

Table of Contents

Preface

SECTION 1 Introduction

Q1 2026 in Review	i
PJM Market Summary Statistics	2
PJM Market Background	2
Conclusions	9
Energy Market Conclusion	9
Capacity Market Conclusion	10
Synchronized Reserve Market Conclusion	11
Nonsynchronized Reserve Market Conclusion	13
Secondary Reserve Market Conclusion	14
Regulation Market Conclusion	14
FTR Auction Market Conclusion	15
Role of MMU	15
Reporting	16
Monitoring	17
Market Design	17
New Recommendations	18
New Recommendations from Section 10, Ancillary Services	18
Total Cost of Wholesale Power	19
Section Overviews	28
Overview: Section 3, Energy Market	32
Overview: Section 4, Energy Uplift	40
Overview: Section 5, Capacity Market	44
Overview: Section 6, Demand Response	54
Overview: Section 7, Net Revenue	61
Overview: Section 8, Environmental and Renewables	62
Overview: Section 9, Interchange Transactions	68
Overview: Section 10, Ancillary Services	71
Overview: Section 11, Congestion and Marginal Losses	82
Overview: Section 12, Generation and Transmission Planning	84
Overview: Section 13, FTRs and ARRs	100

SECTION 2 Recommendations 108

Recommendation Priority	108
Recommendation Status	108
New Recommendations	108
New Recommendations from Section 10, Ancillary Services	109
Complete List of Current MMU Recommendations	109
Section 3, Energy Market	109
Section 4, Energy Uplift	113
Section 5, Capacity Market	115
Section 6, Demand Response	119
Section 7, Net Revenue	122
Section 8, Environmental and Renewables	122
Section 9, Interchange Transactions	123
Section 10, Ancillary Services	124
Section 11, Congestion and Marginal Losses	124
Section 12, Planning	127
Section 13, FTRs and ARRs	130

SECTION 3 Energy Market 132

Overview	133
Supply and Demand	133
Competitive Assessment	135
Recommendations	137
Conclusion	142
Supply and Demand	146
Market Structure	146
Market Behavior	164
Generator Offers	164
ICAP Must Offer Requirement	167
Emergency Maximum MW	168
Parameter Limited Schedules	168
Virtual Offers and Bids	175
Market Performance	184
LMP	184

Zonal LMP and Dispatch	210	Concentration of Energy Uplift Credits	317
Fuel Prices, LMP, and Dispatch	219	Uplift Credits and Market Power Mitigation	320
Components of LMP	226		
Shortage	232	SECTION 5 Capacity Market	324
Emergency Procedures	232	Overview	325
Power Balance Constraint Violation	238	RPM Capacity Market	325
Shortage and Shortage Pricing	239	Part V Reliability Service (RMR)	327
Competitive Assessment	254	Generator Performance	327
Market Structure	254	Recommendations	327
Market Behavior	262	Conclusion	331
Market Performance	291	Market Design	338
Market Structure, Participant Behavior, and Market Performance	299	Installed Capacity	340
		Fuel Diversity	342
SECTION 4 Energy Uplift (Operating Reserves)	302	RPM Capacity Market	343
Overview	303	Market Structure	343
Energy Uplift Credits	303	Market Conduct	361
Energy Uplift Charges	304	Market Performance	367
Recommendations	305	FRR	373
Conclusion	307	CRF Issue	375
Energy Uplift Credits	307	Timing of Unit Retirements	376
Categories of Credits and Charges	307	Part V Reliability Service (RMR)	378
Types of Units	311	Generator Performance	383
Day-Ahead Unit Commitment for Reliability	312	Capacity Factor	383
Balancing Uplift (Operating Reserve) Credits/Balancing Generator	312	Generator Performance Factors	384
Credits	312	Generator Outage Rates	386
Lost Opportunity Cost Credits	313	Generator Testing Issues	392
Energy Uplift Charges	314		
Energy Uplift Charges	314	SECTION 6 Demand Response	398
Uplift Eligibility	316	Overview	398
Energy Uplift Issues	316	Recommendations	399
Uplift Resettlement	316	Conclusion	399
Uplift Forfeiture Rule	317	PJM Demand Response Programs	405
Regulation Market Offsets	317		

Non-PJM Demand Response Programs	406	SECTION 8 Environmental and Renewable	
PJM Demand Response Programs	406	Energy Regulations	482
Emergency and Pre-Emergency Load Response Programs	409	Overview	482
Energy Efficiency	449	Federal Environmental Regulation	482
History	449	State Environmental Regulation	484
Peak Shaving Adjustment	449	State Renewable Portfolio Standards	484
Distributed Energy Resources	449	Emissions Controls in PJM Markets	484
EDC Role	450	Renewable Generation	485
Net Metering Resources	451	Recommendations	485
		Conclusion	485
SECTION 7 Net Revenue	454	Federal Environmental Regulation	487
Overview	454	CAA: NESHAP/MATS	488
Net Revenue	454	CAA: NAAQS/CSAPR	488
Recommendations	454	CAA: NSR	489
Conclusion	454	CAA: RICE	491
Net Revenue	455	CAA: Greenhouse Gas Emissions	492
Spark Spreads and Dark Spreads	456	CWA: WOTUS Definition	492
Theoretical Energy Market Net Revenue	457	CWA: Effluents	493
New Entrant Combustion Turbine	460	RCRA: Coal Ash	494
New Entrant Combined Cycle	461	State Environmental Regulation	495
New Entrant Coal Plant	462	State Coal Ash Regulations	495
New Entrant Nuclear Plant	463	State Emissions Regulations	496
New Entrant Diesel	464	State Renewable Portfolio Standards	507
New Entrant Onshore Wind Installation	465	Transco Regional Energy Access Expansion Project	530
New Entrant Offshore Wind Installation	466	Mountain Valley Pipeline	530
New Entrant Solar Installation	467	Transco Southeast Supply Enhancement	531
Historical New Entrant CC Revenue Adequacy	468	Transco Commonwealth Energy Connector Project	531
Nuclear Net Revenue Analysis	472	Columbia Gas Transmission Virginia Reliability Project	531
		Texas Eastern Transmission Appalachia to Market II Project	532
		Eastern Gas Transmission and Storage Inc. Capital Area Project	532
		Emission Controlled Capacity and Emissions	532
		Emission Controlled Capacity	532
		Emissions	534
		Renewable Energy Output	537

Wind and Solar Peak Hour Output	538	Balancing Authority Operations Coordination Agreement between Wisconsin Electric Power Company (WEC) and PJM Interconnection, LLC	583
Wind Units	538	Northeastern ISO-Regional Transmission Organization Planning Coordination Protocol	583
Solar Units	541	Interchange Transaction Issues	584
SECTION 9 Interchange Transactions	546	PJM Transmission Loading Relief Procedures (TLRs)	584
Overview	546	Up To Congestion Transactions	585
Interchange Transaction Activity	546	Sham Scheduling	583
Interactions with Bordering Areas	546	Elimination of Ontario Interface Pricing Point	588
Recommendations	547	PJM and NYISO Coordinated Interchange Transactions	589
Conclusion	548	Reserving Ramp on the PJM/NYISO Interface	592
Interchange Transaction Activity	549	PJM and MISO Coordinated Interchange Transaction Proposal	593
Charges and Credits Applied to Interchange Transactions	549	Willing to Pay Congestion and Not Willing to Pay Congestion	596
Aggregate Imports and Exports	550	Transmission Service Requests	597
Real-Time Interface Imports and Exports	552	Spot Imports	598
Real-Time Interface Pricing Point Imports and Exports	554	Interchange Optimization	598
Day-Ahead Interface Imports and Exports	556	Interchange Cap During Emergency Conditions	599
Day-Ahead Interface Pricing Point Imports and Exports	559	45 Minute Schedule Duration Rule	599
Loop Flows	562	MISO Multi-Value Project Usage Rate (MUR)	600
PJM and MISO Interface Prices	568		
PJM and NYISO Interface Prices	569	SECTION 10 Ancillary Service Markets	602
Summary of Interface Prices between PJM and Organized Markets	572	Overview	603
Linden Variable Frequency Transformer (VFT) facility	575	Primary Reserve	603
Interchange Activity During High Load Hours	579	Synchronized Reserve Market	604
Operating Agreements with Bordering Areas	579	Nonsynchronized Reserve	606
PJM and MISO Joint Operating Agreement	580	30-Minute Reserve Market	606
PJM and New York Independent System Operator Joint Operating Agreement (JOA)	582	Secondary Reserve	607
PJM and TVA/LG&E and KU Joint Reliability Coordination Agreement (JRCA)	583	Regulation Market	607
PJM and Duke Energy Progress, Inc. Joint Operating Agreement	583	Black Start Service	608
PJM and VACAR South Reliability Coordination Agreement	584	Reactive	609
		Frequency Response	609
		Market Procurement of Real-Time Ancillary Services	610

Recommendations	610
Conclusion	613
PJM Reserve Markets	615
Implementation of PJM Reserve Markets	619
Reserve Subzones	623
Primary Reserve	624
Market Structure	624
Market Performance	627
Synchronized Reserve	628
Market Structure	628
Market Behavior	631
Market Performance	627
Synchronized Reserve Performance	637
Nonsynchronized Reserve	650
Market Structure	650
Market Behavior	652
Market Performance	652
30-Minute Reserve	656
Market Structure	653
Market Performance	656
Secondary Reserve	657
Market Structure	658
Market Behavior	659
Market Performance	659
Regulation Market	661
Market Design	662
Market Structure	663
Market Conduct	669
Market Performance	670
Black Start Service	675
CRF Issues	681
Reactive Service and Capability	683
Reactive Costs	683
Frequency Control Definition	686
Primary Frequency Response	687

SECTION 11 Congestion and Marginal Losses	690
Overview	692
Congestion Cost	692
Marginal Loss Cost	693
System Energy Cost	693
Conclusion	694
Issues	694
Artificial Constraints, Closed Loop Interfaces and CT Pricing Logic	694
Locational Marginal Price (LMP)	695
Components	695
Hub Components	698
Congestion	699
Congestion Accounting	699
Total Congestion	703
Charges and Credits versus Congestion: Virtual Transactions, Load and Generation	704
UTCs and Negative Balancing Explicit CLMP Charges	707
Zonal and Load Aggregate Congestion	715
Fast Start Pricing Effect on Zonal Congestion	715
Monthly Congestion	715
Congested Facilities	717
Congestion Event Hours	718
Congestion by Facility Type and Voltage	719
Constraint Frequency	721
Top Constraints	722
Congestion Event Summary: Impact of Changes in UTC Volumes	729
Marginal Losses	729
Marginal Loss Accounting	729
Total Marginal Loss Cost	732
System Energy Costs	739
Energy Accounting	739
Total System Energy Costs	739

SECTION 12 Generation and Transmission Planning	746		
Overview	746		
Generation Interconnection Planning	746		
Regional Transmission Expansion Plan (RTEP)	750		
Transmission Facility Outages	752		
Recommendations	752		
Conclusion	755		
Generation Interconnection Planning	763		
Existing Generation Mix	763		
Generation Retirements	769		
Generation Queue	777		
Regional Transmission Expansion Plan (RTEP)	830		
RTEP Process	830		
Market Efficiency Process	830		
PJM MISO Interregional Market Efficiency Process (IMEP)	834		
PJM MISO Targeted Market Efficiency Process (TMEP)	834		
PJM MISO Interregional Transfer Capability Study (ITCS)	836		
Multi Driver Process	837		
Long Term Regional Transmission Planning	840		
Supplemental Transmission Projects	840		
Competitive Planning Process Exclusions	845		
Storage As A Transmission Asset (SATA)	847		
Board Authorized Transmission Upgrades	847		
Qualifying Transmission Upgrades (QTU)	848		
Cost Allocation	848		
Transmission Line Ratings	850		
Dynamic Line Ratings (DLR) and Grid Enhancing			
Technology (GETs)	852		
Transmission Facility Outages	853		
Scheduling Transmission Facility Outage Requests	853		
Rescheduling Transmission Facility Outage Requests	856		
Long Duration Transmission Facility Outage Requests	857		
Transmission Facility Outage Analysis for the FTR Market	858		
		Transmission Facility Outage Analysis in the Day-Ahead Energy Market	864
		SECTION 13 Financial Transmission and Auction Revenue Rights	868
		Overview	872
		Auction Revenue Rights	872
		Financial Transmission Rights	874
		Recommendations	876
		Conclusion	877
		Auction Revenue Rights	880
		Market Design	881
		Market Structure	882
		Market Performance	882
		IARRs	891
		Financial Transmission Rights	892
		Market Performance	898
		Surplus Congestion Revenue	923
		“Revenue Adequacy”	926
		Target Allocations and Congestion by Constraint Do Not Match	931
		ARRs as an Offset to Congestion for Load	933
		Zonal ARR Congestion Offset	935
		Offset If All ARR Are Held As ARR	937
		Offset If All ARR Are Self Scheduled	937
		ARR Allocation and Congestion In and Out of Zone	938
		Credit	940
		Treatment of Defaulted Portfolios	941
		FTR Forfeitures	941

