Comments of Pacific Gas and Electric Company
Commitment Cost Enhancements Phase 3 Workshop – Proxy Demand Resource

Submitted by	Company	Date Submitted
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PG&E provides the following comments on the CAISO July 27, 2016 workshop on commitment cost enhancements for proxy demand resources (PDR).

PG&E appreciates the CAISO's responsiveness to the CPUC request at the CAISO March Board meeting for more discussion around opportunity cost and use limited status for preferred resources. Based on the workshop discussion, PG&E understands that some PDRs may lend themselves well to having their opportunity cost modeled by CAISO and included in commitment cost bids, and others may not. Given the limited participation of PDR in the CAISO market today, it is also difficult to judge whether this new market enhancement is necessary to improve PDR dispatch. Therefore, PG&E encourages CAISO to maintain some optionality for PDRs to either register as a Use-Limited Resource or not if their dispatch would not be optimized using opportunity cost headroom on commitment costs. If not registered as a Use Limited Resource, CAISO should preserve the ability for those PDRs to utilize outage cards to manage their RAAIM exposure. As these resources are bid into the market more in the future, market participants will gain valuable operational experience that can inform whether a commitment cost adder would be appropriate for a given resource.

I. PG&E provides the following feedback on specific questions posed to stakeholders by CAISO at the CCE3 workshop.

a. Are there demonstrable costs that exist for PDR that may be analogous to a start-up or minimum load cost for a traditional generator? (Excluding opportunity costs)

There are some administrative costs associated with calling a DR program, such as communication/notification costs; however, many of these costs are de minimis relative to the cost of modeling and tracking them, so the CAISO should decide if these are worth incorporating. If CAISO moves forward with a design that contemplates commitment costs for PDR, the CAISO should also consider what accommodations would be necessary to the PDR model itself. It is PG&E's understanding that the CAISO's PDR model today cannot reflect commitment costs, because the resource is assumed to have a 0 MW Pmin. Therefore, it is not possible to assign start-up costs for dispatching a PDR from 0 MW to Pmin, or minimum load cost for remaining its Pmin. This would require significant changes to the PDR model along with new internal LSE cost tracking mechanisms that are not in scope of the Commitment Cost Enhancements initiative.

b. *Are there other resources characteristics necessary to include in the model? Can all limitations be captured by the types and granularities listed here - PMin, PMax, Min up and down time, start/run hour/energy output limits and temporal granularity, limitation effective dates, energy costs, commitment costs based on proxy cost formulation? If not, what else exists that warrants an opportunity cost?*

PDRs limitations can be further constrained by factors such as the time of day, week-day or weekend, or by the season. Furthermore, technology-specific limitations (e.g., storage) exist that may limit participation.

c. *What type of documentation can SC's provide on PDRs to substantiate the use limitations?*

Terms and conditions, including limitations for Demand Response programs, including PDR are generally incorporated into Utility tariffs and/or contractual terms. An important distinction is that in certain cases there could be a set of contracts each specifying limitations. For example, with the Demand Response Auction Mechanism (DRAM) pilot there is a contract between the Investor Owned Utility and the Demand Response Provider (DRP, who may or may not be the Scheduling Coordinator) as well as a separate contract between the DRP and the ultimate DR provider (customer). Both contracts may specify certain terms and conditions. The following bullets illustrate the two possible contracts:

- Between PG&E and the Demand Response Provider (DRP)
- Between the DRP and the DR provider (customer)

II. PG&E would like further clarity around how PDR resources would qualify for use limited status, and how this status would impact the market rules for PDR.

a. CAISO requires that resources provide a minimum of 2 starts per day to the market. An exemption is available if the resource is physically incapable of more than one start per day[1]. PG&E recommends that registration with the CAISO as a Use-Limited Resource should not be a pre-condition for a PDR, or any resource, to qualify for the one start per day exemption. We request that CAISO clarify that the Master File start

[1] CAISO Memo to ISO Board of Governors on Commitment Cost Bidding Improvements Proposal. http://www.caiso.com/Documents/DecisionCommitmentCostBiddingImprovementsProposal-Memo-Mar2016.pdf

value requirement does not create an obligation to register as Use-limited under the CCE3 framework.

b. At the workshop CAISO indicated that "non use-limited PDR" (PDR that does not register with the CAISO as Use-Limited) will have access to Monthly, Annual, and Other use-limited reached outage cards to manage their exposure to the RAAIM when their limitations run out. PG&E supports maintaining access to these use-limited outage cards for PDR. We further support allowing "non use-limited PDR" to utilize the Short term use-limited reached outage card to reflect fatigue breaks. "Non use-limited PDR" should have access to those outage cards during both the CCE3 interim period and the CCE3 post interim period, since their limitations will not be managed intra-month through the CAISO's opportunity cost adder.

c. A Reliability Demand Response Resource (RDRR) is dispatched by the CAISO under emergency conditions. PG&E would like CAISO to confirm our understanding that the Use-Limited registration process and opportunity cost calculation doesn't apply to RDRR.

III. While modeling opportunity cost for limited start-ups over a year could help better utilize resources and increase flexibility in CAISO markets, PG&E recommends that some modifications be made to the proposed model to give more accurate and more stable results.

Calculating an opportunity cost is actually a very complex process due to the uncertainty in the future and sensitivity due to including integers in the optimization. PG&E has done internal testing of the model with a sample resource, which has shown that the opportunity cost is very sensitive to the number of starts, market prices, and generator costs. Additionally, the model does not incorporate potential day-ahead settlements and uses an unclear estimation of startup costs. More details on our testing of the model and concerns are available in the Appendix section of these comments.

PG&E has two primary concerns based on this limited internal testing of the model methodology:

a. Comparing the profits between two model runs as proposed may not result in opportunity costs that monotonically increase as the number of starts/run hours/energy output decrease.
b. The model assumes that the resource is dispatched only when the CAISO's locational marginal prices (LMPs) are sufficient to cover the costs of the resource. In reality however, it is not uncommon for a resource to be dispatched when their costs are not fully recovered by the LMPs. The resource would be awarded Bid Cost Recovery

payments to cover their costs. If a use-limited resource is frequently dispatched in the market when it is uneconomic (and subsequently receives BCR), the CAISO's opportunity cost model would underestimate the dispatch of those resources, resulting in an opportunity cost that was too low.

PG&E appreciates the opportunity to provide this feedback for CAISO and stakeholder's consideration. We propose the following as potential improvements to the model, and welcome thoughts that CAISO and stakeholders have on the concerns and recommendations we've raised here. For simplicity, we've focused on start limitations.

Where N is the number of starts:

a. Once N is chosen, calculate the opportunity cost of N-15 through N+15 starts. The opportunity cost can then be an average of these opportunity costs, broadly a maximum of these opportunity costs, or perhaps the 75th percentile of the opportunity costs. The variability in opportunity costs from varying the number of starts will likely capture much of the expected variability in market prices and generator costs as well.
b. Include day-ahead revenue as part of the opportunity cost.
c. Have the startup cost be the cost per startup times the number of startups over the time horizon.
d. Recalculate the opportunity cost when the distribution of prices and/or costs changes significantly from what was estimated. This may mean updates of more than once a month.
e. To address the non-economic dispatch concern, consider reducing N to % of economic dispatches multiplied by contract-limited starts rather than simply 90% multiplied by number of starts. Higher opportunity costs will also likely lead to resources being dispatched economically more of the time.

Appendix

Executive Summary

PG&E commends the CAISO for seeking to better utilize use limited resources over a longer time horizon. The CAISO is proposing to increase the bid cap on energy bid, minimum load, and startup costs via calculating an opportunity cost for each of these items for each relevant resource. The opportunity cost for each relevant restriction (total energy, total hours run, and total allowed starts) is then a component of a cap on bid costs. These comments focus on the opportunity cost for resources with a limited number of starts over the year. The CAISO-modeled opportunity cost for limited starts is calculated as the total yearly optimal fifteen-minute revenue difference between N starts and N-1 starts. This opportunity cost calculation remains the same for the entire month, and then is updated at the start of the next month with the remaining number of starts. It uses prices from the previous year that have been adjusted for expected differences in prices for natural gas, greenhouse gas, and power. For the beginning of the year, the number of starts, N, is set as 90% of the restriction on the total number of starts over the year. The CAISO then calculates the opportunity cost for each subsequent month of the year by setting the number of starts at the beginning of a month, N_m, to being 90% of the expected remaining starts, $90*(N-E[N_{m-1}])$, that is, it subtracts off the number of starts that were historically used in the previous month, aka month m-1.

To understand what might be the results of this model, we simulated what we understand to be the CAISO's model. We maximized the objective function of the sum of the following over a year: LMP times the fifteen-minute generation minus the following items: bid cost times the fifteen-minute generation, startup cost times the number of startups, and minimum load cost times the number of fifteen-minute intervals the unit was on. The constraints included the minimum and maximum generation levels for the unit, the minimum on and off times for the unit, and the maximum number of startups over the year.

There are a number of important questions about and issues with this model. One of the largest broad issues is that deterministic optimization models with integer constraints do not smoothly change with changes in constraints. It appears that the opportunity costs calculated are highly sensitive to the prices used and the generator's costs. Additionally, the assumption that the unit is profit-maximizing is not necessarily how the market runs, and there is often significant revenue for these units from the day-ahead market that is not considered.

Opportunity Cost Model

This section discusses how we interpreted the CAISO's model given in the Technical Appendix of the CAISO's *Commitment Cost Enhancements Phase 3 Opportunity Cost Methodology*. For our example, we used a representative resource, henceforth referred to as Resource A. This resource is modeled as being limited to 365 starts per year. Resource A is modeled with a nonzero minimum power generation, minimum load costs, and startup costs and modeled with having two bid segments beyond its minimum load level.

Indexes

t: 15-minute time interval. We consider time in 15 minute intervals, so for a full year, there 4 intervals/hour times 24 hours per day times 366 days per year (2016 was a leap year) which gave a total of 35136 intervals over the year. So, *t* is in (1, 2,…, 35135, 35136).

Parameters

LMP_t: The LMP at time interval *t*

$B1_t$: The first bid cost segment, also considered to be resource's cost per MW at that generation level

$B2_t$: The second bid cost segment, also considered to be the resource's cost per MW at that generation level

SUC: Startup cost for the unit

MLC: Minimum load cost for the unit

PMAX: The maximum possible power generation

PMIN: The minimum possible power generation

GTRANS: The MW value at which you transition from the first segment of the bid curve to the second segment of the bid curve

MOT: Minimum up time of the unit

MOD: Minimum down time of the unit

N: Number of starts per year

Variables

g_t: Generation at time t

$ginc1_t$: Generation from the power production in segment 1 of the bid curve above the generator's PMIN at time *t*

$ginc2_t$: Generation from power production in segment 2 of the bid curve above the transition to the second bid segment, aka generation above GTRANS, at time *t*

u_t: A binary variable that is 1 if the unit is on and 0 if the unit turns on at time *t*

d_t: A binary variable that is 1 if the unit is on and 0 if the unit shuts down at time *t*

y_t: A binary variable that is 1 if the unit is on and 0 if the unit is off at time *t*

Data Sources

LMP_t: The fifteen-minute prices for the resource are used and are referred to as the 'original' model run

$B1_t$: Resource A's cost for its first segment of power generation beyond its minimum load level

$B1_2$: Resource A's cost for its second segment of power generation beyond its minimum load level

SUC : For simplicity, a constant startup cost was assumed over the year and set to be Resource A's startup cost.

MLC: Resource A's minimum load cost

PMAX: The PMAX of Resource A

PMIN: The PMIN of Resource A

GTRANS: The MW transition point from the first bid segment to the second bid segment.

MOT: The hourly minimum on time of Resource A multiplied by 4, since we are looking at 15-minute intervals

MOD: The hourly minimum off time of Resource A multiplied by 4, since we are looking at 15-minute intervals

N: Resource A is allowed 365 starts per year. We varied N all the way from 1 to 365 to understand the opportunity cost of each start.

Note: The LMPs, bid costs, and minimum load costs are all given as hourly costs, so we divide them all by 4 in the objective function to obtain the correct 15-minute cost. The startup cost is per startup and as such does not to be modified.

Model

$Z^* = \text{Maximize} \sum_{t=1}^{t=35136} (1/4)*(LMP_t*g_t - B1_t*ginc1_t - B2_t*ginc2_t - MLC*y_t) - SUC*u_t$

Subject to

$PMIN*y_t \leq g_t \leq PMAX*y_t$	*Minimum and maximum generation*
$ginc1_t \leq (GTRANS-PMIN)$	*Generation in segment 1 of the bid curve*
$ginc2_t \leq (PMAX-GTRANS)$	*Generation in segment 2 of the bid curve*
$g_t = ginc1_t + ginc2_t + PMIN*y_t$	*Total generation balance*
$y_t - y_{t-1} = u_t - d_t$	*Define startups and shutdowns*
$u_1 = y_1$	*Assume unit is off before start of the time horizon*

$\sum_{t=1}^{t=35136} u_t \leq N$ *Limit maximum starts over the year*

$y_t+y_{t+1}+y_{t+2}+y_{t+3} \geq MOT\ (u_t)$ *If the unit turns on, it must stay on for MOT periods*

$y_t+y_{t+1}+y_{t+2}+y_{t+3} \leq MOD(1\text{-}d_t)$ *If the unit turns on, it must stay off for MOD periods*

Calculating Opportunity Costs

We calculate the opportunity cost by finding the optimal objective function at N starts, Z^*_N, and the optimal objective value at N-1 starts, Z^*_{N-1}. The opportunity cost for N starts is then defined as Z^*_N – $Z^*_{N-1.}$

LMP Variations

In this paper, we consider two sets of prices. The original prices, as mentioned before, are the actual 15-minute prices over the contract year for Resource A. The slightly modified prices are the original prices plus a random number that is drawn from a distribution with mean 0 and standard deviation 2. That is, the slightly modified price stream will have the same mean and shape as the original price stream. The actual standard deviation of fifteen-minute prices is over 20. Therefore, the price stream selected for testing has much less variability than one would expect to see in the actual price stream.

Sensitivity to Number of Starts

CAISO should consider running the opportunity cost model for a wider range of starts than only N and N-1 starts; for example, it may want to consider N-20 to N+20 starts. While the objective function will only stay the same or decrease when going form N starts to N-1 starts, all else held equal, the opportunity cost, aka the difference in the objective functions, does exhibit instability between different numbers of starts. If we reduce starts one-by-one the opportunity cost may increase, then decrease, then increase again; that is, the opportunity cost does not monotonically increase with decreasing numbers of starts.

If the opportunity cost was calculated as removing the lowest-revenue dispatch period of time where the resource is continuously on, then the opportunity cost would be monotonically increasing in decreasing the number of starts. However, the opportunity cost is calculating as optimizing the dispatch for N starts versus N-1 starts. Due to the startup cost, it is unlikely that your dispatch for N starts would be the same as your dispatch for N-1 starts, plus one more start. Rather, it is more likely that your dispatch for N-1 starts will be different from N starts. For a simple example, let us assume that you have LMP-cost of 6, -1, and 4. If you have 2 starts, you will be on in the 1st and 3rd periods, gaining a net revenue of $10. If you have 1 start, rather than drop the lowest price segment, or the 3rd period, you will simply stay on through the 2nd period, gaining a net revenue of $9.

In normal convex duality theory, the dual value of a constraint is the incremental value of changing the right-hand side. It is often referred to the value of changing the right-hand side by one unit; however, duality holds for a particular basis and range of right-hand sides. It can be that the valid range for that right-hand side is actually less than one unit. The opportunity cost model is a mixed integer program, so there is no 'real' dual of its constraints. Normal optimization theory fixes the integer variables and solves for the sensitivities. However, here the integer variables include startup and commitment variables, which would not give any meaningful dual for the number of starts constraint. If, on the other hand, one relaxed the commitment variables, one would not obtain a meaningful dispatch answer; therefore, the CAISO calculates a proxy dual by finding the objective value at N starts versus N-1 starts. The issue with this is that a dual value is only relevant when the basis (the active constraint set) remains the same. However, while the basis will likely remain the same if the number of starts constraint is not binding and is not binding for a range of starts, whenever the number of starts constraint is binding, it is very likely and in fact in examples does change the basis of the solution. Therefore, if there was such a thing as integer duality, we would likely have a different dual for N starts than N-1 starts whenever the limited start constraint is tight.

The CAISO's plan to recalculate opportunity costs once per month means it is expecting that the basis for the opportunity cost remains the same the entire month. CAISO should test this assumption by calculating the opportunity cost for a range of starts. It can also reduce the time range as it reduces the number of starts, but running this sensitivity analysis would be very useful. We tested the model described in the *Opportunity Cost Model Section* using the historical LMPs as described as the 'original' model. Figure 1 shows the phenomenon that while the opportunity cost increases with decreasing number of starts *on average*; decreasing the number of starts does not mean that the opportunity cost will increase unilaterally. We can see that the opportunity cost for 75 starts remaining is much higher than 275 starts remaining; however, there are many instances where the opportunity cost for N starts is actually *lower* than N+1 starts. You can see examples of this instability in prices in many places in Figure 1.

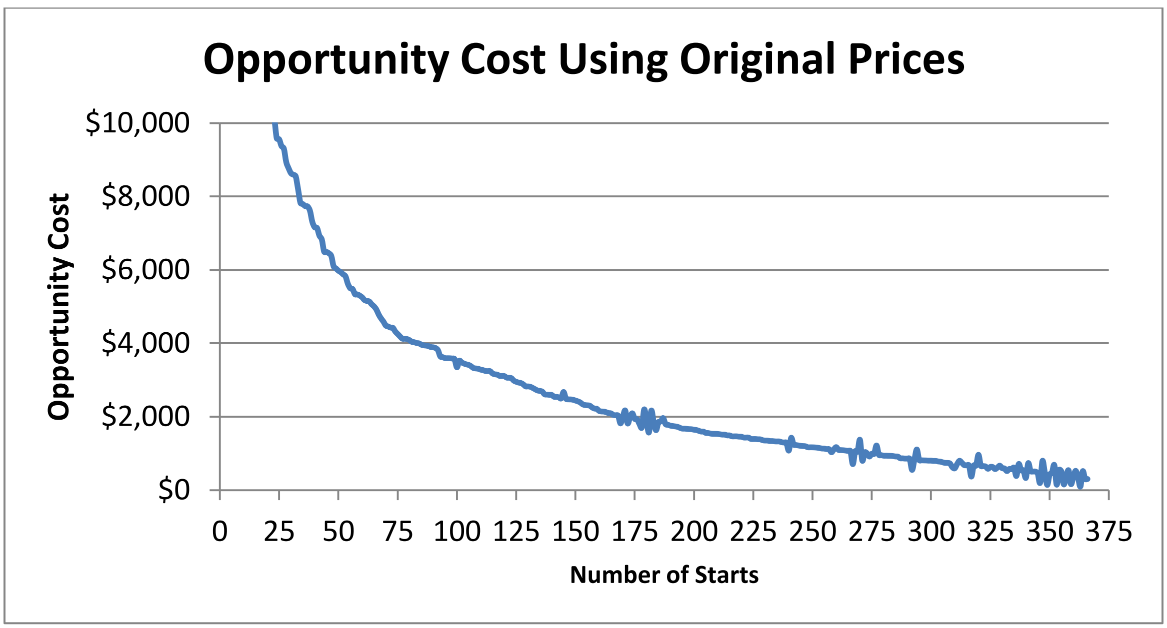

Figure 1: Opportunity Costs for the Original Price Scenario, Through a Wide Range of Starts. While the opportunity cost increases on average with fewer starts, it does not increase monotonically with fewer starts. In some cases, fewer starts results in a lower opportunity cost.

To observe this phenomenon more closely, Figure 2 has the same data as Figure 1 with zooming in on the range of 309-349 starts for Resource A. This range was selected since Resource A is limited to 365 starts, and taking 90% of that is N=329 starts.

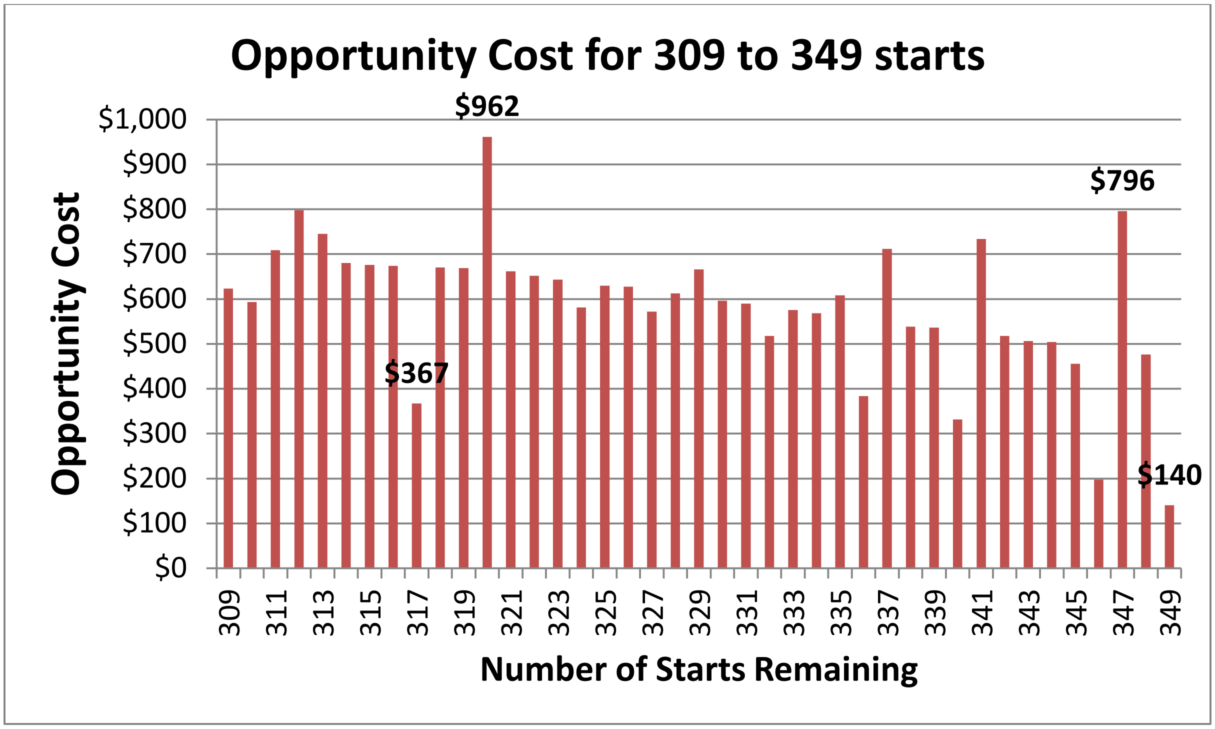

Figure 2: Opportunity Cost for 309 to 349 starts

If we examine 309 through 349 starts for Resource A, while most opportunity costs are between $400 and $700, there is a lot of fluctuation in these costs. For example, the opportunity cost of 349 starts is $140.13, of 347 starts is $796, and of 346 starts is $198. This fluctuation also happens at a lower number of starts; the opportunity cost of 317 starts is $367, while the opportunity cost of 320 starts is $962. As the current proposal stands, CAISO could easily calculate an opportunity cost that would be too low or too high simply based on the fact that changing an integer constraint often greatly changes the basis of the optimization problem.

Sensitivity to Market Prices and Unit Costs

CAISO should account for the fact that integer programs are highly sensitive to the uncertainty in market prices as well as resource costs. Many of the resources that would be a part of CCE3 are gas-fired units and their costs are sensitive to the gas price. CAISO may want to determine the opportunity cost via doing a number of separate scenario optimizations and averaging the opportunity cost determined by the difference scenarios. CAISO should rerun the opportunity cost model whenever the expected opportunity costs changes materially. The opportunity costs may change materially due to the unit using starts or when market prices or resource costs change greatly from expectations.

Resource unit commitment is an integer program that includes a startup cost, minimum load cost, and bid cost. The total revenues generated from production must be greater than the total startup cost, minimum load cost, and bid cost in the time range. If a resource has unlimited starts, then the resource will only turn on for periods where the sum of the (market price – bid cost)*production is greater than the (minimum load cost – bid cost)*min load + startup cost, and it will turn on for every such time range. As such, any change in price or bid cost may materially change the length of the commitment or generation dispatch. If there are no minimum load or startup costs and no minimum up or down times, the variation in prices would not matter as much. However, the minimum load and startup costs lead the optimization to have lumpy behavior that is highly sensitive to even small fluctuations in prices and the costs. Given that the standard deviation of fifteen-minute prices of resource A is over 20 while the average price is between 20 and 40 for Resource A over its contract year, actual price fluctuations cannot be described as minor. Therefore, the expectation that your actual fifteen-minute prices will equal the forecasted ones is a poor assumption. This sensitivity to prices is likely higher on units that are close to being the marginal unit, and will likely be less for units that have extremely low or high commitment costs.

To show the change in opportunity cost between two scenarios, we first used the original actual prices for Resource A, and then the slightly modified prices (actual prices plus a normal random variable with mean of 0 and standard deviation of 2). Figure 3 shows the opportunity costs for the two price sets side-by-side, while Figure 4 shows the difference in the two opportunity costs. Both Figures 3 and 4 show that the opportunity cost for the two sets of prices can vary greatly at the same number of starts. For example, at 327 starts, the opportunity cost for the original price stream is $284 more than the modified price stream, which is nearly 50% of the opportunity cost. The average opportunity costs for the two price sets over the 319-339 range would be very similar, but we may have significant fluctuations by choosing only one single number for the number of starts.

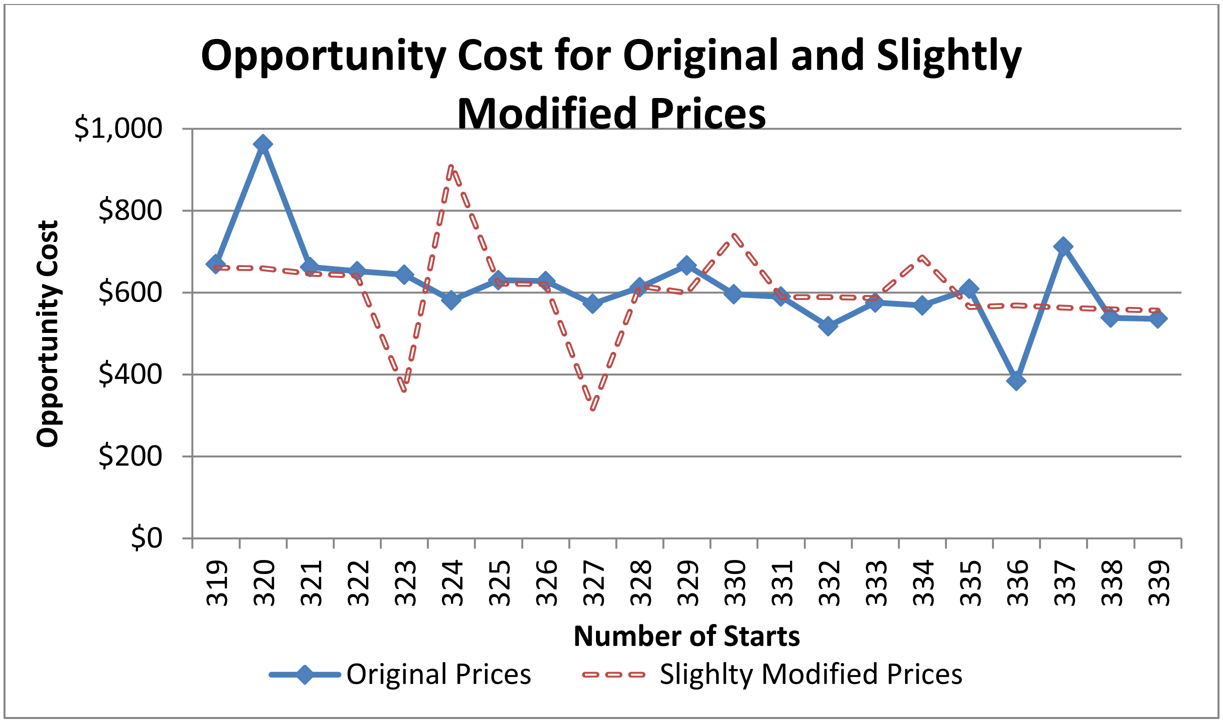

Figure 3: Opportunity Costs for Calculated for Resource A for Two Difference Price Streams. While the range of opportunity costs is similar, there is a big difference in opportunity cost between the price streams when only choosing one number for the number of starts.

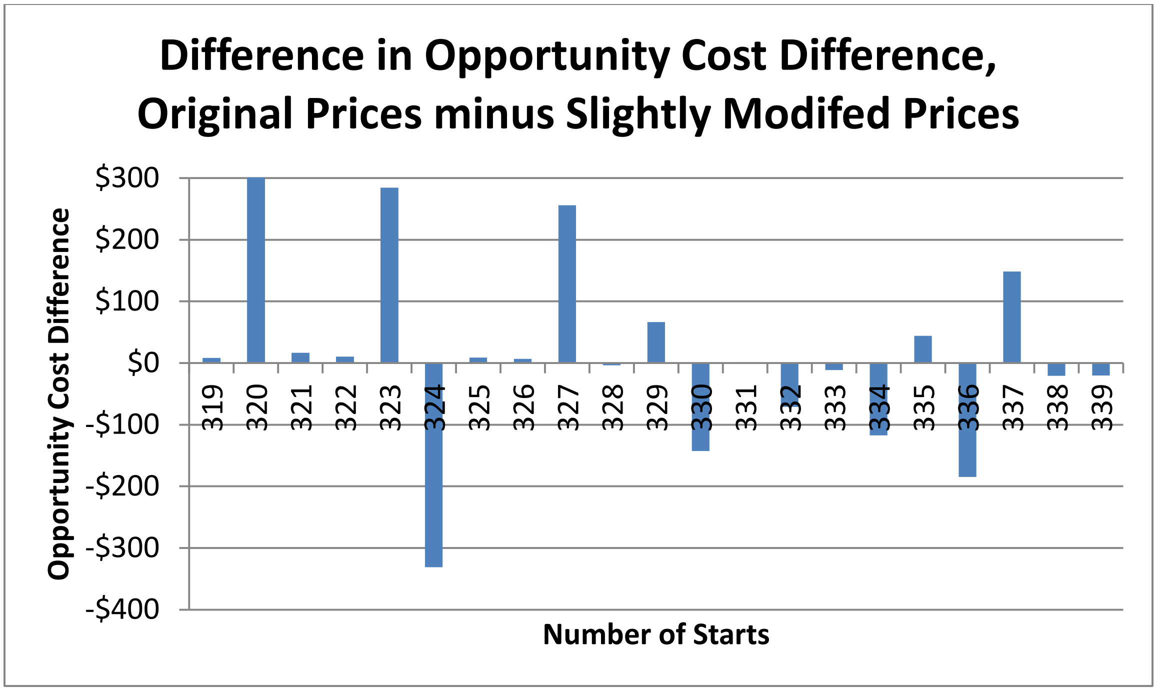

Figure 4: Difference in the Opportunity Costs Calculated for Resource A based on two price streams, for 319 to 339 Starts. We see that the opportunity cost difference between the two very similar price sets can be as great as $300 or as much as 50% of the calculated opportunity cost.

Actual Fifteen-Minute Dispatch is Not Equivalent to Profit-Maximizing in the Fifteen-Minute Awards

CAISO should consider that not all starts are going to be economic for the unit. Therefore, the opportunity cost may need to be higher or the number of starts considered to be lower since the model construction only results in economic starts.

The model assumes that the resource is a profit-maximizer in the fifteen-minute market; however, resources may not be dispatched economically in the real-time market. Some resources may even receive BCR 25-75% of the time. Therefore, a start may be worth more than anticipated because the pool of remaining economic starts may be much smaller than the pool of remaining total starts, since the resource is often going to be dispatched uneconomically.

Incomplete Revenue Characterization

CAISO should include expected day-ahead revenue as part of the opportunity cost. Resources often are dispatched economically in day-ahead but not real-time, and therefore most of the opportunity comes from the day-ahead market.

Another issue from the CAISO proposal is that it does not well-describe the different revenue streams received by use-limited resource. As stated before, many resources receive no profit 25-75% of the time in the real-time market; they mainly receive compensation in the day-ahead market. The opportunity cost model does not include day-ahead revenue, nor does it consider ancillary service revenue either. The value of the day-ahead awards in many cases is much larger than the real-time awards.

Startup Cost

CAISO should use the startup cost parameter as the given startup cost in the RDT, and then calculate the total cost of startups as the startup cost parameter times the number of startups in a year. The proposed methodology appears to be some sort of estimation of the startup cost; given the optimization will know how many times the unit is started up, there isn't a need to estimate the monthly startup cost.

In the proposal, the startup cost appears to be stated as the monthly startup cost divided by the total consecutive 15-minute intervals the resource is running, SUC/Total Int. In the proposal, it references the calculation for the startup cost to be equation 2, 2.1, or 2.2. Given that Equation 2.1 is for non-gas-fired resources without a GHG compliance obligation and equation 2.2 is for non-gas fired resources with a GHG obligation, it appears that a gas-fired resource would have its costs governed by Equation 2. However, Equation 2 gives the monthly startup and minimum load costs. First of all, given the optimization model will give the number of commitments, the startup cost should simply be the cost per startup times number of startups. Secondly, the definition of TotalInt is confusing; it appears to be defined as the total consecutive 15-minute intervals over a year. However, the unit will likely be started up multiple times over the year's horizon, so it may be dispatched for say 8, 12, 67, 5, 10, and 20 consecutive intervals. What would TotalInt be in that case since it is consecutive intervals? If TotalInt is the total number of consecutive intervals, then we are dividing a number over a variable, which will give a nonlinear, nonconvex and integer program that will take the CAISO longer to solve when it could have simply kept it as a mixed integer linear program, which will be much faster to solve. The optimization model will give the number of commitments, and therefore the startup cost should simply be the cost per startup multiplied by number of startups.

Conclusion

While modeling opportunity cost for limited startups over a year could help better utilize resources and increase flexibility in CAISO markets, we recommend that some modifications be made to the proposed model to give more accurate and more stable results. Calculating an opportunity cost is actually a very complex process due to the uncertainty in the future and sensitivity due to including integers in the optimization. This limited testing of the model has revealed that the opportunity cost is very sensitive to the number of starts, market prices, and generator costs. Additionally, it ignores the potential day-ahead settlements and uses an unclear estimation of startup costs. As such, we recommend a few steps to improve this model.

- Once N is chosen, calculate the opportunity cost of N-15 through N+15 starts. The opportunity cost can then be an average of these opportunity costs, broadly a maximum of these opportunity costs, or perhaps the 75th percentile of the opportunity costs. The variability in opportunity costs from varying the number of starts will likely capture much of the expected variability in market prices and generator costs as well.

- Include day-ahead revenue as part of the opportunity cost.
- Have the startup cost be the cost per startup times the number of startups over the time horizon.
- Recalculate the opportunity cost when the distribution of prices and/or costs changes significantly from what was estimated. This may mean updates of more than once a month.
- Consider reducing N to % of economic dispatches multiplied by contract-limited starts rather than simply 90% multiplied by number of starts. Higher opportunity costs will also likely lead to resources being dispatched economically more of the time.