Net Benefits Test Methodology For Demand Response Compensation Update

October 3, 2023

1 Introduction

Compensation for demand response in wholesale markets has been the subject of debate and controversy for several years. The most recent pronouncement on the topic by the FERC in Order 745[1] requires the payment of full locational marginal prices (LMP) to demand response providers, with the caveat that such payments only occur when the demand reduction provides "net benefits" to the market.[2] The Order goes on to specify that ISOs/RTOs are to determine a monthly "price threshold" above which such net benefits occur in their energy markets.[3] FERC recognizes that this procedure of determining a monthly threshold price is a relatively crude approach, but one it believes will suffice for the interim period while further analysis is done to examine the feasibility of more accurate procedures.[4]

This paper describes the steps taken by MISO to comply with FERC's Order 745. In general, our approach has been to allow the data to provide the answers required, rather than to administratively impose parameters or impacts. Using econometrics, it is possible to quantify relationships rather than assume them, and it is possible to test hypotheses and evaluate alternatives with quantitative evidence. Given the considerable data available, this approach results in a transparent and efficient determination of the desired price thresholds.

1.1 Summary

Estimation of the supply curve for MISO, based on price, outage, and firm bid offers, is done through an ordinary least squares approach. The shape of the curve is closely approximated, in the region of interest, by the functional form and specification described below. The high degree of model fit is achieved using a multi-year look-back period and limiting the price range estimated to be between $4 and $100. All hours of the day are used rather than limiting the hours to a period in the afternoon as historical data demonstrates that periods of high need are possible throughout the day rather than just in the afternoon.

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[1] *Demand Response Compensation in Organized Wholesale Energy Markets*, Final Rule, 134 FERC ¶ 61,187 (2011) ("Order No. 745" or "Final Rule"). The Final Rule was issued March 15, 2011.

[2] "We find, based on the record here that, when a demand response resource has the capability to balance supply and demand as an alternative to a generation resource, and when dispatching and paying LMP to that demand response resource is shown to be cost-effective as determined by the net benefits test described herein, payment by an RTO or ISO of compensation other than the LMP is unjust and unreasonable. When these conditions are met, we find that payment of LMP to these resources will result in just and reasonable rates for ratepayers." See Final Rule, ¶ 47, p. 39.

[3] "First we direct each RTO and ISO to undertake an analysis on a monthly basis, based on historical data and the RTO's or ISO's previous year's supply curve, to identify a price threshold to estimate where customer net benefits, as defined herein, would occur." See Final Rule, ¶ 79, p. 62.

[4] "We recognize that the threshold price approach we adopt here may result in instances both when demand response is not paid the LMP but would be cost-effective and when demand response is paid the LMP but is not cost-effective. We accept this result given the apparent computational difficulty of adopting a dynamic approach that incorporates the billing unit effect in the dispatch algorithms at this time." See Final Rule, ¶ 80, p. 63.

As ordered in the Final Rule, the monthly price threshold at which point demand response provides a net benefit to the system must be determined. The estimated equation can be solved each month for the quantity, Q, at which the price threshold can be calculated. A projection of the outage index, the price of coal, and the price of natural gas is made to determine the desired price threshold. By using forward prices, obtained from publicly traded data on the first business day of the month prior to the operating month, in conjunction with a projected outage index, using then-current information about existing and planned outages in conjunction with data from the same month of a prior year, the desired price threshold can be posted and made publicly available by the 15th of the month prior to the operating month, per the Final Rule.

1.2 Changes To 2015 Model

This update includes two changes to the methodology used previously. The first is that the data range is updated to use data from 2021. We evaluated a model that looked across the previous 6 years, 2017 to 2022, and found it to provide no improvement beyond that when looking at only the 2021 year. This is necessary as price changes caused by COVID and Federal policy have created an environment where fuel prices in 2022 were outside of their historical range, by about a factor of 4, creating out of sample estimation error. These outliers cannot be thrown out because they impacted the supply curve moving forward, but also should not be used exclusively as in previous years because prices have returned to historical levels. For the values moving forward, the comparison year will be 2021 as 2021 provides the optimal mixture of historical and temporary prices. To be precise, there is greater price volatility than has historically been seen and 2021 is the year that best captures this price volatility.

The second change corrects the multicollinearity that is caused by the use cubic function in the specification. Multicollinearity is exclusively a modelling problem, which means that the statistical properties of the estimators as $n \to \infty$ remain unchanged, that is they are statistically consistent. What multicollinearity does cause is an increase in the variance of the colinear estimators which could mean some variables are found to be outside the 95% confidence interval from zero when they otherwise would not be.

In the specification MISO uses, this collinear problem arises because of the use of a cubic function and so a correction to the model can be made which causes the overall estimator to remain unchanged, but which significantly reduces collinearity. By subtracting the mean quantity from each observation, the correlation between the quantities in the cubic function is reduced by two orders of magnitude while maintaining the desirable statistical properties of the original formulation. The result of this modification is that every month indicator is now statistically significant. The rest of the methodology remains unchanged.

Complete statistical results for the final estimated equation are provided in Appendix B.

1.3 Specification

The short-run supply of any good or service is driven by marginal cost considerations. In the wholesale electricity market, such marginal considerations would include primarily fuel prices. Economics further states that short-run supply is related to the number of suppliers which, in the current context, could be related to the number of resources available to provide service. These considerations suggest that our general specification for the aggregate supply curve of MISO should include certain fuel prices, a measure of resource availability, and the quantity of power offered at each price.

Model specification, the art and science of determining an appropriate mathematical formulation relating the variable to be explained, the "dependent variable", and the list of factors that are paramount to that explanation – is comprised of the following steps:

1. ***Choosing the explanatory variables or factors***
   This step includes selecting those variables that are believed to have a significant and important influence on the dependent variable.
2. ***Selecting the correct functional form***
   This step focuses on determining the mathematical form, e.g. logarithms, of each variable included in the analysis.
3. ***Choosing the correct form of the stochastic error***
   This step examines the residuals and seeks to ensure that the assumptions underlying the statistical results are valid.

The first step, variable selection, has already been briefly described. Further consideration revealed that two primary fuels are used by the resources that are marginal in MISO's energy and operating reserve market: coal and natural gas. Another variable is required to account for resource availability which is captured by the outage measure described above.

The second step, selecting the correct functional form, was addressed initially by a visual examination of the daily supply pattern, which suggested (a) that the underlying functional form is a cubic polynomial of some type, and (b) that the offer prices rise quickly as the maximum quantity offered is approached. Taken together, the initial functional form suggested was an exponential cubic polynomial over a restricted range. Below $4 per MW the curve is convex due to cheap, intermittent resources providing marginal MW. Failing to set a sufficient lower bound requires a higher degree polynomial to be fit which risks overfitting the model. Overfit is a problem because small changes in subsequent samples can cause large changes in the resultant prices. On the high end of supplied quantities, the exponential rise in the curve above $100 per MW dominates the shape of the curve causing an underestimate of the price, quantity pair where elasticity provides a net benefit to the market. The econometric results described below confirm that the choice of a cubic exponential function is suitable and provides an excellent representation of the aggregated offer pairs over the necessary range. In results not displayed, it also was confirmed that including prices outside of the specified range creates issues with model fit and stability.

The third step, stochastic error examination, is typically performed during the analytical portion of an econometric study. We found no evidence suggesting that the residuals resulting from the selected specification did not meet the stochastic requirements assumed in such an analysis. We did find that, as expected of a cubic function in a linear regression, there is multicollinearity in the results of the model. Multicollinearity is a problem that leaves estimators unbiased but increases their variance. Tests for multicollinearity include the variance inflation indicator, through which an estimate of how much the variance of an estimate has been artificially increased can be calculated. Performing this test on the uncorrected specification described below showed inflation of the variances by a factor of 1000. The large number of observations helps reduce the magnitude of this problem, but a collinear correction still needs to be implemented to provide maximum model performance. The procedure for this step will be discussed in detail below.

1.4 Data

Price and quantity data are obtained by aggregating the energy offers made by Market Participants for their resources. Market Participants offer their resources into MISO's energy and operating reserve market by providing two paired values: a given amount of power (MW), and the minimum price for providing that amount of power. Up to ten (10) such quantity and price pairs may be provided for each resource, for each hour. By combining these offers for each resource, an "offer curve" for that resource may be determined. See Figure 1 below. Once this procedure has been followed for each available resource,[5] the results may be combined to determine the aggregate amount of power offered to the market at a given price.

The diagram below illustrates an example of one resource's offers, shown in blue. The aggregate supply curve is obtained by summing all individual unit offer curves for each hourly period. The red dashed lines provide a representation of how the aggregate offer curve looks in a given hour.

[5] Market Participants indicate the status of a resource to MISO through an offer parameter, enabling MISO to determine whether a given resource is capable of providing service if called upon.

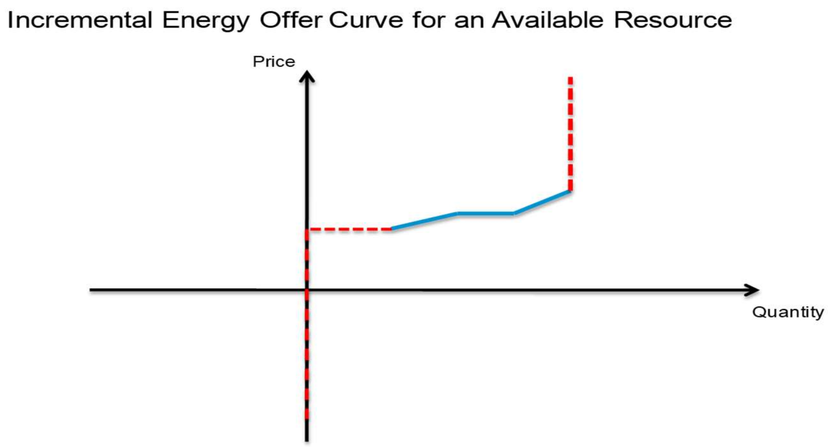


Figure 1

Initially, these hourly offers were combined to determine the price and quantity pairs that form an hourly aggregate supply “curve”. Based on analytical results, we ultimately used the daily average of hourly price-quantity pairs starting at $4 and increasing to $100 for the final estimates of the price threshold.[6]

As described above, an hourly aggregated set of price-quantity pairs was obtained from offers made by Market Participants. An example of one of these hourly sets is provided below.

[6] The sole purpose of estimation is to determine the price threshold, not to estimate the entire supply curve. Provided that the supply curve outside the area estimated behaves in such a fashion that it does not affect the location of the price threshold, such areas are irrelevant to the task at hand.

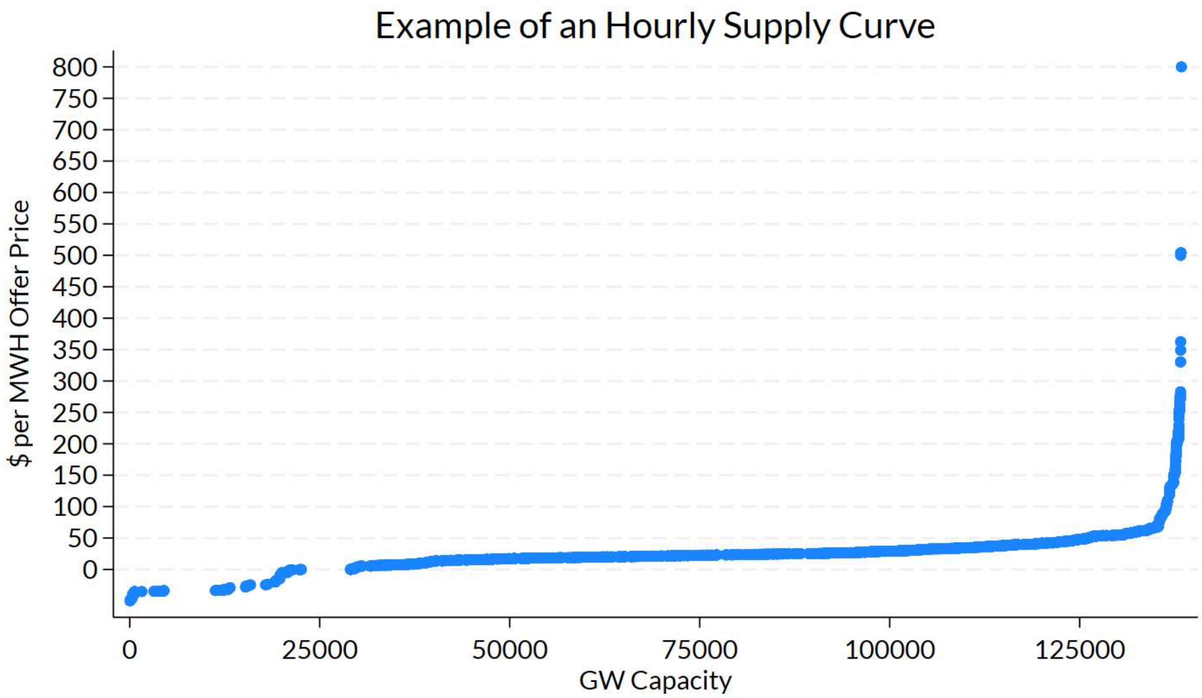
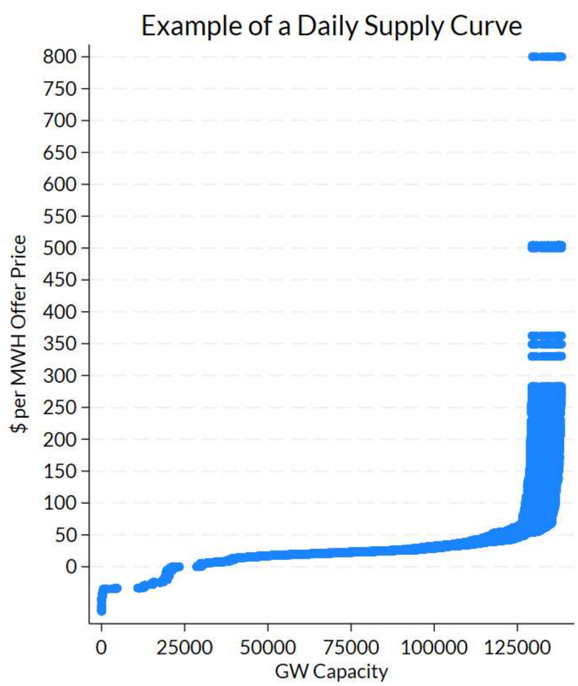
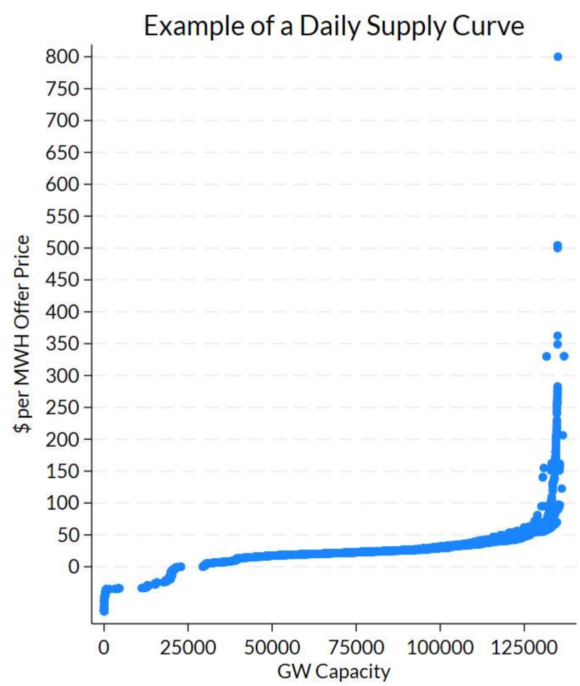


Figure 2

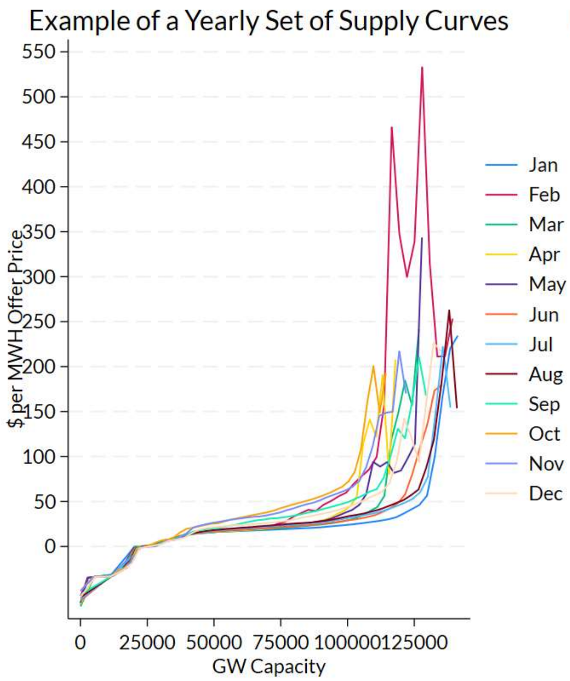
Hourly price-quantity pairs were then averaged up to the day to determine the daily price-quantity pairs used in the estimation procedures. Since none of the explanatory variables varied by hour, the variation in hourly supply pairs adds nothing to the analysis. An illustration of the hourly pairs for a single day and the resultant daily price-quantity pair average is shown below in Figures 3 and 4.

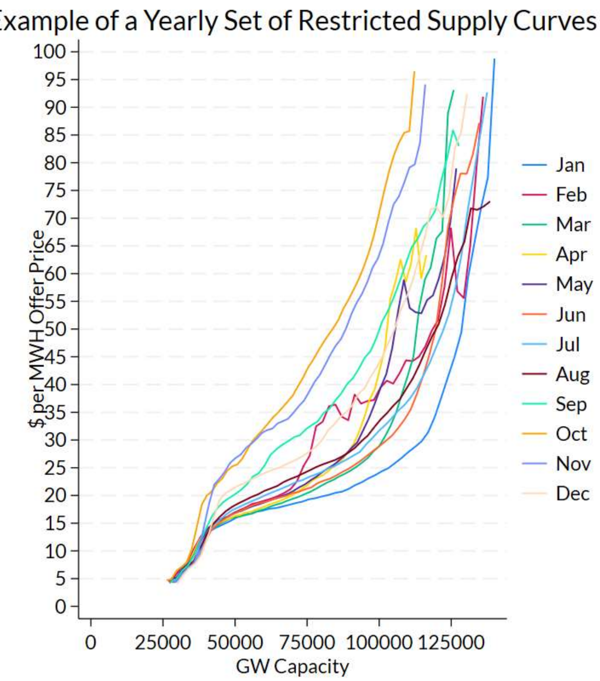




Figures 3 and 4

Figures 5 and 6 show two sets of smoothed yearly sets of supply curves. They are fitted using a non-parametric technique that makes easily visible what the yearly fit curve will approximately look like. They demonstrate the reason why month indicators are included in the regression model by showing how each month has such a different shape. It also shows why the price truncation needs to happen by showing how divergent prices become outside of the price range.





Figures 5 and 6

Four primary external variables were considered and analyzed; three of these are included in the final specification, the fourth, fuel oil prices, was excluded on the grounds that the associated parameter failed to meet the FERC ordered 95% statistical significance level.

- Daily natural gas prices, for Henry Hub
- Coal prices, for the Powder River region – this is chosen as it has more volatility than the Appalachian region and provides better statistical performance
- Fuel oil prices, for West Texas Intermediate, Cushing
- An outage index, to reflect seasonal availability of resources

All of the fuel price series are available from publicly available sources[7][8]. Each fuel price series is measured in dollars per MMBTU.

The outage proxy was defined by comparing the maximum quantity (MW) of resources available for each day with the maximum quantity of resources available for any day during that year. In other words, the outage proxy is an index, between 0 and 1.0, where 1.0 represents the day of maximum resource availability; smaller values represent lesser availabilities.

[7] Coal Markets (eia.gov)

[8] Henry Hub Natural Gas Spot Price (Dollars per Million Btu) (eia.gov)

Economics suggests that the expected relationship between each of the fuel price variables and the electricity price variable should be positive; that is, higher fuel prices should drive the price offers higher, all other factors being held constant. Similarly, economics suggests that the outage proxy and the electricity price variable should be negatively related; that is, higher amounts of available resources should result in lower price offers for any given quantity, all other factors equal.

1.5 Estimation

Estimation of the parameters of the average daily supply curve proceeded from the use of least-squares regression analysis. The specific form of the estimation is:

$$P = NGAS^{\beta_1} \cdot COAL^{\beta_2} \cdot OUTAGE^{\beta_3} \cdot exp^{\left(\alpha+\gamma Q^* + \delta Q^{*2} + \theta Q^{*3} + \sum_1^{11} D_i\left(\alpha_i + \gamma_i Q^* + \delta_i Q^{*2} + \theta_i Q^{*3}\right) + \varepsilon\right)}$$

- P = Price of electricity ($/MWh)
- NGAS = Price of natural gas ($/MMBTU)
- COAL = Price of coal ($/MMBTU)
- OUTAGE = Availability Index
- Q = Quantity of electricity offered (MW)
- D_i = Binary indicator variables
- α, γ, δ, θ = Parameters estimated (48)
- β = Parameters estimated (3)
- ε = Stochastic error
- Q^* = $Q - \bar{Q}$ The collinear correction

Note that the estimation described above was achieved using monthly binary indicator variables, with January excluded as the base.[9] In other words, the specification allowed each month to have a unique supply curve shape, but our approach also allowed us to examine whether a unique shape for any given month was statistically supportable.

The equation was estimated using daily data for each day in 2021, for a total of 365 daily supply curves and a total of 890,687 observations.

This formulation allowed for a consistent set of fuel price elasticities throughout the year, while the specific shape of the curve, as determined by the exponential cubic parameters, is month-specific.[10] Parameters that failed to meet the 95% confidence level criteria were excluded from the final regression.

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[9] The choice of base month is based on the month with the greatest number of observations. One month must be excluded for econometric reasons. Any month with 31 days will suffice.

[10] Analysis of each month separately showed that consistent fuel price elasticity for both natural gas and coal was a reasonable assumption.

The collinear correction factor is a technique to correct for collinearity. In the case of the cubic function, the specific collinear correction is a mean centering one. Each quantity value, Q, has the mean value of $Q, \bar{Q},$ subtracted from it. Therefore, Q^*, may be positive or negative, ${Q^*}^2$, will be strictly positive, and ${Q^*}^3$, will be positive or negative, which significantly reduces the collinearity of the three variables. This also leaves the estimated results unchanged, satisfying the criteria of providing a correction without altering the model.

1.6 Analysis

From a statistical sense, results of our analysis showed convincing evidence that the functional form selected was an excellent representation of the daily offer pairs. Both the overall goodness of fit, adjusted R-squared and F-statistic, as well as the individual variables t-tests results, showed statistical significance at or above the 95% confidence level. As a result, our price threshold estimates can be relied upon to be accurate estimates of the desired point on the aggregate supply curve, where the elasticity becomes, and remains, less than one in absolute value.

From a broader perspective of generally reasonable results, the specified functional form makes sense. The coefficients on the fuel price and outage variables have the expected signs and are of reasonable magnitudes; the monthly supply curves derived from the analysis appear to be reasonable representations of expected supply curves for electricity in an ISO market.

The estimated elasticities for the three external variables are shown below:

- Coal Prices +0.023
- Natural Gas Prices +0.324
- Outage Index -2.315

Note that these elasticities are not typical demand elasticities, i.e., the relationship between a given percentage change in price and the resultant percentage change in quantity demanded, but rather describe the relationship between a given percentage change in fuel price (e.g. coal) and the associated percentage change in the price of electricity. For example, a 10% increase in the price of natural gas will result in an increase in offer prices of roughly 3.2%, all other things being equal.

Complete statistical results for the final estimated equation are provided in the Appendix A.

The table (below) provides the price thresholds estimated by the analysis based on historical data for 2021, as well as the major inputs used in the supply curve determination for each month. For the three input variables shown below, the average of the historical data for each month was used. The procedure used to determine the values shown in the table was:[11]

[11] The process of determining the price threshold is described in greater detail in Appendix A.

1. Use the estimated parameters of the equation to solve for the monthly mean adjusted quantity, Q^*, where the supply curve becomes inelastic, that is, becomes 1.0 or less for all greater quantities;
2. Insert this quantity result, Q^* into the estimated equation, along with the historical average values for the outage index, the price of coal, and the price of natural gas to determine the price threshold.

2021 – Historical Data				
Month	**Outage Index**	**Coal Price**	**Natural Gas Price**	**Estimated Price Threshold ($/MWh)**
January	0.9662	$0.649	$2.61	**$37.16**
February	0.9193	$0.656	$5.38	**$48.50**
March	0.8508	$0.678	$2.56	**$32.56**
April	0.7824	$0.684	$2.58	**$35.34**
May	0.8285	$0.684	$2.88	**$40.37**
June	0.9167	$0.681	$3.19	**$37.03**
July	0.9562	$0.676	$3.80	**$40.37**
August	0.9588	$0.678	$4.02	**$42.78**
September	0.8682	$0.753	$5.02	**$54.91**
October	0.7783	$0.759	$5.49	**$64.44**
November	0.8167	$1.40	$5.04	**$63.78**
December	0.8966	$1.72	$3.72	**$51.53**

Table 1-1

In addition to determining the historical price thresholds based on actual historical data shown above, forecasts were prepared of the monthly price thresholds for the period January 2021 through Dec 2021. In preparing these forecasts, the same procedures were employed that are expected to be used in preparing such forecasts on an on-going basis. For example, for fuel prices, publicly available forward futures prices were obtained. Historical monthly average values (for the same month in the prior year) were input for the outage variable.[12]

[12] For purposes of determining price thresholds that will be applied in the market, then-currently available information regarding existing and planned outages will be incorporated into the projected value of the outage index.

The table below shows the input values and the resultant price thresholds projected for the first 10 months of 2023:

Month	Outage Index	Coal Price	Natural Gas Price	Price Threshold ($/MWh)
January	0.832	$ 0.880	$ 6.74	**$ 71.96**
February	0.815	$ 0.878	$ 3.99	**$ 58.57**
March	0.778	$ 0.860	$ 2.47	**$ 39.81**
April	0.727	$ 0.847	$ 2.81	**$ 43.28**
May	0.758	$ 0.869	$ 2.10	**$ 45.01**
June	0.874	$ 0.824	$ 2.21	**$ 36.88**
July	0.914	$ 0.816	$ 2.16	**$ 37.48**
August	0.898	$ 0.813	$ 2.70	**$ 43.94**
September	0.851	$ 0.813	$ 2.56	**$ 46.32**
October	0.772	$ 0.827	$ 2.77	**$ 52.70**

Table 1-2

The estimated price thresholds shown in Table 1-2 are lower than those estimated for 2021, a result that is traceable to the significant decline in natural gas prices that has occurred. As would be expected from an examination of the estimated parameters of the supply equation, a decline in natural gas prices should reduce supply curve prices. A decline in coal prices is also evident, although such prices have a smaller impact on the supply curve when compared with natural gas prices. The combined effect of declining fuel prices reduces the price threshold, as can be seen by comparing Table 1-1 and Table 1-2.

2 Appendix A

2.1 Price Threshold Determination

As described in Order No. 745 ¶80, the desired price threshold can be located by finding the price-quantity location where the supply curve becomes inelastic for all greater quantities. Price elasticity of supply is described by the following equation:

$$Price\ Elasticity\ of\ Supply = \eta = \frac{dQ^*}{dp} \cdot \frac{p}{Q^*}$$

Given the specification of our estimated equation, price elasticity of supply becomes:

$$\eta = \left({}^{1}\!\Big/\!\frac{dp}{dQ^*} \right) \cdot \frac{p}{Q^*} = {}^{1}\!\Big/\!\left(\gamma_i Q^* + 2\delta_i {Q^*}^2 + 3\theta_i {Q^*}^3\right) = 1$$

where the subscript, *i*, references the particular month at issue. This equation is set equal to one (1.0) and solved for Q^*, taking care to note that there will be 3 solutions, of which two may be complex valued.[13] The largest real component of these Q^* solutions is to be used. Once the appropriate Q^* has been determined, that value is input to the estimated equation to determine the corresponding price, p, which is the price threshold associated with the mean corrected quantity at which the supply curve becomes inelastic.

2.2 Statistical Results

Shown below are the statistical results as obtained from the computer software program $\mathrm{STATA}^{©}$, which was used to estimate the final equation and solve the elasticity problem. To linearize what is a non-linear problem the natural log is taken of each side of the equation. This makes the estimated equation linear in the estimated parameters but leaves unchanged their interpretation described above.

Notation:

$\mathrm{D_i}$ = Binary indicator variable, set = 1 for each day in month *i*, 0 otherwise

GW = Aggregated quantity offered at the given price

COAL = price of coal ($/MMBTU)

GAS = price of natural gas ($/MMBTU)

OUTAGE = outage index

LOG = natural logarithm

2.2.1 Parameter Examples:

The estimated equation for January would be:

$$\hat{P} = NGAS^{0.324} \cdot COAL^{0.023} \cdot OUTAGE^{-2.315} \cdot exp^{(2.711+6.79e^{-6}Q-2.77e^{-10}Q^2+6.91e^{-15}Q^3)}$$

For January, all of the included monthly binary indicator variables are equal to zero (0).

The estimated equation for February would be:

$$\hat{P} = NGAS^{0.324} \cdot COAL^{0.023} \cdot OUTAGE^{-2.315} \cdot exp^{(2.711-0.047+6.79+2.68e^{-6}e^{-6}Q-2.77e^{-10}+7.05\ ^{-11}Q^2+6.91e^{-15}+3.77e^{-1}\ Q^3)}$$

[13] This is due to the Fundamental Theorem of Algebra.

For February, the monthly binary indicator variable for February is equal to one (1), while all other monthly indicator variables are equal to zero (0). The parameters of the exponential cubic portion of the function become equal to the sum of each base value plus the associated specific value for February. As an example, for the constant parameter the estimated value becomes:

$$2.711 + 0.047 = 2.758$$

2.2.2 Price Threshold Calculation Example:

The price threshold calculation for January, as an example, would begin by finding the largest real component to the mean adjusted quantity, Q^*, that satisfies the following equation:

$$\frac{1}{\left(0.6.79e^{-6}\, Q^* + (2 \cdot\ 2.77e^{-10})\, Q_i^{*2} + (3 \cdot\ 6.91e^{-15})\, Q_i^{*\,3}\right)} = 1$$

The largest real-part of the solutions to this equation is Q = 121.49 GW.

Finally, use the estimated equation with the Q^* value, and the appropriate values for the price of natural gas, the price of coal, and the outage index, to determine the price threshold. Using the historical averages for January 2021, the result is $33.39, shown in Table 1-1. Please note that the centered Q value must be used when calculating the elasticity. The Q shown after the equation is the uncentered version.

3 Appendix B (2023 Parameter Estimates)

log_price	Coefficient	std. err.	t	P>t	[95% conf. interval]
LN Henry Hub Gas	0.324259	0.003344	96.98	0	.3177055 .3308117
LN Powder River Coal	0.023063	0.001105	20.87	0	.0208967 .0252285
LN Outage	-2.315	0.005558	-416.5	0	-2.325893 -2.304105
month					
Jan	2.711217	0.003131	865.95	0	2.705081 2.717354
Feb	0.046743	0.00173	27.02	0	.0433524 .0501342
Mar	-0.27591	0.000982	-280.92	0	-0.2778368 -0.2739867
Apr	-0.44462	0.001419	-313.34	0	-0.4474023 -0.4418399
May	-0.21365	0.001255	-170.2	0	-0.2161115 -0.211191
Jun	-0.04844	0.000955	-50.75	0	-0.0503069 -0.0465653
Jul	0.118094	0.001392	84.83	0	.1153658 .1208226
Aug	0.162484	0.001585	102.54	0	.1593785 .1655901
Sep	0.086409	0.002378	36.34	0	.0817492 .0910694
Oct	-0.0466	0.002766	-16.85	0	-0.0520248 -0.041181
Nov	0.073142	0.002712	26.97	0	.0678258 .0784572
Dec	0.155538	0.002006	77.54	0	.151607 .1594699
Month * Q^*					
Jan	6.79E-06	3.25E-08	208.97	0	6.73e-06 6.85e-06
Feb	7.64E-06	9.73E-08	78.44	0	7.45e-06 7.83e-06
Mar	2.68E-06	5.46E-08	49.08	0	2.57e-06 2.79e-06
Apr	6.60E-06	7.18E-08	92.03	0	6.46e-06 6.74e-06
May	8.82E-06	6.88E-08	128.15	0	8.69e-06 8.96e-06
Jun	3.18E-06	5.01E-08	63.47	0	3.08e-06 3.28e-06
Jul	2.56E-06	4.61E-08	55.49	0	2.47e-06 2.65e-06
Aug	3.34E-06	4.88E-08	68.39	0	3.24e-06 3.43e-06
Sep	5.75E-06	5.08E-08	113.13	0	5.65e-06 5.84e-06
Oct	6.16E-06	5.74E-08	107.39	0	6.05e-06 6.28e-06
Nov	5.22E-06	6.42E-08	81.42	0	5.10e-06 5.35e-06
Dec	5.47E-06	6.12E-08	89.32	0	5.35e-06 5.59e-06
Month * ${Q^*}^2$					
Jan	2.77E-10	7.90E-13	350.08	0	2.75e-10 2.78e-10
Feb	7.05E-11	1.52E-12	46.5	0	6.75e-11 7.35e-11
Mar	3.31E-10	1.29E-12	256.96	0	3.28e-10 3.33e-10
Apr	3.51E-10	2.18E-12	160.68	0	3.47e-10 3.55e-10
May	1.52E-10	1.04E-12	146.09	0	1.49e-10 1.54e-10
Jun	3.13E-10	9.06E-13	345.6	0	3.11e-10 3.15e-10
Jul	1.77E-10	6.31E-13	280.55	0	1.76e-10 1.78e-10
Aug	1.38E-10	6.39E-13	216.75	0	1.37e-10 1.40e-10

Sep	4.70E-11	7.76E-13	60.53	0	4.54e-11 4.85e-11
Oct	1.90E-11	1.05E-12	18.09	0	1.69e-11 2.10e-11
Nov	6.96E-11	1.10E-12	63.5	0	6.75e-11 7.18e-11
Dec	1.55E-10	9.31E-13	166.6	0	1.53e-10 1.57e-10
Month * Q^{*3}					
Jan	6.91E-15	2.41E-17	286.37	0	6.86e-15 6.96e-15
Feb	3.77E-15	5.96E-17	63.18	0	3.65e-15 3.88e-15
Mar	1.01E-14	4.74E-17	212.24	0	9.96e-15 1.01e-14
Apr	1.17E-14	8.74E-17	134.21	0	1.16e-14 1.19e-14
May	5.21E-15	5.05E-17	103.28	0	5.11e-15 5.31e-15
Jun	8.17E-15	3.16E-17	258.87	0	8.11e-15 8.24e-15
Jul	6.02E-15	2.56E-17	235.2	0	5.97e-15 6.07e-15
Aug	5.33E-15	2.73E-17	195.31	0	5.27e-15 5.38e-15
Sep	6.83E-15	3.84E-17	178.08	0	6.76e-15 6.91e-15
Oct	1.14E-14	5.80E-17	195.7	0	1.12e-14 1.15e-14
Nov	1.10E-14	6.92E-17	158.24	0	1.08e-14 1.11e-14
Dec	7.22E-15	4.74E-17	152.23	0	7.13e-15 7.31e-15