

**2003 NYISO PRL Evaluation**

**Executive Summary**

***Background***

The NYISO has undertaken extensive reviews and evaluations of the performance of its demand response programs since their inception in the summer of 2001. This year's evaluation was focused on analyzing the effects of the changes to the program protocols instituted in 2003, and gauging interest in a new, real-time demand response program option. As is customary, the evaluation quantified the level and distribution of benefits from the demand response (DR) program curtailments, including a new feature of the valuation methodology, the calculation of the net social welfare implications of the DADRP program.

***NYISO Demand Response Program Overview***

The NYISO offers three different DR programs that meet specific market needs. Participants in the Emergency Demand Response Program (EDRP) are asked to curtail with two or more hours notice when emergency system conditions are anticipated, and are guaranteed a minimum price of \$500/MWh for verified load reductions during such events. The Installed Capacity, Special Case Resource (ICAP/SCR) program allows participants to sell their load reduction capability as installed capacity in exchange for a guarantee to curtail when called upon. Events can be declared with two-hours notice, at any time of the year or day, provided that participants were given notice of the possibility of an event the previous day. The Day-Ahead Demand Response Program (DADRP) allows end-use customers to offer demand reduction bids into New York ISO's day-ahead electricity market as supply resources, and receive market-clearing prices for scheduled curtailments. Curtailment under the latter two programs is compulsory, and the penalties for curtailment shortfalls can exceed the payments made for committing to curtail.

***Summary of Demand Response Program Changes***

Substantial changes were made to the ICAP/SCR and EDRP programs in 2003. First, customers were required, starting in 2003, to subscribe to one program or the other. Previously, joint participation was allowed, which resulted in ICAP/SCR participants receiving the same

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\$500/MWh minimum curtailment payment as their EDRP counterparts, which supplemented the up-front capacity payment ICAP/SCR participants received.<sup>1</sup> Second, ICAP/SCR subscribers are now required to specify a strike price, which will be used by NYISO dispatchers to determine which resources are dispatched in the case where not all available ICAP/SCR resources are required. Third, those strike prices will be used to determine the level of the energy payment received by those that are called upon to curtail. Each was assured of receiving a payment at least as large as its strike price. Finally, ICAP/SCR resources will be called upon first when operating reserve shortfalls are anticipated. An EDRP event, applicable to all subscribers to the program, will be called only if the ICAP/SCR curtailments are deemed to be insufficient to meet exigent circumstances. In addition, the NYISO's pricing algorithm has been modified to allow resources from either of these two reliability programs to set the market price.

Two changes were made to the DADRP program. First, a \$50/MWh bid floor was instituted to deter opportunistic bidding, defined as low bids submitted when the customer's load was well below normal, such as on holidays or during scheduled plant maintenance.<sup>2</sup> Second, the 10% incremental penalty was eliminated so that non-compliance results in a penalty equal to the higher of the scheduled day-ahead price, or the real-time price.

Because these changes were substantial in nature, and therefore may have impacted program participation or performance, two surveys of the entities that market participation to retail customers were undertaken to both characterize the effects these program changes had on their recruitment efforts and to gauge interest in new ones. In addition, an analysis of the migration patterns from one program to another was performed to provide insight into how these changes affected actual enrollment.

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<sup>1</sup> Once subscribed to ICAP/SCR, participants may sell their qualified capacity to Load-Serving Entities, or commit it to the six-month capability or monthly auctions administered by the NYISO.

<sup>2</sup> Compliance is determined by the difference between the level of usage the participant is otherwise deemed to have used, called a CBL, and its actual hourly usage during the event. The CBL for each event hour is the average usage of the corresponding hours in the five highest usage days of the ten days prior to the scheduling of the DADRP curtailment.

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***Satisfaction with Program Changes***

To characterize how the program changes affected recruiting efforts and program administration, a survey was administered during the fall of 2003 to regulated and competitive load serving entities (LSEs) and curtailment service providers (CSPs) that market program participation to retail customers, as well as to customers that subscribe to programs directly. Respondents were asked to indicate which programs they promoted, and how the program changes impacted those efforts. Surveys were completed by entities that represent hundreds of MWs of load subscribed to the programs.

Almost three-quarters of the respondents reported that they had enrolled customers in ICAP/SCR in 2003, and nearly half sponsored customer participation in EDRP. However, only two reported promoting DADRP, and only one of them actually enrolled a customer in the day-ahead program. These results generally square with previous evaluations of the DADRP program that found that the entities marketing EDRP and ICAP/SCR do not promote participation in DADRP. Consequently, the program changes enacted in 2003 likely had little impact on 2003 participation.

Most of the respondents indicated that the changes in the EDRP program had little impact on their recruitment success, despite the fact that half indicated that they expected benefits from participation would be lower in 2003. This is based on the view that while previously ICAP/SCR and EDRP curtailments were called simultaneously, under the new protocols in some cases only ICAP/SCR resources would be needed to restore reliability, and therefore an EDRP event would not be declared.

Most survey respondents were satisfied with the separation of ICAP/SCR from EDRP, and reported that it was not particularly detrimental to their marketing initiatives, despite the fact that participants were no longer guaranteed an energy payment of \$500/MWh when they curtailed. Most indicated that customers found nominating a strike price to be not very difficult. Overall, the changes in the program EDRP and ICAP/SCR protocols were not viewed as having an adverse affect on participation, at least by survey respondents. However, as is discussed below, there were important changes in the distribution of participants between EDRP and ICAP/SCR, as befits the change in expectations for benefits from participation.

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***Interest in Participation in Real-Time Energy and Ancillary Services Markets***

To gauge interest in participation in the proposed Real-Time Demand Response Program (RTDRP), wherein customers would bid to supply reserves in real-time, the NYISO conducted workshops that included end-use customers, potential program providers (LSEs and CSPs) and other stakeholders, such as enabling technology providers. The protocols of the proposed RTDRP were described to attendees, supplemented by examples of the potential benefits from participation in each program.

The important protocols in the proposed program were that bids to supply reserves that were accepted would result in a reservation payment to the customer, but it would receive no additional energy payment if called upon to curtail. Moreover, a bid could be rejected for supplying reserves, but later called upon to supply balancing energy, in which case the customer received no payment at all for its curtailment. Participants could avoid such adverse outcomes by bidding a high supply price, but doing so would reduce the likelihood of being selected to provide reserves and thereby defeat the purpose of participation. Clearly, participation in this market would require a sound understanding of market fundamentals to devise and execute even a simple bidding strategy.

When asked about their interest in participation, more than half of the LSEs/CSPs/Other Stakeholders, entities that recruit and represent retail customers, indicated that they were at least somewhat interested in promoting the RTDRP program, despite its obvious drawbacks. But, most of the end-use customers indicated that they were not interested. Customers and their representatives also expressed different views on what would be required to induce participation. End-use customers indicated that higher benefits would be required, while the LSEs/CSPs were more concerned with standardization of the NYISO service with those offered by the other northeast ISOs. Both, however, agreed that the high costs of the required five-minute measurement telemetry were a significant barrier to participation.

To provide a frame of reference, workshop attendees were also provided comparable information about alternative market participation options: a Day-Ahead Ancillary Services bidding program, which would allow end-use customers to bid to provide ancillary services in the Day-Ahead Market to meet the reliability needs of the NYISO and an LSE-sponsored day-ahead

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bidding program, whereby the LSEs incorporates customer bids into its day-ahead bidding activities and shares the proceeds with the customers.<sup>3</sup> The main advantage of these options is that the curtailment commitment is made the day-ahead at posted market prices. In addition, because the estimated benefits of RTDRP based only on a reserve payment were so low, a variation on the RTDRP was offered whereby participants received an energy payment in addition to a reservation payment, to ascertain if short notice of the level of payment was the biggest barrier to participation, since such payments are inconsistent with the NYISO’s vision for this program.

Among the choices offered, customers selected RTDRP with energy payments as their favorite, and the base RTDRP design as their last choice, which is not surprising since the energy payments increased the expected benefits of RTDRP participation ten-fold. For at least some customers, managing load in near real-time is apparently feasible, if the rewards are sufficient. However, many also expressed interest in the day-ahead ancillary service-bidding program, involving less risky bidding circumstances, which suggests such a program would be worth evaluating. The program provider respondents indicated either that they wanted none of the programs implemented, or if they had a strong preference, it was for the RTDRP with energy payments.

**2003 Demand Response Program Enrollment**

Table E-1 provides a detailed accounting of how participation in the demand response programs has changed from 2002 to 2003.

The rows in the table represent the program options, which are defined in

	Total 2002 (count)	2003 (count)					Total 2003
		EDRP	DADRP	ICAP	Dropped	New	
EDRP	1535	1021	0	7	507	269	1323
ICAP	226	33	0	117	76	89	213
DADRP	24	0	24	0	0	3	27
sub	1785	1054	24	124			
	NEW 2003	269	3	89			
		1323	27	213			

**Table E-1. Change in Participation 2002 to 2003**

<sup>3</sup> This can be accomplished by a customer submitting a price above which designated load is not committed to NYISO day-ahead clearing prices.



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the first column. The second column indicates 2002 participation (number of subscribers) by program option. The next five columns of the table categorize changes in participation from 2002 to 2003 participation according to: a) re-subscriptions to the same option or migration to another program option (the third, fourth and fifth columns), b) those that left the program altogether (the sixth column), and c) new subscribers to the program option (the seventh column). The final column shows the net result – 2003 subscription to the program option.

In 2003, the number of participants in all demand response programs declined by about 10%.<sup>4</sup> Moreover, there was a substantial amount of churn in program participation. For example, 507 of the 2002 EDRP participants failed to re-subscribe in 2003. The loss of these participants, however, had little effect on the performance of EDRP load as a resource, since 41% of the EDRP dropouts in 2003 provided no load curtailment in any of the 11 EDRP event hours in 2002.

EDRP, which imposes no penalty for failure to curtail during events, was envisioned from its inception as providing customers with a low-risk way to get experience with participation in demand response. In designing the program, the NYISO anticipated that some would discover that their curtailment costs exceed their market value and drop out, but that others would realize that they could accommodate curtailments linked to system conditions, and migrate to the ICAP/SCR and DADRP programs to realize greater benefits. However, only seven of the 2002 EDRP participants switched to ICAP/SCR and none elected to participate in DADRP. It appears that EDRP is considered by most customers to be an end-state product, and not a stepping-stone to potentially more lucrative, but riskier, involvement in the NYISO's capacity and energy markets.

Table E-2 describes 2003 demand response participation by program option and NYISO pricing zone. Zones J (New York City) and K (Long Island) account for 69% of EDRP participants, but only 33% of curtailable load. These zones have an even greater disparity in ICAP/SCR; they account for 37% of participants but only 16% of total load enrolled. The difference is due, in large measure, to the large number of residential customers and small businesses in these zones that are aggregated for program purposes. Due to the relatively small curtailment per capita that characterizes participants in this area, and the high churn rate, building

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<sup>4</sup> A single customer or an aggregation of customers defines a participant.

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up the stock of curtailable load downstate, where the resources are most needed, will require the ongoing recruitment of new customers.

The data in Table E-3 show the changes in participation in all three

programs from 2001- 2003. In 2002, overall participation increased dramatically, by 1,570 customers, over the 2001 level. As discussed above, in 2003 there was a 10% reduction in participation, but the load pledged for curtailment remained about the same. While participation in ICAP/SCR declined slightly in 2003, the amount of load pledged for curtailment increased by over 20%. The new subscribers

offered more of curtailable load per capita (3.7 MW) than what had been provided by the dropouts (2.0 MW), resulting in an increase in the average curtailable MW/participant. Curiously, almost none of the ICAP/SCR dropouts migrated to the more accommodating provisions of EDRP.

Zone	EDRP		DADRP		ICAP	
	#	MW	#	MW	#	MW
A	54	53.38	9	162.40	39	399.00
B	16	62.59	0	0.00	17	30.20
C	145	36.78	4	40.40	31	75.90
D	9	219.43	0	0.00	5	108.60
E	46	55.67	3	114.00	9	14.10
F	66	68.98	9	91.00	14	68.80
G	42	58.97	0	0.00	1	0.40
H	8	7.20	1	1.00	4	2.40
I	25	13.04	0	0.00	14	12.00
J	107	98.72	1	2.50	67	130.30
K	805	179.24	0	0.00	12	8.60
<b>Total</b>	<b>1323</b>	<b>853.994</b>	<b>27</b>	<b>411.30</b>	<b>213</b>	<b>850.30</b>

**Table E-2. 2003 Program Participation by Zone**

	EDRP		DADRP		ICAP	
	2001 to 2002	2002 to 2003	2001 to 2002	2002 to 2003	2001 to 2002	2002 to 2003
<b>Dropped</b>	117	508	6	0	34	76
<b>New</b>	1497	269	4	3	91	90
<b>Transfers</b>		33				7
<b>Renewals</b>	190	1021	20	24	117	116
	1687	1323	24	27	208	213

**Table E-3. Participation Changes 2001-2003 (Number of Participants)**

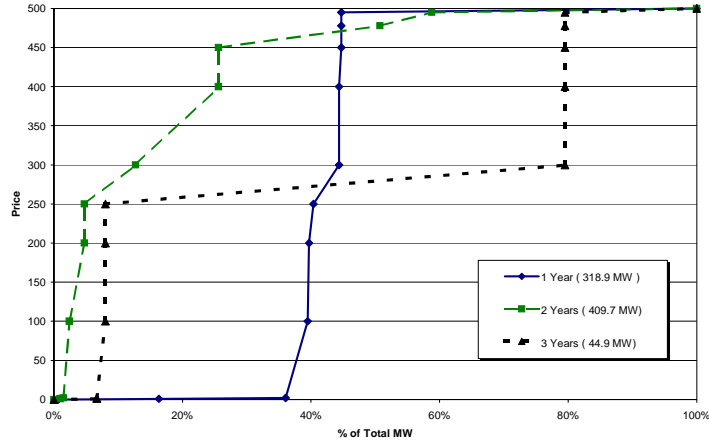
**Strike Price Nominations for ICAP/SCR**

As noted above, program providers indicated that nominating a strike price under ICAP/SCR was not perceived as difficult. But, do the nominations reflect differences in customers' outage costs, yielding, as one might expect a fairly uniform distribution of prices? Or, do other factors result in clusters of bids that make this resource lumpy and less divisible, and therefore more difficult to dispatch precisely?



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Prior program experience seems to have influenced the bidding strategies undertaken by participants. Figure E-1 displays three bid curves comprised of the strike prices ICAP/SCR participants nominated, grouped according to the number of years they have participated in the program. First-year participant bids exhibit a bimodal distribution, with 40% bidding zero and over 50% bidding \$500/MWh, the price cap. This suggests that



**Figure E-1. ICAP/SCR Curtailment Bid Curves by Years of Experience**

these customers either wanted to be assured of being called, and submitted a very low strike price, or sought to avoid that result by submitting a high strike price. Second-year participants' bids were somewhat less clustered, 20% lying between zero and \$450/MWh. Third-year participants' are quite diverse, and characterized by more low bids; about 80% of strike prices were less than \$300/MWh. Perhaps these customers have learned that they should bid their outage cost, so that they get paid at least their direct cost of curtailing, and that way they will not regret the outcome of any individual event. An important consequence is that such bidding results in diversity that makes the resources more valuable to dispatchers.

***The Benefits of Demand Response***

Curtailments undertaken under the auspices of EDRP and ICAP/SCR improve the reliability of the bulk transmission grid, but are now eligible to set market prices, thus if the curtailment payment level exceeds the marginal generation bid, the result of calling such events can be that real-time market-clearing prices are higher.



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Conversely, DADRP curtailments scheduled in the day-ahead market and delivered in the real-time market, exert downward pressure on market prices that produce savings to buyers purchasing energy from the NYISO spot markets during those times.<sup>5</sup> Moreover, all customers realize benefits over the long run. By lowering price volatility, DADRP curtailments act to reduce the premiums that buyers of hedged supply pay because the alternative, purchasing from the spot market, is less risky. Finally, curtailments undertaken by DADRP participants can reduce the dead-weight losses that arise from the gap between the retail rate that customers pay and the cost of supplying their needs.

### **EDRP and ICAP/SCR Evaluation Results**

In 2003, the EDRP and ICAP/SCR curtailment events were declared only during the period following the August 14<sup>th</sup> blackout. Because real-time market operations were suspended during part of this period, EDRP and ICAP/SCR curtailments had no explicit impact on market prices. Moreover, all available resources were called, so the new provision for partial dispatch based on nominated strike prices was not tested.

On August 15<sup>th</sup>, curtailments by EDRP and ICAP/SCR participants in effect allowed other customers, whose service had not been restored, to come on line faster. Service had been fully restored by the 16<sup>th</sup>, but reserves were at times deficit, and the inter-connections to other systems tentative. Program curtailments provided operators with more flexibility in dispatching generation units, and thereby contributed to maintaining reliability of New York's electricity system.

The value of improved reliability, established in previous program analyses, is calculated as the product of the change in the expected loss of load probability (LOLP) attributed to the curtailments, times the percentage of load deemed to be at risk, the product of which is the expected unserved energy, times the value of lost load. For August 15, the explicit unserved energy was identically equal to load curtailment, since for each MW curtailed, a MW of load was restored. On the subsequent day, the change in LOLP was set at .20 and the load at risk at .05%,

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<sup>5</sup> In order for a DADRP curtailment bid to be scheduled, it must lower overall supply cost that would result from scheduling a generation (or DADRP) alternative.

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the product of which is multiplied times the actual load during hour of the event to establish the expected unserved energy. The same VOLL value, \$5.00/kWh, was used both days.

On August 15, 2003, the average hourly load reduction was 803 MWh, with 56% coming from EDRP participants, and the rest from ICAP/SCR participants, resulting in curtailment payments to participants of just over \$5.9 million. The curtailment payment rate was \$500/MWh for EDRP, and averaged \$460/MWh for ICAP/SCR.<sup>6</sup> On August 16, 2003, a Saturday, the hourly average load reduction was 473 MWh, with 37% coming from EDRP participants, and almost two-thirds from ICAP/SCR participants, with curtailment payments of about \$1.7 million.

The value attributed to these curtailments is described in Figure E-2. On August 15th, the programs are credited with providing over \$50 million in reliability benefits, and an additional \$3.5 million were generated on August 16. Overall, the ratio of benefits to program payments was almost 7:1, indicating that the curtailments dispatched by the NYISO were very cost effective in terms of delivered reliability improvements to consumers.

*Outage cost = \$5,000/MW*

Date	System State	Benefits (million)
August 15	Recovering	\$50.8
August 16	Fully Recovered	\$3.5
Total Blackout Value of DR Resources =		\$54.3
<b>Total August event curtailment payments</b>		
August 15	\$5.9 million	<b>Total = \$7.6</b>
August 16	\$1.7 million	

Ratio Reliability Benefits to Curtailment Payments:	
August 15	= 8.6
August 16	= 2.01
Overall	= 6.7

**Figure E-2. Estimates of Reliability Benefits August 15 and 16, 2003**

**DADRP Evaluation Results**

Average prices in New York State have been increasing since 2001 in both the Real-Time and Day-Ahead markets, while price volatility has been on the decline. As Figure E-3 illustrates, the supply curve in 2003 is dramatically flatter at high loads compared to 2001. The price flexibility of the estimated supply curves, the curve’s slope at its steepest segment, is three times less in 2003. Consequently, DADRP curtailments had a much lower impact on market prices in 2003.

<sup>6</sup> The lower average ICAP/SCR payment rate reflects the influence of the nominated strike price.



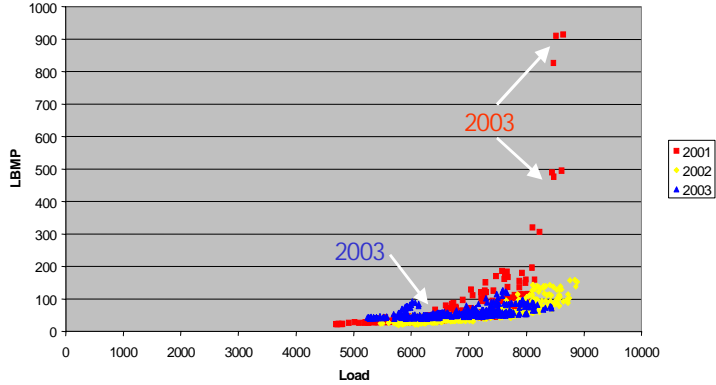
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The total scheduled DADRP load reduction during the summer months of 2003 was 1,752 MWh, down slightly

from that of 2002. All curtailments were in the Capital (90%) and Western (10%) zones, where prices are generally lower than downstate, especially compared to those of New York City or Long Island.<sup>7</sup>

The average scheduled DADRP load reduction was 3

MW in the Capital Zone and over three times higher, 10 MW, in Western New York. Scheduled curtailments were on average about one-tenth of one percent of the corresponding day-ahead load, and the estimated reduction in the DAM LBMP was \$0.03/MWh in the Capital zone and \$0.05/MWh in the Western NY, substantially lower than in previous years.



**Figure E-3. Declining Day-Ahead Market Price Volatility (Load vs. LBMP in the DAM, by Year, Western New York)**

**The effect of DADRP**

curtailments on 2003 market prices was very small compared to those of previous years (Figure E-4), and barely larger than the incentives paid out for curtailments.

This is primarily the result of the majority of these bids being scheduled at relatively low prices, when the supply flexibility is nearly equal to one.

	Scheduled DADRP (MWh)	Collateral Savings (\$ Mil.)	Reduced Hedge Cost (\$ Mil.)	Total Benefits (Mil.)	Curtailment Payments (Mil.)
2001	2,694	\$1.5	\$0.7	\$2.2	\$0.2
2002	1,468	\$0.2	\$0.2	\$0.4	\$0.1
2003	1,752	\$0.05	\$0.16	\$0.21	\$0.2

**Benefits measure savings by purchasers of electricity**

**Figure E-4. Market Price Impacts for DADRP Summer 2001-2003**

**Change in Net Social Welfare**

When the price consumers pay are below the cost to supply those goods or services, both consumers and producers suffer from the less than optimal utilization of resources. In New York,

<sup>7</sup> No participants were enrolled in DADRP in any zones except the Capital and Western zones.



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most electricity consumers are served under a rate that does not vary with the hourly supply cost, as measured by NYISO spot market clearing prices, resulting in lower net social welfare. By inducing customers to respond to marginal prices, especially when they are high, DADRP closes the gap between actual and optimal market performance.

However, at low prices and low supply flexibilities, the DADRP payments to curtail may not exceed the corresponding reduction in deadweight losses, and as a result the net social benefits of the program may be low, or even negative.<sup>8</sup> Estimates of net social welfare changes were developed for each year that DADRP has been in existence to compare the current year's results with those of previous years, where market price volatility was higher. The change in net social welfare attributed to DADRP scheduled curtailments was positive in 2001, when the supply curve exhibited the eponymous hockey stick shape. But, in 2002 and 2003, with a relatively flat supply curve, the net social change was negative. In other words, the payments made to participants to curtail were greater than the improvement in resource usage they provided.

Summer of	Curtailment Payments	Reduction in Deadweight Loss		Change Net Social Welfare
		Day-Ahead	Real-Time	
<b>2001</b>	\$213,944	\$129,567	\$127,365	\$42,737
<b>2002</b>	\$110,294	\$59,109	\$27,266	(\$23,919)
<b>2003</b>	\$121,144	\$30,371	\$18,502	(\$72,271)

These negative benefit contributions are small in comparison to market transaction volumes. Nonetheless, the prospect of such an outcome militates for changes in the program that reduce the incidence of negative welfare contributions, but in a way that does not abate incentive to bid curtailments when prices are high.

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<sup>8</sup> When the supply curve is flat, the variance of an average price rate from the marginal supply cost is small. That difference defines deadweight loss. For there to be an increase in net social welfare, the rate/price difference, on a unit basis, must exceed the incentive paid to the participant to curtail, the spot market price. A complete graphic discussion is provided in the report.