4. Ancillary Services Markets

4.1 Introduction and Summary of A/S Market Performance in 2003

The CAISO procures regulation, spinning reserve, non-spinning reserve and replacement reserves in its Day-Ahead and Hour-Ahead markets. The total procurement plus the quantity self-provided by load-serving entities must meet or exceed the WECC Minimum Operating Reliability Criteria (MORC) and NERC Control Performance Standards (CPS2). Ancillary service capacity is procured at the lowest overall cost while maintaining the competitiveness of the markets. The four ancillary services are defined as follows:

- **Regulation**: Provided by generation that is operating and synchronized with the CAISO-controlled grid so that its output can be increased (incremented) or decreased (decremented) instantly by automatic generation control (AGC) to allow supply and demand to be continuously balanced.
- **Spinning Reserves**: Provided by generation that is currently operating ("spinning") and has the ability to increase output within 10 minutes and maintain that increase for at least two hours. Spinning reserve is needed to maintain system frequency stability during emergency operating conditions and unforeseen load swings.
- **Non-spinning Reserves**: Provided by generation that is available but not running, that is capable of being synchronized and ramping to a specified level within 10 minutes, and then capable of running for at least two hours. Non-spinning reserve can also be provided by curtailable demand that is telemetered and capable of receiving dispatch instruction and performing accordingly within 10 minutes. Non-spinning reserve is needed to maintain system frequency stability during emergency conditions.
- **Replacement Reserves**: Provided by generation that is capable of starting up if not already operating, synchronized with the CAISO-controlled grid and ramping to a specified level within one hour, and running for at least two hours. Replacement reserve can also be provided by curtailable demand that is telemetered and capable of receiving dispatch instruction and performing accordingly within 60 minutes.

CAISO market participants, the Scheduling Coordinators (SCs), can self-provide any or all of these A/S products, bid them into the CAISO markets, or purchase them from the CAISO. The CAISO procures two other A/S, *voltage support* and *black start*, on a long-term basis primarily through the Reliability Must Run (RMR) contracts. In the rest of the section, we use the term "ancillary services" to only refer to the four reserves defined above.

The SC's simultaneously submit bids to supply any or all four ancillary services to the CAISO in conjunction with their preferred day-ahead and hour-ahead schedules. A/S bids submitted must be associated with specific resources (system generating units, import interchange location, load, or curtailable export) and must contain a capacity component and an energy component. The CAISO selects resources to provide A/S capacity based only on their capacity bid prices. Once the CAISO has selected units to provide A/S capacity, it uses their energy bid prices to dispatch those units to provide real-time energy.

4.2 Market Overview

2003 Ancillary Service Market Highlights:

- The CAISO was able to efficiently procure ancillary services at low cost during 2003.
- A/S prices increased 38.5 percent from 2002's record low overall average of $7.11/MW to $9.85/MW. Even with this increase, 2003 became the second-lowest priced full year in the CAISO's history.
- Procurement of A/S declined 8.5 percent from an hourly average of 2,524 MW in 2002 to 2,309 MW in 2003.
- Net supply of A/S capacity declined 25 percent from 5,772 MW in 2002 to 4,329 MW in 2003.
- The frequency of bid insufficiency increased from 2002 to 2003.

Ancillary services prices were lower on average than in any full year other than 2002. There was a 38.5% increase in overall prices from 2002 to 2003. Combined with the 8.5% decline in procurement, the value of the ancillary services markets grew by 26.7% from 2002 to 2003. Table 4.1 presents annual ancillary services price and volume information for the past five years. In the vast majority of hours of 2003, the CAISO procured all required ancillary service capacity at a lower cost than in all prior complete years other than 2002.

Table 4.1 Annual A/S Prices and Volumes, 1999-2003[1]

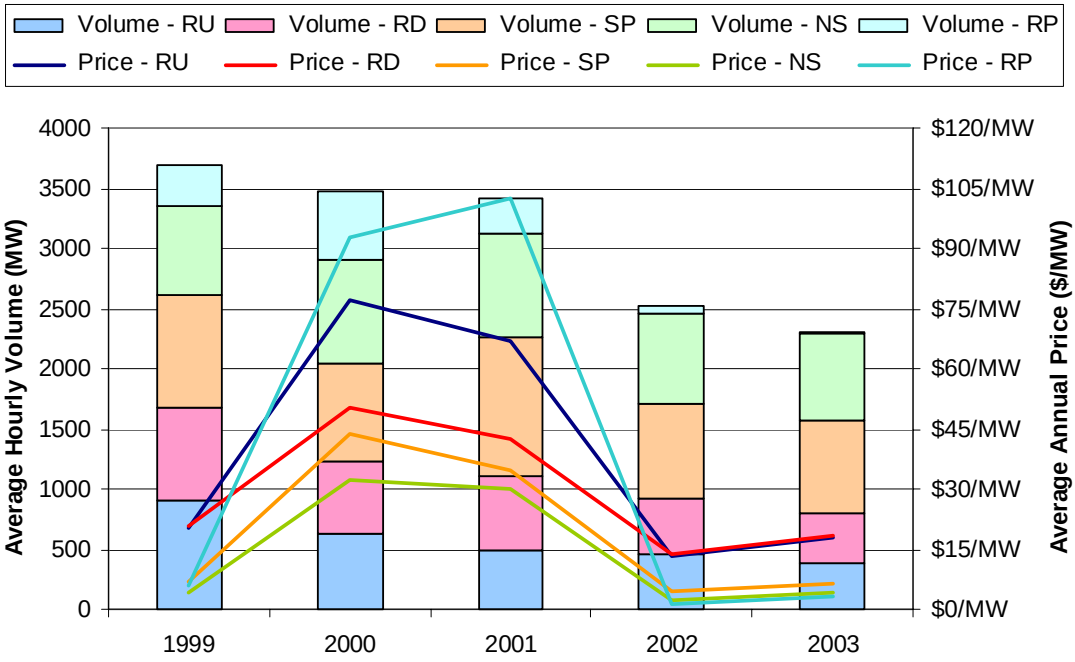
	Year	RU	RD	SP	NS	RP	Overall
Price	1999	$ 20.22	$ 20.84	$ 7.07	$ 4.35	$ 5.86	$ 12.51
	2000	$ 77.28	$ 50.15	$ 44.07	$ 32.46	$ 92.94	$ 56.32
	2001	$ 66.72	$ 42.33	$ 34.69	$ 30.03	$ 102.38	$ 45.51
	2002	$ 13.41	$ 13.76	$ 4.66	$ 2.15	$ 1.48	$ 7.11
	2003	$ 18.08	$ 18.43	$ 6.62	$ 4.20	$ 3.22	$ 9.85
Volume	1999	903	769	942	735	338	3,687
	2000	633	594	818	861	572	3,479
	2001	492	614	1,148	862	304	3,420
	2002	460	469	775	763	58	2,524
	2003	381	416	767	722	23	2,309

The ancillary services markets have changed in several ways since their inception. During 2000 and 2001, reserves were procured at levels much higher than in previous years to maintain reliability through the energy crisis. During 2002, the CAISO suspended replacement reserve procurement when FERC's must-offer requirement, to sufficient extent, ensured that capacities not bid into the day-ahead and/or hour-ahead markets would be available in real-time. Also during 2002, the calculation for the regulating reserve requirement was modified resulting in reduced procurement. For these reasons and others, the ancillary services markets of 2002 and 2003 resemble each other more than they resemble markets in previous years. For the most part, trends beginning in 2002 were continued through 2003. Figure 4.1 shows the financial and volumetric impact of these changes.

The differences between 2002 and the three years prior were documented thoroughly in the CAISO's 2002 Annual Report on Market Issues and Performance. The remainder of this report focuses on the similarities and differences between 2002 and 2003.

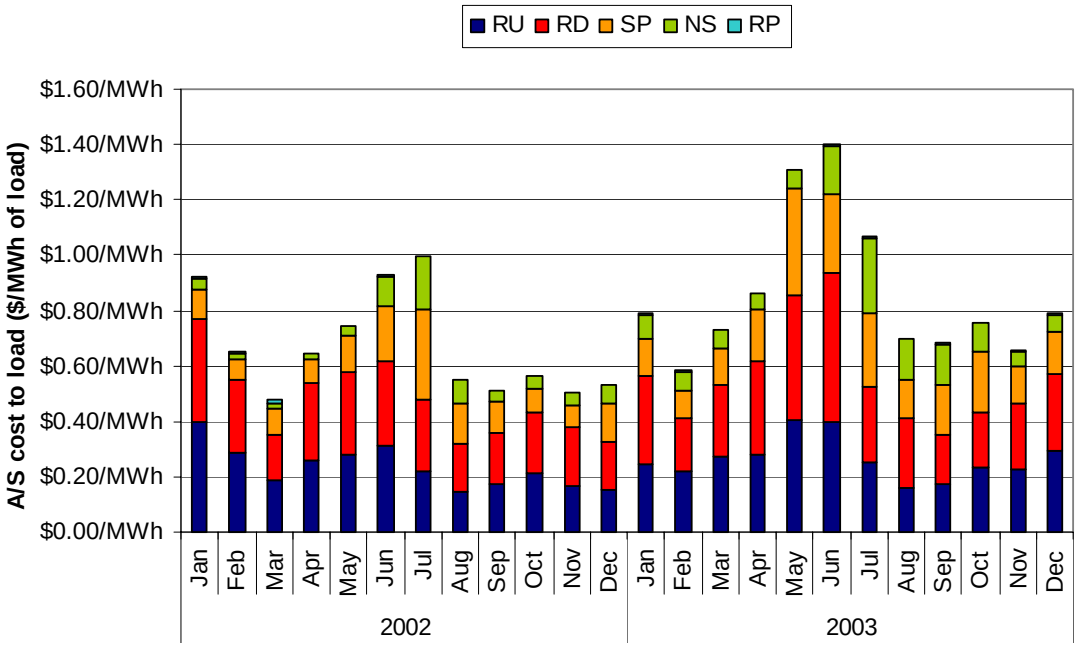
[1] Average A/S prices – whether annual or monthly – are computed by weighting the hourly prices for each market by the total procurement of the product. This computation values the portion of the service that was self-provided at the market price.

Figure 4.1 Annual A/S Prices and Volumes, 1999-2003



The cost of ancillary services load grew by 25.3% from $0.691/MWh in 2002 to $0.865/MWh in 2003. The monthly variation of this cost is shown in Figure 4.2. Monthly costs peaked in May/June rather than in June/July as they did in 2002. This shift was due to three factors: bid insufficiency in the regulation markets peaked during May; several regulation-providing units extended their spring maintenance periods with must-offer waivers until late June; and a declared emergency on May 28th, 2003 prompting increased procurement of spinning reserves at increased prices during late May, early June. Further details are provided in the following discussions of market prices and procurement and bid sufficiency.

Figure 4.2 Monthly Cost of A/S per MWh of Load



4.3 Market Prices and Procurement

The overall increase in ancillary services prices from 2002 to 2003 was a result of price increases in regulation up (RU) by 34.8%, regulation down (RD) by 33.9%, spinning reserves (SP) by 42.1% and non-spinning reserves (NS) by 95.3%. These four products are the only A/S products that the CAISO actively procures through markets. The increase in prices was the result of the following circumstances:

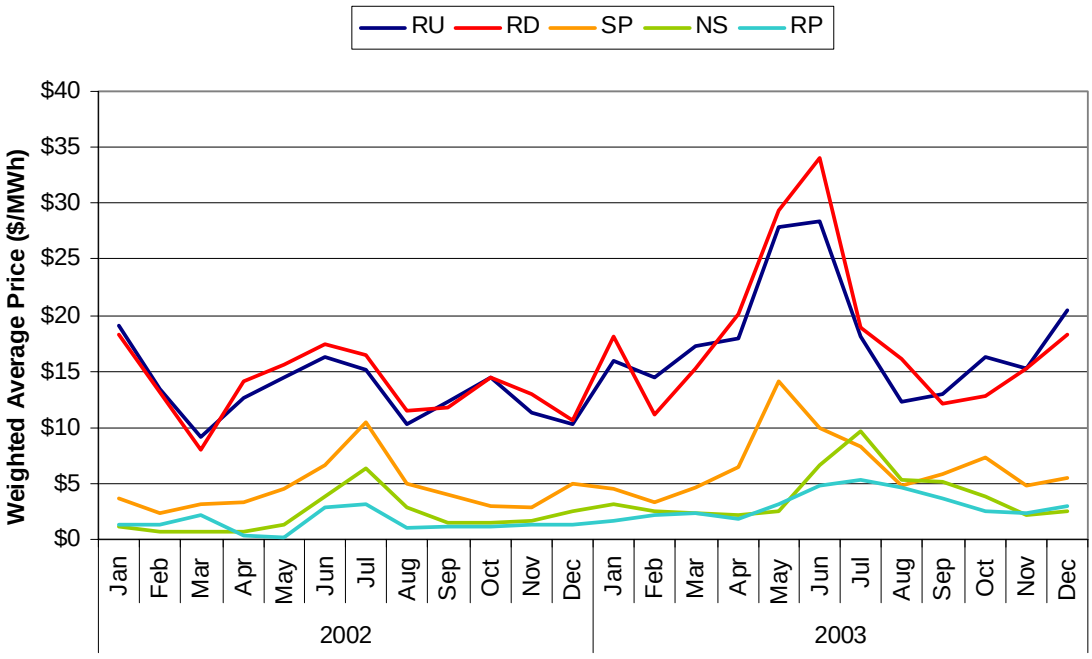
A/S capacity bid into the market declined by 25 percent. The decline in supply was driven by three major factors: the loss of capacity from several resources opting for RMR Condition 2 contracts, several unit retirements and an increase in load which reduced available, unloaded capacity.

Increased frequency of bid insufficiency caused increases in A/S prices especially for RU, RD and SP during shoulder months (mid-April through mid-June, mid-October through mid-December).

The declared emergency of May 28, 2003 spurred increased procurement of reserves during a period in which less efficient resources with high costs of running were brought into the market.

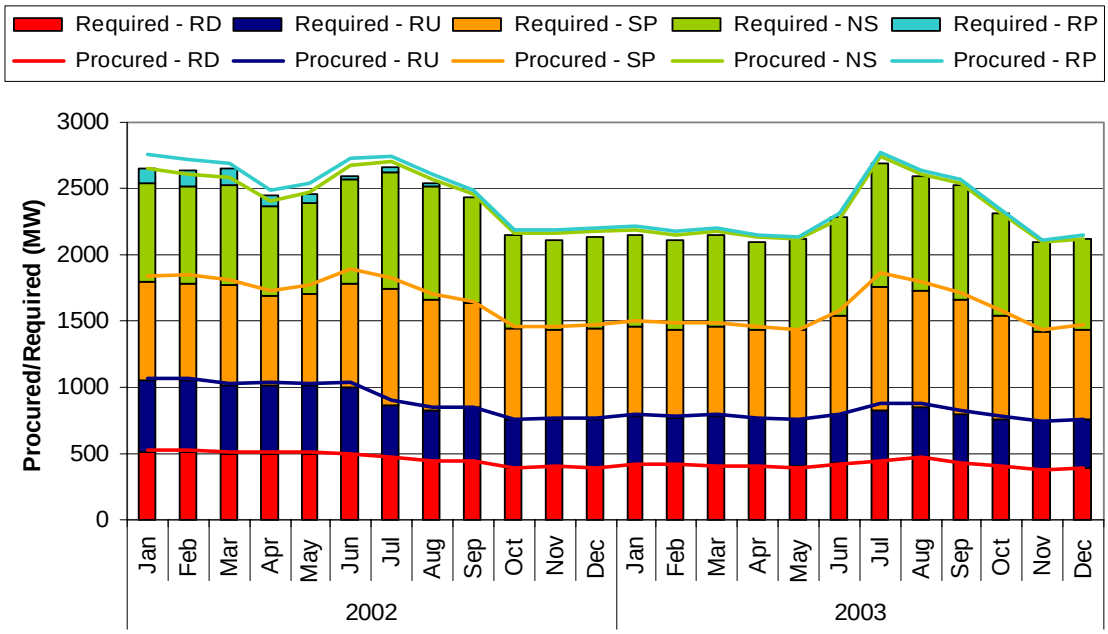
Figure 4.3 below shows monthly average prices for each ancillary service product. Although RU and RD prices were greater in most months of 2003 than in the same month of 2002, the difference during the May/June period is most obvious. Supply was lower during this period than in the previous year, but the frequency of bid insufficiency was much greater. Procurement of SP after the May 28, 2003 emergency did not result in a noticeable, cumulative increase in procurement, but it did lead to a noticeable increase in prices. In 2002, SP prices peaked in July, while in 2003 SP prices peaked in May. The increase in peak monthly prices in the NS markets was due to a small number of hours of prices above $80/MW during July.

Figure 4.3 Monthly Weighted Average A/S Prices, 2002-2003



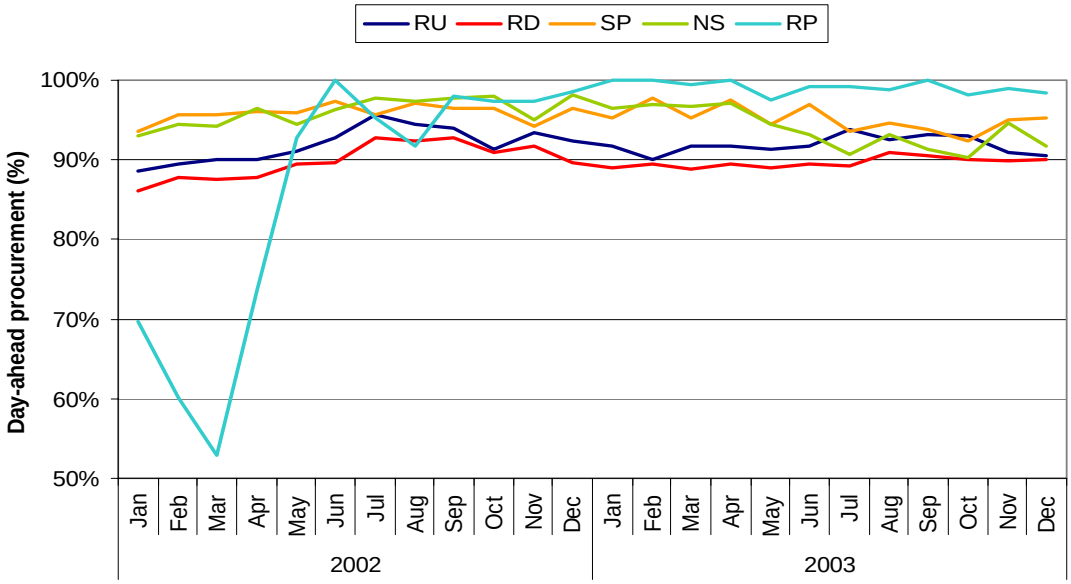
Procurement followed typical seasonal trends. The early part of 2002 is higher because the calculation of ancillary service requirements had not yet been revised. The CAISO procured the vast majority of required capacity through the ancillary services markets.

Figure 4.4 Monthly-Average Hourly A/S Demand and Procurement, 2002-2003



There were no major deviations from the day-ahead procurement targets for ancillary services. The CAISO's day-ahead procurement target for RU and RD is 90% of the hourly requirement, while the target for SP and NS is 95%. In July and October, there were significant deferrals of procurement from the day-ahead market to the hour-ahead market for SP and NS. In October, this was due to day-ahead market bid insufficiency. In July, unexpected demand related to forecast error caused the shift.

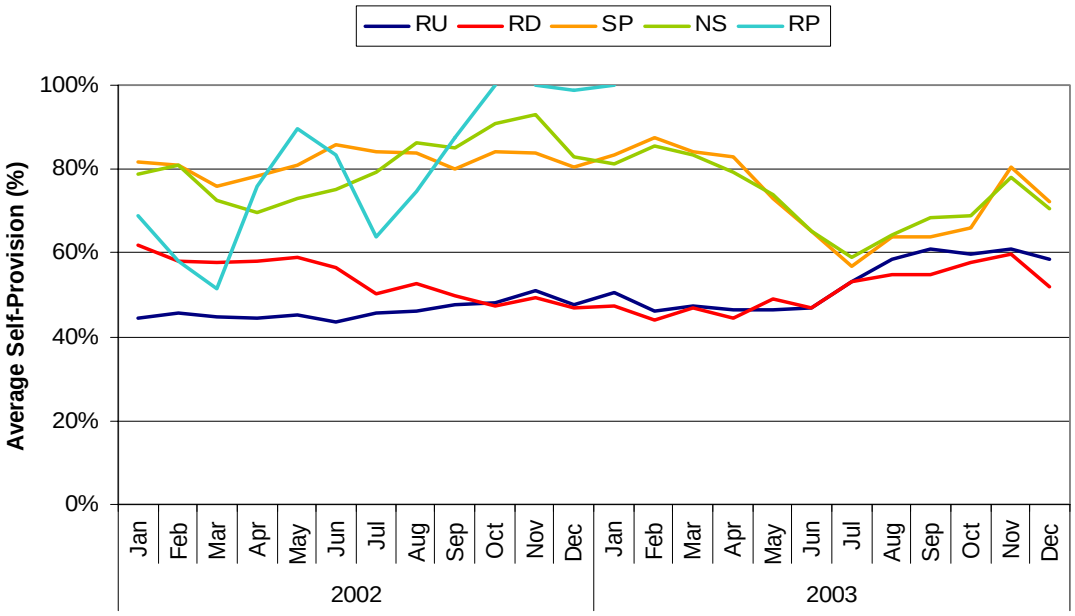
Figure 4.5 Hourly Average Day-Ahead Procurement, 2002-2003



Self-provision of ancillary services continued to be a major component of A/S market supply in 2003. One hundred percent of replacement reserves (RP) were self-provided because the CAISO no longer actively procured this service through its markets. Regulation self-provision was similar to 2002. Comparing SP and NS for 2002 and 2003 shows greater differences, especially in June, July and August when self-provision of these services is much lower in 2003 than in 2002. Several market participants changed from self-providing to making market offers during this period.

Figure 4.6 shows the monthly average percentage of self-provided A/S for 2002 and 2003.

Figure 4.6 Hourly Average Self-Provision, 2002-2003

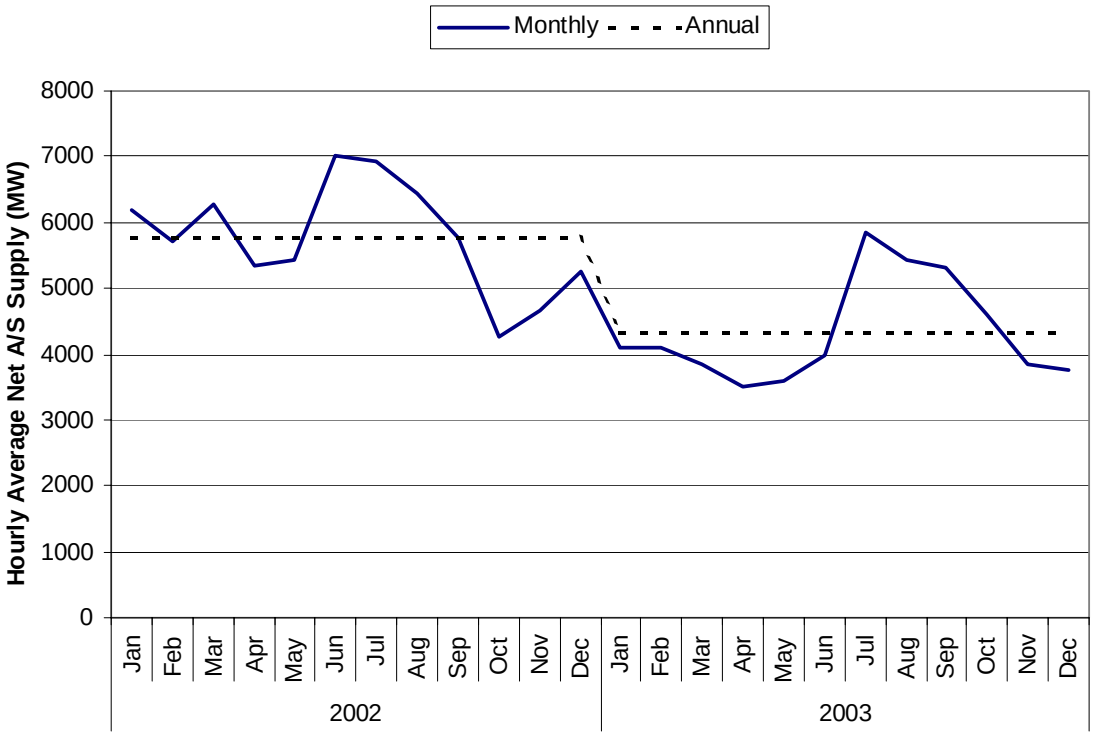


4.4 Ancillary Service Bid Sufficiency

4.4.1 Market Supply

Offers of physical capacity to the A/S markets declined by 25% from 2002 to 2003. Migration from RMR Condition 1 contracts to RMR Condition 2 contracts, plant retirements and higher loads contributed to this decline. RMR Condition 2 contracts preclude contracted resources from participating in the California markets. The decrease of more than 1000 MW in physical offers between December 2002 and January 2003 is not entirely attributable to this change, but a very large part of the decline is. The nature of this impact varies by product; it is discussed in further detail on the following page.

Figure 4.7 Average Hourly Net A/S Supply by Month, 2002-2003[2]



This decline in physical capacity offered to the market was related to an increase in bid insufficiency. In a particular hour, bid insufficiency is the inability of the hour-ahead market to procure all required ancillary service capacity for a product. For example, if the hour-ahead bid stack for the spin market contains 300 MW of bids and 310 MW are required, the hour-ahead spin market is said to be bid-insufficient in that hour. In such cases, the CAISO employs existing procedures[3] to procure the remaining required capacity.

The CAISO's ancillary services markets procured all required capacity more than 96 percent of the time during 2003. Bid insufficiency in RD declined substantially in 2003 compared to 2002, while increasing in SP. The increase in SP bid insufficiency is the most significant change. Increasing bid insufficiency is caused by three factors:

- Several A/S-providing RMR resources opted for RMR Condition 2 contracts;
- Several A/S-providing resources were retired or mothballed;

[2] Net A/S supply measures the physical capacity offered to the market. The market accepts offers of the same physical capacity into several markets in the case of upward reserves. The market clearing mechanism only allocates the capacity to one market. For this reason, summing all capacity offers from a resource overstates the physical capacity offered to the markets. This does not apply to self-provision, because the SC allocates the capacity to each market.

[3] Operating procedures M-402 and G-203K are the primary operating procedures that govern this situation.

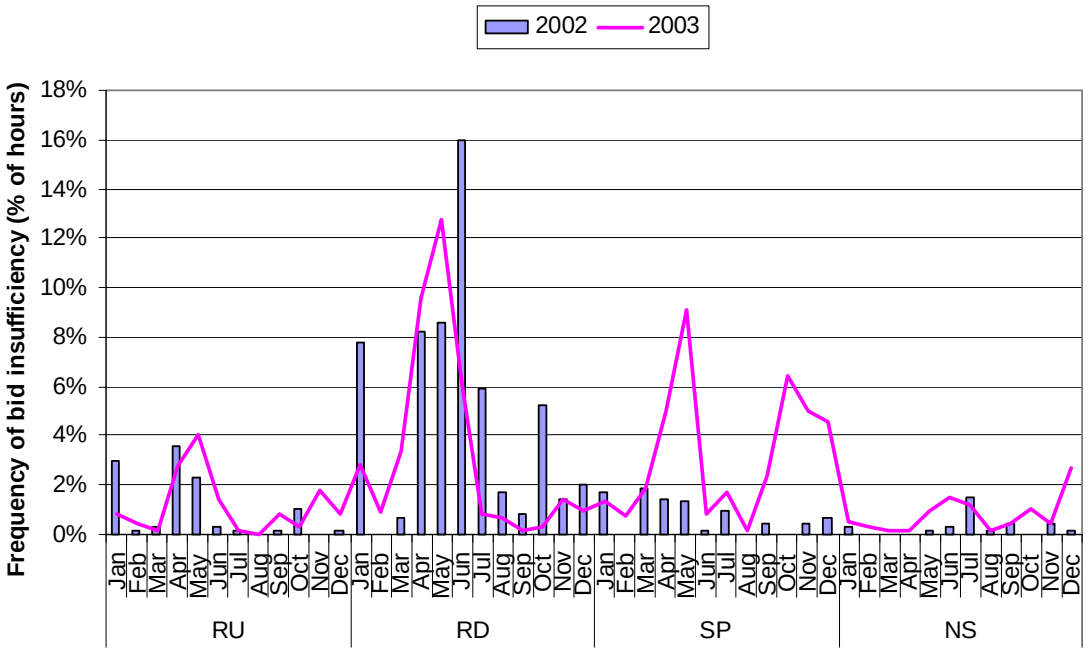
- Load growth reduced the available unloaded capacity for A/S-providing resources.

Table 4.2 Frequency of Bid Insufficiency, 2002-2003

	RU	RD	SP	NS
2002	0.9%	4.9%	0.8%	0.3%
2003	1.1%	3.3%	3.3%	0.8%

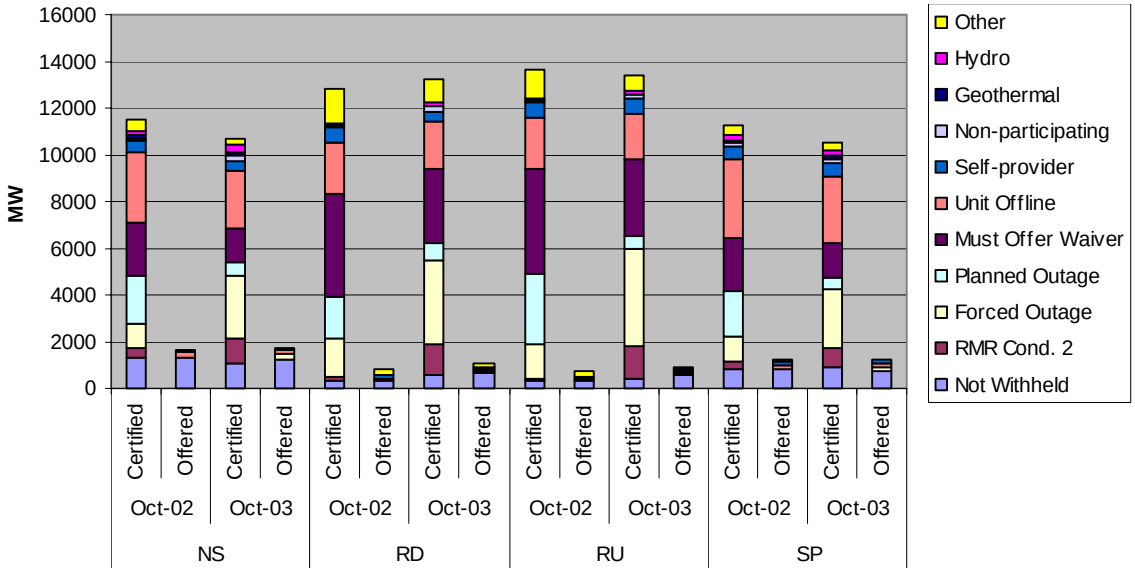
The increase in SP bid insufficiency occurred mostly during the spring and the fall. Bid insufficiency in SP peaked in May corresponding with peak prices for SP. In the spring, hydro resources that usually supply a significant portion of A/S capacity are often required to generate rather than supply reserves. With plentiful hydro generation and relatively low loads, thermal units are less likely to be committed to serve load. However, they must be committed to provide spinning reserves. Similar unit commitment issues occur in the fall. Despite these conditions, SP bid insufficiency was not a major factor in 2002 during spring or fall. The removal of capacity due to RMR Condition 2 contracts and the retirement of several units in 2003 were the major causes of the increase in bid insufficiency. During the fall of 2003, load growth also was a factor.

Figure 4.8 Frequency of A/S Bid Insufficiency, 2002-2003



The CAISO developed a capacity study for October 2003. The purpose of this study was to determine the causes of bid insufficiency. The study identified RMR Condition 2; unit commitment and disincentives related to must offer waiver denials (categorized as "Other" in Figure 4.9) as areas of focus. The results of this study were described in more detail in the Market Analysis Report, October 2003.

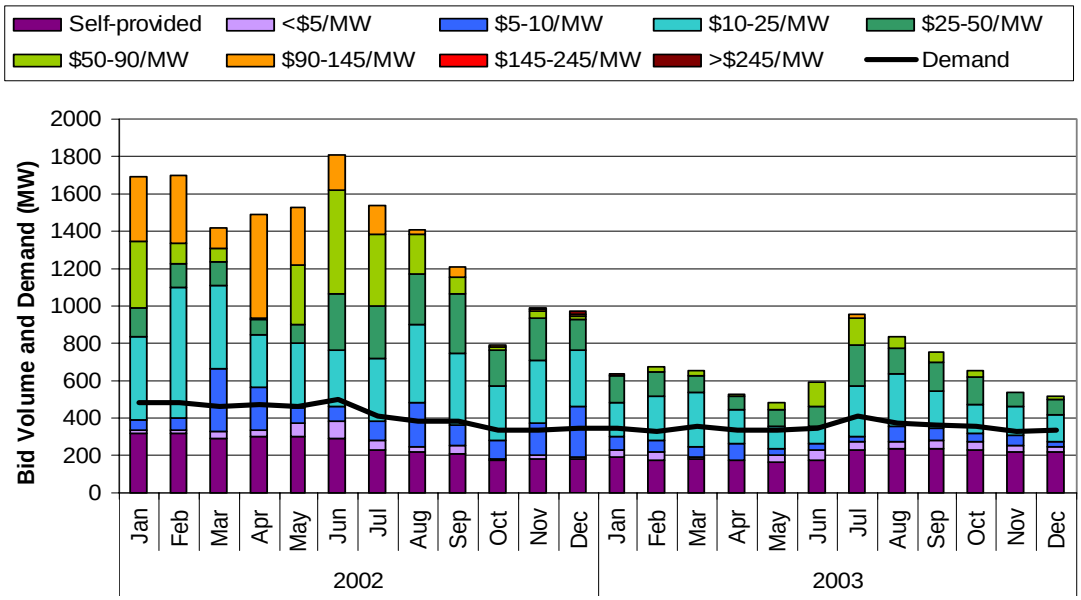
Figure 4.9 A/S Certified and Offered Capacity, October 2002 vs. October 2003



4.4.1.1 Regulation UP (RU)

Regulation Up supply declined sharply from 2002 to 2003. It is estimated that 450 MW of capacity was removed from the regulation markets due to RMR contract changes in an average hour. The difference in total bid volume between December 2002 and January 2003 was approximately 350 MW. Migration to RMR Condition 2 contracts does not entirely explain the 1000 MW gap between average bid volumes in May 2002 compared to May 2003. In addition to RMR contract changes, several regulation-providing resources were retired during this period. Figure 4.10 on the following page shows the hourly average day-ahead RU bid composition for 2002 and 2003.

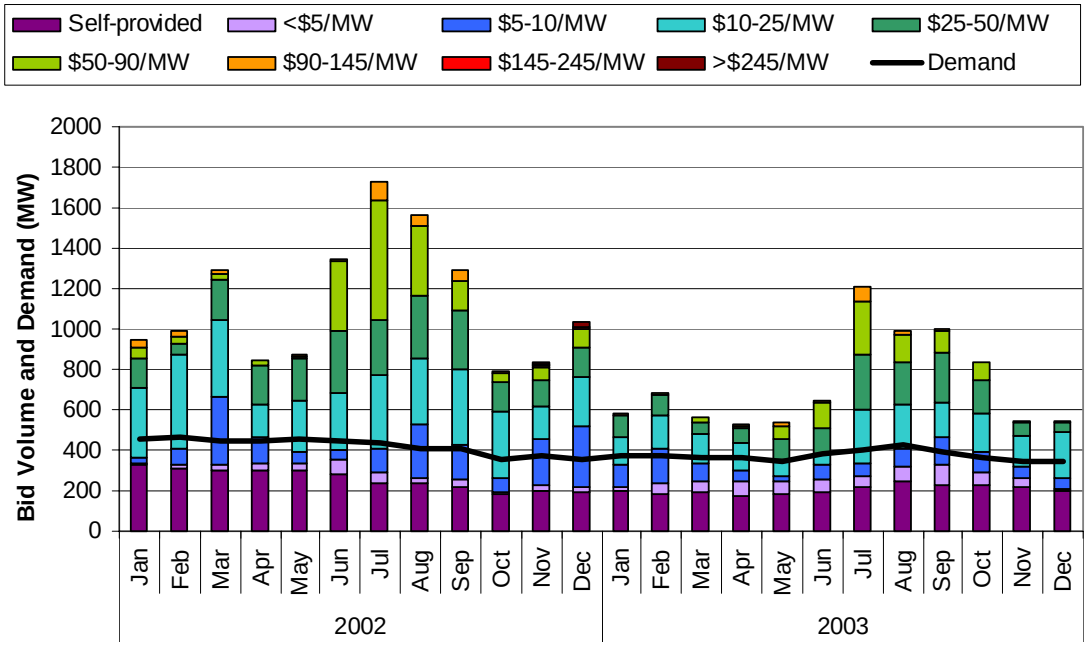
Figure 4.10 Hourly-Average, Day-Ahead Regulation Up Bid Composition, 2002-2003



4.4.2 Regulation Down (RD)

Although the decline in supply was not as great in the RD market as in RU, there was a substantial decline in all months other than October. The factors causing this decline were identical to those causes for declines in RU. In October 2003 there was a small increase in supply. However, loads in October 2003 were more than 5% higher than loads in October 2002. This meant that RD-providers generally ran above the mid-point of their regulation-providing range. This is evident in October 2003 because the average hourly RU bid volumes were less than 700 MW, while in RD the same figure exceeded 800 MW. Figure 4.11 shows the hourly average day-ahead RD bid composition for 2002 and 2003.

Figure 4.11 Hourly-Average, Day-Ahead Regulation Down Bid Composition, 2002-2003



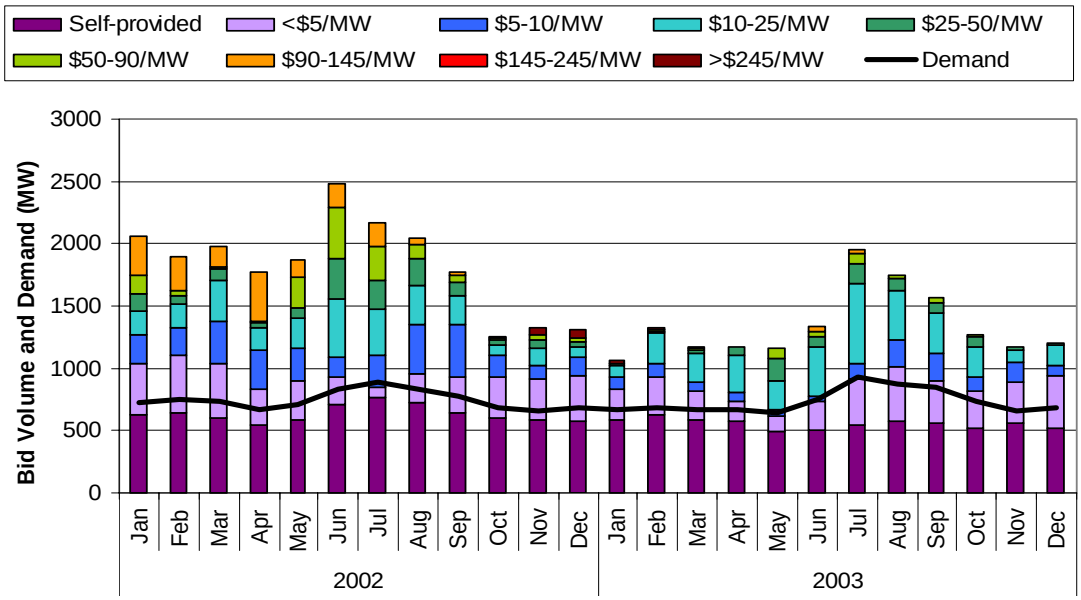
4.4.3 Spinning Reserves (SP)

The spinning reserve (SP) markets also experienced declining average supply. Like the regulation markets but to a lesser extent, about 125 MW of the difference between December 2002 and January 2003 was associated with the migration to RMR Condition 2 contracts. The decline in RU supply also affected the SP and NS markets indirectly. Many resources offer capacity to all three markets. The CAISO cannot procure SP from a resource that is providing RU unless the resource has additional unloaded capacity. When supply is tighter in RU markets, resources with offers in both RU and SP are more likely to be awarded capacity in the RU market thus reducing the capacity available to the SP markets.

The difference in supply between 2002 and 2003 were significant in April and May, while in the fall the differences were smaller. The differences in spring supply obviously affected bid insufficiency in the spring. Supply declined slightly in November and December 2003 compared to 2002, while supply increased slightly in October. Demand in the SP markets increased during these months, especially in October when load grew by more than 5% year-over-year.

Small movements in supply and demand produced a substantial increase in bid insufficiency. This highlights the small amount of capacity required to relieve it. Figure 4.12 shows the hourly average day-ahead SP bid composition for 2002 and 2003.

Figure 4.12 Hourly-Average, Day-Ahead Spinning Reserve Bid Composition, 2002-2003



4.4.4 Non-spinning Reserves (NS)

The non-spinning reserve (NS) markets experienced similar changes to those in the SP markets. However, average supply in NS was much greater than in SP. Thus, bid insufficiency was less frequent in the NS markets than in the SP markets in 2003. Figure 4.13 shows the hourly average NS bid composition for 2002 and 2003.

Figure 4.13 Hourly Average Non-Spinning Reserve Bid Composition, 2002-2003