UNITED STATES DISTRICT COURT
FOR THE EASTERN DISTRICT OF VIRGINIA
RICHMOND DIVISION

Federal Energy Regulatory Commission,

Plaintiff,

v. **Civil Action No. 3:15-cv-0452**

Powhatan Energy Fund, LLC,
Houlian "Alan" Chen,
HEEP Fund, Inc., and
CU Fund, Inc.

Defendants.

Expert Report
of
Cliff W. Hamal

May Contain Confidential Material

Subject to Protective Order

December 17, 2021

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I. INTRODUCTION

1. My name is Cliff Hamal, and I am a Senior Managing Director for Ankura Consulting. I am an economic consultant specializing in the electricity industry. I have been asked by Counsel for the Federal Energy Regulatory Commission (Commission or FERC) to provide my opinions on issues pertaining to the trading activities of Houlian "Alan" Chen in his trading of electricity products for Powhatan Energy Fund, LLC (Powhatan), HEEP Fund, Inc. (HEEP), and CU Fund, Inc. (CU Fund). The Commission found that Chen, Powhatan, HEEP and CU Fund engaged in manipulative Up-To-Congestion (UTC) transactions in the PJM Interconnection, L.L.C. (PJM) energy markets.[1]

2. The trades in question for all three entities were placed by Chen. Chen owned HEEP and CU Fund, and was engaged to trade UTC products for Powhatan under a contractual arrangement. Chen similarly traded UTC products for Huntrise Energy Fund, LLC (Huntrise), and TFS Capital, LLC (TFS Capital) under an arrangement that ended

[1] Order Assessing Civil Penalties, Houlian Chen, Powhatan Energy Fund, LLC, HEEP Fund, LLC, CU Fund, Inc., Docket IN15-3-000, May 29, 2015.

prior to any of the trades at issue in this case. Powhatan, Huntrise, and TFS Capital were owned by a very similar group of investors, with similar ownership shares, and managed by TFS Capital. In this report I refer to these entities collectively as the TFS Investors.[2]

3. UTC trades are financial trades involving the difference in prices for electricity between two locations on the electricity grid. A key part of the financial performance of the transaction involves how that price difference changes in the day-ahead market when the UTC trade is placed and in the real-time market the next day when the UTC trade is settled. The defendants engaged in paired trading of UTC transactions in opposite directions wherein the price changes offset each other. The Commission has found these "Round Trip Trades" to be manipulative. The three trading entities (Powhatan, HEEP and CU Fund) engaged in Round Trip Trades from June 1 through August 3, 2010 (the period defined by the Commission's Order as the Manipulation Period). As a result of these Round Trip Trades, these entities achieved profits of $4,718,895, which is composed of $3,465,220 for Powhatan, $173,100 for HEEP and $1,080,576 for CU Fund.

4. I have been asked by counsel for the Commission to review the UTC trades conducted by these parties, principally over the time period from August 1, 2008 through the Manipulation Period. My review includes the characteristics of the trades and how those evolved over time, leading to the Round Trip Trades. I specifically focus on the Round Trip Trades, the source of profits for those trades, and the market consequences of the trades:

    1. The characteristics of Powhatan's, HEEP's and CU Fund's Round Trip Trades are inconsistent with trades aimed at profiting from price spreads, and instead are consistent with trades primarily aimed at profiting from Marginal Loss Surplus Allocation (MLSA) payments; indeed, Round Trip Trades largely eliminate the potential for changes in price spreads to affect profitability.

    2. These Round Trip Trades caused harm. They led PJM to pay these entities over $10 million that would otherwise have gone to other market participants, including utilities. These Round Trip Trades also made the PJM market less efficient, resulting in increased costs for other market participants. Consumers of electricity within PJM, including homeowners and businesses, were harmed by this diversion of funds and increased inefficiencies because they ultimately bore the majority of the increased costs caused by the Round Trip Trades.

5. In this report I provide support for these opinions by first describing the electricity market and the provisions in the PJM Tariff[3] that created the opportunity for such trading and harm to occur. I then describe the trading conducted by the defendants in this matter, including the Round Trip Trades. In order to describe the evolution of the parties' trading

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[2] Individuals with significant financial interests in these entities, either directly or indirectly, include Kevin Gates, Richard Gates, Larry Eiben, Chao Chen, Eric Newman, Greg Sekelsky, Mike "Freddy" Frederick and Sam Harris.

[3] PJM Open Access Transmission Tariff, hereafter PJM Tariff. Docket ER10-2710-000.

activities, I reference three periods: the Initial Period (August 2008 through January 2010), the Transition Period (February 2010 through May 2010) and the Manipulation Period (June 1, 2010 to August 3, 2010). All of the Round Trip Trades took place in the Manipulation Period, concurrent with other trades.

6. Among the changes that occurred over time was the use of three different types of trades. One of these types is Round Trip Trades. The second category is Spread Trades, which are standard, or typical, UTC trades. In a Spread Trade a trader takes a UTC position between two points and profits if the spread value increases between the day-ahead market when it is purchased and the real-time market when the position is cleared (i.e., sold back to the market). The vast majority of Chen's trades in the Initial Period were Spread Trades. The third category is Correlated Trades. Correlated Trades involve paired trades, similar to Round Trip Trades, except they are not between identical node pairs in opposing directions. Depending on the circumstance, Correlated Trades can have characteristics similar to Spread Trades or to Round Trip Trades.

7. Chen and the TFS Investors became aware of the MLSA payments near the end of the Initial Period. The Transition Period is distinct because their trading began targeting the MLSA payments. This was accomplished using Correlated Trades during the Transition Period, and these trades continued at more modest levels in the Manipulation Period. The Commission has not alleged that the Correlated Trades were manipulative. Nevertheless, I find it useful to distinguish these trades in discussing changes in trading strategies that led to the use of Round Trip Trades in the Manipulation Period.

8. All of the trading in this analysis was done through four different entities. Chen was the primary owner of two of those entities, HEEP and CU Fund, and thus Chen traded with his own money in those accounts. Most of trades, however, were placed through two entities owned by the TFS Investors: Huntrise and Powhatan. Of these two, only Powhatan engaged in Round Trip trades. My analysis of trading data and other evidence supports the conclusion that the TFS Investors greatly increased their exposure to UTC trading coincident with a deliberate shift in strategy to target MLSA payments and this included the Round Trip Trades.

9. Following the narrative description of the evolution in trading strategies, I provide summary statistics on the Round Trip Trades. I then describe the market harm these trades caused. The harm includes the capturing of MLSA payments that would have otherwise gone to others and making the market less efficient by impeding trade.

10. There is no dispute that the Round Trip Trades targeted MLSA payments as a source of profits. I discuss specific aspects of Round Trip Trades that demonstrate this objective. There is an additional assertion that these trades were aimed at spread revenues that might be achieved under circumstances where one of the two sides, or legs, of the trade did not clear the market and the other side is exposed to spread value changes which could lead to either profits or losses. I evaluate this so-called "broken-leg" strategy. No leg of a Round Trip Trade ever broke in this manner and therefore such profits are merely hypothetical. Further, the Round Trip Trades were executed in a manner that reduces the chance of a leg breaking to minimize the chance of substantial losses that could result. I conclude that it would not have been economically rational for the Round

Trip Trades to have been placed with a primary purpose of targeting profits from broken-leg circumstances.

11. I reserve the right to supplement my opinions based on additional discovery that is conducted in this case, in response to any opinions provided by Defendants' experts, or as requested by counsel.

II. EXPERTISE

12. I graduated from the U.S. Merchant Marine Academy and have a Bachelor of Science degree with a double major. One of those majors was Marine Engineering, which is the study of power systems, or power plants, as they pertain to the operation of ships. As part of my study, I received an Engineer's license from the U.S. Coast Guard. The other major was Marine Transportation, which involves other operations of merchant ships and led to my receiving a Mate's license.

13. I spent the first decade of my career as an engineer working on technical issues associated with power systems. This included working on six cargo ships and then as an engineer for General Electric and Westinghouse. At General Electric, I worked at a nuclear power station owned by the Department of Energy, which was used in the testing and training of U.S. Naval nuclear personnel. I ultimately received qualifications as an Engineer Officer of the Watch and as a Nuclear Plant Engineer. I then worked as an engineering operator of the D1G nuclear power plant and also as an instructor to Navy personnel in nuclear power plant operations.

14. After roughly three years, I took a position with Westinghouse in Pittsburgh in its commercial nuclear power division. I received a Nuclear Regulatory Commission certification as a Senior Reactor Operator, and then taught nuclear operations to commercial operators from around the world. Among other things, I specialized in dealing with the most severe nuclear accidents. I then became a Project Engineer at Westinghouse, where I was responsible for supporting the full range of services Westinghouse provided to three commercial nuclear power generators in Wisconsin.

15. While at Westinghouse I received a Master of Science degree in Industrial Administration from Carnegie Mellon University (CMU). The degree had a heavy focus on quantitative analysis. I focused on economics, and roughly two-thirds of my courses concerned either economics, finance, or accounting. This program has evolved since I graduated and CMU now confers graduates of the program with a Master of Business Administration degree.

16. Upon graduation from CMU, I made the professional transition to economic consulting. I was initially hired by Putnam, Hayes and Bartlett, and immediately began working on engagements that involved the economics of the electricity industry and electricity markets. Other firms I have worked for include LECG for fifteen years, Navigant Consulting for eight years, and a short period for JFG Associates and The Tesla Group (which I founded). I joined Ankura Consulting as a Senior Managing Director in August of 2018 when Ankura acquired the Navigant business unit in which I worked. Virtually all of my work throughout this period involved the economics of the electricity industry.

17. I have considerable experience in evaluating and predicting electric system operations. In many cases this involves using computer models to develop hourly projections of which generators will be operating in every hour for years into the future. Critical issues in these analyses include how electric generators are able to run in response to changing demand and how the transmission system may limit the ability to use the lowest-cost generators for supply. This work is often used to develop market price

forecasts. The issues involved in market price forecasting are directly related to changes in prices that are central to the issues in this case. This work can also be used to make decisions about investments, among other things.

18. I also have extensive experience evaluating the performance of entities in the electricity marketplace. For example, I was involved in evaluating the performance of generation-owning companies in California and claims that their actions contributed to the many power outages associated with the California electricity market crisis of 2000-2001. More recently, I have evaluated how changes in market rules and the expansion of independent system operators in the marketplace have allowed sellers of electricity and financial traders to sell power across broader geographic regions over time. I have evaluated whether companies have market power, which is associated with the ability to raise prices above competitive levels due to having a large market share. I filed an expert report in the Coaltrain v. FERC matter on issues similar to this case and expect to testify in that case at trial.

19. I have been involved in the design of electric power markets and establishing the rules under which they operate. This work most recently has focused on the evolution of market features that are meant to provide sufficient funds to incent new generation construction when needed, while not imposing excessive costs on consumers. I have been involved in related projects pertaining to the development of markets to ensure that individual generators are incentivized to keep the overall system reliable. On other occasions I have worked on market rules associated with importing electricity across regions to promote trade.

20. I also have been involved in the evaluation of long-term power contracts, providing economic analysis related to disputed interpretations of such contracts, and valuing them. As part of this work, I have reviewed hundreds of electricity power contracts.

21. My clients have been firms from across the industry, including traditional regulated utilities, unregulated electric power generating companies, electric power cooperatives, electricity traders, suppliers of equipment and fuel to the industry, and financial entities such as Standard & Poor's. I have also worked for government agencies in the United States and Canada, including state regulators and the United States Department of Justice.

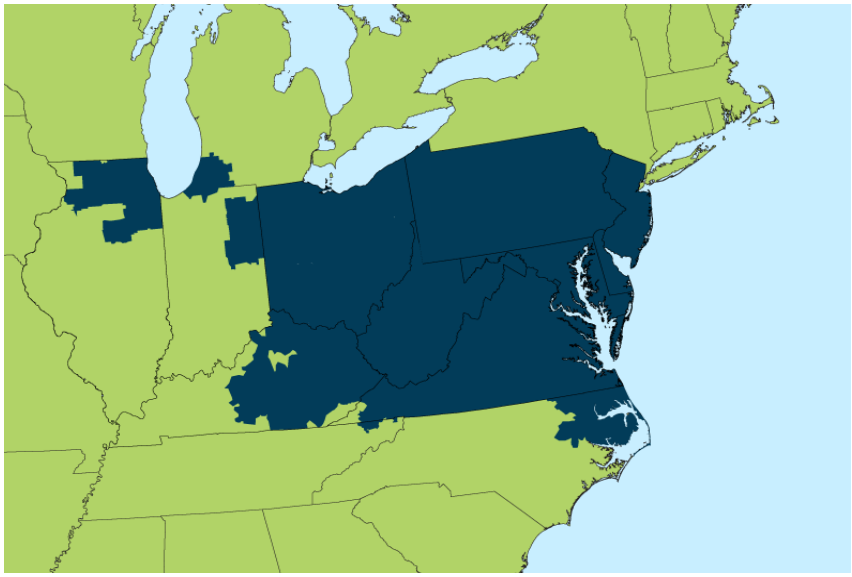
22. My work often involves testimony. I have provided written and live testimony in more than forty proceedings, including in courts, regulatory proceedings, and arbitrations. Within the past four years I have provided deposition testimony in the matter of FERC v. Coaltrain Energy, L.P., et al, on December 11, 2019, and expert reports on September 19 and November 18, 2019. My curriculum vitae is attached as Exhibit 1 and provides additional detail on my background and testimony experience, including my publications during the past ten years. My firm charges $675 per hour for my work on this case.

23. In forming my opinions in this matter, I draw upon my education and experience, and am informed by the facts in this case. Attached as Exhibit 2 is a list of documents that I have considered in providing my opinions. Where my analysis is based on specific facts, I cite them in my report and workpapers.

III. ELECTRICITY MARKETS AND ELECTRICITY TRADING

24. This case involves the trading of electricity products in PJM. PJM is a non-profit membership organization responsible for operating the electricity system in an area that includes portions of 13 states. PJM is regulated by FERC. PJM's responsibilities include ensuring that the system operates reliably, and that rates (prices) are just and reasonable.[4]

Figure 1
Service Territory of PJM Interconnection, LLC



25. PJM seeks to ensure the reliable operation of the system and procurement of adequate amounts of electricity by (among other things) operating a wholesale electricity market. That market sends price signals to generators and customers (i.e., load) that keep the system in balance.

26. Electricity products in the wholesale markets are measured in megawatt-hours (MWh). One MWh equals a million watt-hours. A typical incandescent light bulb uses 60 watts, or 60 watt-hours if turned on for an hour. That bulb would have to burn for around two years to equal one MWh. The average house in the U.S. uses around 10 MWh in a year.[5] The average wholesale price of electricity paid to generators in PJM during 2010 was $48.35/MWh.[6] For further perspective, the peak hourly demand for electricity (or

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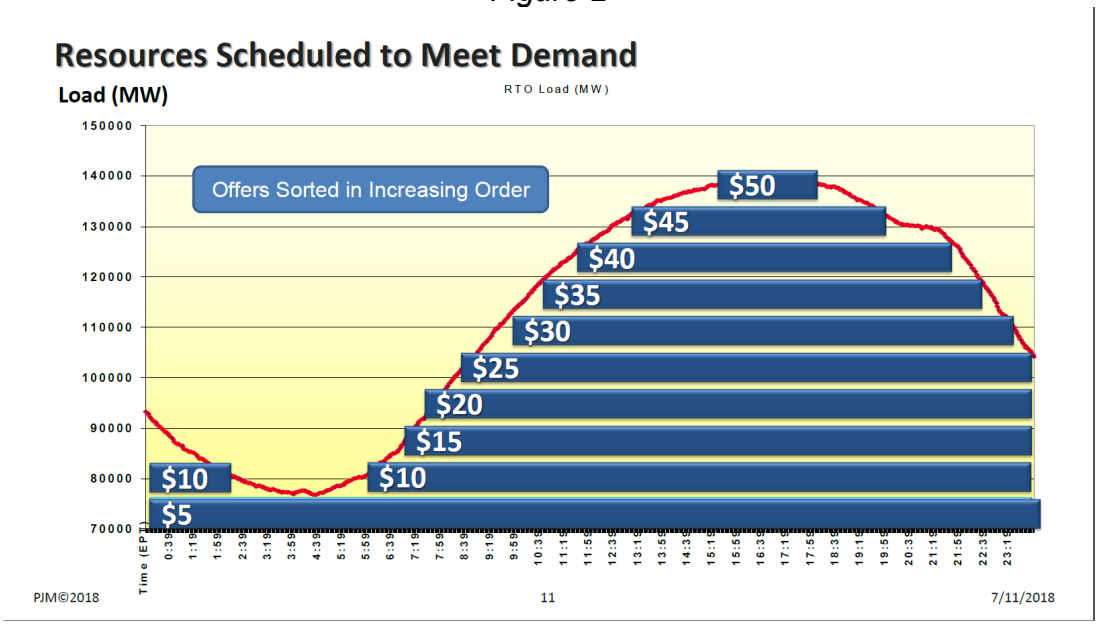
[4] Unless otherwise stated, the description of the PJM electricity market, PJM Tariff, and the process for placing UTC trades are as they existed in the summer of 2010.
[5] U.S. Energy Information Agency, "How much electricity does an American home use?", http://www.eia.gov/tools/faqs/faq.php?id=97&t=3
[6] 2010 State of the Market Report for PJM, Monitoring Analytics, Independent Market Monitor for PJM, Volume 1, section 2, Energy Market, Part 1, March 20, 2011, p. 11. ("2010 PJM IMM State of the Market Report").

load) in PJM was 136,465 MWh and PJM's total billings for electricity in 2010 were $35 billion.[7]

A. Prices in Electricity Markets

27. Electricity generally cannot be stored, so the electricity being consumed at any moment on the grid is in exact balance with the amount being generated. The figure below provides an overview of how PJM can use prices to call on additional generation to meet changing load over the course of a day. Each horizontal bar with a price corresponds to a different electric generator available at that price. As load increases, PJM raises prices and additional generators turn on to sell at that price or higher. As prices climb higher when additional supply is needed, the price paid to all operating generators increases. This is shown in Figure 2.[8] Thus, a generator hopes to be called to run when the price exceeds its costs so that it can earn money when prices climb higher. In operating the system on the day the electricity flows, PJM calculates new prices every five minutes. For various reasons, prices are sometimes set on an hourly basis as well and the issues in this case are mostly addressed using hourly prices.

Figure 2



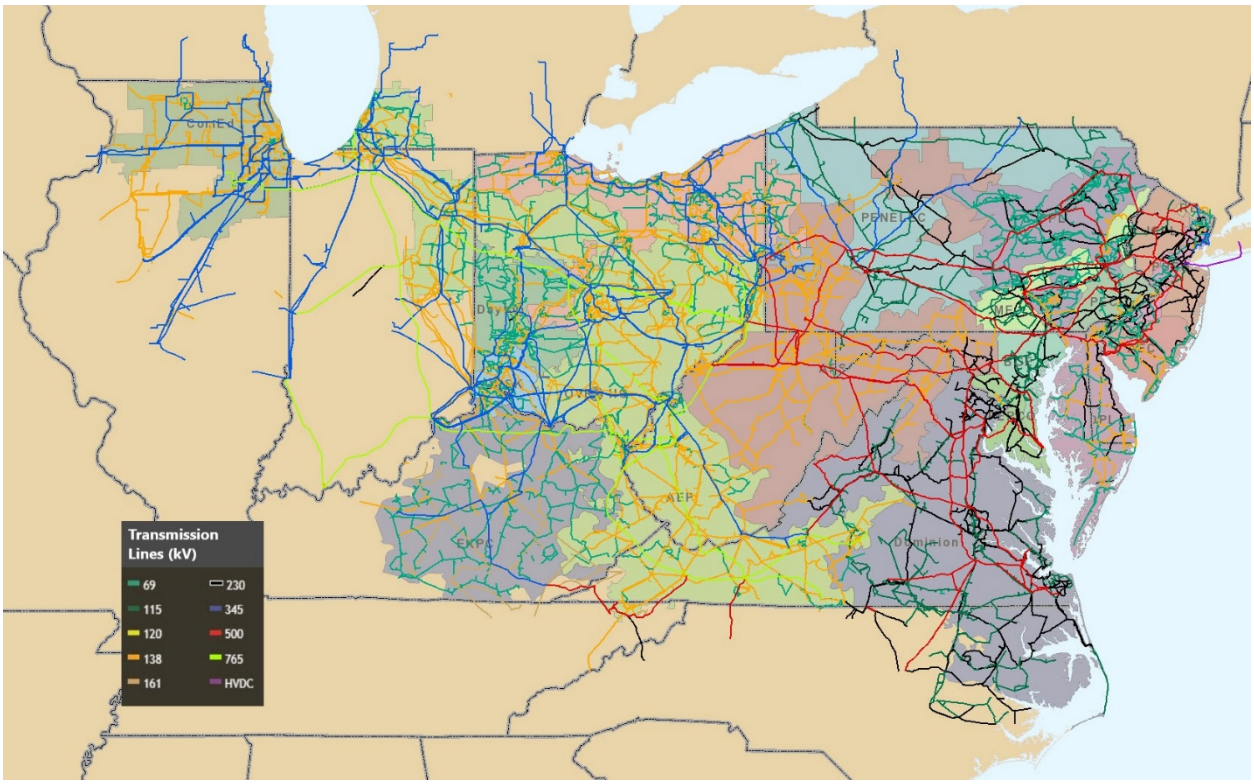
28. Electricity moves instantaneously across the network of wires from generators to consumers. The figure below provides a map of the highest voltage lines in PJM, with different colors corresponding to different voltages, and there are many other lines at lower voltages. Near the border of PJM's service territory there are many connections to

[7] Ibid, pp. 11 and 1, respectively.
[8] PJM 101: The Basics, p. 11 (PDF p. 30). https://www.pjm.com/-/media/training/core-curriculum/ip-pjm-101/pjm101-the-basics.ashx?la=en

neighboring systems. Those connections allow electricity to flow into and out of PJM. UTC trades involve the pricing of electricity flows into, out of, and across PJM. These three types of UTC trades are called imports, exports, and wheeling transactions.

Figure 3

PJM Major Transmission Facilities[9]



29. In coordinating the electricity system, PJM uses prices to incent generators to run, but it has very little control over how electricity flows on the system. That can be a problem when an element on the transmission system is in danger of being overloaded. That element is called a constraint, as it is limiting the flow of the lowest-cost electricity to serve customers. What PJM can do is to tell different generators to turn on and off. It does this by changing the electricity price at different locations on the system. Electricity prices vary based on specific locations, or nodes, in the market and there are thousands of such pricing points (also called nodes or Pnodes) in PJM. Every node has a specific price at every moment. Thus, overall prices change with load throughout the day, while prices vary at every node as a result of constraints on the transmission system. The constraints that affect prices are changing continuously.

30. All but the largest and most sophisticated consumers can ignore this detail. Most consumers simply use electricity whenever they want and pay a monthly bill. PJM and the wholesale market participants, however, deal with this level of detail continuously.

[9] PJM, "System Map," www.pjm.com/library/maps.aspx, Accessed December 16, 2021.

31. In order to keep supply and demand in exact balance at all times, PJM operates both day-ahead and real-time markets. The day-ahead market uses a forecast of expected load in the following day and sets up an hourly schedule of supply from generators. The day-ahead market operations involve bids in the morning of the day before the electricity is delivered (as of the summer of 2010). In the afternoon PJM runs its market-clearing computer models and establishes hourly prices for every node in the system over the next day. PJM also provides operating schedules to generators, telling them when to start up and shut down, as well as the level to operate at over the course of the day. This allows generators to plan for the next day. As long as they generate at the levels assigned by the schedule, they will be paid the day-ahead price.

32. The next day, the real-time market is used to keep the system in exact balance. PJM sets market prices every five minutes in the real-time market. Those real-time prices are intended to provide incentives for generators to respond to specific system needs. For example, a generator might have sold 60% of its output at one price in the day-ahead market for hour 14. In real time, it might just sell its output as scheduled in the day-ahead market and get paid the day-ahead price. Alternatively, it might look to prices in the real-time market and decide to sell more if prices are higher or sell less if prices are lower. And it might change output every five minutes in response to prices.

33. The generator's ability to respond to instantaneous calls for changing output might be different than how it can handle such requests on a day-ahead basis, so its offers could be different. For PJM, the combination of day-ahead and real-time markets gives it the ability to line up resources before the day starts and also respond to changes in real time. As a result, there is almost always a difference between real-time and day-ahead prices at a given point.

B. Virtual Trading of Electricity Products and the UTC Trade

34. PJM allows trading firms to engage in financially settled, or virtual, trading in its markets. These are financial trades that do not result in the generation or consumption of electricity. Financial traders place these trades to make money, not for other purposes. Trading firms profit in virtual trading when they buy low and sell high.

35. One type of virtual trading is based on changes in prices at a single point between the day-ahead and real-time markets. For example, a financial trader can buy electricity in the day-ahead market and then sell the electricity back in the real-time market. If the price has increased between the two markets, the trader has a gain. If the price decreases, the trader has a loss. Because the trader sells in real-time all the electricity they bought in the day-ahead market, their trade does not result in the actual generation or consumption of electricity. That is, the purchase and sale offset each other. Also, virtual traders can place trades that profit from moves in the opposite direction.

36. Success in virtual trading depends on predicting the changes in the market from day-ahead to real-time. Unsuccessful traders lose money and leave the marketplace. In theory, the successful traders benefit the market. First, virtual trades can cause price convergence between the day-ahead and real-time markets. Second, price convergence can help ensure that the generators that are actually needed to deliver

electricity in the real-time market are committed in the day-ahead market. Third, virtual trades may promote what economists refer to as "market efficiency," which generally means that prices are lower for consumers overall. Fourth, the actions of virtual traders may help diminish problems of market power in the marketplace, by providing a means to trade against—and reduce the effectiveness of—market power exploitation strategies. Price convergence, commitment efficiency, market efficiency, and diminishment of market power are all potential benefits of virtual trading.[10]

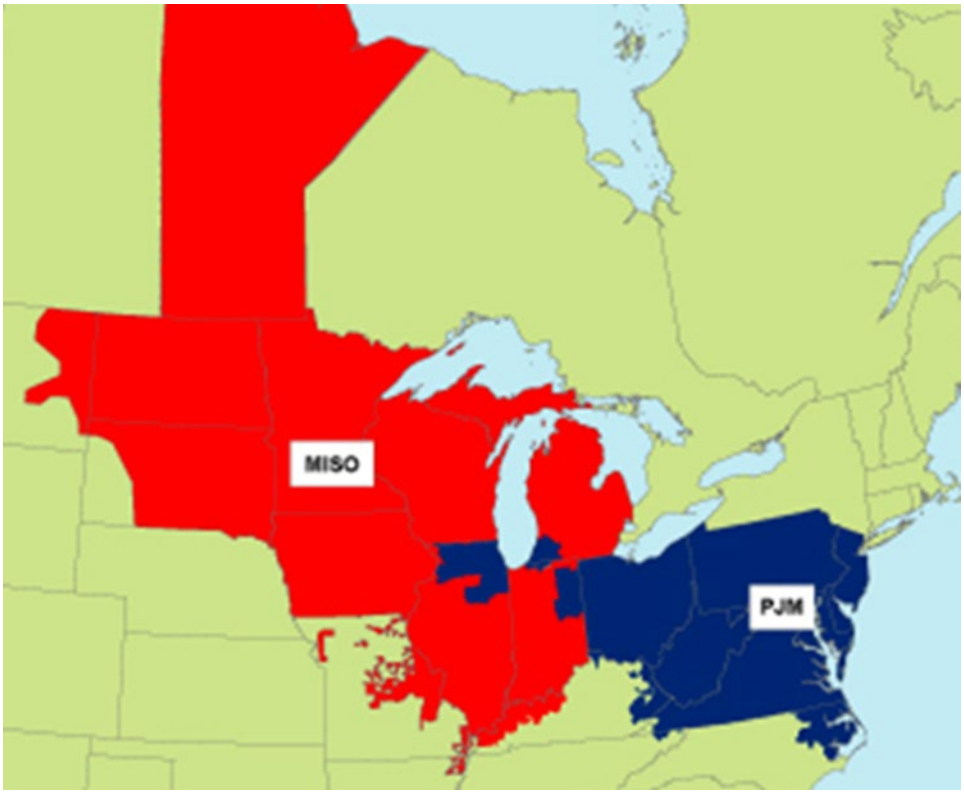
37. A second type of virtual trading available in PJM is based on the difference in prices between two pricing points or nodes. This price difference is called the spread, and this trade is called Up-To Congestion (UTC) trading. With this type of trading, a financial trader can attempt to profit by correctly predicting how the price difference, or spread, between pricing points will change between the day-ahead and real-time markets. The two pricing points, or nodes, are referred to as the path of the UTC trade.

38. The price differences between two nodes are principally caused by constraints, or bottlenecks, on the transmission system. Those constraints can change from hour-to-hour and between the day-ahead and real-time markets. This will cause the price spread on the UTC to change, leading to profits or losses on the trade. Modest price differences are also caused by electrical losses on the system, but those tend not to change dramatically. UTC trades were originally designed to support imports and exports of electricity, so one of the two nodes needed to be a point of interface between PJM and a neighboring region. The other node can either be within PJM or another interface point.

39. For example, on June 10, 2010 Powhatan made a UTC trade from MISO to DAY. MISO is the name of the entity that manages a regional transmission area, similar to PJM, but located to the west, as shown in the following figure. In making the trade on PJM's system, the MISO node represents the interconnection point to the overall MISO system. The other node is in the interior of PJM, in this case representing the area associated with Dayton Power & Light's service area, around Dayton, Ohio. While this example is for a one-directional Spread Trade, it should be noted that almost all of the Round Trip Trades were made with MISO. DAY was a commonly used internal node for those trades.

[10] It is also true that virtual trading might detract from market efficiencies via the exercise of market power or price manipulation. A full evaluation of virtual trading depends on many factors, including the specific product and market tariff. Such an evaluation is beyond the scope of this review.

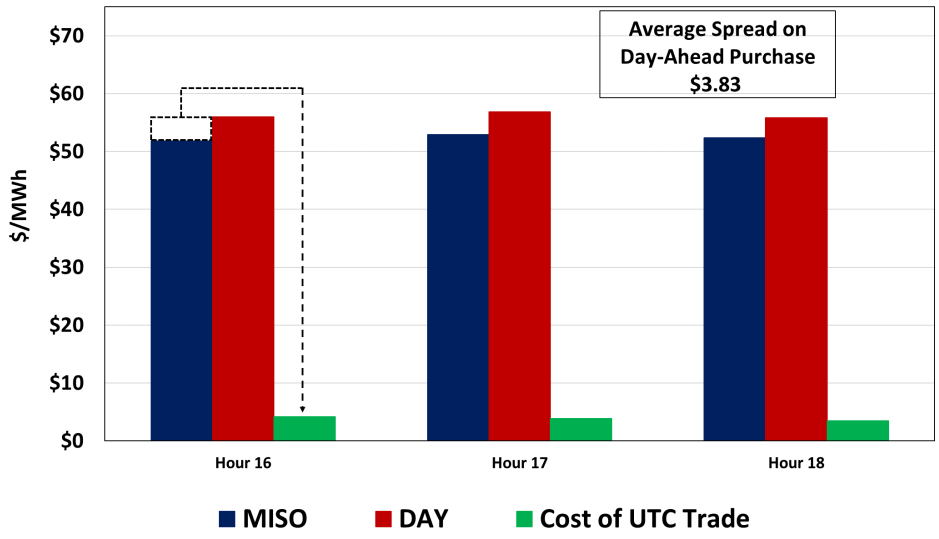
Figure 4
PJM and MISO, Summer of 2010



40. The trade was placed for all 24 hours of the day, but only three hours of the trade will be examined to explore UTC trading mechanics. In the day-ahead market, the prices were stable, with prices at DAY a few dollars higher than at MISO. This price difference indicates the direction of electricity flow, as it will flow toward the higher price. The cost of the UTC trade depends on the difference in price between these two locations, not the prices themselves. In this case the price difference averages $3.83/MWh. The UTC can be purchased in either direction; I consider here buying the trade in the “forward” direction, so Powhatan paid this amount in the day-ahead market for this position. This trade will be profitable if that spread increases when that position is sold back in the real-time market.

Figure 5

MISO-DAY
Day-Ahead Pricing
June 10, 2020



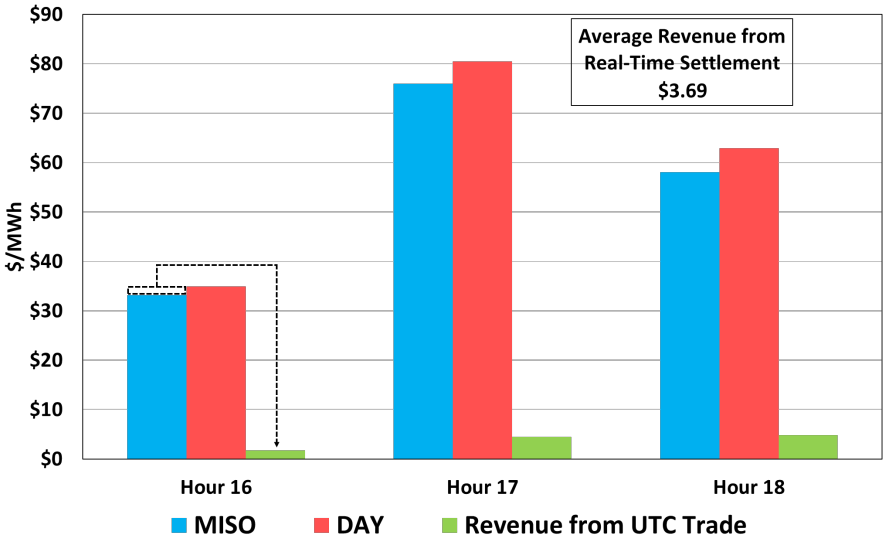
41. The price paid for the UTC depends, in part, on market prices.

Purchase price = Day-Ahead Spread

42. The real-time prices are shown in the next figure. Rather than having stable prices as in the day-ahead market, these prices change dramatically, from around $35/MWh in one hour to as high as $80/MWh in the next. This kind of change in electricity prices is not unusual. Electricity prices change dramatically, and quickly, all of the time. Electricity prices are more volatile than those for any commodity in history. The price volatility results from the need to keep the system in perfect balance at all times.

Figure 6

MISO-DAY
Real-Time Pricing
June 10, 2020



43. The price for the real-time trade is determined by the same formula as the day-ahead, except the UTC trader is selling back what was purchased. Again, the price is not dependent on the absolute value of the prices at the nodes, which changed dramatically, but the difference between the two locations. The formula is:

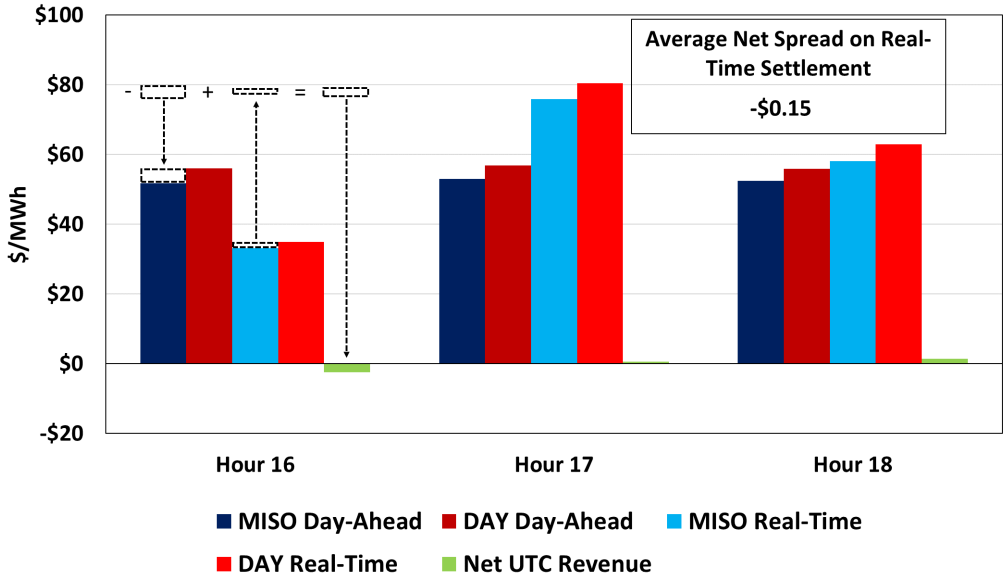
    Sale price = Real-Time Spread

44. Since the UTC trade was not for the commodity itself, but for the spread, the change in absolute value of the nodes is not important. What matters is the change in spread values between the day-ahead and real-time markets. In general, those differences changed much less than the absolute value of the electricity. Those differences are shown in the following figure. The formula for the profitability of the trade is:

    Profit = (RT Spread – DA Spread)

Figure 7

MISO-DAY
Day-Ahead/Real-Time Pricing & Net UTC
June 10, 2020



45. The difference in prices in the darker bars is what the trader pays for the trade in the day-ahead market and the difference in prices is what they get paid in the real-time market when the position is sold back to PJM. Despite all of the movement in the prices of the nodes themselves, the spread changes are small. There is a loss in hour 16, hour 17 is close to break-even, and there is a profit in hour 18. On average there is a small loss of $0.15/MWh in spread value.

46. The day-ahead and real-time price movements depicted above occur over the course of two days. On the first day, the trader purchases the position in the day-ahead market. On the second day they sell it back in the real-time market. The trader does not disburse or receive payment with each individual trade. PJM later settles up for multiple days and pays or charges each trader.

47. There are some additional logistical and cost issues that affect UTC trading. When the UTC trade is first placed in the day-ahead market, the UTC trade is treated as if energy is genuinely transmitted between nodes on the system. This is true even if the trade is made by an energy trader like Powhatan that has no intention (or ability) to deliver the energy in real time. Therefore, PJM requires those placing UTC trades to ensure there is room for the electricity to flow on the transmission system. To arrange for transmission on the electric system, the trader uses the Open Access Same-Time Information System. OASIS is an internet-based system that allows market participants to reserve transmission capacity among different systems in the U.S., including PJM and other electric systems that make up the patchwork of electric system operators across the country.

48. A trader seeking to make a UTC trade first goes on OASIS and looks to ensure there is transmission available on the system for their trade.[11] The system shows how many MWs are available for the hours and locations of interest. If capacity is available, the trader then submits a request for the specific amount of transmission capacity desired. In a short amount of time, usually only a minute or two, OASIS either confirms that the reservation has been made or denies it. If approved, OASIS then reduces the amount of transmission capacity available for other transactions. OASIS also issues an identification number that is needed when making the UTC trade to demonstrate that transmission capacity was reserved for that trade. The specific transmission capacity typically associated with UTC trades is short term, non-firm service. This is available the day before the energy is to flow, in time for day-ahead market transactions.[12]

49. At the time of Chen's Round Trip Trades, the full cost of reserving non-firm transmission service on OASIS under most circumstances was $0.67/MWh. One exception was on exports from PJM to MISO where the cost was zero. Almost all of the Round Trip Trades involved exports to MISO, so that in making the trade the trader would know that the transmission cost would not be more than $0.335/MWh on average for each of the two legs. In addition, the $0.67/MWh cost was often reduced, sometime to as low as zero, through a largely unpredictable (to my knowledge) adjustment made by PJM.[13] The average transmission cost for the Round Trip Trades was $0.23/MWh, which reflects these issues.

50. Another cost incurred in conducting a UTC trade is for ancillary services, which are a variety of services needed to maintain the operation of the system. PJM recovers the cost of these services by charging fees on all transactions, and it published those costs. These costs were known to traders as a constant value over a given month, with slight changes from month-to-month. These costs averaged approximately $0.21/MWh for the Round Trip Trades.

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[11] The description of trading practices is in accordance with the PJM Tariff requirements at the time the trades are made and I particularly focus on the practices in the summer of 2010.

[12] Other capacity reservation options include firm service and longer-term service. These have a higher priority (i.e., those reservations would take priority over short term non-firm service) under certain circumstances, but also come at a higher cost. Generally speaking, in the morning when UTC trades were being placed for the next day, new transmission reservation activity using the higher cost and higher priority capacity options was not significant and is not important to this analysis. Regional Transmission and Energy Scheduling Practices, OASIS, PJM Interconnection, 2010. See also PJM Open Access Transmission Tariff, 2010.

[13] PJM response to fifth data request, May 2, 2012, response 9. This cost was sometimes reduced by a congestion charge adjustment, which is explained in response 20. This adjustment was not known or predictable to traders ahead of time (to my knowledge).

51. To include these factors, the profit formula is re-written as:

Profit = (RT Spread – DA Spread) – Ancillary services – Transmission

C. Overcollection of Losses and the MLSA Payment

52. The opportunity for the trading practices at issue in this case began with rule changes that provided an additional payment to UTC traders: the MLSA payment. To understand the source of this payment, consider that every electric system needs to generate more electricity than the amount customers receive. The difference is called losses. These losses – only a few percent of the total system load – are energy dissipated as heat on the transmission system. In order to operate the system most efficiently and keep electricity prices as low as possible, PJM sets locational prices that consider the losses on a marginal basis. This means, for example, that a generator far away from load gets paid a bit less than one located much closer. When this is done in an optimal fashion, PJM gets paid a bit more from customers than it pays to suppliers. This difference is referred to as over-collected losses (OCL) or marginal loss surplus. This extra money is returned to market participants through marginal loss surplus allocations (MLSA) or OCL payments.

53. PJM calculates the MLSA on an hourly basis, returning the extra money it receives in that hour to market participants such as customers. When this structure was first adopted on June 1, 2007,[14] UTC traders were not granted a share of the MLSA, but that changed over time as a result of complaints and a formal regulatory process. That changed on September 17, 2009, when FERC accepted PJM's proposal that provided a share of the MLSA to be paid to UTC traders.[15] This methodology was in effect during the Manipulation Period and is the basis upon which Round Trip Trades could profit from MLSA. The effective date of this tariff change was June 1, 2009. Payments for MLSA were made on an ongoing basis starting in approximately October 2009, with catch-up lump-sum payments for the period after June 1, 2009, being paid in approximately November 2009.[16] Separately, the Order called for refunds to be made to financial traders of UTC products covering a period from December 3, 2007 to March 3, 2009. Those refunds were made public on June 1, 2010.[17]

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[14] *Atlantic City Electric Company*, 117 FERC ¶ 61,169 (2006) (Order on Rehearing and Compliance Filing, November 6, 2006, EL06-55-001, EL06-55-002).
[15] *Black Oak Energy, LLC*, 128 FERC ¶ 61,262, September 17, 2009.
[16] Email from Kevin Gates, December 8, 2009. POW00008242.
[17] PJM Report of Refund, June 1, 2010. Docket EL08-14-007.

D. Changing Economics for UTC Trades and the Round Trip Trade

54. As a result of this change in PJM Tariff, an additional element entered into the economics of UTC trades with paid transmission: revenue in the form of an MLSA payment. The compensation formula became:

Profit = (RT Spread – DA Spread) – Ancillary Services – Transmission

+ MLSA Payment

55. The MLSA payment is always positive and therefore makes a UTC trade more profitable. The issues in this case come from trading that targeted the MLSA payment itself. This was done by reducing, or eliminating, the consequence of spread variation on the trade (RT Spread – DA Spread). In the Round Trip Trades adopted by Chen and Powhatan, the spread difference was completely eliminated. Two UTC trades were placed between the same two nodes, but in the opposite direction.[18] Whatever spread variation occurred on one trade was exactly offset by spread variation on the other. Each might have profits or losses, but when combined, the economics of the trades are described in the following formula which contains no spread variation at all. These could also be called wash trades.[19] In the profit formula, all reference to the spread changes drops out and the formula becomes:

*Profit = – (2 *Ancillary Services) – Transmission + MLSA Payment*

Or, perhaps easier to follow:

*Profit = MLSA Payment – (2 *Ancillary Services) – Transmission*

---

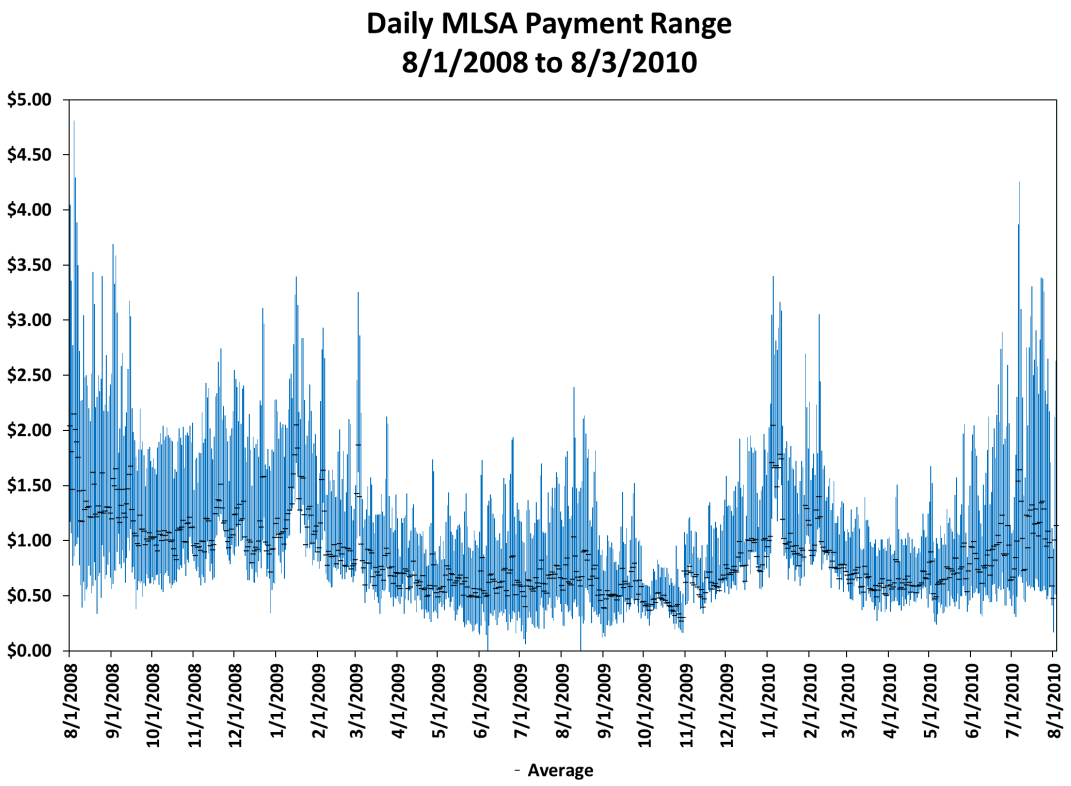
[18] Later in this report broken leg trades will be discussed. For the purpose of this introductory discussion of trade economics, a Round Trip Trade with a broken leg is no longer a Round Trip Trade, but instead a typical one-directional UTC trade as previously described.

[19] "The Commission's original Market Behavior Rules identified wash trades as possessing two key elements – that the transactions: (1) are pre-arranged to cancel each other out; and (2) involve no economic risk." Penalty Order at ¶ 103 (citing Investigation of Terms and Conditions of Public Utility Market-Based Rate Authorizations, 105 FERC ¶ 61,218 at P 53)). "[W]e find Respondents' round-trip UTC trades satisfy both these elements and were, by design, wash trades. That is, Respondents' trades were designed to cancel each other out and to eliminate price spread risk caused by differences in congestion prices between the selected nodes. We find that in Commission-regulated markets, the market risk associated with a wash trade need not be zero; it only need be small enough so that the risk has no practical or expected impact on the transaction, as was the case here." Penalty Order at ¶ 104 (citing *Piasio v. CFTC*, 54 Fed. *App'x* 702, 705 (2nd Cir. 2002); *SEC v. Colonial Inv. Mgmt. LLC*, 659 F. Supp. 2d 467, 473 (S.D.N.Y. 2009); and *Wilson v. CFTC*, 322 F.3d 555, 559 (8th Cir. 2003) ("Wash trading produces a virtual financial nullity because the resulting net financial position is near or equal to zero.").

56. This formulation assumes that the Round Trip Trade was made between MISO and a node internal to PJM. When this is done, only the import leg of the trade pays for transmission and receives the MLSA payment. Both legs pay for the ancillary services. With ancillary service costs of $0.21/MWh and full transmission costs of $0.67/MWh, the trade is profitable if the MLSA payment is more than $1.09/MWh. Average transmission costs on the Round Trip Trades were only $0.23/MWh, making trades profitable when MLSA was above $0.65/MWh.

57. The figures below plot the daily range of hourly MLSA payments, with a mark for the average value on each day. The MLSA payment is higher when load is higher, such as during the middle of the day. On any given day, the MLSA payment can change significantly from off-peak to on-peak hours.[20] It is also higher during seasonal periods of high loads (summer and winter). The first figure plots the data for all three periods of this analysis, while the second one focuses only on the Manipulation Period.

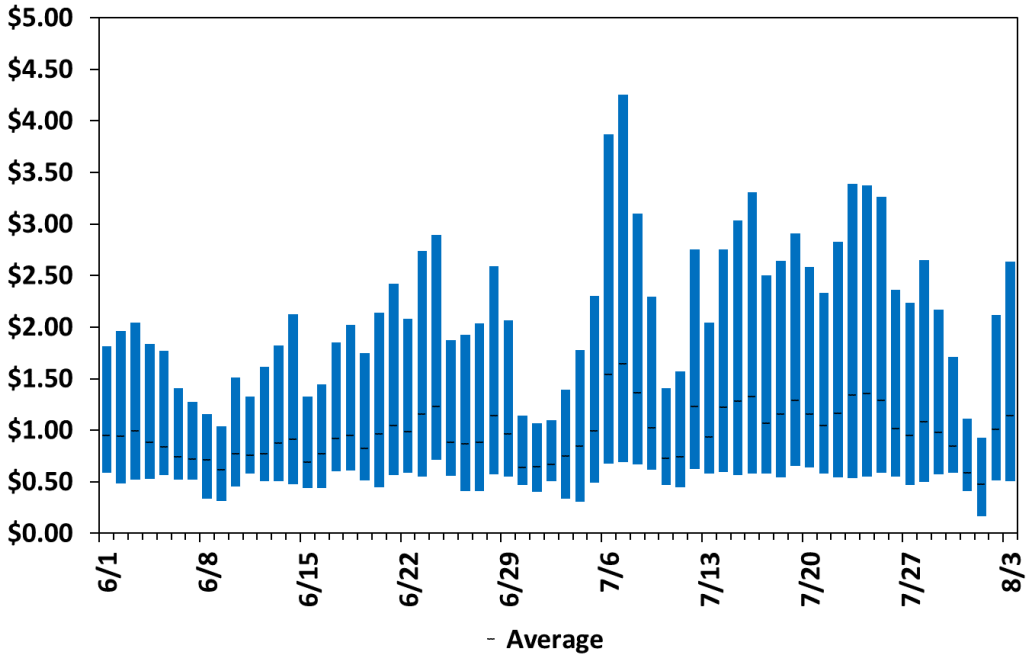
Figure 8



[20] Within the electricity industry, the term "on-peak" is sometimes used to specifically reference the weekday hours of 7-22 (6:00 am to 10:00 pm). In the context of this report I use the term more generally, with on-peak referring to hours of relatively high load, off-peak to lower load.

Figure 9

Daily MLSA Payment Range
Manipulation Period



IV. EVOLVING FOCUS ON MLSA LED TO ROUND TRIP TRADES

58. Chen's exposure to UTC trading came from his experience working in the trading operations of Enron, UBS and Merrill Lynch Commodities from approximately 2003 to 2006.[21] Chen then set up his own firm, HEEP, to trade UTCs for his own account on August 15, 2007,[22] with trading starting in September of that year. He continued to trade in this account through the entire time period analyzed in this report and afterward. He also conducted trades through another entity he owned, CU Fund, from July 17 to August 3, 2010.

59. The TFS Investors were engaged in a variety of trading and investing activities – including electricity trading – before the engagement with Chen,[23] though most of their trading activities did not involve products related to electricity. The TFS Investor trading with Chen was done through three entities. He traded initially for TFS Capital directly for three months, starting on May 1, 2008.[24] He then traded for Huntrise from August 1, 2008 to May 5, 2010 and Powhatan from May 29, 2010 through the end of the Manipulation Period of August 3, 2010 and beyond. Chen did not have any ownership of these funds. He conducted trades for these funds and shared profits under the terms of two Advisory Agreements that he signed on behalf of HEEP. The first agreement with TFS Capital was signed May 1, 2008 and was used for trading with that entity and Huntrise.[25] The second agreement was signed on May 18, 2010 with Powhatan.[26]

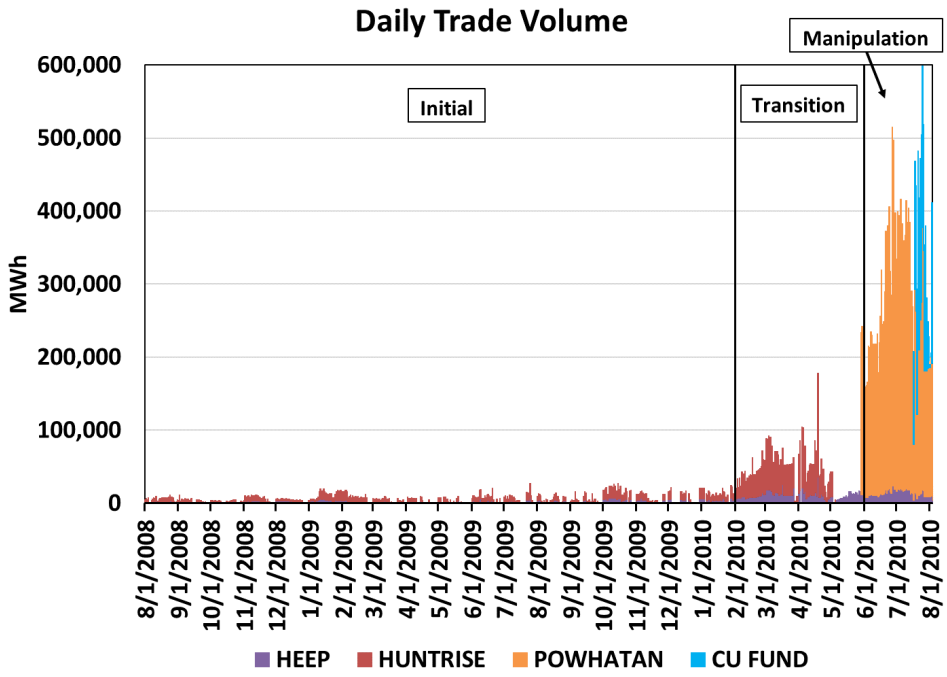
A. Overview of Trading

The chart below presents daily UTC trading volume in MWh for all four Chen-affiliated entities. I have labeled the three different trading periods used in this analysis. The Initial Period starts with the beginning of the Huntrise trading and encompasses the period when the parties become aware of the MLSA payments after more than a year of trading. The Transition Period covers the time when MLSA payments began to be specifically targeted in the UTC trades, but before the Round Trip Trades. Daily volumes increased significantly during the Transition Period. The Manipulation Period covers the time when all of the Round Trip Trades were placed. Trading volume increased even further during this time. The chart also displays the gap in TFS Investor trading from the end of Huntrise trading on May 5, 2010, to the start of Powhatan's

[21] Chen deposition, December 3, 2021, pp 11-17.
[22] Chen deposition, Vol 1, October 7, 2010. Tr. 38:10-16.
[23] Kevin Gates deposition, October 25, 2021, pp. 72-5.
[24] Chen email, May 1, 2008. POW00017816.
[25] Advisory Agreement between HEEP and TFS Capital, entered into May 1, 2008, POW0000071-3.
[26] Advisory Agreement between HEEP and Powhatan, May 18, 2010. POW00000067-70.

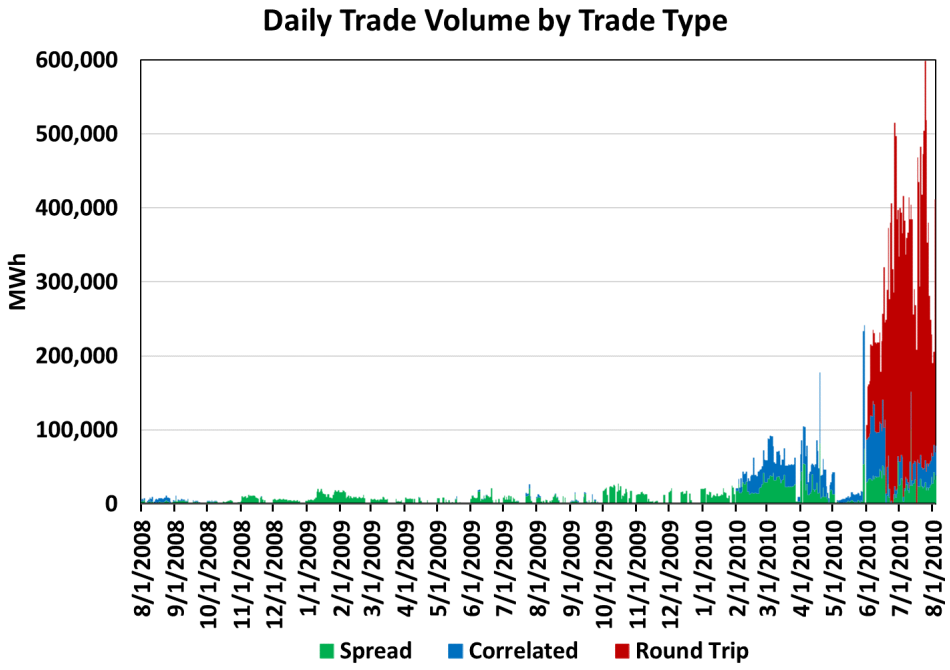
trading on May 29, 2010. The chart also displays CU Fund trading which began on July 17, 2010.

Figure 10



60. The next chart shows trading volume again with the volumes broken out into the three different strategies I have identified. The Spread Trades are typical UTC trades for targeting returns from spread value variations and such trading was continuous throughout the entire time period, with volumes that increased somewhat in the latter two periods. The history of Correlated Trades is more involved: some small amounts were traded in the Initial Period with such low volumes it is difficult to see on the figure below, and in many months there were no correlated trades at all. This changed during the Transition Period when Correlated Trades volume increased significantly and eventually became the dominant strategy of the period. Correlated Trade volume stayed at roughly the same level at the start of the Manipulation Period, but then tapered off. All of the Round Trip Trades were conducted in the Manipulation Period. One can see that the volume of these trades quickly grew and not only dominated the trading but was single-handedly responsible for unprecedented overall volume.

Figure 11

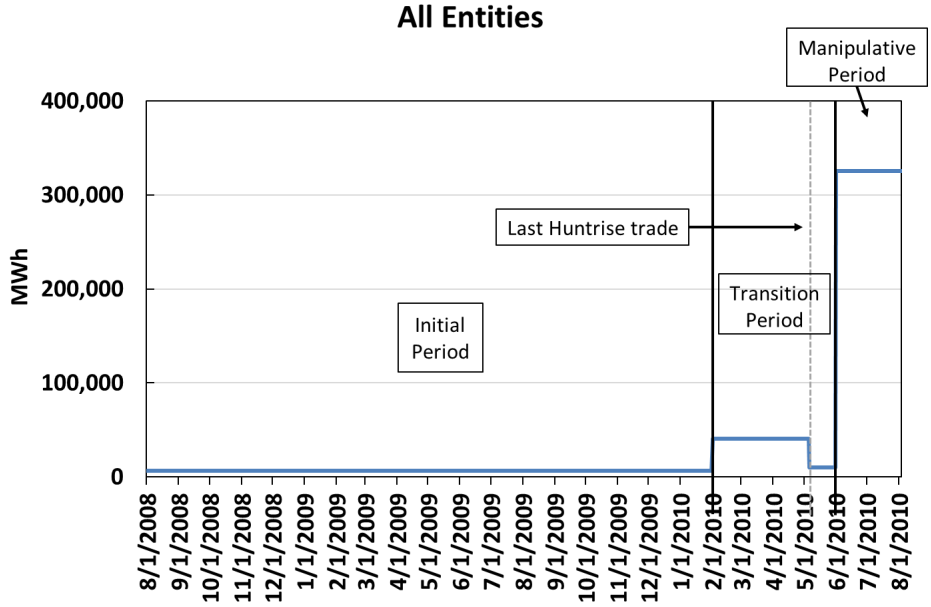


61. The charts below provide the average daily trading volume and average daily profit for the four combined entities in each of the defined periods. For these charts I have split the Transition Period in two, because there was a significant gap in trading for TFS Investors from May 6 to May 28, inclusive, as the accounts were changed from Huntrise to Powhatan. I have also chosen to leave out the data regarding the first two days of trading for Powhatan, May 29 and 30. These are the last two days of trading during the Transition Period (since no trades were made on May 31). Powhatan incurred a $30,710 loss on May 29, and then a much larger loss of $368,602 loss on May 30. The charts do not include those results in order to represent more typical trading activities in each period. I discuss Powhatan's trading activities of May 29 and 30th in detail later in this report. In response to the loss on the May 30, the Round Trip Trade strategy was adopted with the first trades executed for June 1, the first day of the Manipulation Period.

62. Trading volumes increased significantly in the Transition Period relative to the Initial Period. Profits also increased, but not by as big a factor as volume, reflecting smaller margins on each trade. Then, in the Manipulative Period, volumes increased dramatically again, with profits also increasing substantially. The changing tactics and results are consistent with a strategy of increasingly targeting MLSA as the source of profits.

Figure 12

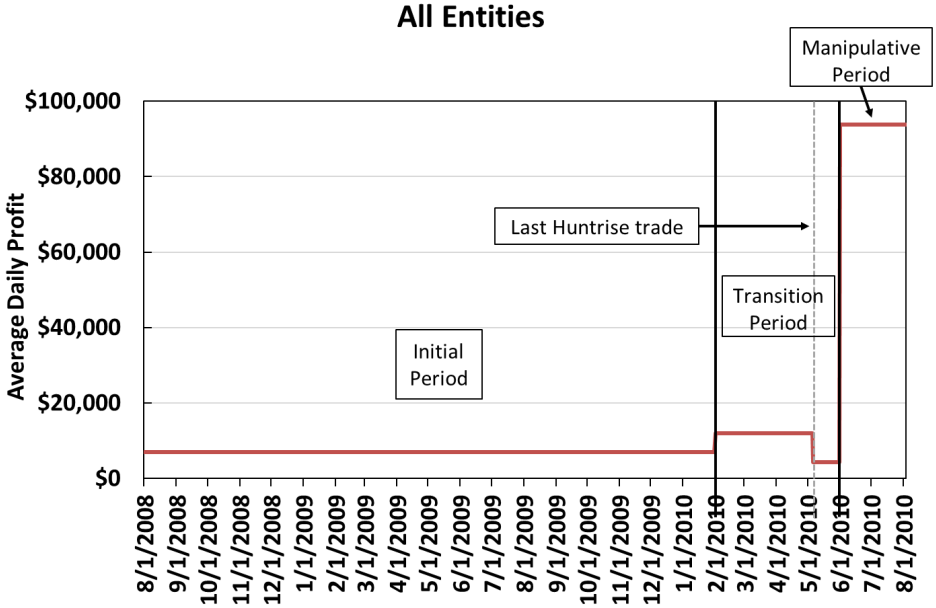
Average Daily Trade Volume
All Entities



Note: Powhatan volume on May 29th and 30th excluded from average.

Figure 13

Average Daily Profit
All Entities



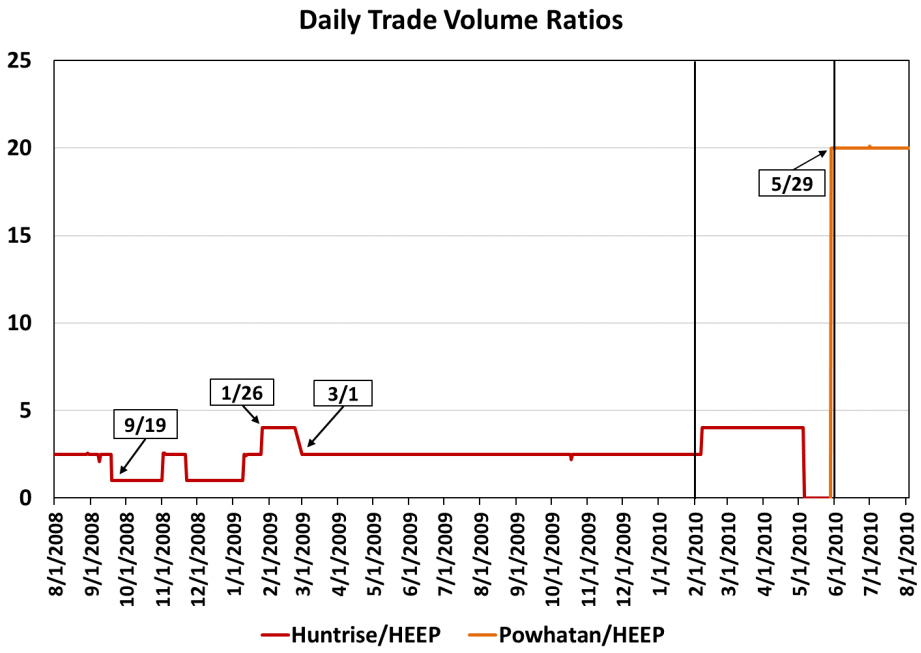
Note: Powhatan profits (and losses) of May 29 and 30 excluded from average

63. Under both of his trading agreements with the TFS Investors, Chen was to trade his own money in his HEEP account and then a multiple of that amount for the TFS

Investors. The purpose of this arrangement was to align interests, and the TFS Investors had used such approaches before.[27] Since Chen was trading his own money, the TFS Investors would have confidence that he was treating their trades with the same care as he would his own.[28] The investors could, and did, adjust the multiplier to increase or decrease their exposure to Chen's trading. This was an important element in their relationship with Chen.

64. The figure below shows the changes in the trading multiplier over time. It was initially set at 2.5x and mostly stayed at that level during the Initial Period, although it briefly shifted to 1x and 4x. It was set at 4x during the Transition Period and then 20x during the Manipulation Period. This is the primary reason why the overall volume increased over time, although Chen's trading for HEEP also increased with his shifting toward a MLSA-focused strategy.

Figure 14

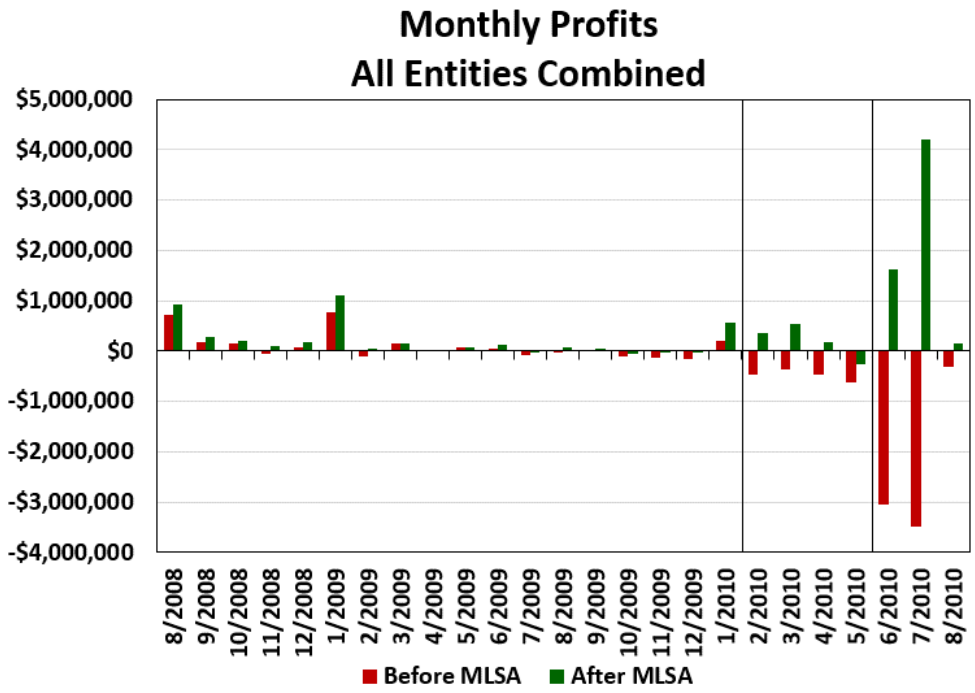


65. The figure below shows monthly profits for all of the trades, both including and excluding MLSA payments. The payments were modest in the early months but were solely responsible for monthly profits (as opposed to losses) during the Transition and Manipulation Periods. While the figure shows MLSA payments dating back to August 2008, the early payments were not made concurrently, and the parties did not learn of MLSA payments until October 2009. The details of how retroactive MLSA payments dating back to 2008 were made are covered later. What is clear from the chart is that, with the exception of January 2010, once the parties became aware of the MLSA payments, no month produced net profits without MLSA payments. That had not been

[27] Kevin Gates deposition, October 25, 2021, pp. 109-111.
[28] Kevin Gates deposition, October 25, 2021, pp. 107-108.

true earlier. While not all of the earlier months were profitable, most were, and the trading was profitable overall without MLSA payments.

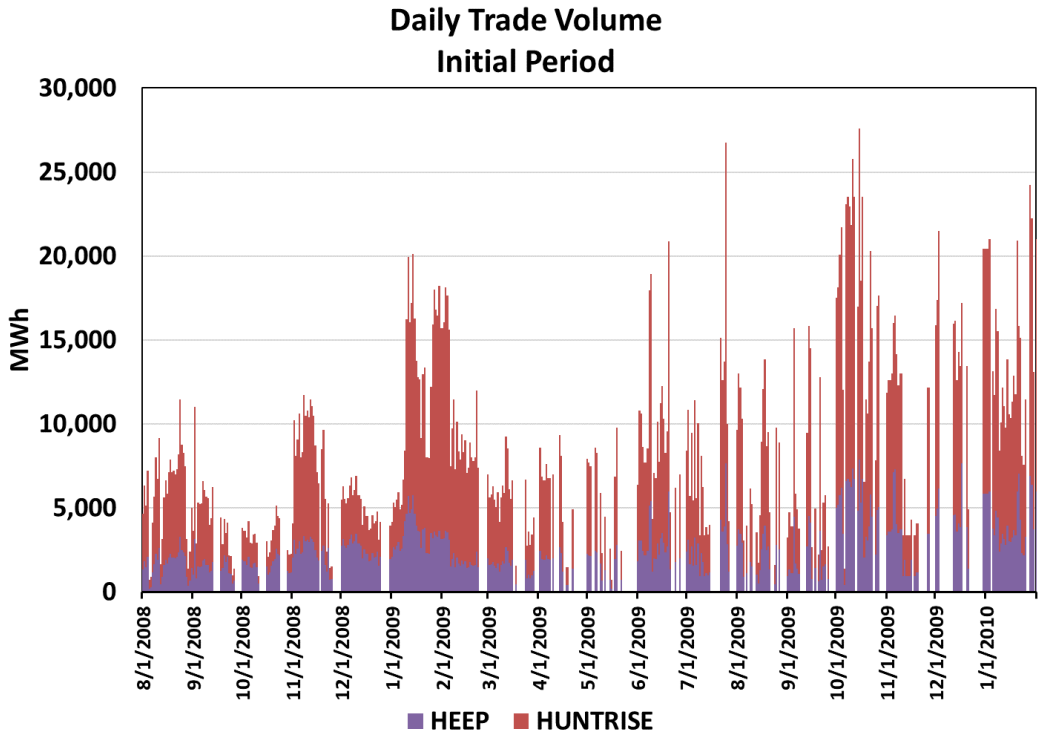
Figure 15



B. Initial Period Trading

66. I now turn to each of the trading periods in order to discuss the evolution of trading strategies. During the Initial Period trades were made on most days. The volume of trades for HEEP was typically in the range of 1,000 – 4,000 MWh, and never higher than 8,000 MWh. Huntrise volumes were consistent with the trading multipliers. Overall, it was rare for volumes to exceed 20,000 MWh/day, although the frequencies of such volumes increased in October after the parties became award of the MLSA payments.

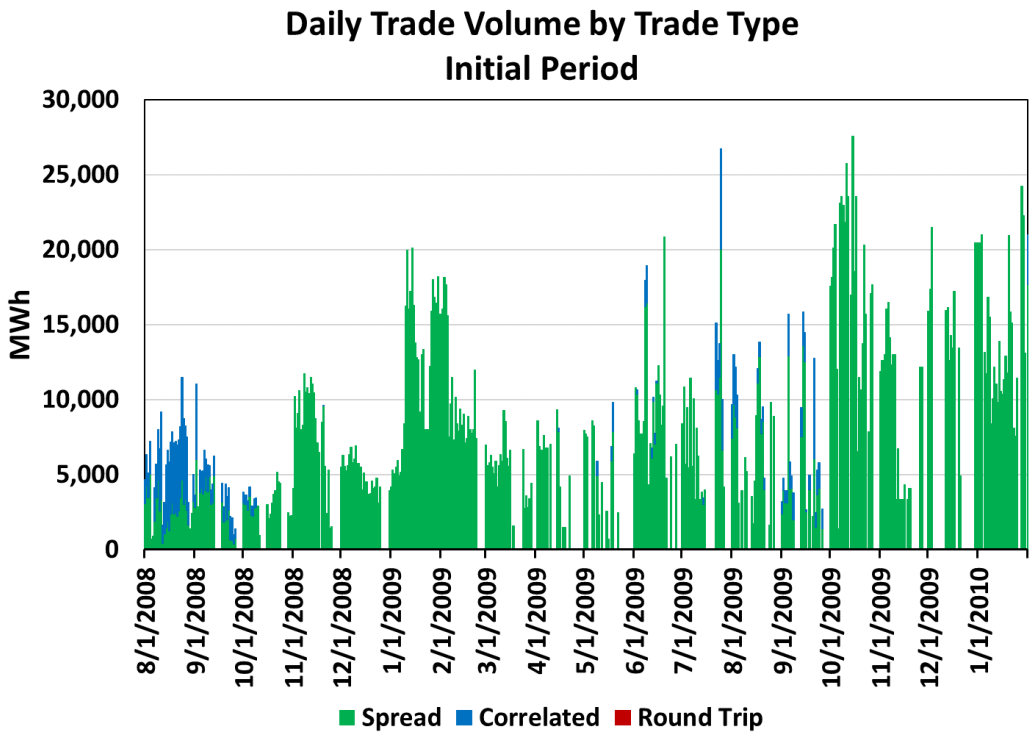
Figure 16



1. Trading Strategies in the Initial Period

67. The figure below displays trading volume by trade type. Essentially all trading during the Initial Period was Spread Trades, although there were some Correlated Trades, particularly in the first month.

Figure 17



68. In order to profit from a Spread Trade, a trader must predict the change in spread values from the day-ahead to real-time markets.[29] Those values are almost never exactly the same. In order to profit after considering the cost of placing the transaction, the change needs to be significant. Most of the Spread Trades placed in the import direction, such as the MISO-DAY example trade discussed earlier. This type of trade will profit when congestion causes the spread to increase in the real-time market. Chen explained this to Kevin Gates in an email:

> Majority of my trades (>90%) are betting for prevailing-flow congestions. I pay the premium beforehand and collect the congestions whenever occurred. So generally speaking the risk is very limited. These types of trades are for volatity [sic]. As long as there are congestions, very likely they are going to make money.[30]

69. Real-time spreads tend to be more volatile and have a much greater potential to be large. This real-time price volatility is not a surprise and is among the reasons electricity markets have both day-ahead and real-time markets. When scheduling the market on a day-ahead basis, PJM sends prices and instructions to generators to ensure that sufficient supply is available when it is expected to be needed. PJM plans for the entire

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[29] See also Chen's description of his spread trades, Chen deposition, December 3, 2021, pp. 22-23.
[30] Email from Chen to Kevin Gates, July 22, 2008. POW00008996.

day, optimizing the system over time to provide electricity at the lowest cost. In real time, things can change unexpectedly. PJM has fewer options and must rely on price signals to get supply to where it is needed, whatever it takes. In fact, the need for fine tuning to maintain a market balance is so critical that while the day-ahead market is solved for hourly prices (only one price per hour), the real-time market is solved in five-minute increments. All of the hourly real-time prices discussed in this report and the hourly real-time prices used to settle UTC trades are actually an average of the twelve five-minute prices that PJM sets in each hour.

70. As a result, while spread values can go up or down, it is in the real-time market where spreads can be most extreme. The table below provides an example of this characteristic by summarizing information for the Spread Trade path that was traded most over the Initial Period. The table looks at all hours in that period (regardless of whether the trade was made) and summarizes certain spread information to demonstrate the greater volatility and price extremes of real-time markets.

Figure 18

Spread Statistics During Initial Period

MISO to HARRISONTAP

DA/RT	Spread of $40.00 to $57.18/MWh Count	Spread of $57.19 to $368.09/MWh Count
Day-Ahead	9	0
Real-Time	218	191

71. There are 13,175 hours in the Initial Period. The highest day-ahead spread in all of those hours is $57.18/MWh. There are 191 hours spreads greater than this amount in the real-time market, with the highest being $368.09. The real-time market is also more likely to have prices in slightly lower range of spread values. As shown in the chart, data is compiled for a range of $40.00/MWh to $57.18/MWh, and prices in this range are much more likely in the real-time market. Those high real-time price spikes are profit opportunities for the forward-flow UTC trades that were the primary focus of Chen's and Huntrise's Spread Trades. In a counter-flow trade, which were generally avoided, those spikes could lead to large losses.

72. Chen described his trading as, "…low risk, low reward, very conservative trading."[31] This generally consisted of purchasing lower-cost spreads in the day-ahead market with the goal of profiting from congestion and its associated increases in spread values in real time. This can also be described as taking forward flow UTC positions, looking for congestion in the real-time market. Chen's approach to finding such opportunities involved reviewing data on thousands of nodes over tens of thousands of hours. He

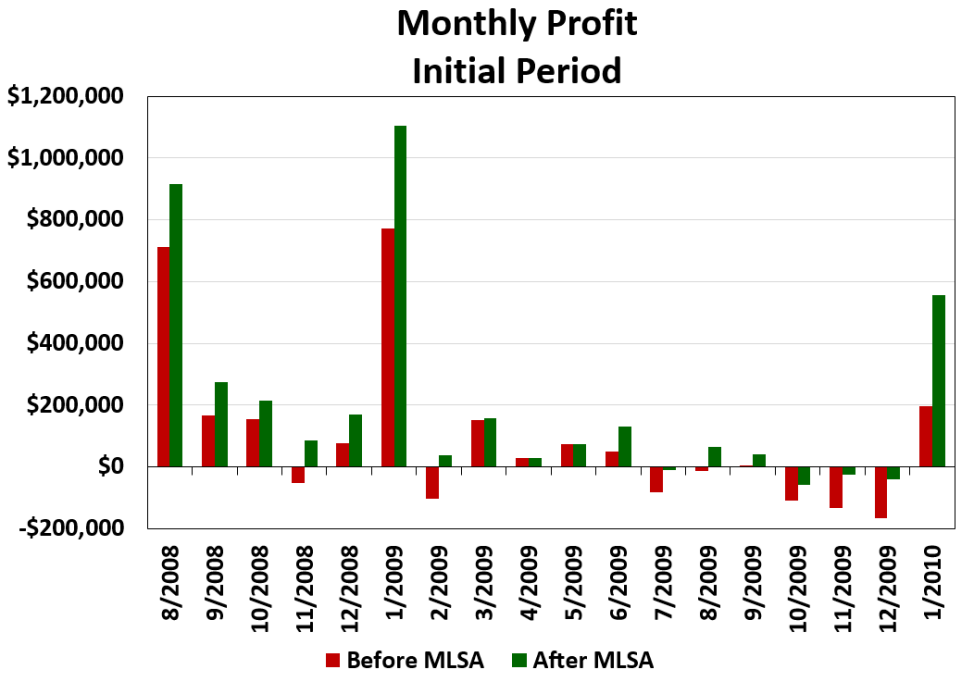
[31] Chen deposition, December 3, 2021, p. 18.

also considered other economic drivers of prices, such as temperatures, weather patterns, outages (generators and transmission), time-of-day and day-of-week.[32]

2. Trading Profits in the Initial Period

73. Over the fifteen-month Initial Period, HEEP achieved a profit before MLSA of $524,084. Huntrise shows a profit of $1,197,030. While this trading was profitable overall, profits varied considerably on a monthly basis, as shown below. The largest monthly gain came in January 2009, immediately before the change in trading ratio to 4x, followed by losses in February and a return to a 2.5x trading ratio.

Figure 19



3. Correlated Trade Example: GREENLAND GAP – MT STORM

74. As noted earlier in this report, Correlated Trades were paired trades that could have characteristics similar to Spread Trades or Round Trip Trades. The paths used to create a Correlated Trade pair involve the same external node for each pair, but different nodes internal to PJM. One can think of a Spread Trade as a trade between two nodes A and B, such that it could be called an AB trade. The MISO-HARRISONTAP example above is a spread trade where MISO is “A” and HARRISONTAP is “B.” In a Round Trip Trade there are two trades in opposite directions, so in this nomenclature they form an AB-BA trade. In a Correlated Trade, there are two trades in roughly opposing directions, but sharing only one common node for the import/export point: an AB-BC trade. In a Correlated Trade, any change value of the B point adds to the value of one trade and detracts from the other. The B node, in effect, cancels out. The value of the trade is effectively a Spread Trade between points A and C.

[32] Ibid, pp 18-23.

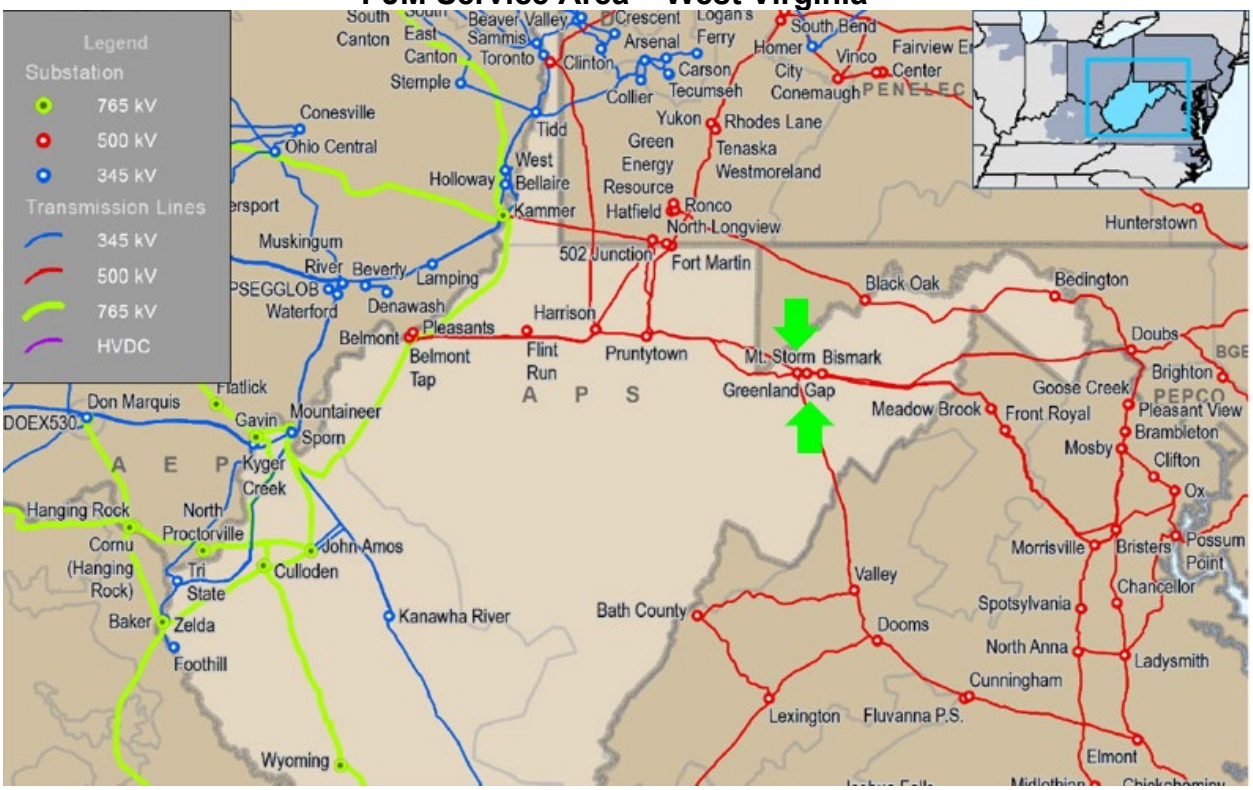
75. If nodes A and C are close together such that they have very similar prices, the Correlated Trade has economic outcomes similar to a Round Trip Trade. That is, the spread value is small and does not change. If there is congestion on the transmission system between points A and C, the prices at those two points will not move together and the trade has an economic outcome similar to a Spread Trade.

76. There is one particular Correlated Trade that is useful for discussing multiple aspects of Chen's, Huntrise's and Powhatan's trading: GREENLAND GAP – MT STORM. I discuss this Correlated Trade path in detail here and return to it later in discussing the transition to Round Trip Trades. Both of GREENLAND GAP and MT STORM are internal to PJM. Under the PJM Tariff it was not possible to conduct a UTC trade between those two nodes. That is why a third node is needed, at the interface of a neighboring electric system. When that is added, the spread between these two locations can be traded as a Correlated Trade, which was done extensively in 2008 from August to October. During August of 2008, $635,176 profit was made on this path, accounting for nearly 70% of the overall profits for this month—the second-most profitable month in the Initial Period. This was the only Correlated Pair traded during that time in the summer and fall of 2008.

77. The GREENLAND GAP and MT STORM nodes are shown on the map below with green arrows. They are near each other in a remote part of northeast West Virginia. The "B" node in these AB-BA trades was of little consequence. During the Initial Period Chen used PJM interface points with New York for his "B" node on most of these trades, and also a point associated with electric systems toward the south for a smaller portion. In the Transition and Manipulation Periods, he did extensive trading of this path using MISO as the interface point.

Figure 20

PJM Service Area – West Virginia[33]



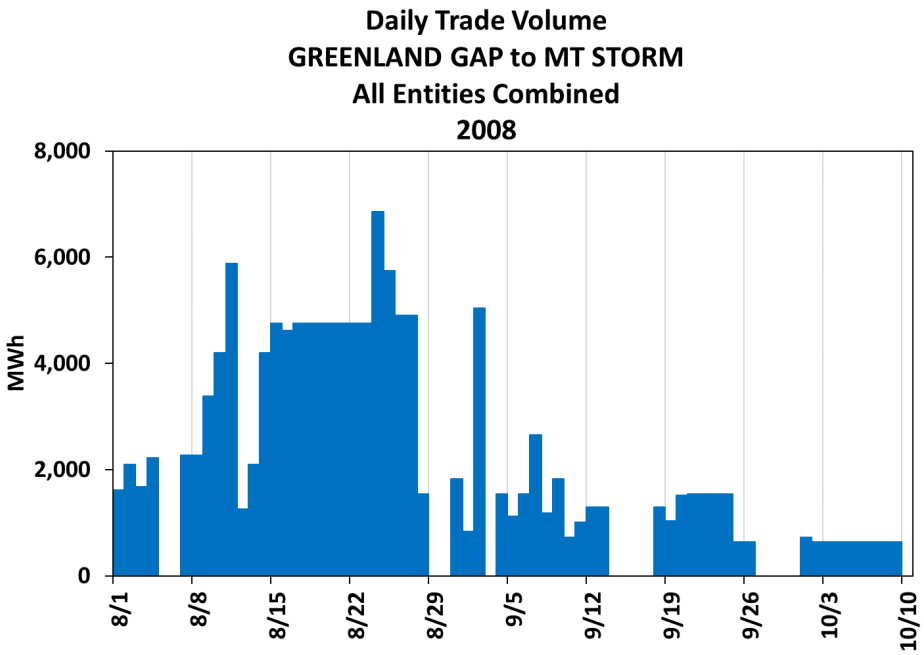
78. MT STORM and GREENLAND GAP are very close together on a high voltage transmission line. The electrical losses between the points are minimal, and in most cases the price difference is small as well. If the short, high-voltage link between the two nodes becomes a limiting transmission component on the system, however, price differences will develop and can be significant. When a line is at risk of being overloaded (i.e., congested), PJM prevents this overload by increasing generation on one side of the constraint and decreasing it on the other. PJM accomplishes this with market signals, setting prices much higher on one side of the constraint than on the other, resulting in changes in supply that lower flow on the congested line. This can happen in both the real-time and day-ahead markets, andit causes major changes in spread values.

79. In 2008 HEEP and Huntrise made Correlated Trades on the GREENLAND GAP to MT STORM path in a strategy that was profitable and consistent with the profit strategy for UTC trades. As was discussed earlier, Powhatan's general strategy, as devised and implemented by Chen, was to purchase low cost positions (i.e., uncongested) in the day-ahead market in anticipation of significant congestion – and therefore increased spreads – in real time. If no congestion occurred, the spread in real time would

[33] 2019 West Virginia State Infrastructure Report (January 1, 2019 – December 31, 2019), May 2020, Updated July 2020, p.5.

problably be similar to the day-ahead spread in the purchase price, and the trade would lose a little money as a result of the transaction costs (transmission and ancillary services). When congestion did occur, the price spread would increase and could lead to significant profits. The chart below shows the daily volume of his purchases on this path.

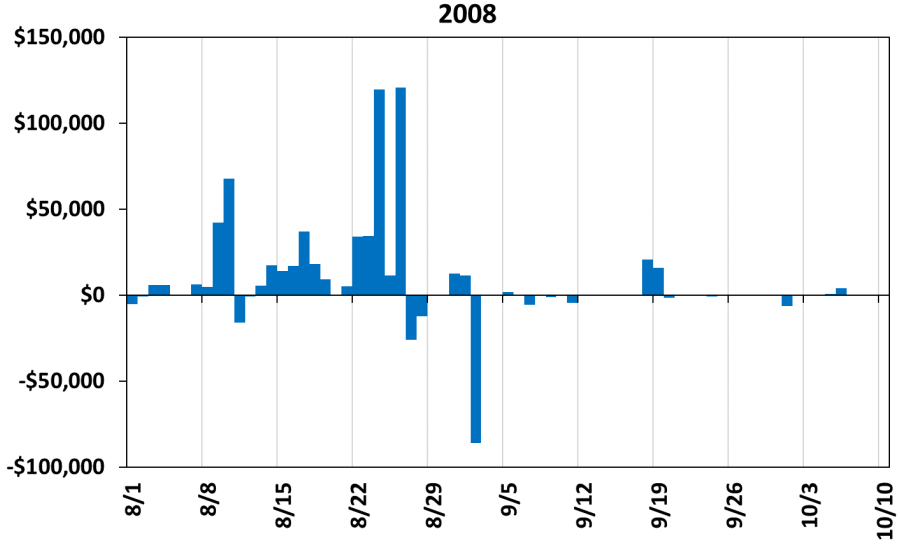
Figure 21



80. Trade volume was consistently high through August 27, and then generally lower, stopping after October 9. The daily profits are shown in the next chart. These profits do not include MLSA payments. While those were later paid on these trades, that did not occur until more than a year later and the parties were unaware of their existance. For the purpose of considering strategy and evaluating behavior, those payments are not relevant.

Figure 22

Daily Profit before MLSA
GREENLAND GAP to MT STORM
All Entities Combined
2008



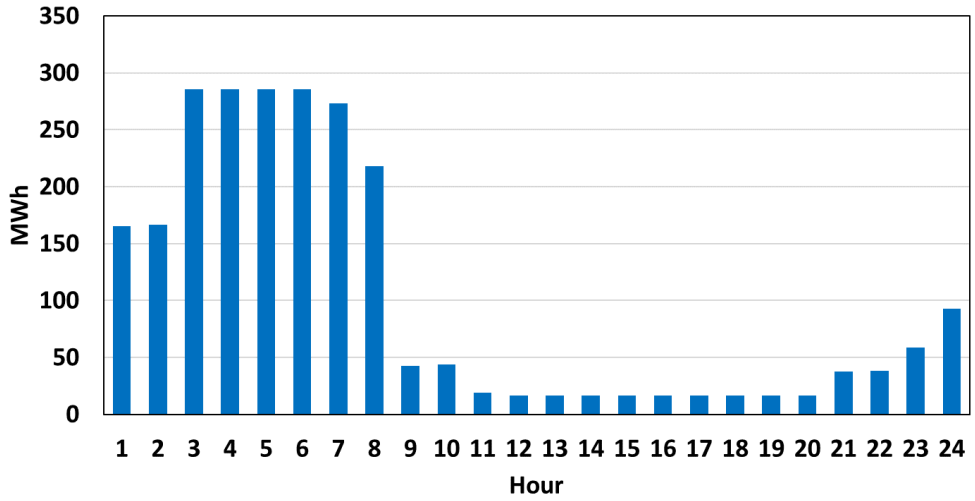
81. Before diving into the details of these profits, it is worthwhile to reflect generally on how such profits occur. PJM covers a large geographic area. The population it serves is most heavily concentrated on the east cost, and as a result, that is the location of greatest load. Electricity flow on the system is generally from west-to-east, and similarly, flow between MISO and PJM also tends to be in that direction, because generators tend to be located west of load. Several factors favor placing generator to the west of load in this region, including lower costs and easier public acceptance in less-populated areas and being closer to fuel sources. While the transmission system is designed to accommodate system needs, its capacity is finite and congestion at some point or points happens in virtually every hour. PJM uses computer systems to pinpoint the exact location of congestion when it occurs, in order to manage the system.

82. The profits in August of 2008 came from accurately predicting when that congestion was not occuring between GREENLAND GAP and MT STORM in the day-ahead market, but was occuring in the real-time market. This divergence between the day-ahead and real-time markets can occur from a combination of circumstances related to supply and demand, outages, and other factors. A trader does not have to understand all of those factors, but only needs to predict the pricing outcomes. HEEP and Huntrise profited from this prediction, with generally consistent profits on a daily basis in up until August 26, 2008. After that there were losses. Whatever combination of market conditions had made this profitable before were no longer present. There was a substantial loss on September 2, 2008, probably due to congestion producing a significant spread in the day-ahead market that went away in real time. Following the losses on August 27, 2008, the trades on this path were never net profitable on a cumulative basis (i.e., going forward from August 27, 2008) and Correlated Trades on this path stopped after October 9, 2008. Market conditions had changed. Despite substantial profits in August, the path was no longer profitable.

83. As shown in the figures above, trading volume on a daily basis was adjusted in light of market conditions. The same behavior can be seen by looking at the hours of the day. The figure below shows the average volume of trades in each hour of the day on days when this path was traded. The focus on the early morning hours reflects hour-by-hour considerations of pricing behavior, the details of which evolved over the months of trading this path.

Figure 23

Average Correlated Trade Volume
Greenland Gap to MT Storm
2008



Note: Averages are found by dividing the total volume of trades in an hour by the number of days when the path was traded in any hour of the day. In this way, days without any trades do not influence the average. On other days when just some hours are traded, the "zeros" in the hours not traded are included in calculating the average.

84. The hour-by-hour intricacies of trading and profits are signficant. In the GREENLAND GAP and MT STORM Correlated Trade example, the most profitable day of trading was August 26, 2008. For simplicity in this discussion, non-spread transaction costs are ignored. In hour 8 the day-ahead spread associated with the purchase price of the Correlated Trade was $6.20/MWh. That position was sold back in real time with a spread of $370.10/MWh, for a $363.90/MWh profit. In the preceding hour the day-ahead price was $20.42/MWh and the real-time price was negative $0.31/MWh, which resulted in a loss of $20.73/MWh.

85. This example is consistent with the UTC trading strategy discussed earlier for Spread Trades where profits were sought from increases in spread values in real time. The example shows a trader following the market, adjusting volumes in response to outcomes, searching for the most profitable hours within a day and attempting to avoid hours with losses. As long as market conditions favor the trade, the trade is pursued. As conditions change, the trade may no longer be profitable and in that case, it is abandoned. The trader is on the constant search for profitable trades and adjusting to market conditions.

4. Limits on Trading Volume Due to Price Effects

86. When adjusting trade volume in pursuit of profits, a trader needs to be concerned that the volume of their trade can move prices in a way that hurts profitability. This is true with UTC trades and Chen was well aware of this consideration. This issue has already been presented, albeit from a different perspective. One of virtual trading's benefits is that it can lead to price convergence in the pursuit of profits. For example, if a trader thinks the spread is too low in the day-ahead market, they will buy a UTC. That purchase clears the market, drives up demand for electricity at one point, and shows up as supply – or reduced demand – in the other. The price effect of that trade increases the spread in the day-ahead market, leading to less of a change in real time. If the trader is right, they will still make a profit, but the price effect of the trade reduces the profit. The larger the volume of the trade, the more prices move and profits fall. This shift in prices is the convergence that benefits markets.[34]

87. Trade volume's impact on prices is well known, including by the parties in this case. When asked about performance being compromised when trading volume increased, Kevin Gates said, "…all market activity affects prices,"[35] and, "I always think about that. There's always –any time you allocate to an investment, the more money that you allocate to an investment, the lower the expected returns."[36] In discussing this issue with Gates in 2010, Chen said, "From my past experience, a few hundred MWs, like 400 MWs, for a pair would likely cause performance degradation. So I general stick to 400 MW max."[37]

88. The trading data reflect Chen's self-imposed 400 MW limit. Over the Initial Period, on only one occasion did path volume exceed 350 MW, and that was on a single path in a single hourly trade. That was a trade of 500 MW. Perhaps fittingly, there was a loss of over $4,200 on that single one-hour trade.[38] The volume effect of trades was an important consideration for Chen in trading and is reflected in the trading data.

89. The connection between the trader's pursuit of profits, the market-moving attributes of the trade, and the benefit of the trades to the market, is important. A bad trader that makes unprofitable trades will move prices in the wrong direction. This decreases market efficiency. The assertion that virtual traders help the market relies on the reasonable expectation that bad traders will exit the market.

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[34] This is the same phenomenon that is talked about when people say that arbitrageurs promote efficient prices in markets. When such traders see anomalous price differences, such as between two locations for the same product or between two very similar products, they trade on that difference to profit when it diminishes. When they do this, their trading volume is what limits the amount difference that might develop in the first place and helps maintain efficient markets.
[35] Kevin Gates deposition, October 25, 2021, p. 84.
[36] Kevin Gates deposition, October 25, 2021, p. 157. See also p. 158-9.
[37] Email from Chen to Kevin Gates, March 5, 2010. POW00012123.
[38] On June 12, 2009 Chen traded 500 MW in hour 8 on QUAD CITIES 1 to MISO.

5. Introduction of MLSA Payments

90. Monthly profits with and without MLSA payments in the Initial Period (which were substantial) were presented earlier in Figure 19. The figure presents the MLSA payments in the month in which the trades were made that produced the payments, but there was a delay in their actual payment. No payments were made over the months and years while the PJM Tariff provisions pertaining to MLSA were being contested and before they were ultimately revised on until September 17, 2009.[39]

91. After that date, MLSA payments were made on an ongoing basis. It could take several days, up to around a week, for a trader to learn of the MLSA payment amounts for trading on a given day. Chen became aware of the introduction of MLSA payments in routine accounting in either September or early October, 2009. He saw a new entry on this based on a new entry on the weekly PJM accounting report, and then followed up with questions to PJM and research into the proceeding under which this change took place.[40] In addition, retroactive payments were made at two different points covering different periods. A retroactive payment for MLSA back to June 1, 2009 was made a number of weeks after the tariff provisions were changed. A calculation of amounts due for the earlier period, which included the trades in this analysis from August 1, 2008 to March 3, 2009, was made public on June 1, 2010. HEEP was to be paid $474,757.28 and Huntrise $863,852.65.[41] As a side note, for reasons having to do with FERC procedures for handling of disputes and of no significance to this analysis, UTC trades for the period March 4, 2009 through May 31, 2009 were never paid MLSA.

92. In November of 2009, Huntrise received approximately $440,000 in back payments for MLSA, and Kevin Gates told the other TFS Investors about this payment in a December email.[42] While January had been a strong month, no other month came close that those profits and overall, the rest of 2009 had not been profitable on a pre-MLSA basis. Performance over the last six months of the year were particularly bad. The figure below provides Huntrise's pre-MLSA profits over this period. December would go on to become the worst month of the Initial Period. These MLSA payments seemingly came out of nowhere and came at a time when trading performance had been poor. To the extent the trading activity would be considered economically attractive at this time, it was all because of MLSA.

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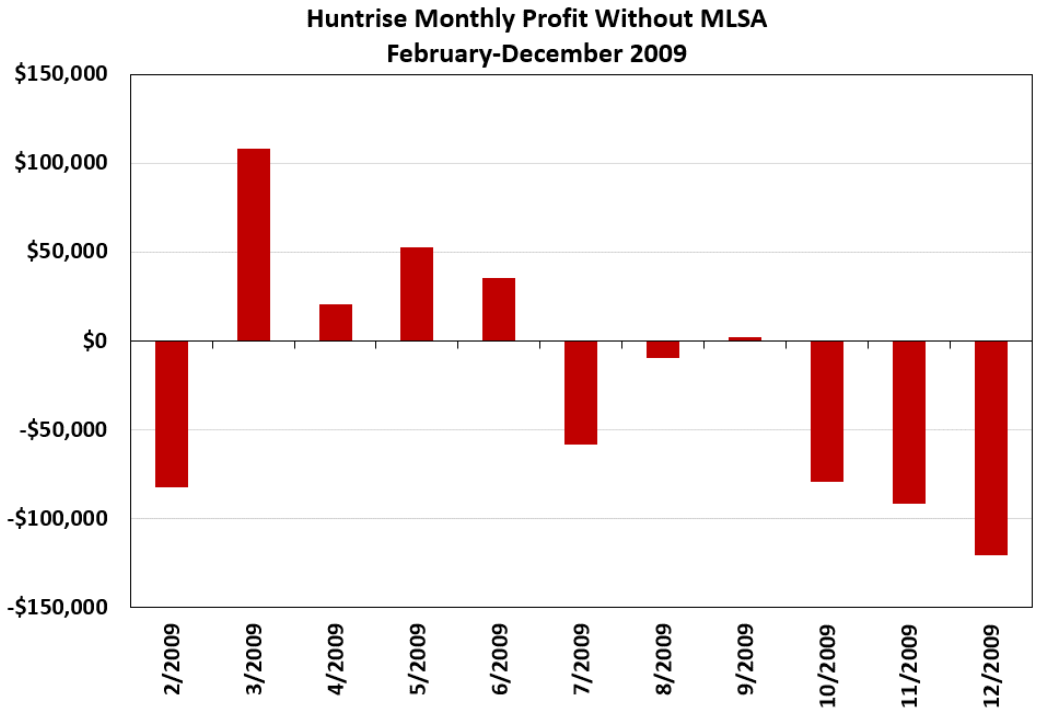
[39] Order Accepting Tariff Revisions, Docket No. ER10-2280-000.
[40] Chen deposition, October 7, 2010, pp. 44-45. December 3, 2021, p. 88.
[41] PJM Report of Refund, June 1, 2010. Docket EL08-14-007.
[42] Kevin Gates email of December 8, 2009. POW00008242.

Figure 24



93. Trading performance improved in January of 2010, but even then, the majority of profits were from MLSA payments. Soon after this period Chen increased trading volumes in HEEP and the TSF Investors increased their trading multiplier for Huntrise, which compounded the increase. The investors also began pursuing a dramatic increase in trading exposure beyond even that level. This is only economically rational based on performance in the Initial Period when one considers the MSLA payments.

C. Transition Period Trading

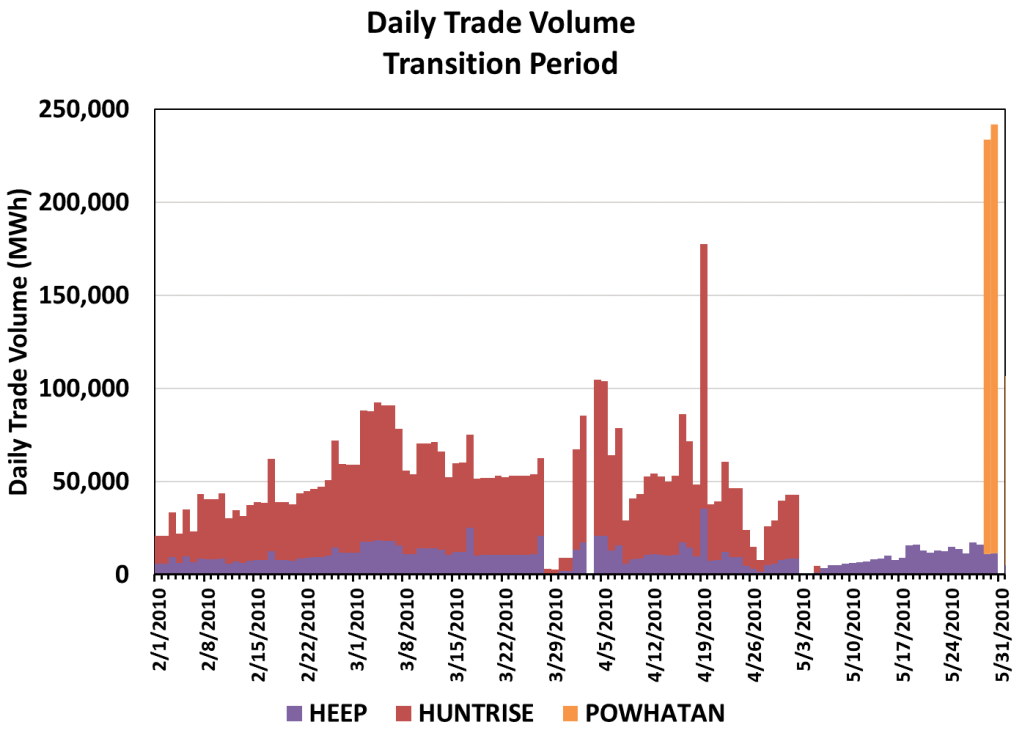
94. The Transition Period covers February 1 to May 31, 2010. The Transition Period saw significant change in Chen's trading practices and in the level of investment by TFS Investors. I have identified three broad changes to the trading practices relative to the Initial Period: 1) the nature of the trades changed, 2) the trading volumes increased, and 3) the TFS Investors sought greater exposure to this trading by increasing the trading multiplier. On the last day of trading in this period, May 30, these parties had the largest single-day loss of any day of UTC trading. This loss was, in part, a consequence of the changes that had been made to the trading strategy over the Transmission Period. Immediately after that loss, the new strategy of Round Trip Trades was adopted, which were not susceptible to the market effects that caused the losses of May 30, 2010. The circumstances leading to the adoption of the Round Trip Trades strategy are discussed in this section.

1. Trading Strategies in the Transition Period

95. While the Spread Trades in January 2010 immediately preceding the Transition Period were profitable, profits nearly tripled when MLSA payments were included. HEEP

volume in trades increased at the start of the Transition Period and several days into the period TFS Investors increased the multiplier to 4x from 2.5x. The chart below presents daily trade volume for HEEP, Huntrise and Powhatan.

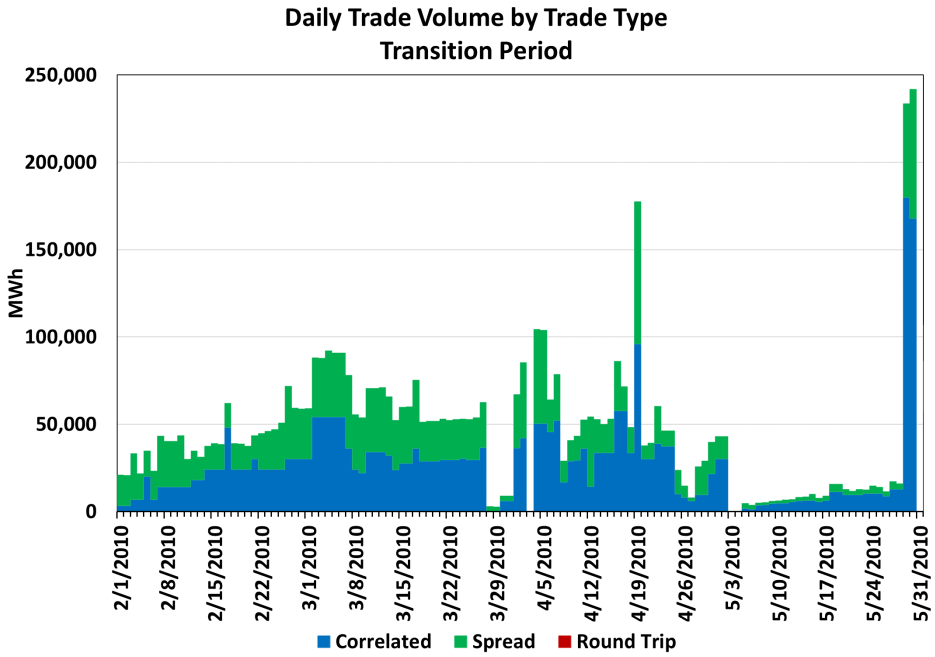
Figure 25



96. At no point in the Initial Period did the total daily trade volume exceed 30,000 MWh. By contrast, during the Transition Period this volume of trades was routinely exceeded. This jump in trade volume was partially attributable to the 4x multiplier, but HEEP volumes were higher as well. April 19 was a day of unusually high volume. Overall, daily trade volume commonly totaled between 50,000 and 100,000 MWh. Volumes dropped when Huntrise stopped trading. After a gap lasting several weeks in May, Powhatan began trading at unprecedented volumes, but then stopped after only two days. HEEP's trading volumes stayed roughly the same on those two days, but the 20x multiplier resulted in nearly 250,000 MWh of daily volume.

97. The figure below shows how the use of Correlated Trades grew quickly in the Transition Period. They accounted for the majority of trades over the period.

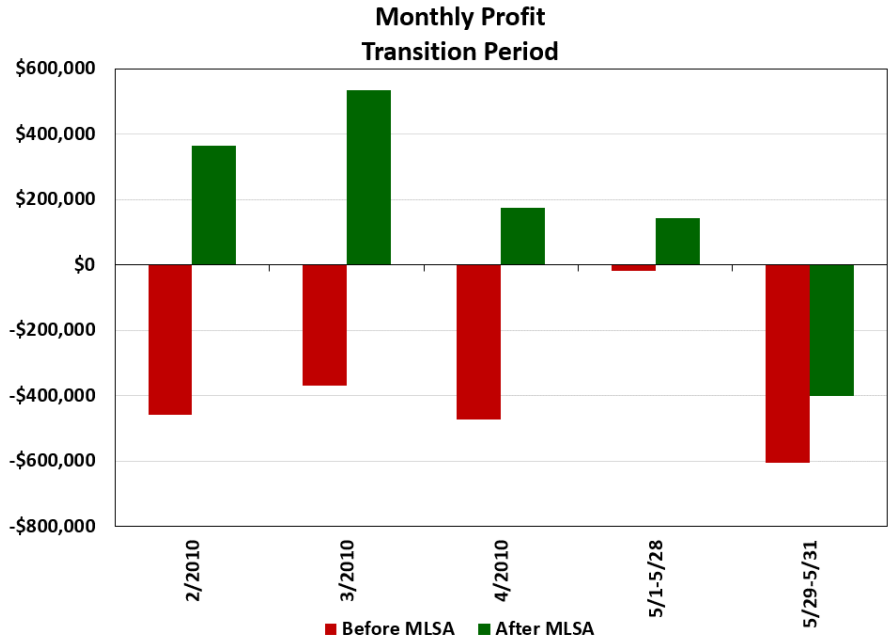
Figure 26



2. Trading Profits in the Transition Period

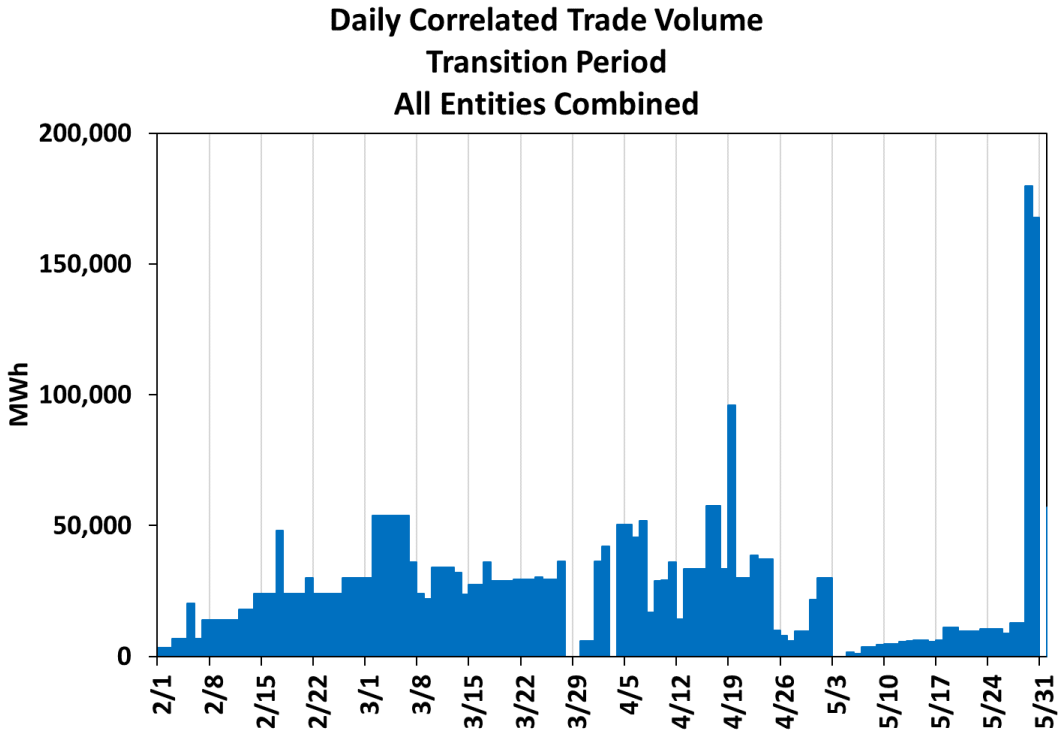
98. The profits from these Transition Period trades are shown in the figure below. In the chart I have broken May 2010 into two periods, from May 1-28 and then May 29-31. I divided the month because the two days of Powhatan trading at the end of the month are fundamentally different in terms of market performance and lead directly to the adoption of the Round Trip Trade strategy. Regardless of that detail, absent MLSA, all months in the Transition Period have significant losses. The MLSA payments turn those losses to significant profits, except for the last two days of trading. This is a significant change from the Initial Period where there were many months that were profitable before consideration of MLSA.

Figure 27



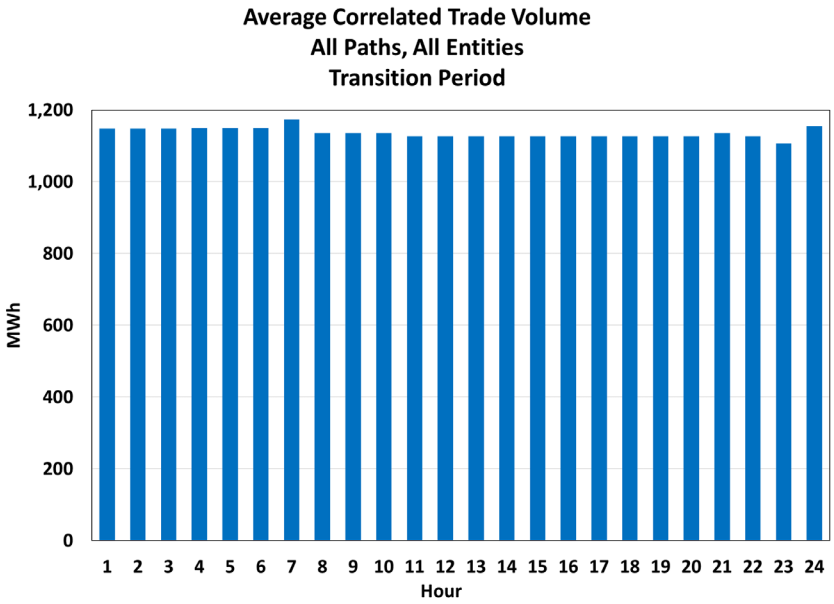
99. Relative to the Initial Period, the drop in profitability derived from price spreads during the Transition Period is dramatic. All four of the months have pre-MLSA losses greater than the largest monthly loss in the preceding 18 months. A major shift that occurred during the Transition Period was the use of Correlated Trades in pursuit of MLSA payments, which is explored in several figures that follow. During the most profitable and highest-volume period of Correlated Trades in the Initial Period (August 2008), daily volume with this strategy rarely exceeded 5,000 MWh. As shown in the following figure, volumes during this period are somewhere between five and ten times that amount. Overall, Correlated Trades throughout the Initial Period average under 200 MWh a day, while they average over 12,000 MWh a day during the Transition Period, including most of May when there was a three-week gap in any trading for TFS Investors.

Figure 28



100. In the Initial Period, there was a significant change in the volume of trade across the hours of the day for Correlated Trades, as was shown in Figure 23. By contrast, in this Transition Period, there was very little variation in trade volume from hour to hour, as shown below.

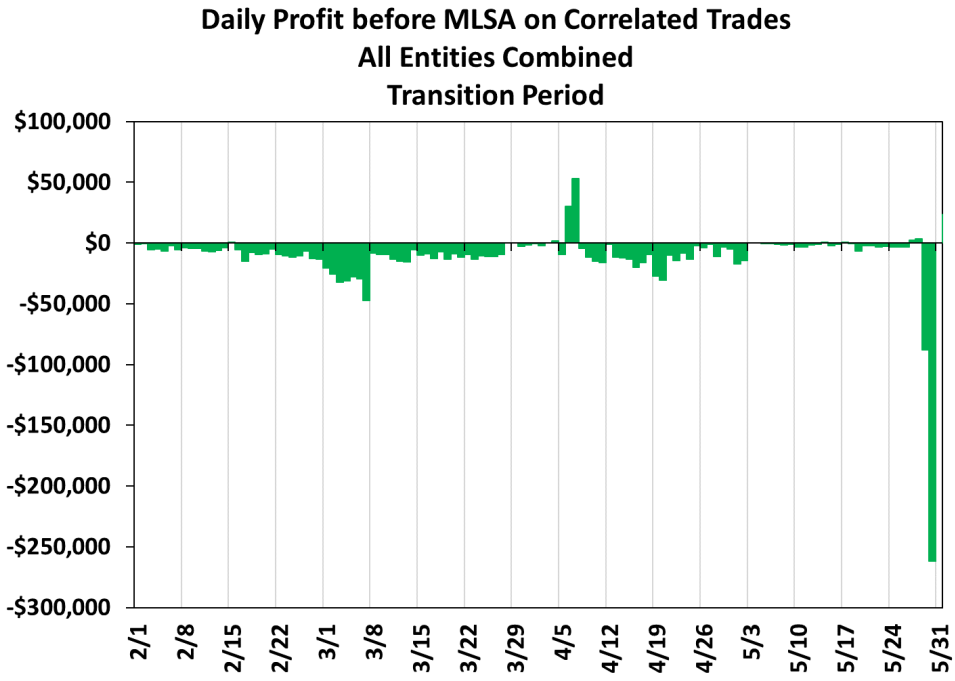
Figure 29



101. The next figure presents daily profits for Correlated Trades before inclusion of MLSA. It has already been shown that the trades were profitable solely on the basis of the MLSA payments. This figure demonstrates that during the Transition period these trades were routinely losing money pre-MLSA on a daily basis, day after day. I see no indication that there was any change in strategy in any significant way as a result of this performance. I infer that if a trader does not change their strategy, it is because the strategy is producing the intended results. Here, the results are profits over the long term solely from MLSA payments. The figure below shows only two days of material price-spread profits. Those two days should be put in perspective. They come in early April 2010, after nearly ten weeks of trading with routine pre-MLSA losses. Then, there are two days of profits on a pre-MLSA basis. Correlated Trades have this potential, as evidenced by the trading in 2008 previously discussed. Chen testified that he chose Correlated Trade paths that had this potential,[43] but neither the gains during two days in April, 2010, nor losses at other times such as early March, 2010, resulted in a change in strategy that was already profitable solely due to MLSA.

[43] Chen deposition, December 3, 2021, pp. 32-38.

Figure 30



102. In the Transition Period 60.8% of the Correlated Trades were on the GREENLAND GAP – MT STORM path discussed earlier. The rest of the Correlated Trades were on three other paths. Two of those were also traded during the Transition Period: COOK – ROCKPORT and APS – PENELEC. The last was MIAMI FORT 7 – EAST BEND 2. Most of these trades used MISO as the intermediary point in the AB-BC trade, but nodes connected to other external systems are used on occasion.

103. At first it may seem contradictory to assert that the same paths could be used for such fundamentally different purposes, profiting from spreads versus profiting from MLSA while keeping other costs (and spread variation) to a minimum. For example, the most actively traded path for MLSA-targeted revenue had been one of significant spread revenues in the prior period. There is a critical difference, however, in the characteristics of spreads on this path between the two periods. While GREENLAND GAP – MT STORM had been profitable more than a year-and-a-half earlier during the Initial Period, that path had been abandoned during the intervening months because profit-producing spread changes had stopped and the trade produced losses absent MLSA. The reason for abandoning the path provides a clear motive to turn back to it in the Transition Period for MLSA profits. A path with low spread variations fits into a strategy of profiting from MLSA. As a practical matter, it is also true that this path was well known.

104. The change in perspective regarding these paths is also evident from the trading patterns. There was no longer the inter- and intra-day trading variation that was evident when this path was traded for spread profits. The path was traded, day after day, with profits from MLSA. There were two days of spread profits in early April, so that was a possibility, but I see no evidence that this was a major consideration in this trading.

Instead, prior to the major loss of May 30, 2010, Chen's trading patterns on the TFS Investor's behalf generally stayed consistent. Traders keep their trading patterns consistent if they are achieving what the trader intends to achieve. Otherwise, am economically rational trader would adjust their trading patterns.

105. My conclusion that Chen and Powhatan were targeting profits from MLSA is supported by email among the parties and other evidence.

    a. On December 8, 2009, Kevin Gates emails TFS Investors, "…we were just reimbursed for a lot of 'transmission losses' that we were previously charged from his trading, but shouldn't have been. And, I do mean a lot: $440,000ish."[44]

    b. The trading multiple increases to 4x from 2.5x in early February, by direction of the TSF Investors. Over the course of the Transition Period, HEEP's volumes also increased, which was indicated in ongoing reports.

    c. In a February 19, 2010 email, Kevin Gates tells Chen, "I think everyone wants to try to get more exposure to power trading."[45]

    d. On March 5, 2010, Chen explained to Kevin Gates the role that Correlated Trades were playing in his trading during the Transition Period and the associated risks: "The volumes have increased pretty significantly, but the risks associated with the trades overall are actually lower than before. Most of the added volumes came from correlated pairs that produce a few cents or tens of cents up-side with almost no down-side risk. Without TLC, the transaction costs would absorb them and deem them unprofitable."[46]

    e. Also on March 5, 2010, Chen reported the February results to Kevin Gates and said, "without TLC we would have lost money in February 2010 and it is not a small amount either: HEEPF would have lost $113,093.15 and HUNT2 would have lost $382,853.00."[47] Instead, MLSA payments turned losses into profits of $62,869 and $264,140, respectively.

    f. In a March 5, 2010 email Chen goes on to say, "If I used 0% of TLC advantage in January 2010 and 25% in February 2010, I'm now using about 50% of TLC advantage in March 2010."

    g. In that same email chain, Chen says, "if PJM ever reverts back to those days without TLC or the TLC calculation was/is incorrect and we have to pay back all or some of the TLC refunds, we are going

[44] Kevin Gates email of December 8, 2009. POW00008242.
[45] Kevin Gates email to Chen, February 19, 2010. POW00012126.
[46] Chen email to Kevin Gates of March 5, 2010. POW00012123.
[47] Chen email to Kevin Gates of March 5, 2010, at 11:28 AM. POW00016981.

to be in big trouble. I have not heard anything about this at all, but just the thought nags me a lot."[48]

h. In that same email chain, Chen specifically presented his strategy to Gates as "tak[ing] advantage of MLSA" and asked for his feedback regarding how much they should take advantage of it.[49]

i. Chen further writes to Kevin Gates, "Without TLC, I would not touch some of the trades and/or would not put in large volumes for some of the trades. But with TLC as is, they are suddenly becoming risk-free (almost to the point) trades. I'll take down a little bit starting tomorrow knowing that we are leaving a lot of money on the table."

j. In response, Kevin Gates says, "Don't 'take down' tomorrow for my sake. I don't want to leave money on the table."

k. On March 19, 2010, Kevin Gates sent a presentation to other investors titled, "Rampin' up with Alan Chen."[50] The presentation notes that Chen has significantly increased volume, but not risk, and says that Chen describes the TLC-focused trading, "as almost a risk-free way to make money"[51] using, "…an atypical trade that is more cost effective than the traditional trades."[52] The role of TLC converting what would have been losses into profits is clearly articulated.[53] "The last couple of months, Alan has found a new 'risk free' trade that takes advantage of the fact that we now collect transmission losses."[54] Gates concludes that, "The strategy has more capacity, and we should scale-up."[55] Gates says in the cover email for the presentation, "In summary, it's too exciting and we need to have a lot of exposure this Summer." Gates also says he is creating a new partnership for this before summer.[56] The investors filed paperwork to create the Powhatan Energy Fund LLC three days later on March 22.[57]

106. Notably absent from the communications of either Chen or Powhatan during this time period is any reference to profiting from price spreads in any capacity. To the contrary, these communications are focused on profiting from MLSA. This is consistent with the

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[48] Chen email to K. Gates of March 5, 2010, at 11:28 AM. POW00016981.
[49] POW00016982.
[50] March 19, 2010 email and presentation from K. Gates. (POW00008000-07.)
[51] Ibid, p. 3.
[52] Ibid, p. 2.
[53] Ibid, p. 5.
[54] Ibid, p. 5.
[55] Ibid, p. 2.
[56] Ibid, cover email.
[57] Powhatan Energy Fund LLC Certificate of Formation, Delaware, March 22, 2010. (POW00001488-9.)

economic analysis above showing how the Correlated Trades were implemented in a manner that focused on profiting MLSA during this period. The emails are also consistent with my economic analysis of the MLSA-targeted trading as it evolved over time. This includes the change in the "TLC-targeted" nature of trades over time as described by Chen, the discussion of "tak[ing] down" volumes, the timing of the TFS Investor interest in "risk free" trades, and the assertion that the "strategy has more capacity."

107. The final Huntrise trades were made for May 5, 2010 as part of TFS Investors switching to Powhatan.[58] Chen traded solely for his own account under HEEP until Powhatan was set up and funded. On May 18, 2010 the advisory agreement between HEEP and Powhatan was established by which Chen traded UTCs for Powhatan's account, with a new compensation arrangement for Chen and an initial trading multiplier of twenty times HEEP volumes.[59] The first day of Powhatan trading was May 29, 2010. On the second day of trading there were substantial losses as a result of the large volume of trades.

108. The major loss on May 30, 2010, demonstrated a problem with the Correlated Trade strategy. By the morning of the next day, less than 24 hours after the losses were incurred, a new strategy had been adopted (Round Trip Trades). In my analysis I make much of the fact that trading patterns continue when outcomes are consistent with objectives. This instance provides an example of how traders react when outcomes are not consistent with objectives. The trading strategy was immediately changed.

3. Powhatan Initiates Trading and May 30 Losses

109. Powhatan began trading on May 29th, 2010, with a 20x multiplier relative to HEEP. HEEP's trading on that day and the next were just a little bit lower than it had been trading over the prior ten days. However, Powhatan's trading volume was now much higher than Huntrise's had ever been, meaning that when combined with HEEP, the two were now trading more volume than Chen and the TFS Investors had ever traded before. As has been discussed, high trading volumes can influence prices in ways that work against the profitability of the trade. This is what happened on May 30, 2010, leading to a loss of $368,602 even after inclusion of MLSA payments.

110. The most striking outcome on that day was a loss of $176,528 on just one Correlated Trade, with the losses coming in just three hours of the day. The path producing the loss is the same GREENLAND GAP – MT STORM path that was so profitable in 2008 and which Chen used with the greatest volume during the Transition Period. As will be discussed below, the loss on this path is reasonably attributed to the large volume Chen placed on the trade. The other losses on this day were clustered on spread trades, with one group of three paths causing the losses in the morning and a different group causing losses in the evening. It is reasonable to conclude that high trade volume of

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[58] Per trading data and emails between Chen and K. Gates of May 4, 2010. (HF-013075-7.)

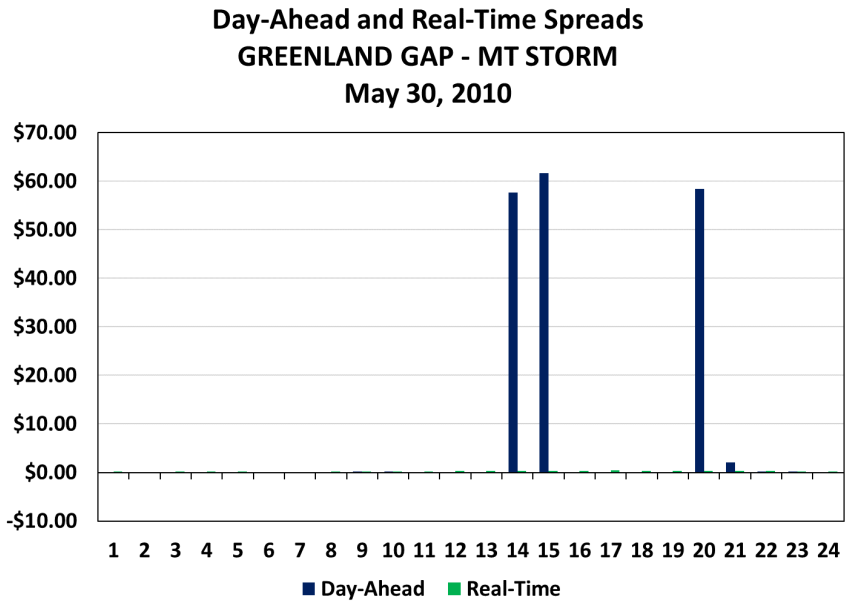
[59] Advisory Agreement by HEEP Fund Inc. and Powhatan Energy Fund LLC, May 18, 2010. (POW0000067-9.)

contributed to the losses on those paths as well, though I do not go through them in detail.

111. The volume of trades on the GREENLAND GAP – MT STORM path was 1,050 MW in each hour on this day, substantially more than the 400 MW that Chen been using as an upper limit to prevent price movements. The "B" point of this trade was MISO, far to the west, and therefore most of the flow caused by the trade was offsetting—except for the net flow directly between these two nodes. In three of the hours traded, the volume was so great it caused congestion that drove up the price difference in the day-ahead market.

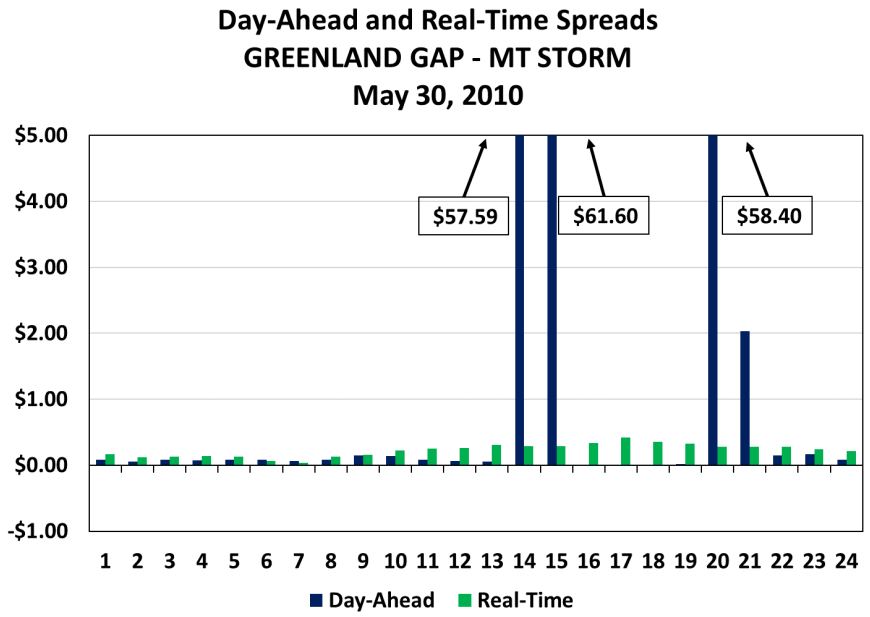
112. A UTC trade is considered virtual because when the trade is finally settled there is no extra generation or load on the system. The computer algorithms, however, treat it as if it is real in calculating prices. The May 30th trade forced the market to assume in each hour that an extra 1050 MWh was being generated at MT STORM and an extra 1050 MWh of load was being taken off as load at GREENLAND GAP in the day-ahead market. The easy solution was to have this energy flow on that very short line between those two points (See Figure 20). As long as the line could accommodate this flow of energy, the price difference was small. On three hours in particular, however, the excessive flow was significant and typical pricing would have overloaded the line. The computer model that sets prices does not let that happen. Instead, it determined that highly disruptive price differences were necessary to keep that line segment from being overloaded. It is worthwhile at this point to step inside the logic of the computer program that sets these prices. The only way to reduce flow is to dramatically change prices so that other sources of supply—real electric generators—either back down or start up to reduce flow on this line. Those disruptive prices show up as a dramatically different price spread in three hours, as shown in the figure below.

Figure 31



113. The same data is presented in the next figure, with the scale reduced. While the day-ahead price spreads were extreme, there is nothing unusual about the real-time prices in those hours. That is because the overloading effect of the UTC trade in the day-ahead market goes away in the real-time market. The line between these two points is not overloaded by normal flows. That does not mean the trade does not have some disruptive effects in the day-ahead market that carry over to real time. Some generators were given unusual operating instructions for those hours in the day-ahead market to alter their expected operating levels to reduce the flow on the line. While real-time prices likely returned the system to somewhat more normal operations for real-time operations, it should be expected that market inefficiencies remained as a result of the disruptive UTC trade.

Figure 32



114. The trades lost over $55/MWh on each MW in those hours. The volume of Correlated Trades on this path drove up the massive price difference in the day-ahead market. A knowledgeable trader would realize as soon as the day-ahead prices were published what had happened and would know substantial losses were inevitable even before the real-time prices were determined. This was true for Chen.

115. Chen did no trades for the next day, even though none of the losses in those three hours were known by the morning of the 30th when UTC trades for the 31st had to be placed. After the results of hour 12 came in, but before the results were in for the worst hours of the day, Chen emailed Kevin Gates to say, "Today's a pretty bad day."[60] He went on to say, "Too high volumes on very few nodes exacerbated the day-ahead spreads and I suspect the trades we put on affected the day-ahead model runs so much that some of the spread are looking abnormal to me. There are three hours (HE14,

[60] Email from Chen to K. Gates of May 30, 2010. HF-013511-3.

HE15, HE20) that the spread between two nodes (MT STORM and GREENLAND GAP) exceed $50, while only average $0.17 for all the remaining hours. These hours are going to be extremely bad for us." He added, "I'm staying away for today and will try to put on much smaller volumes tomorrow." There was additional email correspondence over the course of this day.

116. It bears noting that these May 30, 3010, extreme prices occurred on Sunday of Memorial Day weekend. Sunday is usually the lowest load day of the week, and a holiday weekend is typically even lower than usual. Congestion on the transmission system often happens during high load periods. Thus, not only did these high volumes traded by Chen and Powhatan cause problems almost immediately, they did so in hours where one would least expect transmission congestion on this scale.

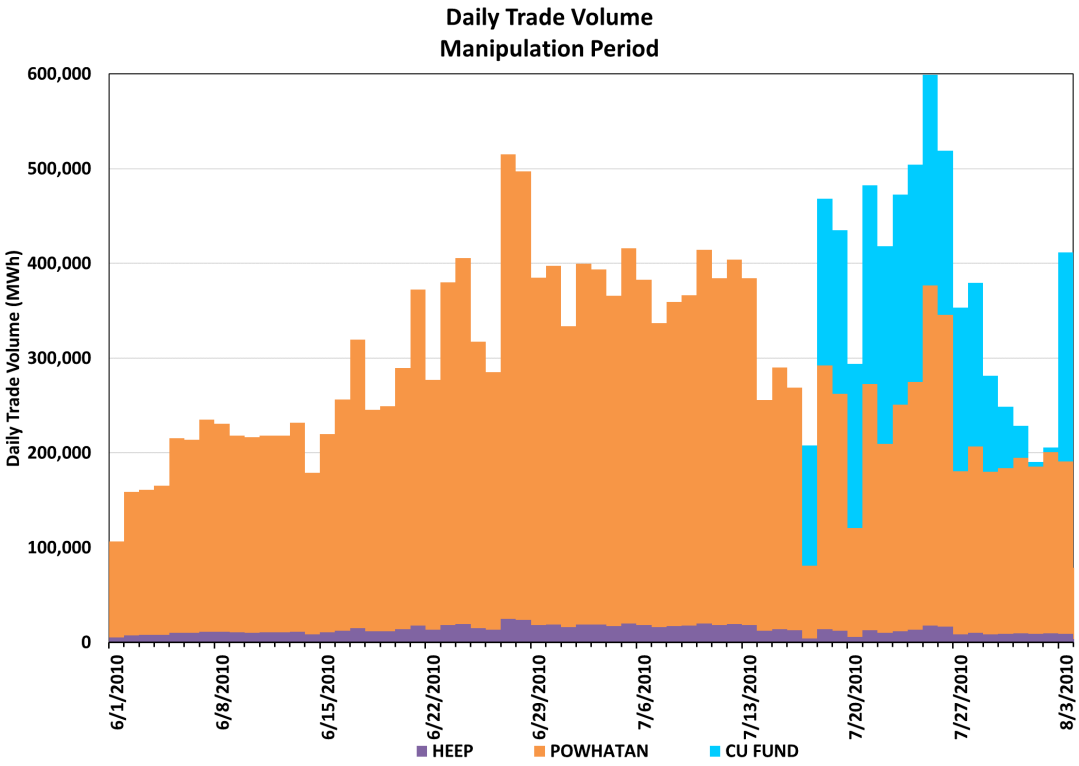
D. Manipulation Period Trading

117. The Manipulation Period spans from June 1 to August 3, 2010. All of the Round Trip Trades were conducted during this period and there were Round Trip Trades placed every day. Chen also placed Spread Trades and Correlated Trades on Powhatan's behalf during this period.

1. Trading Strategies in the Manipulation Period

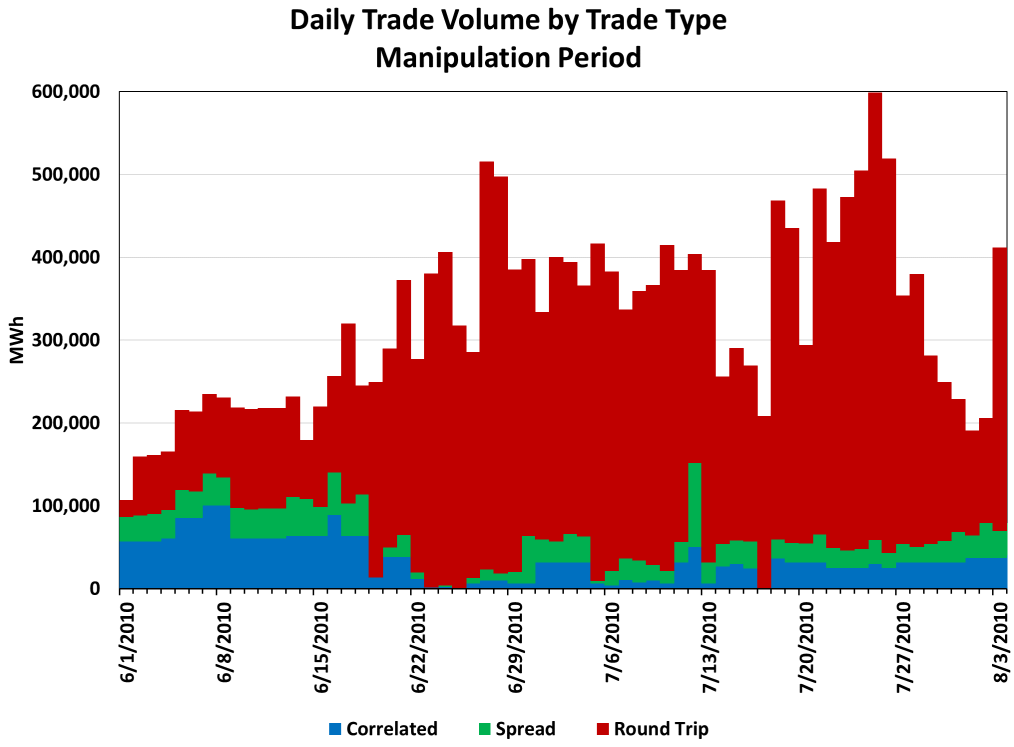
118. Trade volume increased substantially during the Manipulation Period, as shown in the figure below. Large-volume days during the Transition Period were usually around 100,000 shares or below, and under 25,000 shares during the Initial Period. This high volume consisted solely of HEEP and Powhatan until CU Fund started trading on July 17, 2010.

Figure 33



119. As shown in the figure below, Round Trip Trades dominated trading during the Manipulation Period. The volume of Spread Trades was similar to what it had been during the Transition Period. Correlated Trades started out with higher volumes, somewhat more than what HEEP and Huntrise traded during the Transition Period, but these volumes were reduced after around June 19. The growth in Round Trip Trades more than offset this reduction.

Figure 34

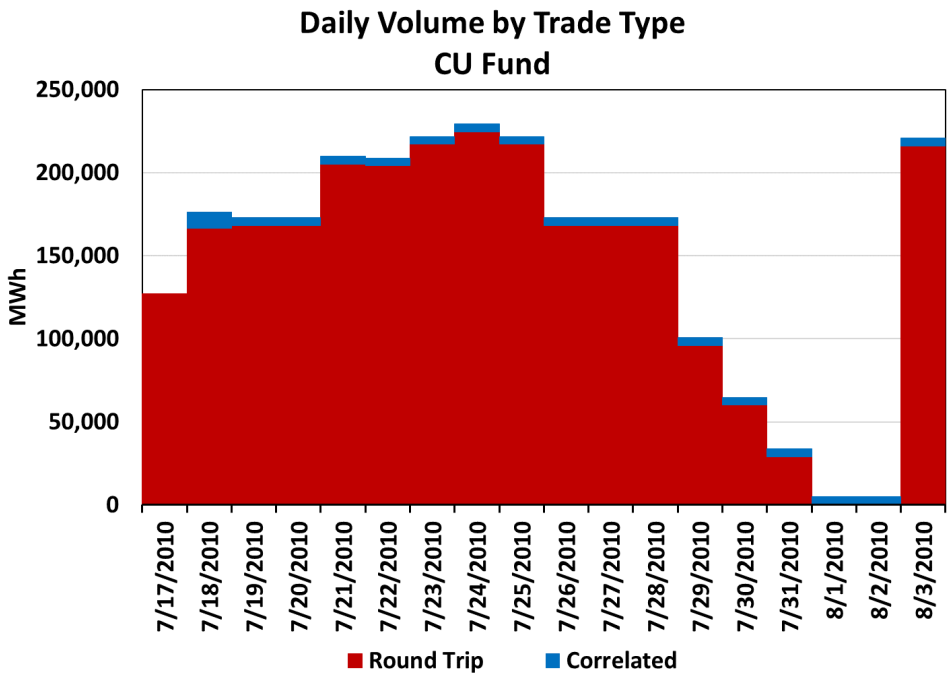


120. The first Round Trip Trades were placed by Chen and Powhatan on the morning of May 31, 2010 (Memorial Day) for June 1. These were placed just hours after the large losses of May 30, 2010. As discussed above, those losses were a direct result of the market effects of the large volume of trades on that day. Round Trip Trades solved the problem caused by extremely large volumes of Correlated Trades. There are no market price effects when supply and demand are equal and at the same point. Round Trip Trades were a logical next step in an evolving strategy in the pursuit of MLSA profits. As Chen testified in deposition, he realized that he could eliminate the risk of loss associated with price differences between the A and C nodes of a Correlated Pair by using the same node for both – that is, by eliminating the price differences caused by A and C nodes, and trading directly from A to B and B to A.[61]

121. A trader's actions provide insights into their view of trading activities. With CU Fund, Chen's actions indicate he was no longer satisfied with merely having a share of the profits. Chen chose to put his own money at risk in order to capture all of the profits on those trades. Further, it is reasonable to expect that he would put his best, most-profitable, least-risky trades in that account. As shown in the figure below, when Chen traded for his own account with his own money, nearly all of the trades were Round Trip Trades.

[61] Chen deposition December 3, 2021, pp. 55-56.

Figure 35



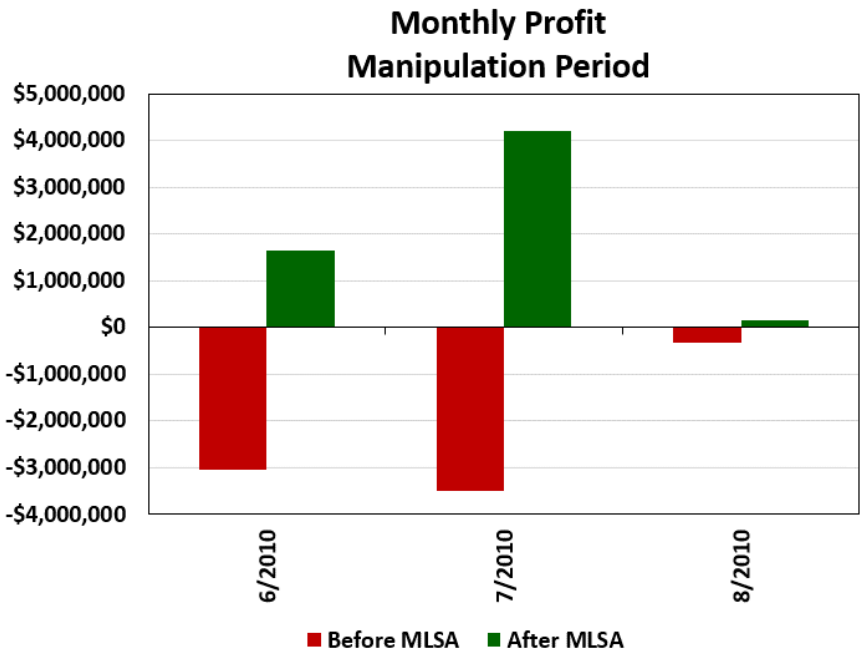
122. Chen received a call from Joe Bowring, President of Monitoring Analytics, the firm that is PJM's Independent Market Monitor on August 2, after his trades for August 3 had been placed, asking him to stop making Round Trip Trades.[62] Chen made no further trades of any kind for CU Fund after this call. He continued making Correlated Trades and Spread Trades for HEEP and Powhatan until August 16 when PJM made a formal referral to FERC regarding potential violations of the PJM Tariff by Powhatan, HEEP, CU Fund and others.[63] There were no further trades on these accounts in 2010, although HEEP and Powhatan did have other trades in later years unrelated to the trades at issue in this case.

2. Trading Profits in the Manipulation Period

Overall, the trades of Powhatan, HEEP and CU Fund were profitable the Manipulation Period. Those profits resulted solely from the MLSA payments. August profits appear small in this figure below because only three days are included. The figures for August on a daily rate basis are similar to July.

[62] Chen deposition, December 3, 2021, pp. 76-78.
[63] PJM Referral to FERC, August 16, 2010.

Figure 36


Monthly Profit
Manipulation Period
$5,000,000
$4,000,000
$3,000,000
$2,000,000
$1,000,000
$0
-$1,000,000
-$2,000,000
-$3,000,000
-$4,000,000
6/2010
7/2010
8/2010
Before MLSA
After MLSA

V. THE MANIPULATIVE ROUND TRIP TRADES

123. The Commission has found that the Round Trip Trades are manipulative wash trades. These Round Trip Trades were made on every day from June 1 through August 3, 2010, through three different trading entities: Powhatan, HEEP and CU Fund. The table below provides summary statistics on these trades.

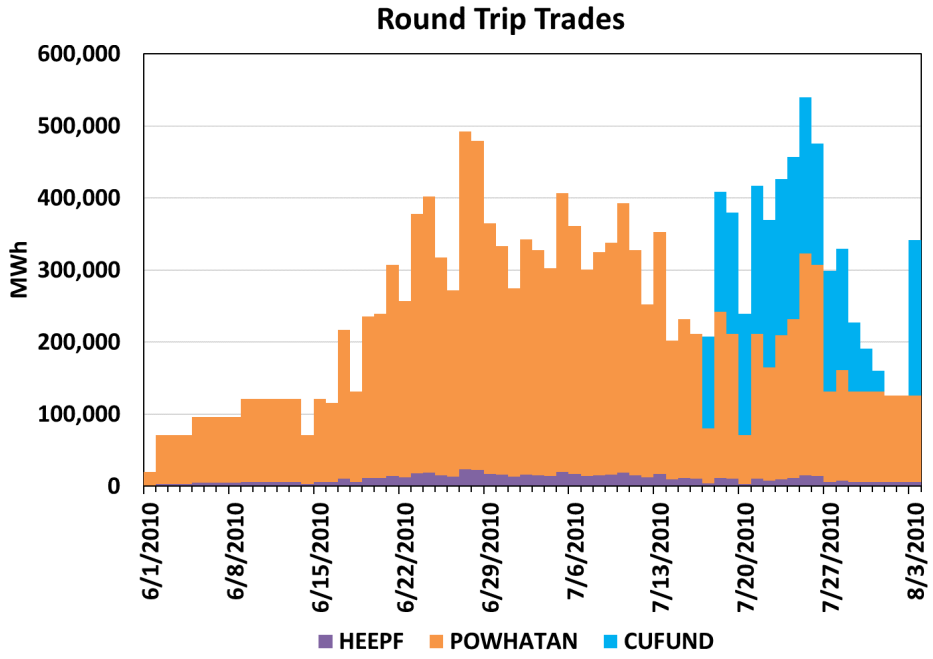
Figure 37

Round Trip Trades

Entity	Trade Volume (MWh)	Spread Revenue	Fees	MLSA	Profits
POWHATAN	13,352,560	$0	$4,510,184	$7,975,403	$3,465,220
HEEP	667,628	$0	$225,670	$398,770	$173,100
CU Fund	2,602,000	$0	$703,570	$1,784,145	$1,080,576
Total	**16,622,188**	**$0**	**$5,439,423**	**$10,158,319**	**$4,718,895**

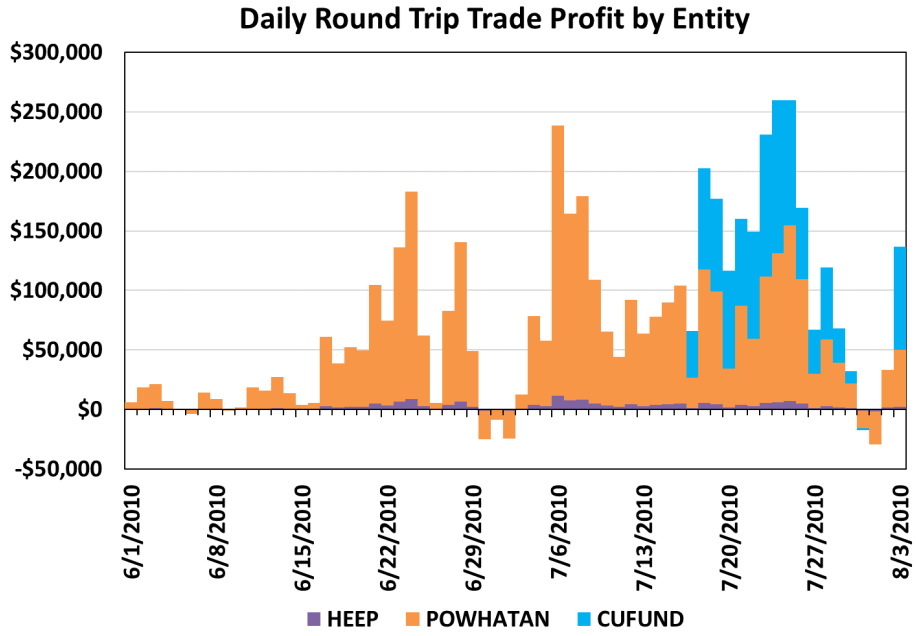
124. Throughout this period, Round Trip Trade volumes in the HEEP and Powhatan accounts were made in direct proportion, with 20 MWh of trades in the Powhatan account for every 1 MWh of trades in HEEP. Over the 64 days of the Manipulation Period, there were Round Trip Trades on every day for both of these accounts. Chen started trading CU Fund on July 17 and made Round Trip Trades for that entity on almost every day until it was also stopped on August 3. The figure below shows the daily volume of these trades for the three entities. In general, the Round Trip Trades in the HEEP and Powhatan accounts grew for the first three weeks of June, stayed consistently high for the following three weeks, and then was somewhat reduced and essentially replaced with CU Fund trade volume.

Figure 38



125. HEEP, Powhatan, and CU Fund made over $4.7 million in profits from the Round Trip Trades. All of those profits came solely from the MLSA, which – at over $10 million – was enough to overcome the cost of ancillary services and transmission. The MLSA payments were variable, but routinely in excess of those costs. Over this period Round Trip Trades averaged a profit of $73,731 a day.

Figure 39



The paths for these trades are summarized in the table below. The trading volume is highly concentrated, with 87.4% conducted on only three paths, 12.5% more on the next two most-traded paths, and less than 0.2% on the remaining six least-traded paths.

Figure 40

Round Trip Trade Statistics

Trade Data by Path and Entity

Round Trip Trade Data by Path											
Entity	First Trade	Last Trade	Path	Volume (MWh)	Trades	Spread Revenue	Ancillary Services	Transmission	Fees	MLSA	Profits
POWHATAN	6/2/2010	8/3/2010	COMED - MISO	5,005,200	3,024	$0	$1,053,793	$706,032	$1,759,825	$2,979,176	$1,219,351
POWHATAN	6/1/2010	8/3/2010	DAY - MISO	4,129,600	3,070	$0	$871,120	$513,109	$1,384,229	$2,446,789	$1,062,560
POWHATAN	6/19/2010	8/3/2010	COOK - MISO	2,227,200	2,208	$0	$468,972	$244,173	$713,145	$1,350,736	$637,590
POWHATAN	6/23/2010	7/26/2010	ROCKPORT - MISO	1,401,600	1,488	$0	$289,602	$159,814	$449,416	$893,002	$443,586
POWHATAN	6/2/2010	6/20/2010	AEP - MISO	566,400	912	$0	$123,038	$71,786	$194,824	$284,886	$90,062
POWHATAN	6/29/2010	7/7/2010	YUKON - MISO	12,800	128	$0	$2,676	$2,476	$5,152	$9,855	$4,703
POWHATAN	6/29/2010	6/29/2010	APS - MISO	3,200	32	$0	$695	$198	$893	$2,233	$1,340
POWHATAN	6/29/2010	6/29/2010	PENELEC - MISO	3,200	32	$0	$695	$134	$829	$2,233	$1,404
POWHATAN	6/24/2010	6/24/2010	PSEG - NYIS	1,680	28	$0	$365	$577	$942	$3,246	$2,304
POWHATAN	6/24/2010	6/24/2010	MARION - NYIS	1,120	28	$0	$243	$375	$618	$2,164	$1,546
POWHATAN	6/24/2010	6/24/2010	LEONIA 230 T-1 - NYIS	560	28	$0	$122	$188	$309	$1,082	$773
Subtotal				**13,352,560**	**10,978**	**$0**	**$2,811,322**	**$1,698,862**	**$4,510,184**	**$7,975,403**	**$3,465,220**
HEEP	6/2/2010	8/3/2010	COMED - MISO	250,260	3,024	$0	$52,867	$35,302	$88,168	$148,959	$60,790
HEEP	6/1/2010	8/3/2010	DAY - MISO	206,480	3,070	$0	$43,578	$25,656	$69,234	$122,339	$53,105
HEEP	6/19/2010	8/3/2010	COOK - MISO	111,360	2,208	$0	$23,460	$12,209	$35,669	$67,537	$31,868
HEEP	6/23/2010	7/26/2010	ROCKPORT - MISO	70,080	1,488	$0	$14,487	$7,930	$22,417	$44,650	$22,233
HEEP	6/2/2010	6/20/2010	AEP - MISO	28,320	912	$0	$6,155	$3,589	$9,744	$14,244	$4,500
HEEP	6/29/2010	7/7/2010	YUKON - MISO	640	128	$0	$134	$124	$258	$493	$235
HEEP	6/29/2010	6/29/2010	APS - MISO	160	32	$0	$35	$10	$45	$112	$67
HEEP	6/29/2010	6/29/2010	PENELEC - MISO	160	32	$0	$35	$7	$41	$112	$70
HEEP	6/24/2010	6/24/2010	PSEG - NYIS	84	28	$0	$18	$29	$47	$162	$115
HEEP	6/24/2010	6/24/2010	MARION - NYIS	56	28	$0	$12	$19	$31	$108	$77
HEEP	6/24/2010	6/24/2010	LEONIA 230 T-1 - NYIS	28	28	$0	$6	$9	$15	$54	$39
Subtotal				**667,628**	**10,978**	**$0**	**$140,788**	**$84,882**	**$225,670**	**$398,770**	**$173,100**
CUFUND	7/17/2010	8/3/2010	COMED - MISO	1,142,000	768	$0	$235,244	$64,484	$299,728	$782,978	$483,250
CUFUND	7/17/2010	8/3/2010	DAY - MISO	1,139,800	768	$0	$234,795	$84,397	$319,191	$784,943	$465,751
CUFUND	7/17/2010	8/3/2010	COOK - MISO	320,200	720	$0	$65,897	$18,753	$84,651	$216,225	$131,574
Subtotal				**2,602,000**	**2,256**	**$0**	**$535,936**	**$167,634**	**$703,570**	**$1,784,145**	**$1,080,576**
Grand Total				**16,622,188**	**24,212**	**$0**	**$3,488,046**	**$1,951,378**	**$5,439,423**	**$10,158,319**	**$4,718,895**

Figure 41

Summary Trade Data by Path

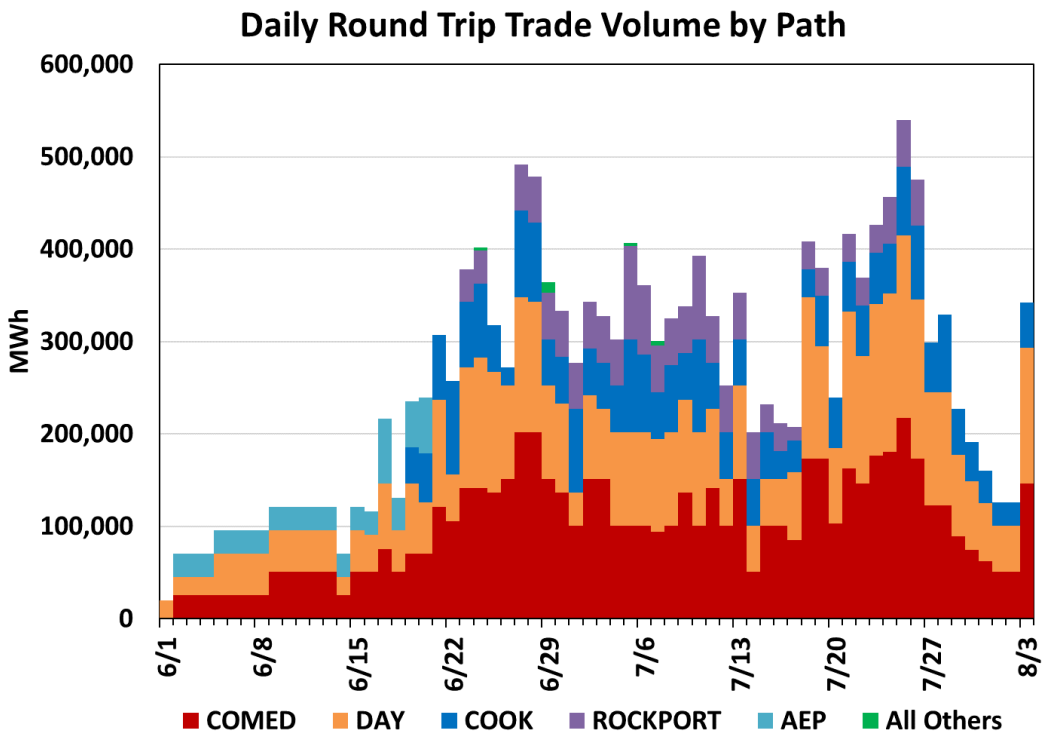
Percentage Share				Total							
Profits	Trade Volume (MWh)	Hours Traded	Path	Volume (MWh)	Trades	Spread Revenue	Ancillary Services	Transmission	Fees	MLSA	Profits
37.4%	38.5%	28.2%	COMED - MISO	6,397,460	6,816	$0	$1,341,904	$805,817	$2,147,722	$3,911,113	$1,763,391
33.5%	32.9%	28.5%	DAY - MISO	5,475,880	6,908	$0	$1,149,493	$623,161	$1,772,654	$3,354,071	$1,581,417
17.0%	16.0%	21.2%	COOK - MISO	2,658,760	5,136	$0	$558,330	$275,136	$833,465	$1,634,497	$801,032
9.9%	8.9%	12.3%	ROCKPORT - MISO	1,471,680	2,976	$0	$304,089	$167,744	$471,833	$937,652	$465,819
2.0%	3.6%	7.5%	AEP - MISO	594,720	1,824	$0	$129,193	$75,375	$204,568	$299,131	$94,562
0.1%	0.1%	1.1%	YUKON - MISO	13,440	256	$0	$2,810	$2,600	$5,410	$10,348	$4,938
0.0%	0.0%	0.3%	APS - MISO	3,360	64	$0	$730	$207	$937	$2,345	$1,407
0.0%	0.0%	0.3%	PENELEC - MISO	3,360	64	$0	$730	$141	$871	$2,345	$1,474
0.1%	0.0%	0.2%	PSEG - NYIS	1,764	56	$0	$383	$606	$989	$3,409	$2,420
0.0%	0.0%	0.2%	MARION - NYIS	1,176	56	$0	$255	$394	$649	$2,272	$1,623
0.0%	0.0%	0.2%	LEONIA 230 T-1 - NYIS	588	56	$0	$128	$197	$325	$1,136	$812
100.0%	**100.0%**	**100.0%**	**Total**	**$16,622,188**	**$24,212**	**$0**	**$3,488,046**	**$1,951,378**	**$5,439,423**	**$10,158,319**	**$4,718,895**

126. As shown in the table above, the spread revenue was zero for every Round Trip Trade. Thus, not only were the Round Trip Trades profitable from the MLSA payments, but the strategy successfully eliminated all spread value changes.

127. The next chart plots daily trade volume by path. All three entities are combined in this table. The two most heavily traded paths, involving COMED and DAY, were traded throughout the period. The AEP path was traded initially, but then essentially replaced

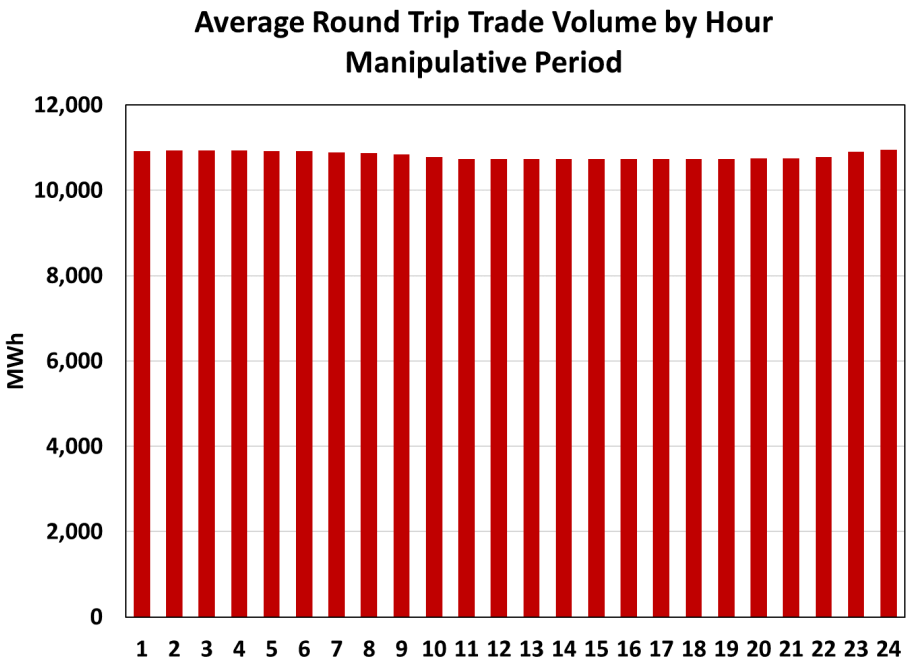
with the COOK and ROCKPORT paths. Trading on other paths was rare and is barely noticeable on the figure. With the exception of a very small amount of trades on a single day, June 24, all of the trades were with MISO as the “other” node.

Figure 42



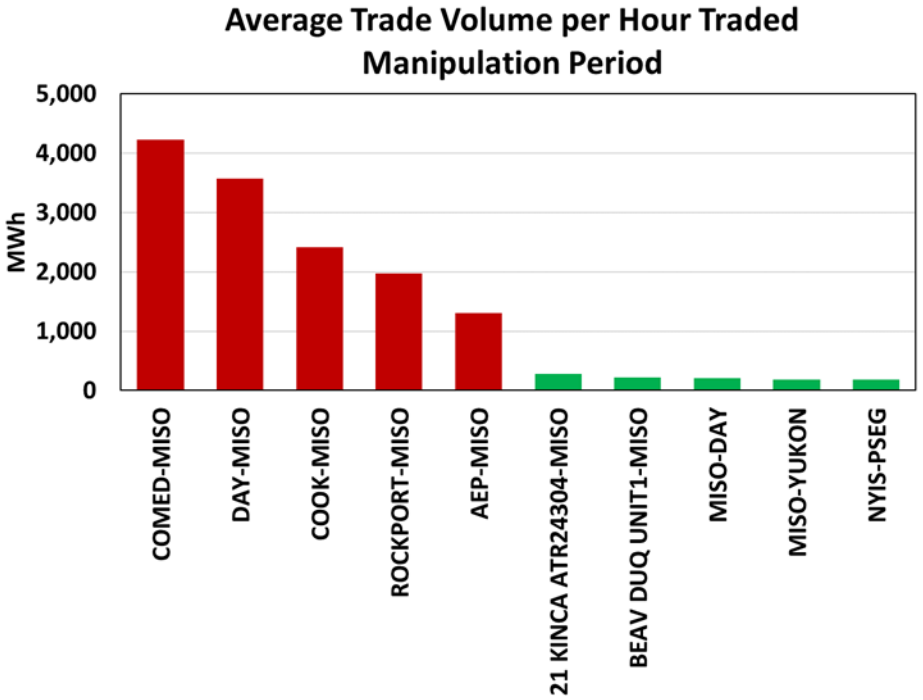
128. There was essentially no variation among the Round Trip Trades in the trade volume in each hour of the day. The following chart provides average Round Trip Trade volume for all three entities combined in each hour of the day. Over the course of a given day there was very little hourly variation in trading volume.

Figure 43



129. Another difference between Round Trip Trades and Spread Trades is the sheer volume of the former. Whereas Chen used a 400 MW threshold to protect against negative price effects for his Spread Trades for the combination of funds he was trading, including those for the TFS Investors, the wash-trade nature of Round Trip Trades meant that they had no effect on prices and thus that was no longer a limit. The figure below presents the maximum and average trading volume of the most frequently used Round Trip Trade paths (summing both directions), and compares that to the average volume of the five Spread Trade paths with the highest volume over the Manipulation Period.

Figure 44

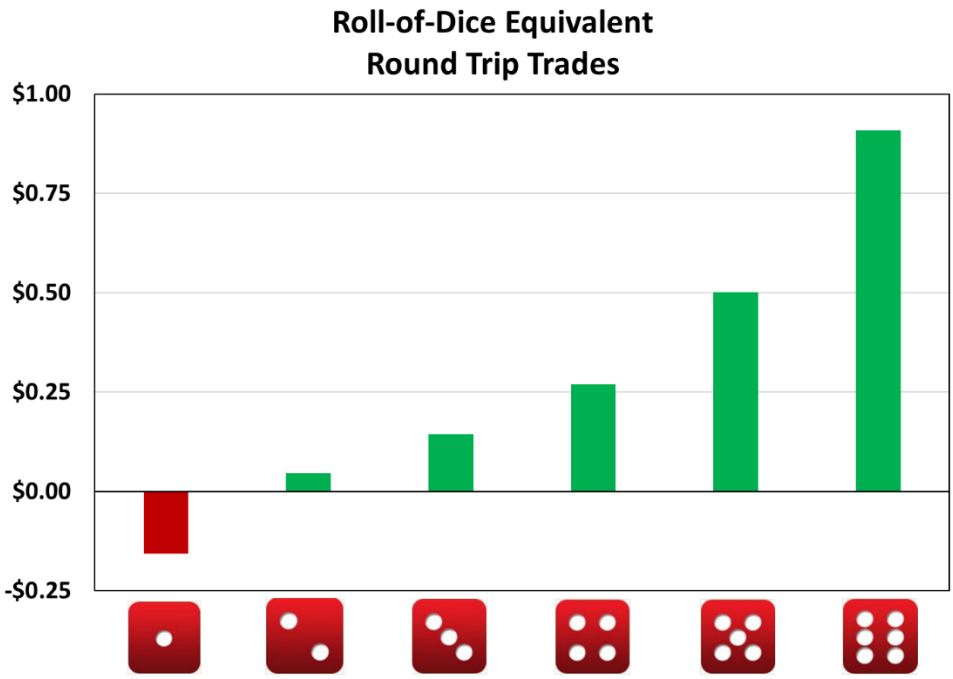


130. The Round Trip Trade strategy was profitable. It was also simple. A high volume of trades was placed on a small number of paths, day in and day out. The specific paths did not significantly affect the economics of these trades, since the spread values always netted to zero. That said, the paths chosen used PJM nodes that are particularly close to MISO, minimizing the risk of a leg breaking. The MLSA payments varied, but they greatly exceeded the costs over the long run. There was no significant refinement in the strategy over time to reflect market conditions, other than the overall strategy of targeting the high load summer period, and perhaps some minor volume variations based on daily load levels. While there was a minor change in the paths selected, I find no basis to conclude that market conditions were a material factor in the selection of Round Trip Trade paths. There is no variation in trading based on the hour of the day, despite the fact that electricity markets routinely change dramatically from low-load conditions in the middle of the night to peak-load conditions in daytime hours.

131. The individual Round Trip Trades were not profitable in every instance. Occasional losses on individual trades or in individual hours does not mean that the strategy was risky in the long run. To make this point by way of an analogy, I sorted the Round Trip Trades from most to least profitable on a $/MWh basis and divided them into six different groups, or tranches, such that each tranche has the same MWh volume. I then calculated the average performance of each tranche. This is shown in the chart below. One can think of the six values as the outcome of a role of a dice. These trades essentially involved rolling this dice in every hour of every day, from the day the trades were first made until the day the Independent Market Monitor called to stop the trading. There was uncertainty in the outcome of any single roll of the dice. Losses did occur. But the profits greatly, and consistently, exceeded the losses. This conceptualization of

the trading allows for consideration of what constitutes risk. There is uncertainty in any single roll of the dice. With repeated rolls of the dice, however, profits are essentially guaranteed.[64]

Figure 45



[64] There are likely patterns of serial correlation in the outcomes of Chen's trading involving the hours of the day and from day-to-day, while the analogy does not have any such correlation.

VI. MARKET HARM RESULTING FROM ROUND TRIP TRADES

132. The Round Trip Trades harmed the market, other participants in the market, and consumers. The market harm includes the fact that these trades received MLSA payments that would have otherwise gone to other entities. The harm also extends to other effects of the trading, including market disruptions in the spreading of false information and market inefficiencies. Specifically, the harm caused by the Round Trip Trades includes:

- Receiving payments of over $10 million that should have gone to other market participants.
- Depriving electricity consumers of money that would have gone to them in the pass-through of MLSA payments.
- Impeding trade through the reservation of transmission capacity.
- Sending false information to the market.
- Making the market less efficient, and otherwise impeding a well-functioning market, to the detriment of other market participants.

133. I note that the Commission,[65] PJM,[66] and the Independent Market Monitor[67] have also concluded that the Round Trip Trades, as well as other MLSA-targeted trades of the summer of 2010, harmed the market. Once the problem of large volumes of MLSA-targeted trading was discovered, PJM and the Independent Market Monitor took steps quickly to address the problem by calling parties engaged in such trading, conducting analysis of the trading, preparing materials for presentation to PJM members in the Market Committee meeting, proposing changes to the PJM Tariff to change the MLSA allocation procedure, engage PJM members in approving those changes and ultimately filing the changes for FERC approval on an expedited basis.

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[65] Order Assessing Civil Penalties, P 1, et al.

[66] The PJM Referral states, "PJM believes the conduct constitutes manipulation under the Commission's rules and results in unjust and unreasonable outcome to other participants in PJM's markets" (p. 4). The referral describes transactions that "illegitimately collect larger allocations of the marginal loss surplus" (p. 2). The PJM Referral discusses a market participant's complaint about the problem to PJM on July 23, referencing transmission reservations of Coaltrain and City Power Marketing, LLC (City Power), and questioning whether some parties were "trying to game the system in some way" by "trying to lock people out of transmission purchases." Another market participant made a similar call on July 28. In addition, Serge Picard of Black Oak Energy described in testimony how he discovered the activity because of the problems it was causing him when arranging transmission, and how he contacted PJM on August 3. Serge Picard testimony, September 10, 2010, pp. 115-116 (PJM call), pp. 84-154 (discussion of transmission reservation problems).

[67] IMM MLSA Referral.

A. Round Trip Trades Take Payments That Would Have Gone to Others

134. As a result of the Round Trip Trades, the entities received MLSA payments that would otherwise have gone to other market participants. These amounts were $7,975,403 for Powhatan, $398,770 for HEEP and $1,784,145 for CU Fund, for a total of $10,157,169. This is a direct measure of one type of harm to the market.

135. As discussed, PJM makes MLSA payments because it over-collects losses in operating its market. The hourly over-collection is then distributed on an equal $/MWh basis to wholesale market participants that purchased paid transmission. If Powhatan, HEEP and CU Fund had not conducted Round Trip Trades, the MLSA payments they received would have gone to others. In response to a data request, PJM provided a breakdown of the participants that would have received this money, and the top ten recipients are summarized below.[68] All of these entities are utilities that buy electricity on the wholesale market and serve retail customers.

Figure 46

Total Simulated Loss Credit Adjustment by Participant: June to August 2010

Company	Powhatan	HEEP	CU Fund	Total
Appalachian Power Company	$1,135,311	$54,122	$239,394	$1,428,827
Dominion Virginia Power	$898,632	$42,839	$188,070	$1,129,540
Commonwealth Edison Company	$508,885	$24,268	$113,564	$646,717
PECO Energy Company	$446,661	$21,286	$93,335	$561,281
Constellation NewEnergy, Inc.	$233,953	$11,150	$48,686	$293,789
PSEG Energy Resources and Trade LLC	$224,599	$10,706	$47,201	$282,506
Allegheny Energy Supply Company, LLC	$188,509	$8,988	$39,328	$236,825
Metropolitan Edison Company	$146,446	$6,981	$30,876	$184,303
Dayton Power & Light Company	$145,741	$6,951	$31,173	$183,865
Pennsylvania Electric Company	$134,917	$6,430	$27,765	$169,113

136. I have excluded from this list any market participants that were also accused of MLSA-targeted trading. In PJM's calculations for this case, those other trades were assumed to still be eligible for MLSA payments. If those entities were excluded from the calculations, the values in the table above would be higher. In any case, all of the $10 million would have been re-distributed absent the Round Trip Trades.

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[68] Data is provided with a letter from Steven Shparber, Counsel for PJM, to Samuel G. Backfield of FERC, January 20, 2015 (AR_000790-855). The analysis was done individually for each entity, such that, for example, if when Powhatan is analyzed, some of the MLSA it received from Round Trip Trades is assumed to go to HEEP. That means that the numbers in the table underestimate the likely outcomes if one assumes that all MLSA-targeted trades had not been made.

B. Redistributed MLSA Payments Would Largely Flow to Consumers

137. As noted above, absent the Round Trip Trades, approximately $10 million of MLSA payments that the three entities received would have gone to other wholesale market participants. The majority of those funds would have been passed on to consumers. The process by which this is done depends on the wholesale entity that receives the distribution and its regulatory framework. There are several categories of wholesale entities.

138. The first are investor-owned, regulated public utilities that serve customers on a cost-of-service basis. The general principle of how electricity rates are set is that all costs are passed on to consumers. The process is typically regulated at the state level. States adopt different methods for dealing with different categories of costs. Some are passed through directly, some are dealt with prospectively, and some are passed through over time. While this can mean there is no direct identification of the recovery of every dollar of costs incurred, it is the general principle in setting rates. Absent the Round Trip Trades, the cost of energy to consumers would have been lower, because the MLSA payments would have been higher. The regulatory process routinely deals with energy cost variations and the setting of rates to customers to allow the recovery of costs incurred by utilities.

139. Some customers are served by not-for-profit utilities, such as municipal power agencies or rural electric cooperatives. These entities are either “owned” by their members or by a government agency. In any event, they pass all costs along to consumers. The increased MLSA payments would be reflected as lower costs, and so consumers would have benefitted.

140. There are circumstances where the MLSA payments may not be passed along to retail consumers. Some consumers are served under fixed contracts by for-profit, non-rate-regulated energy providers. In those cases, the increased MLSA payments would likely have been retained by those companies. Some traders were engaged in transactions that were eligible for MLSA payments but were not MLSA-targeted trades (such as spread-focused UTC trades), and they would have received higher payments.

C. Round Trip Trades Impede Interregional Trade

141. Round Trip Trades disrupt the operation of the overall electric system by impeding trade into and out of PJM. This is because Round Trip Trades required transmission capacity on OASIS and transmission capacity is a limited resource. By reserving exceptionally large amounts of non-firm transmission capacity, the Round Trip Trades, in combination with others targeting MLSA payments through UTC trades, contributed to a transmission shortage that prevented others from fully participating in the day-ahead market. It was this shortage of available transmission capacity, and the difficulty market participants were having arranging for transactions, that lead to the discovery of the practice MLSA-targeted trading by PJM and the Independent Market Monitor in the first place.

142. OASIS provides information for market participants looking to arrange additional transactions. The transmission capacity Chen and Powhatan reserved for Round Trip

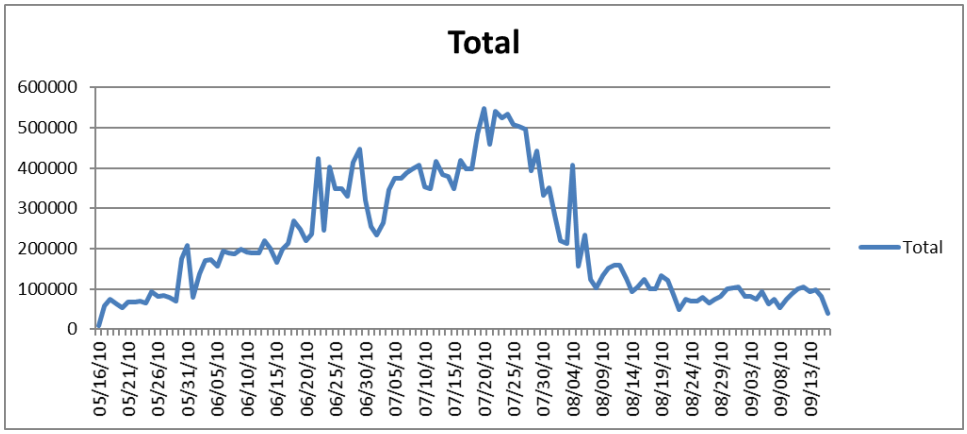
Trades was not available for other transactions in the day-ahead market. The system does not provide a record of how much might have been available had different trades been conducted or determine how much desired trade was blocked due to inadequate transmission capacity. To evaluate the effect of Round Trip Trade reservations on the market, evidence can be found elsewhere. I note that the Round Trip Trades relied on the lowest-priority, non-firm service. Although a trader can gain access by reserving transmission using a higher priority service, this comes at a higher cost, and this higher cost is an impediment to trade.

143. The available capacity did not have to be reduced to zero to disrupt trades, but merely needed to be below the level at which a trader wished to trade. In addition, while transmission might be unavailable and later become available, the timing difference could create practical problems for other traders.[69] There is substantial evidence of problems faced by traders in arranging for transmission reservations in July 2010.

144. Filings by Black Oak Energy, LLC and supporting testimony of its Managing Director, Serge Picard, provide a first-person narrative of the problems MLSA-targeted trading caused in the marketplace. Black Oak describes the "extreme difficulty" it had in arranging transmission in June and July because of the large volume of transmission capacity being reserved by others, and the process by which it traced the problem to MLSA-targeted trading.[70] The lack of available transmission capacity impeded Black Oak's ability to conduct UTC transactions and physical transactions that would move electricity (as opposed to virtual transactions) between regions. Black Oak compiled statistics on transmission reservations, which required some data processing and excluded the reservations from PJM to MISO which did not involve paid transmission. Black Oak's analysis is presented below.

[69] Frederick Stuart Bresler deposition, September 12, 2019, pp. 40-41.]
[70] Black Oak Energy, LLC Response to Second Data Request, question 2, (October 4, 2010).

Figure 47
Paid Transmission Reservations
As Compiled by Black Oak Energy[71]



145. Mr. Picard discussed the lack of transmission capacity further in testimony, describing how "this growth of usage of capacity, which culminated about mid-July, started being a problem for us." In response to the question, "In what respect?," Mr. Picard said, "In the respect that we were not able to trade anymore."[72] He also described how transmission reservations were being drawn down quickly: "you'd see it being used and consumed in minutes."[73] "[W]e realized exactly what we thought was going on in the system, that was, I call it, the capacity hoarding of OASIS, and that it seemed to be just for the purpose in good part…for collecting losses."[74] Mr. Picard also discussed how the consumption of transmission on OASIS disrupted his business, blocking access completely on some days, and more generally disrupting trading and preventing him from putting capital at risk in the market.[75] He ultimately called PJM on August 3 to complain about the issue.[76] This was after other traders had already contacted PJM with similar complaints.[77]

146. The Market Monitor was explicit in its conclusion about the effect of such trading and how it would "Distort market outcomes," and made it, "more difficult for other market participants to acquire transmission."[78] In the August 5, 2010 briefing to market participants, the presentation went on to say:

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[71] Ibid, ¶ 1, BOE0002088 - BOE0002090.xls.
[72] Testimony of Serge Picard, September 10, 2010, p. 86.
[73] Ibid, p. 93.
[74] Ibid, pp. 112-113.
[75] Ibid, pp. 137-141.
[76] Ibid, p. 115.
[77] Frederick Stuart Bresler of PJM also discussed the impact of transmission reservations on other market participants in deposition, September 12, 2019, p. 248.
[78] "Virtual Transactions and Marginal Loss Surplus Allocations," MRC, Joseph Bowring, August 5, 2010, p. 2.

> "The marginal loss surplus allocation distributions incented market participants to schedule large quantities of up to congestion bids, limiting the amount of transmission available for other market participants."[79]

147. Chen described the process by which he sought out transmission reservations, "So I'm kind of trying to get the transmission as soon as I can."[80] When asked whether it was difficult to get transmission capacity, Chen replied, "It was. It was very difficult."[81] He went on to say that over the summer it got more difficult, as he feels more people were doing UTC trades.[82] In his deposition taken in 2011 he described how if he woke up a little bit late or if he was five minutes late in his manual entry of the transmission requests, all of the capacity could be gone.[83]

148. The figure below plots monthly UTC bids. The levels in July, 2010, dwarfed earlier months as some market participants greatly expanded UTC trading with MLSA-targeted trading. UTC trading by Powhatan, HEEP and CU Fund totaled 11.7 million MWh and 8.2 million MWh in June, over 50% of the total in each month.

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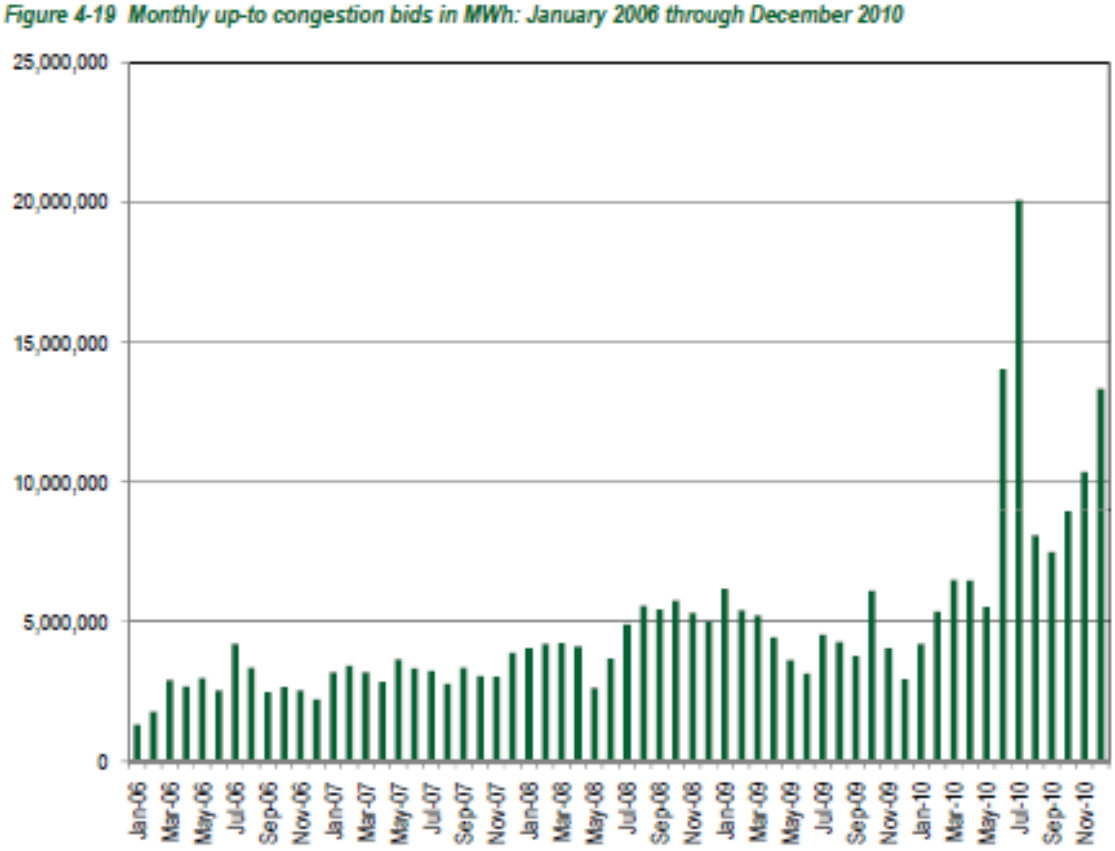
[79] Ibid, p. 10.
[80] Chen deposition, December 3, 2021, p. 72.
[81] Ibid, p. 72.
[82] Ibid, pp. 73-74.
[83] Chen deposition, July 20, 2011, p. 191.

Figure 48[84]



149. The Round Trip Trades required Chen and Powhatan to reserve significant quantities of transmission capacity. The total volume of Round Trip Trades exceeded 480,000 MWh on some days, which is more than 20,000 MWh/hour, or 10,000 MWh in each direction. For comparison purposes, total imports and exports of energy for all of PJM averaged a little over 10,000 MWh per hour, respectively, in the year.[85] On a large-volume day, through his trades for Powhatan, HEEP and CU Fund, Chen was reserving the same amount of transmission capacity as actually used by the entire system to import and export electricity on an average day.

D. MLSA-Targeted Trading Creates Market Inefficiencies

150. A fundamental tenet of good market design is market efficiency. From an economic standpoint, this involves maximizing social welfare. When a product is sold, both parties

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[84] 2010 State of the Market Report for PJM, p. 334.

[85] In 2010, gross monthly day-ahead exports averaged 7,881 GWh and gross imports average 7,342 GWh. On an hourly basis, this is 10,795 MWh and 10,057 MWh, respectively. (E.g., (7,881 x 12 x 1,000)/8760 = 7,342.) 2010 PJM IMM State of the Market Report, p. 289.

are better off because the seller would rather have the money and the buyer would rather have the product. Social welfare is the measure economists use to study trade and determine if both sides benefit. In broad markets, market prices provide the signals that consumers and producers depend upon to engage in trade to improve their social welfare. This is a foundational point of market theory.[86] It is central to the design of electricity markets which, by their nature, require detailed rules to establish how the markets will function.[87] In PJM:

> "Maximizing social welfare is the objective function of the market clearing algorithms. The goal of this objective function is to optimally allocate resources for energy and reserves such that the final allocation simultaneously maximizes the benefit to consumers and the revenues to suppliers."[88]

151. Market efficiency benefits are a key reason why virtual trades are allowed in the market. The MLSA-targeted trades, including Round Trip Trades, in contrast, reduced social welfare. The MLSA-targeted trader engages in transactions that disrupt the existing balance by forcing themselves into the market, capturing payments, and not providing any service (or other value) to any other participant. Instead, the money such traders earn is a direct efficiency loss. It detracts from the social welfare of buyers and sellers. With largely inelastic demand, the payments come mostly from the demand side, and wholesale customers pass those costs on to retail customers. Consumers end up paying more than necessary for the electricity they need.

152. The loss of efficiency from MLSA-targeted trading can also be considered in more practical terms. The MLSA-targeting traders' profits are paid for by someone. For the most part, this payment does not come from producers, because producers are already competing with each other on the basis of price and only being paid the amount necessary to deliver the desired quantity of electricity. Consumers are largely captive to the PJM market for their electricity needs and therefore have to pay the cost of production—and also fund the payments made to MLSA-targeted traders. Mechanically, that payment may come in the form of receiving less of the MLSA payments. The overall cost of electricity increases.

153. I note that spread UTC traders also receive MLSA payments when they pay for transmission. Such trading, however, is fundamentally different. These trades focus on price differences that are expected to change between the day-ahead and real-time markets. In the process of profiting from the price differences, the trades shift demand

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[86] William C. Spaulding, thisMatter.com, https://thismatter.com/economics/total-surplus.htm, and Thomas Herold and Wesley Crowder, *Principles of Economics Explained,* 2017, pp. 229-230.
[87] Crampton, Peter (2017), Electricity Market Design, *Oxford Review of Economic Policy,* 33(4), 589-612.
[88] PJM Energy Price Formation Senior Task Force, *Price Formation,* December 14, 2018, p. 4, https://www.pjm.com/-/media/committees-groups/task-forces/epfstf/20181214/20181214-item-04-price-formation-paper.ashx.

and promote price convergence. Social welfare improves because price convergence leads to overall improvements in efficiency.[89] The Round Trip Trades did not lead to such convergence, however, as none of them had any net spread value difference.

154. MLSA-targeted trading, including the Round Trip Trades, impedes the use of the transmission system by other participants, making it more difficult to use the most efficient generators to serve customers. In evaluating the efficiency loss due to the Round Trip Trades, one must recognize that trading would not have been perfectly efficient even without the reduced transmission availability. Impeding transmission reservations makes things worse. When trade is inefficient, higher cost generators are running in one area that could have been displaced by lower cost generators elsewhere. The cost savings that could have been achieved by running lower cost generators equate to the efficiency losses. In addition, the transmission impediments caused by MLSA-targeted trading result in prices that do not reflect the legitimate forces of supply and demand.

155. Finally, it must be noted that interregional trade of electricity is valuable and important. PJM and neighboring regions work continuously to try to improve efficiencies in trade. The existence of interconnected transmission lines themselves is a testament to the importance of interregional trade. System operators including PJM and its neighbors are seemingly always looking to improve efficiencies in trade among regions. This is a frequent issue in annual State of the Market reports by independent market monitors. To help improve trade, PJM has operating agreements with neighboring areas including NYISO, MISO, Tennessee Value Authority, Progress Energy Carolinas, and Virginia and Carolinas Area (VACAR).[90]

E. Broken Leg Round Trip Trades Would Likely Harm the Market

156. It has been asserted that the Round Trip Trades would have benefited the market in the event that a leg broke. Since this never happened, it is a hypothetical consideration. As I detail later in this report, a fully breaking Round Trip Trades on a given path, with the high volumes of trades that were often conducted, is much more likely to have severely negative consequences for the market than any benefit. Not only will this involve extra costs and inefficiencies, but there is the very real possibility that such trades could result in insufficient supply of electricity and rolling blackouts.

157. The large spreads needed for a leg to break is an indication of substantial congestion and a severe need of energy in the day-ahead market. The existence of a counterflow UTC (i.e., the remaining leg of the trade after the forward flow UTC leg fails to clear) is a promise of supply that is used to clear the day-ahead market at the location where it is desperately needed. Come real time, that supply does not arrive. The market needs to

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[89] Celebi, M, Hajos, A., and Hanser, P., Virtual Bidding: The Good, the Bad and the Ugly, *The Electricity Journal,* 23(5), 16-25 (2010); Isemonger, Alan G., The Benefits and Risks of Virtual Bidding in Multi-Settlement Markets, *The Electricity Journal,* 19(9), 26-36 (2006). As detailed in these articles, there are other issues that are weighed in an overall assessment of the pros and cons of convergence bidding.
[90] 2010 PJM IMM State of the Market Report, pp. 283-284.

find that supply from some other source and the flexibility provided by 24-hour ahead planning is no longer available. At that point, the mechanism that the market has left to draw supply is largely real-time prices issued on a five-minute basis. Only those generators who can respond to such short-term signals and still have available capacity will be able to respond. If their response isn't sufficient, shortages will occur.

158. Chen testified that a broken leg trade will help the market in that circumstance.[91] Much earlier I described how traders can help the market; the market price effects of profitable trades can lead toward convergence between markets. Under the broken leg scenario, the remaining UTC trade will reduce the price spread between the nodes. A reduced spread is only helpful if the day-ahead spread is anomalous and reduced spreads in real time are reasonably expected. In that instance, the trade is helping the market converge. That is not true if the high price spreads are caused by a real shortage. The spread reduction caused by the trade decreases the price signal to attract the needed supply. The assumption of the trade helping the market to converge is not justified.

159. As was discussed earlier, a UTC trade that targets price spreads helps the market to converge because traders seek out instances where they can predict the change in spreads. Those that are good at these predictions make money and stay in the market. Those traders who are unsuccessful exit. The Round Trip Trades were not placed upon consideration of pricing anomalies. Instead, they were placed with an indifference to market conditions altogether. Further, all trades have price effects that move prices in a direction that works against the profitability of the trade.

160. This is discussed in greater detail in a later section, along with calculations that show how losses on broken Round Trip Trades could total millions of dollars and bankrupt the trading entities. If those entities went bankrupt and failed to cover the losses of those trades, those losses would be passed on to other PJM market participants, with most of those losses passing to consumers. That would be yet another harm to the market from these trades.

F. MLSA-Targeted Trading Sends False Information to the Market

161. The Round Trip Trades injected false information into the market, causing PJM to make unjustified MLSA payments and undermining the efficient operation of the market in additional ways. The transaction information entered into the system for these trades was false: it communicated that trades were placed on the basis of intending to profit from spreads. That was not true, and as a result the trades provided false information about the expectation of price changes.

162. The Round Trip Trade strategy required the purchase of transmission that would not ultimately be used for legitimate purposes. The Round Trip Trades consumed transmission capacity that would otherwise have been available to others. This information—the consumption of transmission through OASIS reservation—is false information in the market. This information is also readily available to other market participants, who take that information into account when making their trades. Indeed,

[91] Chen deposition, December 3, 2021, pp. 63, 81. See also pp. 17-18.

the problem of MLSA-targeted trading, like Powhatan's, was brought to PJM's attention by a trader who noticed the unexpectedly large consumption of transmission capacity.[92]

G. What If Everyone Did This?

163. One way to look broadly at the implications of trading practices is to consider what would happen if the practice were widespread and actively pursued. Good trading practices generally produce better outcomes for the market. Increased activity and increased participation are generally associated with increased competition, which is better for the market. Profit margins may get squeezed through increased competition, and some participants that cannot compete may exit, but the outcome is sustainable and good for consumers, who typically benefit from competition through lower prices and better service. This is, in essence, why we have markets.

164. With Round Trip Trades, however, the situation is very different. There is essentially no limit to the quantity of such trades that would be profitable (other than availability of transmission capacity). MLSA payment values, while variable, were sufficiently high to make such trading routinely profitable. As Kevin Gates said in an email describing Powhatan's Round Trip Trades, "UTC is a loophole that probably a dummy can exploit."[93] Absent restrictions, one would expect that MLSA-targeting traders would be highly aggressive in purchasing transmission capacity when available, making it much more difficult for those looking to arrange day-ahead transfers of energy and conduct legitimate UTC trades. Entities attempting to schedule energy transfers in the day-ahead markets and conduct UTC spread trades would be dealing with a range of uncertainties and complexities in deploying profitable (and market-beneficial) strategies. The MLSA-targeting traders' most significant challenge would be to arrange transmission. It is reasonable to expect that the MLSA-targeting traders would largely crowd out all other trade. Chen testified that he was having trouble arranging transmission and that he suspected that automated trading algorithms were so much faster than mere manual attempts that even he was having trouble getting transmission, even though he was highly focused on that aspect of trading.[94]

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[92] PJM Referral, p. 1.
[93] Kevin Gates email, June 25, 2010, POW00002438.
[94] Chen deposition, December 3, 2021, pp. 73-74. Also, July 20, 2011, p. 191.

VII. IRRATIONALITY OF BROKEN LEG PROFIT EXPECTATIONS

165. Two rationales have been asserted for making the Round Trip Trades. The first is to profit from MLSA and I understand that rationale is not in dispute. The second is that the trades were made to profit from one leg of the Round Trip Trade breaking (i.e., failing to clear the market). In evaluating this second rationale as an explanation for all of the Round Trip Trades, I consider the circumstance where the trade fully breaks, that is, where the entire volume of one leg of the trade fails to clear. As will become clear, the situation where the entire leg fails to clear can be different than where only a few MWs fail to clear. As my focus is on the rationale for all of the trades, I focus on the fully-breaking scenario. If it was argued that all of the trades were placed to profit from MLSA, but a small portion were also targeted at potential profits from broken legs, my analysis would be different (although the conclusion would be largely the same).

166. As a result of my analysis, I conclude that it was not economically rational to expect profits when the Round Trip Trades fully broke. In addition, I identify many aspects of the Round Trip Trades that are inconsistent with this objective. I show how attempting to do so would have been inconsistent with other aspects of Chen's and Powhatan's trading practices. I consider further the risks of devastating losses could occur from a broken leg with these volumes. Taking all of these factors together, I conclude that it was not economically rational to have placed the Round Trip Trades with a primary objective of profiting from spread value changes when a leg breaks. To be clear, I offer no opinion to contradict Chen's assertion that this was one of his objectives, which he has made in deposition testimony, affidavits and filings from lawyers on his behalf.[95] Instead, I am offering an economic analysis of that stated objective.

167. This section considers several detailed economic factors. It is also possible to reach a conclusion about the primary purpose of the Round Trip Trades very simply. The Round Trip Trades were made hour-after-hour, day-after-day, with essentially no adjustment for market conditions that might be related to broken-leg circumstances. There were no changes in the paths traded to increase the potential for such profits. Chen even started up his own fund to capitalize on the trades, and continued to trade in this manner.[96] All of this occurred while the Round Trip Trades were producing substantial profits from MLSA and no leg broke. On the basis of these facts alone one can reasonably conclude that MLSA profits, not broken-leg profits, were the primary objective of Round Trip Trades.

A. Risks Associated with Broken Legs

168. If a leg were to fail to clear, the remaining leg would be unhedged and exposed to both profits and losses. Those losses could be significant. There is substantial economic

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[95] For example, Affidavit of Houlian Chen, ¶ 5-6, et al, February 2, 2015, Docket IN15-3-000.

[96] Only three paths were used for Round Trip Trades in the CU Fund, using COMED, DAY and COOK, avoiding the AEP path which was the only path that had day-ahead spreads exceeding $20

rationale and anecdotal evidence to support the conclusion that this risk was a significant concern in Chen's and Powhatan's Round Trip Trades.

169. The leg breaks if the day-ahead price spread exceeds the amount bid for that UTC trade, and such bids were limited to $50/MWh. The risk comes from the leg of the UTC trade that remains. Assuming the day-ahead price spread is $50/MWh in the MISO to PJM direction and the import leg does not clear, what remains is a counterflow UTC where the holder gets paid $50/MWh in the day-ahead market. In real-time, there is a potential that the spread could increase, resulting in losses. Real-time prices can be extreme, with prices up to $1,000/MWh (or more) possible. Using that extreme figure, losses of $950/MWh are possible.

170. Chen recalls discussing this risk at an in-person meeting with TFS Investors in West Chester, Pennsylvania on June 25-26, 2010.[97] Kevin Gates testified that he was concerned about this risk in the Summer of 2010 and that this was something he wanted to avoid.[98] It is not known the extent to which Chen quantified the potential losses at the time, but one can use his trading volumes and potential market price spreads to provide an order-of-magnitude assessment. The table below provides statistics on the counterflow-only size of paths Chen traded with his Round Trip Trades. If the trades fully "broke" the counterflow positions would be equal to these values. These statistics include all of Chen's trading, including CU Fund. A single 1,000 MWh trade that breaks for one hour and whose spread increases to $1,000/MWh in the real-time market, would result in a loss of $950,000. There could be multiple paths, multiple hours, and certainly multiples of 1,000 MWh on a day where the legs break. Losses of $10 million or more are possible. This would greatly exceed the posted capital for Powhatan (and HEEP and CU Fund) and likely resulting in a bankruptcy and the loss of the entire investment. This could happen as quickly as in a single day. This risk had not been present in the earlier trading because the volumes had been lower.

Figure 49

Counterflow Positions Resulting from Round Trip Trades with Broken Legs

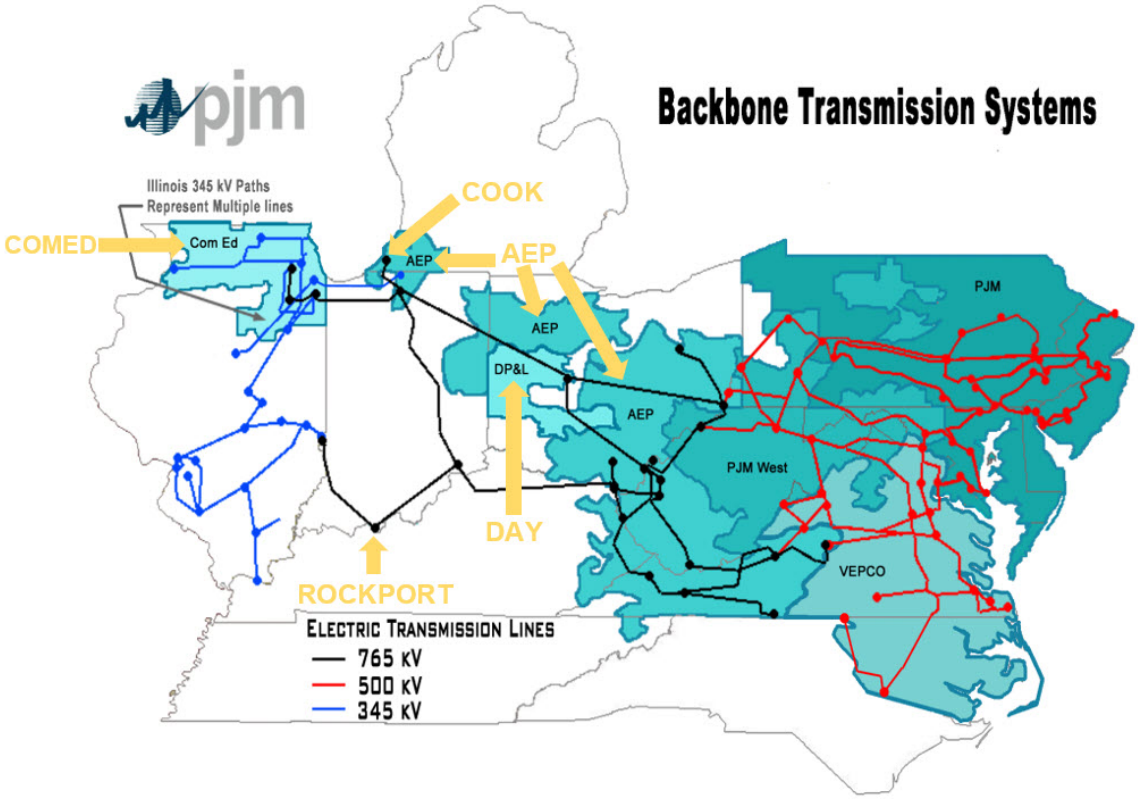
Path	Avg MWh/hr	Hours 2,000 MWh/hr or Above	Day of Peak	Peak MWh/hr
COMED	2,116	875	7/25/2010	4,520
DAY	1,783	662	7/25/2010	4,600
COOK	1,204	91	6/27/2010	2,520
ROCKPORT	989	24	7/5/2010	2,100
AEP	652	-	6/17/2010	1,470

[97] Chen deposition, December 3, 2021, pp. 64-67.
[98] Kevin Gates deposition, October 25, 2021, p. 244.

B. Actions Taken to Minimize Risk of Legs Breaking

171. Chen testified that he took actions to minimize the risk of a leg breaking.[99] I have confirmed this in my review of the trading data. One step was to choose internal PJM nodes that were close to MISO in order to minimize the spread difference.[100] While price differences are not solely dependent on geography, nodes that are closer together are less likely to have substantial spreads. The figure below shows the major transmission lines on PJM's system, as well as the service territories of some of the traditional utilities. The nodes associated with the five paths Chen relied on most for his Round Trip Trades are located very close to MISO, as shown in the figure. All of these nodes are connected by 765 kV transmission lines, which are some of the highest voltage and greatest capacity transmission lines anywhere. This high voltage and capacity reduces the likelihood of congestion. For these physical reasons, these paths are less likely to have transmission congestion between their location and MISO than most other locations in PJM.

Figure 50[101]



[99] Chen deposition, December 3, 2021, p. 60-63.
[100] Chen deposition, December 3, 2021, p. 61.
[101] Transmission System Operations T01, 2011, p. 10.
https://www.pjm.com/~/media/training/nerc-certifications/to1-transmissionops.ashx

172. More important than physical location is the actual history of price spreads for these trades. The table below provides statistics on the day-ahead spreads associated with Chen's top five Round Trip Trades. While this discussion has focused on legs breaking in the import-to-PJM direction, they can technically break in either direction. Over the time periods presented for the five different paths, there are over 60,000 potential trades in each direction. The spreads never exceeded $40/MWh for any path, and never exceeded $20/MWh in the export direction. All of the day-ahead spreads in excess of $20/MWh were on the AEP path in the import direction, which only accounts for 4% of the Round Trip Trades and stopped being traded on June 20, 2010. No leg ever broke on any Round Trip Trade, meaning, the actions taken to avoid the legs breaking were successful.

Figure 51

Count of Hourly Day-Ahead Spreads by Price Interval
Top 5 Round Trip Paths

Spread Interval	Imports to PJM			Exports to MISO		
	Manipulation Period	Jan-May 2010	2009	Manipulation Period	Jan-May 2010	2009
$50+	0	0	0	0	0	0
$40-$49.99	0	0	0	0	0	0
$30-$39.99	0	0	3	0	0	0
$20-$29.99	0	7	24	0	0	0
$10-$19.99	75	160	414	0	41	103
Less than $10	7,605	17,948	43,369	7,680	18,074	43,707

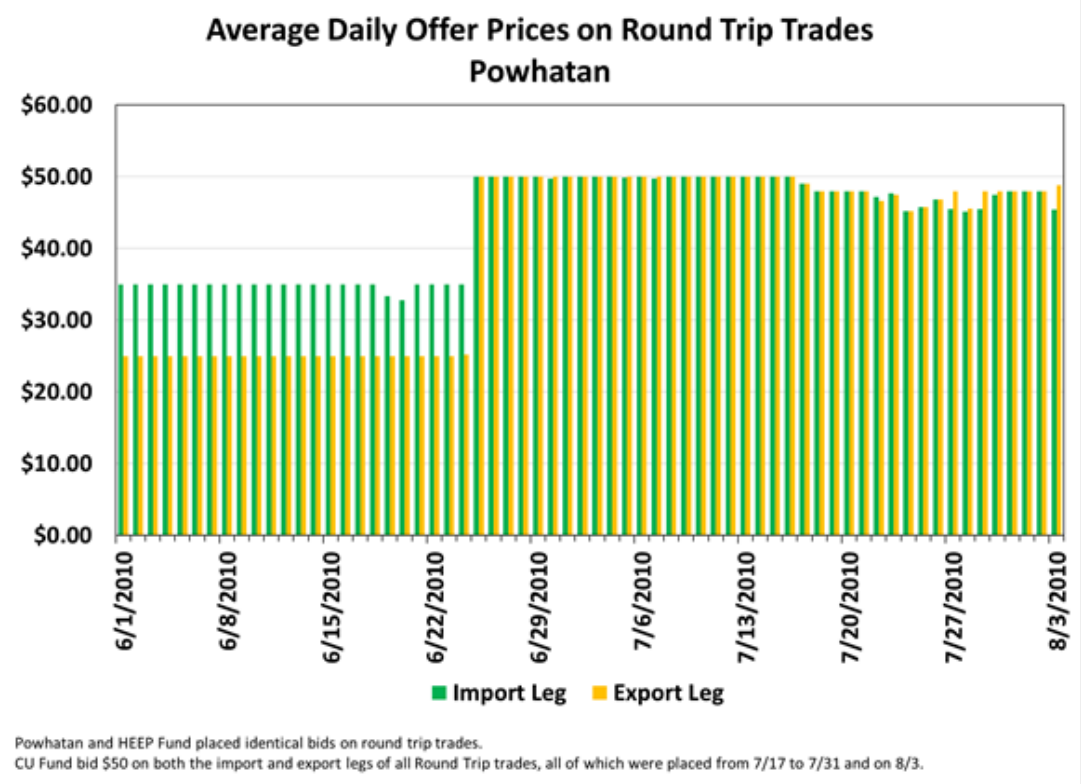
173. As shown in the figure above, there were only three occasions where the spreads exceeded $30/MWh. Among those three hours, the real-time spreads fell for the two hours with the greatest day-head spreads and increased for the third. In that third instance, the real-time spread increased to almost $100, such that on average for the three, spreads increased by $10.21/MWh. Thus, Chen would have lost money when the legs broke had he bid $30/MWh for Round Trip Trades on these paths over this time period.[102] If we assume a bid price of $20, the average spread change over the 34 hours that would have had a broken leg increased by $2.84/MWh. Again, Chen would have lost money on average.

174. Another action taken to avoid a leg breaking was to increase the bid price for the trade, increasing the spread needed for the break. When starting Round Trip Trades, Chen's bid prices for Powhatan and HEEP were made with bids of $35/MWh in the import

[102] Actual calculation of losses would require determining the price effect of the trade, as discussed later, as well as transaction costs. A bid price of $35/MWh would show positive spread changes for the two trades that break in that instance, again without consideration of price effects or other costs.

direction and $25/MWh in the export direction. These prices were generally consistent with bids for Correlated Pairs that had been made during the Transition Period. Chen's bid prices for Powhatan and HEEP changed abruptly on June 25, 2010, when both imports and exports were bid at the maximum value, $50/MWh in both directions. This is shown in the figure that follows which is based on Powhatan data (HEEP data was the same). Powhatan bids in both directions decreased to $49/MWh on July 17 and then $48/MWh on the 18th, remaining at that level for the substantial majority of remaining Round Trip Trades. From the standpoint of reducing the bid to increase the chance of a broken leg, this difference is inconsequential. The change occurred on the same day that CU Fund started trading on the July 17, 2010, it always bid $50/MWh for its Round Trip Trades.

Figure 52



175. All of these factors point to the Round Trip Trades being executed to minimize the chances of a leg breaking, which is inconsistent with profits from that occurrence being a primary purpose of the trades. The historical data provides essentially no support for any expectation that spreads would develop sufficient for a leg to break. And, the trades were specifically structured and executed to minimize this seemingly-infinitesimal risk. There is also the issue of timing. Market conditions that lead to the extreme spreads in the day-ahead market would have to be included by PJM in model runs in the afternoon for the following day. Market conditions such as extreme weather that might lead to unusual price spreads would be well-known on the morning when bids are submitted. Since the economic analysis shows the Round Trip Trades strategy of Chen and

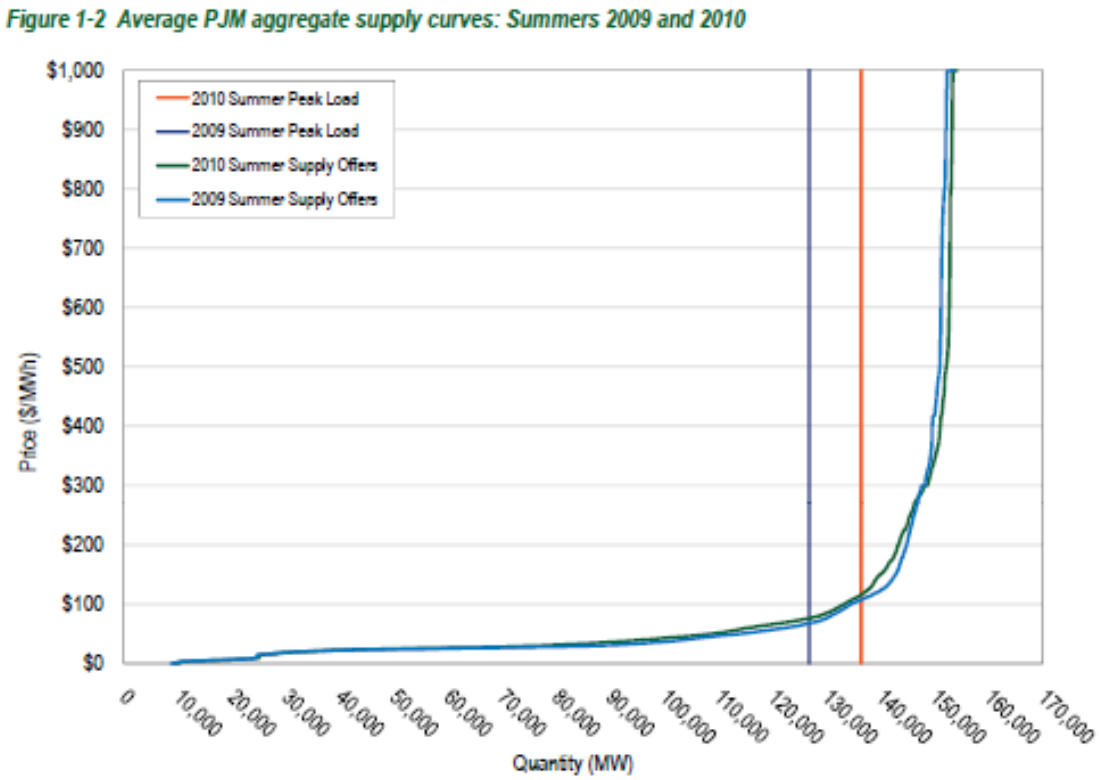
Powhatan was executed in a manner that minimized the risk of legs breaking, it is logical that bids for Round Trip Trades would not be submitted at all when these rare market conditions were evident. That would also be economically rational, as Round Trip Trades on such days would be particularly risky with the potential for massive losses.

C. Consequence of Price Effects of Fully Breaking Leg of Round Trip Trade

176. I now turn to the price effect such trading would have. All trades have the potential to move market prices, which move against the profitability of the trade. This effect should not be ignored (in general) and was not ignored in the trading conducted by Chen and Powhatan. Fully broken trades could result in 4,000 MWh/hour one-direction trades on a single path and more than 10,000 MWh/hour across multiple paths for the system. (See Figure 49.) The price effects of any trade works against the profitability of that trade.

177. For perspective, the 400 MW threshold was routinely used by Chen in his trading based on his assessment of the marketplace, and therefore it would apply under common circumstances. The extreme market conditions associated with the price spreads needed to cause a leg to break are likely to involve markets even more sensitive to price effects. These large price spreads results when the larger market effectively splits into smaller submarkets with prices that are more independent. Smaller markets are more sensitive to price effects from a given volume change. Another way to see this is to consider the shape of the PJM supply curve. A $50 spread difference on the supply curve in the common range of prices is associated with roughly 70,000 MW. Once the price hits $100/MWh, an extra $50/MWh will only bring on approximately 7,000 MW. At $200/MWh, the supply curve is dramatically steeper still. This is the supply curve for the overall market, of course, not a submarket that would result from transmission congestion.

Figure 53[103]



178. The sensitivity to prices under extreme conditions is also a factor in the earlier table that presented data on price spreads between MISO and HARRISONTAP. (See Figure 18.) The day-ahead spread never exceeded $57.18/MWh while the real-time spread exceeded that level 191 times with a maximum of $368.09/MWh. Later in this report the differences between day-ahead and real-time prices during the 2014 Polar Vortex will be presented, which also demonstrates this effect. When prices are stressed, as indicated by unusually large price spreads, the prices are susceptible to substantial changes.

179. When the leg breaks, the spread will be at least as high at the UTC bid. The issue is what the price would otherwise had been if the broken Round Trip Trade had not had spread-suppressing effects on the marketplace. Thus, there may be a $50/MWh price spread with the trade. Absent that trade, the spread would have been greater. Then, in real time, the counterflow UTC settles out of the market. The MWs of supply at the high-price node are not delivered. The market is short of supply at a location where day-ahead prices indicate it is greatly needed.

180. The supply curve above gives the impression of a smooth continuous function, such that market price changes might be gradual. Often, they are not, particularly when the system is stressed. Consider again the figure showing hourly price spreads for May 30, 2010. (See Figure 31.) On that day the Correlated Trade had the effect of a 1,050 MWh

[103] State of the Market Report for PJM, Volume 1: Introduction, Monitoring Analytics, LLC, March 10, 2011, p. 24.

trade between the GREENLAND GAP and MT STORM nodes. That trade had essentially no effect on the market for 20 hours of the day yet drove a $50+/MWh price spread on three hours.

181. When PJM solves for prices in the day-ahead market, a counterflow (export) UTC shows up as a generator at the interior PJM node. The transmission system is not designed for that generator, so if the size of the UTC trade is large enough, it will overload the system and cause congestion. Chen's 400 MW trading limit is the size of a medium size generator. The process of actually building a generator of that size and integrating it into the electric transmission system involves extensive analysis and likely making significant changes to that system. Thus, Chen's conclusion that a UTC trade of this size starts to have price effects corresponds to real physical characteristics of the system. The system is designed around supply and demand, and the planning for a 400 MW generator often involves physical changes to the system to ensure it can integrate smoothly. To add further perspective, a very large generator on the PJM system has a capacity of around 1,000 MW, and more substantial changes are typically required for the system to accommodate that supply. One can also consider market-effect characteristics from the demand side. One most favored nodes for Round Trip Trades was DAY, which is associated with the service territory for Dayton Power & Light, which is home to just over half a million people. The greatest load ever recorded for that territory is only 3,270 MW, with load levels commonly only half that amount.[104]

182. A broken leg of the DAY path, in contrast, could result in up to 4,600 MW of supply being forced on the system. The system is not designed for that. It will have huge consequences that go beyond merely major price effects. It should be noted that in order for this to happen, the DAY price must be at least $50/MWh higher than MISO, even with this huge amount of supply that exceeds total demand in that area. This scenario is challenging to understand, let alone imagine. Despite supply from the non-broken-leg UTC trade that exceeds the highest load ever incurred, this location has a price that signals significant shortages and congestion on transmission lines in that direction. This highly implausible circumstance is central to justifying these trades on the basis of broken leg profit opportunities. If one concludes that this simply cannot happen, one must conclude that the broken leg strategy is not rational.

183. In attempt to further consider the broken leg strategy, I assume that this condition occurs through some undefined scenario, despite the fact that this price separation has never occurred in the prior timeframe I analyzed. And I assume that it occurs with thousands of MWs of extra, price-spread-suppressing supply in the shortage area of the system, as a result of the non-broken-leg UTC trade.

184. The question then arises as to what might occur in the real-time market. The "supply" associated with the UTC trades is not delivered in real time. The most likely outcome is for prices and spreads to rise, dramatically, to keep the system from failing (i.e., shortages and blackouts). The earlier analysis of day-ahead and real-time spreads between MISO and HARRISONTAP demonstrate the increased potential for extreme prices in real-time. When prices are stressed, as indicated by unusually large price

[104] AES Ohio, "Fast Facts," www.aes-ohio.com/fast-facts.

spreads, the prices are even more susceptible to substantial changes. Alternatively, in order for the spreads to not increase, thousands of MWs of supply would have to miraculously appear in the real time market to replace the UTC-implied generation (more than actually exists) and accept prices that it was unwilling to accept in the day ahead market. And even more capacity would have to arrive in order for the broken-leg trade to be profitable.

D. Polar Vortex as Example of Market Conditions Leading to Broken Legs

185. Chen's 2015 affidavit points to circumstances in January 2014 to support the contention that the broken leg strategy would have been profitable and "supportive to the market."[105] My analysis of those circumstances reaches the opposite conclusion. The filing made on his behalf also includes analysis of potential profits from hypothetical Round Trip Trades during that time.[106] There were two severe-cold weather events during that period, the "Polar Vortex" of January 6-8, 2014 and Winter Storms of January 17-29, 2014. These events are well-known and deeply studied. This was a significant electricity supply crisis caused by severely cold January temperatures coincident with substantial generator outages. The North American Electric Reliability Corporation [NERC] report on the crisis describes how through the effective response "…using interruptible load, demand-side management tools, and voltage reduction, only one B[alancing] A[rea] was required to shed firm load."[107] In plainer words, NERC acknowledges that severe circumstances caused the lights to go out (not in PJM), and that comprehensive and coordinated actions kept a bad situation from getting worse. PJM also studied the events and produced a report, where it states, "PJM called on all available resources, issued public appeals for conservation and called on load management resources…"[108] PJM did not have to turn the lights out involuntarily to any customer, but reserves dropped below required levels and emergency actions were taken. This was an extreme event. The fact that both entities prepared comprehensive studies of the events attests to its severity.

186. The simplistic analysis of some hours during this period provided by Chen show hypothetical profits from broken leg trades. But, it is deeply wrong to conclude that this supports the Round Trip Trades as having had the potential for profits if they had been placed at that time. First, the Polar Vortex was not some random event that one would seek to capitalize on by routinely placing Round Trip Trades, day in and day out, without regard to weather or system conditions. The NERC and PJM reports detail the extreme circumstances building over days prior to the crisis, long before day-ahead trades were

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[105] Chen Affidavit, February 2, 2015, IN15-3-000, ¶ 26. See also

[106] Answer to Show Cause Order and Request for Oral Argument, Houlian Chen, et al, February 2, 2015, IN15-3-000, pp 24-5.

[107] "Polar Vortex Review," September 2014, North American Electric Reliability Corporation, p. iii.

[108] "Analysis of Operational Events and Market Impacts During the January 2014 Cold Weather Events." PJM Interconnection, May 8, 2014. P. 5. Hereafter, PJM Polar Vortex Report.

placed. As discussed above, Chen's and Powhatan's strategy of avoiding conditions where spreads would be sufficiently large to cause legs to break would have resulted in not trading on these days in the first place. Second, the analysis assumes that there would be no price effects from the Round Trip Trades. Third, the analysis presented in the response to the Show Cause order focuses on January 28, 2014, where prices moved in the direction leading to profitability (ignoring price effects), but ignores January 7, 2014, when they did not. For example, if one assumes a 6,000 MWh/hour Round Trip Trade (3,000 MWh/hour in each direction) on the DAY path with MISO on January 7, 2014, and had it broken when the day-ahead spread exceeded $35/MWh, this single path would have produced losses in excess of $2,000,000 based on the actual prices in the market. The trade, however, would have had price effects that dramatically increased the losses. Those losses could easily be doubled, tripled or more. That would be enough to bankrupt the entities that placed those trades making them unavailable for the hypothetical profits in the flawed analysis of January 28, 2014.

187. The figure below gives added insight into the possible losses that could occur in placing such large counterflow trades in times of system stress. The chart is from PJM's own study of the event, and plots prices comparing day-ahead and real-time prices on January 7, 2014 for PJM more generally. Day-ahead prices were extreme and sufficient for Round Trip Trades to break at the $50/MWh spread level, but the truly shocking prices occur in real time. The chart plots PJM prices, not spreads, but MISO did not experience quite the same extreme conditions PJM and so I will assume these are indicative of spread values. The chart indicates that real-time prices were around $1,500/MWh higher in real-time than in the day-ahead market for around six hours. If the broken legs left 10,000 MWh in each of these hours, losses would have totaled $90 million. This provides an indication of the magnitude of risks involved in placing counterflow UTCs at a time of market crisis. Again, these losses do not reflect the significant price effects from the trades themselves that would have increased the losses. The potential losses are staggering and certainly exceed the reserves of Powhatan, HEEP and CU Fund. The shortfalls not covered by those entities' reserves would have to be covered by other market participants, with the majority of costs likely falling on consumers.

Figure 54[109]

188. Peak load on several of these January days was between 130,000-140,000 MWh. The amount of energy associated with the Round Trip Trades was at times over 7% of this amount, many multiples of the largest generators on the system. Even without the disruptive effects of such a trade, PJM had to bring on 175-200 generators that had not run in months to deal with the crisis.[110] Other actions included voltage reductions, public requests for curtailment of electricity use, emergency requests to neighboring regions, etc. The PJM report has a four-page listing of emergency procedures invoked during January.[111]

189. The extreme prices that occurred during this period came from Shortage Pricing protocols used by PJM to keep the system in operation. Under these protocols, PJM purposely sets prices above the level that would normally be set by supply and demand. This is done precisely to ensure that there is sufficient supply. It is true that 10,000 MWh of counterflow UTC trades would have acted to reduce day ahead prices, but it would have done so directly in opposition to PJM's emergency procedures designed to keep the system operating during a crisis by providing appropriate price signals. The Round Trip Trades would have disrupted a well-functioning market at a time of crisis.

E. Summary of Broken Leg Considerations

190. When considering the volume of the Round Trip Trades, it is economically rational to be concerned about very large losses that could result from broken legs of those trades. Contemporaneous emails and deposition testimony indicate that Chen and the TFS

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[109] PJM Polar Vortex Report, p. 28.
[110] Ibid, p. 12.
[111] Ibid, pp. 65-69.

Investors knew of this risk and took actions to minimize legs breaking on these trades. The actions taken in trading to avoid this occurrence are rational from an economic perspective.

191. The volume of Round Trip Trades is particularly relevant in considering the of profiting from broken leg trades. My economic analysis shows it is highly unlikely, and virtually impossible, that these trades could fully break in the first place, as described above. The severe circumstances involving such an outcome would be almost certainly known ahead of time, and consistent with the risk-adverse strategy adopted by Chen and Powhatan would have likely resulted in no Round Trip Trades being placed under those conditions.

192. Had Round Trip Trades been placed and the trades fully broken, the only reasonable expectation would be bankrupting losses because of the price effects of the trades. In total, I find no economic support for the assertion that an objective of the Round Trip Trades was to profit from a broken leg.

VIII. CONCLUSION

193. In summary, it is my opinion, based on my knowledge, experience, and the analysis of data and other evidence I have reviewed in this matter, that the characteristics of Powhatan's, HEEP's and CU Fund's Round Trip Trades are inconsistent with trades aimed at profiting from price spreads, and instead are consistent with trades primarily aimed at profiting from Marginal Loss Surplus Allocation (MLSA) payments; indeed, Round Trip Trades largely eliminate the potential for changes in price spreads to affect profitability. These Round Trip Trades caused harm. They led PJM to pay these entities over $10 million that would otherwise have gone to other market participants, including utilities. These Round Trip Trades also made the PJM market less efficient, resulting in increased costs for other market participants. Consumers of electricity within PJM, including homeowners and businesses, were harmed by this diversion of funds and increased inefficiencies because they ultimately bore the majority of the increased costs caused by the Round Trip Trades.

S/ Cliff W. Hamal
Cliff W. Hamal
December 17, 2021

Addendum

Figure 55

Monthly Trade Volume by Trade Type

		Huntrise				HEEP Fund			
Year	Month	Round Trip	Correlated	Spread	Total	Round Trip	Correlated	Spread	Total
2008	8	-	72,600	56,959	129,559	-	29,040	22,774	51,814
2008	9	-	19,912	45,107	65,019	-	11,420	21,367	32,787
2008	10	-	2,920	34,180	37,100	-	2,920	34,180	37,100
2008	11	-	50	133,400	133,450	-	20	57,956	57,976
2008	12	-	-	65,758	65,758	-	-	65,758	65,758
2009	1	-	-	261,090	261,090	-	-	107,827	107,827
2009	2	-	-	191,086	191,086	-	-	47,772	47,772
2009	3	-	-	88,935	88,935	-	-	35,574	35,574
2009	4	-	150	61,500	61,650	-	60	24,600	24,660
2009	5	-	2,800	50,775	53,575	-	1,120	20,310	21,430
2009	6	-	4,550	155,287	159,837	-	1,820	62,091	63,911
2009	7	-	13,900	115,825	129,725	-	5,560	46,330	51,890
2009	8	-	11,350	96,897	108,247	-	4,540	38,759	43,299
2009	9	-	21,650	67,400	89,050	-	8,660	26,960	35,620
2009	10	-	-	313,475	313,475	-	-	125,630	125,630
2009	11	-	-	133,725	133,725	-	-	61,670	61,670
2009	12	-	-	142,672	142,672	-	-	60,891	60,891
2010	1	-	-	268,900	268,900	-	-	111,080	111,080
	Total	**-**	**149,882**	**2,282,970**	**2,432,852**	**-**	**65,160**	**971,528**	**1,036,688**

Figure 56

Monthly Profit by Trade Type

		Huntrise					HEEP Fund				
Year	Month	Round Trip	Correlated	Spread	Profit before MLSA	Total Profit	Round Trip	Correlated	Spread	Profit before MLSA	Total Profit
2008	8	$0	$453,780	$201,261	$508,228	$655,041	$0	$181,331	$79,801	$202,420	$261,132
2008	9	$0	($19,007)	$217,633	$125,298	$198,626	$0	($981)	$77,924	$41,026	$76,944
2008	10	$0	$767	$107,374	$77,479	$108,142	$0	$779	$106,439	$76,554	$107,218
2008	11	$0	$25	$70,262	($31,975)	$70,286	$0	$10	$22,687	($21,235)	$22,696
2008	12	$0	$0	$88,146	$40,374	$88,146	$0	$0	$83,126	$35,354	$83,126
2009	1	$0	$0	$797,387	$559,044	$797,387	$0	$0	$307,447	$210,779	$307,447
2009	2	$0	$0	$31,419	($82,133)	$31,419	$0	$0	$6,879	($21,509)	$6,879
2009	3	$0	$0	$112,758	$108,331	$112,758	$0	$0	$45,170	$43,399	$45,170
2009	4	$0	($94)	$20,876	$20,782	$20,782	$0	($36)	$8,141	$8,104	$8,104
2009	5	$0	($88)	$52,662	$52,574	$52,574	$0	($37)	$20,844	$20,808	$20,808
2009	6	$0	$5,713	$88,790	$35,302	$94,503	$0	$2,270	$35,226	$13,835	$37,496
2009	7	$0	$1,906	($8,284)	($58,288)	($6,378)	$0	$510	($4,000)	($24,254)	($3,490)
2009	8	$0	$4,973	$41,133	($9,399)	$46,106	$0	$1,864	$16,006	($4,332)	$17,870
2009	9	$0	$8,181	$21,591	$2,302	$29,773	$0	$3,284	$8,583	$879	$11,867
2009	10	$0	$0	($42,004)	($78,926)	($42,004)	$0	$0	($15,716)	($30,484)	($15,716)
2009	11	$0	$0	($21,965)	($91,514)	($21,965)	$0	$0	($3,137)	($35,526)	($3,137)
2009	12	$0	$0	($34,700)	($120,304)	($34,700)	$0	$0	($6,284)	($43,132)	($6,284)
2010	1	$0	$0	$398,691	$144,773	$398,691	$0	$0	$157,885	$53,711	$157,885
	Total	**$0**	**$456,156**	**$2,143,031**	**$1,201,948**	**$2,599,187**	**$0**	**$188,995**	**$947,020**	**$526,398**	**$1,136,015**

Figure 57

Spread Trade Statistics by Path, Entity

Path	Entity	Period	Days Traded	Trade Volume (MWh)	Profit before MLSA	MLSA	Total Profit
21 KINCA ATR24304-MISO	HUNTRISE	1 - INITIAL	324	473,662	-$66,634	$0	-$66,634
BEAV DUQ UNIT1-MISO	HUNTRISE	1 - INITIAL	263	186,635	-$160,308	$0	-$160,308
MISO-HARRISONTAP	HUNTRISE	1 - INITIAL	220	159,775	$309,189	$129,233	$438,422
MISO-COOK	HUNTRISE	1 - INITIAL	272	154,675	$269,573	$161,827	$431,400
QUAD CITIES 1-MISO	HUNTRISE	1 - INITIAL	150	116,175	$45,566	$0	$45,566
MISO-PLEASANTS	HUNTRISE	1 - INITIAL	93	101,100	-$38,022	$76,071	$38,049
ROCKPORT-MISO	HUNTRISE	1 - INITIAL	91	97,350	-$8,216	$0	-$8,216
SOUTHIMP-APS	HUNTRISE	1 - INITIAL	88	92,290	$16,084	$114,302	$130,387
MISO-CABOT	HUNTRISE	1 - INITIAL	132	78,723	$59,153	$82,394	$141,546
MISO-YUKON	HUNTRISE	1 - INITIAL	78	67,775	$77,138	$80,381	$157,519
NYIS-ECRRF	HUNTRISE	1 - INITIAL	120	58,377	-$11,066	$80,105	$69,039
MISO-PRUNTYTOWN	HUNTRISE	1 - INITIAL	64	56,770	$209,259	$80,934	$290,193
OVEC INTERFACE-DAY	HUNTRISE	1 - INITIAL	15	46,025	-$30,897	$52,230	$21,333
MISO-WYLIERIDGE	HUNTRISE	1 - INITIAL	106	39,780	$92,397	$50,013	$142,410
BELMONT-MISO	HUNTRISE	1 - INITIAL	25	34,875	$10,278	$0	$10,278
MISO-DOM	HUNTRISE	1 - INITIAL	40	30,507	-$16,569	$27,748	$11,178
SOUTHIMP-MITCHELL 1-2 AP	HUNTRISE	1 - INITIAL	36	29,176	$30,245	$42,554	$72,799
NYIS-LEONIA 230 T-1	HUNTRISE	1 - INITIAL	48	25,195	-$13,551	$31,952	$18,401
EDANVILL T1-MISO	HUNTRISE	1 - INITIAL	125	24,175	$24,236	$0	$24,236
BRAIDWOOD 2-MISO	HUNTRISE	1 - INITIAL	109	21,300	-$2,674	$0	-$2,674
COMED-MISO	HUNTRISE	1 - INITIAL	40	19,330	-$34,382	$0	-$34,382
MISO-APS	HUNTRISE	1 - INITIAL	33	18,589	-$15,961	$18,483	$2,521
MISO-MITCHELL 1-2 AP	HUNTRISE	1 - INITIAL	54	16,492	$40,329	$21,450	$61,779
SULLIVAN-AEP-MISO	HUNTRISE	1 - INITIAL	14	15,925	$23,648	$0	$23,648
CLOVERD2 138 KV T1-MISO	HUNTRISE	1 - INITIAL	37	15,650	$4,758	$0	$4,758
All Others	HUNTRISE	1 - INITIAL	--	302,644	$57,245	$222,538	$279,783
Huntrise Subtotal				2,282,970	$870,816	$1,272,215	$2,143,031
21 KINCA ATR24304-MISO	HEEPF	1 - INITIAL	324	196,641	-$20,203	$0	-$20,203
BEAV DUQ UNIT1-MISO	HEEPF	1 - INITIAL	263	82,679	-$70,114	$0	-$70,114
MISO-COOK	HEEPF	1 - INITIAL	272	66,616	$117,664	$70,544	$188,208
MISO-HARRISONTAP	HEEPF	1 - INITIAL	220	64,572	$123,798	$52,964	$176,762
QUAD CITIES 1-MISO	HEEPF	1 - INITIAL	150	45,255	$13,507	$0	$13,507
MISO-PLEASANTS	HEEPF	1 - INITIAL	93	41,880	-$12,846	$31,633	$18,787
ROCKPORT-MISO	HEEPF	1 - INITIAL	91	38,940	-$3,347	$0	-$3,347
MISO-CABOT	HEEPF	1 - INITIAL	132	35,809	$26,326	$37,896	$64,221
SOUTHIMP-APS	HEEPF	1 - INITIAL	88	34,090	$11,766	$41,723	$53,489
MISO-YUKON	HEEPF	1 - INITIAL	78	29,630	$31,108	$34,835	$65,943
NYIS-ECRRF	HEEPF	1 - INITIAL	121	28,777	-$9,084	$39,451	$30,367
MISO-PRUNTYTOWN	HEEPF	1 - INITIAL	65	24,976	$82,555	$34,908	$117,463
MISO-WYLIERIDGE	HEEPF	1 - INITIAL	106	21,527	$43,465	$27,437	$70,902
OVEC INTERFACE-DAY	HEEPF	1 - INITIAL	15	19,530	-$13,704	$21,985	$8,281
BELMONT-MISO	HEEPF	1 - INITIAL	25	13,950	$4,093	$0	$4,093
MISO-DOM	HEEPF	1 - INITIAL	40	12,203	-$6,892	$11,099	$4,207
EDANVILL T1-MISO	HEEPF	1 - INITIAL	125	12,150	$17,654	$0	$17,654
SOUTHIMP-MITCHELL 1-2 AP	HEEPF	1 - INITIAL	36	10,576	$12,417	$15,437	$27,854
MISO-MITCHELL 1-2 AP	HEEPF	1 - INITIAL	54	10,402	$20,190	$13,613	$33,802
BRAIDWOOD 2-MISO	HEEPF	1 - INITIAL	107	9,515	$2,604	$0	$2,604
NYIS-LEONIA 230 T-1	HEEPF	1 - INITIAL	48	8,830	-$4,233	$10,955	$6,722
COMED-MISO	HEEPF	1 - INITIAL	41	8,005	-$11,624	$0	-$11,624
MISO-APS	HEEPF	1 - INITIAL	33	7,594	-$7,253	$7,596	$343
HARRISON-MISO	HEEPF	1 - INITIAL	8	6,960	$2,883	$0	$2,883
SULLIVAN-AEP-MISO	HEEPF	1 - INITIAL	14	6,370	$9,450	$0	$9,450
All Others	HEEPF	1 - INITIAL	--	134,051	$31,956	$102,811	$134,766
HEEP Subtotal				971,528	$392,134	$554,885	$947,020

Figure 58

Correlated Trade Statistics by Path, Entity

Path	Entity	Period	Days Traded	Trade Volume (MWh)	Profit before MLSA	MLSA	Total Profit
GREENLAND GAP-MT STORM	HUNTRISE	1 - INITIAL	57	95,432	$332,524	$103,016	$435,540
COOK-ROCKPORT	HUNTRISE	1 - INITIAL	40	49,650	-$498	$20,158	$19,660
APS-PENELEC	HUNTRISE	1 - INITIAL	8	4,800	-$894	$1,850	$956
Huntrise Subtotal				149,882	$331,132	$125,025	$456,156
GREENLAND GAP-MT STORM	HEEPF	1 - INITIAL	57	43,380	$135,201	$45,928	$181,129
COOK-ROCKPORT	HEEPF	1 - INITIAL	40	19,860	-$563	$8,063	$7,500
APS-PENELEC	HEEPF	1 - INITIAL	8	1,920	-$375	$740	$366
HEEP Subtotal				65,160	$134,263	$54,732	$188,995

Figure 59

Correlated Trades Irrespective of "B" Border Node

(AB-BC trades defined by A-C)

	Trade Volume (MWh)					
Date	COOK-ROCKPORT	GREENLAND GAP-MT STORM	MIAMI FORT 7-EAST BEND 2	APS-PENELEC	Total Trade Volume	Profit
8/1/2008	-	1,610	-	-	1,610	(2,566)
8/2/2008	-	2,100	-	-	2,100	2,458
8/3/2008	-	1,680	-	-	1,680	7,807
8/4/2008	-	2,226	-	-	2,226	9,056
8/7/2008	-	2,268	-	-	2,268	9,497
8/8/2008	-	2,268	-	-	2,268	7,406
8/9/2008	-	3,388	-	-	3,388	45,041
8/10/2008	-	4,200	-	-	4,200	70,416
8/11/2008	-	5,880	-	-	5,880	(9,325)
8/12/2008	-	1,260	-	-	1,260	41
8/13/2008	-	2,100	-	-	2,100	8,127
8/14/2008	-	4,200	-	-	4,200	21,627
8/15/2008	-	4,760	-	-	4,760	19,325
8/16/2008	-	4,620	-	-	4,620	21,482
8/17/2008	-	4,760	-	-	4,760	40,809
8/18/2008	-	4,760	-	-	4,760	23,173
8/19/2008	-	4,760	-	-	4,760	14,650
8/20/2008	-	4,760	-	-	4,760	5,324
8/21/2008	-	4,760	-	-	4,760	9,254
8/22/2008	-	4,760	-	-	4,760	39,211
8/23/2008	-	4,760	-	-	4,760	39,020
8/24/2008	-	6,860	-	-	6,860	125,661
8/25/2008	-	5,740	-	-	5,740	18,830
8/26/2008	-	4,900	-	-	4,900	126,126
8/27/2008	-	4,900	-	-	4,900	(20,933)
8/28/2008	-	1,540	-	-	1,540	(10,298)
8/31/2008	-	1,820	-	-	1,820	13,893
9/1/2008	-	840	-	-	840	11,834
9/2/2008	-	5,040	-	-	5,040	(79,714)
9/4/2008	-	1,540	-	-	1,540	1,570
9/5/2008	-	1,120	-	-	1,120	2,942
9/6/2008	-	1,540	-	-	1,540	2,084
9/7/2008	-	2,660	-	-	2,660	(2,736)
9/8/2008	-	1,188	-	-	1,188	887
9/9/2008	-	1,820	-	-	1,820	1,337
9/10/2008	-	728	-	-	728	596
9/11/2008	-	1,008	-	-	1,008	(3,393)
9/12/2008	-	1,288	-	-	1,288	938
9/13/2008	-	1,288	-	-	1,288	1,915
9/18/2008	-	1,288	-	-	1,288	21,563
9/19/2008	-	1,040	-	-	1,040	16,550
9/20/2008	-	1,520	-	-	1,520	(560)
9/21/2008	-	1,536	-	-	1,536	711
9/22/2008	-	1,536	-	-	1,536	1,505
9/23/2008	-	1,536	-	-	1,536	849
9/24/2008	-	1,536	-	-	1,536	674
9/25/2008	-	640	-	-	640	247
9/26/2008	-	640	-	-	640	210
10/1/2008	-	720	-	-	720	(5,866)
10/2/2008	-	640	-	-	640	257
10/3/2008	-	640	-	-	640	630

	Trade Volume (MWh)					
Date	COOK-ROCKPORT	GREENLAND GAP-MT STORM	MIAMI FORT 7-EAST BEND 2	APS-PENELEC	Total Trade Volume	Profit
10/4/2008	-	640	-	-	640	352
10/5/2008	-	640	-	-	640	1,012
10/6/2008	-	640	-	-	640	4,450
10/7/2008	-	640	-	-	640	404
10/8/2008	-	640	-	-	640	195
10/9/2008	-	640	-	-	640	111
11/20/2008	70	-	-	-	70	34
4/15/2009	210	-	-	-	210	(130)
5/9/2009	980	-	-	-	980	(234)
5/18/2009	980	-	-	-	980	393
5/19/2009	1,960	-	-	-	1,960	(284)
6/3/2009	280	-	-	-	280	(72)
6/8/2009	1,750	-	-	-	1,750	4,232
6/9/2009	2,520	-	-	-	2,520	3,393
6/12/2009	700	-	-	-	700	(57)
6/13/2009	280	-	-	-	280	123
6/14/2009	700	-	-	-	700	309
6/15/2009	140	-	-	-	140	55
7/14/2009	420	-	-	-	420	(58)
7/22/2009	4,480	-	-	-	4,480	942
7/23/2009	2,240	-	-	-	2,240	(150)
7/24/2009	2,240	-	-	-	2,240	486
7/25/2009	6,720	-	-	-	6,720	(2)
7/26/2009	3,360	-	-	-	3,360	1,198
8/1/2009	2,240	-	-	-	2,240	138
8/2/2009	3,360	-	-	-	3,360	621
8/3/2009	3,360	-	-	-	3,360	(601)
8/4/2009	2,240	-	-	-	2,240	2,104
8/17/2009	980	-	-	-	980	1,132
8/18/2009	980	-	-	-	980	1,743
8/19/2009	980	-	-	-	980	(82)
8/20/2009	980	-	-	-	980	1,392
8/21/2009	770	-	-	-	770	391
9/1/2009	-	-	-	840	840	364
9/2/2009	-	-	-	840	840	132
9/3/2009	-	-	-	840	840	(819)
9/4/2009	-	-	-	840	840	1,768
9/5/2009	1,960	-	-	840	2,800	(205)
9/6/2009	980	-	-	840	1,820	(257)
9/7/2009	-	-	-	840	840	142
9/8/2009	980	-	-	840	1,820	(274)
9/13/2009	1,960	-	-	-	1,960	171
9/14/2009	2,240	-	-	-	2,240	5,193
9/15/2009	1,960	-	-	-	1,960	(18)
9/16/2009	140	-	-	-	140	(65)
9/18/2009	980	-	-	-	980	150
9/21/2009	6,720	-	-	-	6,720	948
9/22/2009	980	-	-	-	980	3,071
9/23/2009	1,680	-	-	-	1,680	193
9/24/2009	1,680	-	-	-	1,680	1,091
9/26/2009	1,330	-	-	-	1,330	(120)

Figure 60

Monthly Trade Volume by Trade Type

		Powhatan				Huntrise				HEEP Fund			
Year	Month	Round Trip	Correlated	Spread	Total	Round Trip	Correlated	Spread	Total	Round Trip	Correlated	Spread	Total
2010	2	-	-	-	-	-	444,800	449,240	894,040	-	116,240	123,875	240,115
2010	3	-	-	-	-	-	745,800	661,601	1,407,401	-	198,530	176,290	374,820
2010	4	-	-	-	-	-	784,760	523,394	1,308,154	-	200,990	126,049	327,039
2010	5	-	331,056	121,792	452,848	-	49,400	23,200	72,600	-	204,793	75,150	279,944
	Total	**-**	**331,056**	**121,792**	**452,848**	**-**	**2,024,760**	**1,657,435**	**3,682,195**	**-**	**720,553**	**501,364**	**1,221,917**

Figure 61

Monthly Profit by Trade Type

		Powhatan					Huntrise					HEEP Fund				
Year	Month	Round Trip	Correlated	Spread	Profit before MLSA	Total Profit	Round Trip	Correlated	Spread	Profit before MLSA	Total Profit	Round Trip	Correlated	Spread	Profit before MLSA	Total Profit
2010	2	$0	$0	$0	$0	$0	$0	$84,681	$214,149	($348,164)	$298,830	$0	$21,528	$45,272	($109,162)	$66,801
2010	3	$0	$0	$0	$0	$0	$0	($11,517)	$446,207	($278,387)	$434,690	$0	($3,121)	$102,183	($90,114)	$99,062
2010	4	$0	$0	$0	$0	$0	$0	$134,968	$13,180	($369,768)	$148,148	$0	$32,222	($5,107)	($102,364)	$27,116
2010	5	$0	($206,924)	($173,388)	($576,147)	($380,313)	$0	($961)	$34,526	($2,453)	$33,565	$0	$32,014	$59,766	($44,143)	$91,780
	Total	**$0**	**($206,924)**	**($173,388)**	**($576,147)**	**($380,313)**	**$0**	**$207,171**	**$708,062**	**($998,772)**	**$915,233**	**$0**	**$82,643**	**$202,115**	**($345,781)**	**$284,758**

Figure 62

Spread Trade Statistics by Path, Entity

Path	Entity	Period	Days Traded	Trade Volume (MWh)	Profit before MLSA	MLSA	Total Profit
21 KINCA ATR24304-MISO	POWHATAN	2 - TRANSITION	2	21,600	-$17,698	$0	-$17,698
MISO-YUKON	POWHATAN	2 - TRANSITION	2	14,400	-$19,686	$11,425	-$8,261
MISO-CABOT	POWHATAN	2 - TRANSITION	2	14,400	-$29,711	$11,425	-$18,286
MISO-DAY	POWHATAN	2 - TRANSITION	1	12,000	-$34,732	$10,418	-$24,314
MISO-PRUNTYTOWN	POWHATAN	2 - TRANSITION	2	9,600	$11,233	$7,258	$18,490
BEAV DUQ UNIT1-MISO	POWHATAN	2 - TRANSITION	2	9,600	-$38,538	$0	-$38,538
NYIS-PSEG	POWHATAN	2 - TRANSITION	1	7,200	-$5,477	$5,091	-$385
MISO-AEP-DAYTON HUB	POWHATAN	2 - TRANSITION	1	7,200	$26,264	$4,635	$30,900
NYIS-MARION	POWHATAN	2 - TRANSITION	2	5,760	-$11,615	$5,067	-$6,548
SOUTHIMP-PEPCO MD	POWHATAN	2 - TRANSITION	1	4,800	-$33,550	$4,167	-$29,382
SOUTHIMP-BGE	POWHATAN	2 - TRANSITION	1	4,800	-$28,864	$4,167	-$24,696
SOUTHIMP-DOM	POWHATAN	2 - TRANSITION	1	4,800	-$31,357	$4,167	-$27,189
167 PLANO-MISO	POWHATAN	2 - TRANSITION	1	3,000	-$23,365	$0	-$23,365
NYIS-LEONIA 230 T-1	POWHATAN	2 - TRANSITION	1	2,560	-$5,305	$1,931	-$3,374
MT STORM-MISO	POWHATAN	2 - TRANSITION	2	72	-$740	$0	-$740
Powhatan Subtotal				121,792	-$243,141	$69,753	-$173,388
OVEC INTERFACE-DAY	HUNTRISE	2 - TRANSITION	58	293,500	-$241,499	$271,863	$30,364
21 KINCA ATR24304-MISO	HUNTRISE	2 - TRANSITION	54	188,980	$41,172	$0	$41,172
MISO-YUKON	HUNTRISE	2 - TRANSITION	82	179,380	-$65,742	$153,873	$88,130
NYIS-PSEG	HUNTRISE	2 - TRANSITION	69	133,280	-$16,112	$106,494	$90,382
NYIS-MARION	HUNTRISE	2 - TRANSITION	68	115,520	$67,244	$96,231	$163,475
MISO-PRUNTYTOWN	HUNTRISE	2 - TRANSITION	34	104,440	-$110,537	$105,900	-$4,637
MISO-COOK	HUNTRISE	2 - TRANSITION	87	90,460	-$19,571	$79,271	$59,700
PENELEC-MISO	HUNTRISE	2 - TRANSITION	31	86,200	-$24,927	$0	-$24,927
MISO-CABOT	HUNTRISE	2 - TRANSITION	41	68,420	-$36,260	$53,891	$17,631
HARRISON-MISO	HUNTRISE	2 - TRANSITION	15	52,800	-$21,712	$0	-$21,712
WALDWICK JK-DUKEXP	HUNTRISE	2 - TRANSITION	46	44,240	$24,191	$32,217	$56,408
NYIS-LEONIA 230 T-1	HUNTRISE	2 - TRANSITION	43	39,701	$158,271	$31,294	$189,565
MT STORM-MISO	HUNTRISE	2 - TRANSITION	85	35,920	$40,294	$0	$40,294
MISO-HARRISONTAP	HUNTRISE	2 - TRANSITION	16	31,040	-$1,145	$22,365	$21,219
CLOVERD2 138 KV T1-MISO	HUNTRISE	2 - TRANSITION	23	20,400	$22,746	$733	$23,479
MISO-BATH COUNTY	HUNTRISE	2 - TRANSITION	23	18,280	$23,659	$12,142	$35,801
QUAD CITIES 1-MISO	HUNTRISE	2 - TRANSITION	29	12,920	-$6,550	$0	-$6,550
MISO-CLOVER	HUNTRISE	2 - TRANSITION	12	10,520	-$15,735	$9,019	-$6,716
SOUTHIMP-GREENLAND GAP	HUNTRISE	2 - TRANSITION	3	9,600	-$47,434	$6,455	-$40,978
RECO-MISO	HUNTRISE	2 - TRANSITION	6	9,520	-$425	$0	-$425
BEAV DUQ UNIT1-MISO	HUNTRISE	2 - TRANSITION	5	7,960	$14,886	$0	$14,886
FORDMILL FE 2ACT-MISO	HUNTRISE	2 - TRANSITION	5	7,680	-$8,124	$0	-$8,124
167 PLANO-MISO	HUNTRISE	2 - TRANSITION	4	6,500	$19,925	$0	$19,925
COMED-MISO	HUNTRISE	2 - TRANSITION	7	6,340	$1,156	$0	$1,156
DOM-MISO	HUNTRISE	2 - TRANSITION	3	5,760	$6,617	$0	$6,617
All Others	HUNTRISE	2 - TRANSITION	--	78,074	-$133,045	$54,971	-$78,074
Huntrise Subtotal				1,657,435	-$328,656	$1,036,718	$708,062
OVEC INTERFACE-DAY	HEEPF	2 - TRANSITION	58	78,265	-$71,666	$73,279	$1,613
21 KINCA ATR24304-MISO	HEEPF	2 - TRANSITION	80	65,645	$118	$0	$118
MISO-YUKON	HEEPF	2 - TRANSITION	107	54,235	-$11,744	$46,560	$34,816
NYIS-PSEG	HEEPF	2 - TRANSITION	94	46,270	-$11,974	$38,744	$26,770
NYIS-MARION	HEEPF	2 - TRANSITION	85	32,676	$10,355	$27,823	$38,178
MISO-PRUNTYTOWN	HEEPF	2 - TRANSITION	39	30,580	-$29,421	$31,153	$1,732
MISO-CABOT	HEEPF	2 - TRANSITION	66	25,145	-$3,794	$20,291	$16,497
MISO-COOK	HEEPF	2 - TRANSITION	112	24,720	-$7,314	$21,895	$14,581
PENELEC-MISO	HEEPF	2 - TRANSITION	51	22,530	-$3,163	$0	-$3,163
HARRISON-MISO	HEEPF	2 - TRANSITION	15	15,360	-$5,874	$0	-$5,874
NYIS-LEONIA 230 T-1	HEEPF	2 - TRANSITION	59	12,821	$35,973	$10,765	$46,738
WALDWICK JK-DUKEXP	HEEPF	2 - TRANSITION	46	11,310	$6,524	$8,224	$14,748
MISO-HARRISONTAP	HEEPF	2 - TRANSITION	16	7,760	-$484	$5,591	$5,107
MISO-AEP-DAYTON HUB	HEEPF	2 - TRANSITION	11	7,620	$13,627	$6,894	$20,522
MT STORM-MISO	HEEPF	2 - TRANSITION	109	6,743	$2,312	$0	$2,312
CLOVERD2 138 KV T1-MISO	HEEPF	2 - TRANSITION	30	6,070	$5,028	$183	$5,212
MISO-BATH COUNTY	HEEPF	2 - TRANSITION	30	5,495	$7,033	$3,693	$10,726
BEAV DUQ UNIT1-MISO	HEEPF	2 - TRANSITION	13	4,990	-$59	$0	-$59
QUAD CITIES 1-MISO	HEEPF	2 - TRANSITION	33	3,960	-$3,973	$0	-$3,973
167 PLANO-MISO	HEEPF	2 - TRANSITION	16	3,490	-$8,496	$0	-$8,496
MISO-CLOVER	HEEPF	2 - TRANSITION	12	2,630	-$4,140	$2,255	-$1,885
RECO-MISO	HEEPF	2 - TRANSITION	6	2,380	-$110	$0	-$110
FORDMILL FE 2ACT-MISO	HEEPF	2 - TRANSITION	5	1,920	-$2,034	$0	-$2,034
COMED-MISO	HEEPF	2 - TRANSITION	7	1,785	$527	$0	$527
WALDWICK JK-MISO	HEEPF	2 - TRANSITION	5	1,750	$2,131	$0	$2,131
All Others	HEEPF	2 - TRANSITION	--	25,214	-$33,100	$18,482	-$14,618
HEEP Subtotal				501,364	-$113,717	$315,832	$202,115

Figure 63

Correlated Trade Statistics by Path, Entity

Path	Entity	Period	Days Traded	Trade Volume (MWh)	Profit before MLSA	MLSA	Total Profit
MIAMI FORT 7-EAST BEND 2	POWHATAN	2 - TRANSITION	2	120,000	-$39,709	$44,014	$4,304
GREENLAND GAP-MT STORM	POWHATAN	2 - TRANSITION	2	95,856	-$204,775	$36,203	-$168,572
COOK-ROCKPORT	POWHATAN	2 - TRANSITION	2	86,400	-$60,434	$33,198	-$27,237
APS-PENELEC	POWHATAN	2 - TRANSITION	2	28,800	-$28,087	$12,667	-$15,419
Powhatan Subtotal				331,056	-$333,006	$126,081	-$206,924
GREENLAND GAP-MT STORM	HUNTRISE	2 - TRANSITION	82	1,336,800	-$479,074	$552,105	$73,031
COOK-ROCKPORT	HUNTRISE	2 - TRANSITION	81	513,960	-$75,102	$209,597	$134,494
MIAMI FORT 7-EAST BEND 2	HUNTRISE	2 - TRANSITION	17	174,000	-$115,939	$115,585	-$354
Huntrise Subtotal				2,024,760	-$670,115	$877,287	$207,171
GREENLAND GAP-MT STORM	HEEPF	2 - TRANSITION	107	436,913	-$164,130	$183,646	$19,517
COOK-ROCKPORT	HEEPF	2 - TRANSITION	106	179,420	-$28,123	$74,317	$46,195
MIAMI FORT 7-EAST BEND 2	HEEPF	2 - TRANSITION	36	87,900	-$45,893	$48,733	$2,839
APS-PENELEC	HEEPF	2 - TRANSITION	19	16,320	$6,081	$8,012	$14,093
HEEP Subtotal				720,553	-$232,064	$314,708	$82,643

Figure 64

Correlated Trades Irrespective of "B" Border Node

(AB-BC trades defined by A-C)

	Trade Volume (MWh)					
Date	COOK-ROCKPORT	GREENLAND GAP-MT STORM	MIAMI FORT 7-EAST BEND 2	APS-PENELEC	Total Trade Volume	Profit
2/1/2010	-	3,360	-	-	3,360	1,273
2/2/2010	-	3,360	-	-	3,360	1,506
2/3/2010	-	6,720	-	-	6,720	1,570
2/4/2010	-	6,720	-	-	6,720	2,270
2/5/2010	6,720	13,440	-	-	20,160	4,949
2/6/2010	-	6,720	-	-	6,720	2,876
2/7/2010	2,000	12,000	-	-	14,000	4,262
2/8/2010	2,000	12,000	-	-	14,000	7,944
2/9/2010	2,000	12,000	-	-	14,000	5,918
2/10/2010	2,000	12,000	-	-	14,000	3,475
2/11/2010	2,000	12,000	-	-	14,000	(15)
2/12/2010	6,000	12,000	-	-	18,000	2,942
2/13/2010	6,000	12,000	-	-	18,000	3,778
2/14/2010	12,000	12,000	-	-	24,000	9,146
2/15/2010	12,000	12,000	-	-	24,000	13,589
2/16/2010	12,000	12,000	-	-	24,000	7,884
2/17/2010	24,000	24,000	-	-	48,000	6,643
2/18/2010	12,000	12,000	-	-	24,000	4,040
2/19/2010	12,000	12,000	-	-	24,000	3,247
2/20/2010	12,000	12,000	-	-	24,000	2,225
2/21/2010	12,000	18,000	-	-	30,000	8,302
2/22/2010	6,000	18,000	-	-	24,000	1,265
2/23/2010	6,000	18,000	-	-	24,000	(1,034)
2/24/2010	6,000	18,000	-	-	24,000	(589)
2/25/2010	6,000	18,000	-	-	24,000	642
2/26/2010	6,000	24,000	-	-	30,000	7,139
2/27/2010	6,000	24,000	-	-	30,000	1,531
2/28/2010	6,000	24,000	-	-	30,000	(567)
3/1/2010	6,000	24,000	-	-	30,000	(8,213)
3/2/2010	6,000	24,000	24,000	-	54,000	4,932
3/3/2010	6,000	24,000	24,000	-	54,000	(3,761)
3/4/2010	6,000	24,000	24,000	-	54,000	1,306
3/5/2010	6,000	24,000	24,000	-	54,000	2,934
3/6/2010	6,000	24,000	24,000	-	54,000	3,189
3/7/2010	12,000	24,000	-	-	36,000	(31,755)
3/8/2010	-	24,000	-	-	24,000	1,953
3/9/2010	4,000	12,000	6,000	-	22,000	3,309
3/10/2010	4,000	24,000	6,000	-	34,000	6,155
3/11/2010	4,000	24,000	6,000	-	34,000	255
3/12/2010	4,000	24,000	6,000	-	34,000	(1,453)
3/13/2010	2,000	24,000	6,000	-	32,000	(3,618)
3/14/2010	2,850	21,000	-	-	23,850	5,603
3/15/2010	3,600	24,000	-	-	27,600	1,540
3/16/2010	3,600	24,000	-	-	27,600	1,986
3/17/2010	7,200	28,800	-	-	36,000	3,163
3/18/2010	4,800	24,000	-	-	28,800	2,744
3/19/2010	4,800	24,000	-	-	28,800	(3,772)
3/20/2010	4,800	24,000	-	-	28,800	466
3/21/2010	5,600	24,000	-	-	29,600	(2,267)
3/22/2010	5,600	24,000	-	-	29,600	1,094
3/23/2010	5,600	24,000	-	-	29,600	(4,369)
3/24/2010	6,400	24,000	-	-	30,400	(528)
3/25/2010	5,600	24,000	-	-	29,600	(948)
3/26/2010	5,600	24,000	-	-	29,600	(59)
3/27/2010	7,680	28,800	-	-	36,480	6,058
3/30/2010	-	6,000	-	-	6,000	(1,000)
3/31/2010	-	6,000	-	-	6,000	416

	Trade Volume (MWh)					
Date	COOK-ROCKPORT	GREENLAND GAP-MT STORM	MIAMI FORT 7-EAST BEND 2	APS-PENELEC	Total Trade Volume	Profit
4/1/2010	6,400	24,000	6,000	-	36,400	13,808
4/2/2010	6,000	24,000	12,000	-	42,000	12,766
4/4/2010	14,400	24,000	12,000	-	50,400	19,328
4/5/2010	14,400	24,000	12,000	-	50,400	9,390
4/6/2010	9,600	24,000	12,000	-	45,600	52,888
4/7/2010	16,000	24,000	12,000	-	52,000	78,046
4/8/2010	4,800	12,000	-	-	16,800	(270)
4/9/2010	4,800	24,000	-	-	28,800	(1,744)
4/10/2010	5,200	24,000	-	-	29,200	(4,828)
4/11/2010	12,000	24,000	-	-	36,000	(2,764)
4/12/2010	9,600	4,800	-	-	14,400	3,864
4/13/2010	9,600	24,000	-	-	33,600	1,352
4/14/2010	9,600	24,000	-	-	33,600	(281)
4/15/2010	9,600	24,000	-	-	33,600	192
4/16/2010	9,600	48,000	-	-	57,600	1,356
4/17/2010	9,600	48,000	-	-	57,600	2,130
4/18/2010	9,600	24,000	-	-	33,600	2,579
4/19/2010	48,000	48,000	-	-	96,000	6,719
4/20/2010	6,000	24,000	-	-	30,000	(32,558)
4/21/2010	6,000	24,000	-	-	30,000	(240)
4/22/2010	13,250	24,000	1,500	-	38,750	(757)
4/23/2010	13,250	24,000	-	-	37,250	4,665
4/24/2010	13,250	24,000	-	-	37,250	242
4/25/2010	10,100	-	-	-	10,100	1,573
4/26/2010	8,000	-	-	-	8,000	(42)
4/27/2010	6,000	-	-	-	6,000	1,734
4/28/2010	9,600	-	-	-	9,600	(6,943)
4/29/2010	9,600	-	-	-	9,600	681
4/30/2010	9,600	12,000	-	-	21,600	4,305
5/1/2010	6,000	24,000	-	-	30,000	(2,703)
5/2/2010	6,000	24,000	-	-	30,000	1,577
5/5/2010	1,750	-	-	-	1,750	73
5/6/2010	1,200	-	-	-	1,200	(76)
5/7/2010	1,200	2,400	-	-	3,600	534
5/8/2010	1,350	2,400	-	-	3,750	(218)
5/9/2010	1,350	2,400	-	800	4,550	934
5/10/2010	1,650	2,400	-	800	4,850	(1,040)
5/11/2010	1,680	2,400	-	800	4,880	(1,639)
5/12/2010	1,200	2,400	1,200	800	5,600	664
5/13/2010	1,620	2,400	1,200	800	6,020	1,483
5/14/2010	1,920	2,400	1,200	800	6,320	2,954
5/15/2010	1,920	2,400	1,200	800	6,320	786
5/16/2010	1,200	2,400	1,200	800	5,600	1,524
5/17/2010	1,920	2,400	1,200	800	6,320	2,919
5/18/2010	2,400	4,800	2,400	1,600	11,200	4,885
5/19/2010	2,400	4,800	2,400	1,600	11,200	(2,027)
5/20/2010	2,400	4,800	2,400	-	9,600	2,486
5/21/2010	2,400	4,800	2,400	-	9,600	2,508
5/22/2010	2,400	4,800	2,400	-	9,600	811
5/23/2010	2,400	4,800	2,400	800	10,400	1,214
5/24/2010	2,400	4,800	2,400	800	10,400	1,723
5/25/2010	2,400	4,800	2,400	800	10,400	1,637
5/26/2010	1,200	4,800	2,400	480	8,880	2,063
5/27/2010	2,400	4,800	4,800	800	12,800	9,756
5/28/2010	2,400	4,800	4,800	800	12,800	8,586
5/29/2010	40,320	50,400	75,600	13,440	179,760	(29,170)
5/30/2010	50,400	50,249	50,400	16,800	167,849	(188,115)

Figure 65

Monthly Trade Volume by Trade Type

		Powhatan				HEEP Fund				CU Fund			
Year	Month	Round Trip	Correlated	Spread	Total	Round Trip	Correlated	Spread	Total	Round Trip	Correlated	Spread	Total
2010	6	5,668,960	1,334,886	786,450	7,790,296	283,448	66,744	39,329	389,521	-	-	-	-
2010	7	7,323,600	661,097	767,284	8,751,980	366,180	33,055	38,296	437,531	2,386,000	72,000	14	2,458,014
2010	8	360,000	92,400	97,260	549,660	18,000	4,620	4,863	27,483	216,000	14,400	3	230,403
	Total	**13,352,560**	**2,088,382**	**1,650,994**	**17,091,936**	**667,628**	**104,419**	**82,488**	**854,535**	**2,602,000**	**86,400**	**17**	**2,688,417**

Figure 66

Monthly Profit by Trade Type

		Powhatan					HEEP Fund					CU Fund				
Year	Month	Round Trip	Correlated	Spread	Profit before MLSA	Total Profit	Round Trip	Correlated	Spread	Profit before MLSA	Total Profit	Round Trip	Correlated	Spread	Profit before MLSA	Total Profit
2010	6	$1,118,271	$141,368	$294,724	($2,909,574)	$1,554,362	$55,882	$7,061	$14,700	($145,563)	$77,643	$0	$0	$0	$0	$0
2010	7	$2,295,048	$217,039	$530,575	($2,692,679)	$3,042,662	$114,627	$10,849	$27,440	($133,804)	$152,916	$994,227	$25,012	($127)	($665,158)	$1,019,112
2010	8	$51,901	($17,220)	$15,296	($244,982)	$49,977	$2,591	($862)	$763	($12,256)	$2,492	$86,348	$2,241	($6)	($65,961)	$88,583
	Total	**$3,465,220**	**$341,187**	**$840,595**	**($5,847,234)**	**$4,647,002**	**$173,100**	**$17,048**	**$42,903**	**($291,623)**	**$233,051**	**$1,080,576**	**$27,253**	**($133)**	**($731,119)**	**$1,107,695**

Figure 67

Spread Trade Statistics by Path, Entity

Path	Entity	Period	Days Traded	Trade Volume (MWh)	Profit before MLSA	MLSA	Total Profit
21 KINCA ATR24304-MISO	POWHATAN	3 - MANIPULATION	46	293,800	-$79,382	$0	-$79,382
MISO-DAY	POWHATAN	3 - MANIPULATION	64	248,000	-$186,602	$333,917	$147,315
MISO-YUKON	POWHATAN	3 - MANIPULATION	57	238,580	-$261,783	$272,578	$10,795
BEAV DUQ UNIT1-MISO	POWHATAN	3 - MANIPULATION	41	161,800	$130,240	$0	$130,240
NYIS-PSEG	POWHATAN	3 - MANIPULATION	50	139,754	-$69,330	$182,947	$113,616
MISO-PRUNTYTOWN	POWHATAN	3 - MANIPULATION	35	131,300	$33,474	$140,544	$174,019
MISO-CABOT	POWHATAN	3 - MANIPULATION	19	98,400	-$188,883	$101,303	-$87,580
NYIS-MARION	POWHATAN	3 - MANIPULATION	56	84,767	-$23,974	$112,545	$88,571
NYIS-LEONIA 230 T-1	POWHATAN	3 - MANIPULATION	47	56,899	-$15,687	$74,660	$58,973
MISO-COOK	POWHATAN	3 - MANIPULATION	64	37,400	$7,330	$33,700	$41,030
DAY-MISO	POWHATAN	3 - MANIPULATION	64	21,200	-$23,687	$0	-$23,687
QUAD CITIES 1-MISO	POWHATAN	3 - MANIPULATION	5	20,600	$243,026	$0	$243,026
PENELEC-MISO	POWHATAN	3 - MANIPULATION	57	19,629	$100,708	$0	$100,708
SOUTHIMP-APS	POWHATAN	3 - MANIPULATION	3	13,359	-$120,547	$18,179	-$102,368
HOMERCIT-MISO	POWHATAN	3 - MANIPULATION	5	11,600	-$10,647	$0	-$10,647
MISO-PLEASANTS	POWHATAN	3 - MANIPULATION	1	9,600	-$14,414	$14,125	-$289
SOUTHIMP-DOM	POWHATAN	3 - MANIPULATION	9	8,060	-$41,537	$13,066	-$28,470
ROCKPORT-MISO	POWHATAN	3 - MANIPULATION	59	4,800	-$1,681	$0	-$1,681
SOUTHIMP-CLOVER	POWHATAN	3 - MANIPULATION	8	4,609	-$43,440	$7,085	-$36,354
NYIS-DOM	POWHATAN	3 - MANIPULATION	6	4,574	$72,200	$6,649	$78,849
CLOVERD2 138 KV T1-MISO	POWHATAN	3 - MANIPULATION	4	4,480	$991	$0	$991
NYIS-BGE	POWHATAN	3 - MANIPULATION	4	4,000	-$25,594	$5,559	-$20,035
NYIS-ECRRF	POWHATAN	3 - MANIPULATION	1	3,159	-$51,949	$3,382	-$48,567
HARRISON-MISO	POWHATAN	3 - MANIPULATION	1	2,400	-$9,919	$0	-$9,919
MISO-PSEG	POWHATAN	3 - MANIPULATION	1	2,400	$2,621	$3,009	$5,630
All Others	POWHATAN	3 - MANIPULATION	--	25,824	68,621	27,189	95,810
Powhatan Subtotal				1,650,994	-$509,844	$1,350,439	$840,595
21 KINCA ATR24304-MISO	HEEPF	3 - MANIPULATION	46	14,690	-$3,971	$0	-$3,971
MISO-DAY	HEEPF	3 - MANIPULATION	64	12,400	-$9,332	$16,696	$7,364
MISO-YUKON	HEEPF	3 - MANIPULATION	57	11,930	-$13,110	$13,630	$520
BEAV DUQ UNIT1-MISO	HEEPF	3 - MANIPULATION	41	8,090	$6,511	$0	$6,511
NYIS-PSEG	HEEPF	3 - MANIPULATION	50	6,988	-$3,475	$9,148	$5,673
MISO-PRUNTYTOWN	HEEPF	3 - MANIPULATION	35	6,565	$1,673	$7,027	$8,700
MISO-CABOT	HEEPF	3 - MANIPULATION	19	4,920	-$9,445	$5,065	-$4,380
NYIS-MARION	HEEPF	3 - MANIPULATION	56	4,243	-$1,121	$5,642	$4,520
NYIS-LEONIA 230 T-1	HEEPF	3 - MANIPULATION	47	2,845	-$785	$3,733	$2,949
MISO-COOK	HEEPF	3 - MANIPULATION	64	1,870	$366	$1,685	$2,051
DAY-MISO	HEEPF	3 - MANIPULATION	64	1,060	-$1,184	$0	-$1,184
QUAD CITIES 1-MISO	HEEPF	3 - MANIPULATION	5	1,030	$12,151	$0	$12,151
PENELEC-MISO	HEEPF	3 - MANIPULATION	57	981	$5,035	$0	$5,035
SOUTHIMP-APS	HEEPF	3 - MANIPULATION	3	668	-$6,026	$909	-$5,117
HOMERCIT-MISO	HEEPF	3 - MANIPULATION	5	580	-$532	$0	-$532
MISO-PLEASANTS	HEEPF	3 - MANIPULATION	1	480	-$721	$706	-$14
SOUTHIMP-DOM	HEEPF	3 - MANIPULATION	9	403	-$2,077	$653	-$1,424
ROCKPORT-MISO	HEEPF	3 - MANIPULATION	59	240	-$84	$0	-$84
SOUTHIMP-CLOVER	HEEPF	3 - MANIPULATION	8	230	-$2,155	$353	-$1,802
NYIS-DOM	HEEPF	3 - MANIPULATION	6	229	$3,610	$333	$3,943
CLOVERD2 138 KV T1-MISO	HEEPF	3 - MANIPULATION	4	224	$50	$0	$50
NYIS-BGE	HEEPF	3 - MANIPULATION	4	200	-$1,280	$278	-$1,002
NYIS-ECRRF	HEEPF	3 - MANIPULATION	1	158	-$2,595	$169	-$2,426
MISO-PSEG	HEEPF	3 - MANIPULATION	1	120	$131	$150	$281
HARRISON-MISO	HEEPF	3 - MANIPULATION	1	120	-$496	$0	-$496
All Others	HEEPF	3 - MANIPULATION	--	1,226	4,280	1,307	5,586
HEEP Subtotal				82,488	-$24,581	$67,484	$42,903

Figure 68

Correlated Trade Statistics by Path, Entity

Path	Entity	Period	Days Traded	Trade Volume (MWh)	Profit before MLSA	MLSA	Total Profit
COOK-ROCKPORT	POWHATAN	3 - MANIPULATION	59	1,045,600	-$498,623	$590,598	$91,975
MIAMI FORT 7-EAST BEND 2	POWHATAN	3 - MANIPULATION	20	576,000	-$208,806	$284,442	$75,636
APS-PENELEC	POWHATAN	3 - MANIPULATION	55	437,982	-$109,199	$281,038	$171,839
GREENLAND GAP-MT STORM	POWHATAN	3 - MANIPULATION	2	28,800	-$10,579	$12,316	$1,737
Powhatan Subtotal				2,088,382	-$827,207	$1,168,394	$341,187
COOK-ROCKPORT	HEEPF	3 - MANIPULATION	59	52,280	-$24,937	$29,530	$4,593
MIAMI FORT 7-EAST BEND 2	HEEPF	3 - MANIPULATION	20	28,800	-$10,443	$14,222	$3,779
APS-PENELEC	HEEPF	3 - MANIPULATION	55	21,899	-$5,462	$14,052	$8,590
GREENLAND GAP-MT STORM	HEEPF	3 - MANIPULATION	2	1,440	-$529	$616	$87
HEEP Subtotal				104,419	-$41,372	$58,420	$17,048
MIAMI FORT 7-EAST BEND 2	CUFUND	3 - MANIPULATION	17	86,400	-$27,416	$54,669	$27,253

Figure 69

Correlated Trades Irrespective of "B" Border Node

(AB-BC trades defined by A-C)

	Trade Volume (MWh)					
Date	COOK-ROCKPORT	GREENLAND GAP-MT STORM	MIAMI FORT 7-EAST BEND 2	APS-PENELEC	Total Trade Volume	Profit
6/1/2010	25,200	-	25,200	6,720	57,120	56,597
6/2/2010	25,200	-	25,200	6,720	57,120	8,123
6/3/2010	25,200	-	25,200	6,720	57,120	14,878
6/4/2010	25,200	-	25,200	10,080	60,480	(321)
6/5/2010	25,200	-	50,400	10,080	85,680	6,648
6/6/2010	25,200	-	50,400	10,080	85,680	(529)
6/7/2010	25,200	15,120	50,400	10,080	100,800	14,411
6/8/2010	25,200	15,120	50,400	10,080	100,800	4,138
6/9/2010	25,200	-	25,200	10,080	60,480	(12,759)
6/10/2010	25,200	-	25,200	10,080	60,480	39,241
6/11/2010	25,200	-	25,200	10,080	60,480	37,957
6/12/2010	25,200	-	25,200	10,080	60,480	(4,240)
6/13/2010	25,200	-	25,200	13,440	63,840	18,942
6/14/2010	25,200	-	25,200	13,440	63,840	5,196
6/15/2010	25,200	-	25,200	13,440	63,840	3,103
6/16/2010	50,400	-	25,200	13,440	89,040	(72,877)
6/17/2010	25,200	-	25,200	13,440	63,840	26,213
6/18/2010	25,200	-	25,200	13,440	63,840	(11,048)
6/19/2010	-	-	-	13,440	13,440	132
6/20/2010	-	-	25,200	13,440	38,640	19,128
6/21/2010	-	-	25,200	13,440	38,640	(7,112)
6/22/2010	11,760	-	-	-	11,760	870
6/23/2010	-	-	-	1,680	1,680	8,516
6/24/2010	-	-	-	2,190	2,190	9,362
6/26/2010	-	-	-	6,720	6,720	(19,945)
6/27/2010	-	-	-	10,080	10,080	125
6/28/2010	-	-	-	10,080	10,080	(5,166)
6/29/2010	-	-	-	6,720	6,720	14,796
6/30/2010	-	-	-	6,720	6,720	(5,946)
7/1/2010	25,200	-	-	6,720	31,920	10,737
7/2/2010	25,200	-	-	6,720	31,920	(1,740)
7/3/2010	25,200	-	-	6,720	31,920	(18,272)
7/4/2010	25,200	-	-	6,720	31,920	21,025
7/5/2010	-	-	-	6,720	6,720	49,460
7/6/2010	-	-	-	3,780	3,780	66,211
7/7/2010	7,560	-	-	3,024	10,584	73,355
7/8/2010	-	-	-	7,362	7,362	(499)
7/9/2010	-	-	-	10,080	10,080	(12,819)
7/10/2010	-	-	-	6,720	6,720	(11,087)
7/11/2010	25,200	-	-	6,720	31,920	12,862
7/12/2010	50,400	-	-	-	50,400	1,060
7/13/2010	-	-	-	6,720	6,720	643
7/14/2010	20,160	-	-	6,720	26,880	3,035
7/15/2010	20,160	-	-	9,665	29,825	6,716
7/16/2010	20,160	-	-	4,620	24,780	5,875
7/18/2010	20,160	-	9,600	6,720	36,480	19,390
7/19/2010	20,160	-	4,800	6,720	31,680	35,498
7/20/2010	20,160	-	4,800	7,140	32,100	15,329
7/21/2010	20,160	-	4,800	7,140	32,100	(22,086)
7/22/2010	20,160	-	4,800	-	24,960	(3,480)
7/23/2010	20,160	-	4,800	-	24,960	25,909
7/24/2010	20,160	-	4,800	-	24,960	12,093
7/25/2010	25,200	-	4,800	-	30,000	(5,405)
7/26/2010	20,160	-	4,800	-	24,960	(3,464)
7/27/2010	20,160	-	4,800	7,140	32,100	(20,286)
7/28/2010	20,160	-	4,800	7,140	32,100	14,744
7/29/2010	20,160	-	4,800	7,140	32,100	(485)
7/30/2010	20,160	-	4,800	7,140	32,100	(2,761)
7/31/2010	20,160	-	4,800	7,140	32,100	(18,658)
8/1/2010	25,200	-	4,800	7,140	37,140	(9,785)
8/2/2010	25,200	-	4,800	7,140	37,140	(3,711)
8/3/2010	25,200	-	4,800	7,140	37,140	(2,345)

Figure 70

Round Trip Trade Statistics by Path, Entity

Path	Entity	Days Traded	Trade Volume	Profit before MLSA	MLSA	Total Profit
MISO-COMED	POWHATAN	63	5,005,200	-$1,759,825	$2,979,176	$1,219,351
MISO-DAY	POWHATAN	64	4,129,600	-$1,384,229	$2,446,789	$1,062,560
MISO-COOK	POWHATAN	46	2,227,200	-$713,145	$1,350,736	$637,590
MISO-ROCKPORT	POWHATAN	31	1,401,600	-$449,416	$893,002	$443,586
MISO-AEP	POWHATAN	19	566,400	-$194,824	$284,886	$90,062
MISO-YUKON	POWHATAN	3	12,800	-$5,152	$9,855	$4,703
MISO-PENELEC	POWHATAN	1	3,200	-$829	$2,233	$1,404
MISO-APS	POWHATAN	1	3,200	-$893	$2,233	$1,340
NYIS-PSEG	POWHATAN	1	1,680	-$942	$3,246	$2,304
NYIS-MARION	POWHATAN	1	1,120	-$618	$2,164	$1,546
NYIS-LEONIA 230 T-1	POWHATAN	1	560	-$309	$1,082	$773
Subtotal			13,352,560	(4,510,184)	7,975,403	3,465,220
MISO-COMED	HEEPF	63	250,260	-$88,168	$148,959	$60,790
MISO-DAY	HEEPF	64	206,480	-$69,234	$122,339	$53,105
MISO-COOK	HEEPF	46	111,360	-$35,669	$67,537	$31,868
MISO-ROCKPORT	HEEPF	31	70,080	-$22,417	$44,650	$22,233
MISO-AEP	HEEPF	19	28,320	-$9,744	$14,244	$4,500
MISO-YUKON	HEEPF	3	640	-$258	$493	$235
MISO-PENELEC	HEEPF	1	160	-$41	$112	$70
MISO-APS	HEEPF	1	160	-$45	$112	$67
NYIS-PSEG	HEEPF	1	84	-$47	$162	$115
NYIS-MARION	HEEPF	1	56	-$31	$108	$77
NYIS-LEONIA 230 T-1	HEEPF	1	28	-$15	$54	$39
Subtotal			667,628	(225,670)	398,770	173,100
MISO-COMED	CUFUND	16	1,142,000	-$299,728	$782,978	$483,250
MISO-DAY	CUFUND	16	1,139,800	-$319,191	$784,943	$465,751
MISO-COOK	CUFUND	15	320,200	-$84,651	$216,225	$131,574
Subtotal			2,602,000	(703,570)	1,784,145	1,080,576
Grand Total			**16,622,188**	**(5,439,423)**	**10,158,319**	**4,718,895**

Figure 71

Daily Trade Volume on Round Trip Paths

All Entities Combined

Date	MISO-DAY	MISO-AEP	MISO-COMED	MISO-COOK	MISO-ROCKPORT	NYIS-LEONIA_230_T_1	NYIS-MARION	NYIS-PSEG	MISO-APS	MISO-PENELEC	MISO-YUKON
6/1/2010	20,160	0	0	0	0	0	0	0	0	0	0
6/2/2010	20,160	25,200	25,200	0	0	0	0	0	0	0	0
6/3/2010	20,160	25,200	25,200	0	0	0	0	0	0	0	0
6/4/2010	20,160	25,200	25,200	0	0	0	0	0	0	0	0
6/5/2010	45,360	25,200	25,200	0	0	0	0	0	0	0	0
6/6/2010	45,360	25,200	25,200	0	0	0	0	0	0	0	0
6/7/2010	45,360	25,200	25,200	0	0	0	0	0	0	0	0
6/8/2010	45,360	25,200	25,200	0	0	0	0	0	0	0	0
6/9/2010	45,360	25,200	50,400	0	0	0	0	0	0	0	0
6/10/2010	45,360	25,200	50,400	0	0	0	0	0	0	0	0
6/11/2010	45,360	25,200	50,400	0	0	0	0	0	0	0	0
6/12/2010	45,360	25,200	50,400	0	0	0	0	0	0	0	0
6/13/2010	45,360	25,200	50,400	0	0	0	0	0	0	0	0
6/14/2010	20,160	25,200	25,200	0	0	0	0	0	0	0	0
6/15/2010	45,360	25,200	50,400	0	0	0	0	0	0	0	0
6/16/2010	40,320	25,200	50,400	0	0	0	0	0	0	0	0
6/17/2010	70,560	70,560	75,600	0	0	0	0	0	0	0	0
6/18/2010	45,360	35,280	50,400	0	0	0	0	0	0	0	0
6/19/2010	75,600	50,400	70,560	39,060	0	0	0	0	0	0	0
6/20/2010	55,440	60,480	70,560	52,920	0	0	0	0	0	0	0
6/21/2010	115,920	0	120,960	70,560	0	0	0	0	0	0	0
6/22/2010	50,400	0	105,840	100,800	0	0	0	0	0	0	0
6/23/2010	131,040	0	141,120	70,560	35,280	0	0	0	0	0	0
6/24/2010	141,120	0	141,120	80,640	35,280	588	1,176	1,764	0	0	0
6/25/2010	131,040	0	136,080	50,400	0	0	0	0	0	0	0
6/26/2010	100,800	0	151,200	20,160	0	0	0	0	0	0	0
6/27/2010	146,160	0	201,600	93,660	50,400	0	0	0	0	0	0
6/28/2010	141,120	0	201,600	85,680	50,400	0	0	0	0	0	0
6/29/2010	100,800	0	151,200	50,400	50,400	0	0	0	3,360	3,360	5,040
6/30/2010	96,600	0	136,080	50,400	50,400	0	0	0	0	0	0
7/1/2010	35,280	0	100,800	90,720	50,400	0	0	0	0	0	0
7/2/2010	90,720	0	151,200	50,400	50,400	0	0	0	0	0	0
7/3/2010	75,600	0	151,200	50,400	50,400	0	0	0	0	0	0
7/4/2010	100,800	0	100,800	50,400	50,400	0	0	0	0	0	0
7/5/2010	100,800	0	100,800	100,800	100,800	0	0	0	0	0	3,360
7/6/2010	100,800	0	100,800	84,000	75,600	0	0	0	0	0	0
7/7/2010	100,800	0	93,660	50,400	50,400	0	0	0	0	0	5,040
7/8/2010	100,800	0	100,800	73,080	50,400	0	0	0	0	0	0
7/9/2010	100,800	0	136,080	50,400	50,400	0	0	0	0	0	0
7/10/2010	100,800	0	100,800	100,800	90,720	0	0	0	0	0	0
7/11/2010	85,680	0	141,120	50,400	50,400	0	0	0	0	0	0
7/12/2010	50,400	0	100,800	50,400	50,400	0	0	0	0	0	0
7/13/2010	100,800	0	151,200	50,400	50,400	0	0	0	0	0	0
7/14/2010	50,400	0	50,400	50,400	50,400	0	0	0	0	0	0
7/15/2010	50,400	0	100,800	50,400	30,240	0	0	0	0	0	0
7/16/2010	50,400	0	100,800	30,240	30,240	0	0	0	0	0	0
7/17/2010	73,200	0	85,200	34,320	15,120	0	0	0	0	0	0
7/18/2010	175,040	0	172,800	30,240	30,240	0	0	0	0	0	0
7/19/2010	122,400	0	172,800	54,240	30,240	0	0	0	0	0	0
7/20/2010	81,660	0	103,080	54,240	0	0	0	0	0	0	0
7/21/2010	169,600	0	162,600	54,240	30,240	0	0	0	0	0	0
7/22/2010	138,180	0	146,400	54,240	30,240	0	0	0	0	0	0
7/23/2010	164,040	0	176,640	55,240	30,240	0	0	0	0	0	0
7/24/2010	171,600	0	180,200	54,240	50,400	0	0	0	0	0	0
7/25/2010	197,800	0	216,960	74,400	50,400	0	0	0	0	0	0
7/26/2010	172,800	0	172,800	79,440	50,400	0	0	0	0	0	0
7/27/2010	122,400	0	122,400	54,240	0	0	0	0	0	0	0
7/28/2010	122,400	0	122,400	84,480	0	0	0	0	0	0	0
7/29/2010	88,800	0	88,800	49,440	0	0	0	0	0	0	0
7/30/2010	74,400	0	74,400	42,240	0	0	0	0	0	0	0
7/31/2010	62,400	0	62,400	35,040	0	0	0	0	0	0	0
8/1/2010	50,400	0	50,400	25,200	0	0	0	0	0	0	0
8/2/2010	50,400	0	50,400	25,200	0	0	0	0	0	0	0
8/3/2010	146,400	0	146,400	49,200	0	0	0	0	0	0	0
Total	**5,475,880**	**594,720**	**6,397,460**	**2,658,760**	**1,471,680**	**588**	**1,176**	**1,764**	**3,360**	**3,360**	**13,440**

Figure 72

Daily Trade Volume on Round Trip Paths

Powhatan

Date	MISO-DAY	MISO-AEP	MISO-COMED	MISO-COOK	MISO-ROCKPORT	NYIS-LEONIA_230_T_1	NYIS-MARION	NYIS-PSEG	MISO-APS	MISO-PENELEC	MISO-YUKON
6/1/2010	19,200	0	0	0	0	0	0	0	0	0	0
6/2/2010	19,200	24,000	24,000	0	0	0	0	0	0	0	0
6/3/2010	19,200	24,000	24,000	0	0	0	0	0	0	0	0
6/4/2010	19,200	24,000	24,000	0	0	0	0	0	0	0	0
6/5/2010	43,200	24,000	24,000	0	0	0	0	0	0	0	0
6/6/2010	43,200	24,000	24,000	0	0	0	0	0	0	0	0
6/7/2010	43,200	24,000	24,000	0	0	0	0	0	0	0	0
6/8/2010	43,200	24,000	24,000	0	0	0	0	0	0	0	0
6/9/2010	43,200	24,000	48,000	0	0	0	0	0	0	0	0
6/10/2010	43,200	24,000	48,000	0	0	0	0	0	0	0	0
6/11/2010	43,200	24,000	48,000	0	0	0	0	0	0	0	0
6/12/2010	43,200	24,000	48,000	0	0	0	0	0	0	0	0
6/13/2010	43,200	24,000	48,000	0	0	0	0	0	0	0	0
6/14/2010	19,200	24,000	24,000	0	0	0	0	0	0	0	0
6/15/2010	43,200	24,000	48,000	0	0	0	0	0	0	0	0
6/16/2010	38,400	24,000	48,000	0	0	0	0	0	0	0	0
6/17/2010	67,200	67,200	72,000	0	0	0	0	0	0	0	0
6/18/2010	43,200	33,600	48,000	0	0	0	0	0	0	0	0
6/19/2010	72,000	48,000	67,200	37,200	0	0	0	0	0	0	0
6/20/2010	52,800	57,600	67,200	50,400	0	0	0	0	0	0	0
6/21/2010	110,400	0	115,200	67,200	0	0	0	0	0	0	0
6/22/2010	48,000	0	100,800	96,000	0	0	0	0	0	0	0
6/23/2010	124,800	0	134,400	67,200	33,600	0	0	0	0	0	0
6/24/2010	134,400	0	134,400	76,800	33,600	560	1,120	1,680	0	0	0
6/25/2010	124,800	0	129,600	48,000	0	0	0	0	0	0	0
6/26/2010	96,000	0	144,000	19,200	0	0	0	0	0	0	0
6/27/2010	139,200	0	192,000	89,200	48,000	0	0	0	0	0	0
6/28/2010	134,400	0	192,000	81,600	48,000	0	0	0	0	0	0
6/29/2010	96,000	0	144,000	48,000	48,000	0	0	0	3,200	3,200	4,800
6/30/2010	92,000	0	129,600	48,000	48,000	0	0	0	0	0	0
7/1/2010	33,600	0	96,000	86,400	48,000	0	0	0	0	0	0
7/2/2010	86,400	0	144,000	48,000	48,000	0	0	0	0	0	0
7/3/2010	72,000	0	144,000	48,000	48,000	0	0	0	0	0	0
7/4/2010	96,000	0	96,000	48,000	48,000	0	0	0	0	0	0
7/5/2010	96,000	0	96,000	96,000	96,000	0	0	0	0	0	3,200
7/6/2010	96,000	0	96,000	80,000	72,000	0	0	0	0	0	0
7/7/2010	96,000	0	89,200	48,000	48,000	0	0	0	0	0	4,800
7/8/2010	96,000	0	96,000	69,600	48,000	0	0	0	0	0	0
7/9/2010	96,000	0	129,600	48,000	48,000	0	0	0	0	0	0
7/10/2010	96,000	0	96,000	96,000	86,400	0	0	0	0	0	0
7/11/2010	81,600	0	134,400	48,000	48,000	0	0	0	0	0	0
7/12/2010	48,000	0	96,000	48,000	48,000	0	0	0	0	0	0
7/13/2010	96,000	0	144,000	48,000	48,000	0	0	0	0	0	0
7/14/2010	48,000	0	48,000	48,000	48,000	0	0	0	0	0	0
7/15/2010	48,000	0	96,000	48,000	28,800	0	0	0	0	0	0
7/16/2010	48,000	0	96,000	28,800	28,800	0	0	0	0	0	0
7/17/2010	24,000	0	24,000	14,400	14,400	0	0	0	0	0	0
7/18/2010	76,800	0	96,000	28,800	28,800	0	0	0	0	0	0
7/19/2010	48,000	0	96,000	28,800	28,800	0	0	0	0	0	0
7/20/2010	9,200	0	29,600	28,800	0	0	0	0	0	0	0
7/21/2010	72,000	0	72,000	28,800	28,800	0	0	0	0	0	0
7/22/2010	51,600	0	48,000	28,800	28,800	0	0	0	0	0	0
7/23/2010	64,800	0	76,800	28,800	28,800	0	0	0	0	0	0
7/24/2010	72,000	0	72,000	28,800	48,000	0	0	0	0	0	0
7/25/2010	96,000	0	115,200	48,000	48,000	0	0	0	0	0	0
7/26/2010	96,000	0	96,000	52,800	48,000	0	0	0	0	0	0
7/27/2010	48,000	0	48,000	28,800	0	0	0	0	0	0	0
7/28/2010	48,000	0	48,000	57,600	0	0	0	0	0	0	0
7/29/2010	48,000	0	48,000	28,800	0	0	0	0	0	0	0
7/30/2010	48,000	0	48,000	28,800	0	0	0	0	0	0	0
7/31/2010	48,000	0	48,000	28,800	0	0	0	0	0	0	0
8/1/2010	48,000	0	48,000	24,000	0	0	0	0	0	0	0
8/2/2010	48,000	0	48,000	24,000	0	0	0	0	0	0	0
8/3/2010	48,000	0	48,000	24,000	0	0	0	0	0	0	0
Total	**4,129,600**	**566,400**	**5,005,200**	**2,227,200**	**1,401,600**	**560**	**1,120**	**1,680**	**3,200**	**3,200**	**12,800**

Figure 73

Daily Profit by Trade Type, Entity

Manipulation Period

	Powhatan				HEEP				CU FUND				Combined			
Date	Round Trip	Correlated	Spread	Total	Round Trip	Correlated	Spread	Total	Round Trip	Correlated	Spread	Total	Round Trip	Correlated	Spread	Total
6/1/2010	$5,829	$53,902	-$7,380	$52,352	$291	$2,695	-$369	$2,617	$0	$0	$0	$0	$6,121	$56,597	-$7,749	$54,969
6/2/2010	$17,731	$7,737	-$20,367	$5,101	$886	$387	-$1,019	$254	$0	$0	$0	$0	$18,617	$8,123	-$21,385	$5,355
6/3/2010	$20,568	$14,170	$45,244	$79,982	$1,028	$708	$2,262	$3,998	$0	$0	$0	$0	$21,596	$14,878	$47,506	$83,980
6/4/2010	$6,743	-$306	$29,635	$36,072	$337	-$16	$1,482	$1,803	$0	$0	$0	$0	$7,080	-$321	$31,116	$37,875
6/5/2010	-$428	$6,332	$28,978	$34,882	-$22	$316	$1,423	$1,717	$0	$0	$0	$0	-$450	$6,648	$30,401	$36,599
6/6/2010	-$3,606	-$504	$93,721	$89,612	-$181	-$26	$4,686	$4,479	$0	$0	$0	$0	-$3,787	-$529	$98,407	$94,091
6/7/2010	$13,452	$13,725	-$17,252	$9,925	$672	$686	-$863	$495	$0	$0	$0	$0	$14,124	$14,411	-$18,115	$10,420
6/8/2010	$8,394	$3,941	-$54,675	-$42,340	$419	$196	-$2,734	-$2,118	$0	$0	$0	$0	$8,813	$4,138	-$57,409	-$44,459
6/9/2010	-$976	-$12,151	-$6,917	-$20,044	-$49	-$608	-$346	-$1,003	$0	$0	$0	$0	-$1,025	-$12,759	-$7,263	-$21,047
6/10/2010	$1,711	$37,372	$76,233	$115,316	$85	$1,868	$3,811	$5,765	$0	$0	$0	$0	$1,796	$39,241	$80,045	$121,081
6/11/2010	$17,883	$36,150	$13,189	$67,222	$894	$1,807	$659	$3,360	$0	$0	$0	$0	$18,777	$37,957	$13,848	$70,582
6/12/2010	$15,097	-$4,038	$2,913	$13,972	$754	-$202	$146	$698	$0	$0	$0	$0	$15,851	-$4,240	$3,059	$14,670
6/13/2010	$26,082	$18,040	$2,309	$46,430	$1,303	$902	$115	$2,320	$0	$0	$0	$0	$27,385	$18,942	$2,424	$48,750
6/14/2010	$12,975	$4,949	$13,511	$31,435	$648	$247	$677	$1,573	$0	$0	$0	$0	$13,624	$5,196	$14,188	$33,007
6/15/2010	$3,807	$2,955	$52,018	$58,780	$190	$147	$2,601	$2,938	$0	$0	$0	$0	$3,997	$3,103	$54,618	$61,718
6/16/2010	$5,087	-$69,406	$12,736	-$51,583	$254	-$3,471	$637	-$2,580	$0	$0	$0	$0	$5,340	-$72,877	$13,373	-$54,163
6/17/2010	$58,191	$24,965	-$58,855	$24,301	$2,908	$1,248	-$2,945	$1,211	$0	$0	$0	$0	$61,099	$26,213	-$61,800	$25,512
6/18/2010	$36,719	-$10,521	-$34,139	-$7,942	$1,835	-$526	-$1,707	-$398	$0	$0	$0	$0	$38,554	-$11,048	-$35,847	-$8,341
6/19/2010	$49,996	$126	$0	$50,122	$2,499	$6	$0	$2,505	$0	$0	$0	$0	$52,495	$132	$0	$52,627
6/20/2010	$47,368	$18,217	$17,873	$83,458	$2,367	$911	$891	$4,169	$0	$0	$0	$0	$49,736	$19,128	$18,764	$87,627
6/21/2010	$99,893	-$6,773	-$206	$92,914	$4,993	-$339	-$11	$4,644	$0	$0	$0	$0	$104,886	-$7,112	-$216	$97,557
6/22/2010	$71,282	$828	-$10,333	$61,777	$3,563	$41	-$517	$3,087	$0	$0	$0	$0	$74,844	$870	-$10,850	$64,864
6/23/2010	$129,667	$8,110	$1,442	$139,220	$6,481	$406	$72	$6,959	$0	$0	$0	$0	$136,149	$8,516	$1,514	$146,179
6/24/2010	$174,550	$8,916	$18,393	$201,859	$8,725	$446	$919	$10,090	$0	$0	$0	$0	$183,276	$9,362	$19,312	$211,949
6/25/2010	$59,234	$0	$0	$59,234	$2,960	$0	$0	$2,960	$0	$0	$0	$0	$62,194	$0	$0	$62,194
6/26/2010	$5,324	-$18,995	-$15,349	-$29,021	$265	-$950	-$767	-$1,453	$0	$0	$0	$0	$5,588	-$19,945	-$16,117	-$30,473
6/27/2010	$78,872	$119	$128,747	$207,738	$3,941	$6	$6,434	$10,381	$0	$0	$0	$0	$82,813	$125	$135,180	$218,118
6/28/2010	$133,789	-$4,920	$35,435	$164,303	$6,687	-$246	$1,772	$8,213	$0	$0	$0	$0	$140,476	-$5,166	$37,207	$172,516
6/29/2010	$46,940	$14,091	-$15,097	$45,933	$2,345	$705	-$755	$2,295	$0	$0	$0	$0	$49,285	$14,796	-$15,852	$48,228
6/30/2010	-$23,902	-$5,663	-$37,081	-$66,647	-$1,197	-$283	-$1,854	-$3,334	$0	$0	$0	$0	-$25,099	-$5,946	-$38,936	-$69,981
7/1/2010	-$8,499	$10,226	-$924	$803	-$365	$511	$706	$852	$0	$0	$0	$0	-$8,865	$10,737	-$218	$1,655
7/2/2010	-$22,994	-$1,657	-$1,576	-$26,227	-$1,151	-$83	-$79	-$1,313	$0	$0	$0	$0	-$24,145	-$1,740	-$1,655	-$27,540
7/3/2010	$12,042	-$17,401	-$23,147	-$28,506	$601	-$870	-$1,157	-$1,427	$0	$0	$0	$0	$12,643	-$18,272	-$24,304	-$29,933
7/4/2010	$74,890	$20,024	-$53,093	$41,821	$3,743	$1,001	-$2,655	$2,089	$0	$0	$0	$0	$78,633	$21,025	-$55,748	$43,911
7/5/2010	$54,893	$47,105	$10,180	$112,178	$2,743	$2,355	$509	$5,607	$0	$0	$0	$0	$57,636	$49,460	$10,689	$117,785
7/6/2010	$227,111	$63,058	$86,728	$376,896	$11,354	$3,153	$4,394	$18,900	$0	$0	$0	$0	$238,465	$66,211	$91,121	$395,797
7/7/2010	$156,780	$69,862	$440,912	$667,554	$7,838	$3,493	$22,082	$33,413	$0	$0	$0	$0	$164,618	$73,355	$462,995	$700,967
7/8/2010	$170,647	-$475	$91,954	$262,126	$8,531	-$24	$4,598	$13,105	$0	$0	$0	$0	$179,178	-$499	$96,552	$275,230
7/9/2010	$103,536	-$12,209	$22,331	$113,659	$5,175	-$610	$1,116	$5,681	$0	$0	$0	$0	$108,712	-$12,819	$23,447	$119,340
7/10/2010	$62,120	-$10,559	-$25,739	$25,822	$3,104	-$528	-$1,287	$1,289	$0	$0	$0	$0	$65,225	-$11,087	-$27,026	$27,111
7/11/2010	$41,846	$12,250	$11,326	$65,422	$2,091	$612	$566	$3,269	$0	$0	$0	$0	$43,937	$12,862	$11,892	$68,691
7/12/2010	$87,541	$1,010	-$463,648	-$375,097	$4,376	$50	-$23,177	-$18,751	$0	$0	$0	$0	$91,917	$1,060	-$486,826	-$393,848
7/13/2010	$60,502	$612	$14,860	$75,975	$3,023	$31	$743	$3,797	$0	$0	$0	$0	$63,526	$643	$15,603	$79,771
7/14/2010	$74,055	$2,890	-$27,483	$49,462	$3,702	$144	-$1,374	$2,472	$0	$0	$0	$0	$77,757	$3,035	-$28,857	$51,934
7/15/2010	$85,463	$6,396	$12,611	$104,470	$4,272	$320	$631	$5,223	$0	$0	$0	$0	$89,735	$6,716	$13,242	$109,693
7/16/2010	$98,925	$5,596	$72,134	$176,655	$4,945	$280	$3,587	$8,812	$0	$0	$0	$0	$103,871	$5,875	$75,721	$185,467
7/17/2010	$25,496	$0	$0	$25,496	$1,274	$0	$0	$1,274	$39,332	$0	-$21	$39,312	$66,103	$0	-$21	$66,082
7/18/2010	$111,904	$14,185	$19,727	$145,815	$5,594	$709	$986	$7,289	$84,856	$4,497	$0	$89,352	$202,353	$19,390	$20,713	$242,457
7/19/2010	$94,238	$31,406	$42,531	$168,175	$4,711	$1,570	$2,126	$8,408	$78,302	$2,522	-$15	$80,809	$177,252	$35,498	$44,642	$257,392
7/20/2010	$32,912	$12,339	$77,100	$122,351	$1,495	$617	$3,930	$6,042	$81,991	$2,374	-$12	$84,352	$116,398	$15,329	$81,018	$212,745
7/21/2010	$83,186	-$23,548	$2,973	$62,611	$4,158	-$1,178	$164	$3,145	$73,036	$2,640	-$14	$75,662	$160,380	-$22,086	$3,124	$141,418
7/22/2010	$56,661	-$5,232	$8,091	$59,521	$2,832	-$262	$404	$2,975	$89,895	$2,013	-$9	$91,900	$149,389	-$3,480	$8,487	$154,396
7/23/2010	$106,542	$22,984	$26,628	$156,154	$5,326	$1,149	$1,331	$7,807	$118,953	$1,776	-$13	$120,717	$230,821	$25,909	$27,947	$284,677
7/24/2010	$125,231	$10,476	$95,502	$231,209	$6,260	$524	$4,775	$11,559	$128,481	$1,094	-$2	$129,573	$259,973	$12,093	$100,275	$372,341
7/25/2010	$147,489	-$6,825	$50,805	$191,469	$7,373	-$341	$2,531	$9,563	$104,848	$1,762	-$3	$106,607	$259,710	-$5,405	$53,334	$307,639
7/26/2010	$104,426	-$4,801	$842	$100,467	$5,220	-$240	$42	$5,022	$59,963	$1,576	-$10	$61,529	$169,609	-$3,464	$874	$167,018
7/27/2010	$28,397	-$20,744	-$1,914	$5,739	$1,419	-$1,037	-$96	$286	$37,102	$1,495	-$9	$38,589	$66,919	-$20,286	-$2,019	$44,614
7/28/2010	$55,928	$12,061	$12,618	$80,607	$2,796	$603	$631	$4,029	$60,473	$2,080	-$8	$62,546	$119,197	$14,744	$13,241	$147,182
7/29/2010	$37,431	-$1,022	$49,314	$85,723	$1,871	-$51	$2,466	$4,285	$28,766	$587	$0	$29,353	$68,067	-$485	$51,780	$119,362
7/30/2010	$21,052	-$3,389	-$784	$16,879	$1,052	-$170	-$39	$843	$10,108	$797	-$6	$10,898	$32,211	-$2,761	-$830	$28,620
7/31/2010	-$14,704	-$17,578	-$20,286	-$52,569	-$736	-$879	-$1,014	-$2,629	-$1,880	-$201	-$6	-$2,087	-$17,320	-$18,658	-$21,307	-$57,285
8/1/2010	-$27,847	-$8,489	$13,434	-$22,902	-$1,394	-$425	$671	-$1,147	$0	-$871	-$1	-$872	-$29,240	-$9,785	$14,104	-$24,921
8/2/2010	$31,762	-$4,772	$783	$27,774	$1,587	-$239	$39	$1,386	$0	$1,300	-$2	$1,298	$33,349	-$3,711	$820	$30,458
8/3/2010	$47,985	-$3,958	$1,079	$45,106	$2,398	-$198	$54	$2,253	$86,348	$1,811	-$4	$88,156	$136,731	-$2,345	$1,129	$135,515
Total	**$3,465,220**	**$341,187**	**$840,595**	**$4,647,002**	**$173,100**	**$17,048**	**$42,903**	**$233,051**	**$1,080,576**	**$27,253**	**-$133**	**$1,107,695**	**$4,718,895**	**$385,488**	**$883,365**	**$5,987,748**