firing fuel. Seven of the biomass restarts were now actively engaged in negotiations with DWR. The other two attempted restarts, twin 10 MW facilities near Chowchilla (Chow II and El Nido), had already suspended their restart efforts.

The newspapers continued to be full of dire warnings of looming summer blackouts. The crisis was beginning to spread to the entire Western United States, and electricity supplies were reportedly strained in the Northeast. The Governor pushed hard for conservation in California, and for FERC price caps to be imposed in Washington. Finally FERC acted and imposed price caps on the wholesale electric market in the western United States.

The Crisis Evaporates as Suddenly as it Appeared

Then something totally unexpected happened. The long-dreaded summer of 2001 arrived. But wholesale energy prices fell from May to June by more than a third, despite the fact that it was the beginning of the peak demand season. By the middle of the summer, prices had fallen below four cents per kWh, which was within the range of pre-crisis levels. Not one blackout occurred during the entire summer. A combination of factors,

including aggressive conservation efforts by consumers, an economic recession, an unusually cool summer, the long-term contracts signed by the DWR, the end of the drought in the Northwest, and the breaking of the bottleneck in the natural gas market, seemed to have combined to knock out the energy crisis. The FERC price caps were reached a couple of times soon after their imposition, then quickly became irrelevant. By late summer there were grumblings that the state had signed too many contracts at too high of prices. There were even periods when the state was purchasing more contract electricity than it could use, and had to sell the excess into out-of-state markets at a loss.

More than 99% of the long-term contracts signed by the state in the spring of 2001 were for energy generated from natural-gas fired power plants, a result of the crisis atmosphere that had been in effect when the DWR began to seek long-term power supplies. Due to size and other considerations, renewables had been put on the back burner in the spring, and were just coming up for consideration at the DWR as the summer reached its peak, and the energy crisis ebbed.

Timing was distinctly against the biomass facilities seeking power contracts. The DWR was coming under fire for the contracts they had already signed with the natural gas generators. Negotiations for additional long-term power purchase contracts suddenly ground to a halt, even in cases where there were signed letters of intent. Biomass project proponents complained that their questions went unanswered, and their phone calls were not returned. With the exception of Soledad, all of the facilities attempting to restart, as well as several operating biomass power plants that did not have standard-offer PPAs, found themselves relegated to selling into the short-term market at prices that were insufficient to cover their fuel and operating costs.

December 2001 was the sixth consecutive month in which short-run avoided cost rates were insufficient to cover the operating costs of biomass power generation. The group of facilities that did not have long-term contracts were nearing the end of their ability to hang on. Two restart projects, Capital Power Ione, and Imperial Power Brawley, were able to finalize contracts with DWR during the last months of 2001. They both came to terms that were substantially less favorable than those that had been granted to natural gas generators earlier in the year. Capital Power, on the basis of its DWR contract, never was able to secure financing to initiate operations, while Imperial Power did startup, but shut down again in 2002, and has no plans to resume operations.

Recognizing that long-term contracts were not going to be available anytime soon, the DWR signed 90-day interim contracts with eleven biomass facilities before the end of the year, with a common intention to enter into long-term contracts as soon as it became possible to do so. The interim contracts were given a series of extensions, carrying them into mid-2003. The DWR's authority to contract expired at the end of 2002, so these contracts have been extended as far as they could go, and have now expired.

The interim contracts provided for average revenues of 6.5 ¢/kWh, differentiated by time-of-use and seasonal factors. The payment level covers both energy and capacity, and as such is below the level earned by the facilities with old standard offer utilities contracts

(5.37 ¢/kWh energy plus 2.0 ¢/kWh capacity), and on the low side of the range of the legitimate costs of energy production from biomass (see, e.g., Morris 2000).

California currently has thirty-one biomass power plants in operation, representing a total of 631 MW of electricity generating capacity. Figure 9 shows the current map of California's biomass generating facilities. Approximately two-thirds of the total are operating under old standard-offer power purchase agreements with fixed energy prices that will remain in effect through the middle of 2006. These facilities are well served by their contracts, and should be able to operate viably through July 2006. The other one-third of California's biomass power plants are operating under a variety of arrangements. The long-term fate of this group of facilities is a function, in large part, of whether they are ultimately able to obtain longer-term contracts with adequate power purchase provisions.

The Future of the California Biomass Power Industry

The California RPS Program

Natural gas shortages helped to trigger the California energy crisis. Natural gas-fired generators were the worst manipulators during the crisis. Nevertheless, ninety-nine percent of the long-term power purchase contracts signed by the DWR were for electricity produced from natural gas. Renewables, which provide almost 10% of the state's electricity supply, were virtually shut out of the DWR process. Of the ten idle biomass facilities that initiated startup activities during the crisis, only three were able to obtain long-term PPAs with the DWR, and two of those contracts turned out to be inadequate to allow operations to proceed. Four of the attempted restarts abandoned their efforts, and the other three started up with short-term contracts with the DWR. The problem for renewables was that, with the DWR already exiting the long-term contracting arena by the middle of 2001, direct access suspended, and the utilities either bankrupt or on the brink, there was no credit-worthy buyer for a new renewable project to contract with. Many promising renewable generation projects were simply left adrift.

In order to bring some amount of balance to the situation, California enacted a Renewable Portfolio Standard (RPS) during the summer of 2002 (SB1078). SB 1078 seeks to double the contribution of renewable energy production to the state's electricity supply over a fifteen year period, from the current level of approximately 10% to a target level of 20%. The RPS program covers the entire state's electricity supply, which means that it has to be applied in several different jurisdictions, by a variety of state and local agencies. The CPUC is expected to lead the way with respect to utility regulation, with public utilities expected to follow with the development of their own programs. The California Energy Commission (CEC) is charged with a variety of support and compliance functions, including certifying and tracking renewable energy production, and designing and administering the system to use public goods charge funds to provide incentives for renewables.

The CPUC and CEC have each opened rulemakings to implement the RPS at their respective agencies. The rulemakings are coordinated, and the agencies have designated a collaborative staff to work on the various issues of mutual concern. The collaborative staff issued a proposed work plan in February. The plan identified all of the functions that each agency was charged with performing by the end of 2003, and divided them into three categories: those needing immediate action, those needing action in the mid-term (by the end of June), and those that could wait until the second half of the year.

The legislation required the CPUC to report to it by the end of June 2003 on four specific issues:

- compliance and flexible compliance rules
- standard contract terms and conditions
- least cost and best fit bid ranking
- setting of the market referent price

The workplan provided for workshops on each of these topics, on four consecutive Tuesdays during March. Following the workshops, the sixteen participating parties, including the Green Power Institute, filed testimony on the four topic areas, which was followed by hearings, briefs, and reply briefs. On May 20, the CPUC issued a Proposed Decision (PD) on the four issues, which itself elicited comments, reply comments, and a proposed Alternative Decision (AD). The PD and AD were both revised, and brought before the Commission on June 19, 2003. The two documents differed only with respect to the issue of flexibility in compliance requirements, with the AD proposing compliance rules that are more stringent for the utility companies. The CPUC voted unanimously for the AD, which has been designated Decision 03-06-071 in Rulemaking 01-10-024.[3]

Decision 03-06-071 has many features that will affect the current and future biomass energy industry in California. Many elements of the decision are highly favorable to the existing biomass generators. For example, the decision reinforces the importance of the existing renewable generating infrastructure in the state, and requires utilities to maintain their existing base of renewable procurement, or face having to replace their losses in addition to acquiring a specified amount of new renewable generators each year until the level of 20% of the overall energy supply is attained, and then maintained. This was a heavily litigated issue, as both SCE and PG&E maintained that their only requirement for new procurement was the specified annual increment of 1% of retail sales, regardless of what happened to their existing supply portfolio. If the utilities had prevailed, electricity from existing renewables generators would have been effectively cut out of the RPS program, and the utilities would have had little incentive to work cooperatively with these facilities.

During the RPS proceeding at the CPUC, California's two largest utilities, PG&E and SCE, argued for compliance rules that were so flexible that the ultimate goals of the RPS program would have been placed in serious risk. Instead, the Decision adopts

[3] http://www.cpuc.ca.gov/WORD_PDF/FINAL_DECISION/27360.PDF

compliance rules that allow for a reasonable amount of flexibility while applying sufficient rigor to ensure that ultimate compliance can be achieved. Adopting unlimited forward banking of RECs, combined with limited rights to under-procurement, will help to maintain the market value of electricity from existing biomass and renewable generators.

One of the interesting aspects of the RPS proceeding was that many of the parties, including the utilities and several consumer and environmental advocates, favored the concept that a Renewable Energy Certificate (REC), which is the accounting tool that was adopted for the RPS, would include all of the non-energy attributes of renewable energy. Such a finding could threaten the financial viability of many biomass power generators by depriving them of the right to market the ancillary waste-disposal benefits they produce. It would also be contrary to prior efforts by the legislature to encourage cost-shifting measures for biomass power generation, many of which involve separating some of the environmental benefits of renewable energy from the attributes required for compliance with the RPS program. Due to the efforts of the Green Power Institute, as well as other parties, the Decision leaves the definition of a REC open, and recognizes the principle that the environmental products produced by a generator should be marketed separately from RPS-qualifying renewable energy (D.03-06-071, page 62).

Prospects for a Biomass Policy in California

Biomass power generators in California have long recognized their predicament, which is that generating electricity from biomass is inherently more expensive than generating electricity from fossil fuels or hydro power. At the same time, a variety of sources have demonstrated that biomass power generation produces ancillary waste-disposal services that, although not usually compensated, are worth considerably more than the electricity produced. An NREL report written just prior to the energy crisis (Morris 2000) lays out the case for why California needs an integrated biomass policy that coordinates the work of a variety of agencies and jurisdictions. While initiatives and committees have come and gone, a comprehensive approach has never materialized.

The California biomass power industry pioneered the concept of a renewable portfolio standard when they introduced legislation during the mid-1990s that would have created a minimum purchase requirement for biomass energy of 1½%, which was its contribution to the state's electricity supply at that point in time. At the time, the CPUC was engaged in their electric utility restructuring proceeding, and in 1996 an RPS had been incorporated into the CPUC's restructuring plan. While details were never finalized, some versions of the CPUC's RPS program included a specific tier, or allotment, for biomass. The state RPS program was derailed by the legislature's adoption of its own deregulation plan, but when that program was abandoned in the wake of the state energy crisis, a state RPS program was resurrected and passed in 2002. While the California RPS program offers some attractive features for existing biomass generators, it does not differentiate among renewable power sources, and thus may not do much to promote any significant growth of biomass power generation in the state in the absence of additional policy support for biomass.

While a comprehensive state biomass policy has not coalesced, a number of policy initiatives have been enacted that provide support for targeted forms of biomass utilization. Policies aimed at reducing air pollution from the open burning of agricultural residues, diverting usable forms of solid waste from landfill disposal, and improving the health and fire resistance of California's forests, are all components of what a comprehensive biomass policy might entail.

One of the early policy initiatives undertaken by former Governor Gray Davis was an economic development program for the San Joaquin Valley launched in the spring of 2000. The initiative included a number of environmental components. Of particular relevance to the biomass energy industry was a grant program for diverting agricultural residues that were then not being used as fuel in appreciable quantities, such as orchard prunings. Agricultural residues that were already well represented in the biomass-fuel marketplace, such as whole-tree chips from orchard removals, were not eligible for the grants. The Ag Grant program was initially funded with $10 million for the first year of the program (state fiscal year 2000-2001), and grants were made for the use of qualifying fuel for up to $10 per ton. The following year the program was funded at a level of $11.5 million, but after functioning for two years it was allowed to expire.

During the summer of 2003, the legislature, through SB 704, created a new grant program for agricultural residues. This measure, which at publication was awaiting signature from the governor, will make $6 million available in fiscal year 2003-2004 to support the diversion of residues from open burning to use as fuel, making grants of up to $10 per ton of material diverted, as in the previous program. The funding for SB 704 comes from public-goods charge monies collected in accordance with SB 90, but not dispersed under their original allocation. Future funding for the program is highly uncertain, considering California's current fiscal situation.

The open burning of agricultural residues has long been known as a major source of air pollution in California's agricultural valleys. However, the right to burn as a part of regular agricultural practice is a cherished right of farmers, and limiting open burning can only be accomplished at a cost (unregulated burning is the lowest-cost disposal option). This has made the task of improving air quality in agricultural regions of the state very difficult.

Rice-straw in the Sacramento Valley was the first agricultural residue to come under intense pressure to prevent open burning. The California Air Resources Board (CARB) funded millions of dollars of research during the 1990s aimed at developing beneficial use options for the disposal of rice straw. Options studied included a variety of building materials applications, and conversion to ethanol or electricity. To date, no major commercial application has come forward to relieve the state of its rice straw disposal problem. Nevertheless, rice straw burning was banned as of September 2001. As a result, the state's rice farmers are left with a difficult disposal problem. Many are incorporating the straw into their soil. This practice uses large amounts of water as an additional flooding of the fields is required after incorporating the straw. In addition to increased

water use, the practice is causing an increase in disease problems in treated fields, and is leading to significant levels of methane emissions from anaerobic decomposition. The other disposal alternative that is being used is baling and storage, which is leading to a legacy of unwanted piles of bales. Rice straw does not make a good fuel for solid-fuel combustors, so the existing power-generating industry is not a viable solution to the rice-straw disposal problem.

Air quality across the San Joaquin Valley is plagued by the open burning of a variety of agricultural residues, some of which are suitable fuels for solid-fuel combustors, such as orchard and vineyard prunings. The Ag Grant program described above has helped to bring some of this material into the biomass fuel mix, but the amount of material still being open-burned is considerable. In this year's session (2003), the California legislature passed a ban on all agricultural burning in the state (SB 705). At publication, the measure was awaiting signing by the Governor, which was expected to happen. SB 705 phases out open-field burning by 2010, and requires local air districts to help farmers find alternatives for disposing of agricultural residues. While the law leaves a good deal of discretion for enforcement to the local districts, it should provide an inducement to divert material to the biomass fuels market.

The major disposal option for unused biomass residues in California is landfill burial. However, state policy strongly favors minimizing the amount of material that is landfilled. In 1990 California passed a landmark landfill diversion law, AB 939, that mandates a 50% diversion rate for the state's solid waste as compared to the 1990 baseline, to be achieved by 2000. Although the statute limits, to some extent, the amount of material used for fuel that can be counted as diversion, for the most part the law has promoted the diversion of a significant portion of the state's waste-wood stream from landfill disposal to use as a fuel. Although the deadline for compliance has come, about half of the State's Counties are not in full compliance with the law. The law's enforcement mechanism, which entails draconian fines for cash-strapped public entities, is not being used. If some mechanism can be applied to move more jurisdictions into compliance, that could only have a positive effect for the state's biomass fuel supply.

California's forests are in rather poor condition today. Extensive stands are severely overstocked with both live and dead biomass material, and as a result are at severe risk of destructive wildfires, and are not providing the level of ecosystem services that healthy forests provide, such as wildlife habitat and functioning watersheds. Federal forestlands, which account for approximately half of California's commercial forests, are in considerably worse condition than state and private holdings. There has been a good deal of talk over the past few years at the U.S. Forest Service (USFS) about the need to perform thinning operations of all kinds on federal lands, in California, and throughout the West. Federal funds have been allocated to perform treatments on federal forestlands, and studies are underway. However, there is little evidence in the field of increased thinning activity on USFS holdings. Forestry contractors in California are anxious to go to work on timber stand improvement operations, however many are so discouraged by the lack of available projects that they are talking about selling their equipment and closing shop. In-forest residues represent the state's most extensive under-tapped source

of additional biomass fuel. The value of using this material is much greater than the value of the electricity that can be derived from it, and significantly less that the cost of delivering it to the market (Morris, 1999). Thus, a serious program of funding for increased forest thinning would be highly desirable.

At the present time, there is sufficient unused capacity in the state's existing biomass power industry to accept a limited amount of additional fuel, should current or proposed programs increase the supply of targeted fuels (see Figure 10). Ultimately, however, incentives to increase the use of targeted types of biomass fuels will lead to a zero-sum process, in which other types of biomass will be squeezed out of the marketplace, unless additional idle biomass facilities in the state are restarted, and/or new biomass facilities are built. That will not be easy, for a couple of reasons. First, new facilities are expensive, and require higher revenues than existing, amortized facilities. Second, expanding the use of biomass fuels in the state will cause the average cost of fuel in the state to increase in accordance with the observed state biomass fuel supply curve, as shown in Figure 11. These factors need to be taken into account in the design of an integrated biomass energy policy. The amount of increased production of forest residues alone that could be recovered from thinning operations could easily exceed 250 MW equivalent, if sufficient incentives were enacted to underwrite the program. The existing industry alone could not absorb the amount of residues that could be produced if a strong and funded biomass policy was put into effect. As far as we can see, however, there is little chance of that happening in the near future.

Use of New Biomass Technologies in California

California's biomass power plant developers have shown themselves to be willing to innovate, and have repeatedly expressed interest in future technological innovations, subject to the understanding that they have to operate in a sound business environment. During the 1980s, when the major part of the industry's development took place, seventeen California biomass power plants were built with fluidized-bed combustors. This represented more than 50% of the total global installation of these units during this period, and was a major contributor to the advancement of the technology. Fluidized-bed combustion is still considered state-of-the-art with respect to efficient and low-emissions combustion of solid biomass fuels.

Only a few new biomass power plants have been built in California since the end of the development cycle that was spurred by the 1980s PPAs. One new project that started up in 2001, a seven MW project built by Sierra Pacific Lumber Co. at their sawmill in Anderson, utilizes a close-coupled gasifier / combustor technology. This technology has the potential to decrease emissions below the level achievable with a fluidized bed, and may contribute to the deployment of gasifier technology in the future.

As interest has grown in developing technology to convert cellulose to ethanol, ethanol developers have become interested in the possibility of co-locating ethanol production facilities with existing biomass power plants. Co-location would allow each process to share facilities and coordinate operations, with benefits for each (see, for example, Morris

2002b). Several California biomass generators have shown an interest in exploring co-location options, with two or three having conducted comprehensive engineering studies for projects at their sites. Ethanol-from-cellulose has not yet achieved competitiveness with grain-based ethanol produced in the mid-west, so these projects have not been able to move forward.

California's biomass power producers recognize that their costs of operations are higher than those of their fossil-based competitors. While they have managed to persevere through wild and wooly changes in the electricity market, they understand the precariousness of their position. For this reason alone, they are always open to the possibility of incorporating new technologies and processes into their operations that will allow them to increase their competitiveness. Indeed, significant new development of biomass generating capacity in California appears unlikely in the current environment, unless new technology becomes available that can increase efficiencies and/or decrease the costs of operations.

Conclusion

California currently has thirty-one biomass power plants in operation, representing a total of 631 MW of electricity generating capacity. This is less than the 750 MW that were operating during the beginning of the 1990s, but considerably more than the 540 MW that were operating during the later 90s.

Approximately two-thirds of the state's operating biomass facilities are operating under old standard-offer power purchase agreements with fixed energy prices that will remain in effect through the middle of 2006. These facilities should be able to operate viably until their fixed-price periods expire, then they will have to make other arrangements to continue operating. The CPUC's reinforcement of the RPS program's rules requiring utilities to maintain their baselines as part of their overall compliance requirements will maintain pressure on the utilities to deal with these facilities when the expiration date comes.

The other one-third of California's biomass power plants are operating under a variety of shorter term power sales arrangements. Short-term prices have been relatively high in California during 2003, so most of these facilities have been able to persevere while they pursue longer-term arrangements. However, the immediate future of some of these facilities remains in doubt, more so than the future of the facilities that have longer term contracts.

California's ambitious RPS program is designed to restore the state's leading role in renewable energy production. Biomass energy production is one of the keystone resources in California's existing renewable energy infrastructure, and it has the potential to be a key contributor to the growth of renewable power production in the state. It has also become a key component of the state's solid-waste disposal infrastructure. However, converting biomass to electricity is expensive, and the future of biomass energy production in the state is dependent in large part on policy decisions that will be made

over the coming years. The RPS program by itself, which is designed to advance the lowest-cost renewables, may not be much of a stimulus to new biomass energy development in California if supplementary policy actions aren't taken to support biomass energy.

A variety of elements over the past decade have been attempting to foment an integrated biomass policy for California, which combines energy concerns with environmental and waste-disposal issues. So far little progress has been made, although several limited programs have been put into effect. Biomass power production reduces the open burning of agricultural and forest residues, and reduces the amount of material entering the state's landfills. It also promotes forestry treatment operations that improve the fire-tolerance of the state's forests, and increases their health and productivity. Although it is well documented that the ancillary benefits of biomass energy production are worth far more than the cost of providing incentives, establishing a biomass policy will be extremely difficult in the current budget climate.

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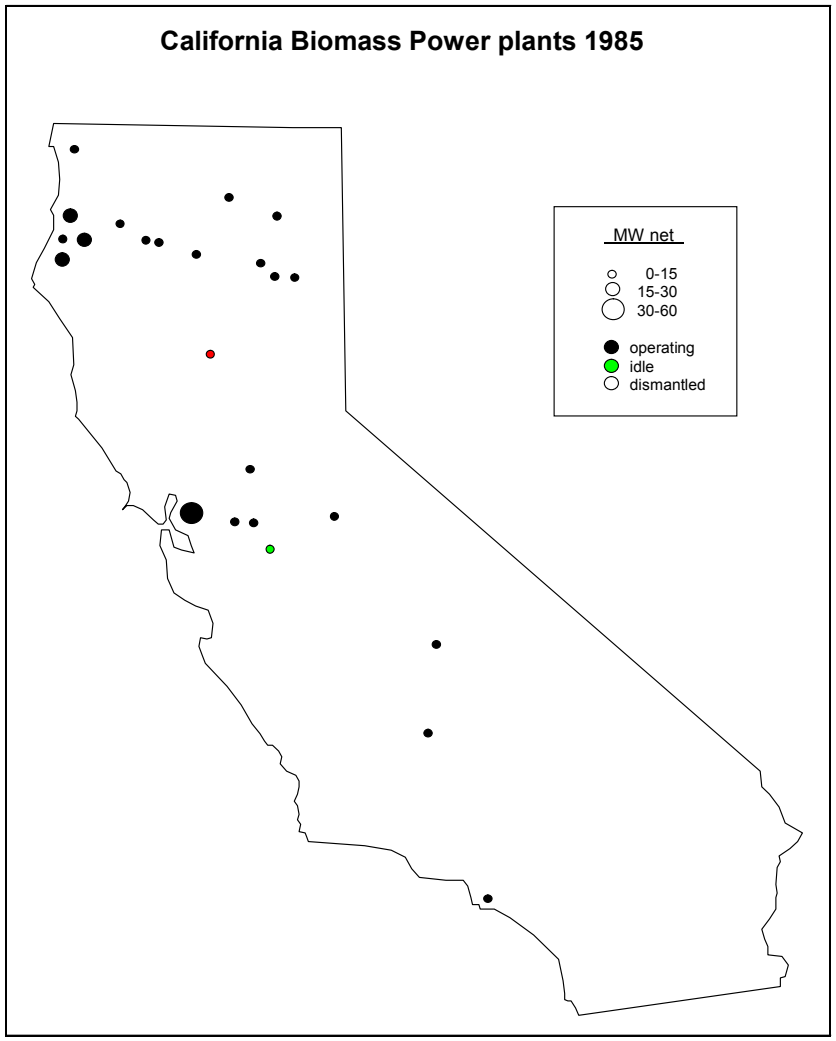
Morris, G., *Bioethanol Co-Location Study: August 15, 2000—February 28, 2002*, NREL Report No. NREL/SR-510-33000, November 2002b.

Figure 1


California Biomass Power plants 1985
MW net
0-15
15-30
30-60
operating
idle
dismantled

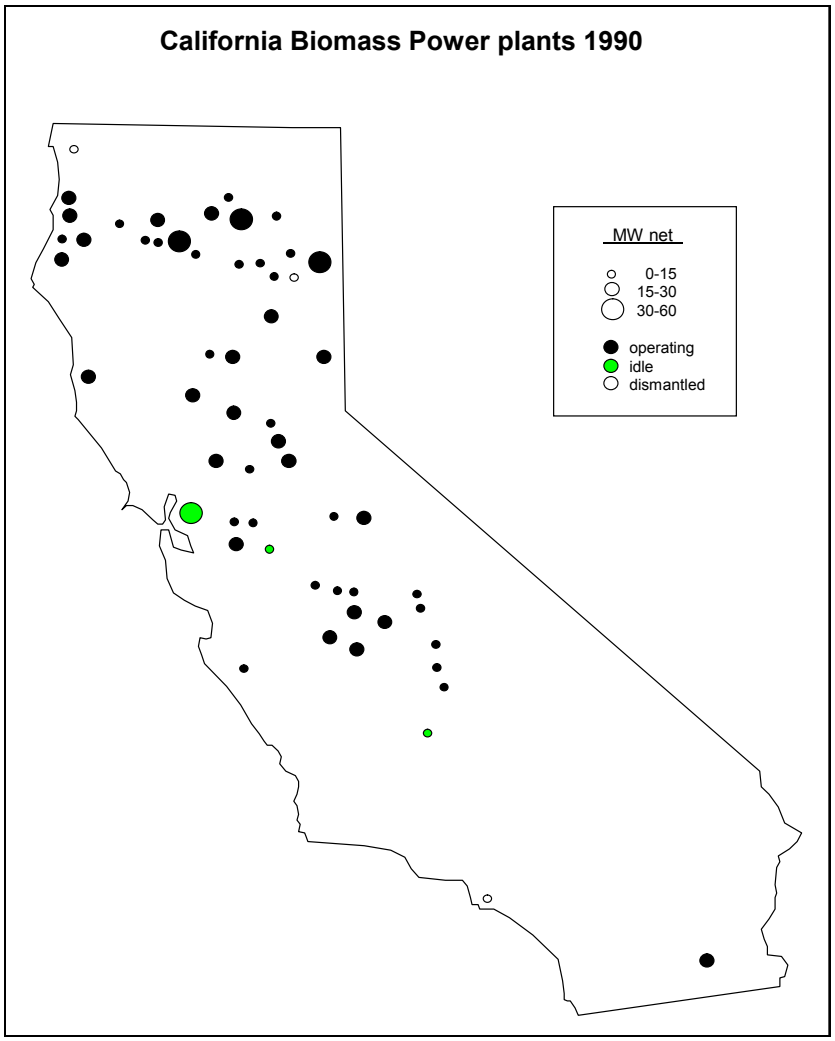

California Biomass Power plants 1990
MW net
0-15
15-30
30-60
operating
idle
dismantled

Figure 2

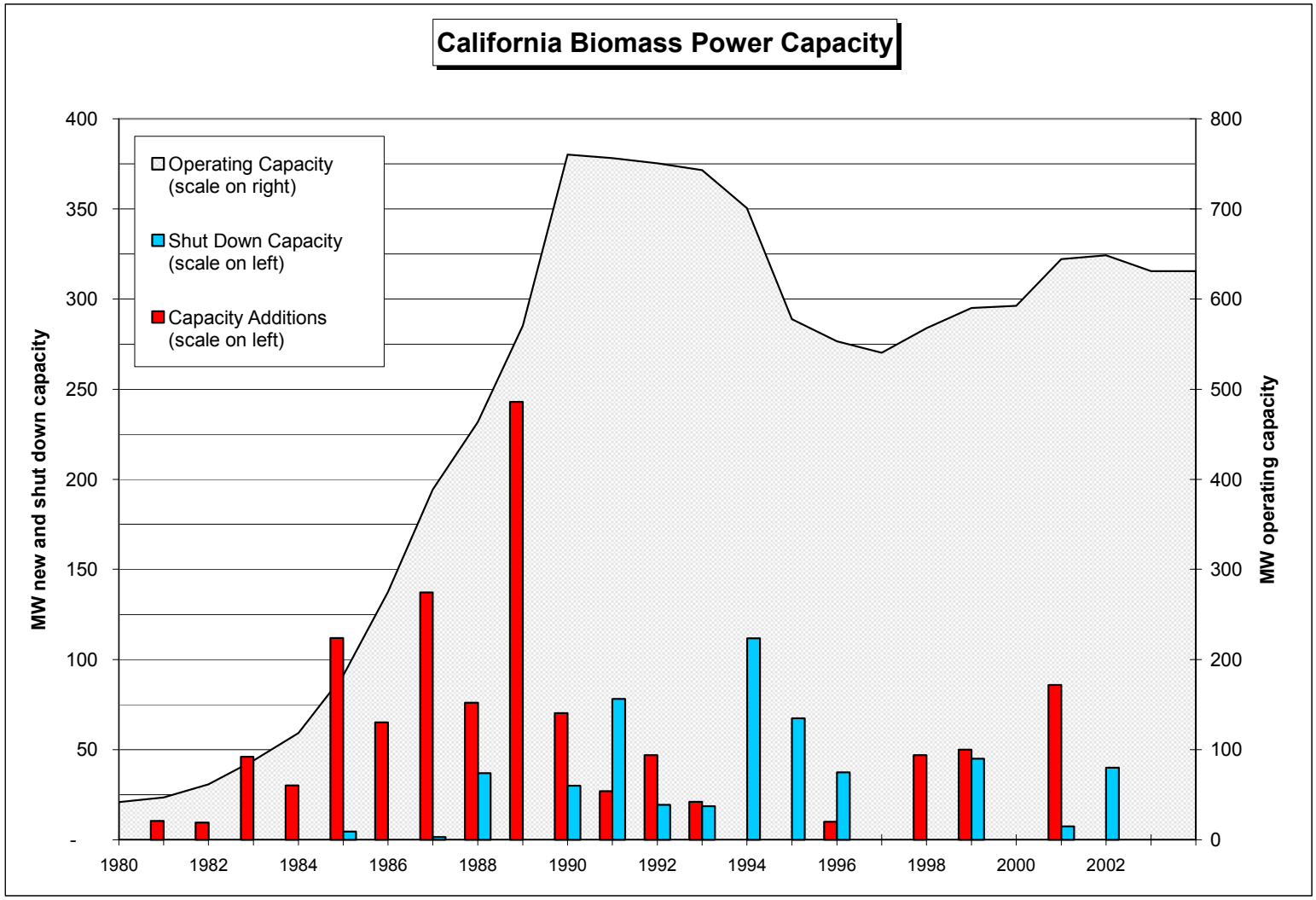

California Biomass Power Capacity
Operating Capacity (scale on right)
Shut Down Capacity (scale on left)
Capacity Additions (scale on left)
MW new and shut down capacity
MW operating capacity
400
350
300
250
200
150
100
50
-
800
700
600
500
400
300
200
100
0
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002

Figure 3

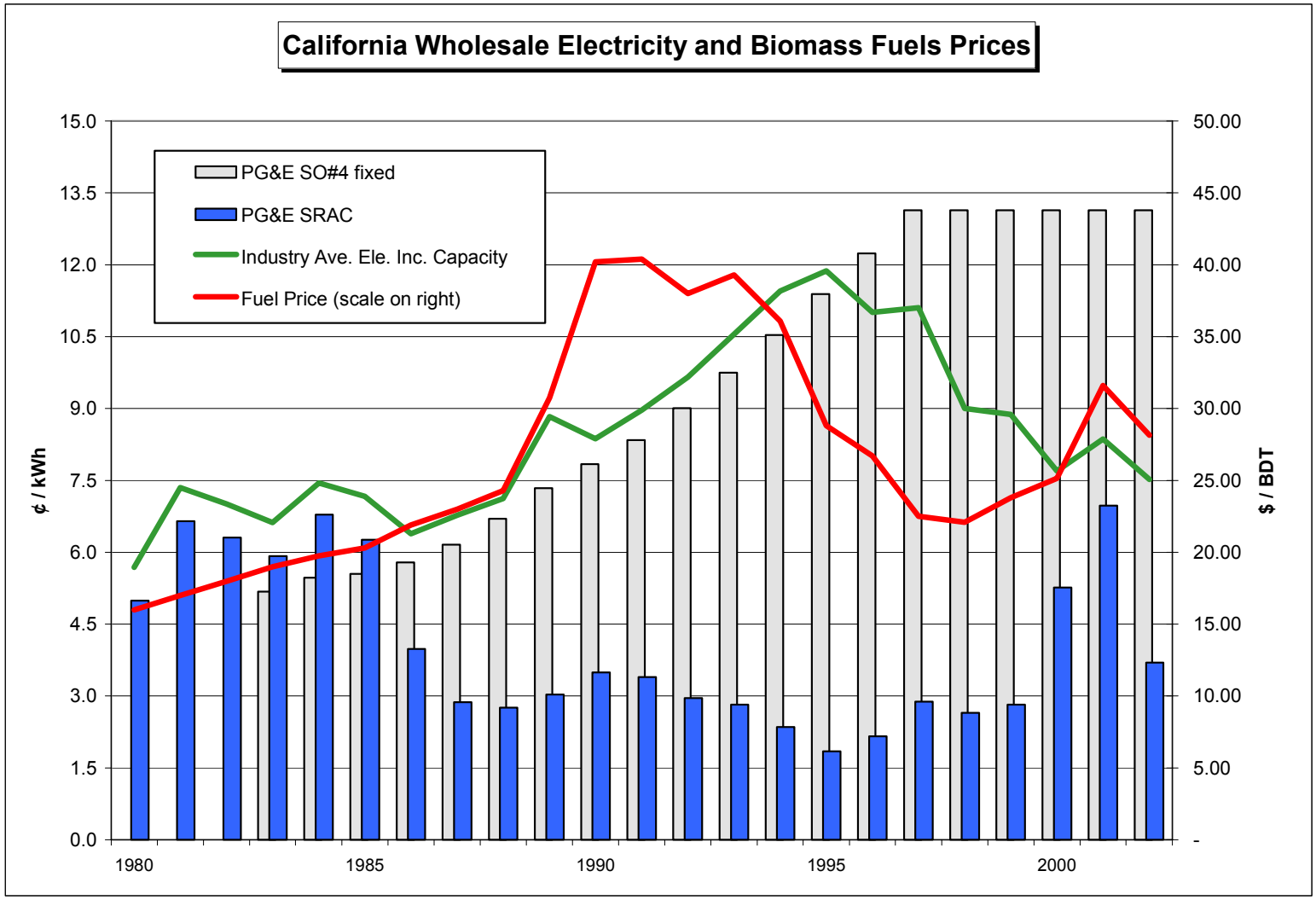

California Wholesale Electricity and Biomass Fuels Prices
PG&E SO#4 fixed
PG&E SRAC
Industry Ave. Ele. Inc. Capacity
Fuel Price (scale on right)
¢ / kWh
$ / BDT
15.0
13.5
12.0
10.5
9.0
7.5
6.0
4.5
3.0
1.5
0.0
50.00
45.00
40.00
35.00
30.00
25.00
20.00
15.00
10.00
5.00
-
1980
1985
1990
1995
2000

Figure 4

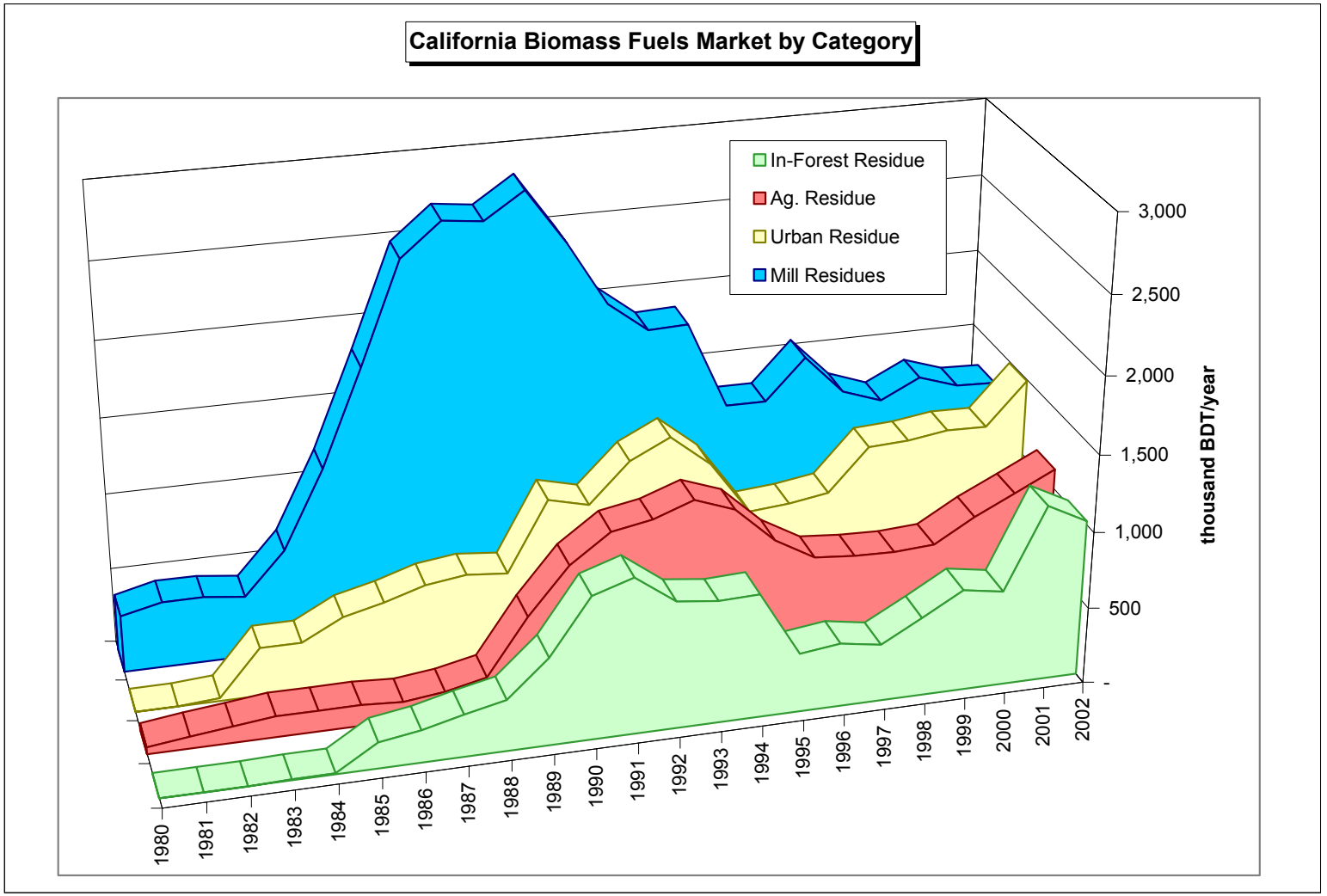

California Biomass Fuels Market by Category
In-Forest Residue
Ag. Residue
Urban Residue
Mill Residues
3,000
2,500
2,000
1,500
1,000
500
-
thousand BDT/year
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002

Figure 5

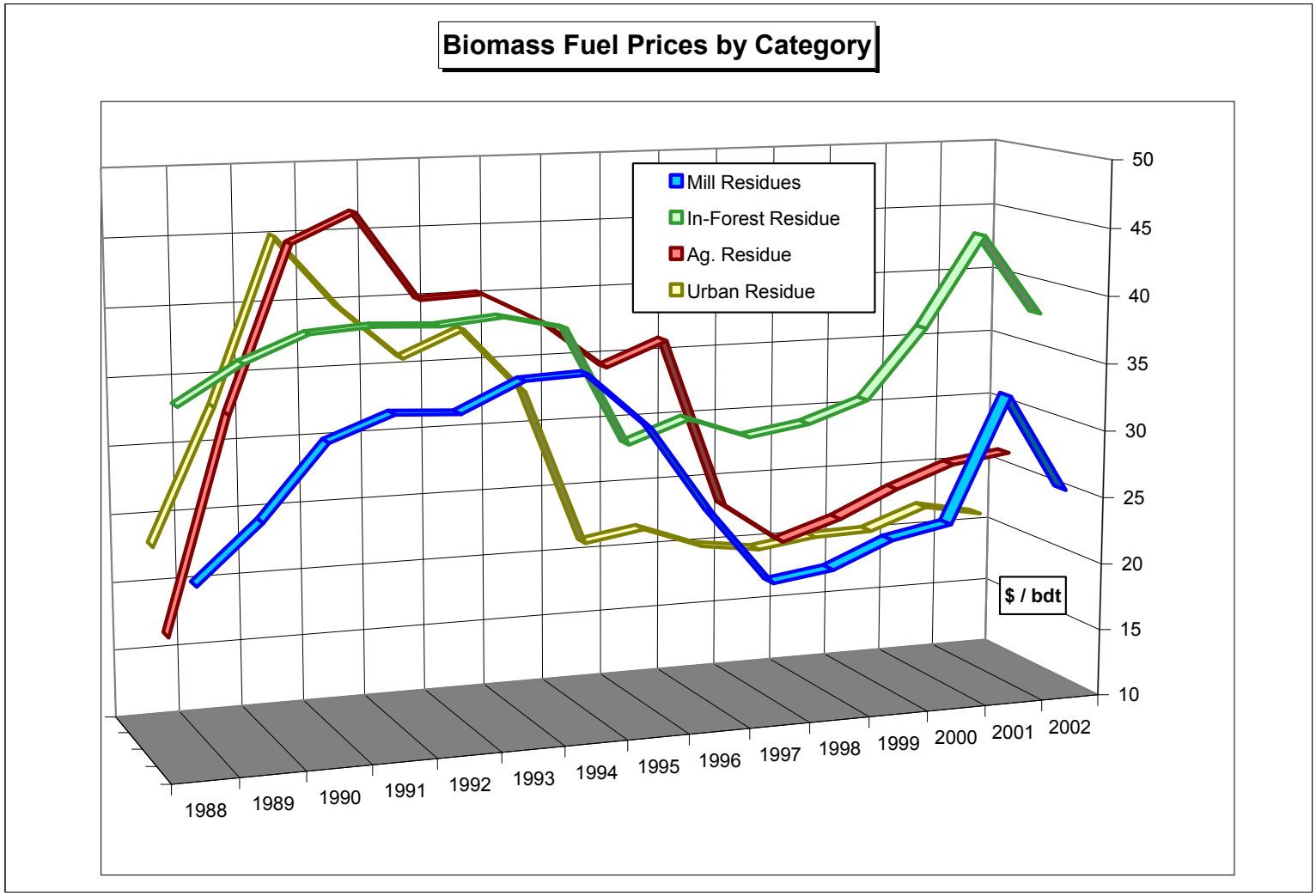

Biomass Fuel Prices by Category
Mill Residues
In-Forest Residue
Ag. Residue
Urban Residue
$ / bdt
50
45
40
35
30
25
20
15
10
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002

Figure 6

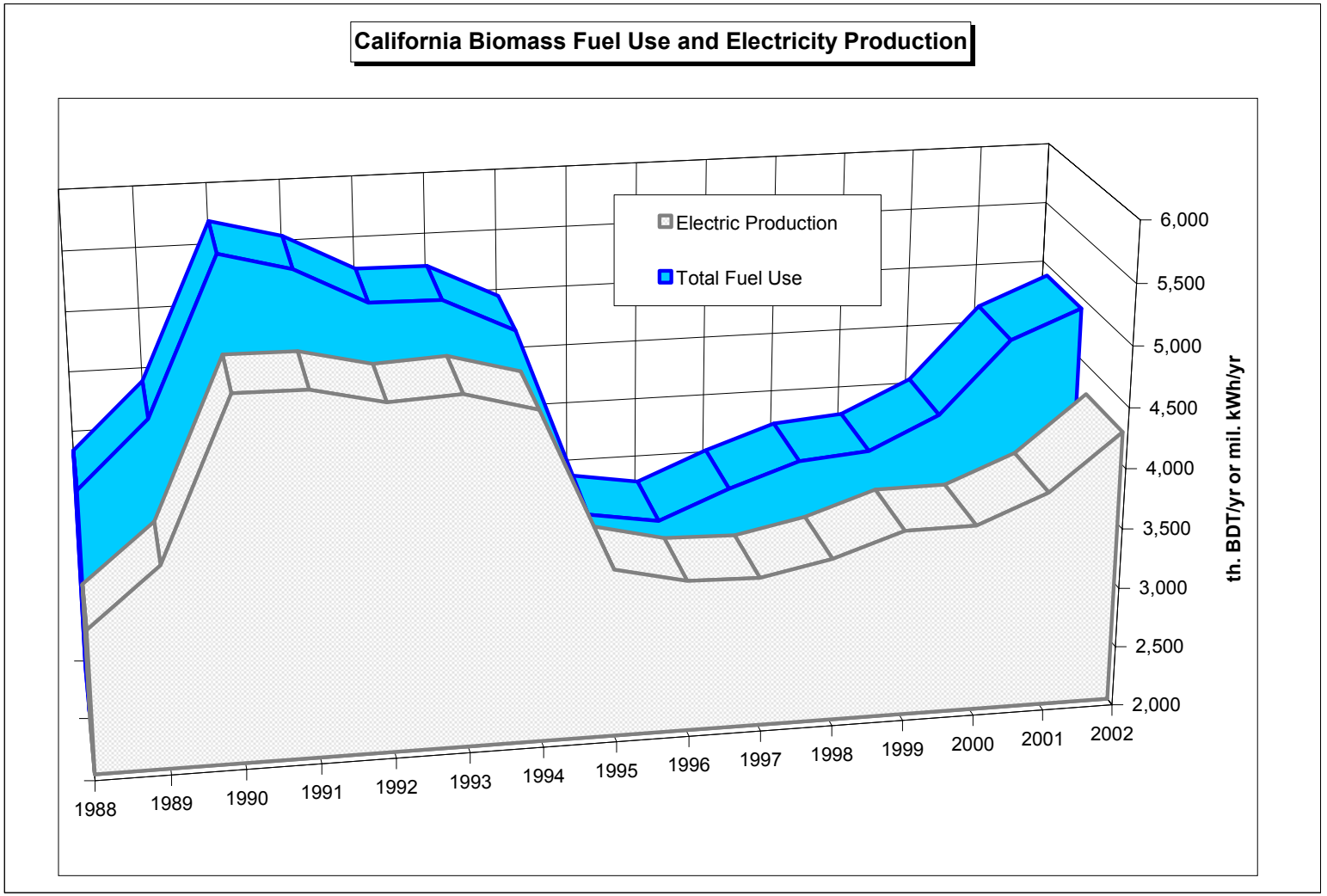

California Biomass Fuel Use and Electricity Production
Electric Production
Total Fuel Use
6,000
5,500
5,000
4,500
4,000
3,500
3,000
2,500
2,000
th. BDT/yr or mil. kWh/yr
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002

Figure 7

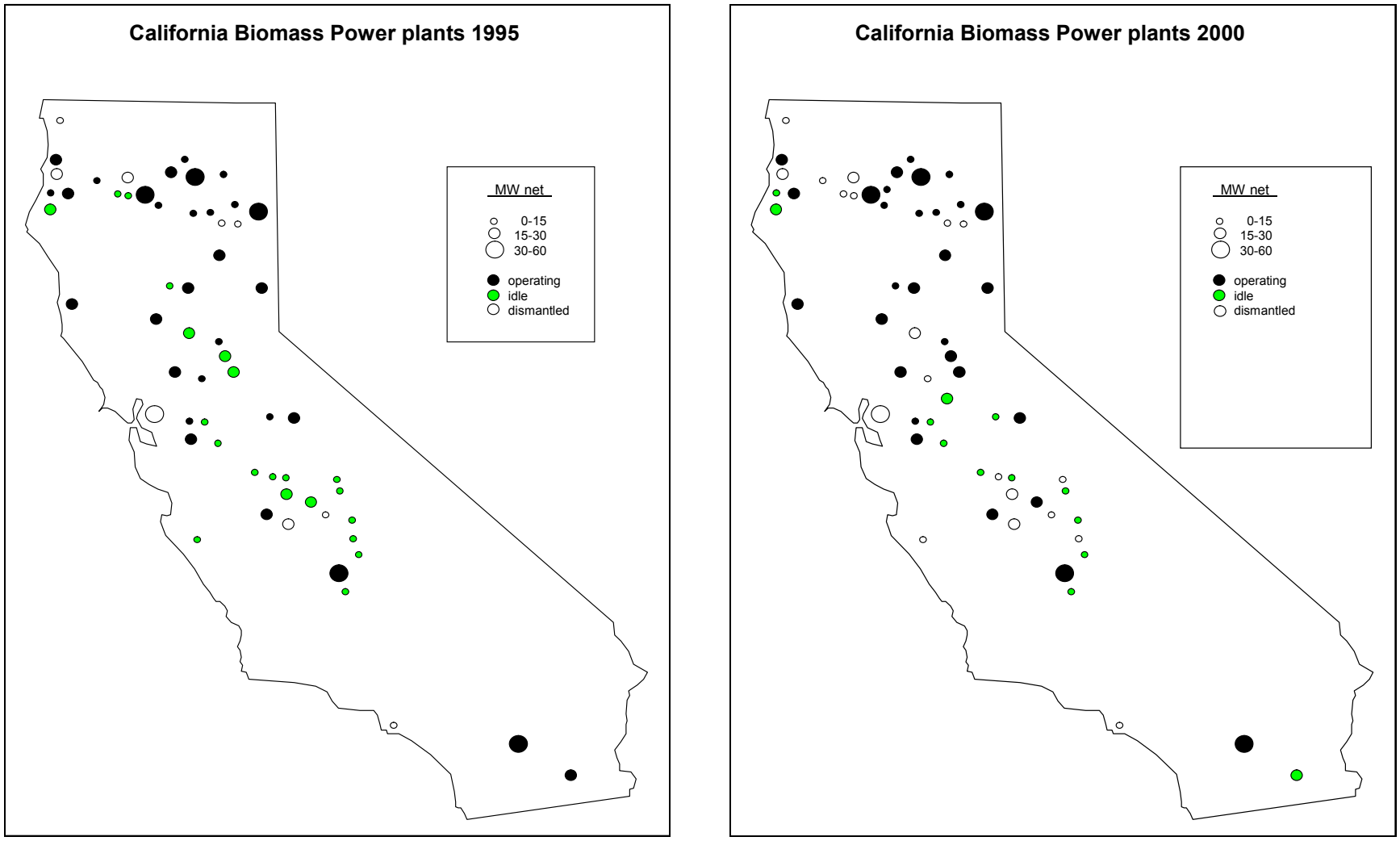

California Biomass Power plants 1995
MW net
0-15
15-30
30-60
operating
idle
dismantled
California Biomass Power plants 2000
MW net
0-15
15-30
30-60
operating
idle
dismantled

Figure 8

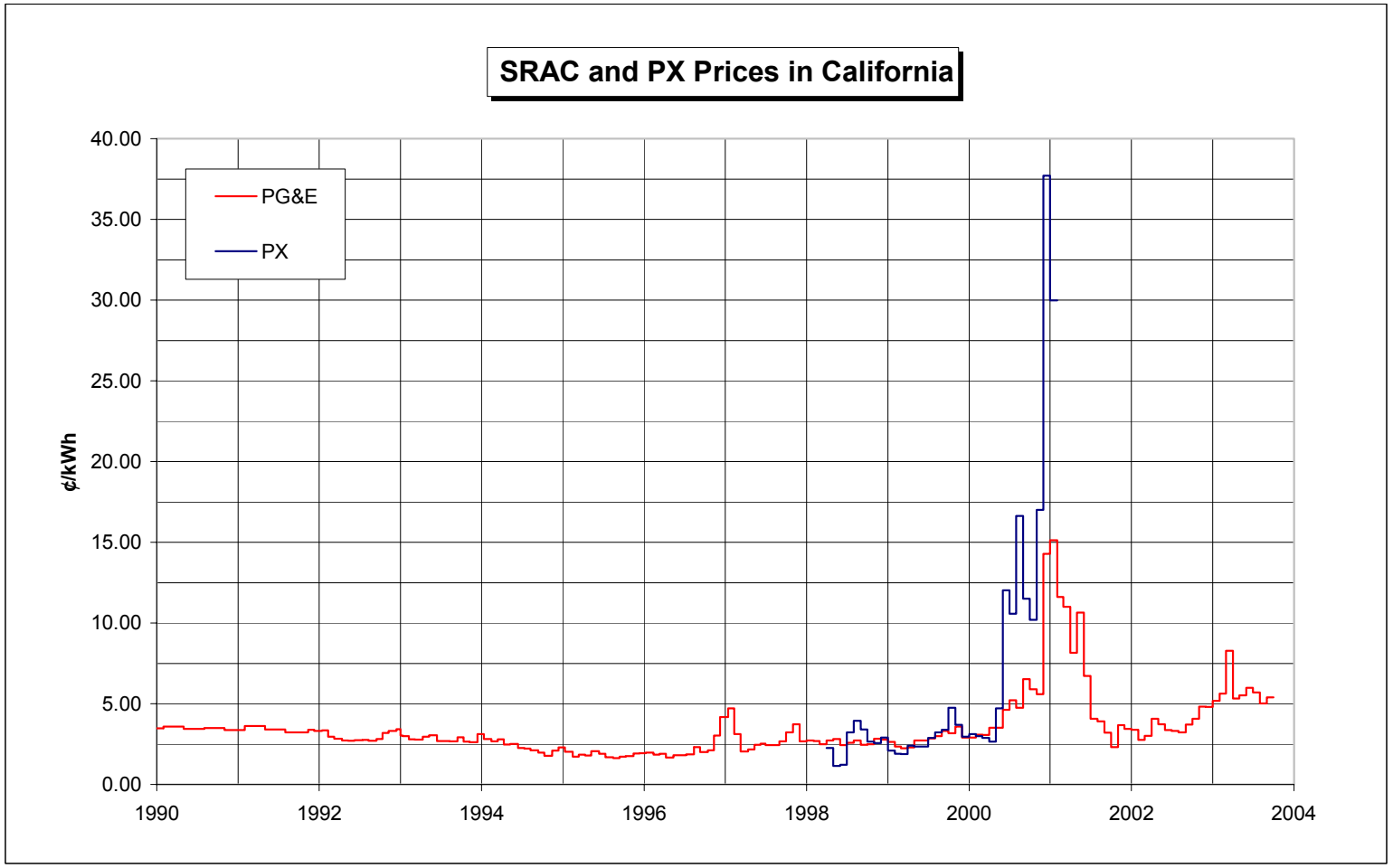

SRAC and PX Prices in California
PG&E
PX
¢/kWh
40.00
35.00
30.00
25.00
20.00
15.00
10.00
5.00
0.00
1990
1992
1994
1996
1998
2000
2002
2004

Figure 9

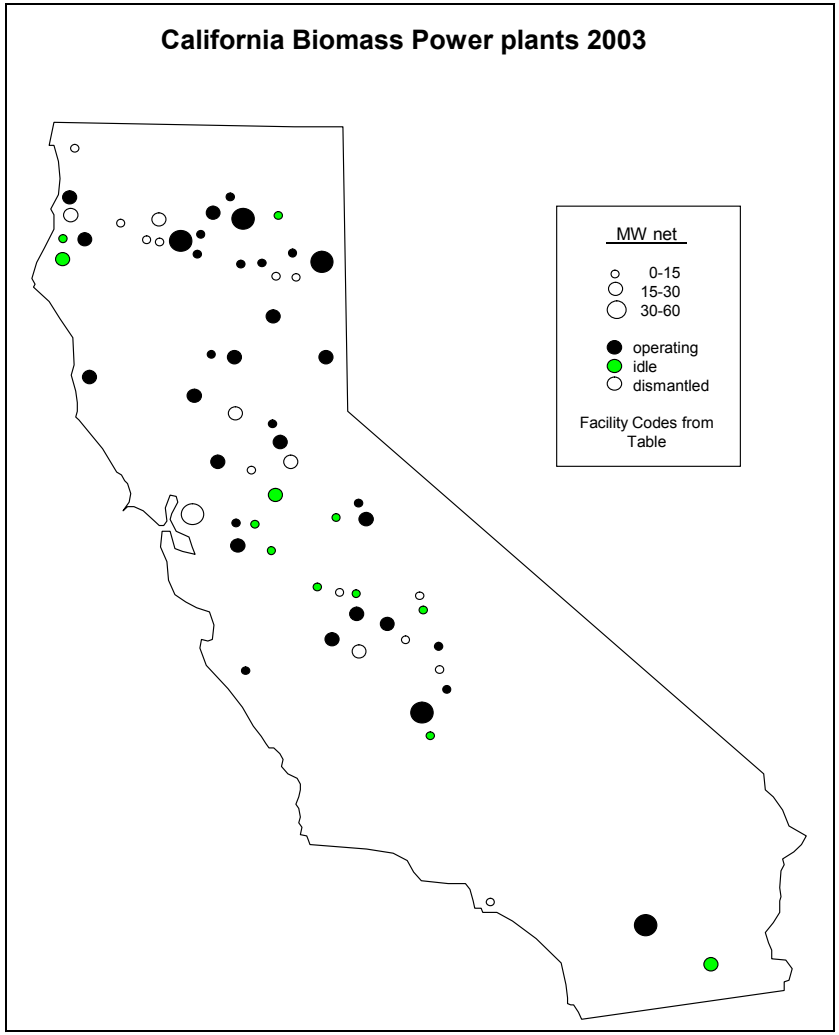

California Biomass Power plants 2003
MW net
0-15
15-30
30-60
operating
idle
dismantled
Facility Codes from Table

Figure 10

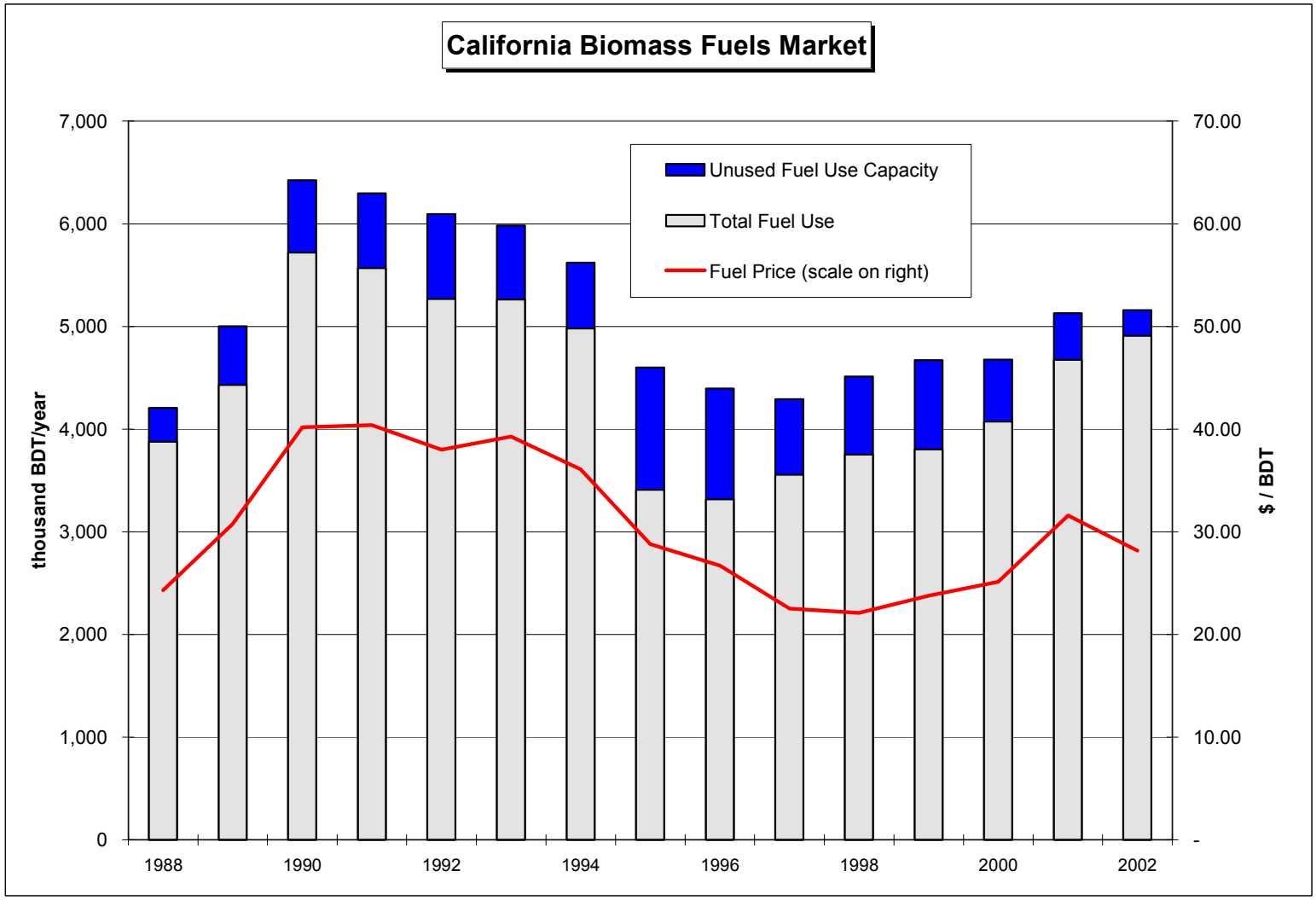
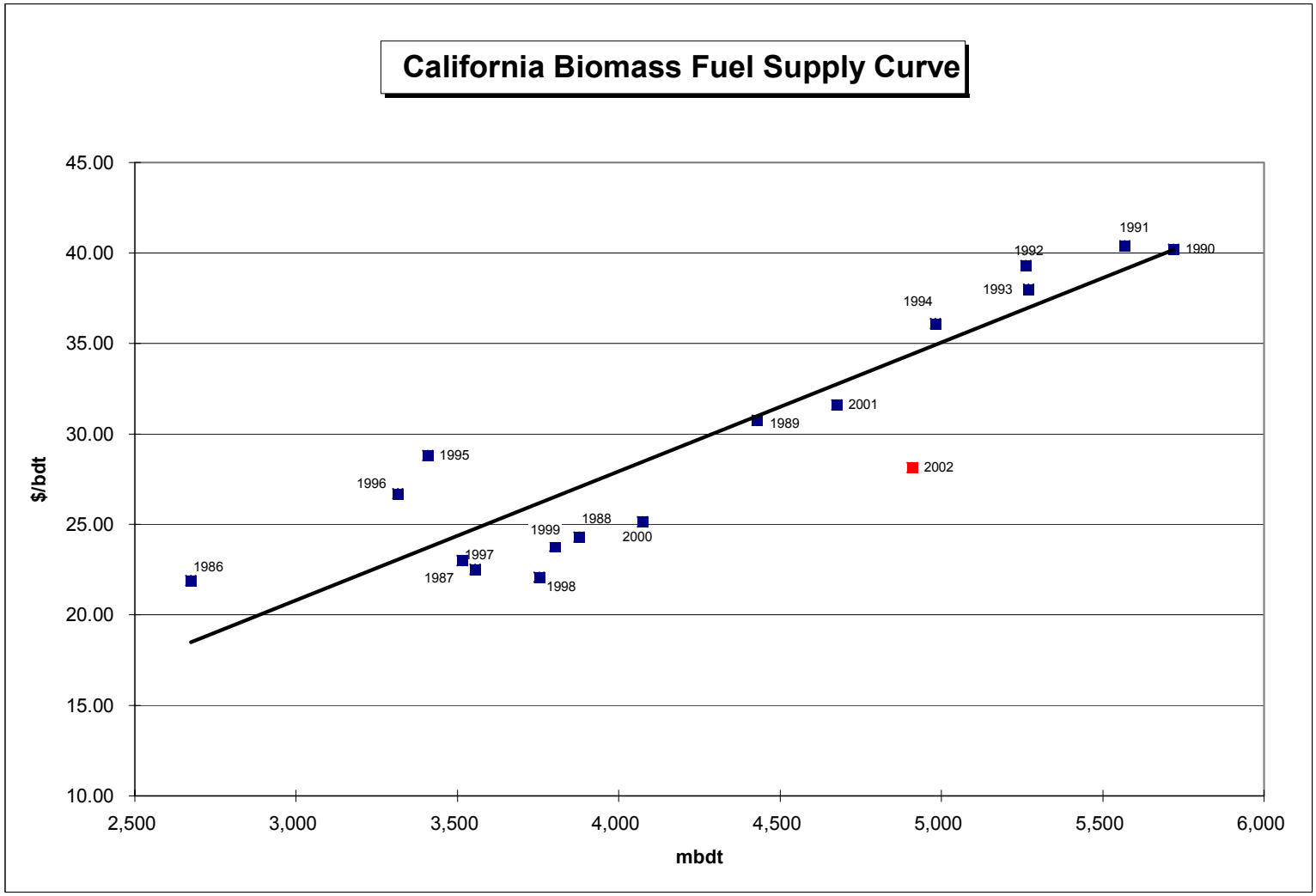

California Biomass Fuels Market
Unused Fuel Use Capacity
Total Fuel Use
Fuel Price (scale on right)
thousand BDT/year
$ / BDT
7,000
6,000
5,000
4,000
3,000
2,000
1,000
0
70.00
60.00
50.00
40.00
30.00
20.00
10.00
-
1988
1990
1992
1994
1996
1998
2000
2002

Figure 11


California Biomass Fuel Supply Curve
$/bdt
mbdt
45.00
40.00
35.00
30.00
25.00
20.00
15.00
10.00
2,500
3,000
3,500
4,000
4,500
5,000
5,500
6,000
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002

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13. ABSTRACT *(Maximum 200 words)*

This report describes the development of the biomass power industry in California over the past quarter century, and examines its future outlook. The development of a state biomass policy, which has been under discussion in California for the better part of the past decade, has never gotten off the ground, but a number of smaller initiatives have helped to keep the biomass power industry afloat and have promoted the use of some targeted types of residues. In this report we analyze the prospects for policy development and the application of new biomass technologies in California.

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