3. Real Time Imbalance Energy Market

3.1 Prices and Volumes

One of the key functions of the CAISO is to maintain the reliable physical operation of the system. In order to do this, the CAISO must perform real-time balancing of load and generation at a system-wide level. The CAISO maintains real-time balance through the combined use of (1) units providing regulation reserves, which are on automatic generation control (AGC) and therefore require no explicit dispatch instructions, (2) units providing operating reserve ancillary services (A/S), and (3) resources that submit supplemental energy bids. The latter two categories are dispatched through awards of bids in the real-time imbalance energy market. In that market, supply (and some load) resources submit energy bids to *increment*, or increase, or *decrement*, or decrease their operating levels in response to CAISO dispatch instructions.

Whenever generation output is less than load, the CAISO will pay generators to increment their output above their schedules. Generators offer to increment generation at the price they are willing to accept to increase output. The CAISO calls upon as much energy as it needs, in order of the least to the most expensive price bid (subject to operating constraints), and pays all generators it calls upon to generate the marginal (or last) bid taken. Thus, no generator receives less for its energy than it was willing to accept to increment output.

Sometimes utilities may actually schedule more energy than is needed to serve their customers. This situation occurred frequently during 2003. It has occurred often since mid-2001 when the State of California entered into long-term contracts with limited dispatch flexibility to provide for a significant amount of the utilities' load. As a result, the CAISO must dispatch some generators to decrement their output below their schedules. Generators bid prices they are willing to pay to decrement, since they avoid costs such as fuel and variable operations and maintenance expense they would otherwise incur to produce electricity. In this case, the CAISO sorts bids from the highest to the lowest price, and allows units to decrement in economic merit (decreasing price) order. All units asked to decrement must pay the CAISO the marginal price. Thus, no generator is required to pay any more to be allowed to decrement than it had bid to do so.

3.1.1 Real-time Imbalance Energy Prices

While peak incremental energy (INC) prices were usually $20 to $30/MWh higher than off-peak prices during 2003, off-peak prices were at or above peak prices between March and April, due to the "Hour 23 problem." This is a situation in which load decreases during the hours ending 22:00 and 23:00 (between 9:00 and 11:00 p.m.). However, the decrease in generation is comparatively sharper and occurs with the ending of delivery of a significant amount of peak-hour power under long-term contracts between 9:50 and 10:10 p.m. To correct for this mismatch and balance generation with load, the CAISO often must increment generation in the hour ending 23:00. Due to seasonal energy use and the switch to daylight savings time, this problem was especially acute in March and April, often accounting for the bulk of those months' incremental transactions. Please see the DMA's *Monthly Board Reports* for these months for further details.

Decremental energy (DEC) prices tend to be lower in off-peak hours; that is, generators are not willing to pay as much in off-peak hours to avoid generating. This is due largely to the fact that fewer units are available to be decremented in off-peak hours. Many units shut down entirely at night, and most units that are on line at this time already are operating near or at their minimum levels of output.

Figure 3.1 and Table 3.1 show monthly zonal volume-weighted average prices in 2003.

Figure 3.1 Monthly Zonal Market-Clearing Prices in All, Peak, and Off Peak Hours

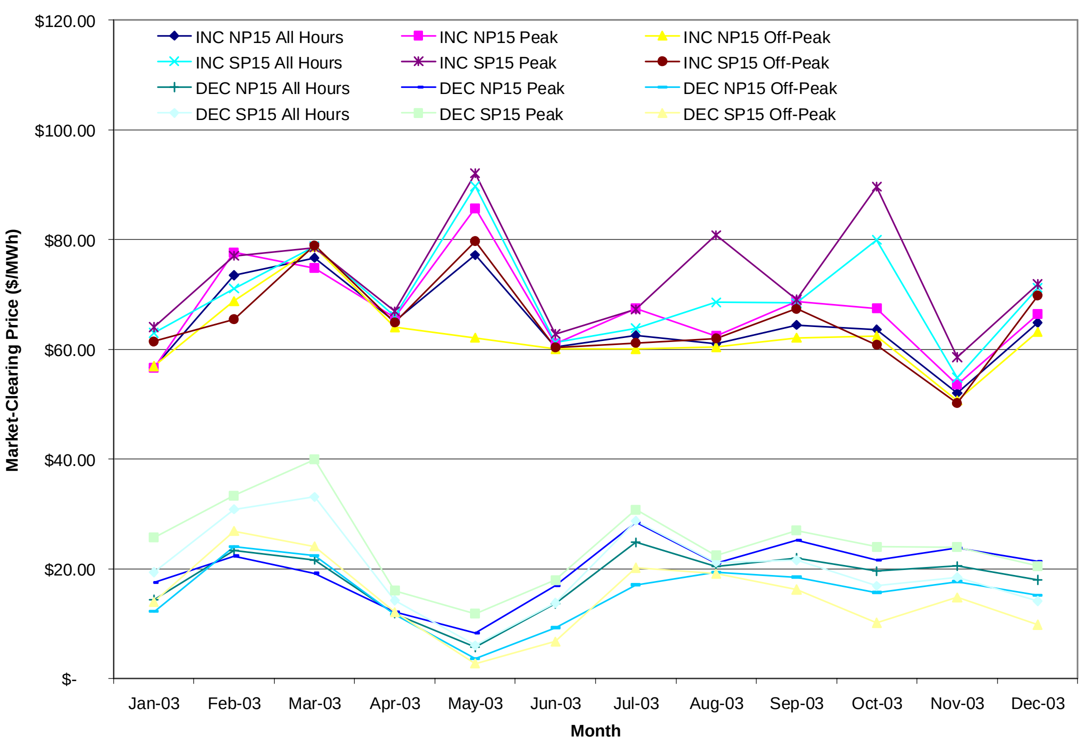
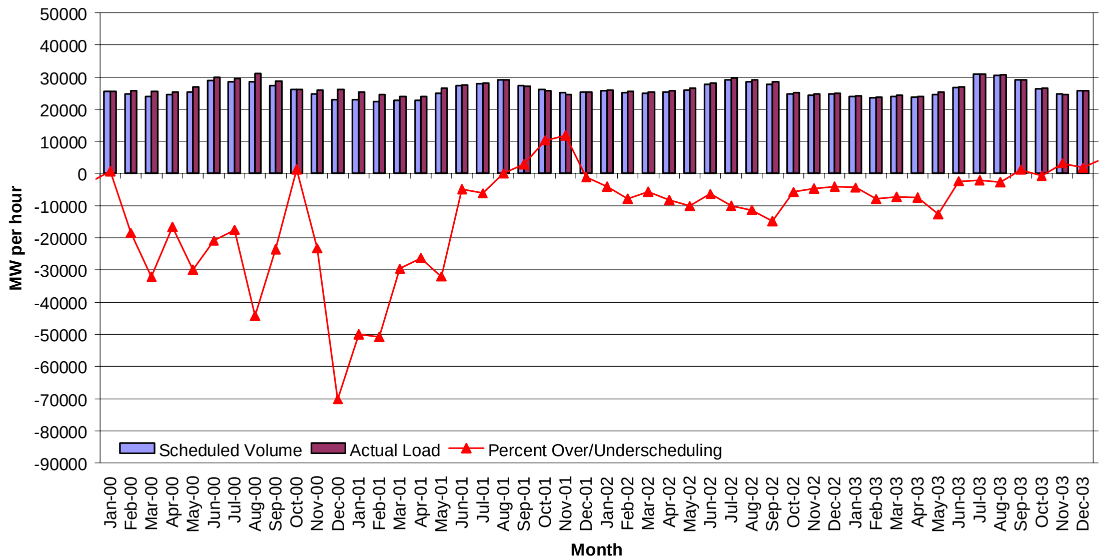


Table 3.1 2003 Monthly Zonal Real-Time Weighted Average Prices In All, Peak, and Off Peak Hours

Month	INC						DEC					
	NP15			SP15			NP15			SP15		
	All Hours	Peak	Off-Peak	All Hours	Peak	Off-Peak	All Hours	Peak	Off-Peak	All Hours	Peak	Off-Peak
Jan	$ 56.74	$ 56.60	$ 56.95	$ 63.00	$ 64.04	$ 61.46	$ 14.38	$ 17.53	$ 12.21	$ 19.37	$ 25.67	$ 13.98
Feb	$ 73.49	$ 77.64	$ 68.80	$ 71.09	$ 77.04	$ 65.49	$ 23.41	$ 22.34	$ 24.06	$ 30.86	$ 33.34	$ 26.88
Mar	$ 76.69	$ 74.81	$ 78.68	$ 78.75	$ 78.57	$ 78.93	$ 21.61	$ 19.19	$ 22.45	$ 33.11	$ 39.94	$ 24.08
Apr	$ 65.14	$ 65.86	$ 64.05	$ 66.04	$ 66.92	$ 64.87	$ 11.84	$ 12.10	$ 11.63	$ 14.24	$ 16.02	$ 12.12
May	$ 77.22	$ 85.71	$ 62.14	$ 89.72	$ 92.11	$ 79.70	$ 5.72	$ 8.32	$ 3.62	$ 6.04	$ 11.80	$ 2.73
Jun	$ 60.38	$ 61.04	$ 60.11	$ 61.30	$ 62.78	$ 60.30	$ 13.62	$ 16.88	$ 9.27	$ 13.80	$ 17.92	$ 6.73
Jul	$ 62.53	$ 67.43	$ 60.11	$ 63.88	$ 67.29	$ 61.18	$ 24.83	$ 28.50	$ 17.06	$ 28.77	$ 30.80	$ 20.18
Aug	$ 60.98	$ 62.45	$ 60.41	$ 68.54	$ 80.82	$ 61.97	$ 20.41	$ 21.03	$ 19.37	$ 21.18	$ 22.42	$ 19.12
Sep	$ 64.46	$ 68.76	$ 62.12	$ 68.43	$ 69.06	$ 67.40	$ 22.00	$ 25.20	$ 18.47	$ 21.53	$ 27.00	$ 16.23
Oct	$ 63.64	$ 67.48	$ 62.41	$ 79.98	$ 89.67	$ 60.83	$ 19.56	$ 21.59	$ 15.67	$ 16.90	$ 23.99	$ 10.18
Nov	$ 52.00	$ 53.55	$ 50.68	$ 54.86	$ 58.57	$ 50.18	$ 20.51	$ 23.78	$ 17.67	$ 18.48	$ 23.95	$ 14.80
Dec	$ 64.85	$ 66.41	$ 63.20	$ 71.21	$ 71.87	$ 69.80	$ 17.97	$ 21.36	$ 15.17	$ 14.13	$ 20.52	$ 9.79

Real-time market activity changed dramatically from 2001 to 2003. This was due to changes in both market conditions and market rules. The long-term contracts entered into in 2001 by the State of California combined with significant new generation additions to result in stable short-term energy markets and competitive short-term wholesale energy prices. This combination has also led to a dramatic reduction in underscheduling, to the point at which the CAISO issued significantly more decremental dispatch instructions than incremental instructions in 2003. Therefore, load-serving entities have not had to rely on market power mitigation measures to protect them from high prices. Figure 3.2 shows monthly average loads and monthly average deviations between schedules and loads from January 2000 through December 2003.

Figure 3.2 Monthly Average Loads and Deviations between Schedules and Loads Through 2003



The incremental price cap has varied dramatically over the past three years, ranging from a low of $55.27/MWh on July 11, 2002, to no price cap whatsoever between May 29, 2001 and June 20, 2001. Since October 30, 2002, the incremental price cap has been $250/MWh, and the decremental cap -$30/MWh.

Figures 3.3 and 3.4 and Table 3.2 show INC and DEC price duration curves, comparing years 2001 through 2003.

Figure 3.3 Real-Time Incremental Price Duration Curves, 2001-2003

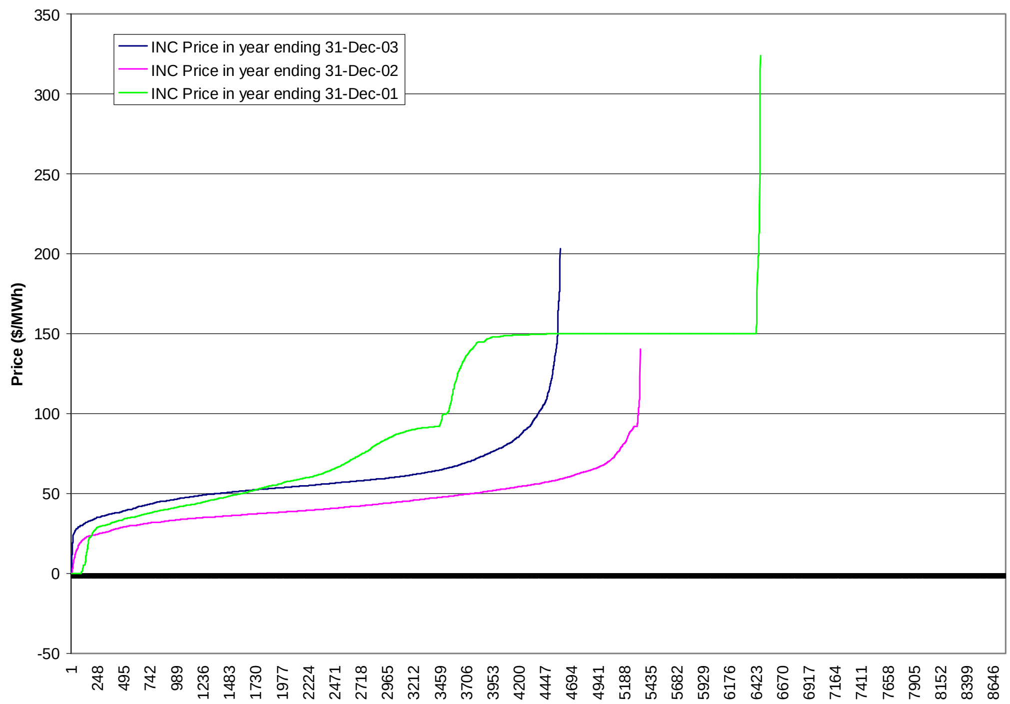


Figure 3.4 Real-Time Decremental Price Duration Curves, 2001-2003

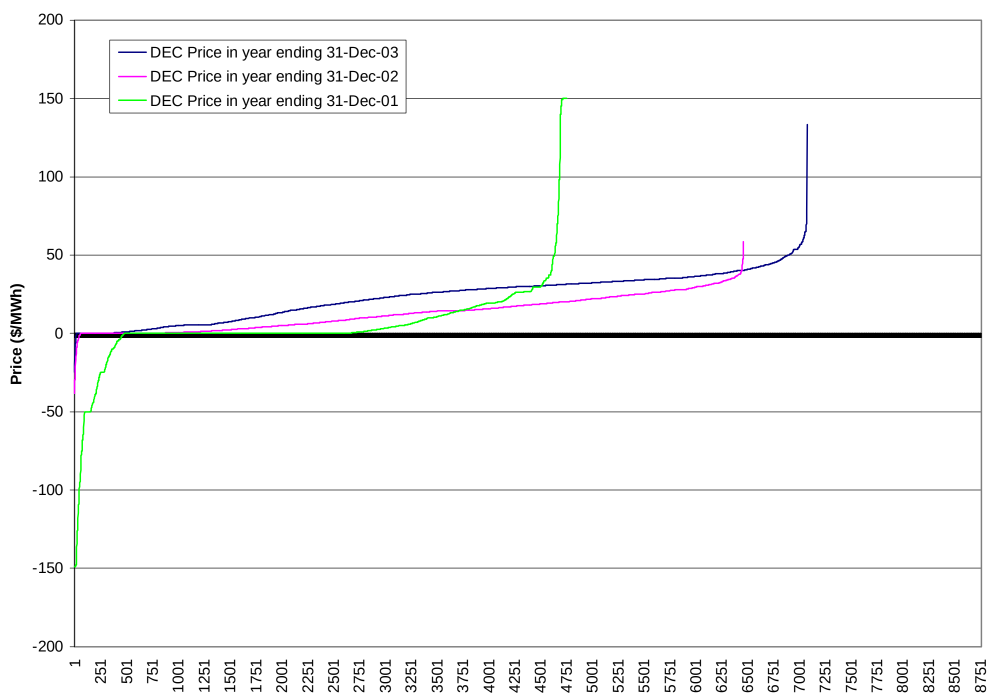


Table 3.2 Annual System wide INC and DEC Price Metrics, 2001-2003

Year	Average INC Price	Min. INC Price	Max. INC Price	St. Dev. INC Price	Average DEC Price	Min. DEC Price	Max. DEC Price	St. Dev. DEC Price
2001	123.56	-7.7	323.97	49.97	-0.8	-149	150	27.47
2002	52.86	-0.04	140.53	14.83	8.78	-38.23	58.29	10.62
2003	68.83	0.04	203.06	20.31	18.46	-25	133.45	14.27

3.1.1.1 Price Volatility

Volatility has decreased dramatically since 2001. One measure of volatility is the "Volatility Index", a ratio of the standard deviation to the average price. A small volatility index indicates low volatility relative to price. Incremental energy price volatility indices decreased from a range of 0.50 to 0.51 in 2001 to the range of 0.32 to 0.34 in 2003. The decrease in decremental energy price volatility was much more substantial. Volatility decreased from a range of 4.86 to 7.62 in 2001 to a range of 0.61 to 0.62 in 2003. Table 3.3 shows annualized volatility of real-time balancing energy by zone.

Table 3.3 Annualized Price Volatility

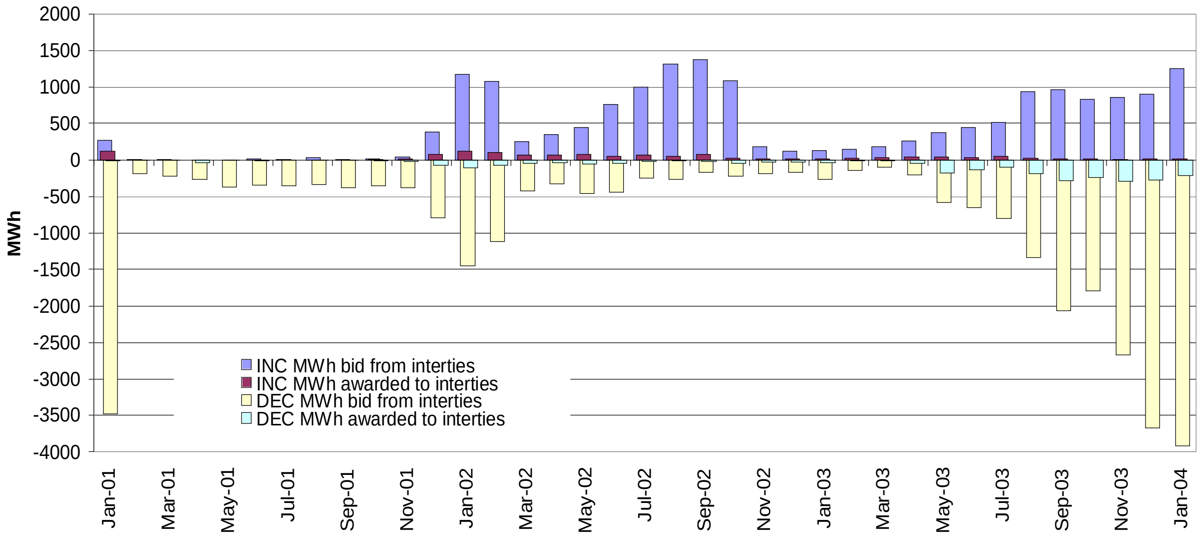
	INC						DEC					
	NP15			SP15			NP15			SP15		
	Avg. Price	St. Dev.	Volatility Index	Avg. Price	St. Dev.	Volatility Index	Avg. Price	St. Dev.	Volatility Index	Avg. Price	St. Dev.	Volatility Index
2001	$ 99.04	$ 49.76	0.50	$ 96.93	$ 49.86	0.51	$ 4.52	$ 21.98	4.86	$ 3.55	$ 27.04	7.62
2002	$ 44.02	$ 13.93	0.32	$ 46.32	$ 14.38	0.31	$11.29	$ 10.50	0.93	$12.57	$ 10.50	0.84
2003	$ 58.77	$ 18.95	0.32	$ 60.41	$ 20.33	0.34	$22.31	$ 13.67	0.61	$23.20	$ 14.42	0.62

3.1.2 Import Bids into Real-time Imbalance Energy Market

On December 19, 2001, as part of its market power mitigation measures, the Federal Energy Regulatory Commission directed that bids from imports, or *system resources*, into the real-time market would automatically be set to a price of $0/MWh, effective February 19, 2002. Shortly thereafter, the Commission clarified its Order directing the CAISO to pay pre-dispatched bids awarded for a full hour of operation the uninstructed price in those intervals when the CAISO had not dispatched all resources. This, combined with the requirement that system resources receive uninstructed prices in real-time, resulted in a dramatic decrease in average import bid volume from approximately 1,300 MW in early February 2002 to approximately 200 MW one month later. On June 11, 2002, the Commission accepted CAISO Tariff Amendment 43, which permits system resources to receive the instructed price when pre-dispatched for a full hour of operation. This encouraged importers to increase their bid volumes to the California real-time market and returned real-time import bid volumes by midsummer near to those seen in early 2002. However, as import resources became scarce and opportunity costs increased in the fall of 2002, import bids decreased to approximately 150 MW on average by late 2002. On July 17, 2002, the Commission issued its Order on MD02 Phase 1, leaving the status of the zero-bid requirement in some doubt. The Commission clarified in its Order of October 11, 2002, that the zero-bid requirement remain in effect, and then directed in its Order of January 17, 2003, that the zero-bid requirement be removed upon implementation of Phase 1B of MD02. Since Phase 1B has since been delayed, the Commission accepted CAISO Tariff Amendment 52 on June 24, repealing the zero-bid requirement and the CAISO implemented its direction on June 25.

Since that time, resources bid to the real-time market have increased, usually at prices significantly above $0/MWh, with some seasonal fluctuations. The weekly average peaked above 1,800 MW in the last week of the year. In comparison, the import bid volume in December 2002 was less than 200 MW on average. Additionally, volume growth has been primarily among bids priced below $25/MWh. Figure 3.5 shows weekly average import bid volume in the real-time balancing energy market from 2001 through December 2003.

Figure 3.5 History of Import Bid Volume in Real Time Market: Weekly Averages through December 2003



3.2 Bid Sufficiency

In 2003, incremental bids were more than sufficient to balance generation with load in almost all hours. As noted in Chapter 2, resources that bid above the $250/MWh price cap were procured as bid in only seven hours during the year, indicating that the incremental bid stack was nearly exhausted in those hours.

During the last few months of 2003, insufficiency in decremental bids emerged as an issue. On occasion, the CAISO has literally run out of bids when issuing decremental dispatches in periods when real-time generation exceeds actual load. When this happens, the CAISO must resort to decremental out-of-market instructions to balance generation with load. The Department of Market Analysis conducted an informal analysis to determine the reasons for the lack of sufficient decremental bid volume in the real-time balancing energy market.

The preliminary results of the investigation indicate that the reason for lack of decremental bids is that few units tend to be available to be decremented in these low load hours. For a generating unit to be decremented it must be capable of having a variable level of output and it must be operating at a level above its minimum operating point. The insufficiency problem occurs most often in early morning hours, between 3:00 and 7:00 a.m. when many units are shut off for the night or are configured to run at minimum output levels. For example, a combined-cycle unit that has two gas turbines and one steam exhaust turbine may be running at that time with only one gas turbine at its minimum operating level. In addition, some units are being held on pursuant to the Must-Offer Obligation. When this is the case, they must also be running at their minimum output levels.