California ISO
Shaping a Renewed Future

Department of Market Monitoring White Paper

Potential Impacts of Lower Bid Price Floor and Contracts on Dispatch Flexibility from PIRP Resources

Revised: November 21, 2011

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1 Executive Summary

The ISO has undertaken several efforts to accommodate the increase in supply from renewable technologies that will happen as we move toward meeting the 20 percent and 33 percent renewable portfolio standard. In addition to representing increased generation, much of the energy from new renewable sources is intermittent or variable. The ISO anticipates needing additional downward dispatch flexibility to address over-supply conditions and additional general dispatch flexibility to address the increase in intermittent generation.

The ISO has revisited the participating intermittent resource program (PIRP) in this vein to determine if modifications to the program could be made to better align the output from PIRP resources with what is needed in the imbalance market. The current ISO proposal offers only to change how the cost of the PIRP program is allocated – now to the load-serving entity contracting with the PIRP resource rather than allocated across participant uninstructed deviation. The ISO is also proposing to lower the bid price floor to provide market incentive to suppliers to offer additional downward dispatch capability. This change will have an impact on spot market revenue for PIRP resources as well.

There are three general areas that have influence on the amount of dispatch flexibility from PIRP resources:

- ***Market-based incentives:*** The ISO is proposing to lower the bid price floor to provide additional incentive to offer downward dispatch capacity. With a negative price, suppliers are paid to reduce output. Similarly, over-producing suppliers are charged which provides a disincentive to over-supply.

- ***Technology and contract terms:*** In order to respond to dispatch instructions from the imbalance market, resources must have the proper equipment to receive and act on these instructions. Also, contract terms must allow for economic dispatch of the resource. Based on conversations with market participants it appears that there is very little economic dispatch flexibility provided for in the existing contracts. Nearly all (if not all) capacity under PIRP is under contract with a load-serving entity.

- ***Regulatory allowance:*** The current renewable portfolio standard requires load-serving entities to meet a percent of the load they serve with energy produced by renewable sources. Reducing output in response to market signals of over-supply, while helping the imbalance market to clear reduces the extent to which load-serving entities are in compliance with the renewable portfolio standard requirements. This is a regulatory disincentive for the contracting load-serving entity to pursue economic dispatch provisions in their contracts.

This paper addresses the market-based incentives provided by a lower bid price floor and also discusses the impact of contract terms on the potential effectiveness of market-based incentives on eliciting more dispatch flexibility from PIRP resources. Key findings of this analysis include the following:

- Despite the increase in revenues for PIRP resources if they opt out of PIRP and submit decremental bids during intervals of negative prices, this has not occurred to date and it appears that the prevailing contract structures may preclude direct short-term response to changes in pricing or settlement.

- Phase I of the Renewable Integration Initiative also proposes to allocate PIRP uplift directly to the load-serving entities who have a contractual agreement with a variable energy resource, effectively negating any direct benefit for the majority of load-serving entity contracts. The impact of the cost allocation change and the effect of a lower bid price floor on incentives to submit decremental bids will ultimately be determined by the contract terms between the load-serving entity and variable energy resource.

- Analysis in this paper shows that while a lower bid floor may not significantly change the benefit of participating in PIRP, a lower bid floor may have a considerable effect on lowering overall revenues of PIRP resources. This decrease in revenues would result from an increase in the frequency of prices significant lower than the current $30 bid floor. Given that contracting load-serving entities' net PIRP revenue against their energy contract cost with the PIRP resource, these lower prices may provide an incentive for load-serving entities to include dispatch flexibility when possible in their variable energy resource contracts.

Other highlights from analysis provided in this paper are summarized below:

- Most over-supply conditions observed in the twelve month period were resolved using economic dispatch and did not result in penalty pricing.

- PIRP resources generate the most energy in the spring and summer which also corresponds to the highest incidence of over-supply and negative imbalance prices.

- Lowering the bid price floor may have a significant impact on overall PIRP market revenue, only a small portion of which would come from a reduction in the PIRP benefit from monthly netting.

- Nearly all contracts between PIRP resources and load-serving entities do not allow for economic dispatch, while a few do provide for limited non-economic reliability-based dispatch.

- A lower bid price floor will likely not result in additional downward dispatch flexibility from PIRP resources in the short run, but may provide incentive for load-serving entities to renegotiate PIRP contracts to allow for economic dispatch. This incentive comes from both increased PIRP revenue from dispatch flexibility as well as a reduced imbalance price risk for the load-serving entity's broader load portfolio.

2 The PIRP Program

2.1 Background

PIRP was implemented in August of 2004 in order to allow intermittent resources to schedule their energy in the forward market without incurring hourly or daily imbalance charges when their delivered energy differed from the scheduled amount. Eligible intermittent resources may voluntarily elect to participate in PIRP and receive the associated rights and responsibilities. This decision can be made hourly. Most eligible intermittent resources have a power purchase agreement with a load-serving entity and it varies whether the agreement stipulates that the load-serving entity or the eligible intermittent resource has the decision rights on PIRP participation.

Regardless of who has decision rights, each PIRP participant must submit a self-schedule to the hour-ahead scheduling process and the real-time market equal to their hourly forecast from an ISO forecast provider service. Under PIRP settlement, any deviation from this schedule is netted monthly and settled at the weighted monthly average locational marginal price at the participating intermittent resource's pricing node. The difference between settling using PIRP settlement methodology and conventional settlement is the PIRP subsidy, as this uplift is allocated to net negative uninstructed deviators.

Under PIRP settlement rules participating intermittent resources derive revenues from energy sales under two methodologies. First, a participating intermittent resource's instructed imbalance energy, which is the energy produced that is less than or equal to a resource's schedule, is settled at the appropriate 10-minute nodal price. Second, a participating intermittent resource's uninstructed imbalance energy, which is the MWh difference between the resource's schedule and metered output, is settled under the aforementioned PIRP settlement rules.

Resources that elect to participate in PIRP do not have the flexibility to adjust their schedule based on economics. Participating intermittent resources are not able to adjust their output to respond to prices, as they are required to self-schedule their entire hourly forecast amount. Lowering the bid price floor is expected to cause the real-time dispatch energy price to decrease in some intervals to a lower negative amount, particularly in the spring months when wind output is at its highest. The decrease in the bid price floor is expected to have a higher relative negative impact on the revenues of participating intermittent resources compared to non-participating intermittent resources.

2.2 Proposed Policy Changes

In addition to lowering the bid price floor, Renewable Integration Phase (RIMPR) I and II contain two other discussions that involve the PIRP program:

Cost Allocation: The ISO proposes to allocate costs back to the scheduling coordinator of the load-serving entity which contracts with the PIRP resource. The scheduling coordinator of the PIRP resource will have to provide a signed form identifying the scheduling coordinator of the load-serving entity to whom the output is contracted. The intent is to provide more cost transparency of each resource and potentially provide an incentive to the scheduling coordinator of the load-serving entity to reduce the cost of meeting the renewable portfolio standard goals.

Decremental Bidding in PIRP: The ISO proposed to explore in Phase II of the RIMPR adding the ability of participating intermittent resources to provide economic bids. This would incent participating intermittent resources to submit decremental bids as they would not have to lose their benefits from PIRP by doing so. This is difficult to implement operationally and only in the early stages of discussion.

3 Potential Impact of Lower Bid Price Floor

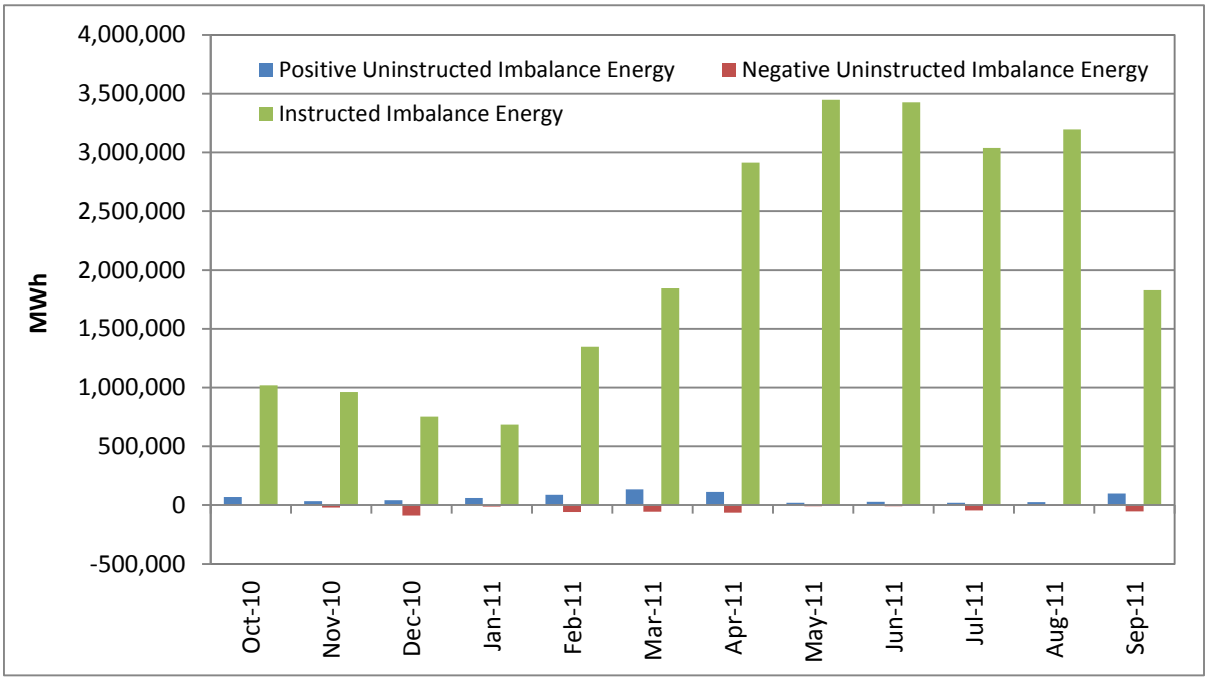
3.1 Current PIRP Settlement

For PIRP resources there are two components that make up their total monthly revenue from energy sales in the ISO market. The first component is revenue from instructed imbalance energy, which is the generated power less than or equal to the resource's submitted hourly schedule. Revenue from instructed imbalance energy will be positive if the price is positive and negative if the price is negative.

The second component is revenue from uninstructed imbalance energy, which is the difference between units' metered energy and the hour-ahead schedule. Revenue from a positive uninstructed imbalance energy amount will be positive if the price is positive and negative if the price is negative; however, revenue from a negative uninstructed imbalance energy amount will have the reverse effect and actually have positive prices when the price is negative. On average, PIRP resources generate more than their schedules and there are positive prices, making their net monthly uninstructed imbalance energy revenue positive.

Figure 3.1 shows the output of PIRP resources broken up by instructed and uninstructed imbalance energy from October 2010 to September 2011. Clearly resources comply with schedules far more often than they deviate. Uninstructed imbalance energy makes up only a small fraction of the total energy generated by PIRP resources, and can be positive or negative depending on the time period and specific resource. As PIRP settlement only affects the settlement of uninstructed imbalance energy, any changes to the program itself will be small compared to any changes that impact all revenues.

Figure 3.1 PIRP Energy for October 2010 through September 2011



For this analysis, DMM first benchmarked the revenues received by PIRP resources using the current bid price floor at -$30. We calculate the subsidy and revenue by "re-settling" each PIRP resource monthly at their pricing node under both PIRP settlement and conventional settlement conditions for October, 2010, through September, 2011.[1] We can then determine the PIRP benefit (the gain from settling net

[1] Conventional settlement calculates spot market revenue by applying the day-ahead locational marginal price to the resource's day-ahead schedule and the 10-minute real-time dispatch price to energy deviations compared to the day-ahead schedule. There is no day-ahead schedule for PIRP resources, so all energy delivered is imbalance energy and is settled at the 10-minute imbalance nodal price.

uninstructed imbalance output at a monthly average price rather than following the conventional 10-minute settlement). We also use this benchmark calculation in comparison of revenue under other bid price floor alternatives.

PIRP settlement nets resources' uninstructed imbalance energy monthly which is multiplied by the weighted average price of their relevant pricing node. This is added to their instructed imbalance energy revenue to get their PIRP settlement monthly revenue.

Under conventional settlement a resource's uninstructed imbalance energy is settled at its relevant 10-minute locational marginal price and added to its instructed imbalance energy revenue, and then the revenue from all 10-minute intervals is summed over a month, to get the conventional settlement monthly revenue. Each resource's monthly revenue is then divided by their metered monthly MWh to get a Revenue/MWh amount for both PIRP and conventional settlement. The difference in these amounts is the benchmarked PIRP subsidy.

Revenues for PIRP resources varied widely depending on the size of the unit – from annual spot market revenue of less than $1 million to over $50 million. Average revenue showed seasonal effects with the spring and summer producing higher revenues than the fall and winter. Overall average revenues were around $2 million which is $25/MWh for the twelve month study period. The average PIRP benefit for this period was $1.58/MWh; however, we also find the PIRP benefit varies widely both by resource and by month. In fact, the PIRP benefit was on average negative for May through July.

In general, the PIRP benefit is greater the more a resource deviates from their hour-ahead schedule in the direction inconsistent with the real-time price signal. In other words, when real-time prices are negative and a PIRP resource is over-producing, the PIRP benefit will be greater, as this positive deviation will be netted across the month and the impact of a negative price in those intervals will be reduced. The PIRP benefit is also greater when real-time prices are high and a PIRP resource is under-producing. Our analysis also found that resources with a higher positive correlation between output deviation and real-time price can have a negative PIRP benefit. Assuming PIRP resources have the capability to respond to real-time dispatch, the PIRP program not only insulates these resources from price signals but actually rewards resources for deviating in the opposite direction from what the market signal indicates.

3.2 Inferring the Potential Impact of a Lower Bid Price Floor

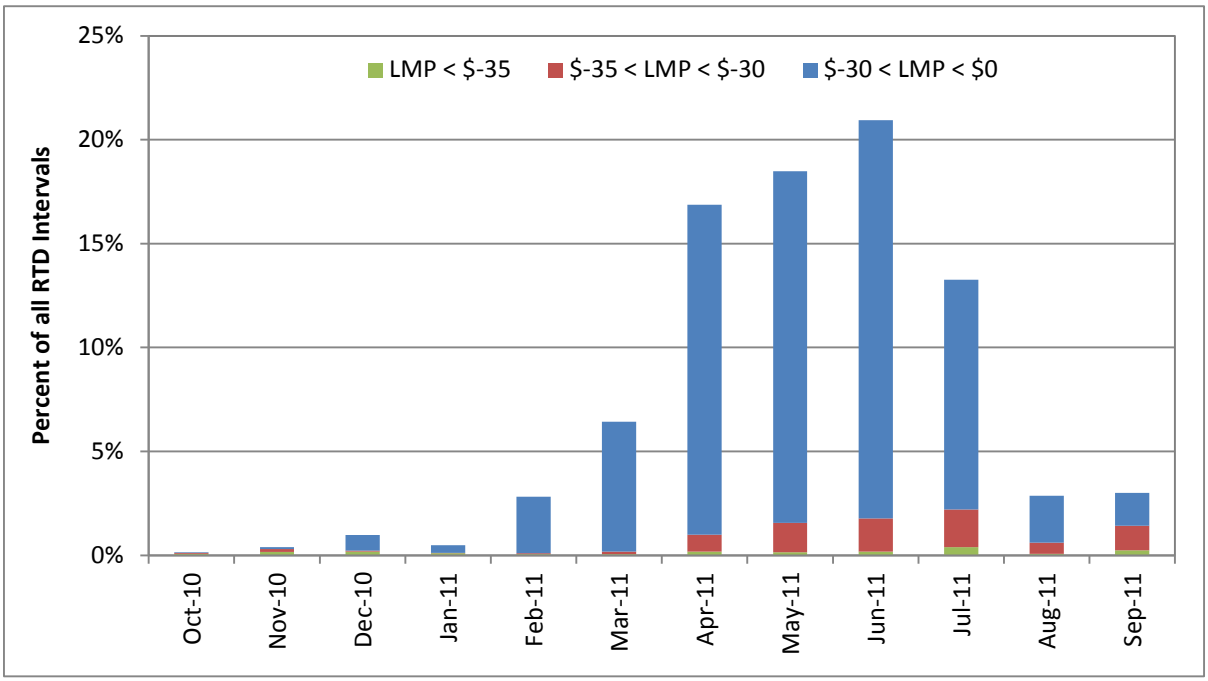
To evaluate the potential impact of lowering the bid price floor on PIRP revenue and benefit, we evaluated the frequency of locational marginal prices that were sufficiently low so as to indicate an over-supply condition that was not resolved through economic dispatch. We replaced the locational marginal price in all intervals where it was at or below -$30 with the initial proposed bid price floor of -$150 and re-calculated revenues to PIRP resources for the twelve month study period.

This approach will allow us to measure a book-end impact where there is no change in bidding behavior, the lower bid price floor does not resolve the over-supply condition, and the -$150/MWh bid price floor is reached in every such instance. We cannot reasonably assume what changes in bidding would occur and what the new real-time market prices would be as a result. We do anticipate that a -$150/MWh bid price floor will have an impact on offers and will improve the frequency with which the real-time market resolves over-supply conditions through economic dispatch. This will result in a distribution of real-time prices between -$30/MWh and -$150/MWh, not a pure shift from -$30/MWh to -$150/MWh. The analysis below will show that the relationship between the realized negative real-time prices and the

impact on PIRP revenue is linear, so an assumed distribution of negative prices between -$30/MWh to -$150/MWh can be applied to infer the impact on PIRP revenue.

First, we review the frequency and degree of negative prices in the 5-minute real-time dispatch market. Negative prices indicating an over-supply condition were fairly infrequent, occurring less than two percent of the time. Figure 3.2 illustrates the relative frequency of negative prices by month.[2] While a large percentage of intervals are negative, over 20 percent in June, the majority of these prices are greater than -$30/MWh, indicating the market was able to resolve the over-supply condition through economic dispatch.

Figure 3.2 Distribution of 5-minute RTD LMPs below $0 / MWh



Next we replace the PIRP resource locational marginal prices where an over-supply condition was not resolved through economic dispatch with the lower bid price floor of -$150/MWh. The aggregate results are shown in Figure 3.3. Despite the small subset of prices being replaced, there is still an observable effect on PIRP revenues. On average, we see the bookend revenue change being around $1 million annually, or roughly a 4 percent decrease in revenues.

During the study period, PIRP resources generated more than their hour-ahead schedules on average, making their net monthly uninstructed imbalance energy a positive number. In this circumstance, lowering the bid price floor will decrease uninstructed imbalance energy revenue as PIRP resources will have to pay more for energy when the price is -$150 compared to -$30. Lowering the bid price floor will also decrease revenue from instructed imbalance energy for these resources.

[2] We use the energy component of the locational marginal price to determine if the price indicates an over-supply condition.

Figure 3.3 shows the potential magnitude of the effects of lowering the bid price floor to -$150 on both instructed and uninstructed imbalance energy revenue. On average, PIRP resources derive considerably more revenue from instructed than uninstructed imbalance energy, and so lowering the bid price floor has the net effect of reducing revenues in all months and in significantly large amounts during the spring. This is because most wind generators produce comparatively more energy in the spring and prices tend to go negative more often, and so the decrease in revenue is higher.

Figure 3.3 Observed PIRP revenues under -$30 bid floor compared with PIRP revenues with -$150 prices when over-supply conditions exist

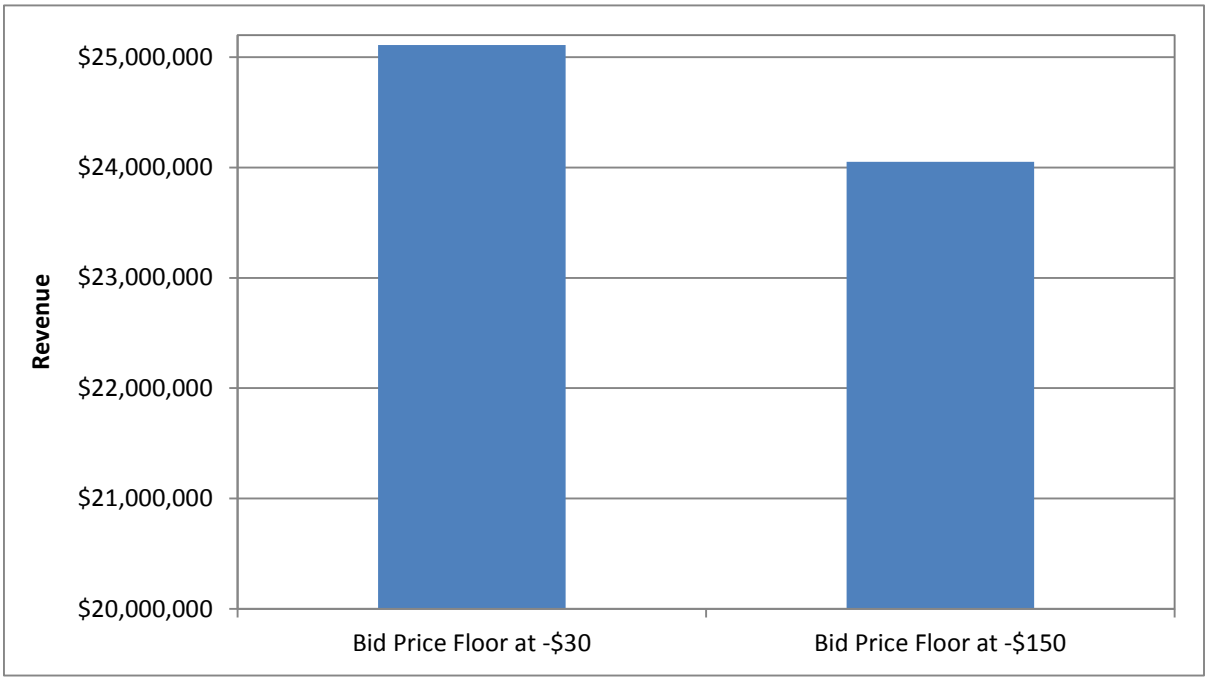
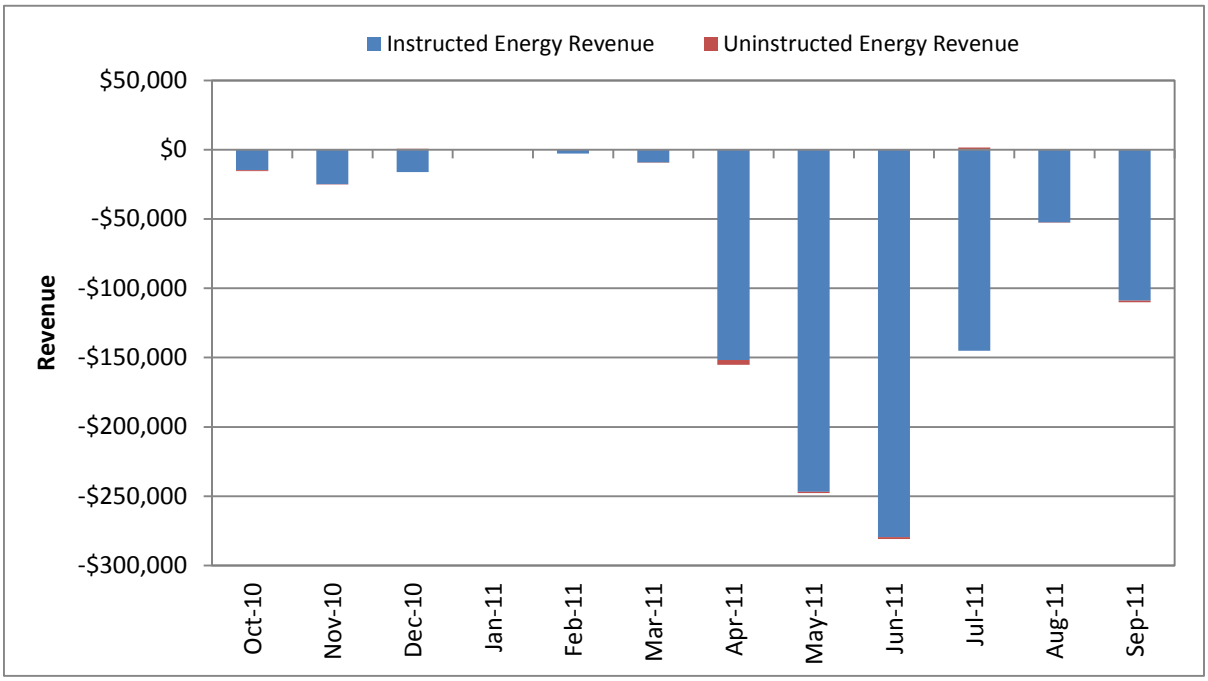
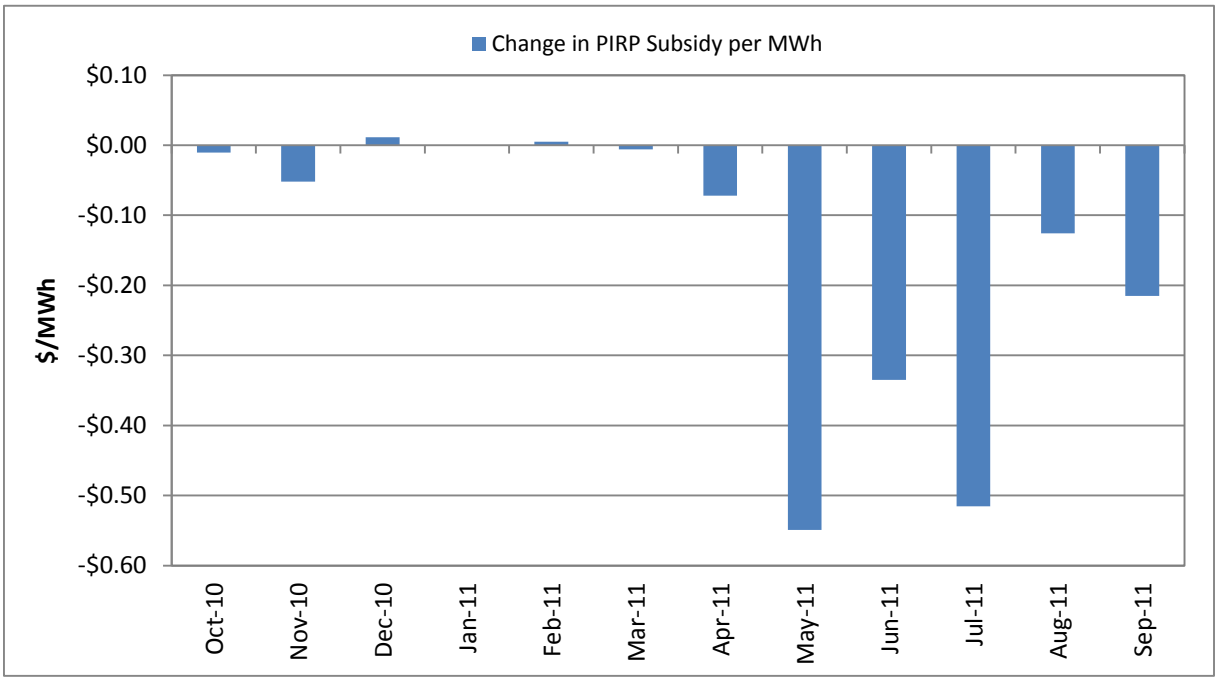


Figure 3.4 Potential Change in PIRP monthly revenue from replacing -$30 prices with -$150



Using this approach we can also identify the change in benefit to PIRP resources from monthly netting of uninstructed imbalance energy and application of an average price. Figure 3.5 shows the change in PIRP benefit when all observed over-supply conditions in 2011 prices are at -$150 instead of -$30. Even in the month with the greatest impact, May, there is only a $.54/MWh reduction in PIRP benefit from lowering the bid price floor to the lowest level. While this is significant relative to the average PIRP benefit across the year, it still amounts to only a half-dollar per MWh of output. On average across the twelve month period there is only a $.16 reduction in the PIRP benefit from this change.

Figure 3.5 Potential impact on PIRP benefit from changing over-supply LMPs to -$150 / MWh

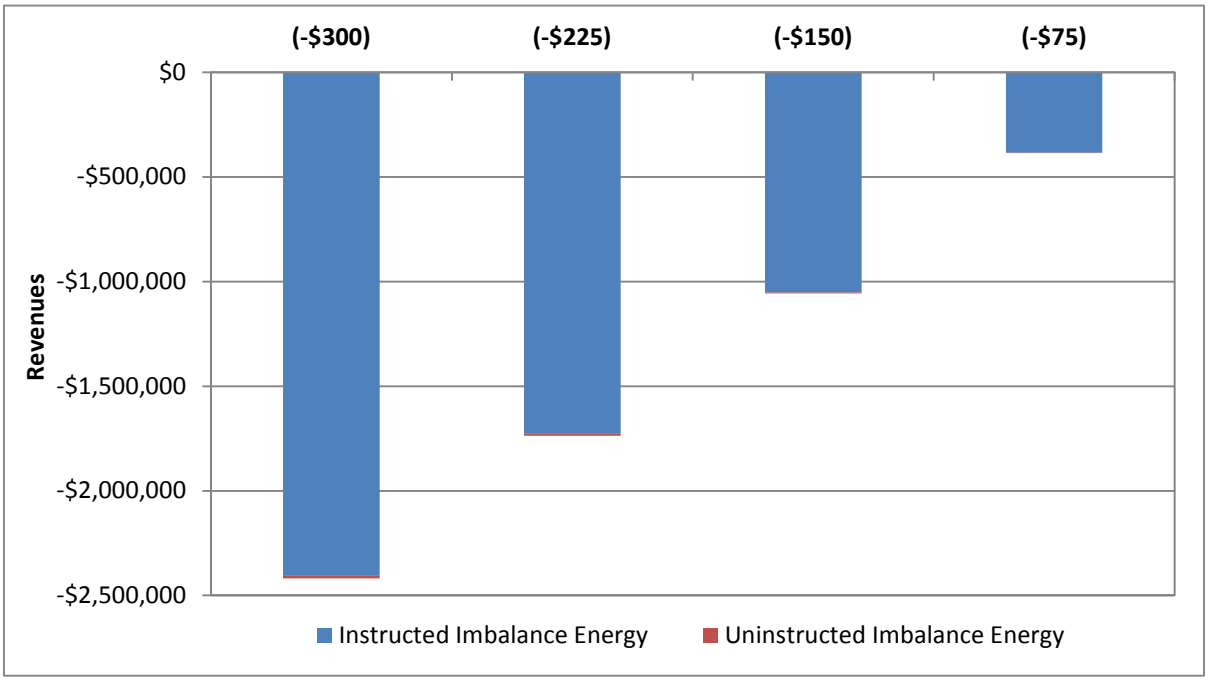


The type of impact analysis presented above can also be used to provide insight into the potential impact of a different lower bid price floor (-$300/MWh) and a different distribution of negative prices that might result from a lower bid price floor.

We identified a range of potential outcomes that a lower price floor could effect on PIRP revenues by applying the same methodology under a variety of bid price floor values as presented in Figure 3.6. The relationship between the lower bid price floor value and the resulting decrease in PIRP revenue is linear. The relationship of these extreme outcomes, where prices in all intervals where over-supply conditions resulted in -$30 prices are replaced with the new lower bid price floor, allows us to infer how a different distribution of negative prices would impact PIRP revenue.

The reduction shown in Figure 3.6 with the "(-$150)" bar label indicates a $1 million reduction in PIRP revenue from a -$150/MWh bid price floor when all (observed) intervals where there was over-supply price at that lower bid price floor. Consider the case where half of the over-supply intervals could not be resolved through economic dispatch, and as a result priced at -$150, but half could due to increased offers, and priced at -$75/MWh. In this case the reduction in PIRP revenue would be 0.5 * (-$400k) + 0.5 * (-$1,000k) = -$700k.

Figure 3.6 Potential decrease in PIRP revenues under different assumptions of LMPs when over-supply conditions exist



4 Implication of Contract Terms

In addition to ISO market structure and regulatory requirements, variable energy resources are influenced by a third factor: contractual agreements. It is our understanding that most variable energy resources in general, and all variable energy resources that participate in PIRP, are under contract with a load-serving entity for their entire output. The contract between a variable energy resource owner and load-serving entity has a significant impact on the motivation and ability of a variable energy resource to participate in PIRP and respond to economic incentives. In order for lowering the bid price floor to effectively motivate decremental bids from renewable resources, the entity controlling the resource must have financial incentive, contractual ability, and technical ability to economically dispatch the resource.

There are many different contract structures between renewable resources and load-serving entities. Some key components vary widely from contract to contract, but can be broken into two broad categories; first, which entity controls the plant output, and second, how costs are allocated.

Based on our review, it appears that in the majority of cases the load-serving entity is the scheduling coordinator for the resource, giving the load-serving entity the ability (from the ISO's perspective) to submit economic bids. Under this arrangement, the load-serving entity takes on the ISO market risk and pays the variable energy resource for all output per the contract terms. In this case, a negative bid price floor will incent the load-serving entity to offer decremental bids at any negative price. Spot market revenue earned by the load-serving entity for the PIRP resource will offset contract payments to the resource. Under current ISO rules, PIRP resources can submit decremental bids, but in those hours they

will be settled under conventional settlement rules. Contracts vary on whether the load-serving entity or resource owner makes the decision on whether the unit is in PIRP and on the ability of a party to curtail output.

A common contract provision is to allocate the PIRP cost to the contracting load-serving entity; however, this does not appear to be universal and some contracts dictate cost sharing of certain ISO costs. A common contract is where the load-serving entity pays the resource a pre-determined amount for every MWh they generate over the period of the contract and any market costs or revenues from the ISO market offset this amount.

An optional output reduction clause is becoming more common throughout the industry. Generally, more recent contracts are more likely to have a buyer curtailment clause, while older contracts will have a weak or no buyer curtailment clause.

Alternatively, a variable energy resource may not have a contract with a load-serving entity and may be its own scheduling coordinator as a merchant generator. In this case their bid price would have to be low enough to account for outside payments or subsidies. It appears that a bid price floor of -$150 is adequate to cover any of these costs. The demand for energy from variable energy resources has sufficiently increased as a result of California's renewable portfolio standard policy, so that it appears all or nearly all variable energy resource capacity is under contract with a load-serving entity.

Because most existing contracts do not allow for economic dispatch of the resource, there is not likely to be a significant short-term impact on downward dispatch offers from (current PIRP) renewable resources resulting from a lower bid price floor. There appears to be some direct benefit to load-serving entities to get additional dispatch flexibility that would help relieve over-supply conditions, reduce the frequency and magnitude of negative imbalance prices, and ultimately increase PIRP revenue the load-serving entity receives (as the scheduling coordinator for the resource) that would offset contract payments from the load-serving entity to PIRP resources. The impact of this PIRP revenue effect on the incentive to renegotiate for dispatch flexibility will depend on the extent to which the load-serving entity is simultaneously paying for the imbalance energy provided by those PIRP resources.

The greater incentive for load-serving entities may lie in the potential impact of lower negative prices on the imbalance position of their load. If the load-serving entity is over-scheduled (day-ahead scheduled load is greater than realized actual load) then the load-serving entity will be charged the imbalance price if that price is negative. Under normal (non-over-supply) circumstances, the load-serving entity would be paid the positive price for the over-scheduled quantity. In over-supply conditions when the price is negative, the lower load contributes to the over-supply condition and the amount of load that did not materialize in the imbalance market will be charged the negative price. A lower bid price floor represents a greater exposure to this cost risk and may provide incentive for load-serving entities to renegotiate contracts with PIRP resources to provide additional downward dispatch flexibility to help relieve over-supply conditions.