Assessment of the Impact of Proposed Local Market Power Mitigation Enhancements

White Paper

Department of Market Monitoring

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Contents

Executive Summary

The analyses discussed below was performed to assess the impact of the local market power mitigation (LMPM) enhancements that the CAISO proposes in this proceeding and to supplement the discussion of those enhancements contained in the Direct Testimony of Jeffrey D. McDonald submitted in the proceeding.

To perform the analyses, the proposed dynamic competitive path assessment approach and an approximation of the proposed locational marginal price "decomposition" methodology (decomposition methodology) for resource bid mitigation under the LMPM enhancements were applied to historical market outcomes for both the day-ahead and real-time markets. The analyses focus specifically on the three-month period from July 1, 2011, through September 30, 2011. The analyses indicate the following:

- In the day-ahead market, the dynamic competitive path assessment greatly improves the accuracy of path designations, and reduces the frequency with which paths are designated as uncompetitive.
- In the day-ahead market, including bid-in demand and convergence bids in the mitigation process will potentially have a dramatic impact on the accuracy of predicting congestion in the mitigation run, and consequently improve the accuracy of local market power mitigation.
- In the day-ahead market, the net impact of implementing the new mitigation trigger improves overall accuracy and reduces the frequency of mitigation by 13 percent. This is largely due to the elimination of unintended mitigation.
- For HASP during the first phase, the net impact of implementing the new mitigation trigger resulted in a 48 percent decrease in the frequency of mitigation – largely from the elimination of the high degree of unintended mitigation.
- Full implementation in the real time market improved the accuracy of identification of local market power – attributed to the addition of mitigation in the pre-dispatch run after HASP. These gains come from both improved congestion prediction as well as more accurate assessment of the available supply to relieve congestion.
- Improved accuracy and reduced frequency (compared to the current approach) of mitigation estimated for HASP is expected to persist during full implementation in the real time market.

Comparison of Current and Proposed Approaches

Identifying Local Market Power

Local market power is created when transmission constraints limit the supply available to serve load in a local area to the point where there is limited capacity and/or few suppliers. Both the current and proposed approaches for identifying where local market power exist employ a pivotal supplier test. However both the timing of the calculations and the methodologies differ between the two approaches.

The current process for determining which transmission constraints do not have a competitive supply of counter-flow is referred to as the *competitive path assessment*. This determination is made four times a year through an analysis of the sufficiency of supply of counter-flow for internal transmission constraints that have been congested (or have been managed for congestion) in over 500 hours in the most recent 12 months. The study is performed by DMM staff and assesses path competitiveness by simulating the sufficiency of supply for counter-flow to congested constraints when capacity from the three largest potentially pivotal suppliers (system-wide or regionally) is withheld from the market.

The test for supply sufficiency, and thus competitiveness, is done for each candidate transmission constraint. If the market simulation used for this study is able to arrive at a solution without the withheld capacity while respecting the limits of the tested transmission constraint, then the test for that constraint under those conditions is passed. If the market simulation must violate the tested transmission constraint to solve, or cannot reach a solution, then the test for that constraint under those conditions is failed. This test is run for various load and hydro conditions based on historical observation. If a tested constraint fails the supply sufficiency test under any of the test conditions, then that constraint is deemed uncompetitive.

Transmission constraints that do not exceed the threshold of 500 hours of congestion in the most recent 12 months are not tested and are deemed uncompetitive by default. These determinations are made four times a year and are static in the sense that they apply until a subsequent study is performed.

The current approach for assessing path competitiveness is performed outside of the execution of the CAISO's market process and the results are used in the market execution process to facilitate identifying and mitigating for local market power.

The proposed approach to dynamic competitive path assessment (DCPA) will be run directly within the market software, and will therefore reflect more refined measures of demand and supply of counter-flow tailored to the market run where it is applied, and will use the most recent market and system information in assessing competitiveness. Technical details regarding the proposed DCPA can be found in the most recent paper published by the ISO[1].

The CAISO currently employs a static competitive path assessment in all of the markets it operates. In stage one of its proposed LMPM enhancements, which will go into effect in the Spring of 2012, the CAISO will implement improvements in how it applies LMPM procedures to resources with the potential to exercise local market power in the day-ahead market and the HASP. In this sage, the CAISO will implement a new dynamic competitive path assessment in the day-ahead market only.

[1] See "Revised Draft Final Proposal – Dynamic Competitive Path Assessment" at http://www.caiso.com/Documents/RevisedDraftFinalProposal-DynamicCompetitivePathAssessment.pdf for a more detailed description.

In stage two of the proposed LMPM enhancements, which the CAISO anticipates will go into effect in the fourth quarter of 2012, the CAISO will further enhance its LMPM procedures by adding an additional mitigation run as part of its 15-minute real-time unit commitment process. In this second stage, the CAISO will also implement a dynamic competitive path assessment for the HASP and each real-time unit commitment process.

Both the current static competitive path assessment and the proposed dynamic competitive path assessment use a form of pivotal supplier test to evaluate the competitiveness of transmission constraints (sometimes also called paths). However, the approach taken in evaluating the competitiveness of transmission constraints differs considerably under the static competitive path assessment as compared with the dynamic competitive path assessment.

The following is a high-level comparison of the static competitive path assessment and dynamic competitive path assessment.

Static Competitive Path Assessment	**Dynamic Competitive Path Assessment**
Analysis and path determinations are based primarily on historical information, with resulting designations applied going forward (one to four months forward).	Analysis and path determinations are performed in-line with the market software using resource, transmission, and load information that is also used by the market software in the subject dispatch interval.
Based on simulation that uses hourly schedules for a 24-hour optimization (similar to the day-ahead market).	Based on dispatch interval length for which the assessment is being done. More accurately reflects resource ramp limitations than does the static competitive path assessment.
Withholds all capacity in portfolio of potentially pivotal suppliers.	Adjusts capacity withholding to reflect the interval-specific ramp-limited quantity that could have been withheld (short of full unit outage).
Pivotal suppliers are evaluated and withdrawn from supply on a system-wide basis.	Pivotal suppliers and calculations of the residual supply index are specific to each constraint being evaluated.
Default designation of “uncompetitive” if constraint is not tested.	Tests all binding constraints that are not permanently deemed competitive.

A more detailed description of the current static competitive path assessment can be found on the CAISO website in the CAISO Business Practice Manual for Market Operations (particularly in Attachment

C of that document), and in the Department of Market Monitoring (DMM) paper entitled "Competitive Path Assessment for MRTU - Final Results for MRTU Go-Live."[2]

Mitigating Local Market Power

The current local market power mitigation mechanism assesses and mitigates local market power in two pre-market LMPM runs. The first of the two LMPM runs clears the market with only competitive constraints enforced in the full network model (competitive constraints run). The resulting dispatch reflects a competitive market outcome absent any impacts from the exercise of local market power. By not enforcing the uncompetitive transmission constraint limits, this set of constraints is not able to bind and create a circumstance where local market power exists.

The second of the two LMPM runs (all constraints run) applies all transmission constraints in the full network model. The dispatch from the all constraints run is compared to the dispatch from the competitive constraints run. Generating resources that were dispatched upward in the all constraints run relative to their competitive constraints run dispatch are presumed to be dispatched upward to manage congestion on an uncompetitive constraint and as such are deemed to have local market power. Bid mitigation is applied to the set of resources that have an all constraints run dispatch greater than their competitive constraints run dispatch. Bid prices are mitigated to a resource-specific reference price curve (default energy bid) but not below the bid price of the resource's highest priced bid segment dispatched in the competitive constraints run.

For the day-ahead market, this mitigation process is performed as part of the 24-hour optimization of integrated forward market (IFM). For the real-time market, this mitigation is done as part of the HASP. Bids mitigated in HASP are then used in the 5-minute real-time market.

The appeal of this approach is that it focuses mitigation on resources that have local market power and are anticipated to be critical for managing any congestion that gives rise to local market power. This approach relies heavily on an underlying assumption that any increase in a unit's dispatch in the all constraints run (compared to its dispatch level in the competitive constraints run) is indicative of local market power due to the need to manage congestion on an uncompetitive constraint.

However, experience under the first few years of the CAISO's nodal market indicates that this underlying assumption is not always valid. There has often been mitigation of generation resources that do not appear to be associated with, or effective in managing congestion on, binding uncompetitive transmission constraints, and therefore do not appear to have local market power.[3] This type of mitigation is unintended and is eliminated by the proposed LMPM trigger. During the study period, approximately 94 percent of the mitigation that occurred in the day-ahead market appeared to be unintended. In this context, unintended refers to a circumstance where (a) a unit was mitigated in an

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[2] This DMM methodology paper is available at http://www.caiso.com/2365/23659ca314f0.pdf. Recent DMM papers presenting path determinations are available at http://www.caiso.com/Documents/Competitive%20path%20assessments%20for%202011

[3] This definition may over-state over-mitigation in cases where the market software observed congestion on an uncompetitive constraint and, as part of its iterative process, increases the dispatch of effective resources to a point where the congestion no longer exists. In this case, the incremental dispatch of effective resources was made under uncompetitive conditions however the uncompetitive constraint is no longer binding, creating the appearance of over-mitigation.

interval where there were no binding uncompetitive constraints or (b) there were one or more binding uncompetitive constraints however the mitigated unit could not have been effective in relieving congestion on those constraints.

The very high percentage of instances of over-mitigation raises concern with respect to the accuracy of the CAISO's current mitigation process. While inaccuracy is a concern, both the current and proposed bid mitigation mechanisms include a mitigation floor that limits the extent to which a resource's bid price can be mitigated. In both cases, the bid price will not be mitigated below the higher of a calculated competitive price or the resource's default energy bid. This limits the likelihood that market prices resulting from over-mitigation will not reflect at least the resource's marginal cost.

The proposed revised LMPM methodology, known as the decomposition methodology, will apply mitigation to all resources that have a positive non-competitive congestion component in their locational marginal prices that is attributed to a binding uncompetitive constraint. This process uses the relationship between the generation resource and the binding constraints (the shift factor), the shadow price on binding constraints, and the competitive / uncompetitive designations of binding constraints to decompose the congestion component of each locational marginal price into parts attributable to competitive and uncompetitive binding constraints. If a resource has a positive congestion price component that is attributable to a binding uncompetitive constraint, the resource will be subject to mitigation. Bid prices will be mitigated to the higher of the resource's default energy bid or a calculated competitive baseline price.

By using the impact of a binding uncompetitive transmission constraint on price at the generator location to trigger mitigation, the proposed decomposition methodology limits bid mitigation to only those resources whose locational marginal price is increased as a result of uncompetitive conditions created by congestion. This therefore limits bid mitigation to only those resources that have and potentially could benefit from exercising local market power created by the binding uncompetitive transmission constraint and eliminates the unintended mitigation observed under the current LMPM process. Also, by eliminating these instances of unintended mitigation, the decomposition methodology will reduce the overall frequency of mitigation compared to the current approach.

Methodology for Assessing Impact of Changes

Assessing Path Competitiveness

This assessment of the current and proposed approaches focuses on the accuracy with which each approach in the mitigation run accurately predicted path competitiveness as it was observed in the actual market run (where local market power would be exercised). We calculated the proposed DCPA approach for both the mitigation run and the market run, where the latter is assumed to be the accurate representation of where and when local market power existed. Assessing the accuracy of the static CPA was done by comparing the static CPA path designations for binding constraints in the mitigation run to the DCPA designations for binding constraints in the actual market run. This was repeated using the DCPA in the mitigation run instead of the current static CPA.

The accuracy statistics embody two separate effects. First, congestion in the mitigation run and market run are not always consistent. The ability of any method of detecting local market power prior to the actual market run depends on the accuracy of the mitigation run in reflecting congestion in the actual market run. Inconsistencies in congestion between the two runs will cause either methodology to over or under predict local market power. The second effect is the ability of the CPA method to accurately capture supply conditions relative to the constraint being tested. The fact that both methods are applied in the mitigation run makes them equally susceptible to error resulting from inconsistency in congestion.

The analysis uses the integrated forward market (actual market run) results as the common benchmark for the analysis because of the difference in inputs between the LMPM run and the actual market run and the observed discrepancy in congestion between the day-ahead mitigation run and market run. Currently, the LMPM run clears forecast load against physical supply and exports and excludes virtual bids. The integrated forward market, on the other hand, clears bid-in physical and virtual demand against all bid-in supply and exports – thus, it includes virtual bids. Because the dynamic competitive path assessment will account for virtual bids, it is necessary to use the integrated forward market as the common benchmark for the analysis. Performing the dynamic competitive path assessment for the LMPM run and comparing the resulting path designations to those produced by performing the dynamic competitive path assessment for the integrated forward market would result in an invalid comparison.

There is an additional factor that supports assessing accuracy in the day-ahead market within the IFM (market run) and not between the mitigation run and market run. The ability for the mitigation run to accurately predict congestion in the market run should improve with the addition of bid-in demand, convergence bids, and demand response in the mitigation run. For the study period, the day-ahead mitigation run under-predicted roughly 80 percent of congestion that occurred in the subsequent integrated forward market run on internal lines. This represents an opportunity for under-mitigation as undetected congestion will not trigger mitigation. Further, the mitigation run predicted congestion on internal lines in excess of what was observed by 10 percent. This represents an opportunity for over-mitigation as mitigation may be triggered in the mitigation run in response to congestion that did not actually occur in the market run. Including bid-in demand and all virtual bids, and clearing the market power mitigation run based on bid-in demand, will allow the market power mitigation run to more closely match inputs used in the actual market run.

The assessment of the accuracy when applied in HASP used the DCPA designations from the real-time dispatch (RTD) market run as the benchmark since this is where internal resources would be able to exercise local market power. Designations resulting from the SCPA and DCPA applied in the HASP mitigation run and DCPA applied in the real-time pre-dispatch (RTPD) run were compared to the benchmark designations.

Bid Mitigation

This analysis estimates which resources would be mitigated under the proposed decomposition methodology. Conceptually, within a dispatch interval, any resource that can provide counter-flow to a binding uncompetitive constraint and has a positive congestion component in its locational marginal price is identified as a mitigated resource under the revised LMPM rules. This analysis only identifies the resources that would have been mitigated under the proposed decomposition methodology and does not evaluate the impact on their bid curves. This measure is useful in comparing the frequency and accuracy of resources mitigated under the two methodologies.

An additional adjustment is performed to make the estimate of the number of resources mitigated under the proposed decomposition methodology comparable to the count of effectively mitigated resources observed under the current LMPM approach. As described above, the measure of observed mitigated units discounts resources that were not dispatched in the market run for which the mitigation applied or did not have their bid price lowered at the point of market dispatch as a result of mitigation. A large portion of resources identified as being subject to mitigation (because of all constraints run dispatch being greater than competitive constraints run dispatch) are discounted due to no effective impact on their bid curve. About 70 percent of mitigated resources in the day-ahead market and 66 percent of mitigated resources in the real-time market had no effective impact on their bid curves resulting from mitigation.

This analysis does not construct mitigated bid curves for resources expected to be mitigated under the proposed LMPM and hence no determination can be made whether the mitigation would have impacted the resource (*i.e.*, the mitigation lowered the bid price of the resource at the point of market dispatch). The high proportion of observed mitigation that did not effectively impact the bid curve suggests that many resources bid at or below their default energy bids and are not effectively impacted by mitigation. The proportion of zero bid price impact for the day-ahead and real-time markets is applied to the estimated set of resources that would have been mitigated under the proposed approach. This is reasonable given the observed impact of mitigation on bid prices and allows for a more direct comparison to assess changes in mitigation frequency under the two approaches.

By using the impact of a binding uncompetitive transmission constraint on price at the generator location to trigger mitigation, the proposed decomposition methodology limits bid mitigation to only resources whose locational marginal price is increased as a result of uncompetitive conditions created by congestion. This thereby limits bid mitigation to only those resources that have and potentially could benefit from exercising local market power created by the binding uncompetitive transmission constraint and eliminates over-mitigation effects observed with the current LMPM procedures. The determination of whether a resource was over-mitigated in the analysis rests on whether or not that resource had a shift factor to a binding uncompetitive constraint that indicates that the resource could be effective in supplying counter-flow to that constraint. If a resource was mitigated and was not effective on any binding uncompetitive constraint in the hour in which it was mitigated, then that resource was deemed to be over-mitigated.[4]

Impact of Full Implementation in the Day Ahead Market

The following discussion of the analysis will highlight three primary outcomes:

- The dynamic competitive path assessment greatly improves the accuracy of path designations, and reduces the frequency with which paths are designated as uncompetitive.
- Including bid-in demand and convergence bids in the mitigation process will potentially have a dramatic impact on the accuracy of predicting congestion in the mitigation run, and consequently improve the accuracy of local market power mitigation.

[4] One caveat to this measure is the potential that the pre-market mitigation runs, as they iterate to an optimal solution, may have dispatched up and/or committed resources (relative to their output level in the competitive constraints run) and completely resolved congestion on the uncompetitive constraint. In this circumstance, the mitigation would be appropriate despite the fact that the uncompetitive constraint for which the dispatch was made is no longer binding. The way that over-mitigation is measured here would falsely identify this mitigation as over-mitigation. Therefore, the over-mitigation figures presented reflect an upper bound.

- The net impact of implementing the new mitigation trigger in the day-ahead market improves overall accuracy and reduces the frequency of mitigation by 13 percent. This is largely due to the elimination of unintended mitigation.

Identifying Local Market Power

The analysis reflected in Table 1 below compares the path designations that have occurred with the current static competitive path assessment with those that would have been made using the dynamic competitive path assessment for the day-ahead market. In order to make this comparison, the analysis examined the percentages of competitive and uncompetitive designations under the static competitive path assessment approach and under the dynamic competitive path assessment approach with regard to the common benchmark of all binding eligible constraints in the integrated forward market.

Table 1 shows that using the static competitive path assessment for the day-ahead market results in designation of 53 percent of the paths as competitive and 47 percent of the paths as non-competitive, whereas using the dynamic competitive path assessment for the day-ahead market results in designation of 66 percent of the paths as competitive and 34 percent of the paths as non-competitive. Use of the dynamic competitive path assessment results in a 13 percent increase in designation of paths as competitive (i.e., 66 percent versus 53 percent) and a corresponding 13 percent decrease in designation of paths as non-competitive (i.e., 34 percent versus 47 percent). Because local market power mitigation is triggered only for non-competitive paths, it follows that use of the dynamic competitive path assessment likewise results in a 13 percent decrease in instances where local market power mitigation is triggered.

Table 1 Comparison of Path Designations from Static Competitive Path Assessment and Dynamic Competitive Path Assessment in the Day-Ahead Market

		Dynamic CPA		
		Competitive	Non-competitive	***Total***
Static CPA	Competitive	23%	30%	***53%***
	Non-competitive	43%	4%	***47%***
	Total	***66%***	***34%***	

Table 1 also shows that, almost 75 percent of the time, using the static competitive path assessment for the day-ahead market results in designation of paths that differs from the designation of paths using the dynamic competitive path assessment for the day-ahead market. Specifically, both of those approaches agree as to the competitiveness of 23 percent of paths and the non-competitiveness of 4 percent of paths – a total of 27 percent agreement. Conversely, however, there is disagreement between the approaches as to the competiveness or non-competitiveness of paths a total of 73 percent of the time.[5] Using the dynamic competitive path assessment approach rather than the static competitive path assessment approach makes a dramatic difference in which paths are designated as competitive or non-competitive.

Bid Mitigation

The analysis reflected in Table 2 below evaluates various impacts on local market power mitigation in the day-ahead market and the HASP due to implementation of the CAISO's proposed LMPM enhancements, ignoring for purposes of this analysis the impacts of the CAISO's proposed transition from the static competitive path assessment to the dynamic competitive path assessment. This section will discuss the impact in the day-ahead market. Impacts in the real time-market are discussed in the next section.

The first row in Table 2 shows the percentages of hours in the day-ahead market in which bid mitigation occurs. The second row in Table 2 shows the percentage of hours in the study period in which bid mitigation occurs and there is no binding uncompetitive constraint that could trigger mitigation.

The third row in Table 2 shows the decrease in the percentage of resource-hours during which over-mitigation occurs under the decomposition methodology. The over-mitigation rate in both the day-ahead and real-time market was very high under the current approach. The proposed LMPM approach using the decomposition methodology will eliminate this type of mitigation by mitigating only those resources whose locational marginal price was increased as a result of a binding uncompetitive constraint. Thus, based on the statistics in Table 2, application of the decomposition methodology would have reduced the frequency of mitigation by 94 percent in the day-ahead market.

As described in the CAISO's filing in this proceeding, the proposed LMPM approach will also apply mitigation to a broader set of resources that have local market power as a result of a binding uncompetitive constraint, some of which are not mitigated by the current LMPM process. The fourth row in Table 2 shows the percentage increase in mitigation frequency resulting from applying mitigation to the broader set of resources that have local market power.[6] This effect will increase the frequency of mitigation by 81 percent in the day-ahead market.

The net effect of applying the proposed decomposition methodology for mitigation (with no changes to the path assessment approach) is the sum of the effects of eliminating the over-mitigation and increasing the number of resources accurately mitigated specifically for local market power created by a binding uncompetitive constraint. As shown in the fifth row in Table 2, this net effect reduces the frequency of mitigation by 13 percent in the day-ahead market.

The sixth, seventh, and eighth rows in Table 2 provide some statistics on the set of mitigated resources that were observed under the current LMPM approach during the study period. As shown in the sixth row, the average dispatch differential that triggered mitigation was between 32 MW and 40 MW. The

[5] *I.e.*, the 30 percent and 43 percent figures shown in Table 1 add up to 73 percent.

[6] The observed frequency of mitigation is used as a baseline for measuring these impacts in terms of percent. For example, if the observed mitigation was 500 unit-hours, then a 94 percent reduction in mitigation (where the new method eliminates unintended mitigation) is a reduction of 470 unit-hours of mitigation. If the new method is also broader-reaching in mitigating units that do have local market power and results in a 81 percent increase in mitigation this is equal to 405 unit-hours of mitigation.

seventh row indicates that the average decrease in bid price at the point of market dispatch resulting from the current mitigation was $3.69/MWh for the day-ahead market and $9.15/MWh for the HASP (including mitigated resources that had a $0 impact on their bid curves). The eighth and final row shows that 70 percent of the mitigated resources in the day-ahead market and 66 percent of the mitigated resources in the HASP had no decrease in their bid prices at the point of market dispatch as a result of bid mitigation.

Table 2 Impact of New LMPM on the Frequency of Mitigation

	Day Ahead	HASP
Percent of hours with bid mitigation	32%	68%
Percent of hours with bid mitigation and no binding uncompetitive constraint	25%	50%
Percent of mitigated resources that were unintended	94%	93%
Percent increase in mitigated resource hours from new LMPM	81%	46%
Net change in resource mitigation hours (eliminate unintended, add increase from new LMPM)	-13%	-48%
Average increase in MPM dispatch that triggered mitigation	40	32
Average decrease in bid price from mitigation (measured at market dispatch)	-$3.69	-$9.15
Percent of resource mitigation hours where there was no effective change in bid price	70%	66%

Impact of Implementing Only the New LMPM in HASP in the Real Time Market

The first phase of implementation will put the new LMP decomposition approach to triggering mitigation in the HASP market, but will not include the DCAP in HASP nor the combined DCPA and LMP decomposition in the subsequent RTUC run just prior to the five minute real time dispatch (RTD) market.

Analysis of the impact on the frequency of mitigation from implementing only the new LMP decomposition in the HASP shows similar results as were found in the day-ahead market. Eliminating the unintended mitigation reduces mitigation frequency (compared to the baseline) by 93 percent, as seen in Table 2. The increase in mitigation frequency resulting from applying mitigation to the broader set of resources that have local market power results in a 46 percent increase. The net result is a 48 percent decrease in the frequency of mitigation. The elimination of the high degree of unintended mitigation indicates a significant improvement in the accuracy of mitigation from applying the new approach.

Impact of Full Implementation in the Real Time Market

Full implementation of the proposed enhancements in the real time market includes the DCPA and LMP decomposition method in both the HASP (primarily to provide mitigation for the short start unit commitment processes) and just after the RTUC (to provide mitigation for the 5-minute dispatch market). This section discussed analysis that support the following:

- Accuracy in the identification of local market power is improved when the DCPA is implemented in the pre-dispatch run after HASP. These gains come from both improved congestion prediction as well as more accurate assessment of the available supply to relieve congestion.
- Improved accuracy and reduced frequency (compared to the current approach) of mitigation that was estimated for HASP is expected to persist during full implementation in the real time market.

Identifying Local Market Power

The purpose of the comparison shown in Table 3, below, is to assess the risk of under-mitigation associated with implementing the dynamic competitive path assessment in the HASP in stage one without application of LMPM in the real-time unit commitment.

In this regard, it is important to note that the outcomes of the LMPM conducted in the HASP often do not closely reflect the outcomes ultimately observed in the five-minute real-time market, which is where the CAISO is most focused on achieving accurate LMPM in the real-time market. Accurate prediction of the congestion that can create local market power is critical to accurate application of LMPM. The HASP market does not accurately predict congestion in the real-time market. Analysis of the data for the study period indicates that the LMPM run in the HASP under-predicted congestion in the real-time market 45 percent of hours where real-time congestion occurred, The HASP LMPM correctly predicted congestion in 21 percent of hours where real-time congestion occurred, and over-predicted congestion in 35 percent of hours reviewed.

These results suggest the HASP mitigation run outcomes often do not reflect conditions seen in the real-time market. Under-prediction of congestion can lead to instances of under-mitigation, and vice versa for over-prediction of congestion. Both of these cases are the function of mismatch in market outcomes and do not speak directly to the relative accuracy of the static and dynamic competitive path assessments. The instances where the HASP LMPM run correctly predicted congestion in the real-time market are useful for comparing the relative accuracy of the static and dynamic competitive path assessments when used in the HASP alone.

When the HASP mitigation run does accurately predict congestion in the real-time market, application of the dynamic competitive path approach results in significant under-identification of local market power (22 percent accurate) compared with application of the current competitive path assessment approach (89 percent accurate). This result indicates that the dynamic competitive path assessment, when applied in the HASP alone, presents an additional risk of under-mitigation.

This is likely due to the fact that the HASP market is sufficiently removed in time from the real-time market runs and so even when congestion is accurately predicted, the conditions reflected in the HASP and the calculations that produce the path designations do not reflect conditions observed in the real-time market where the mitigation is targeted. The static competitive path assessment uses a default designation non-competitive for non-tested constraints. Although imprecise, this default designation appears to predict uncompetitive conditions in the real-time market better than the dynamic competitive path assessment when applied in the HASP only.

The analysis reflected in Table 3 below compares the difference in accuracy in path designation between implementing a dynamic competitive path assessment in the HASP only and implementing a dynamic competitive path assessment as part of a mitigation run performed every 15 minutes in conjunction with the CAISO's real-time unit commitment process. The purpose of this comparison is to evaluate the gain in accuracy when implementing the LMPM process in the real-time unit commitment in stage two.

In Table 3, the impact on path designation accuracy due to implementing the dynamic competitive path assessment for only the HASP is shown in the row titled "HASP," and the impact on path designation accuracy due to implementing the dynamic competitive path assessment on a 15-minute basis in the real-time unit commitment is shown in the row titled "RTUC." The percentages in both rows were calculated with regard to the common benchmark of path determinations resulting from application of the dynamic competitive path assessment in the real-time market.

The data in Table 3 represent the percentages of dispatch intervals for which the analysis indicates correct and incorrect path designations for competitive and non-competitive paths in any LMPM run with a binding constraint. For example, the analysis indicates that, for 63 percent of the dispatch intervals studied, implementing the dynamic competitive path assessment in the HASP only results in correct designations of competitive paths where there was a binding constraint in either a HASP or a real-time market run. The Table 3 omits dispatch intervals for which there were no binding constraints in either a HASP or a real-time unit commitment run. In those cases, there is no risk of local market power arising and no path designation produced.

Table 3 Accuracy of Dynamic Competitive Path Assessment in HASP Relative to Real-Time Unit Commitment

Designation Accuracy w/DCPA			Competitiveness As Measured in RTD w/ DCPA		
			Competitive	Uncompetitive	All
	HASP	Correct	63.0%	1.9%	64.9%
		Incorrect	5.8%	28.9%	34.7%
	RTUC	Correct	75.1%	11.0%	86.1%
		Incorrect	5.6%	8.5%	14.1%

Table 3 shows that implementing the dynamic competitive path assessment on a 15-minute basis results in significantly more accurate path designations than implementing the dynamic competitive path assessment in the HASP only. Overall, performing the dynamic competitive path assessment in the real-time unit commitment results in 86.1 percent of path designations being assessed correctly versus 64.9 percent when the dynamic competitive path assessment is run in the HASP only – an improvement of approximately 21 percent. This improvement in accuracy stems from better prediction of real-time market congestion and more current information used in the residual supply index calculations.

It is also important to recognize that limits that establish the floor to which a bid price can be mitigated limit the potential damage from over-mitigating resources. There is no such limit that applies when under-mitigation occurs. Applying the dynamic competitive path assessment approach in the real-time unit commitment run results in a decrease in instances where an uncompetitive path is falsely deemed competitive from 28.9 percent to 8.5 percent, which is a very significant improvement in reducing under-identification of local market power.

Bid Mitigation

The results that were presented for the impact in HASP of the LMP decomposition are expected to reflect the impact under full implementation in the second phase. The HASP will retain the LMP decomposition method in the second phase and an additional mitigation run will be applied in the RTUC just prior to the 5-minute dispatch market. The ISO does not currently apply mitigation after the application in HASP, so there is no empirical or observed mitigation to compare the new approach to for RTUC.