Report of the Independent Consultants on the GreenHat Default

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Foreword: A note from the report authors

PJM's Financial Transmission Rights (FTR) auction market differs in some ways from other financial energy markets and exchanges. However, the differences are not so great that the exchange model cannot be relied upon to improve collateral policies and operations of PJM's FTR market.

The leading practices that we promote in this report are based on many well-established risk management best practices with which we have substantial experience.

In the "Complications" section of this report we take a hard look at the internal practices and specific actions (or inaction) of PJM's management with respect to the GreenHat situation. We have been tasked to identify gaps and missteps wherever we see them so as to arrive at the most effective recommendations for the future. Our identification of these "Complications" and recommendations are not meant to imply that PJM violated any law, regulation, or internal PJM policy. We found no evidence of any such violations.

Moreover, we fully appreciate the business and regulatory constraints that face PJM in administering and making rule changes to its financial markets. Certain of our recommendations, therefore, would require rule changes that must be approved by PJM's membership, as well as by PJM's primary regulator, the Federal Energy Regulatory Commission (FERC). While there can be no assurance that PJM's membership or FERC will accept any specific change, in this study we were not asked to accept current external constraints as immutable, but rather to recommend best practice improvements. We also note that certain of our recommendations would require no rule changes or regulatory approvals at all.

In fact, beyond the evident changes in internal policies and procedures at PJM that we discuss at length here, we see two important external opportunities for advancement of PJM's role as a risk manager of the financial markets it hosts:

- 1) A new opportunity to use knowledge herein gained to continue to remedy any aspects of the current regulatory construct that may run contrary to what we see as *shared* objectives of PJM and FERC. (See Recommendations B2).
- 2) An opportunity to create a new process for member-to-PJM direction that is appropriate for the unique nature of challenges in administering financial markets. (See Recommendations B1).

Our years of experience observing missteps in other financial markets have taught us that inadequate risk management policies and procedures at the market host or within any market participant have serious consequences. Such inadequacies can lead to market shocks from defaults or fraudulent conduct on the part of counterparties, precipitating declines in liquidity that put the market at risk or obstruct its growth. We see it as critical that PJM members appreciate those well-established consequences of inadequate risk management practices.

We hope that PJM, its stakeholders, and regulators all will embrace PJM's desire to advance its practices, which PJM has demonstrated here by commissioning this study and taking affirmative actions to update the regulatory framework.

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Background

Our Engagement

This report on the GreenHat Energy, LLC (GreenHat) default of June 21, 2018, has been commissioned by a Special Committee of the Board of Managers (the Board) which is chaired by Board member Susan Riley and includes Board members Mark Takahashi and John McNeely Foster.

In October 2018, the Special Committee hired the authors of this report, Robert Anderson, Neal Wolkoff, and Arleigh Helfer, as independent consultants with experience and expertise in energy markets, risk management, energy regulation, contracts law, and corporate governance practices.

Mr. Anderson is the Executive Director of the Committee of Chief Risk Officers (CCRO). Before joining the CCRO Mr. Anderson developed his experience and expertise in risk management at such companies as BP, El Paso Energy, and McKinsey Consulting. Mr. Anderson has been expert witness for a number of major industry cases involving corporate failures in risk management.

Mr. Wolkoff is an attorney and independent consultant and has worked for the CFTC, the NYMEX, where he was the Chief Operating Officer, and the American Stock Exchange where he was Chairman and Chief Executive Officer.

Mr. Helfer is an attorney in the Litigation Services Department at Schnader Harrison Segal & Lewis LLP in Philadelphia. Among other firm groups, he is a member of the Energy and Environmental Group practice with experience in litigation matters involving both FERC and PJM.

Environment and Scope for Our Study

The Board and management of PJM are to be commended for taking a proactive and transparent approach to understanding what decisions and mistakes made by PJM, what aspects of the then-current framework of PJM's tariff and other governing documents, and what misconduct by a third party, contributed to the GreenHat default.

With regard to the GreenHat default, the Board Committee asked us to focus on PJM and all relevant facts and activities during the years prior and up to the time of default. In this study we did not investigate GreenHat or evaluate the lawfulness of their actions. We were not given any special access to internal GreenHat documents and had no need for such.

Our investigative scope regarding PJM was not limited, and we were provided unfettered access to data and any individual inside PJM whom we thought might provide us with relevant information. We interviewed some thirty PJM professionals, some of them multiple times. Appendix D provides a detailed listing of our interviewees. In addition, we spoke with the Independent Market Monitor on several occasions, and as mentioned later throughout this report, we spoke at length with a number of FTR market participants.

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Within PJM Interconnection, we focused on all areas related to the administration of the Financial Transmission Rights (FTR) markets. Our findings do not necessarily relate to any other areas of PJM Interconnection.

PJM's staff, management, and Independent Market Monitor furnished us with hundreds if not thousands of documents and emails in response to all of our requests, and always erred on the side of inclusion when making documents available.

The Board Committee encouraged us to make ourselves available to FTR market participants or stakeholders interested in sharing their insights with us. In that vein, the PJM Members Committee sent a letter to all members inviting them to interact with us. We spoke with all participants that reached out to us, more than a dozen stakeholders, and found in all cases their insights to be useful for this report.

All stakeholders are being kept anonymous here, as their identification is not required for their contributions to represent a valuable part of our study.

Report Development and Objectives

The purpose of our study and this report is to:

- Set forth the facts and circumstances that led to a sizable default.
- Assess complications that emerged from PJM's action or inaction.
- Recommend changes to prevent, deter, or mitigate defaults that may occur in PJM's FTR markets in the future, and increase the robustness of the PJM FTR markets going forward.

Relevant Time Period and Data

Our study primarily focuses on the period from January 2016 through July 2018, immediately following PJM's declaration of GreenHat's default. The timeline on page 8 provides a graphical representation of our timeline and related milestones.

In addition, we include a qualitative assessment of PJM policy responsiveness up to our timeline period, following a different default in 2007.

We derived the charts and statistics related to FTR transactions from an FTR database provided by PJM. The database provides a position snapshot of all FTR market participants' cumulative open positions on the first of January, April, July, and October of 2016 through 2018.

Reader's Understanding of PJM and its FTR Auction Market

For brevity here, we must assume a certain level of knowledge about PJM and its FTR auction market. However, for the convenience of the reader we do provide some basic information about the FTR market and PJM in <u>Appendix A</u>. Much more can be found on-line at the websites for PJM, FERC, and the Independent Market Monitor.

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Executive Summary

PJM operates a multi-state business that administers the continuous delivery of bulk power to millions of citizens and businesses. To that end, in addition to coordinating the real time operation of the high-power transmission grid in its footprint, PJM administers market functions "soup-to-nuts" that come together to create a vibrant and effective marketplace. Our report focuses on PJM's administration of the Financial Transmission Rights market, which is an important component of the whole marketplace.

In summary, we find that:

- PJM did not have staff with the necessary training and credentials to successfully manage
 the financial risks posed by the numerous participants in its FTR markets. For a number of
 years prior to GreenHat, PJM's FTR market participants self-regulated their conduct, and
 the market ran smoothly. GreenHat, however, provided a set of conditions for which the
 framework that PJM developed over time to manage risk was inadequate.
- PJM made a decision not to terminate GreenHat's trading rights when PJM initially understood the potential for a default. Instead PJM chose to manage the situation, which PJM believed could not get worse. As is discussed in detail in this report, PJM did not effectively manage the situation, which grew materially worse.
- PJM personnel were naive about GreenHat's assurances of creditworthiness and a future revenue stream pledged to PJM. What is more, they did not appreciate GreenHat's determined ability to increase its position, and incur additional risk, thus expanding its losses well beyond anything PJM imagined could happen. PJM mistakenly believed it would contain and control GreenHat's behavior and risk, which in the end it did not. If PJM were better prepared to monitor market participant behavior, and better measure risk, we believe it could have and would have responded more effectively to GreenHat's empty assurances.
- PJM was late to recognize GreenHat as a problem. Had PJM declared a default upon first
 recognizing the GreenHat problem, the amount of the loss would have been substantial but
 far less than what PJM must deal with today. In any case, we find that even if PJM had
 made such a default declaration, our recommendations would stand as set forth in this
 document.

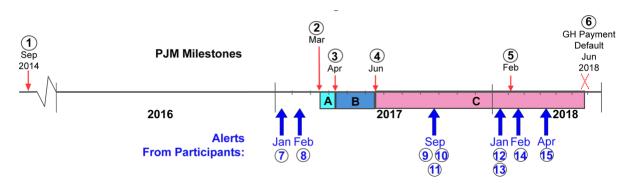
Our goal is to recommend areas of improvement that are specific and proven to work in other markets where similar risk abounds. By taking appropriate actions, PJM will enjoy the full confidence of its markets and growth without fear of being harmed by a bad actor amassing excessive risks.

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Our GreenHat Timeline and Milestones

There are a number of critical milestones during specific periods that help to explain the complications we see. The details of each participant alert are found in Appendix C.

Figure 1 - Timeline and Key Milestones



Fundamental PJM Milestones:

- 1) GreenHat joins PJM with its principals having a questionable history, 9/16/2014
- 2) GreenHat FTR market access rights suspended, 3/21/2017
- 3) PJM surrenders dispute with GreenHat and restores trading, 4/10/2017
- 4) PJM mistakenly envisages greater value than warranted in a GH pledge agreement, 4/10-6/23/2017
- 5) GH takes advantage of "transition period" on new credit rules, 4/1/2018
- 6) GH defaults on failure to satisfy a \$624k net realized loss payment due

Critical Time Periods:

- A) PJM dispute with GreenHat over market access, 3/21 to 4/10/2017
- B) PJM negotiates a GreenHat pledge & assignment, 4/10 to 6/23/2017
- C) PJM rests on assumption that GH will not deepen its positions and losses

Participant Alerts to a Growing Problem

- 7) [FP5] sends e-mail alerting PJM to possible problems with GreenHat's position, 1/5/2017
- 8) [FP1] meets with PJM about GreenHat MTA losses, 2/13/2017
- 9) Telecon between [FP3] and CFO, later confirmed by e-mail, 9/14/2017
- 10) E-mail from [FP1] to CFO and Credit Mgr, 9/27/2017
- 11) Internal e-mail re analysis, 9/27/2017
- 12) E-mail from [FP1] to Credit Mgr & others in FTR group, 1/12/2018
- 13) Internal e-mail re: analysis, Modeler to Credit Mgr, Risk Mgr and others, 1/16/2018
- 14) Verbal [FP4] to Special Consultants re conversation with CFO, 2/13/2018
- 15) E-mail from [FP3] to CFO, Credit Mgr, Gen Counsel, Dir Market Ops, 4/23/2018 this alert mentioned as a surprise by CFO to Special Consultants

¹ For more background on the principals of the GreenHat company, see Footnote 3, Page 10.

Complications that Contributed to Today's GreenHat Situation

In the process of discovering the facts that underlie the GreenHat situation, we have identified ten contributing factors, which we call "complications." In some cases, these complications involve a failure by PJM to do something, in other cases they involve an organizational challenge for PJM based on years of operating in a different trading environment.

In this report, we elaborate on these complications contributing to the GreenHat default:

- 1. The PJM Credit Policy Failed to Address Critical Risks
 - A flawed collateral methodology gave GreenHat room to grow without control.
- **2.** PJM Did Not Take Robust Policy Actions Following Precedent Experience Aggressive action in the past could have implemented relevant policy changes.
- **3.** PJM Failed to Perform Adequate "Know Your Customer" Procedures Several opportunities to interrupt GreenHat's growth were missed.
- **4.** PJM Management Failed to Develop Robust Participant Risk Management Tools and Procedures *Expectations of participant risk management went unfulfilled, giving GreenHat cover.*
- **5.** PJM Surrendered an Early Opportunity to Stop or Restrain GreenHat

 Once withheld, market access was restored without a sufficiently robust supporting investigation.
- **6.** PJM's Management Mistakenly Relied on a GreenHat Pledge Agreement *A seductive but problematic pledge by GreenHat fed months of complacency.*
- **7.** PJM Incorrectly Believed That GreenHat Would Not Worsen the Situation *An assumption about GreenHat's intentions dampened awareness.*
- **8.** Qualifications and Training of PJM Staff Were Insufficient

 Lacking relevant expertise, best practices in risk management were out of reach.
- **9.** PJM FTR Market Design Flaws Gave GreenHat Room to Develop

 Lack of transparency gave GreenHat some benefit of the doubt during problem analysis.
- **10.** An Unwarranted Air of Confidence Facilitated GreenHat's Ability to Grow *PJM personnel did not adequately question convenient internal assumptions.*

The GreenHat Situation

We would like to start by making clear the core facts that characterize the "GreenHat situation" and how it developed.

About GreenHat and Development of its FTR Market Portfolio

GreenHat formed as a "domestic limited liability company" in Texas in June 2014.² Its public filings with the Texas Secretary of State's office name its managers as Andrew Kittell, John Bartholomew, and Kevin Ziegenhorn. Since 2016, GreenHat has reported that it is 100% owned by Off Fannin Holdings, LLC, which reports that its managers are Andrew Kittell, John Bartholomew, and Kevin Ziegenhorn.

Andrew Kittell and John Bartholomew were previously employed in JPMorgan Ventures Energy Corp.'s Houston-based Principal Investments unit, where they were implicated by FERC in JPMorgan's manipulation of energy markets and exploitation of loopholes at CAISO and MISO that caused more than \$125 million in damages, resulting in FERC fining JPMorgan \$410 million.³

GreenHat Membership at PJM

GreenHat became a member of PJM in September 2014 by filing membership and credit applications, and providing PJM with a copy of its risk management policies. As is the case with all member applicants large and small, PJM does not independently audit or confirm compliance with the risk management policies presented to it.

According to GreenHat's audited financial statement for 2014, GreenHat had total assets of \$1.01 million with no liabilities (net worth) and net income of approximately \$56,000. With this level of net assets, GreenHat had just barely met the minimum requirements for participation in PJM's FTR Auction Market.

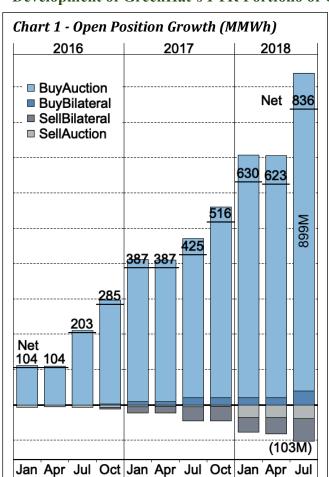
GreenHat and its Chosen Auction Types

Until the long term auction held in June of 2018, GreenHat transacted almost exclusively in the Long Term auctions at PJM. However, in the June annual auction of 2018, GreenHat entered the Annual market to add still more volume to the same time blocks that had since rolled-forward from previous Long-Term positions.

The auction cycle and FTR types offered by PJM during the GreenHat period are detailed further in Appendix A.

² Information about GreenHat's corporate filings is available on the Texas Secretary of State's website's SOSDirect search platform (https://www.sos.state.tx.us/corp/sosda/index.shtml).

³ See Order Approving Stipulation and Consent Agreement, 144 FERC ¶ 61,068 (July 30, 2013) (https://www.ferc.gov/EventCalendar/Files/20130730080931-IN11-8-000.pdf); see also Michael Hiltzik, FERC Lets JP Morgan Walk, L.A. Times (July 30, 2013) (http://articles.latimes.com/2013/jul/30/business/la-fi-hiltzik-20130731); Scott DiSavino, JPMorgan to Pay \$410 Million to Settle Power Market Case, Reuters (July 30, 2013) (https://www.reuters.com/article/us-jpmorgan-ferc/jpmorgan-to-pay-410-million-to-settle-power-market-case-idUSBRE96T0NA20130730).



Development of GreenHat's FTR Portfolio of Open Positions

From its initial FTR trading in January of 2016 until its default in June of 2018, GreenHat systematically amassed a large portfolio of FTRs. As shown in Chart 1, by the time of default, the portfolio of auction transactions in total had reached 899 million MWh of FTR buys, netting to 836 million MWh (net of a small amount of FTRs sold back into the auction and in the bilateral market).

A review of data since 2012 revealed that the GreenHat portfolio had in less than three years become one of the largest portfolios of FTRs in PJM's history.

The chart reflects GreenHat's portfolio growth from 2016 to 2018 at a CAGR of over 100% per year.

Distribution of GreenHat's Auction Portfolio Across Source-Sink Locations

GreenHat's portfolio included many FTR "source to sink" locations, numbering in the thousands. We studied the distribution of the number of source-sink locations to each common position type, and the associated open volume.

Over all three time periods in aggregate, the average number of paths with a position was just under two thousand. It is important to note that further study revealed that the average grew over time at each individual date from 1,062 locations in 2016 to 2,068 locations in 2017 and 2,690 in 2018.

The number of GreenHat's source-sink paths grew through time along with its portfolio's open exposure.

GreenHat Rankings Versus Other FTR Auction Market Participants

Another perspective on the dominant size of the GreenHat portfolio over time is gained by looking at the rankings of GreenHat versus its peer FTR auction participants. In Appendix Chart

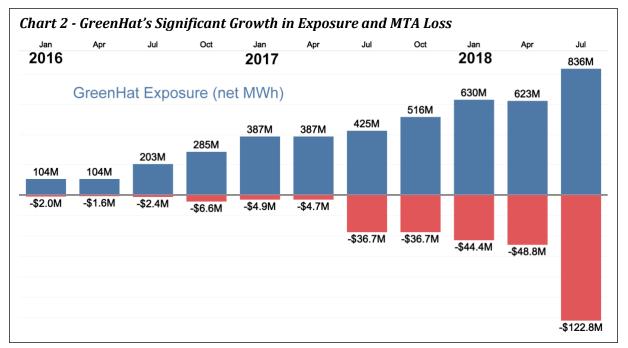
<u>A4</u>, we have ranked on each measurement date the top ten participants by total open volume. GreenHat grows quickly to number one by mid-2017.

Most significantly, GreenHat remains firmly at number one from January 2017 until default in June 2018.

Also notice the difference in volume from GreenHat's number one slot to number two. GreenHat's volume is double, or nearly so, versus the second ranked participant. Prior to 2018, when GreenHat's volumes grew most rapidly, the typical spread between #1 and #2 was much smaller.

Starting in January 2018 to default, GreenHat's portfolio volume of auction transactions was more than the companies ranked 2 and 3 combined.

Mark-to-Auction of the GreenHat Portfolio



GreenHat's growing FTR position overall was subject to unrealized losses when valued using the most recent auction prices available at any point in time (mark to auction or "MTA"). Chart 2 shows GreenHat's open portfolio exposure along with the MTA loss.

Our interviews with PJM senior management and staff, and our review of internal emails, revealed that throughout this time period, PJM failed to recognize the mounting open exposures and unrealized losses associated with the exposures.

More discussion of this is found in the "Complications" section.

Complications Contributing to the GreenHat Situation

1. The PJM Credit Policy Failed to Address Critical Risks

A flawed collateral methodology gave GreenHat room to grow without control.

A Broadly Ineffective Collateral Process

As detailed previously, PJM's collateral requirement process is a central component of PJM's process to manage participant default risk.

This process created periodic changes to each participant's overall collateral requirement. Collateral change would occur upon purchase or sale of any auction or bilateral FTRs, and once per year when PJM conducted a "re-valuation" exercise of all FTRs incorporating updated historical data.

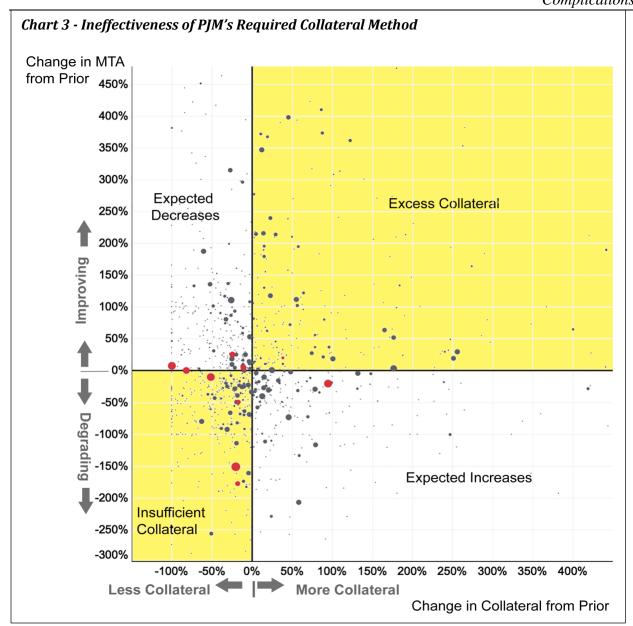
We find that the flawed calculation methodology underlying periodic collateral requirement adjustments created a set of collateral outcomes for participants that were counter-intuitive and sometimes directionally incorrect.

Chart 3 graphically illustrates this unfavorable nature of collateral outcomes over time.

Chart 3 shows on its horizontal axis the collateral requirement change and the vertical axis the change in portfolio performance (MTA) from quarter to quarter for each FTR participant. For perspective on portfolio size, the mark diameters reflect the relative portfolio size for each participant. For interest, GreenHat is shown in red.

The Chart 3 zero lines divide the plot into quadrants, revealing many occasions where PJM's collateral requirement was contrary to management of the risk of each participant's portfolio performance change. These occasions are shown in the yellow quadrants.

Basic principles of risk management would have you expect increases and decreases in required collateral to move at least generally in the same direction as financial performance of the forward portfolio of FTRs. This would position data somewhere in the top-left or bottom-right quadrants, where MTA and collateral changes are directionally similar. However, there are many portfolios in these results, some large (including GreenHat's), where collateral is not changing in such a way.



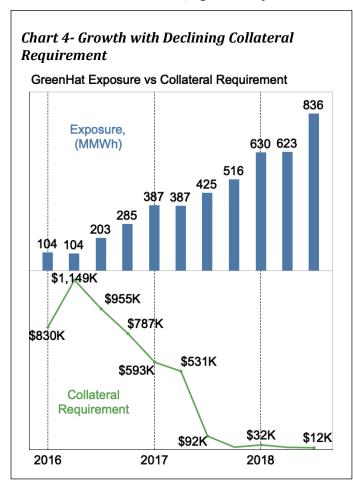
Excess Collateral - "Penalizing Winners"

In the yellow, top-right quadrant, portfolios are being overburdened with collateral requirements relative to their peers in the other quadrants. This area might be called "penalizing winners." Some of the portfolios in this area are quite large.

Insufficient Collateral - "Trading on Others"

In the lower-left quadrant, the forward value (MTA) of portfolios have declined. Such a decline should trigger either no change (if both period MTA is positive) or an *increase* in collateral. Here however, although portfolio credit risk has increased, PJM's collateral requirement has actually been reduced. The portfolios in this quadrant are developing while under-collateralized, meaning they are effectively subsidized by all others in the market.

Collateral Ineffectiveness, Specifically for GreenHat



We find that PJM's collateral methodology was ineffective on GreenHat's growing portfolio.

As mentioned previously, best practices incorporate forward information to determine collateral requirements for market participants. In contrast, PJM's assessment of risk was based entirely on historical, or backwards looking, information.

In Chart 4, we illustrate a rather stark contrast between the growing risk in GreenHat's portfolio on the one hand, and declining collateral requirements on the other.

The development of GreenHat's portfolio exposure (and associated unrealized losses) climbs to record-setting levels. However, at the same time, GreenHat's collateral requirement under PJM's flawed collateral methodology declines sharply to nil. This dysfunction in collateral requirements for GreenHat unfortunately went unnoticed. discussed under complication 4.

2. PJM Did Not Take Robust Policy Actions Following Precedent Experience

Aggressive action in the past could have implemented relevant policy changes.

Twelve years ago, PJM experienced a participant default by affiliates of Tower Research Capital in the FTR market that had similarities to the GreenHat situation. Following the default, a consultant prepared an extensive set of recommendations for PJM, designed to improve its risk management policies and market surveillance.⁴

We see the four most significant recommendations therein as:

- 1. Increasing the frequency of auctions in order to update portfolio valuation more frequently by marking the portfolio to auction.
- 2. Implementing limits on positions that a participant could acquire based upon its available capital.

⁴ See *PJM Credit and Clearing Analysis Project: Findings and Recommendations* (June 2008) http://www.marketreform.com/wp-content/uploads/2013/12/Findings-Recommendations-Report-v1.0.pdf.

- 3. Basing collateral on forward looking metrics of frequent MTA calculations to better capture risk.
- 4. Shortened time period for settlement of outstanding charges.

After receiving the consultant's report, PJM presented the various proposals recommended by the report to its stakeholder committees and allowed PJM's members to determine which recommendations to implement. PJM adopted, obtained FERC approval for, and implemented a shorter time period for settlement of payments due, and several other lesser recommendations. However, the most significant recommendations (noted above) were rejected or deferred after lengthy stakeholder consideration.

In reviewing the materials that PJM presented to its stakeholders, we noted the absence of management recommendations to implement the first three major Market Reform proposals as referred to above. In any case, we find that PJM management did not go far enough to emphasize these critical policy advances to its stakeholders or its Board.

3. PJM Failed to Perform Adequate "Know Your Customer" Procedures

Several opportunities to interrupt GreenHat's growth were missed.

To oversee its members and member applicants (*i.e.*, customers) effectively, PJM needed to do more to "know its customer." Knowing customers brings awareness of changes in market participants' financial health and alertness to any indicators of potential bad actors in the market.

To borrow a phrase used during an interview with a CRO of a major public utility:

"Management is responsible at every point to know its customer . . . [I]n energy credit risk management, common sense must be included."

Gaps in the PJM Membership Admission Process

PJM's membership process represented PJM's first opportunity to get to know its customer. We find that with a more robust admission process, PJM would have recognized early-on the potential risk that GreenHat and its principals brought to the FTR marketplace.

At PJM, the process of onboarding a new member candidate is fragmented and largely clerical. The process involves both the Membership Department (Membership) and Credit Department (Credit). Membership provides applicants with the forms that Membership requires and informs Credit that a would-be applicant needs the Credit Application as well.

The Membership department does not conduct a due diligence process for applicants to membership. PJM did not itself or through a third party conduct a background investigation, nor did Membership conduct "informal" reviews, such as checking Google regarding an applicant or its principals. The PJM membership process is the same for large well-known public companies that apply as it is for small privately-held operations like GreenHat.

We note also that membership in registered exchanges is considerably more restricted than the practice at PJM, where the equivalent of "retail investors" are given direct access to the

marketplace. Nevertheless, the admission process at exchanges provides a good benchmark for comparison.⁵

Registered exchanges have formal membership processes, conduct formal background investigations into member applicants and their senior officials, and maintain rules and procedures to deny membership should an applicant pose a risk on the basis of its background. Given the importance of admission procedures and ongoing oversight, PJM's Membership and Credit functions lack sufficient personnel to screen applicants effectively, and to monitor them over time for any financial difficulties. The Membership function has just one employee and relies on a backup from another department in case of absence. Credit, which shares in some aspects of the onboarding process for new members, consists of five employees and the Credit Manager.

As part of the credit application process required under FERC Order 741,⁶ Credit requests and receives a set of internal risk management procedures and policies from each applicant. However, Credit does not perform due diligence on the applicant by independently confirming that the applicant actually employs the policies, systems, and processes as represented.

In addition, in the course of our interviews, we learned that PJM provides candidates with a listing of what PJM's requirements of a risk management policy are. It is therefore possible that candidates simply parrot that list of required components in their submittal of a risk management policy, assuring acceptance, without actually developing or implementing an effective risk management policy in compliance with the FERC Order 741.

Maintaining Customer Awareness for Active Members

As the situation developed, PJM did not seek-out background information about GreenHat's origins or principal officers, and therefore did not exercise the kind of vigilance it might have exercised if it had known of their past conduct. For instance, PJM failed to adequately react to numerous red flags during the Pledge and Assignment negotiations. The negotiations showed a growing refusal by GreenHat to make meaningful representations or warranties in the Agreement. Nevertheless, PJM went forward with the diluted agreement. PJM ended up relying in part on verbal assurances made by GreenHat principals for which a background check would have been important. If PJM knew its customer better, PJM may have recognized these instances as red flags indicating the GreenHat pledge agreement may have actually been a sham before signing. These red flags may have helped PJM to conclude that GreenHat did not have an asset worth \$62 million to pledge and assign.

⁵ The CME Group's Membership Application, for example requires an applicant to consent to a formal background check: "I understand that the CME Group Exchange may conduct, or cause to be conducted, an investigation into my character, general reputation, and personal characteristics and that the CME Group Exchange may retain a consumer reporting agency for that purpose. I also understand that, upon my written request, CME Group Exchange will disclose to me in writing the nature and scope of the investigation if conducted by a consumer reporting agency. I hereby authorize the Exchange to conduct an investigation as to my credit, character, general reputation, educational history and personal characteristics."

See https://www.cmegroup.com/company/membership/files/CMEGroup_Long_Form.pdf.

⁶ https://www.ferc.gov/whats-new/comm-meet/2010/102110/E-3.pdf.

PJM did not adequately stay on top of GreenHat's financial health status for each year of its membership. As a result, PJM missed a critical insight into GreenHat's viability as a going concern.

According to GreenHat's audited financial statement for 2014 when it first joined PJM, GreenHat had total assets of \$1.01 million with no liabilities (net worth) and net income of approximately \$56,000. The following year, 2015, GreenHat showed an increase in assets to \$4.5 million and net income of \$614,000. Then in 2016, GreenHat showed an increase in current assets to \$9.8 million, but also showed "Level 3 Derivative Assets" of \$150 million. The Level 3 assets reflect the value of GreenHat's FTR portfolio. In its audited financial statement for 2016, GreenHat claimed net income of \$92 million, which included income from a "change in fair value of outstanding FTRs" of about \$87 million. In other words, GreenHat presented itself as having made \$92 million in 2016 where 95% of those earnings were from its unsupported valuation of its open FTR portfolio.

In fact, the asset supporting a claim of \$92 million in income in 2016 (thus saving GreenHat from insolvency) was the very same FTR portfolio that PJM had valued at a \$40 million *loss*.

In a few instances during our interviews, management of PJM pointed to GreenHat's "\$100 million income" on its 2016 financial statement as a reason to believe its losses would not render it insolvent.

We find that had PJM maintained ongoing customer awareness, it would have been more alert to GreenHat's suspicious conduct and financial weakness.

4. PJM Management Failed to Establish Robust Participant Risk Management Tools and Procedures

Expectations of participant risk management went unfulfilled, giving GreenHat cover.

A Market Participant Alert First Brought PJM Awareness

On February 13, 2017, executives from [FP1]⁷ met in Washington, D.C. with PJM's CFO and SVP for Market Operations to discuss PJM's credit policy and [FP1]'s concerns about the GreenHat portfolio. [FP1] asserted its view that GreenHat's portfolio would lose between \$35 and \$40 million by the time the positions settled in two to three years. PJM's system, in contrast, showed a potential loss of less than \$2 million because PJM did not consider the effect of planned grid improvements on portfolio valuation.

By March 17, 2017, PJM used its system forecasting tool called "PROMOD" to revalue the GreenHat portfolio by looking at historical prices and estimating the impact that planned improvements to the grid would have. PJM for the first time then independently concluded that the analysis of [FP1] appeared to be correct. On April 19, 2017, following an annual FTR auction, PJM performed another analysis of the GreenHat FTR portfolio incorporating recent annual auction data. Once again, PJM estimated a loss on the GreenHat FTR portfolio of between \$35 to \$40 million.

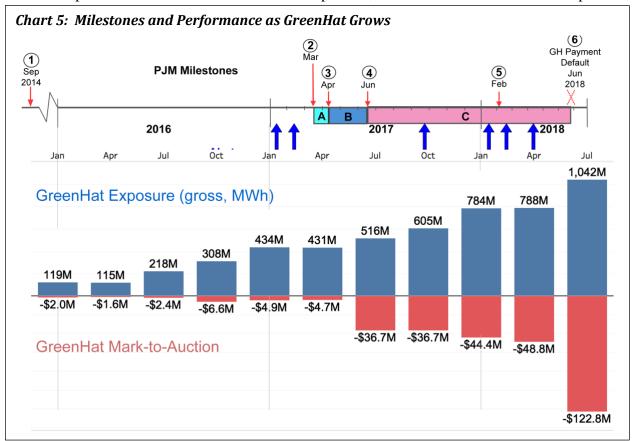
⁷ For anonymity, we refer to various PJM financial market participants with an "FPx" name where "x" is a number randomly assigned to each.

We find that until [FP1]'s alert, PJM was unaware of or failed to employ important methods to effectively monitor its FTR participants for untoward risks.

Surveillance Opportunities Overlooked

We find that PJM missed several opportunities to recognize early the risks of GreenHat's portfolio through fundamental surveillance methods.

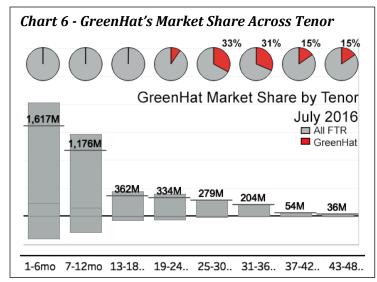
First in Chart 5, <u>our timeline</u> shows how events played out as GreenHat's portfolio grew in size and exposure. With a better and more critical process, PJM could have identified both position



growth and mounting MTA losses over time, from which it could be determined that the GreenHat portfolio was posing increasing risk of default to PJM and its members.

In Chart 5, a problematic pattern is clear. GreenHat's growth in exposure paused briefly in early 2017, when a member alerted PJM to the threat of the size of GreenHat's positions and briefly froze GreenHat's access to trading (period A). However, once PJM restored GreenHat's trading access, GreenHat resumed growth. The growth in exposure continued until default. Had PJM conducted adequate surveillance, it would have seen the steadily mounting losses corresponding to the dramatic growth in GreenHat's volumetric exposure.

As a second surveillance example, market liquidity is an important measure to consider. A market with one participant holding a dominant market share can behave like an illiquid market,

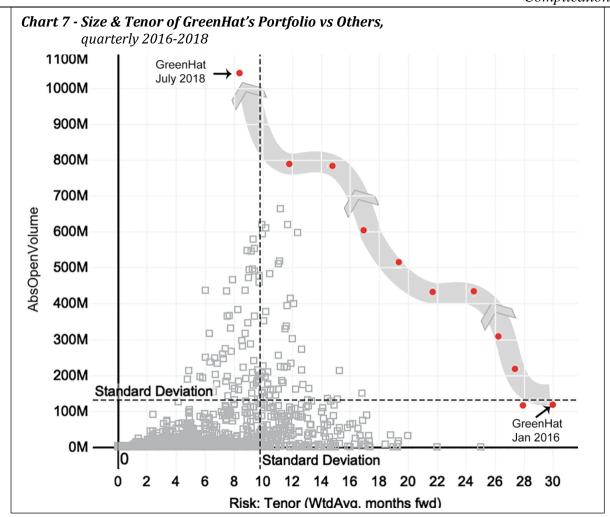


bringing more risk to all participants. Looking again at the FTR market in forward time blocks of six months each, each time block might be considered a market itself. This is because different participants may or may not be interested in the front or the back based on their specific hedging or trading strategies.

From this perspective, GreenHat held large market shares of the long-term time blocks.

The pie charts in Chart 6 show the FTR market share of each time block that GreenHat held in 2016. The bars

show the size of all FTRs (MWh) in each same time block.



As a third example of missed opportunities from surveillance, Chart 7 shows GreenHat and all other market participants, looking at position size and tenor in combination. It is clear what a significant outlier GreenHat was. GreenHat's trading pattern was conspicuous in that its positions were far larger and of longer tenor than those of other financial participants in the FTR market. From its onset in 2016, this perspective points a finger at GreenHat as an outlier in tenor, growing into a more dramatic outlier in both measures with time.

Long tenor of a financial position is riskier than a near term duration because less is known about the distant future than the near future, and more events can intervene to affect the value of a position over time. GreenHat's portfolio was very risky because of its size, and the length of time the positions would be open and subject to market forces before settlement.

5. PJM Surrendered an Early Opportunity to Stop or Restrain GreenHat

We find that, although initially withheld, GreenHat's market access was restored without a sufficiently robust supporting investigation.

A Brief Period of Colloquy Between PJM and GreenHat (timeline period A)

PJM confronted GreenHat on March 17, 2017, with the belief that its portfolio was in the red by tens of millions of dollars. GreenHat disputed PJM's valuation and claimed that its own valuation found that its FTR positions would be profitable. PJM's CFO told GreenHat that PJM was considering issuing a collateral call to GreenHat to provide security against the erosion of value in GreenHat's FTR portfolio. On March 21, 2017, PJM's CFO, acting on her own initiative, turned off GreenHat's rights to execute transactions in any PJM FTR auction or to use a PJM system to report a bilateral trade to PJM.

During late March and early April, a relatively junior attorney in PJM's Legal Department gave verbal advice to the CFO about PJM's Tariff, including its Credit Policy, in the context of the GreenHat situation. It is unclear to what extent, if any, the CFO also sought advice on the topic from the General Counsel or the CEO.

Following the CFO's discussions with the internal PJM lawyer, the CFO chose to restore GreenHat's trading privileges on April 10, 2017.

PJM's Options to Act Under Emergency or Discretionary Authority

Whether because PJM believed it lacked authority to act, or because it developed confidence that it could manage the situation and mitigate GreenHat's expected losses, PJM and GreenHat started negotiations on April 24, 2017, about (1) allowing GreenHat to engage in transactions that would mitigate the anticipated losses in its portfolio and (2) obtaining a pledge of collateral⁸ from GreenHat to significantly mitigate any losses.

PJM may never have started discussions with GreenHat about collateral and a Pledge and Assignment Agreement if it believed early on that it had the power to act against GreenHat. Therefore, we closely reviewed the extent of PJM's regulatory powers to deal with the GreenHat situation and act against GreenHat in the early stages.

Attachment Q⁹ sets forth the actions that PJM may take in certain specific circumstances of extraordinary events (acts outside the normal course of business) to protect its membership from risks associated with a market participant's trading conduct:

- 1. PJM has the right to act in the event of a "Material Change in Financial Condition" (Attachment Q, Section II.A.3);
- 2. PJM may act with respect to "Peak Market Activity" (Attachment Q, Section V.A); and
- 3. PJM may act if a member fails to continue to satisfy its "Eligibility Requirements for Market Participation" (Attachment Q, Section I.A.).

Powers to Act Based on the Event of a Material Change in Financial Condition

In order to declare a Material Change in Financial Condition one or more of 11 conditions must be satisfied. The conditions are enumerated but tend to refer to specific, defined events that

⁸ The term "collateral" is used here in a generic sense and not in the sense of the defined term in PJM's Tariff.

⁹ https://www.pim.com/directory/merged-tariffs/oatt.pdf.

happen to a company such as a ratings downgrade or filing for bankruptcy. The Material Change Provision does not contain a general or catch-all provision to empower PJM to view a forward looking situation such as a participant's amassing a large, losing trading portfolio and declare a Material Change in order to demand additional collateral.

Powers to Act Based on Regulation of Peak Market Activity

There is no unambiguous right to apply the powers conferred on PJM to regulate Peak Market Activity with regards to FTR transactions. Furthermore, by including language that "FTR Net Activity" is excluded, using these powers to regulate the FTR market could have been seen as violating the Tariff.

Powers to Act Based on Eligibility Requirements for Market Participation

PJM had powers to determine at any time whether GreenHat continued to meet the basic requirements of PJM membership. Once PJM calculated the value of GreenHat's positions (February 2017) and deducted the unrealized losses from GreenHat's actual assets (excluding the Level 3 assets) and net worth, GreenHat would not have met the asset or net worth standards to be a market participant in PJM's FTR market. At the least, PJM would have had a significant lever to use in discussions with GreenHat.

PJM as Market Regulator

On several occasions, we heard PJM management express serious concerns about being subject to suit and liability from GreenHat should PJM look too closely at GreenHat's business dealings and thus interfere in its contractual relationships, which would be a tort in normal business dealings. In securities and futures markets, exchanges and their executives are generally given absolute immunity from suit while fulfilling a regulatory function. As the exchange stands in the shoes of the CFTC or SEC in surveillance and enforcement functions, it is given a free hand to work in the public interest and can only be sued when acting as a regulator for acting in bad faith, such as self-dealing.

Like an exchange, PJM has a quasi-regulatory function to make sure that its governing documents are followed, and that markets are fair and free. The Court of Appeals of Texas decided a case closely on point relating to ERCOT's oversight of its markets and found that ERCOT enjoyed absolute immunity when acting in a regulatory capacity. ¹⁰

There is no way of knowing in advance how a court would rule should PJM or any ISO/RTO claim immunity in a lawsuit for acting in its regulatory capacity in good faith (an error in judgement is not the same as bad faith). However, the strength and lengthy history of the rulings in the exchange space and in ERCOT should provide a significant measure of confidence that PJM can regulate its markets assertively without fearing harsh outcomes of litigation as a result. Clearly, however, PJM would benefit from receipt of a clear mandate from its regulator, FERC, to act in this manner as a market regulator.

6. PJM's Management Mistakenly Relied on a GreenHat Pledge Agreement

A seductive but problematic pledge by GreenHat fed months of complacency.

¹⁰ See Elec. Reliability Council of Tex., Inc. v. Panda Power Generation Infrastructure Fund, LLC, 552 S.W.3d 297 (Tex. App. 2018) (https://caselaw.findlaw.com/tx-court-of-appeals/1893978.html).

GreenHat's Proposal

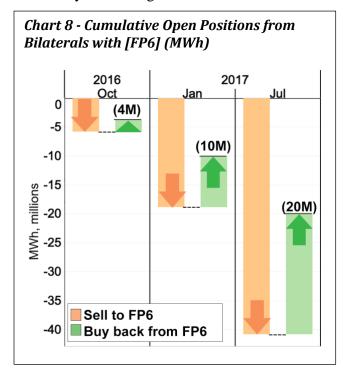
Notwithstanding its stated belief that its FTR portfolio was profitable, GreenHat informed PJM as a means to forestall any adverse action by PJM that it was a counterparty with a large firm [FP6] in three bilateral contracts with similar structures, (cumulatively the "Bilateral Contracts") in which GreenHat was to receive a future stream of revenue from a sale of part of GreenHat's FTR portfolio to [FP6]. On March 20, 2017, GreenHat provided a copy of its third FTR Bilateral Contract to PJM (PJM Timeline).

On April 20, 2017, GreenHat provided PJM an Excel spreadsheet purporting to value the revenue stream due from the FTR Counterparty from the first two bilateral contracts. According to GreenHat's spreadsheet, for the period June 1, 2018, through May 31, 2019, it was due to be paid \$62.2 million, a sum exceeding the projected loss on the GreenHat portfolio.

On April 24, PJM management met and decided to proceed with discussions with GreenHat intended to secure what they believed was the future flow of revenue due to GreenHat under the terms of the first two bilateral contracts.

PJM Accepted GreenHat's Valuation Method

The substance of the Bilateral Contracts was to permit the [FP6] to purchase at a significant discount from GreenHat's original purchase price, whichever contracts [FP6] was able to profitably resell in an upcoming auction. [FP6] retained the right to "put" any unsold contracts back to GreenHat (*see* Chart 8). [FP6] agreed to pay GreenHat the agreed-upon discounted price of the FTRs successfully resold. [FP6] would make any and all payments to GreenHat within fifteen days following the auction.



In fact, the contracts did not provide a stream of revenue as GreenHat maintained to PJM. The contracts specifically refer to a "lump sum" payment to GreenHat.

PJM Chose Not to Exercise Due Diligence with GreenHat's Counterparty

During the negotiations to complete the Pledge and Assignment Agreement, PJM did not contact GreenHat's counterparty [FP6] to the underlying bilateral contracts that were the basis of value of the Pledge and Assignment. GreenHat warned PJM not to contact [FP6] as it would risk interfering with its ongoing business relationship with [FP6].

Furthermore, PJM did not ask anyone from outside the firm to independently value the Bilateral Contracts, nor did it ask for an opinion about the meaning and mechanics of

the Bilateral Contracts. Such due diligence may have provided a reality check for some PJM management that assumed the Pledge and Assignment Agreement was going to erase the prospective loss that GreenHat faced with its FTR portfolio in the May 2017 timeframe.

Negotiations with GreenHat Resulted in an Inadequate Agreement

PJM discussed the Pledge and Assignment with GreenHat. These discussions included a conversation with GreenHat on May 4, 2017, to discuss "primarily the potential calculations of the cashflows." (PJM Timeline entry.)

Certain material differences stand out between the first and final (12th) executed draft that weaken whatever protections PJM expected it was receiving from GreenHat.

Draft 1 had GreenHat representing to PJM that it was due funds under the Bilateral Contracts "that are expected to offset and exceed the net losses that are likely to be incurred by GreenHat as a result of the FTR transactions." In the executed contract, however, GreenHat no longer represents that the Bilateral Contracts have value. To drive home the point, in the executed contract it states: "GreenHat disclaims any warranty about its positions and the bilateral FTR contracts with [FP6], including the value of its positions and FTRs ... and PJM disclaims any reliance on GreenHat for the same."

Draft 1 placed significant restrictions on GreenHat's trading activity: "GreenHat will not use the FTR Account for any activity except for sales (bilateral or in an applicable PJM auction) of existing positions." The final executed contract does not contain such a restriction on trading. Instead, the executed Agreement allows GreenHat to trade FTRs through the 2019/2020 tenor without restriction.

On June 23, 2017, PJM and GreenHat executed the weakened Pledge and Assignment Agreement. PJM did not treat this Pledge and Assignment Agreement as satisfying the collateral requirements under its Tariff, and GreenHat remained in compliance with the minimal collateral specified by the Tariff.

7. PJM Incorrectly Believed That the GreenHat Situation Would Not Worsen

An assumption about GreenHat's intentions dampened awareness.

Following completion of the Pledge and Assignment Agreement, PJM management believed that the risk of loss from GreenHat's FTR portfolio was limited to \$35-\$40 million. A word often used to describe the financial risk was "contained." As stated in interviews, management believed that the GreenHat portfolio could not deteriorate in value beyond the expected loss of \$40 million, but might actually improve. Evidently, this was based on (i) hope for funds yet to be received under the Pledge and Assignment Agreement; (ii) the potential for GreenHat to trade to flatten its position by engaging only in "risk reducing" transactions going forward; and/or (iii) for some as yet unknown market event.

External Alerts of a Growing Risk

According to interviews, PJM's CFO was surprised in late April 2018 to learn by way of an email from a financial market participant [FP3] that GreenHat had substantially increased its position volumetrically and was exposed to far greater losses than before. The CFO had expected that PJM personnel with visibility into the auctions would have raised an alert to senior management in the event of any significant purchases by GreenHat. No such alerts were raised. One of the CFO's subordinates had requested e-mail alerts for any GreenHat activity in the

Complications

bilateral market but had not done the same for activity in the FTR auctions where GreenHat's portfolio rapidly grew.¹¹

However, despite statements that PJM first learned of GreenHat's portfolio's growth in April 2018, we have found evidence that some within PJM were made aware by outside market participants in September of 2017 and several times thereafter that GreenHat had increased its positions (see our timeline, alerts 10 to 15). It has also become clear to us that even given those alerts, PJM did not comprehend the risks posed by the increased GreenHat positions.

Compounding the propensity to dismiss these alerts were the results of PJM's *ad hoc* internal analyses of GreenHat's positions. PJM was occasionally measuring an MTA value of the GreenHat portfolio and updating its PROMOD simulations of potential losses, but PJM did not appreciate the importance of also tracking the volume increases or measuring the volatility in the GreenHat portfolio. The internal PJM analyses thus were contrary to the warnings of additional losses coming in from outside participants. We found that PJM responses such as the following demonstrate the inadequately responsive manner in which PJM was treating valid outside input: "GreenHat is OK, they are making money," and, "I think [[FP1]] is complaining just because he may not have got his FTRs cleared at a lower price because GreenHat was more competitive."

We found that at least four different experts from FTR market participants had alerted PJM management that, based on the publicly posted data they had analyzed, GreenHat's open positions had grown significantly and merited attention and action.

Unfortunately, these warnings were given insufficient weight, and did not prompt action by PJM.

8. Qualifications and Training Were Not Adequate

Lacking relevant expertise, best practices in risk management were out of reach.

We found that during the GreenHat timeline PJM had senior executives and staff overseeing areas of the financial markets business for which they had little or no training or experience. For example, PJM lacked personnel overseeing credit and risk who had training in current best practices for credit risk measurement or management. Likewise, PJM lacked personnel overseeing membership applications who had past experience in market membership admissions. Notwithstanding the best of intentions, such personnel were unable to meet the reasonable expectations that market participants had for the exercise of effective risk management practices. Only well qualified professionals could have recognized the GreenHat situation as it developed, took appropriate steps to demand action, or quickly understood and acted on alerts from outside market participants.

There should always be a strong preference for professionals with experience and technical expertise to oversee the risks of financial markets.

9. PJM Market Design Flaws Gave GreenHat Room to Develop

Lack of transparency gave GreenHat some benefit of the doubt during problem analysis.

¹¹ The CFO explained that she asked the Markets group to look at GreenHat auction activity. However, she did not explicitly ask them to monitor (nor did they monitor) GreenHat's volumetric position.

We find that a few key characteristics of PJM's FTR market actually provided time and cover for GreenHat, allowing risk to snowball before finally reaching default.

Infrequent Long Term FTR Auctions

First, infrequent opportunities for MTA price information was a problem for risk analyses. The infrequency of long-term auctions (*see* Chart A1) delayed assessments of the forward value of GreenHat's portfolio. During the "dispute" period (A) in our timeline, the latest auction prices were months old and did not reflect the current market's thinking about the effect of system improvements. While PJM's PROMOD analyses in April of 2017 were directionally correct, they were only a proxy for a market-based valuation of the complete GreenHat portfolio, which could only come in June when new long term auction prices were available.

Also, as FTR fundamental market information becomes available to participants, infrequent auctions obscure from PJM and the wider market what some astute participants already know. Their knowledge can only be reflected once a long term auction is held. Looking at the long term auction cycle in chart A1, after the December auction there is no long term auction for six months until June. We see dramatic increases in MTA unrealized losses for GreenHat comparing January data (December auction) vs. July data (June auction) for both 2017 and 2018 (see Chart 2). These large changes in MTA are a consequence of this six-month gap in long term MTA information.

Ineffective Bilateral Implementation

Second, the ineffective implementation of the bilateral FTR market platform caused some confusion, resulting in flawed attempts to value GreenHat's bilateral trades. The market operations group understood that a price field in the e-FTR platform for bilateral transactions was not to be used for anything specific, and was there just as "additional information" for parties to use optionally. It did not necessarily reflect the prices of the bilateral transactions at all. However, the Credit group did look incorrectly to the price field provided in the e-FTR system as a verification of consistency when it analyzed the "stream of cash flows" promised by GreenHat in the Pledge and Assignment Agreement.

In spite of obvious differences between exchange markets and PJM's FTR market, ¹² approaches from exchange markets can be borrowed in a slightly modified fashion and applied to the FTR markets to address complications for risk management in PJM's FTR auction market design.

Futures market participants benefit from a continuous auction market that settles each market daily and marks each open contract at least once a day. While it may not be realistic for PJM to adopt a daily auction for thousands of paths, monthly or bi-monthly auctions that include Long Term FTRs is certainly within reach. Some have asserted that liquidity might be an issue, but at the same time they agree that any more frequent pricing information is a benefit for all.

Exchanges allow off-market transactions executed by commercial market participants to be converted into futures contracts and posted at the clearinghouse as a cleared trade. The execution price does not affect the prices that are publicly reported, and so are not part of the price discovery function of futures markets. However, these trades become open interest at the clearinghouse (*i.e.*, available to be offset or modified through on-exchange trading). In that way, they are a future

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¹² See Appendix B here.

source of liquidity. PJM's FTR auction markets should better integrate the system for ongoing bilateral FTR transactions with the auction market system.

10. An Unwarranted Air of Confidence Facilitated GreenHat's Ability to Grow

PJM personnel did not adequately question convenient internal assumptions.

Lack of Critical Internal Communications or a Bias for Action

We are struck by PJM's lack of urgency and delay in confronting many red flags that appeared during our timeline.

After the meeting with [FP1] in February of 2017, PJM became aware and understood that GreenHat's losses could be around \$40 million. GreenHat was known to have little capital, and a loss of this size would almost certainly have resulted in default. Yet, after the CFO took action to freeze GreenHat's access to trading, the research into PJM's authority in support of such action or calling for additional collateral was left to a relatively junior attorney. We were also told there was no call for advice from outside counsel.

We might have expected to find a temporary working group had been set up to coordinate appropriate actions across departments. The GreenHat situation does not appear to have been regularly discussed with the entire executive team.

One explanation provided by some interviewees is that management did not want to declare GreenHat in default so long as PJM stood to collect any amount of funds under the Pledge and Assignment Agreement. Although some were skeptical of GreenHat's Pledge and Assignment, several senior level interviewees nonetheless represented to us that they believed that with the P&A agreement:

"We would certainly not be any worse off, so why not take it?"

We believe that dismissive opinion deterred management from acting more aggressively or marshalling all available resources.

In order for the "Pledge and Assignment" strategy to be reasonable, PJM would have needed confidence that (1) GreenHat's anticipated loss of \$40 million could not grow, and could decrease; and (2) that additional trades executed by GreenHat would not make the problem worse. Many of PJM's executives believed sincerely that both of these conditions were met and that their plan to wait for the Pledge and Assignment to pay out was a sensible course of action that preserved the possibility to save the members from absorbing a larger (*i.e.*, \$40 million) default.

One executive told us that given the MTA internally generated in April 2017, he believed that the value of the position would be stable. This view was surprisingly confident given that PJM had no experience before then with MTA calculations. Given PJM's lack of experience measuring portfolio market risk using an MTA approach, there was a clear risk that PJM might miscalculate the amount of the unrealized loss. However, PJM's initial result seemed in line with the information conveyed by [FP1], when [FP1] brought its GreenHat concerns to PJM's attention in the first place.

In addition, conditions could change over the life of GreenHat's long term FTR portfolio to increase the loss. For example, what if transmission upgrades were completed ahead of schedule and resulted in even less congestion than anticipated? The portfolio could and likely would have

lost more money in that case. However, PJM seems not to have considered the possibility of its own mistake or adverse impacts of unexpected results on the value of GreenHat's position.

Notwithstanding its lack of experience in measuring portfolio valuation based on MTA, PJM did not take the precaution of hiring an independent analyst to review its findings, or review the merits of its strategy. PJM went ahead with confidence, but it was not confidence born of experience or thorough analysis.

PJM's executives believed that PJM's credit rules, which were embedded in the FTR auction system, would protect it. However, the logic fails because PJM's credit rules at that point were the same rules that allowed GreenHat to amass its earlier portfolio that was in the red by \$40 million. PJM implemented the first change to its credit rules after the Pledge and Assignment on April 1, 2018, which allowed PJM to incorporate significant transmission upgrades into the historical value portion of the credit requirements. GreenHat was the only participant that did not meet the new collateral requirements, and the transition period for the new rules permitted GreenHat to continue to trade. GreenHat's failure to comply immediately did not trigger PJM to take preemptive measures to manage-down GreenHat's portfolio risk.

In September 2017, [FP1] that brought the original GreenHat concerns to PJM's attention again alerted PJM to new GreenHat positions and greater potential losses. PJM's credit rules did not recognize the added loss in value of these trades on GreenHat's portfolio, and PJM attributed the concern to competitive jealousy. This illustrates that PJM's credit rules were not capable of rejecting dangerous transactions in advance and that PJM's staff did not have the requisite skills, or use outside resources to supplement its skills, to recognize aberrant and undesirable trades by GreenHat.

The deficiencies in PJM's plan to rely on the Pledge and Assignment and assume that things could not get worse, but only improve, are deficiencies that PJM could have seen or at least questioned in real time. They are not issues that can only be seen with the benefit of hindsight. That no one at PJM showed sufficient skepticism, or reached outside the organization for help and advice, or forced the organization to focus greater attention and resources on the problem and question its strategy, reflects the unfounded sense of confidence we speak to here.

Recommendations

Based on the complications discovered, the following specific actions should be taken by PJM and its members to reduce the probability of a similar failure in FTR markets and to develop more efficient markets that can grow and introduce new financial products creating opportunities for all PJM members to manage their risks in PJM markets.

Our recommendations are targeted at PJM's wholesale energy markets group and do not encompass PJM's larger grid operations functions.

A) Advance Credit/Collateral Best Practices into the Tariff

Recommendation Theme

Complications Addressed



PJM Advances best practices into the credit policy under the FERC tariff

1. The PJM Credit Policy Failed to Address Critical Risks

- **A1)** Use the mark to auction values established in the more frequent auctions (*see* recommendation F) as the basis for "variation margin," charging as a current debt the value erosion between the purchase price and the current market value as determined by the latest auction.
 - **A1.1**) This will help to capture the credit risk for all FTRs, not just near term FTRs, and reduce the current volatility of margining due to infrequent auctions. ¹⁴
- **A2)** Retain the current 10¢/MWh minimum charge, in addition to purchase price, as a form of "original margin" until such time as more precise measurements become available to determine original margin.
- A3) Eliminate the FTR undiversified adder because it is uncorrelated to market risk.
- **A4)** Define a default as any participant that is unable to meet a monthly variation margin call within two business days.
 - **A4.1**) require that the default be declared promptly and without negotiation.

¹³ "Variation Margin" is to address periodic changes in forward value of the open transaction.

¹⁴ N.B.: Having more frequent MTA points should reduce upfront collateral. This is because collateral needs to protect against risk until the next mark, not the ultimate settlement. In addition to collecting margin, PJM may then consider paying out variation margin to profitable portfolios (called "Pay and Collect"). These facts should mitigate initial stakeholder concerns about costs of more frequent collateral assessment.

¹⁵ "Original Margin" is to address the forward value risk of the transaction at the time executed.

B) Clarify the Role of PJM as Manager of Risk in Financial Markets

Recommendation Theme

Complications Addressed

В

PJM bolsters how aggressively it views its role as manager of risk

2. PJM did not Take Robust Policy Actions Following Precedent Experience

5. PJM Surrendered an Early Opportunity to Stop or Restrain GreenHat

It is critical that the duties of PJM as a manager of the risks in its financial markets be transparent to the market participants. PJM is akin to a self-regulatory organization when it comes to market administration and oversight. FERC and PJM's stakeholders should sufficiently empower PJM, and PJM should acknowledge and take ownership of its important duties to provide a fair and orderly market that also protects market participants and other PJM members from risks that they are otherwise unable to manage for themselves. At the same time, we find that PJM should be more assertive in pushing for action needed regarding any critical changes to credit policies, emergency discretion, and the like.

We recognize that there are currently many hurdles, and we recommend that PJM's use of the stakeholder process and its relationship with FERC be reviewed to optimize financial market administration.

We believe that there are many distinct differences in the management of financial markets versus the management of a physical power grid. If PJM's financial markets can be more appropriately self-regulated, our recommendations herein stand to create more efficient markets that can grow and introduce new financial products creating opportunities for all PJM members to manage risk. Therefore we make these actionable recommendations:

- **B1)** PJM should revisit its existing stakeholder process to better facilitate member-to-PJM directions on advances in financial market policies and procedures.
 - **B1.1**) Seek an equitable and efficient process centered on the relevant *expertise* that each PJM member may bring.
 - **B1.2**) Financial market member committees: voting attendees must be qualified member personnel, such as credit professionals, traders, or finance professionals, as appropriate for the committee duties.
 - **B1.3**) The number of committees involved in rule setting for financial markets should be strictly minimized to streamline decision making and assure clear accountability.
- **B2**) PJM should work with FERC to establish appropriate flexibility in policies and rulemaking concerning financial markets. Following are a few specifics we see at this time:
 - **B2.1**) Amend tariff rules to make a parallel rule for FTR contracts, and other markets, to the provisions in Attachment Q for Peak Market Activity Transactions.
 - **B2.2**) Amend rules to include within the definition of Material Adverse Change in Attachment Q an inability to meet any PJM margin call within two business days.
 - **B2.3**) Provide rules that give PJM discretion to deal with unanticipated market emergency events.
 - **B2.3.1**) The financial markets Risk Oversight Committee (*see* E below), comprising independent directors, can be the check on any concern of inappropriate use of such authority.

B3) As benchmark for progress with B1) and B2) - Examine the specifics and the cost/benefits of outsourcing to a credible outside provider the administration of all or part of the FTR market.

C) Build a Customer Awareness Beyond Market Procedures & Rules

Recommendation Theme

Complications Addressed



PJM builds a new keen awareness beyond just company names and market operational procedures

3. PJM Failed to Perform Adequate "Know Your Customer" Procedures

PJM should put in place certain sensible internal practices to increase customer awareness and bring more clarity around criteria used to direct its discretionary power.

- C1) Perform outsourced background checks for any member applicant, and should the applicant not be a public company, for the three most senior officers.
- **C2**) Perform due diligence by confirming that an applicant for membership actually employs the systems and processes for risk management as represented.
- C3) Provide explicit power for the rejection of a membership application should standards of good background and regulatory history not be met.
 - **C3.1)** Create an internal appeal mechanism in order to address any claims of any undue discrimination swiftly without unnecessarily involving FERC.
- **C4)** Update the financial qualifications of participant companies at least annually and clarify PJM's rights to act on a member's failure to meet those requirements.

D) Implement Technical Practices for Participant Risk Management

Recommendation Theme

Complications Addressed



PJM implements technical practices to protect all members from a bad actor in FTR markets

PJM Management Failed to Establish Robust Participant Risk
 Management Tools and Procedures

As demonstrated in the "Complications" section, part 4, a more robust participant risk management capability is needed to catch problems before they become crises. The following actionable recommendations begin to build such capability inside PJM and possibly establish confirming information from the IMM:

- **D1**) Clarify with the IMM any PJM expectations regarding participant risk management of (some) participant behaviors and reporting such with PJM.
 - **D1.1**) We understand that the IMM cannot have all information needed to effectively surveil (*eg.* collateral balances and member good standing status information that only PJM holds).
- **D2**) Establish position limits for FTRs:
 - **D2.1**) Based upon company capitalization.
 - **D2.2**) Based upon position tenor (tighter limits towards the back).
- **D3**) Create internal participant risk management reports that are reliably generated on a periodic basis according to the frequency of opportunities for participants to change portfolio positions.

D3.1) Among other measures, include statistical studies of participant exposure, tenor, collateral, MTA, and relationships between these measures.

E) Bring On-board and Develop New Expertise in Risk Management

Recommendation Theme

Complications Addressed



PJM adds new expertise sorely needed for decision making in financial markets

- 6. PJM's Management Mistakenly Envisaged Greater Value Than Warranted in a GreenHat Pledge Agreement
- 7. PJM Incorrectly Believed That the GreenHat Situation Would Not Worsen
- 8. Qualifications and Training Were Not Adequate

We understand PJM has a long planning process that involves developing the next calendar year's budget (including assumptions necessary to implement additions for staffing changes) late in the second quarter of the preceding year. However, in the case of remedying the management and staffing needs discussed below, PJM will need to accelerate that process.

- **E1**) Establish the position of Chief Risk Officer (CRO) over financial markets. The CRO oversees a broad risk oversight function, makes recommendations on appropriate risk staffing and technology support, and reports directly to the Board, through the ROC (below), with a dotted line to the CEO for certain administrative matters, excluding work priorities, compensation and performance reviews.
- **E2**) Create an independent committee of the Board: the financial markets "Risk Oversight Committee" (ROC), which will oversee the CRO and the risk management functions of the IMG (see E3 below), as well as many risk-based decisions that demand action (*e.g.*, capital allocation, control violations, member alerts, new business, etc.). The ROC will also be responsible for the CRO's compensation and performance reviews.

The ROC may authorize the IMG (below) to perform various duties under the Chairmanship of the CRO.

- **E3**) Form a special Independent Multi-discipline Group of PJM managers (IMG) to address risk-related challenges on a day-to-day basis. This group of managers is authorized by the ROC, and its recommendations are communicated to the ROC through the CRO.
 - E3.1) Chaired by CRO.
 - **E3.2**) IMG members may include CFO, Credit, Market Operations Leaders, Legal, Regulatory and other officers as agreed by the ROC.
- E4) Implement training for risk management -
 - **E4.1)** Financial markets management learns to plan and practice responding to stress scenarios. This can ensure swift and decisive attention to red flags and appropriate responses. The grid operations side of PJM may likely hold good analogues, and gameplay training at some energy companies provides additional useful examples.
 - **E4.2)** Consider risk management certifications from industry service groups.
- **E5**) Stay up-to-date with advances in peer practices, professional development.
 - **E5.1**) Participate in an industry peer group of risk management professionals.

F) Increase the Frequency of Long-term Auctions

Recommendation Theme

Complications Addressed



PJM Enriches forward FTR market information so that PJM & market may better assess risks & rewards

9. PJM Market Design Flaws Gave GreenHat Room to Develop

We discussed in numerous places the need for more frequent MTA information in order to reduce collateral requirements and to better manage risk and to offer more opportunity for market participants to do the same.

- **F1**) Include Long Term FTRs in monthly or at least bi-monthly auctions.
- **F2**) Convene a committee of FTR traders with PJM Credit & Operations to explore new approaches to make more frequent long-term auctions both more efficient to run and as liquid as possible.¹⁶
- **F3**) With expert help, conduct a general review of the FTR market and other PJM markets, to evaluate the risks and rewards of potential structural reforms.

G) Make Critical Organizational Changes

Recommendation Theme

Complications Addressed



PJM makes organizational changes to open the door to a new outlook for robust RTO financial markets

 An Unwarranted Air of Confidence Facilitated GreenHat's Ability to Grow

One fallout of all the previous recommendations is that the business requirements of the financial markets portion of PJM is quite different from that of the rest of PJM. PJM management has as well confirmed this view. Mind-sets and skill-sets are different, and are very challenging to cultivate without aligned organizational objectives. We recommend:

- **G1**) Identify the critical departmental components to the PJM financial markets business, from running auctions to managing risk, and bring them together in a well aligned organization.
 - **G1.1**) Avoid barriers between operations and finance within this Financial Markets organization.
 - **G1.2**) Ensure top management has appropriate financial market skills.

Additionally, during our interviews and our study of actions taken by PJM, we found that PJM missed opportunities that would have improved the situation if certain habits were imbued in PJM staff. We recommend:

- **G2**) Create a culture and environment that encourages staff to challenge internal assertions, and test their own assumptions.
 - **G2.1**) Create an expectation for a "bias for action" when a plan seems unfounded or an opportunity goes unnoticed by others.
 - **G2.3**) Increase documentation of communications among professionals and in meetings of groups like the Executive Team and others.

 $^{^{16}}$ Several FTR participants expressed worthy ideas regarding such in interviews with us.

Appendix A: About PJM and its FTR Markets

Background & Founding Principles

PJM Interconnection, L.L.C. (PJM) is a Regional Transmission Operator (RTO) that coordinates the movement of wholesale electricity and plans transmission expansion improvements to maintain grid reliability across a <u>multi-state region</u> of the mid-Atlantic and Midwest U.S.

PJM operates as a membership organization subject to the oversight of the Federal Energy Regulatory Commission (FERC).

More information is available at PJM's website: http://www.pjm.com.

Overview of the Financial Transmission Rights (FTR)

The PJM FTR auction market is a financial market rather than a physical one. In an FTR trade there is no delivery of a commodity. Nevertheless, FTRs provide a means to hedge or mitigate price risk caused by "line congestion" on the physical power grid system. Line congestion can be thought of as load or demand along a transmission path that exceeds the capacity of the path to handle the load.

A Load Serving Entity (LSE) is a price-taker because it has little or no control over the congestion on particular transmission line(s) it must rely on to serve its load. The FTR financial instrument allows LSEs to hedge the risk of power price uncertainty caused by line congestion. More broadly however, FTRs give any PJM market participant the ability to attain greater price certainty over delivery of energy across the power grid.

By purchasing an FTR for a certain transmission path, the buyer secures a stream of revenue linked to congestion costs for that path. The amount of that revenue stream is based on the day-ahead hourly congestion price difference across an energy path, for each day in each month included in the FTR contract.

More details about FTRs and associated ARRs, can be found here on PJM's website.

Description of the FTR Auction Market

As is the case with energy futures exchanges, the FTR auction market comprises hedgers and speculators. *Hedgers* are mostly asset operators (such as load serving entities, transmission providers, and power generators). *Speculators* include some asset operators with a financial trading group and all financial market participants (no energy operating assets).

GreenHat was a financial market participant, speculating in FTRs.

FERC provides a succinct explanation of the FTR market in its 2009 report regarding the Tower Default. For a detailed FTR market discussion, *see* https://www.ferc.gov/enforcement/market-manipulation/pjm-power-edge-report.pdf.

Auctions are PJM's primary means of allocating and pricing FTRs. PJM conducts Long Term, Annual, and Monthly auctions to allow market participants to purchase and sell back FTRs, with various terms. PJM's auction cycle is based on a June to May "planning period" for this and each year in the future.

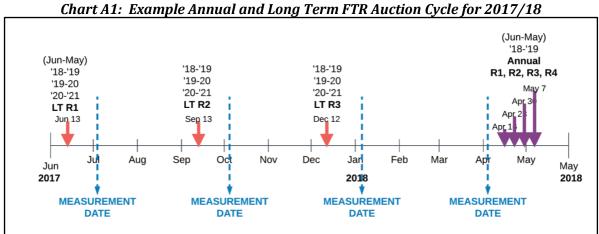
• At the *Monthly Auctions*, individual months remaining in the current quarter and quarterly blocks remaining within the current June/May planning period are available.

The FTR Annual and Long-Term Auction Cycles

GreenHat built its portfolio of FTRs almost exclusively through the Long Term and Annual auctions.

- Four opportunities exist in April & May to transact for the next planning year in what are called "Annual Auctions."
- Three "Long Term Auctions" are held that offer three planning years forward from the next planning year. Thus, congestion costs may be hedged as distantly as four years in the future.

Chart A1 helps clarify this sometimes-confusing auction cycle.



As the blue dotted lines indicate, for our analysis we were given a detailed database that provided cumulative open FTR positions for all market participants, as of the first of January, April, July, and October. This allows us to assess changes in forward positions throughout each year as GreenHat (and all others) buys or sells FTRs in auctions offered in the cycle from 2016 until July of 2018 shortly after their default.

Scale of the PJM FTR Auction Market

Chart A2: Size & Tenor of the FTR Market17

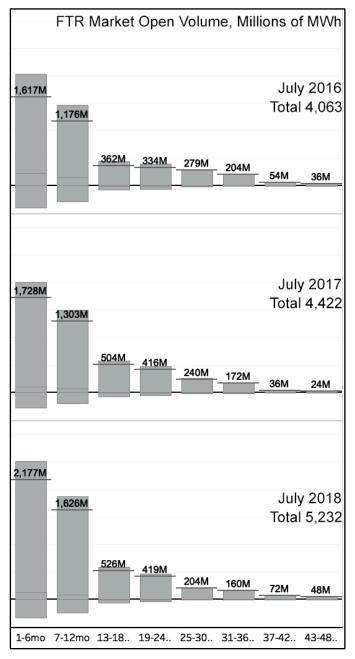


Chart A2 takes a snapshot on July 1st of three years. The chart shows that PJM's FTR auction market (net) open forward volumes in total grew from just over 4 billion MWh in 2016 to 5.2 billion in 2018. This represents a healthy 13% cumulative annual growth rate overall.

Chart A2 also shows open volumes by tenor going back four years, in 6-month time blocks. Known as an "exposure profile" this view shows, as would be expected in any forward market, that the FTR auction market is much larger in the near time periods than the back. Since 2016 when the 1-6 mo. time block included 1.617 billion megawatt hours of FTR transactions, the same forward time block has grown steadily to over 2B MWh in 2018, for a CAGR of 16%.

A closer look shows all the time blocks inside of 24 mo. grew in each year. In contrast, the back time blocks show a more volatile open volume across these three July dates, varying by as much as 100% year-on-year.

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 $^{^{\}rm 17}$ Sum of all forward time blocks, exclude current month, ARRs included.

FTR Market Liquidity

In another perspective on liquidity for the three years of data overall, a look at the approximate number of participant companies with open exposure is provided in Chart A3. Again, toward the front there are many more participants transacting than in the back (e.g., 152 vs. 37). In terms of burden for the Credit department, the total number of participant companies in FTRs is equivalent to the "inside 12mo" category shown.

Chart A3: Participant Counts by Tenor								
Market Participants by Tenor								
2016	2017	2018						
153	137	152						
83	79	83						
66	62	59						
42	35	37						
	2016 153 83 66	ants by Tenor 2016 2017 153 137 83 79 66 62						

These observations about the back tenors of the PJM FTR auction market proved important in this report, particularly when considering GreenHat in the context of risk and market liquidity.

Chart A4 shows the specific participants & rankings discussed in the "Situation" Section.

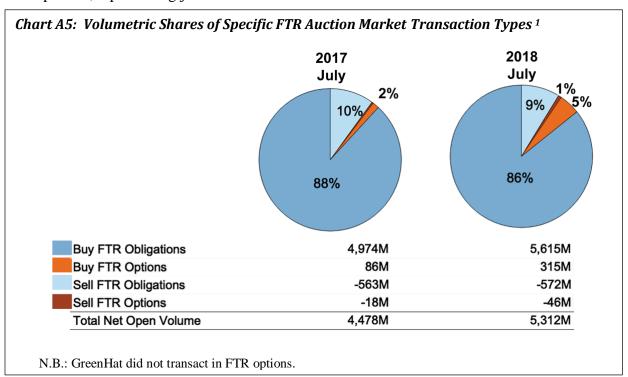
hart A4: Ranking by Portfolio Open Volume									
FTR Auction Participant Rankings, by Period									
	Jan	2016 Apr	Jul	Jan	2017 Apr	Jul	Jan	2018 Apr	Jul
GreenHat	8	8	7	1	1	1	1	1	1
Energy, LLC	104M	104M	203M	397M	397M	445M	650M	650M	861M
DC Energy	2	4	3	3	3	2	2	2	2
Mid-Atlantic, LLC	380M	307M	333M	299M	234M	334M	325M	255M	463M
Solios Power	4	2	4	5	5	3	6	5	3
Mid-Atlantic Tra	370M	317M	299M	220M	179M	328M	231M	169M	338M
Exelon Generation Co.,			6 233M	8 150M	8 94M	7 232M	8 169M	9 118M	4 265M
Apogee Energy Trading LLC						6 234M	4 248M	7 164M	5 248M
Great Barrington	9	9	10	6	6	8	7	4	6
Energy Fund LP	98M	79M	159M	162M	131M	219M	217M	174M	222M
Vitol Inc.	1	1	1	2	2	4	3	3	7
	382M	323M	369M	389M	322M	326M	269M	214M	212M
EDF Trading North America,	3	3	2	4	4	5	5	6	8
	374M	314M	340M	274M	220M	305M	231M	169M	194M
Boston Energy	10	10	18	16	13	12	11	10	9
Trading and Ma	94M	69M	62M	64M	57M	125M	127M	113M	192M
Saracen Energy	6	6	9	7	7	9	9	8	10
East LP	164M	133M	161M	152M	121M	162M	163M	123M	175M

Auction Market Transaction Types

The FTR market includes participants buying from, and selling into the auction, either "FTR Obligations" (a/k/a FTRs) or "FTR Options."

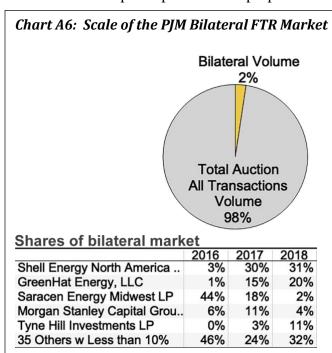
A look into these different auction activities and their relative size reveals two important observations seen in Chart A5. First, selling FTRs back into the auction is not a commonly seen

activity, accounting for roughly 10% of all FTR activity. Second, FTR option activity is a very small portion, representing just 6% of all transaction volumes in 2018.



The Bilateral FTR Market

PJM hosts a platform (the "FTR Center") that allows members to report purchases and sales of FTRs with each other bilaterally. The PJM system tracks each FTR's assignment from one to the other market participant for the purpose of settlement in the future. However, the system



records the original auction price and a price entered by the parties, which may or may not be the price of the bilateral trade. The price field is not informative.

Chart A6 shows the relative size of all bilateral transactions versus all transactions in the FTR auction market from 2016 to 2018, when GreenHat was transacting. The FTR bilateral market represented only about 2% of the overall FTR auction market volume. Many members participate in the bilateral market, with some thirty-five holding less than a 10% share with most of them below 2%.

The bilateral market shares held during this period show GreenHat and a single counterparty to have held almost half the bilateral market volume in 2017 and 2018.

Appendix B: Credit & Collateral Specifics for FTR Market Participants

Minimum Participation Credit Requirements for a Financial Participant

PJM's applicable Minimum Participation Requirement GreenHat had to meet in order to be a market participant in the FTR marketplace incorporated by reference the Commodities Futures Trading Commission's (CFTC) minimum requirement for an "Approved Person," which established the lower of two possible standards to become a financial market participant:

A corporation, partnership, proprietorship, organization, trust, or other business entity with a net worth exceeding \$1,000,000 or total assets exceeding \$5,000,000.

GreenHat's 2014 audited financial statement and balance sheet showed net worth of \$1,016,369 in the form of cash, barely exceeding the minimum requirement of the lower standard for admission.

Specifics of the Required Collateral Policy for FTRs

FERC described the role of an ISO/RTO as being the central manager of risk on behalf of its membership in a 2003 Policy Statement. There, FERC espoused its expectation that ISO/RTOs should act on behalf of their memberships to minimize the likelihood of a credit default. However, FERC left unspecified many of the methods to fulfill that expectation. Each operator of a marketplace is given the responsibility to adopt tariffs and other operating rules and procedures best suited to the specifics of its own markets, subject to FERC review and approval. ¹⁹

Under the basic principles of credit risk measurement, a market participant's *credit risk* reflects both potential adverse changes in the *forward* value of a participant's portfolio, and the participant's financial ability to weather such adverse changes. If a portfolio's forward value drops there is increased potential for future cash flow burdens. Inasmuch as a participant's credit risk involves "potential" value changes that "may" result in cash flow burdens, credit risk should be measured and assessed frequently. Risk should be expected to change as market conditions change.

When GreenHat amassed its FTR positions, PJM's assessment of risk was based entirely on historical, or backwards looking, information. In the absence of forward market pricing, PJM's credit policy did not account for future changes to the grid that might affect the value of an FTR over the coming years while the instruments are open.

When PJM did come to appreciate the size of the unrealized loss that GreenHat had incurred, its credit rules recognized only a tiny fraction of the forward MTA loss because its focus was on historical values to determine risk. Unfortunately, intervening events, such as forward looking transmission improvements and their impact on FTR values, were not captured by PJM's credit calculation based on historical pricing.

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 $^{^{18}\ 109\} FERC\ \P\ 61,186\ (Nov.\ 2004),\ p.8\ (\underline{https://www.ferc.gov/whats-new/comm-meet/111804/E-40.pdf}).$

¹⁹ See generally 16 U.S.C. § 824d(c) & (e).

FTR Collateral Requirement Calculation

When it submits bids to the auction, an auction participant needs to have on account sufficient funds to meet the collateral required to support the FTR positions for which it is bidding (the "collateral requirement"). If an auction takes place and a participant cannot meet the collateral requirements associated with its bids, the auction is canceled and run anew without that participant.

The total portfolio collateral requirement is to be posted against existing and new FTR open positions. The formula details are discussed below.

PJM also applies an "Undiversified Adder," which is relevant to portfolios that are dominated by negative price (sometimes called counterflow positions). Counterflow FTRs were important in the case of the Tower FTR market default in 2007, but were not relevant to the ineffectiveness of GreenHat's portfolio collateral requirement.

As shown below, the credit policy at PJM for the FTR market was entirely based on historical prices and did not take into account the most current *forward* market prices. With this absence of forward market pricing, the credit policy did not account for future changes to the grid that might affect the value of an FTR over the coming years while the instruments are open.

In our expert view, current FTR auction market prices are the best available representation of all FTR market participants' assessments of potential future changes in the underlying system as well as in broader market conditions.

During most of our GreenHat timeline, the formula for a participant's FTR credit requirement was:

$$\sum_{m}^{1} Max(0,$$

$$\sum_{\eta}^{1} \{ [orig\ FTR\ price^{\eta} - (mo\ forecast\ price^{\eta} \times\ adj1) \times mo\ volume^{\eta}] \} + UA - ARR\ credit^{m})$$

Where m is each calendar month, and η is each FTR in the portfolio,

- mo forecast price is based on historical sink minus source, weighted average monthly day-ahead prices: (50% prior year)+(30% second prior)+(20% third prior) stated in dollars per MWh for month m
- orig FTR price is stated as a per MWh price for month m
- adj1 = 0.9 if $forecast\ price^{\eta}$ is positive, or 1.1 if negative
- mo volume = total forward open volume for month m stated in MWh
- ARR credit^m= the amount of ARR credits due to a participant in a given month m
- UA = undiversified adder, which is calculated as:
 If the Orig Portfolio Value < 0, then UA = 3 x ABS(Orig Portfolio Value), else = 0
 Where: Orig Portfolio Value =

$$\sum_{\eta}^{1} orig\ FTR\ price\ \times\ mo\ volume^{\eta}$$

Differences between Futures Markets and PJMs FTR Markets

In trying to fashion recommendations for an FTR market by using the policies and procedures of a futures exchange clearinghouse some key differences need to be recognized.

First, futures markets are intermediated. Customers who use trade on the markets do not have a direct relationship with the exchange or clearinghouse. Instead, customers must establish a relationship, *i.e.*, an account, with a Futures Commission Merchant. The FCM conducts due diligence and is not an open access institution. The FCM is a private business that is not obligated to take all comers. It can discriminate based upon financial wherewithal, regulatory background, or simply a poor word-of-mouth reputation on the Street.

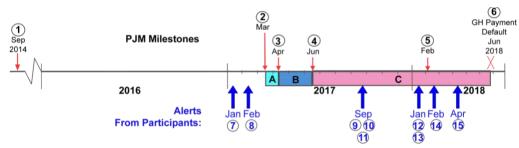
PJM, like other RTO/ISOs, does not have intermediaries, and cannot exclude participants using unduly discriminatory measures. PJM, like exchanges and clearinghouses, is an open access institution, but without the safeguards of a layer of intermediaries making credit decisions for the clearinghouse and taking responsibility for the clients it takes on who trade in the markets.

Futures markets are continuous auction markets. Trading takes place throughout business hours on each and every trading day. Trading sessions are not periodic, scheduled events.

Futures contracts focus liquidity on one, or, at most, a few delivery points. PJM offers FTRs on thousands of paths. PJM does not have liquidity focused on a single point; its liquidity is dispersed across many points.

We suggest a more general review of the FTR market and other PJM markets, to evaluate the risks and rewards of potential structural reforms (*see* recommendation F3).

Appendix C - Alert Details on Timeline



(7) 1/5/17 - internal emails discussing communications from [FP5] to [Credit Mgr] expressing concerns about the volume of positions acquired by GreenHat and the possible adverse consequences due to grid improvements. [Head of Credit] was informed by [FP5] that 30% of most recent long term FTRs were awarded to GreenHat and some of them were along RTEP paths. [FP5] was a bit concerned that there might be circumstances where credit requirements would be less than exposure ... but if outages associated with RTEP upgrades are not likely to impact GreenHat's positions, that will be good. *See* 1-17 DR 008 in PJM's document directory.

(8) 2/13/17 - [FP1] meets with senior PJM officials and alerts them to GreenHat's threat to the market. (9) 9/14/17 - 2/6/18 email [FP3] to [VP Govt Policy] reporting on a September 2017 conversation with [CFO] about GreenHat:

"Subsequent to the email below (9/14/17) [Anonymous] and I met by teleconference with [Credit Mgr] and [CFO] in September and pleaded with PJM to take more active measures to address the potential default. We were told that PJM was constrained by the stakeholder process and the tariff."

(10) 9/27/17 - email from [FP1] to [CFO] and [Credit Mgr]:

"I didn't want to belabor the point, especially on a public call, but I didn't quite understand your comment about limiting the portfolio in question risk. Our calculation is they doubled the default risk by adding 18 GWY in the June and Sep LT auctions."

(11) 9/27/17 – internal email

"I'm running the process I have put together which should cover all of [CFO]'s questions."

(12) 1/12/18 - email from [FP1] to FTR Group and [Credit Mgr] and others

"Hey all. Here's the spreadsheet we discussed yesterday (and mentioned below) on our mark to market view of the GreenHat position. As I tried to articulate, the \$38 million question is will GreenHat pay PJM \$77 million over the term of the FTRs to get back ~\$39 million in congestion payments? [Anonymous] and I would be glad to get on the phone and discuss any questions you have early next week."

(13) 1/16/18 internal email from [Modeler] to [Credit Mgr, Risk Mgr], and others

"We looked at GreenHat's exposure back in Sep. 2017. We studied both June and September new LT FTR transactions GreenHat purchased and marked their exposure. We noticed that they would be making profits from those transactions based on PROMOD adjusted data."

(14) 2/13/18 Verbal to the Special Consultants

A fourth financial participant [FP4] told us that he spoke to [CFO] on February 13, 2018, to express concerns that GreenHat had increased its position and exposure. He reported the CFO's reply as being unconcerned, stating that PJM could call for collateral or liquidate positions if necessary, but did not think GreenHat's positions were problematic. The CFO does not agree with this market participant's recollection of the conversation.

(15) 4/23/18 email from [FP3] to [CFO, Credit Mgr, Gen Counsel, Dir Mkt Ops] reminding them of earlier conversations regarding the dangers of GreenHat

"We want to call your attention to GreenHat's portfolio from round 2 of the auction. We have spoken to you several times in the past regarding what we regard as a flaw in the FTR collateral rules which do not require collateral on mark to market losses, and the exposure that this one market participant has accumulated. We understand that there is a PJM working group addressing collateral in general."

Appendix D - Interviewees at PJM

		First			
Name	Title or Role	Interview	Second	Third	
Asanga Perera	Manager, Advanced Analytics	11/27/18	12/10/18		
Brian Chmielewski	Mgr Market Simulation	11/7/18			
Chris O'Hara	VP, Deputy General Counsel	11/26/18	1/4/2019		
Dave Anders	PJM's Head of Membership	11/7/18			
Denise Foster	VP, State & Member Services	11/27/18			
Dionne Wright	PJM's Head of Human Resources	11/8/18			
Erin Forish	Sr. Business Operations Lead	11/26/18			
Hal Loomis	Head of Credit	11/8/18	11/27/18	12/11/18	
Jacqui Hugee	Office of GC	11/7/18			
Jay Niemeyer	Sr. Analyst, Credit	11/27/18			
Joe Bowring	The Independent Market Monitor	11/8/18	11/27/18	12/10/18	
Lisa Drauschak	Exec Dir, Corp Finance & Risk Mgt	11/26/18	12/10/18		
Megan McLaverty	Member Liaison	11/26/18			
Rebecca Carroll	Dir, Member Relations	11/26/18			
Rebecca Stadelmeyer	Manager, Client Management	11/26/18			
Rob Eckenrod	Chief Compliance Officer	11/26/18			
Steve Pincus	Associate General Counsel	11/26/18			
Suzanne Daugherty	Sr. VP, CFO and Treasurer	11/27/18	12/11/18	1/4/19	
Tim Horger	Dir. Energy Market Ops	11/7/18			
Vince Duane	PJM General Counsel	11/7/18	12/10/18	1/4/19	
Rami Dirani	Trading Experience @ Analytics	12/10/18			
Adam Keech	Exec. Director, Market Operations	12/10/18			
Andy Ott	President & CEO	12/10/18	1/16/19		
Jennifer Tribulski	Associate General Counsel	12/10/18			
Steven Shparber	Ex-PJM Attorney	12/11/18			
Stu Bresler	Sr. VP, Operations & Markets	12/11/18	1/16/19		
Denise Foster	VP, State & Member Services	12/11/18			
Sandra Ritchie	Executive Admin	12/11/18			

Appendix E: Surveillance & Monitoring Duties

FERC Established an Expectation for PJM to Surveil and Manage Risks in the FTR Markets it Hosts

FERC requires ISO/RTOs to have a robust program to detect market manipulation and the exercise of market power, as well as the violation of FERC Market Rules and the RTO's tariff and market rules. There is a lack of explicit instruction on the part of FERC rules, PJM Market Rules, or the PJM Tariff concerning surveillance of participant behavior to determine whether any market participant has a financial exposure that threatens the membership through the risk of default.

However, in a 2005 Policy Statement on Market Monitoring Units, FERC elaborated on the market monitoring function required of ISOs/RTOs or their external Market Monitors and how they are to respond to detections of any sort of potential violation. FERC stated that Market Monitoring Units (MMUs) "should . . . vigilantly monitor participant behavior" and that "there may be situations in which actions of a market participant require investigation and evaluation to determine whether a violation occurred, or in which the provisions of the tariff do not specifically address undesirable market behavior."

Role of PJM's Independent Market Monitor

The scope of services required of the IMM are set forth in Attachment M to the IMM's contract with PJM. PJM's Market Rules and Tariff, and Attachment M, do not explicitly refer to the monitoring of participant behavior for financial risk management purposes, and in fact the CEO of PJM's IMM acknowledged that PJM's IMM did not focus on participant behavior that may cause a financial risk to the membership. We found no one at PJM who questioned the IMM's lack of surveillance of position exposure.

Energy risk management standards make clear that market participants have a reasonable expectation that PJM conduct market surveillance for financial performance and risks of individual market participants. Being the operator of a financial marketplace PJM is in an exclusive position to watch out for the entire membership from actions of a particular member.

PJM could have either performed that function in house or outsourced it to the IMM. We are not determining whether the surveillance function would better reside internally or with the IMM, but it seems clear that the function was not adequately performed *either* by PJM or independently, and therefore PJM needs to clarify the responsibility going forward.

Appendix F: Incremental Impact of GreenHat Trades Following P&A Agreement

We conducted an analysis of the MTA losses that GreenHat amassed as of our measurement date of July 1st, just days after default. This analysis does not address significant increases to the portfolio the losses since default. This analysis is only concerned with the incremental impact of trades UP TO the point of GreenHat's default.

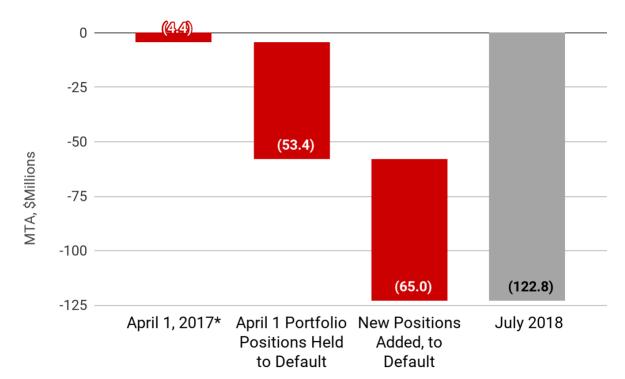


Chart A7 - Incremental Transactions Following the P&A Agreement

We analyzed the contribution to the total default losses that additional trading GreenHat executed after April 2017, versus the losses from the portfolio of FTRs held as of April 2017.

In Chart A7, the total impact of those additional trades is compared to the impact of the portfolio's open positions in April 2017. In the thirteen months from May 2017 to just after default in late June of 2018, GreenHat made additional trades resulting in \$65M of unrealized losses. Had the portfolio been limited to the April 2017 positions until the time of default, the loss can be estimated as \$53.4M.

This analysis provides further emphasis on the importance of the PJM decision to rely on the pledge & assignment agreement from GreenHat and allow GreenHat trading to continue.