Alternative Approaches to PRICING COAL TRANSPORTATION SERVICES

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Capacity factors for coal plants nationwide have seen significant declines since the boom in shale natural gas production, with increased development of renewables also playing a role. Lower coal plant capacity factors have created challenges not only for coal-fired generators, but also for coal producers and railroads that ship coal. Lower coal plant capacity factors are not the only issue driven by lower power prices. The month-to-month, or even week-to-week, volatility in the demand for coal at many power plants makes managing coal supply and coal transportation contracts a significant challenge. This article discusses alternative approaches to pricing coal transportation services. These approaches address the challenges faced by railroads and coal-fired generators.

Historically, pricing in rail transportation contracts has been based on a rate per ton that is escalated through time. These contracts typically included performance guarantees and penalties for contract tonnage requirements not shipped. Rail transportation contracts

with these terms work fine when coal plants are dispatching at about 70% to 85% of their capacity annually and coal burn volumes are consistent and easy to forecast. In the current coal transportation market, with annual coal plant capacity factors for many plants ranging from 50% to 70%, rail transportation contracts with one rate per ton for all tons and strict contract tonnage requirements do not meet the needs of coal-fired generators who want to be able to maximize dispatch and manage coal supply risk.

Prior to the current coal transportation market, there was a period of time where railroads and coal-fired generators were waiting to see if natural gas prices would remain at historic lows before looking for new ways to price rail services. If natural gas prices increased back to historic levels, power prices would increase in kind, coal plants would have higher capacity factors and neither the railroads nor coal-fired generators would need to find new ways to price coal transportation via rail. It would be business as usual… however, this has not happened. Given today's electric generating market and the sustained low prices of natural gas, it is long past due for coal-fired generators and railroads to explore new ways of structuring rail transportation contracts so that plant dispatch can be optimized, thus creating more value for both the railroad and the shipper.

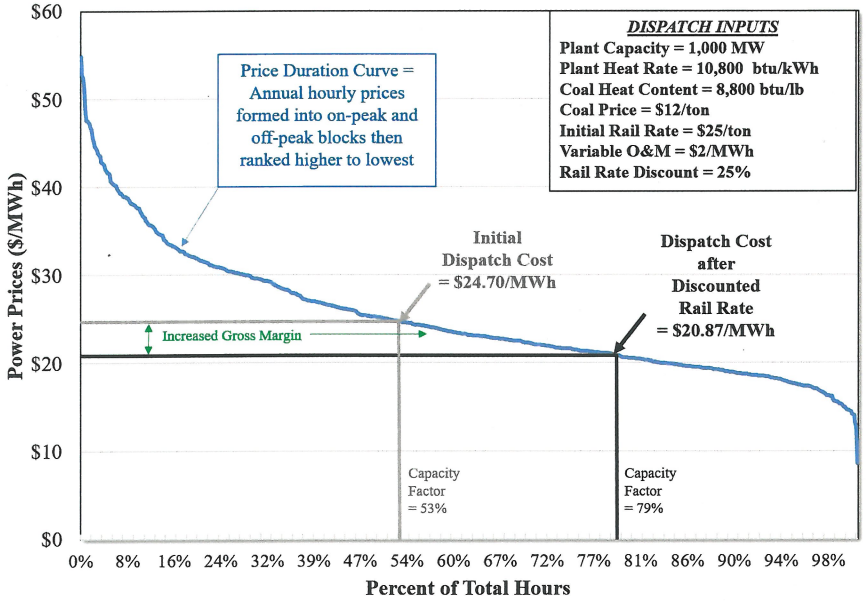
Lower Rail Rates Generate More Combined Margin

Before we explore ways to price transportation services that creates value for both railroads and coal-fired generators, we must first discuss the impact dispatch costs have on optimizing value. In order for a coal-fired generator to turn its plant on, it must be assured that it will be able to recover its variable cost of producing electricity. These variable costs include the cost of coal, the cost to transport coal, the cost of variable operating and maintenance costs and the costs related to environmental controls and allowances. The lower the plant's variable, or dispatch costs the more the plant will dispatch. The cost of rail transportation is usually the largest component of a plant's dispatch costs. For example, a Midwestern plant that burns coal from the Powder River Basin, WY may pay $12/ton for coal and $25/ton for rail transportation. These prices, when expressed on a $/MWh basis translate to $7.36/MWh and $15.34/MWh, respectively, assuming a coal heat content of 8,800 btu/lb. and a plant heat rate of 10,800 btu/lb. Add in $1.50/MWh for variable operating and maintenance expense and $0.50/MWh for environment control costs, and the plant's dispatch cost is $24.70/MWh. Rail transportation then is roughly two-thirds of the total dispatch cost of the plant.

Chart No. 1 demonstrates that lowering a plant's rail transportation rates, which in turn lowers a plant's dispatch costs, can lead to increased generation and more gross margin that the generator and railroad can share. Gross margin is defined as revenues realized from operating a plant minus the variable costs incurred with operating a plant. A common way to measure increased value, or gross margin from lower dispatch costs is with the use of a monte carlo dispatch model, or real option valuation, which simulates a plant's dispatch considering a range of possible power prices. A simpler way to demonstrate increased value from lower dispatch costs is with a price duration curve, which is a tool that allows for a quick estimation for how much a power plant will dispatch against a set of power prices. A price duration curve is developed by sorting power prices for a certain period from largest to smallest and plotting these prices against a factor of volume.

Chart No. 1 also demonstrates, through a hypothetical coal plant, how gross margin increases when dispatch costs are lowered assuming a discounted rail rate, compared to the same annual

Chart No.1 - Impact of Lowering Dispatch Costs on Plant Generation



price duration curve discussed above. The price duration curve in the chart reflects hourly prices for a year formed into on-peak and off-peak price blocks, which are then sorted from highest to lowest.

As shown in Chart No. 1, a 25% discount in the rail rate moves the plant's capacity factor from 53% to 79% in the hypothetical example. Obviously, it is no surprise that lowering a plant's dispatch cost results in more generation. The important thing to determine is how the change in gross margin, both to the generators and the railroad, from lower dispatch costs resulted in increased margin to both parties due to the discounted rail rate. Table No. 1 shows the economics behind this upward shift in generation shown in Chart No. 1.

As can be seen in Table No. 1, lowering the transportation rate results in a higher dispatch rate for the plant and a higher overall combined margin for both generators and railroads. Specifically, the increase in capacity factor shown in Chart No. 1 appears in Line 3 of Table No. 1. This increase in capacity factor translates to an increase in the generator's gross margin of $22.2 million (Line 4 from Table No. 1). However, the railroad's margin decreases by $10.8 million (Line 8 in Table No. 1) as a result of lowering the transportation rate. So, after the railroad is made whole on its margin, there is $11.3 million in additional margin for the generator and the railroad to share (Line 9 in Table No. 1).

The question then becomes, how to share the additional margin generated from lower rail rates. The answer is to develop a pricing mechanism that lowers a plant's dispatch cost but fairly compensates both the generator and the railroad. L. E. Peabody & Associates, Inc. proposes two (2) rail transportation pricing approaches that allow for the equitable sharing of value between generators and railroads.

Approach 1: Tying Rail Rates to Power Prices

The first approach involves tying rail rates to the power prices realized by a coal-fired plant. This approach can be used in an organized market where an independent system operator ("ISO") clears supply offers and demand bids by location in a day-ahead market to create prices commonly referred to as locational marginal prices ("LMP"). The plant's LMP is the most accurate measure for representing the price at which the plant is compensated for its production.

Tying rail rates to natural gas prices, a concept that has been tossed around, is much less efficient than tying rail rates to LMP's because an LMP already reflects the impact of natural gas prices. That is, a plant's LMP factors in the competitive offers from other plants, including natural gas plants, that are able to move power toward loads. Also, LMP's include the impact on the price of transmission flows to and from the plant. The idea of tying rail rates to power prices allows for rail rates to vary with power prices. Under this approach, when power prices for a coal-fired plant are lower than expected, rail rates are discounted so that the plant can dispatch more than it otherwise would under a single transportation rate for all tons. When power prices for a coal-fired generator are higher than expected, rail rates include a premium, which is affordable to a generator because they are realizing a higher than expected gross margin.

Pricing for this approach requires setting a range (or schedule) of rail rates to a range (or schedule) of power prices. Table No. 2 shows a hypothetical example of a rail rate/power price schedule following the pricing approach described.

Table No. 1 - Summary of Increased Combined Margin from Lowering Dispatch Costs

Item	No Rail Discount	Rail Discount	Difference[1]
GENERATOR'S GROSS MARGIN			
Tons Burned (millions)	2.84	4.27	1.42
Electricity Produced (millions of MWh's)	4.63	6.95	2.32
Plant Capacity Factor	53%	79%	26%
Gross Margin (millions)	$33.1	$55.2	$22.2
RAILROAD'S MARGIN			
Tons Shipped (millions)	2.84	4.27	1.42
Revenues (millions)	$71.1	$80.0	$8.9
Variable Costs (millions)[2]	$39.5	$59.3	$19.8
Margin (millions)[3]	$31.6	$20.7	($10.8)
Combined Margin (millions)[4]			$11.3

[1]Rail Discount Case minus No Rail Discount Case.
[2]No Rail Discount Case assumes rail rate is set at 180% of variable costs. Rail Discount Case reflects variable cost per ton implied by No Rail Discount Case.
[3]Revenues minus Variable Costs.
[4]Generator's Gross Margin Difference plus Railroad's Margin Difference.

Table No. 2 - Hypothetical Rail Rate/Power Price Schedule

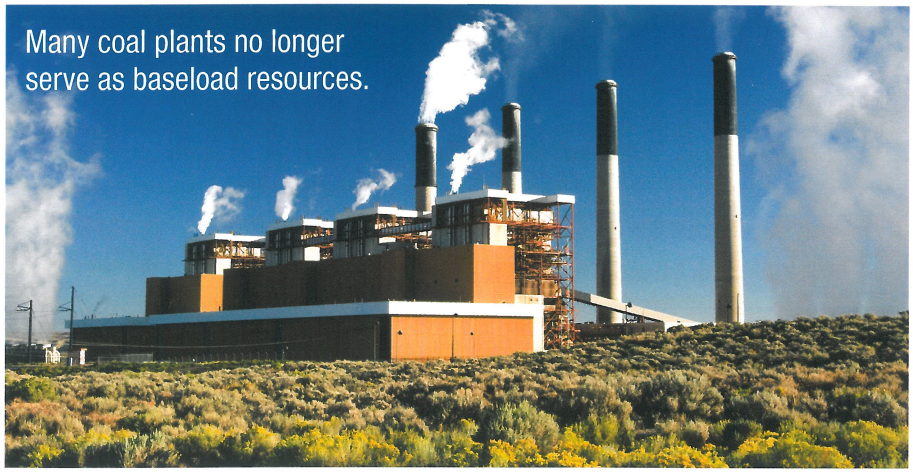
LMP ($/MWh)	Corresponding Transportation Rate ($/Ton)
<$20	$18.75
$20 to $23	$20.83
$23 to $25	$22.92
$25 to $26	$25.00
$26 to $28	$27.08
$28 to $30	$27.08
>$30	$31.25

Tying rail rates per ton to power prices per MWh requires the plant's heat rate and the expected heat content of the coal being delivered to be tied into the rail transportation rate calculation. The rail rate/power price schedules can be calculated monthly or annually. A dispatch cost based on the lowest rail rate in the rail rate/power price schedule would reflect the lowest cost a generator would be willing to offer into an ISO's day-ahead market. A generator's offer into a day-ahead market would need to consider this lowest rail rate in the schedule. When a generator's offer is accepted for a given day, that day's LMP, using the rail rate/power price schedule, determines the rail rate to be charged for deliveries that equal that day's coal burn. This daily process in continued for a month, at which point the generator is invoiced for the quantity of coal delivered that month based on rail rates determined by the actual daily LMP's for the month. This approach requires monthly or quarterly true-ups for

differences between tonnages delivered and tonnages actually burned for a month.

Approach 2: Fixed Demand Charge with Variable Service Charge

The second approach involves dividing rail rates into a fixed demand charge and a variable service charge. Projecting coal burns for a plant has become more difficult because the volume of coal needed for a given month in today's market is much more uncertain now than it was when coal plants had high baseload capacity factors. Many coal plants now operate as intermediate resources rather than baseload resources. In fact, many coal plants today have capacity factors similar to capacity factors for natural gas combined-cycle plants prior to the decline in natural gas prices. The way natural gas pipelines deal with volume uncertainty for intermediate combined-cycle plants is to charge generators a fixed demand charge that gives generators the right to schedule natural gas deliveries at a variable energy charge.



Railroads could adopt a similar approach and price in the same manner as natural gas pipelines. They could charge a fixed demand charge that allows a generator to call, or schedule a varying number of trains monthly at a variable service charge. This approach would allow railroads to recover fixed costs regardless of tonnages shipped. This approach also allows a generator to "sink" a fixed demand charge as a fixed cost and reduce its variable rail charge within its dispatch cost calculation. The resulting lower dispatch cost will allow the plant to dispatch more, increasing net revenues, which recovers the fixed transportation demand charge and more. The railroad increases its net revenues by charging the generator, within its fixed demand charge, for the right, or option to vary its number of scheduled trains within a month. This approach works as essentially a call option for rail service.

We are currently working on both rail transportation pricing options with clients and expect that alternative rail rate pricing structures like these will become more common in the future. ▲

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