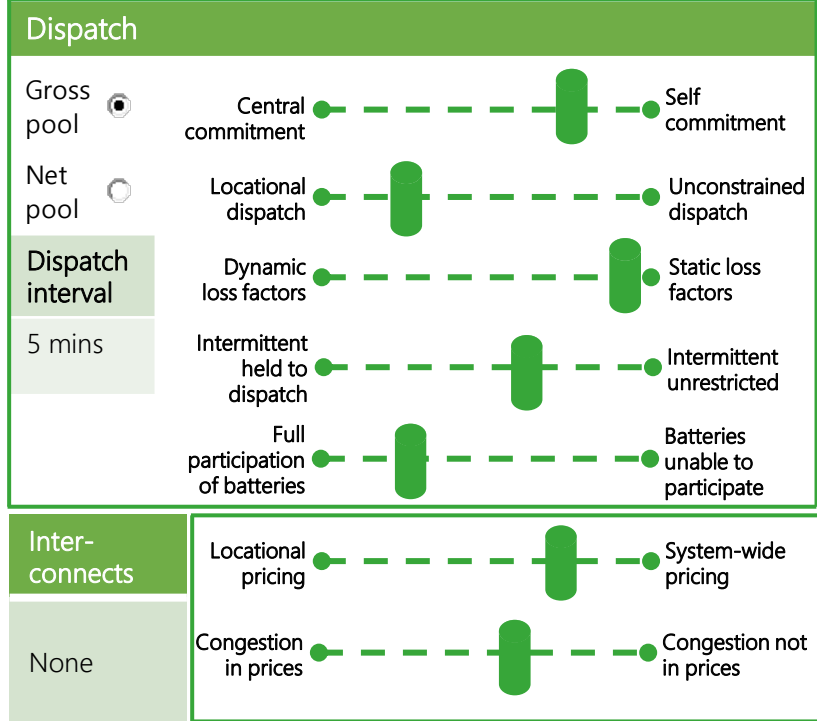


ELECTRICITY MARKET SUMMARY – AUSTRALIA NEM

Governance	
Policy	Energy National Cabinet Reform Committee, Energy Ministers Meeting
Regulation	Australian Energy Regulator
Market design lead	Energy National Cabinet Reform Committee, Energy Ministers Meeting
Rule making	Australian Energy Market Commission
Scheduling & dispatch	AEMO
Power system operation	AEMO
Market operation	AEMO
Metering	Intellihub, Acumen Metering , and 32 other companies
Network planning	Powerlink - Queensland, TransGrid – NSW and ACT, TasNet - Tasmania, ElectraNet – South Aus, AEMO - Victoria
TX owner	Powerlink, TransGrid, TasNet, ElectraNet, AEMO
DX owner	Energex, Ergon , and 10 others



Settlement	
Final prices	Ex-ante
Trading interval	5 minutes
Energy price floor	-\$1,000 /MWh
Energy price ceiling	\$15,000 /MWh
Reserve price floor	N/A
Reserve price ceiling	\$154,200 /MW (2021)
Scarcity pricing	x
Intervention pricing	Yes(AEMO Directions)

Capacity	Contracts		Spot	Retail	
	Auction	x		OTC	✓
Administered price	x	ETFs	✓	Metering competition	✓
Retailer obligations	✓	Locational hedges	✓	Reconciliation approach	Global Settlement
Bilateral agreements	x	Day-ahead	x		
		Intra-day	x		
		Real-time	✓		

Ancillary services		
Service	Procurement	Cost recovered from
Contingency Reserve	Raise & Lower (6s, 60s & 5 min), interconnector risks co-optimised in real-time	Raise – generators pro-rated to injection
Regulation	Raise and lower, co-optimised in real time	Generators and loads based on 4s deviation from linear ramp profile
Inertia	No specific product	N/A
Black start	Generator Restart, Trip to House Load	Recovered from both customers and generators on a 50 / 50 basis
Network support	Network Support and Control Ancillary Services (NSCAS)	recovered fully from market customers



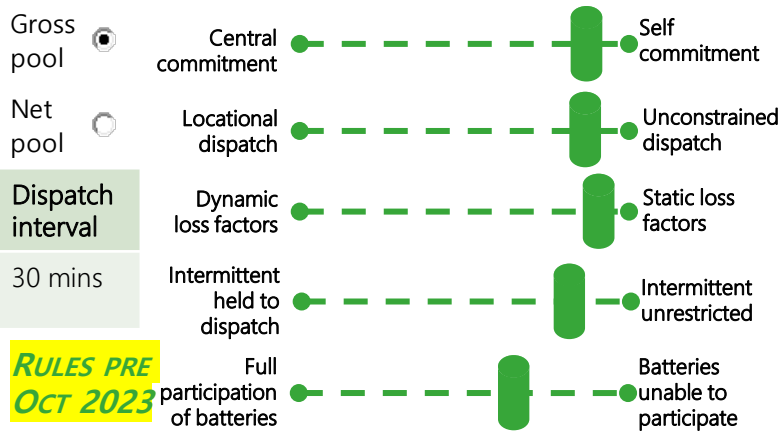
ROBINSON BOWMAKER PAUL

ELECTRICITY MARKET SUMMARY – AUSTRALIA WEM

Governance

Policy	Energy Policy WA (EPWA)
Regulation	Economic Regulation Authority (ERA)
Market design lead	EPWA
Rule making	EPWA
Scheduling & dispatch	Australian Energy Market Operator (AEMO)
Power system operation	AEMO
Market operation	AEMO
Metering	Western Power
Network planning	Western Power
TX owner	Western Power
DX owner	Western Power

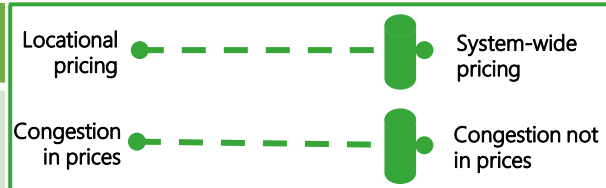
Scheduling and dispatch



Settlement

Final prices	Ex-post
Trading interval	30 mins
Energy price floor	-\$1,000 /MWh
Energy price ceiling	Varies, ~\$300/MWh
Reserve price floor	N/A
Reserve price ceiling	N/A
Scarcity pricing	✗
Intervention pricing	✗

Inter-connects



Ancillary services

Service	Procurement	Cost recovered from
Spinning Reserve / Load Rejection	Raise and lower services, default provider is state owned gentailer, supplemented by contracts with others. Manually cleared.	Raise cost: facilities injecting > 10 MW Lower cost: loads
Load Following	Competitive market for raise and lower services, cleared ahead of energy.	Loads, intermittent generators
Inertia	N/A	N/A
System Restart	Contracted, availability payment plus negotiated contract terms	Loads
Network support	Direct contracts	Locational network charges

Capacity	Auction	✗	Contracts	OTC	✓
	Administered price	✓		ETFs	✗
	Retailer obligations	✓		Locational hedges	✗
	Bilateral agreements	✓		Day-ahead	✓
Spot	Intra-day	✗	Real-time	✓	

Retail	Retail competition	✓	Threshold	50 MWh /yr	Metering competition	✗	Reconciliation approach	Settlement by difference
--------	--------------------	---	-----------	------------	----------------------	---	-------------------------	--------------------------



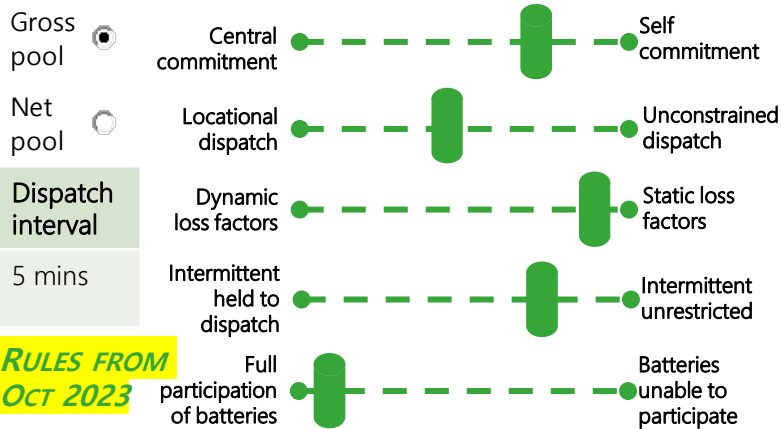
ROBINSON BOWMAKER PAUL

Governance

Policy	Energy Policy WA (EPWA)
Regulation	Economic Regulation Authority (ERA)
Market design lead	EPWA
Rule making	EPWA
Scheduling & dispatch	Australian Energy Market Operator (AEMO)
Power system operation	AEMO
Market operation	AEMO
Metering	Western Power
Network planning	Western Power
TX owner	Western Power
DX owner	Western Power

ELECTRICITY MARKET SUMMARY – AUSTRALIA WEM

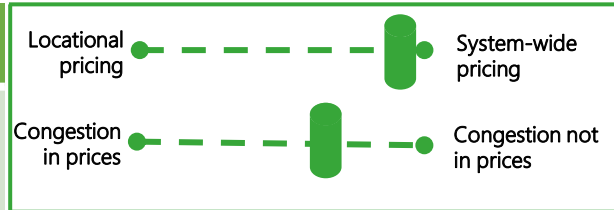
Scheduling and dispatch



Settlement

Final prices	Ex-ante
Trading interval	30 mins
Energy price floor	TBC
Energy price ceiling	TBC
Reserve price floor	TBC
Reserve price ceiling	TBC
Scarcity pricing	✗
Intervention pricing	✓

Inter-connects



Ancillary services

Service	Procurement	Cost recovered from
Contingency Reserve	Five services co-optimised with energy in real-time market: Contingency Reserve Raise and Lower services, Regulation Raise and Lower services, RoCoF Control Service.	Raise cost: facilities injecting > 10 MW Lower cost: loads and generators consuming energy
Regulation		Intermittent generators, loads and generators consuming energy
Inertia	Backup procurement mechanism can provide availability payment in case of market inefficiency.	Minimum requirement: contributing generators, loads, network.
System Restart	Contracted, availability payment plus negotiated contract terms	Loads and generators consuming energy
Network support	Direct contracts	Locational network charges (or market recovery if AEMO procured)

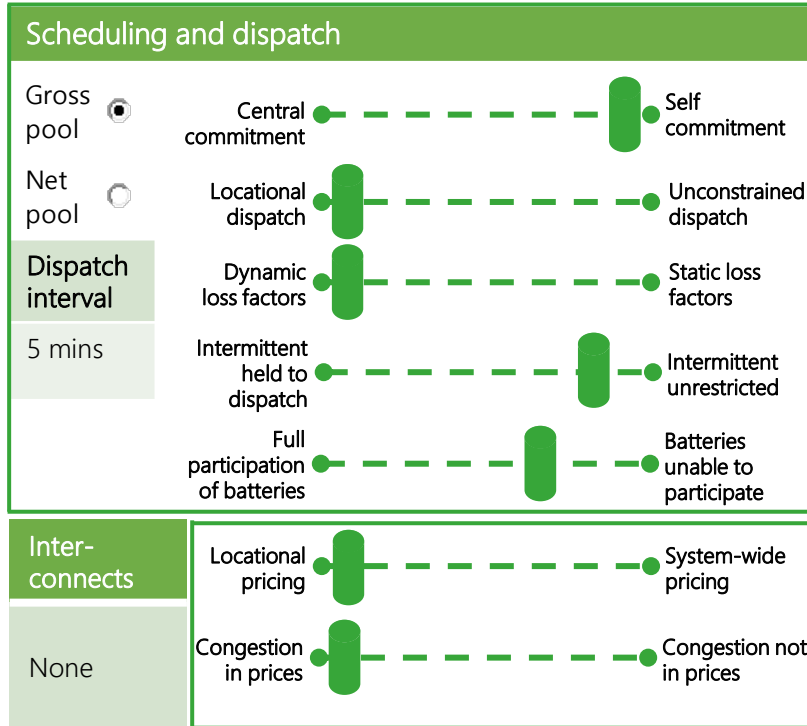
Capacity	Auction	✗	Contracts	OTC	✓
	Administered price	✓		ETFs	✗
	Retailer obligations	✓		Locational hedges	✗
	Bilateral agreements	✓	Spot	Day-ahead	✓
		Intra-day		✗	
			Real-time	✓	

Retail	Retail competition	✓	Threshold	50 MWh /yr	Metering competition	✗	Reconciliation approach	Settlement by difference
--------	--------------------	---	-----------	------------	----------------------	---	-------------------------	--------------------------



ELECTRICITY MARKET SUMMARY - NEW ZEALAND

Governance	
Policy	Ministry of Business, Innovation & Employment
Regulation	Electricity Authority (market) Commerce Commission (monopolies)
Market design lead	Electricity Authority
Rule making	Electricity Authority
Scheduling & dispatch	Transpower
Power system operation	Transpower
Market operation	NZX, EMS (FTRs), ASX (ETFs), Transpower (Ancillary Services)
Metering	Vector AMS , Intellihub , SmartCo , + 9 other metering equipment providers
Network planning	Transpower
TX owner	Transpower
DX owner	Vector , PowerCo , Orion , Wellington Electricity , +25 other regional distributors



Settlement	
Final prices	Ex-post
Trading interval	30 mins
Energy price floor	-
Energy price ceiling	\$20,000/MWh
Reserve price floor	\$0/MW
Reserve price ceiling	None
Scarcity pricing	✓
Intervention pricing	✓

Ancillary services

Service	Procurement	Cost recovered from
Contingency Reserve	Instantaneous Reserve (IR) 6s & 60s: cooptimised with energy Over frequency reserve (OFR): contracted	IR: generating units > 60MW pro-rated to injection, HVDC owner OFR: Tx owner
Regulation	Single service: contracted then cleared ahead of energy	Loads pro-rated to offtake
Inertia	N/A	N/A
Black start	Contracted, availability fee + event fee	Grid owner
Network support	Voltage Support considered, but none currently contracted	Affected distributors in relevant zone per peak kVar

Capacity	Auction		Contracts	OTC	
	Administered price	✗		ETFs	✓
Retailer obligations	✗	Locational hedges	✓		
Bilateral agreements	✗	Spot		Day-ahead	✗
		Intra-day	✗		
				Real-time	✓

Retail competition	✓	Threshold	None	Metering competition	✓	Reconciliation approach	Global settlement
--------------------	---	-----------	------	----------------------	---	-------------------------	-------------------

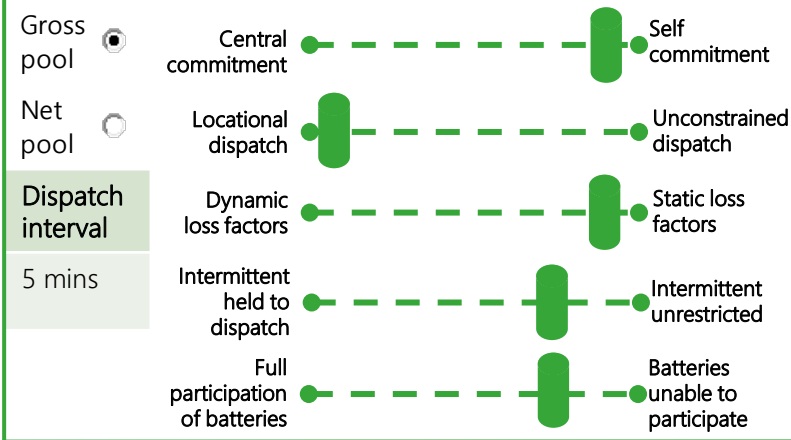


Governance

Policy	Department of Energy (DOE)
Regulation	Energy Regulatory Commission (ERC)
Market design lead	Philippine Electricity Market Corporation (PEMC)
Rule making	DOE
Scheduling & dispatch	Independent Electricity Market Operator of the Philippines (IEMOP)
Power system operation	National Grid Corporation of the Philippines (NGCP)
Market operation	IEMOP
Metering	NGCP
Network planning	NGCP
TX owner	National Transmission Corporation (TRANSCO)
DX owner	Meralco : 119 electric cooperatives, 16 privately owned and 6 local government-owned utilities

ELECTRICITY MARKET SUMMARY – PHILIPPINES

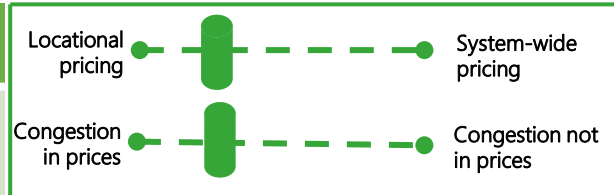
Scheduling and dispatch



Settlement

Final prices	Ex-ante
Trading interval	5 mins
Energy price floor	-
Energy price ceiling	32,000 PhP/MWh
Reserve price floor	-
Reserve price ceiling	-
Scarcity pricing	✗
Intervention pricing	✓

Inter-connects



Ancillary services

Service	Procurement	Cost recovered from
Contingency Reserve	Contingency reserve co-optimised with energy	Generation companies and network service providers in relevant cost recovery zone
Regulation	Regulating reserve – co-optimised with energy	Load and generators in relevant cost recovery zone
Inertia	Not a separate product	N/A
Black start	Contracted	Generators and loads
Network support	None	N/A

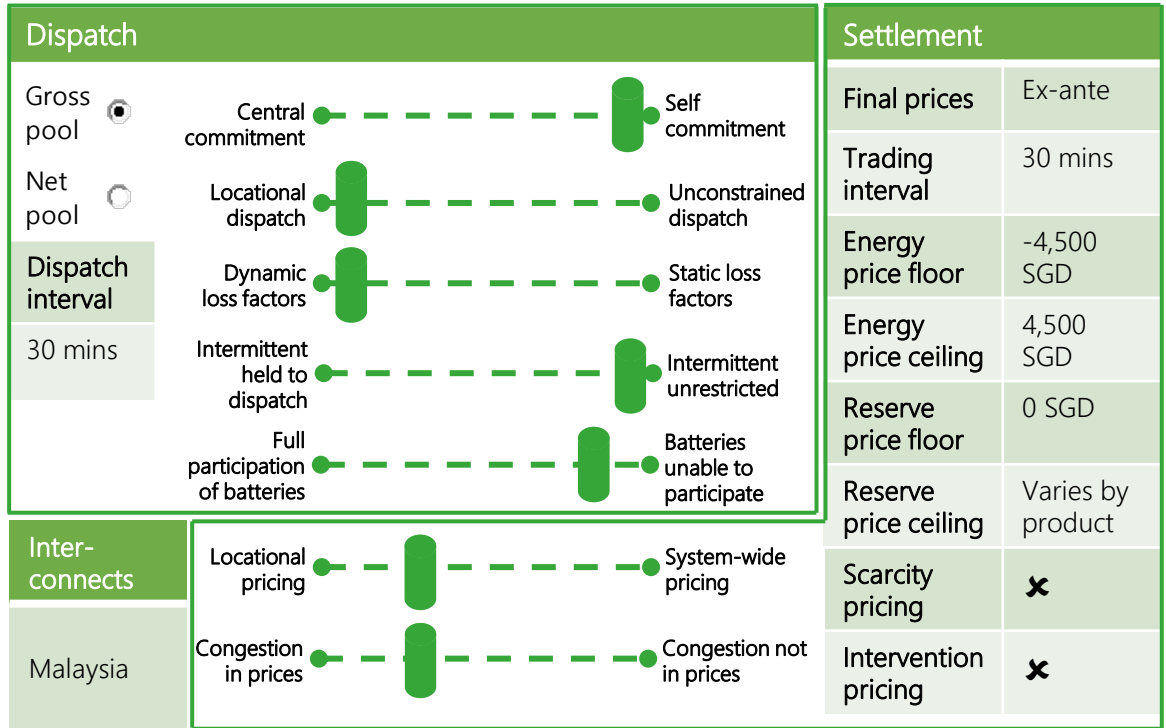
Capacity	Auction	✗	Contracts	OTC	✓
	Administered price	✗		ETFs	✗
Retailer obligations	✗	Locational hedges	✗		
Spot	Bilateral agreements	✗	Day-ahead	✗	
			Intra-day	✗	
			Real-time	✓	

Retail	Retail competition	✓	Threshold	Average monthly peak >= 750kW	Metering competition	✗	Reconciliation approach	Settlement by difference
--------	--------------------	---	-----------	-------------------------------	----------------------	---	-------------------------	--------------------------



ELECTRICITY MARKET SUMMARY – SINGAPORE

Governance	
Policy	Energy Market Authority (EMA)
Regulation	EMA
Market design lead	EMA
Rule making	EMA , on recommendation from Rule Change Panel
Scheduling & dispatch	Energy Market Company (EMC)
Power system operation	EMA as Power System Operator (PSO)
Market operation	EMC
Metering	SP Services Ltd
Network planning	SP PowerGrid Limited , EMA
TX owner	SP PowerGrid Limited
DX owner	SP PowerGrid Limited



Ancillary services

Service	Procurement	Cost recovered from
Contingency Reserve	Primary and Contingency Reserve co-optimized with energy	Generators >= 10MW
Regulation	Regulation co-optimized with energy	Loads, Generators < 10MW
Inertia	No separate service	-
Black start	Supplied under contracts – must run for as long as nearest generator starts	Recovered from load via monthly energy uplift charge
Network support	Required under Transmission Code, or directly contracted by TX operator	-

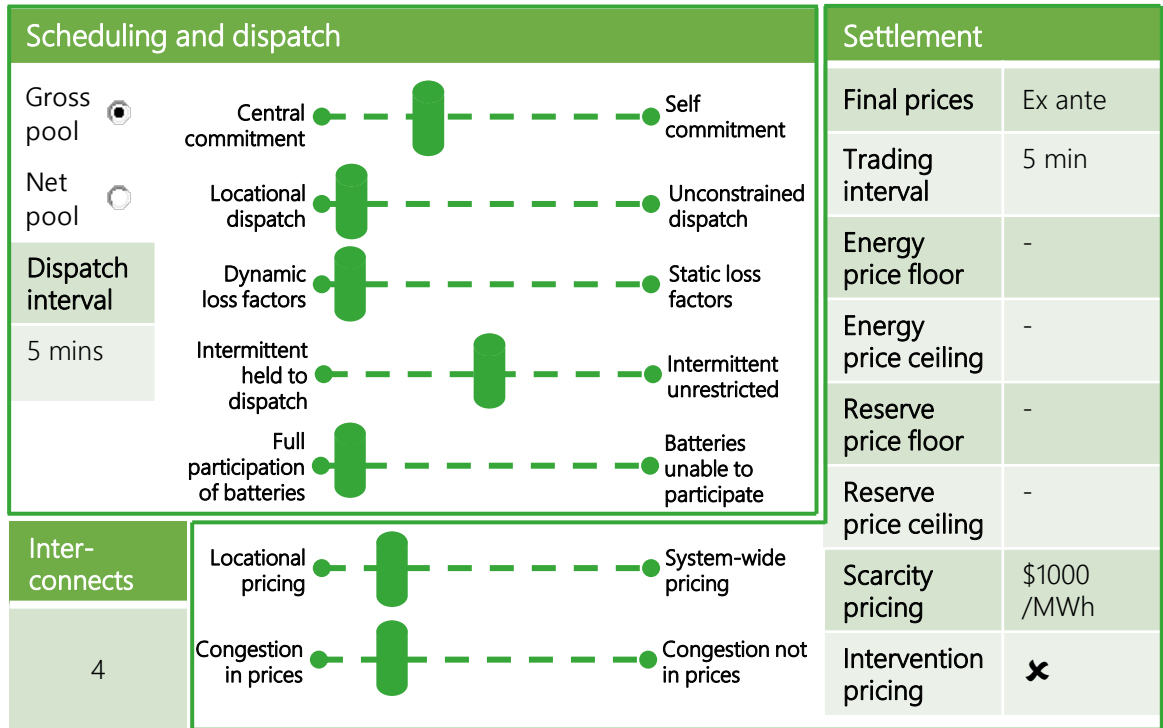
Capacity	Contracts		Spot	Contracts	
Auction	✗	OTC	✓		
Administered price	✗	ETFs	✓		
Retailer obligations	✗	Locational hedges	✗		
Bilateral agreements	✗	Day-ahead	✗		
		Intra-day	✗		
		Real-time	✓		

Retail	Retail competition	✓	Threshold	None	Metering competition	✗	Reconciliation approach	Settlement by difference
--------	--------------------	---	-----------	------	----------------------	---	-------------------------	--------------------------



ELECTRICITY MARKET SUMMARY – CALIFORNIA

Governance	
Policy	California Energy Commission
Regulation	Federal Energy Regulatory Commission , California Public Utilities Commission
Market design lead	California Independent System Operator (CAISO)
Rule making	Federal Energy Regulatory Commission
Scheduling & dispatch	CAISO
Power system operation	CAISO
Market operation	CAISO
Metering	City of Anaheim , Pacific Gas and Electric and 10 others (distribution companies)
Network planning	CAISO
TX owner	Participating Transmission Owners: Pacific Gas and Electric , Trans Bay Cable LLC and 19 others (either tx only or tx/dx)
DX owner	City of Anaheim , Pacific Gas and Electric and 10 others



Capacity	Auction		Contracts	OTC	
	Administered price	✘		ETFs	✓
Retailer obligations	✓	Locational hedges	✓		
Bilateral agreements	✓	Day-ahead	✓		
		Intra-day	✓		
		Real-time	✓		

Ancillary services		
Service	Procurement	Cost recovered from
Contingency Reserve	Four services co-optimised with energy in day-ahead and real-time markets: spinning reserve, regulation up, regulation down and non-spinning reserve.	From market participants based on hourly charge for each type of reserve multiplied by hourly obligation
Regulation		
Inertia	No separate market	-
Black start	contracted or self-provided:	Transmission owners
Network support	CAISO shall select Units which have been certified for additional Voltage Support	From market participants in proportion to demand

Retail	Retail competition	✓	Threshold	Non-residential only totalling max 29K GWh pa	Metering competition	✘	Reconciliation approach	Global Settlement
--------	--------------------	---	-----------	---	----------------------	---	-------------------------	-------------------



ELECTRICITY MARKET SUMMARY – NEW ENGLAND

Governance	
Policy	6 state policy bodies
Regulation	Federal Energy Regulatory Commission (FERC) , 6 state regulators
Market design lead	Independent System Operator New England (ISO NE)
Rule making	ISO NE
Scheduling & dispatch	ISO NE
Power system operation	ISO NE
Market operation	ISO NE
Metering	Madison Electric Works , Danvers Electric Division and 59 others
Network planning	ISO NE
TX owner	30 Participating Transmission Owners (PTOs)
DX owner	Madison Electric Works , Danvers Electric Division and 59 others

Scheduling and dispatch		Settlement	
Gross pool	Central commitment	Final prices	Ex ante
Net pool	Locational dispatch	Trading interval	5 mins
Dispatch interval	Dynamic loss factors	Energy price floor	-
5 mins	Intermittent held to dispatch	Energy price ceiling	-
	Full participation of batteries	Reserve price floor	-
		Reserve price ceiling	-
		Scarcity pricing	✓
		Intervention pricing	✗
Inter-connects	Locational pricing		
13	Congestion in prices		

Capacity	Auction	✓	Contracts	OTC	✓
	Administered price	✗		ETFs	✓
	Retailer obligations	✗		Locational hedges	✓
	Bilateral agreements	✓	Spot	Day-ahead	✓
		Intra-day		✗	
			Real-time	✓	

Ancillary services		Service	Procurement	Cost recovered from				
		Contingency Reserve	Ten Minute Spinning Reserve, Ten Minute Non-Spinning Reserve, Thirty Minute Operating Reserve procured via Forward Reserve Market (FRM) and co-optimized with energy	Tx customer serving as a Regional Network Load				
		Regulation	Procured in FRM and committed in day ahead and real time markets	Paid for as part of Regional Network Service or Through or Out Service by all Market Participants				
		Black start	Contracted	Tx customers in proportion to load				
		Network support	Contracted	Relevant Tx customer				
Retail	Retail competition	✓	Threshold	None	Metering competition	✗	Reconciliation approach	-



Governance

Policy	New York State Public Service Commission (NYSPSC)
Regulation	Federal Energy Regulatory Commission (FERC) , NYSPSC
Market design lead	New York Independent System Operator (NYISO)
Rule making	FERC
Scheduling & dispatch	NYISO
Power system operation	NYISO
Market operation	NYISO
Metering	Central Hudson, Con Edison & 5 others
Network planning	NYISO
TX owner	Central Hudson, Con Edison & 5 others (Local Transmission Owners)
DX owner	Central Hudson, Con Edison & 5 others

ELECTRICITY MARKET SUMMARY – NEW YORK

Scheduling and dispatch		Settlement	
Gross pool <input type="radio"/>	Central commitment	Final prices	Ex ante
Net pool <input type="radio"/>	Locational dispatch	Trading interval	5 mins
Dispatch interval	Dynamic loss factors	Energy price floor	-
	5 mins	Energy price ceiling	-
	Intermittent held to dispatch	Reserve price floor	-
	Full participation of batteries	Reserve price ceiling	-
Inter-connects	Locational pricing	Scarcity pricing	✓
	Congestion in prices	Intervention pricing	✗

Ancillary services

Service	Procurement	Cost recovered from
Contingency Reserve	Four products cooptimised with energy: 10 min SR, 10 min NSR, 30 min SR, 30 min NSR	TX customers and Load serving entities (LSE, market customers)
Regulation	Generator bids into market and ISO commits in DAM and RTM	Tx customers and LSEs
Inertia	Not a separate service	N/A
Black start	Contractually from qualified providers	TX customers and LSEs
Network support	Voltage support procured by contract from qualified generators	TX Customers
Retail	Retail competition	✓
	Threshold	None
	Metering competition	✗
	Reconciliation approach	-

Capacity	Auction	✓	Contracts	OTC	✓
	Administered price	✗		ETFs	✓
	Retailer obligations	✓		Locational hedges	✓
	Bilateral agreements	✓		Day-ahead	✓
Spot	Intra-day	✗	Real-time	✓	



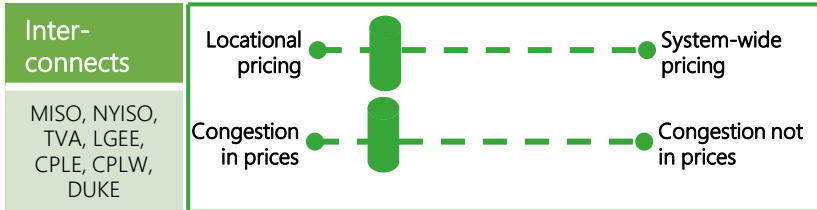
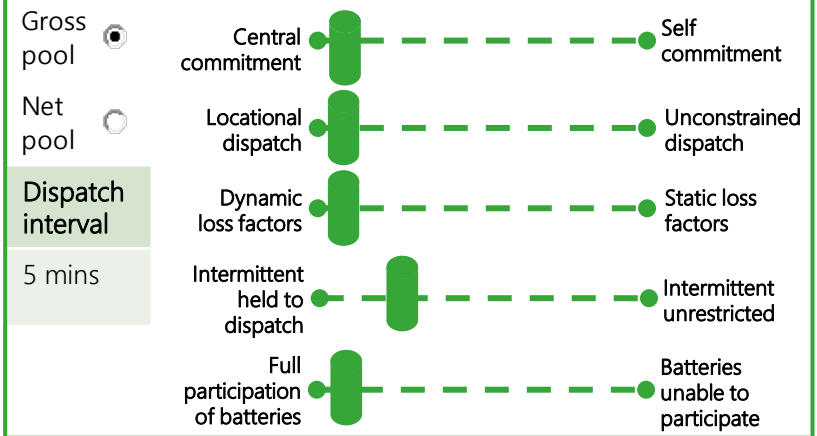
Governance

Policy	Various state policy bodies
Regulation	Federal Energy Regulatory Commission , 14 state/district utility commissions
Market design lead	PJM RTO (Regional Transmission Organization)
Rule making	Federal Energy Regulatory Commission
Scheduling & dispatch	PJM RTO
Power system operation	PJM RTO
Market operation	PJM RTO
Metering	Allegheny Electric Cooperative , American Municipal Power , and other load servers
Network planning	PJM RTO
TX owner	AES Ohio , Appalachian Power Co , and 12 others
DX owner	Allegheny Electric Cooperative , American Municipal Power , and 41 others

Capacity	Auction	✓	Contracts	OTC	✓
	Administered price	✗		ETFs	✓
	Retailer obligations	✗		Locational hedges	✓
	Bilateral agreements	✓		Day-ahead	✓
Spot	Intra-day	✗	Real-time	✓	

ELECTRICITY MARKET SUMMARY – PJM

Scheduling and dispatch



Settlement

Final prices	Ex post
Trading interval	5 mins
Energy price floor	-
Energy price ceiling	\$2000
Reserve price floor	-
Reserve price ceiling	\$1700
Scarcity pricing	✓
Intervention pricing	✗

Ancillary services

Service	Procurement	Cost recovered from
Contingency Reserve	Primary reserve (synchronized and quick start) and Supplemental reserve co-optimized with energy	Tx Customers
Regulation	Bilateral/market: Reg-A (slow) & Reg-D (fast) co-optimized with energy	
Inertia	No separate market	-
Black start	Contracted	Tx owner and customers
Network support	Contracted: Reactive Supply/Voltage Control from capable generators	Tx Customer

Retail	Retail competition	✓	Threshold	0.1 MW	Metering competition	✗	Reconciliation approach	-
--------	--------------------	---	-----------	--------	----------------------	---	-------------------------	---

