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Subcontractor Report

Biomass Energy Production in California 2002: Update of the California Biomass Database

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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 operated 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 wood residues, agricultural residues, and wood residues that are diverted from disposal in the state's sanitary landfills. In all cases energy production from these materials provides an environmentally superior disposal option than the alternatives, which include open burning, landfill burial, and forests choked by overgrowth material. The biomass energy industry provides valuable environmental benefits to California, and has become an integral part of the state's waste disposal infrastructure (Morris, 2000).

In spite of the valuable environmental benefits provided by biomass energy production, the future of the enterprise in California is clouded. This is the result of an inescapable fact: generating electricity from biomass fuels is inherently more expensive than generating electricity from fossil fuels. There are two major reasons why this is so. First, biomass fuels are bulky and expensive to collect, process, transport, and handle. Second, due to the dispersed nature of the fuel supply, biomass generating facilities are much smaller than state-of-the-art power plants that burn fossil fuels. This prevents them from achieving the kinds of economies of scale that are achieved by large fossil generating facilities.
The value of the environmental services provided by biomass energy production are in excess of 10 cents per kWh (Morris, 1999), which is some three times greater than the current market value of the electricity. However, biomass power producers do not receive compensation for these environmental services, and the current market price for electricity in California is insufficient to allow them to recover their costs. Many of California's biomass power producers currently are operating under fixed-price contracts that give them adequate revenues for the next several years, however beyond that threshold they face great uncertainty.

This report begins with an introduction to the California Biomass Energy Database, which has tracked biomass fuel use and power production in California since 1980. The database has been updated and overhauled following a tumultuous period in the electric utility industry. The development of the biomass energy industry is then described, including its recent experience with electricity restructuring and the energy crisis in California. The text is illustrated with graphics from the database.

The California Biomass Energy Database

Development of the Database

The California Biomass Energy Database had its origins in a 1990 research report for Pacific Gas & Electric Co. (Morris, 1991), in which an attempt was made to estimate the ultimate potential for biomass energy production in the state. At the time, the industry was experiencing a period of rapid growth. The original data collection effort was focused on biomass fuel use, and an attempt was made to characterize the growth of the biomass power industry over the preceding decade. During the 1980s the biomass industry had grown from a handful of self-generation facilities in the wood-products industry, to being a major contributor to the state's energy supply. More than 750 MW of biomass generating capacity were operating in the state in 1990, and fuel prices had risen to alarming levels, with quotes occasionally exceeding $60 /bdt.

The facilities that participated in the original survey did so under confidentiality agreements that specified that individual plant data would not be disclosed, but aggregate data on the industry would be freely published and disseminated. These agreements remain intact today. All of the facilities in the state that are currently operating regularly supply confidential data to the database, with the result that the database's statewide average cost for biomass fuels is a highly reliable measure.

A second major impetus to expand the database came during a 1994 study for Hydro Québec, an electric utility company that was interested in learning some of the lessons of the development of the biomass energy industry in California and other parts of North America (Morris, 1994). This effort involved updating the database, and adding some economic information. However, the effort made no attempt to be comprehensive, so many of California facilities were not included.

NREL's involvement with the California Biomass Energy Database began in 1996, as part of a study of the environmental costs and benefits of biomass energy production in California (Morris, 1997). As part of the study, the database was converted from an old Lotus-1-2-3 single-worksheet format to its current excel format, which includes multiple worksheets and charts. It was at this point that the database assumed its current structure and look. A major effort was made to fill in the historical database for all facilities that had operated in the state during the previous fifteen years, often using anecdotal information from people who had worked at then defunct facilities where operating data were no longer available. The newly formed California Biomass Energy Alliance was very supportive of the effort, and encouraged their member facilities to supply data. All of the then operating biomass facilities in the state participated in the data survey. At that point in time the database included data on consumption and cost for all of the biomass fuel that was being used in the state, in four categories: sawmill residues, in-forest residues, agricultural residues, and urban wood residues. The database included actual data for the years 1980 - 1995, and projections for 1996. Much of the early historical data were based on memories and estimates, rather than plant operating records.

Over the next several years, each time with NREL support, an annual survey of the industry was performed in order to update the database. In 1998 a decision was made to add electricity production data to the database, and a retrospective effort was carried out to collect electric production data for the period 1980 - 1997 (Morris, 1998). Only a few facilities had actual operating data going back more than five years, so many of the historical electric production data were derived. The last time the database was updated and the results published was 2000, at which point the database contained actual operating data for 1980 - 1999, and projections for 2000 (Morris, 2000). This report updates the database with actual data for 2000 and 2001, and projections for 2002 that were made around the midpoint of the year.

Since 1995 all of California's operating biomass power plants have contributed actual operating data to the database update efforts, with the result that all data for this period are based on plant operating records, and are extremely accurate. As one goes further back in the time the accuracy of the data in the database deteriorates. In order to make the database complete going back to 1980, where actual data were not available in the historical time series inferred data were developed, usually based on the anecdotal memories of facility managers and fuel buyers.

Some of the fuel that is used by the biomass power industry is captive fuel, most commonly sawmill residues at the sawmills that have combined heat and power generating facilities. Since this material is neither bought nor sold on the open market, it is not included in computations of market fuel prices. The reported average price of biomass fuels is computed based strictly on the prices reported for fuel that is purchased by the power plants from independent fuel providers in the marketplace.

Fuel cost data are considerably more sensitive than fuel use data, with the result that some of the facilities declined to provide cost data early in their participation in the data collection efforts. These fears apparently have been allayed. All of the facilities have been contributing cost data as well as quantity data for the past several years. Before the mid-1990s the price computed for biomass fuels is based on an incomplete data set, as not all purchasers of fuel provided price information. This introduces a possibility of asymmetry in the historical time series, as older points in the series are based on data from a subset of the facilities, which may or may not have represented the market average. I have performed extensive analysis on this issue, and believe the historical data, at least going back as far as 1988, to be representative of the overall market despite being based on a self-selected subset (those willing to supply data) of the total market for data points before 1995. Forty-two of the 63 facilities that have operated in California since 1980 have provided fuel-cost data to the database, although the cost data do not cover the entire operating period for some of the facilities.

Database Update and Overhaul

Prior to this effort the California Biomass Database was last updated in 2000. The last major overhaul of the model was performed in 1996. Thus it was decided to perform a full overhaul of the model and database in conjunction with performing a two-year data update in 2002. Actual operating data were collected for the years 2000 and 2001, and projections for full-year 2002 were provided by all of the 36 facilities that have operated in the state during this period. In addition, the model was completely overhauled, and new graphics were added.

One of the important improvements made to the model concerned the data on start-up and shutdown dates for the various facilities. When the model was originally created, only the years of start-ups and shutdowns were entered in the database. Facilities that started up in the last quarter of a year were usually listed as commencing operations in the following year. As part of the overhaul of the model, start-up and shutdown dates were collected as exact dates for all facilities for which data could be obtained. The model was reprogrammed to compute yearly on-line capacity based on proportional contributions of facilities that either started-up or shutdown in a given year. In cases where only the years of start-up or shutdown are available, the model assumes that the occurrence was at mid-year. Exact dates were obtained for all of the 36 facilities that operated during the period of the fuel survey update (2000 - 2002), and for a variety of additional facilities. This enhancement to the model has dramatically altered the graphic of operating biomass capacity over time in California. (Compare Figure 2 in Morris, 2000, with Figure 2 below.)

An important addition to the model has been a calculation of the industry-average price received for sales of electricity. California's biomass power plants operate under a variety of power purchase arrangements. Many facilities sell capacity, as well as energy, to the grid. The database already contained information on the types of power purchase agreements held by the various biomass facilities in the state. Historical data on fixed and variable prices paid for electricity in the state were added to the database, and the model was programmed to calculate the weighted average price paid for biomass power in the state over time, including energy and capacity payments. This information is displayed in a new graphic, which is introduced below as Figure 3. Figures 4, 8, and 9, also introduced below, were also newly developed for this report. In addition, a number of the pre-existing graphics were upgraded.

Development of the California Biomass Energy Industry

The Eighties and Nineties: Growth and Stabilization

Prior to passage of the federal Public Utilities Regulatory Policy Act (PURPA) in 1978 only a few biomass-fired boilers were operating in California, and little electricity was being generated from biomass. Most of the state's biomass wastes were being disposed of, mainly by open burning and landfill burial. PURPA changed all of that by requiring that electric utility companies buy privately produced power at their "avoided cost" of generation. PURPA created the market context that allowed for the development of the independent power industry in the US. High avoided cost rates in many areas of the country, and favorable federal tax treatment for investments in renewable energy projects, provided the motivation for its development.

California was a leader in the development of renewable energy generating facilities. A combination of circumstances, including a high growth rate in electricity demand, oil dependence, and rising concerns about environmental deterioration led to the implementation of state energy policies that were highly conducive to the development of renewable energy sources. These policies and opportunities stimulated a major development of biomass energy generating capacity in the state. During a period of less than fifteen years nearly 1,000 MW of biomass generating capacity were placed into service. The biomass energy sector expanded from being an outlet for a small quantity of the state's wood processing residues, to being an essential component of the state's solid-waste disposal infrastructure. Figure 1 shows graphically the explosion of biomass generating facilities during the second half of the 1980s. Figure 2 shows the increase in operating capacity during this period.

A major driver in the development of California's biomass power industry was the Interim Standard Offer #4 (SO#4) power purchase agreements that were available during the period 1983 - 1985. These contracts, which were developed during a period when world oil prices were high, offered renewable energy producers the option to be paid for energy deliveries on the basis of a fixed-price schedule for the first ten years of operations, following which the revenues would be based on the then market price for wholesale energy. The bars in Figure 3 show the fixed price energy schedule that was offered in PG&E's service territory (rates in SCE were comparable), and the actual *Short-Run Avoided Cost* (SRAC) that was in effect over the ensuing years. The forecasted price series in the SO#4 schedules were based on an assumption that energy prices would escalate indefinitely into the future. In fact, the world oil market crashed in 1986, and SRAC rates fell to half their previous levels.

Throughout the history of the California biomass power industry the collection of operating facilities at any given time have operated under a variety of power purchase provisions. Figure 3 shows, in green, the weighted average price that the state's biomass power producers received over time for their sales of electricity and capacity to the grid. It is interesting to note that electricity prices and biomass fuel prices have not been

closely linked in California. Fuel prices are responsive to statewide biomass fuel demand, which, due to the capital-intensive nature of biomass power plants, is relatively insensitive to fluctuations in wholesale power prices.

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 (5.7 mil. bdt/yr) of the state's solid wastes, as illustrated in Figure 4. 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. Moreover, some of the facilities that remained in operation reduced their production during off-peak hours. This decrease in capacity factor can be seen in Figure 5, where the darkest part of the bars, which represents unused production capacity, hits a maximum in 1995 - 1996. Biomass power generation in California stabilized at approximately 3.2 billion kWhs per year during the late 1990s, and the enterprise provided a disposal outlet for slightly less than six million tons per year (3.8 million bdt) of the state's solid waste.

Electric utility deregulation was initially 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 all 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 6.5 million tons per year (4.0 mil. bdt).

Throughout the 1980s sawmill residues were the principal source of biomass fuel in California, accounting for more than 50 percent of the total, as illustrated in Figure 6. Sawmill residues are the cheapest form of biomass fuel to produce, and problems with their disposal were a major impetus for the establishment of the biomass industry. However, due to a variety of factors, including an ecomonic recession and increasing environmental restrictions, the California sawmilling industry began a steep decline in the early 1990s. Some sawmills reduced operations to a single shift per day, and others shutdown altogether. This resulted in a decline in the supply of sawmill residues at the very time that overall biomass fuel demand was at its peak. Urban residues, agricultural residues, and in-forest residues all increased their market share through the 1990s, with the result that each category of fuel contributed roughly 25 percent of the total biomass fuel supply by the end of the decade.

As biomass fuel use in California increased rapidly during the late 1980s fuel prices shot up as well. By the early 1990s average fuel prices in the state were in the range of $35 - 40 per bdt (see Figure 5), which represents a nearly four cent per kWh contribution to the cost of electricity production for fuel procurement alone. The decline in biomass energy production in the state during the middle of the decade brought fuel price relief, with prices dropping to the neighborhood of $25 per bdt. California biomass fuel prices have been closely correlated with statewide fuel demand for as long as reliable data are available, as shown in the statewide biomass fuel supply curve in Figure 7. Since 1997 prices have been pushed consistently below the average line, the result of a number of factors, including expiration of the fixed-price provisions in the standard-offer contracts, efforts to comply with the state's solid waste diversion requirements, and agricultural fuels supplements that were available beginning in 1999.

Figure 8 shows the price series over time for each of the major categories of biomass fuels used in California. Fuel prices are influenced by a variety of factors, including supply and demand, local conditions, and cost of production. Sawmill residues are clearly the cheapest source of biomass fuels to produce (Morris, 2000), and were the cheapest source of fuel on the market before the contraction of the forest products industry in the state. In-forest residues are the most expensive source of biomass fuel to produce, and its price has remained near the top of the four curves for most of the past few years. Urban residues, whose cost of production is complicated by one's choice of accounting approaches to the disposal fees that are associated with the resource, have come down in price in recent years as County administrations grapple with meeting the requirements of AB 939, the state's landfill diversion law. Agricultural fuel prices have decreased in recent years as a result of the agricultural fuels credit program.

The earliest biomass generating facilities in the state were combined heat-and-power plants that provided on-site power to their host facilities, and surplus power to the grid. These facilities were associated with sawmills, pulp mills, and food-processing operations. However, as the sawmilling industry in the state has declined, so has the amount of biomass power that is generated for on-site use. Figure 9 shows the relative production of electricity for self-use, and for sales through the interconnected electric grid. In California, sales through the grid have been, and continue to be, the major outlet for the electricity produced by biomass-fired power plants.

The California Energy Crisis of 2000

Natural gas prices in California, which had been stable throughout the 1990s, abruptly shot upwards during the winter of 2000. This was in no small part a result of pipeline capacity bottlenecks that were related more to business issues than to physical capacity constraints. Whatever the cause this staggering increase in gas prices, combined with rapidly growing electricity demand fueled by the booming high tech industries in California, and a drought-caused decrease in hydroelectric production in the Pacific Northwest, led to electricity supply shortages in California in the Spring of 2000.

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, as shown in Figure 10. In June, they hit double digits. By August prices at the California Power Exchange (Cal-PX) were averaging more than 15 ¢/kWh. California was engulfed in a full-fledged energy crisis. The utilities' cash reserves were rapidly evaporating.

Biomass power generators in the state responded quickly to what was a considerable opportunity. Each of the then operating biomass facilities made efforts to expand their fuel procurement, and pushed their facilities to maximize output. All of the facilities that were eligible opted to convert to Cal-PX 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 resume operations. The ten facilities, many of which are located near the state's Central Valley region, are shown in the Table below.

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	start up summer 2002
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 up in 2001
Sierra Forest Products, Terra Bella	9.5 MW	started up in 2001
Soledad Energy, Soledad	13.5 MW	started up in 2001

As market prices for electricity now exceeded the target prices set by the CEC, state support payments to the biomass generators were suspended. By the end of the year 2000 biomass fuel prices were on the rise, but few of the generators were complaining. The complaints started promptly in December of 2000, when the utility companies stopped paying independent 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. To put the topping on the cake, prices at the Cal-PX suddenly shot up again in December, averaging more than 35 ¢/kWh during the month (see Figure 10). They remained at that level into January 2001, when the Cal-PX 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 vary time that they were earning unprecedented profits, they were facing insolvency. The supposed profits, of course, were only on paper. 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, to say the least. 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 full-speed ahead. Wholesale electricity prices had never been higher, actual operations for these facilities were months away, and it seemed reasonable to assume that something would be done to get the flow of money moving again. In fact, in many ways it appeared in 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 were not hobbled by having had to endure a prolonged period of operating without revenues, and they were not saddled by old power purchase contracts that now were paying below-market prices.

The State Steps In

An emergency session of the California state legislature was convened in January 2001 to deal with the burgeoning energy crisis. At the time, many commentators were predicting that a long, hot summer of brownouts and blackouts lay ahead. The Governor was negotiating bailout deals with the utility companies that would have them 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 ten percent. Nevertheless, negotiations with PG&E broke down and the utility company declared bankruptcy. Negotiations with SCE also eventually broke down, although SCE avoided bankruptcy.

The state's electricity generators were desperately searching for a way to get the utility companies to pay them for past deliveries of power. 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 Cal-PX and the crippled financial status of the utility companies, the state legislature passed emergency legislation that allowed the state, through the Department of Water Resources (DWR), to buy electricity on behalf of the state's consumers. DWR immediately set up a trading unit and created an 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 the state 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. One of the potential biomass startups, the 13.5 MW Soledad facility, applied to DWR in spite of not meeting the size qualification. They explained on their application that they understood they were undersized, but hoped that DWR would consider them for what they offered, which included the possibility of starting up before the crucial summer season just ahead. The remaining biomass restarts waited to negotiate with DWR when they were ready to accept applications from smaller generators. That time never came.

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 (mid-2001) the biomass power plants in California could be divided into two 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 already 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. The DWR was stalling.

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 were out of operation, many for prolonged periods of time. A couple of rolling blackouts of two-to-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 petitioning the FERC to impose price controls on the wholesale market, but the FERC was resistant. The situation was rapidly coming to a boiling point.

By the beginning of the summer of 2001 the DWR had signed some 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. Soledad's gamble had paid off. Their 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 trying to pursue negotiations with DWR. The other two attempted restarts, twin 10 MW facilities near Chowchilla (Chow II and El Nido), suspended their re-start efforts.

Newspapers continued to be full of dire warnings of looming summer blackouts. The crisis was beginning to spread to the entire Western U.S., 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 U.S. At the same time, a productive winter's snow was melting and filling reservoirs in the Northwest.

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 (see Figure 10). 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 single 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 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 percent of the long-term contracts the state signed 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 that were seeking long-term 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 for power to be purchased from clean generating sources. With the exception of

Soledad, all of the other 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.

One of the many actions taken by the emergency session of the state legislature was the creation of the California Power Authority (CPA), which began operations in August 2001. The CPA was vested with $5 billion in bonding authority to invest in generating assets that would give the state power grid an adequate reserve margin. A minimum of $1 billion of the total was earmarked for conservation and renewables. Soon after its creation, the CPA put out a request for proposals. All of the biomass facilities that were negotiating with the DWR filed applications for their projects with the CPA.

The CPA was mandated to produce, within six moths of its creation, an investment plan for its $5 billion capital bonding authority. The investment plan had to be submitted to the legislature by the middle of February 2002. The CPA *Investment Plan* recognizes the importance of maintaining and enhancing the state's biomass generating infrastructure, and stated an intention to contract with the biomass generators who did not have standard-offer contracts, and had so far been unable to negotiate contracts with the DWR.

Despite their good intentions with regards to biomass, the CPA has been thwarted in their efforts to move forward with contracts for biomass facilities. The problem is that the CPA is not ready to issue the bonds that will supply the funds they need in order to make commitments to generating facilities. At the present time state underwriters have taken the position that the state lacks the authority to ensure that ratepayers will be held fully responsible for the costs of energy procurement. They will not issue the CPA bonds until the guarantees they are seeking are in place.

December 2001 was the sixth consecutive month in which short-run avoided cost rates were insufficient to cover the 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. Recognizing that the issues that were holding up the issuance of the CPA's bonds were not going to be resolved quickly the DWR, in conjunction with the CPA, signed 90-day interim contracts with eleven biomass facilities, with a common intention to enter into long-term contracts as soon as it became possible. The interim contracts have been extended through the end of 2002.

The interim contracts provide 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 Morris, 2000).

Current Status and Prospects for the Future

California currently has thirty-five biomass power plants in operation, representing a total of 685 MW of electricity generating capacity. This is less than the 750 MW that were operating during the beginning of the 90s, but considerably more that the level that was operating during the second half of the decade (see Figure 2). Figure 11 shows the facility list for California biomass power plants that is at the heart of the database, as well as the current map of the industry, keyed to the facility list.

As Figures 4 and 5 show, as of the Spring of 2002, when the survey was performed, the state's biomass generators were expecting to increase electricity output in 2002 from 2001 levels, mainly by increasing the operating factors at their facilities. Moreover, as shown in Figure 5, facility owners were projecting biomass fuel prices to drop in 2001, even as they were projecting fuel use to increase.

The sum of the facilities' projections of 2002 fuel purchases and prices leads to a spot on the fuel-supply curve, Figure 7, that is a major departure from the market behavior that has held for at least fifteen years. Fuel prices are projected to be in the neighborhood of $28 /bdt in 2002, vs. the approximately $35 /bdt that is historically associated with that level of demand. It will be interesting to see in future database updates what actually happens with respect to 2002 demand and price for biomass fuels.

Approximately two-thirds of the currently operating 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 are well served by their contracts, and should be able to operate viably until at least that time. The other one-third of California's biomass power plants are operating under interim contracts that provide them with minimally acceptable operating revenues. The longer-term fate of this group of facilities is a function of whether they are ultimately able to obtain longer-term contracts with adequate power purchase provisions.

The California Legislature passed into law a Renewable Portfolio Standard (RPS) during the waning moments of the 2002 legislative session, and the Governor signed it into law. SB 1078 sets a goal of doubling the contribution made by renewables to the state's electricity supply by the year 2017, which is an ambitious goal. Achieving this goal will require across-the-board growth in all renewables, including biomass. And it will certainly require preserving the existing biomass-power industry. Biomass today provides approximately 15 percent of California's renewable energy supply. Its future will depend in large part on public policy decisions that will be made in the coming months and years.

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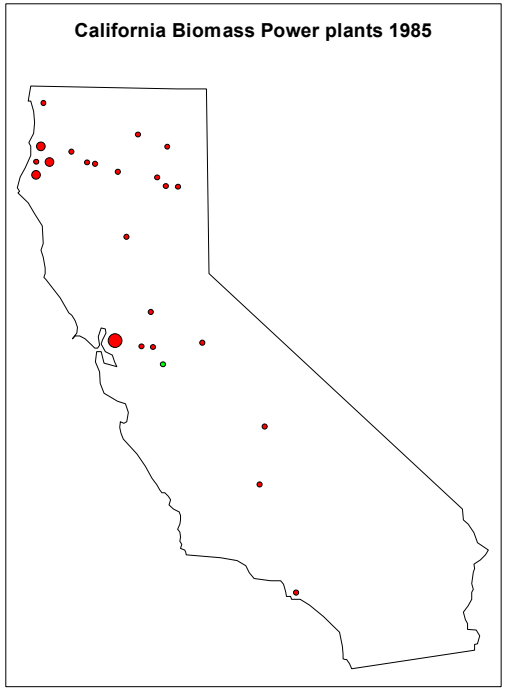
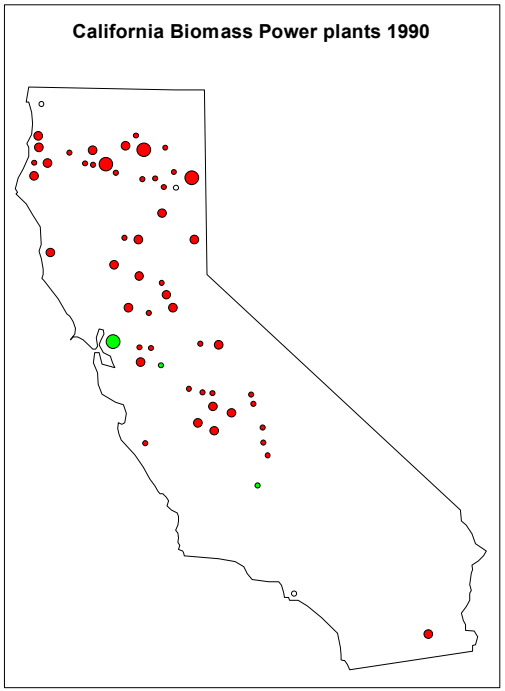
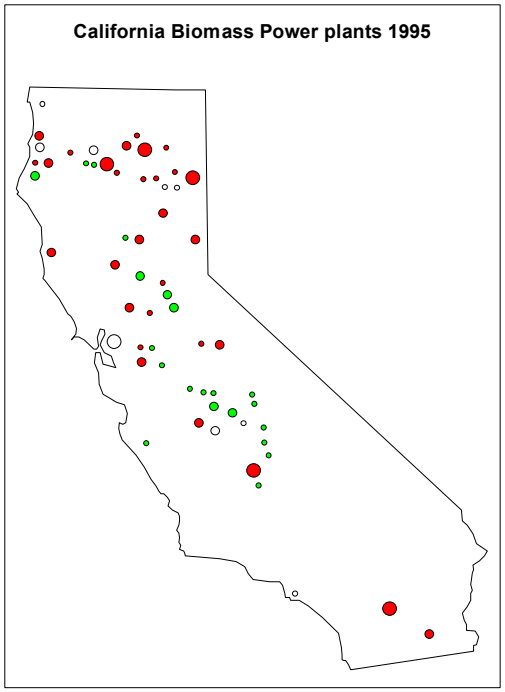
Figure 1: Development of the California Biomass Power Industry







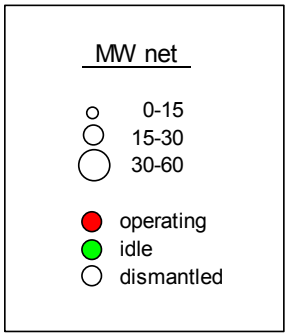


Figure 2: California Biomass Power Capacity

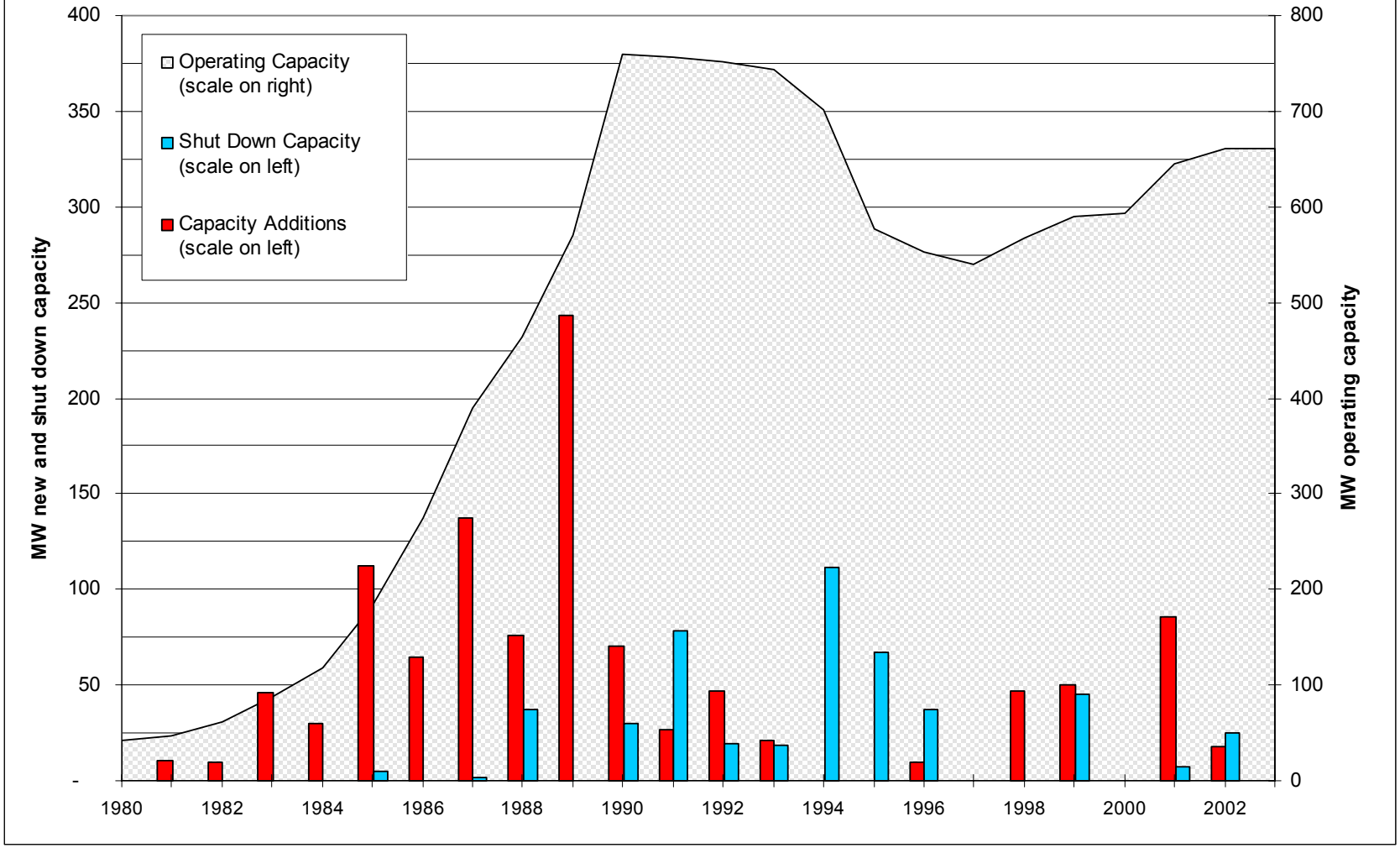


Figure 3: California Wholesale Electricity and Biomass Fuels Prices

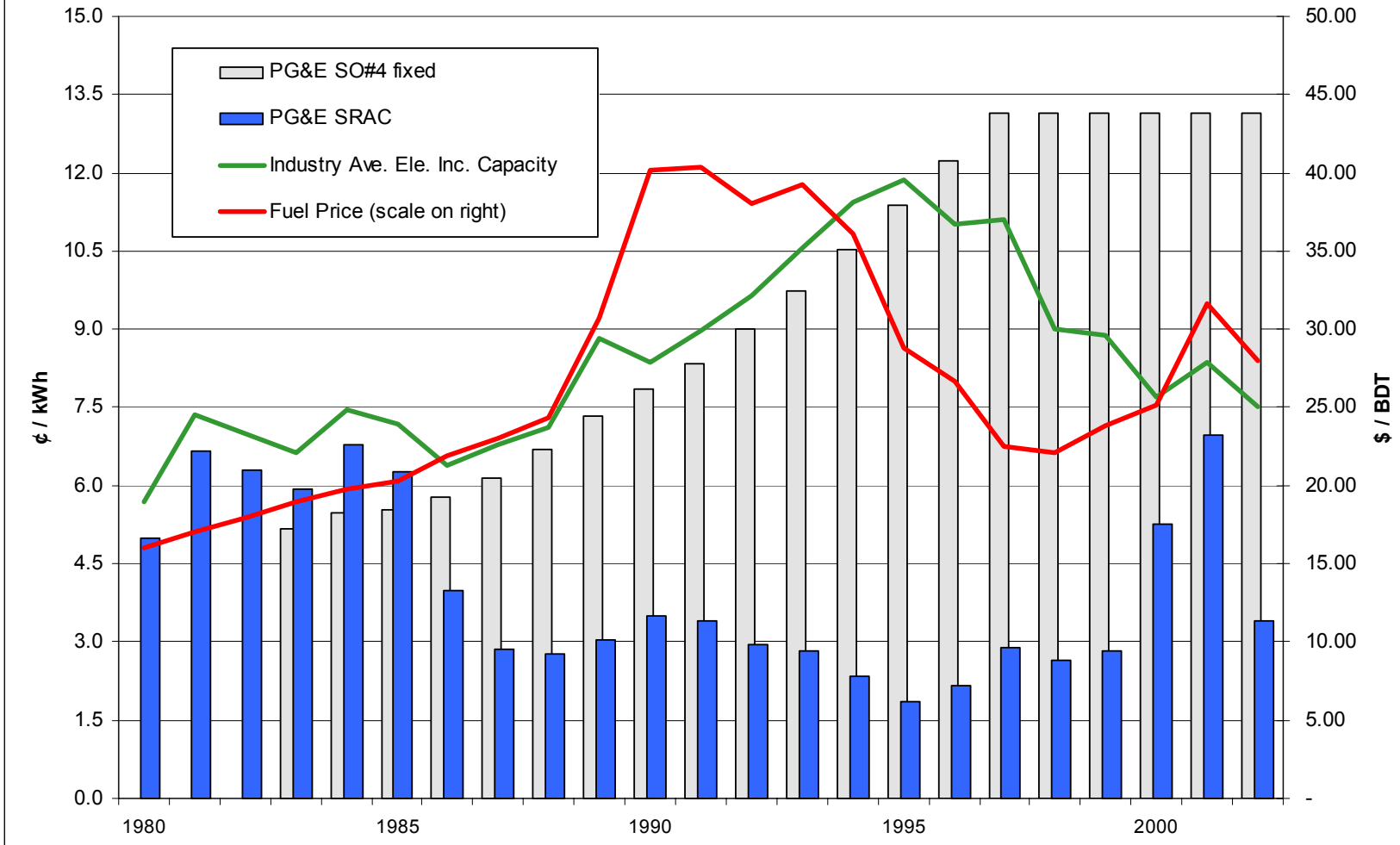
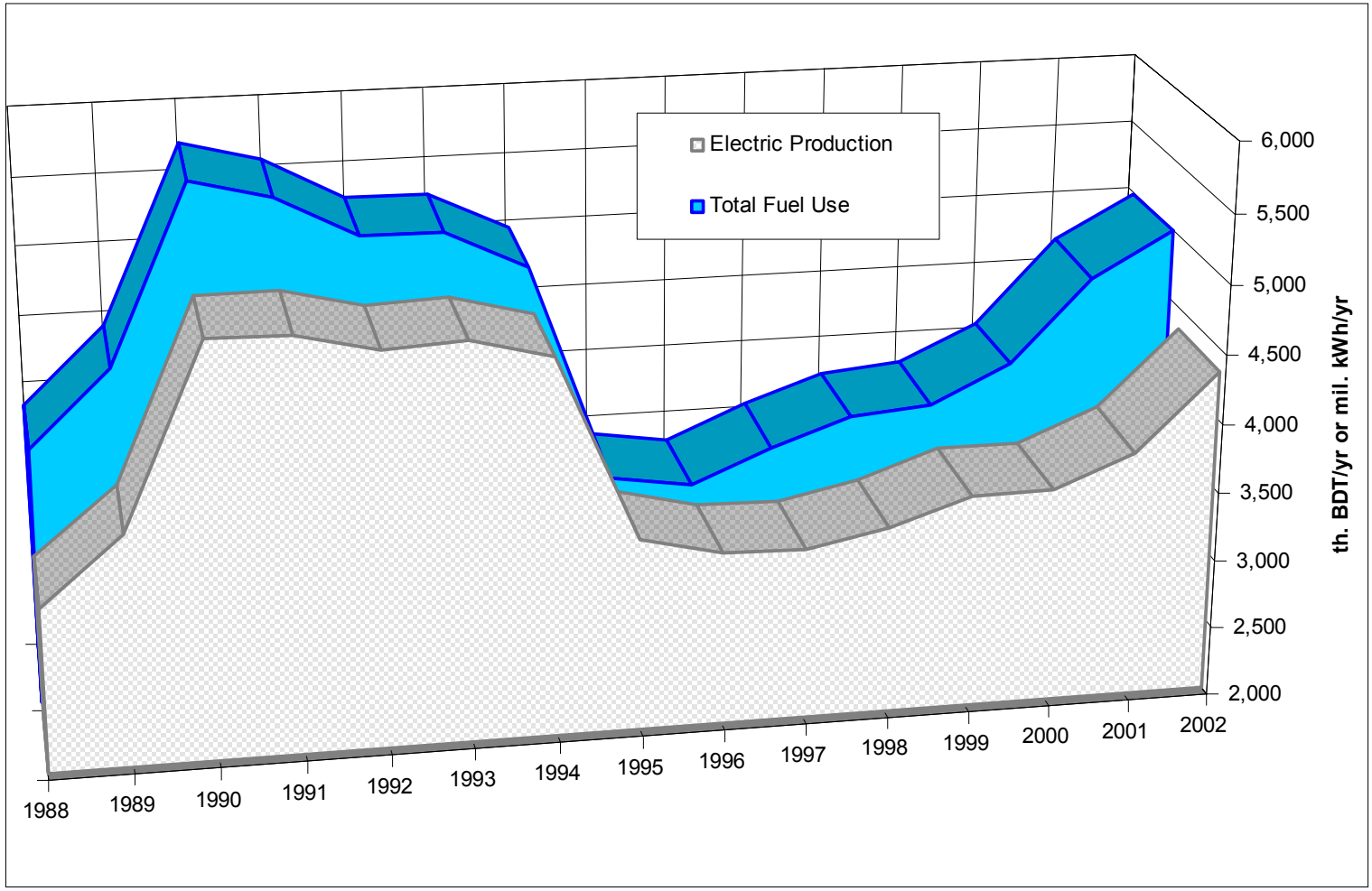


Figure 4: California Biomass Fuel Use and Electricity Production



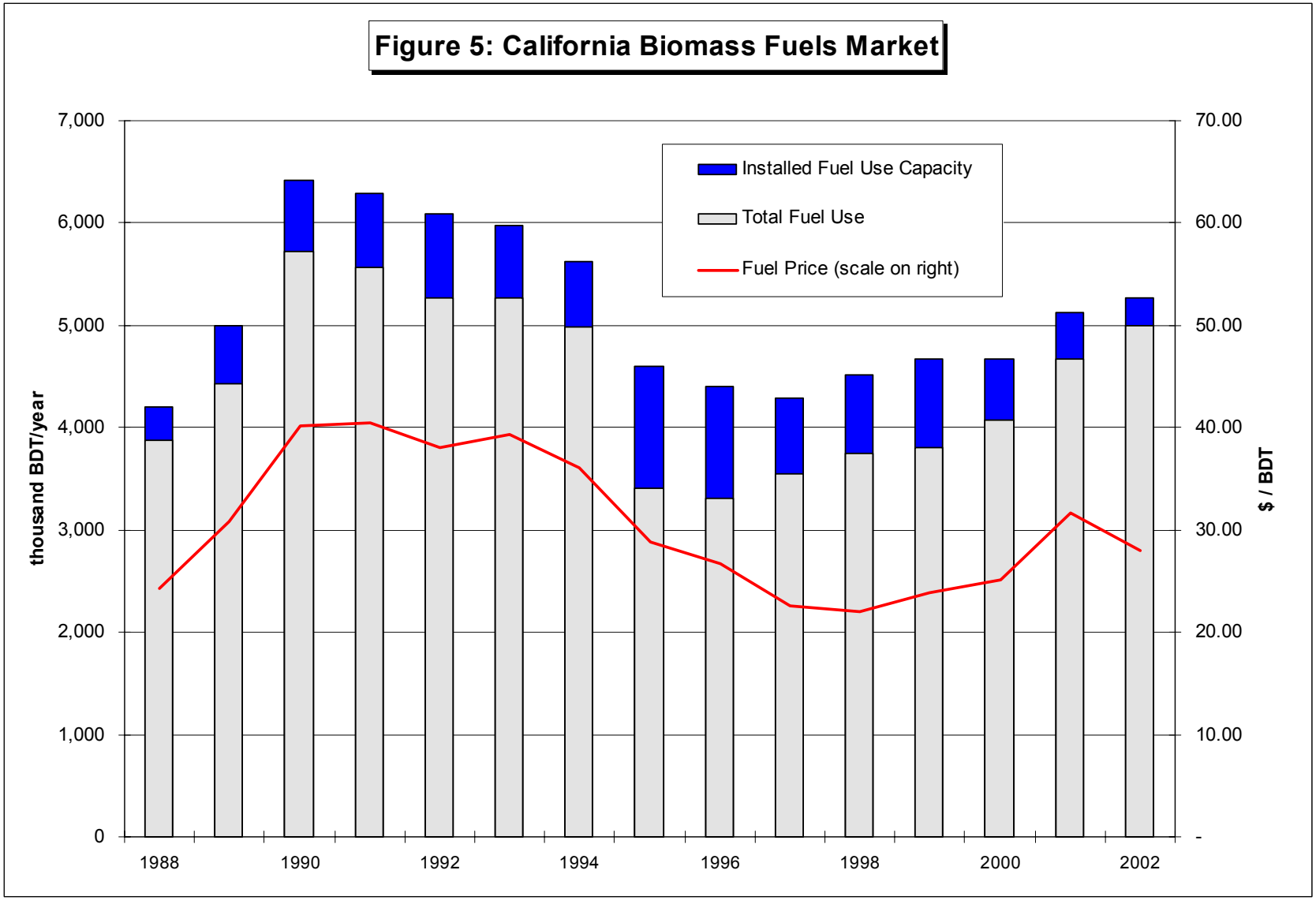


Figure 5: California Biomass Fuels Market
7,000
6,000
5,000
4,000
3,000
2,000
1,000
0
thousand BDT/year
70.00
60.00
50.00
40.00
30.00
20.00
10.00
-
$ / BDT
Installed Fuel Use Capacity
Total Fuel Use
Fuel Price (scale on right)
1988
1990
1992
1994
1996
1998
2000
2002

Figure 6: California Biomass Fuels Market by Category

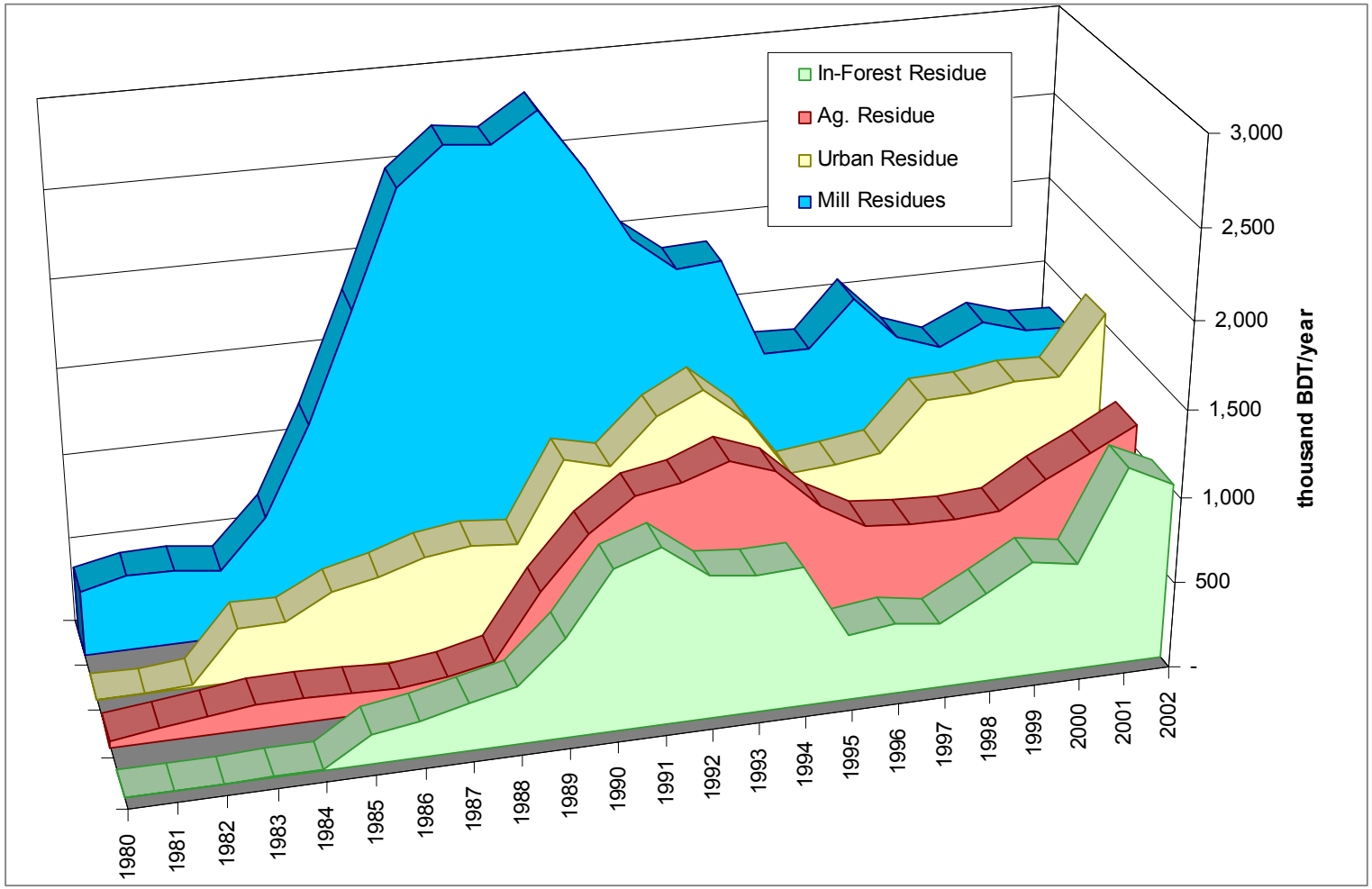


Figure 7: California Biomass Fuel Supply Curve

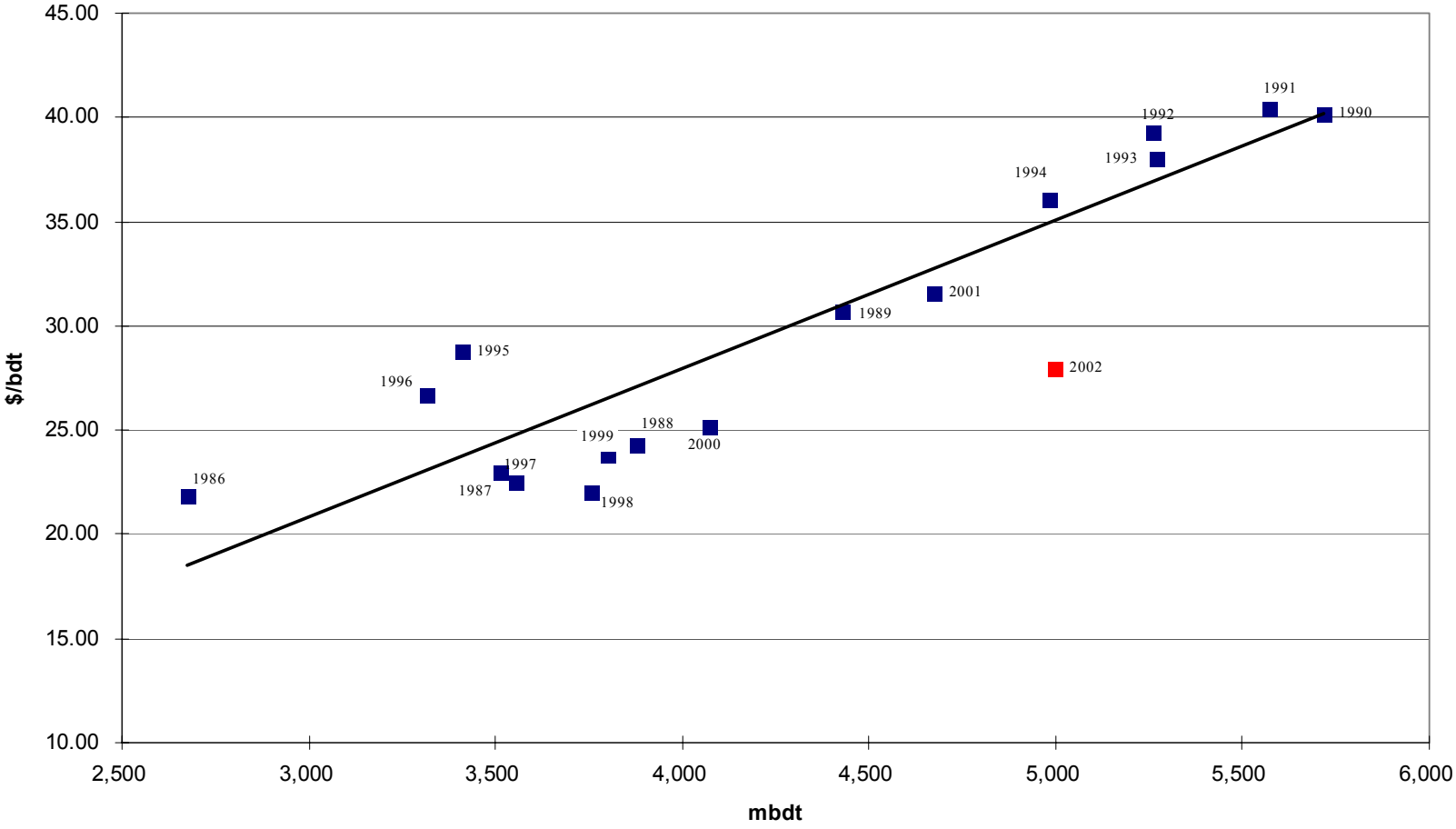


Figure 8: Biomass Fuel Prices by Category

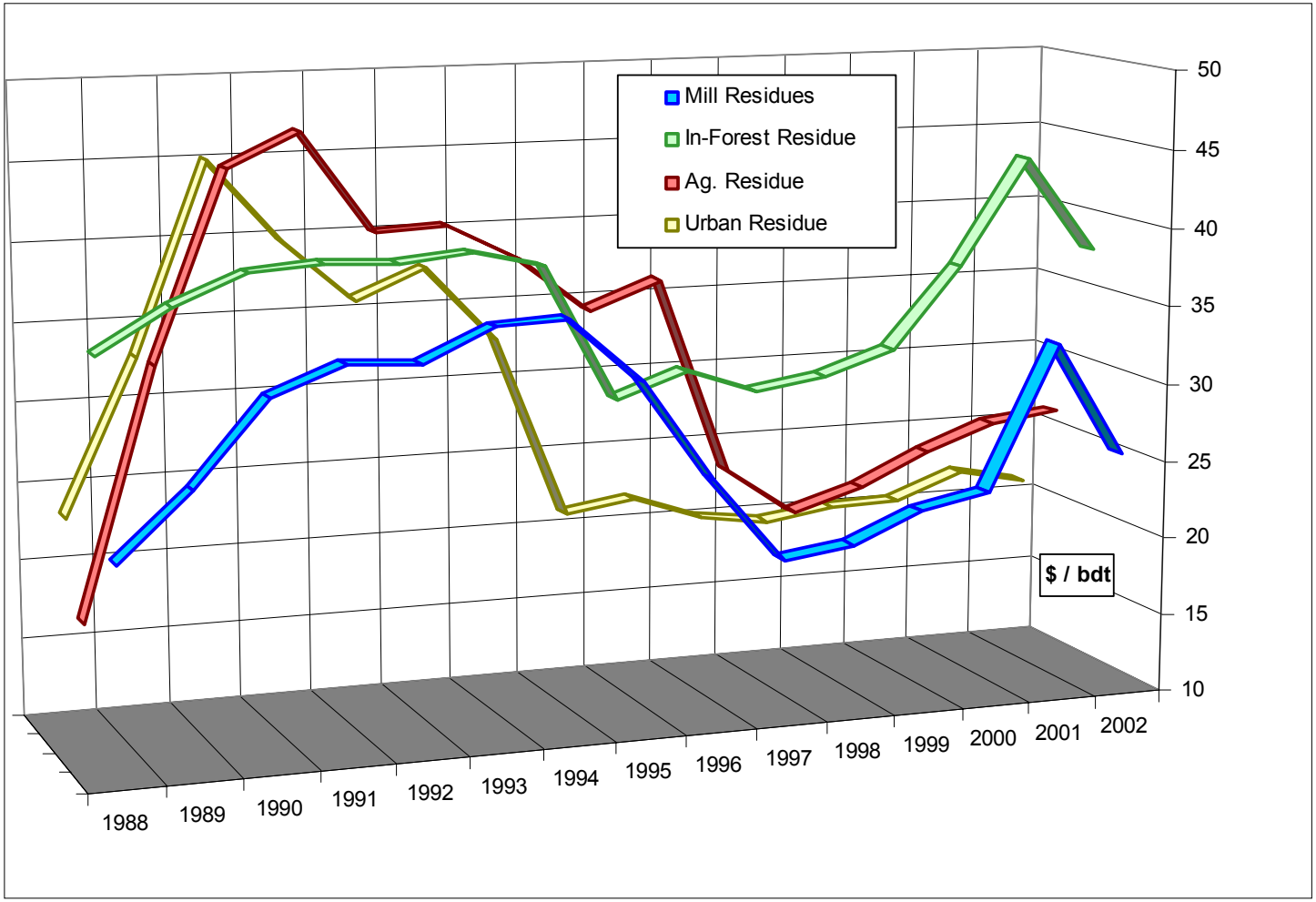


Figure 9: California Biomass Electricity Production

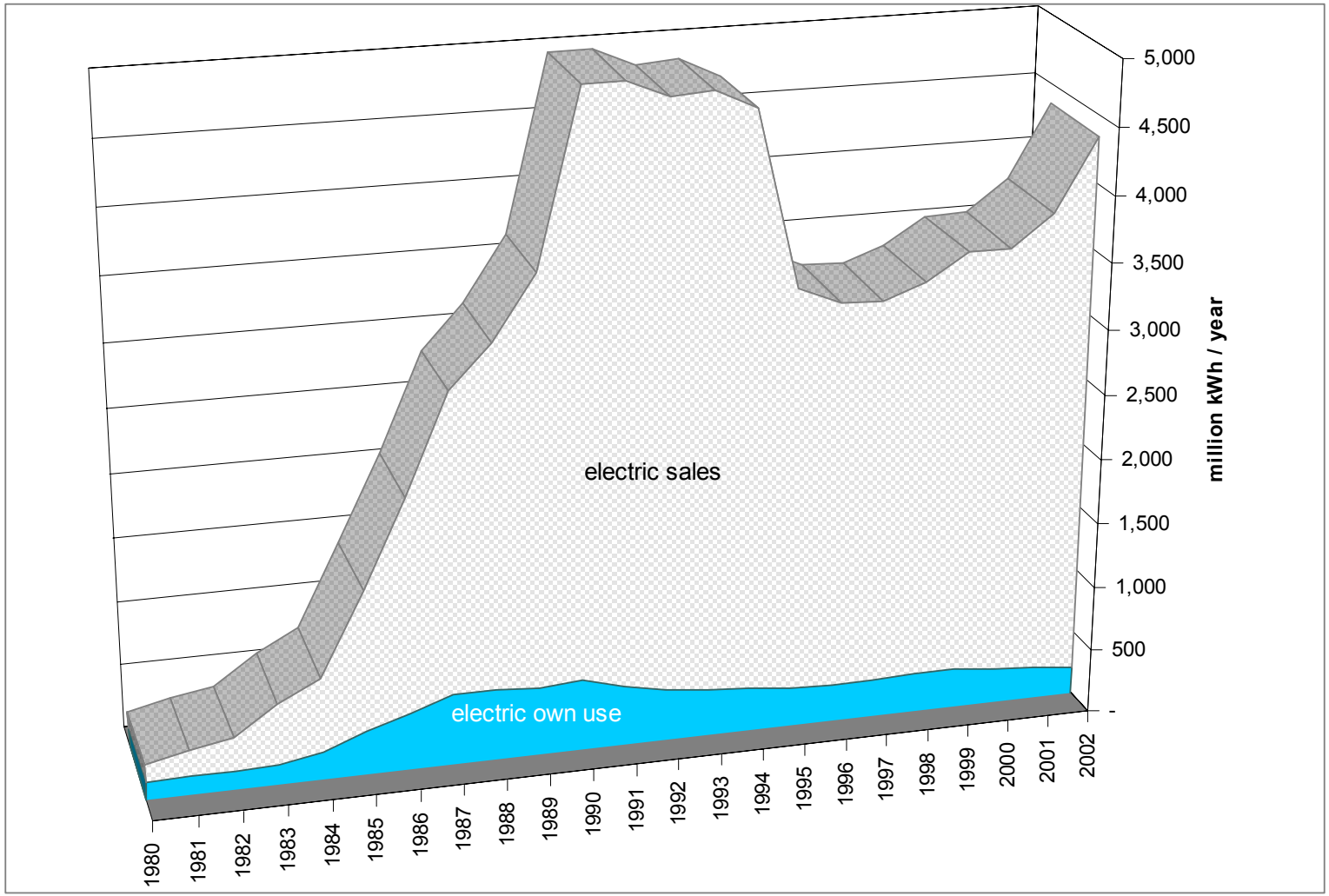


Figure 10: Wholesale Electricity Prices in California, 1990 - 2002

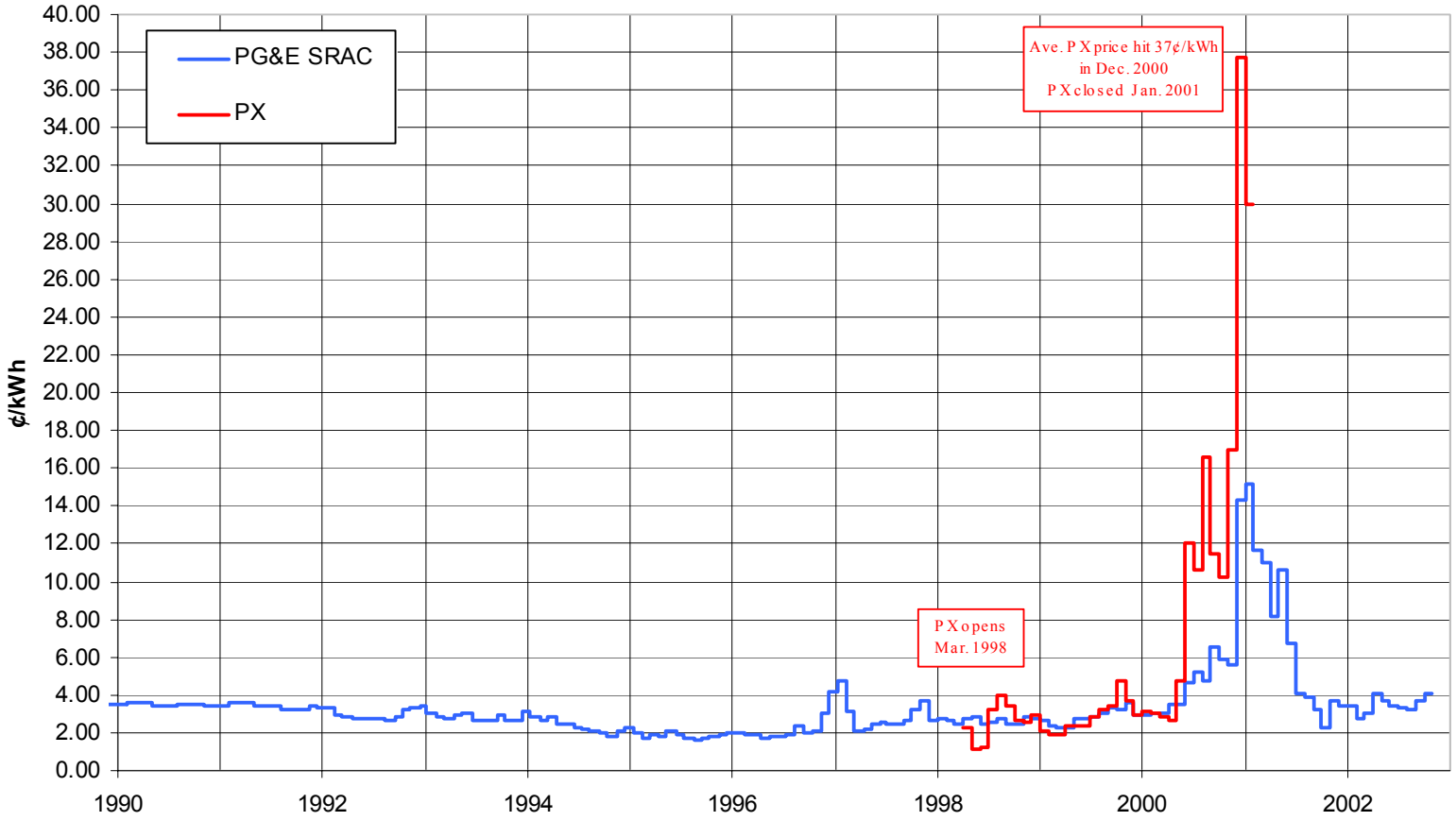


Figure 11: California Biomass Power Plants in 2002

	Project	Net MW
1	Primary Power / Brawley	15.0
2	Colmac Energy	47.0
3	Proctor & Gamble	13.5
4	Apex Orchard	5.5
5	Delano / AES	27.0
5	Delano / AES unit 2	21.0
6	Sierra Forest Products	9.3
7	Lindsay Olive	2.2
8	Dinuba Energy	11.5
9	Auberry Energy	7.5
10	North Fork Energy	8.0
11	Soledad Energy	13.5
12	Mendota Biomass / AES	25.0
13	Agrico Cogen	25.0
14	Sanger (biomass → feed)	0.0
15	Rio Bravo Fresno	25.0
16	EPI Madera	25.0
17	SJVEP--El Nido	10.2
18	SJVEP--Chowchilla I	9.9
19	SJVEP--Chowchilla II	10.8
20	Redwood Food Pkg	4.5
21	Tracy Biomass	19.5
22	Diamond Walnut	4.5
23	California Cedar Products	0.8
24	Gaylord Antioch	30.0
25	Capitol Power, Ione	18.0
26	Fiberboard, Standard	3.0
27	Chinese Station	22.0
28	Sierra Pacific Sonora	7.0
29	Woodland Biomass NRG	25.0
30	Blue Diamond Growers	9.5
31	Martell Cogen	18.0
31	Martell Cogen reconditioned	10.0
32	Rio Bravo Rocklin	25.0
33	Sierra Pacific Lincoln	8.0
34	EF Feather River	16.5
35	Wadham Energy	26.5
36	Georgia Pacific	15.0
37	Koppers	5.5

Thinned Forest Survived Fire

38	Pacific Oroville Power	18.0
39	Sierra Pac. Loyalton	17.0
40	Sierra Pacific Quincy	17.0
40	Sierra Pacific Quincy new	25.0
41	Collins Pine	12.0
42	Sierra Pac. Susanville	13.0
43	Lassen College	1.5
44	Jeld Wen Industries	2.5
45	Covanta Westwood	11.4
46	Honey Lake Power	30.0
47	Big Valley Lumber	7.5
48	Sierra Pacific Burney	17.0
49	Covanta Burney	10.0
50	Burney Forest Products	31.0
51	Roseburg Lumber	4.0
52	Paul Bunyan	3.0
53	Wheelabrator Shasta	49.8
53	Wheelabrator Shasta unit 2	4.5
54	Wheelabrator Hudson	6.0
55	Sierra Pacific Anderson	4.0
56	Redding Power Delmarva	25.0
57	Sierra Pacific Hayfork	10.0
58	LP Samoa	27.5
59	Blue Lake	10.0

60	Pacific Lumber	10.0
60	Pacific Lumber new	23.0
61	Simpson Paper	10.0
62	Fairhaven Power	17.3
63	Arcata Redwood	8.0

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