Table of Contents		Overview: Section 11, Congestion and Marginal Losses Overview: Section 12, Generation and Transmission Planning	77 79
Preface	i	Overview: Section 13, FTRs and ARRs	94
SECTION 1 Introduction	1	SECTION 2 Recommendations	101
Q2 2025 in Review	1	Recommendation Priority	101
PJM Market Summary Statistics	5	Recommendation Status	101
PJM Market Background	5	New Recommendations	102
Conclusions	7	New Recommendation from Section 5, Capacity Market	102
Energy Market Conclusion	8	New Recommendation from Section 6, Demand Response	102
Capacity Market Conclusion	10	New Recommendations from Section 10, Ancillary Services	102
Synchronized Reserve Market Conclusion	11	Complete List of Current MMU Recommendations	102
Nonsynchronized Reserve Market Conclusion	11	Section 3, Energy Market	102
Secondary Reserve Market Conclusion	12	Section 4, Energy Uplift	107
Regulation Market Conclusion	12	Section 5, Capacity Market	109
FTR Auction Market Conclusion	12	Section 6, Demand Response	113
Role of MMU	14	Section 7, Net Revenue	116
Reporting	14	Section 8, Environmental and Renewables	116
Monitoring	14	Section 9, Interchange Transactions	116
Market Design	15	Section 10, Ancillary Services	117
New Recommendations	16	Section 11, Congestion and Marginal Losses	120
New Recommendation from Section 5, Capacity Market	16	Section 12, Planning	120
New Recommendation from Section 6, Demand Response	16	Section 13, FTRs and ARRs	123
New Recommendations from Section 10, Ancillary Services	16		
Total Cost of Wholesale Power	16		
Section Overviews	23	SECTION 3 Energy Market	125
Overview: Section 3, Energy Market	23	Overview	127
Overview: Section 4, Energy Uplift	35	Supply and Demand	127
Overview: Section 5, Capacity Market	39	Competitive Assessment	128
Overview: Section 6, Demand Response	49	Recommendations	130
Overview: Section 7, Net Revenue	55	Conclusion	135
Overview: Section 8, Environmental and Renewables	56	Supply and Demand	139
Overview: Section 9, Interchange Transactions	62	Market Structure	139
Overview: Section 10, Ancillary Services	65		

Market Behavior	157	Lost Opportunity Cost Credits	294
Generator Offers	157	Energy Uplift Charges	296
ICAP Must Offer Requirement	159	Energy Uplift Charges	296
Emergency Maximum MW	160	Uplift Eligibility	298
Parameter Limited Schedules	161	Energy Uplift Issues	298
Virtual Offers and Bids	166	Uplift Resettlement	298
Market Performance	175	Uplift Forfeiture Rule	299
LMP	175	Regulation Market Offsets	299
Zonal LMP and Dispatch	199	Concentration of Energy Uplift Credits	299
Fuel Prices, LMP, and Dispatch	206	Uplift Credits and Market Power Mitigation	301
Components of LMP	213	Polar Vortex 2025 (January 19 - 23, 2025)	302
Shortage	221	June Heat Wave (June 22 – 26, 2025)	304
Emergency Procedures	221		
Power Balance Constraint Violation	225	CTOTION - O I I I	
Shortage and Shortage Pricing	227	SECTION 5 Capacity Market	305
Competitive Assessment	239	Overview	307
Market Structure	239	RPM Capacity Market	307
Market Behavior	246	Part V Reliability Service (RMR)	309
Market Performance	273	Generator Performance	309
Market Structure, Participant Behavior, and Market Performance	279	Recommendations	309
		Conclusion	313
	2.2.2	Market Design	318
SECTION 4 Energy Uplift (Operating Reserves)	283	Installed Capacity	321
Overview	284	Fuel Diversity	323
Energy Uplift Credits	284	RPM Capacity Market	324
Energy Uplift Charges	285	Market Structure	324
Recommendations	285	Market Conduct	340
Conclusion	286	Market Performance	346
Energy Uplift Credits	289	FRR	351
Categories of Credits and Charges	290	CRF Issue	352
Types of Units	292	Timing of Unit Retirements	355
Day-Ahead Unit Commitment for Reliability	293	Part V Reliability Service (RMR)	357
Balancing Uplift (Operating Reserve) Credits/Balancing		Department of Energy (DOE) 202(c) Orders	361
Generator Credits	293	Eddystone	361

iv Table of Contents © 2025 Monitoring Analytics, LLC

Generator Performance	362	New Entrant Combustion Turbine	429
Capacity Factor	362	New Entrant Combined Cycle	430
Generator Performance Factors	363	New Entrant Coal Plant	431
Generator Outage Rates	365	New Entrant Nuclear Plant	432
Generator Testing Issues	371	New Entrant Diesel	433
, and the second		New Entrant Onshore Wind Installation	434
		New Entrant Offshore Wind Installation	434
SECTION 6 Demand Response	375	New Entrant Solar Installation	435
Overview	375	Historical New Entrant CC Revenue Adequacy	436
Recommendations	376	Nuclear Net Revenue Analysis	437
Conclusion	378		
PJM Demand Response Programs	381	CROWION O. R	
Non-PJM Demand Response Programs	383	SECTION 8 Environmental and Renewable	
PJM Demand Response Programs	383	Energy Regulations	447
Emergency and Pre-Emergency Load Response Programs	385	Overview	447
Economic Load Response Program	404	Federal Environmental Regulation	447
Energy Efficiency	413	State Environmental Regulation	449
History	413	State Renewable Portfolio Standards	449
EE Details	415	Emissions Controls in PJM Markets	449
Peak Shaving Adjustment	420	Renewable Generation	450
Distributed Energy Resources	421	Recommendations	450
Nodal Aggregation and Size	421	Conclusion	450
EDC Role	421	Federal Environmental Regulation	453
Net Metering Resources	422	CAA: NESHAP/MATS	453
		CAA: NAAQS/CSAPR	454
CECTION - N . P		CAA: NSR	456
SECTION 7 Net Revenue	423	CAA: RICE	456
Overview	423	CAA: Greenhouse Gas Emissions	457
Net Revenue	423	CWA: WOTUS Definition	458
Recommendations	423	CWA: Effluents	459
Conclusion	423	RCRA: Coal Ash	460
Net Revenue	424	State Environmental Regulation	461
Spark Spreads and Dark Spreads	425	State Coal Ash Regulations	461
Theoretical Energy Market Net Revenue	426	State Emissions Regulations	462

State Renewable Portfolio Standards	472	Neptune Underwater Transmission Line to Long Island, New York	533
Transco Regional Energy Access Expansion Project	493	Linden Variable Frequency Transformer (VFT) facility	535
Mountain Valley Pipeline	493	Hudson Direct Current (DC) Merchant Transmission Line	537
Transco Southeast Supply Enhancement	493	Interchange Activity During High Load Hours	539
Transco Commonwealth Energy Connector Project	493	Operating Agreements with Bordering Areas	539
Columbia Gas Transmission Virginia Reliability Project	494	PJM and MISO Joint Operating Agreement	540
Texas Eastern Transmission Appalachia to Market II Project	494	PJM and New York Independent System Operator Joint	
Eastern Gas Transmission and Storage Inc. Capital Area Project	494	Operating Agreement (JOA)	542
Emission Controlled Capacity and Emissions	495	PJM and TVA/LG&E and KU Joint Reliability Coordination	
Emission Controlled Capacity	495	Agreement (JRCA)	544
Emissions	496	PJM and Duke Energy Progress, Inc. Joint Operating Agreement	544
Renewable Energy Output	499	PJM and VACAR South Reliability Coordination Agreement	545
Wind and Solar Peak Hour Output	499	Balancing Authority Operations Coordination Agreement	
Wind Units	500	between Wisconsin Electric Power Company (WEC) and PJM	
Solar Units	503	Interconnection, LLC	545
		Northeastern ISO-Regional Transmission Organization Planning	
		Coordination Protocol	545
SECTION 9 Interchange Transactions	507	Interchange Transaction Issues	545
Overview	507	PJM Transmission Loading Relief Procedures (TLRs)	545
Interchange Transaction Activity	507	Up To Congestion Transactions	546
Interactions with Bordering Areas	507	Sham Scheduling	548
Recommendations	508	Elimination of Ontario Interface Pricing Point	549
Conclusion	509	PJM and NYISO Coordinated Interchange Transactions	550
Interchange Transaction Activity	510	Reserving Ramp on the PJM/NYISO Interface	554
Charges and Credits Applied to Interchange Transactions	510	PJM and MISO Coordinated Interchange Transaction Proposal	554
Aggregate Imports and Exports	511	Willing to Pay Congestion and Not Willing to Pay Congestion	557
Real-Time Interface Imports and Exports	513	Transmission Service Requests	559
Real-Time Interface Pricing Point Imports and Exports	514	Spot Imports	559
Day-Ahead Interface Imports and Exports	517	Interchange Optimization	560
Day-Ahead Interface Pricing Point Imports and Exports	519	Interchange Cap During Emergency Conditions	560
Loop Flows	523	45 Minute Schedule Duration Rule	561
PJM and MISO Interface Prices	529	MISO Multi-Value Project Usage Rate (MUR)	562
PJM and NYISO Interface Prices	531		
Summary of Interface Prices between PJM and Organized Market	ets 533		

vi Table of Contents © 2025 Monitoring Analytics, LLC

SECTION 10 Ancillary Service Markets	563	Market Behavior	617
Overview	565	Market Performance	617
Primary Reserve	565	Regulation Market	619
Synchronized Reserve Market	565	Market Design	620
Nonsynchronized Reserve	566	Market Structure	636
30-Minute Reserve Market	567	Market Conduct	641
Secondary Reserve	568	Market Performance	644
Regulation Market	568	Black Start Service	648
Black Start Service	570	Fuel Assurance	649
Reactive	570	Definition of Black Start Costs	649
Primary Frequency Response	571	Black Start Backstop Process	650
Market Procurement of Real-Time Ancillary Services	571	Black Start Charges	650
Recommendations	572	CRF Issues	653
Conclusion	574	Reactive Service and Capability	656
PJM Reserve Markets	577	Reactive Costs	656
Implementation of PJM Reserve Markets	580	Frequency Control	658
Reserve Subzones	583	Primary Frequency Response	659
Primary Reserve	585		
Market Structure	585	SECTION 11 Congestion and Marginal Losses	661
Market Performance	587		
Synchronized Reserve	588	Overview	663
Market Structure	588	Congestion Cost	663
Market Behavior	591	Marginal Loss Cost	664
Market Performance	592	System Energy Cost	664
Synchronized Reserve Performance	597	Conclusion	665
Nonsynchronized Reserve	608	lssues	665
Market Structure	609	Artificial Constraints, Closed Loop Interfaces and CT Pricing Logic	
Market Behavior	610	Locational Marginal Price (LMP)	667
Market Performance	610	Components	667
30-Minute Reserve	614	Hub Components	671
Market Structure	614	Congestion	672
Market Performance	615	Congestion Accounting	672
Secondary Reserve	616	Total Congestion	675
Market Structure	616		

Charges and Credits versus Congestion: Virtual Transactions,		Market Efficiency Process	791
Load and Generation	676	PJM MISO Interregional Market Efficiency Process (IMEP)	795
UTCs and Negative Balancing Explicit CLMP Charges	679	PJM MISO Targeted Market Efficiency Process (TMEP)	795
Zonal and Load Aggregate Congestion	682	PJM MISO Interregional Transfer Capability Study (ITCS)	797
Fast Start Pricing Effect on Zonal Congestion	687	Multi Driver Process	797
Monthly Congestion	688	New Jersey State Agreement Approach for Offshore Wind	798
Congested Facilities	689	Long Term Regional Transmission Planning	799
Congestion Event Hours	689	Supplemental Transmission Projects	799
Congestion by Facility Type and Voltage	692	Competitive Planning Process Exclusions	803
Constraint Frequency	693	Storage As A Transmission Asset (SATA)	805
Top Constraints	694	Board Authorized Transmission Upgrades	808
Congestion Event Summary: Impact of Changes in UTC Volumes	700	Qualifying Transmission Upgrades (QTU)	808
Marginal Losses	701	Cost Allocation	808
Marginal Loss Accounting	701	Transmission Line Ratings	808
Total Marginal Loss Cost	703	Dynamic Line Ratings (DLR) and Grid Enhancing	
System Energy Costs	710	Technology (GETs)	810
Energy Accounting	710	Transmission Facility Outages	811
Total System Energy Costs	710	Scheduling Transmission Facility Outage Requests	81
		Rescheduling Transmission Facility Outage Requests	814
		Long Duration Transmission Facility Outage Requests	815
SECTION 12 Generation and Transmission Planning	715	Transmission Facility Outage Analysis for the FTR Market	816
Overview	715	Transmission Facility Outage Analysis in the Day-Ahead	
Generation Interconnection Planning	715	Energy Market	823
Generation Queue	715		
Regional Transmission Expansion Plan (RTEP)	719	CDOTTON 40 Ft 1 J T	
Transmission Facility Outages	720	SECTION 13 Financial Transmission and Auction	
Recommendations	721	Revenue Rights	827
Conclusion	723	Overview	831
Generation Interconnection Planning	730	Auction Revenue Rights	831
Existing Generation Mix	730	Financial Transmission Rights	832
Generation Retirements	737	Recommendations	834
Generation Queue	743	Conclusion	836
Regional Transmission Expansion Plan (RTEP)	791	Auction Revenue Rights	839
RTEP Process	791	Market Design	839
		3	

viii Table of Contents © 2025 Monitoring Analytics, LLC

Market Structure	841
Market Performance	841
IARRs	848
Financial Transmission Rights	849
Market Performance	855
Surplus Congestion Revenue	877
"Revenue Adequacy"	880
Target Allocations and Congestion by Constraint Do Not Match	884
ARRs as an Offset to Congestion for Load	887
Zonal ARR Congestion Offset	888
Offset If All ARRs Are Held As ARRs	890
Offset If All ARRs Are Self Scheduled	890
ARR Allocation and Congestion In and Out of Zone	891
Credit	892
Treatment of Defaulted Portfolios	893
FTR Forfeitures	893