MMU Net Congestion Rent Assignment Proposal

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Purpose

- **The purpose of this presentation is twofold:**
  - Review the MMU’s Net Congestion Rent assignment proposal, including several examples of simulated market outcomes
  - Review future modeling/prototyping efforts needed to fully evaluate the MMU’s proposal

Background

MMU Proposal

- **The MMU has criticized Locational Reserve and Forecast Reserve cost allocation and recovery under Dynamic Reserves**
  - NYISO provided a detailed explanation of the MMU's criticisms at the 5/13 MIWG
- **The MMU is recommending revisions to the NYISO's Net Congestion Rent assignment process which they believe can address these perceived issues**
  - The proposal would allocate DAM Congestion Rent (DAMCR) residuals to individual transmission facilities based on differences between TCC auction flows and DAM flows
  - These revisions would most likely supplant much or all of the existing assignment procedures in Attachment N of the OATT
  - The MMU is not recommending changes to auction activities nor the power flow model upon which TCC auctions are based
- **Under the MMU's Net Congestion Rent assignment proposal:**
  - DAMCR residuals will be allocated to the applicable Transmission Owners (TOs) on a transmission facility by transmission facility basis
    - This allocation would be based on incremental DAM flows arising from binding DAM Energy and/or reserve constraints
  - The TO that owns the transmission facility in question would therefore be responsible for any DAMCR residuals that are attributable to that transmission facility
    - There would no longer be any context in which the NYISO socializes DAMCR residuals, as is done today in the context of, for example, NYISO-directed outages, uprates/derates, or external events.

DAMCR Residuals - Today

- **DAMCR residuals arise when there is a difference in internal transfer capability between the DAM and what was assumed in the relevant TCC auction, or from the re-optimization of the power system in the DAM**
- **A residual is ultimately defined as the difference between the amount of Congestion Rent required to fund payments to TCC holders and the amount of Congestion Rent the NYISO collects in the DAM**
- **Examples of things that may cause Congestion Rent residuals:**
  - Transmission facility operational status and/or limit changes
    - Outages tend to cause DAMCR shortfalls, while returns to service tend to cause surpluses
  - Phase angle regulator (PAR) schedules and operation of other grid enhancing technologies
    - Efficient PAR adjustments to improve flows across the network can result in DAMCR surpluses
    - Efficient operation of capacitors, static voltage compensators, and other devices can increase transfer capability or redirect flows in a beneficial way that can also generate DAMCR surpluses.
  - Parallel Flows
    - Outages on neighboring systems and loop flows from those systems may reduce NYCA transfer capability available in the DAM relative to what was assumed in the TCC auctions.
  - Variations in the direction of flows between the TCC auction and the DAM due to changes in intermittent resource, seasonal and time of day variations in generation, and major generation outages may lead to DAMCR surpluses.

Determination of DAMCR Residuals - Today

- NYISO identifies all binding constraints in each hour of the DAM, then determines whether each constraint was the result of a DAM transmission outage/return-to-service or uprate/derate, and whether each constraint resulted in a DAM Congestion Rent Shortfall/Surplus
- If a DAM transmission outage/return-to-service or update/derate is identified as the cause of a DAMCR residual, then the portion of the residual attributable to such status change is allocated directly to the applicable incumbent TOs
  - If a DAMCR residual is the result of a status change for a transmission facility owned by a single TO, that TO would be responsible for any associated residuals
  - If a DAMCR residual is the result of a status change for a transmission facility owned by multiple TOs, each TO would be responsible for a portion of the residual equivalent to their % ownership of the facility.
  - Separate procedures/settlements apply with respect to DAM-modeled outages of facilities awarded Incremental TCCs
- Residuals resulting from NYISO-directed outage/return-to-service or update/derate, external events, the scheduled operation of PARs and other grid enhancing technologies, and the re-optimization of the transmission system in the DAM based on generation and load schedules are socialized amongst all TOs based on their respective share of TCC auction-related net revenues

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DAMCR Residuals– MMU Proposal

- **The MMU's proposal creates a framework by which all DAMCR residuals are allocated discretely to each TO on an individual transmission facility basis**
  - There would no longer be any context where the NYISO would socialize DAMCR residuals amongst the TOs based on TCC revenue share –DAMCR residuals would be allocated directly to the relevant TOs in all contexts
- **The magnitude of DAMCR residual associated with an individual transmission facility would be calculated as the difference between DAM flows across the facility and TCC Auction flows across that facility**
  - Incremental DAM flows can arise from anything that would cause the DAM flow model to deviate from the TCC flow model used for the TCC auctions
    - Market outcomes, re-optimization of the system in the DAM, outages/returns-to-service, and/or transmission uprates/derates, may all lead to incremental DAM flows
- **Under the MMU's proposal, it is possible for TOs to be assigned a DAMCR residual even if all of their transmission facilities are in-service and operating at normal limits**
  - The MMU's proposal would result in a redistribution of DAMCR residuals amongst the TOs and Incremental TCC holders

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Background Summary

- **The MMU is proposing to assess DAMCR residuals directly to individual transmission facilities based on the value of congestion and the difference in flows across the facility between TCC auctions and the DAM, the latter of which can be driven by a variety of factors. The MMU contends its proposal will:**
  - Improve incentives for transmission investment
  - Improve incentives for scheduling and operation of PARs, capacitors, and other grid enhancing technologies
  - Better facilitate the integration of Incremental TCCs
  - Facilitate the incorporation of locational Dynamic Reserve constraints into the marketplace (i.e., revise the current Rate Schedule 4/5 assignment of locational reserve costs to Load)
  - Reward efficient transmission operations including line switching

MMU DAMCR Residual Simulator

DAMCR Allocation Simulator

- **The MMU has constructed a small transmission network model in Excel to illustrate potential outcomes of their flow-based Net Congestion Rent assignment proposal**
  - The simulation is a simple transmission network model, which includes 9 lines and 5 nodes, including a reference bus
  - The simulation uses a variety of inputs to calculate incremental flows arising from binding Energy and reserve constraints in the DAM
  - These incremental DAM flows are used to allocate DAMCR residuals to TOs/Incremental TCC holders on an individual transmission facility basis
- **While this simulation serves as a sufficient proof-of-concept for the proposed Net Congestion Rent assignment model, it is not sufficient in predicting or modeling the potential real market impacts of the proposal**
  - NYISO will need to pursue a significant prototyping/modeling effort to adequately evaluate the potential market impacts of the MMU's proposal

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DAMCR Allocation Simulator

- The MMU's Simulator is meant to demonstrate potential settlement outcomes, TCC/DAM revenue adequacy, and the effect of nodal Congestion Rent determinations under the MMU’s Net Congestion Rent assignment proposal
- The next several slides describe the different pieces of the MMU’s simulation efforts and how they interact to achieve DAMCR residual allocations under the MMU’s proposed methodology

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Inputs: Physical and Financial Gen/Load Parameters

NODE	A	B	C	D	E
Gen Cost	$38	$45	$80	$40	$1,000
Reserve Cost	$3	$4	$5	$5	$1,000
Load (MW)	0	-500	-200	0	0
PHYSICAL CONSTRAINTS					
Gen LOL (MW)	0	0	0	0	0
Gen UOL (MW)	1000	350	350	350	1000
Gen 10-Minute Reserve	500	350	350	350	1000
SCHEDULES & MARKET PRICES					

- **The table above is used to specify the physical and financial parameters of each Node used in the MMU's DAMCR simulation**
  - "Node E" is treated as the reference bus in this simulation
  - These physical and financial parameters set the bounds of the market optimization function as built into the simulation

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Inputs: Line Ratings/Outages

LINE	L1	L2	L3	L4	L5	L6	L7	L8	L9
DAM Line Impedance	1.0	1.5	1.0	1.0	1.0	1.0	1.0	1.0	10000000000.0
DAM N-1 Line Contingency	1.0	10000000000.0	1.0	1.0	1.0	1.0	1.0	1.0	10000000000.0
TCC Line Impedance	1.0	1.5	1.0	1.0	1.0	1.0	1.0	1.0	1.0
TCC N-1 Line Contingency	1.0	10000000000.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
NORM	71	1000	160	1000	1000	66	1000	1000	1000
LTE	76	1000	1000	1000	1000	70	1000	1000	1000
MTE	150	1000	1000	1000	1000	1000	1000	1000	1000

- **The table above specifies the line ratings and impedances used for each line in each of the NYISO’s TCC-relevant power flow models (SCUC/DAM and OPF/TCC)**
  - The information contained in this table is fed into the MMU’s simulation, and informs simulation outcomes
- **The MMU’s model uses extremely large impedances to denote line outages**
  - In the above table for example, "Line 9" is modeled as being out-of-service in the DAM, but in-service in the TCC power flow model
  - The above table also includes an N-1 line contingency (i.e., the loss of "Line 2") denoted by a large impedance

Calculated Inputs: Pre- and Post-Contingency Shift Factors

DAM Pre-Contingency Shift Factor	L1	L2	L3	L4	L5	L6	L7	L8	L9
Node A	24%	43%	32%	16%	8%	-24%	8%	32%	0%
Node B	-31%	27%	4%	35%	1%	-36%	34%	37%	0%
Node C	-12%	16%	-5%	-19%	-26%	-55%	7%	29%	0%
Node D	-5%	22%	-17%	8%	21%	-29%	-13%	50%	0%
Node E (Reference)	0%	0%	0%	0%	0%	0%	0%	0%	0%

TCC Pre-Contingency Shift Factor	L1	L2	L3	L4	L5	L6	L7	L8	L9
Node A	16%	37%	24%	8%	0%	-32%	8%	32%	24%
Node B	-32%	26%	3%	34%	0%	-37%	34%	37%	3%
Node C	-5%	21%	2%	-13%	-20%	-49%	7%	29%	-18%
Node D	-5%	21%	-18%	7%	20%	-29%	-13%	49%	2%
Node E (Reference)	0%	0%	0%	0%	0%	0%	0%	0%	0%

- **The impedance data described on the previous slide is used in determining a set of pre- and post-contingency shift factors for each Line:Node combination**
    - Post-Contingency shift factors are not pictured here but are included in the simulation
  - A negative shift factor indicates that injections from a Generator at that node will have a negative impact on line flows for the correlated line
  - A positive shift factor indicates the opposite – that injections from a given Generator will have a positive impact on line flows for the correlated line
- **The simulation uses these shift factors to model pre- and post- contingency flows in the DAM and TCC auction power flow model, respectively**

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Generator Schedules & Settlements

SCHEDULES & MARKET PRICES						
Gen Schedule	50.1	340.5	0.0	309.4	0.0	
Reserve Schedule	349.5	0.5	0.0	0.0	0.0	
Generator LBMP	$38.00	$45.00	$53.00	$40.00	$28.42	
Congestion Component	$9.58	$16.58	$24.58	$11.58	$0.00	
Reserve Price	$3.00	$4.00	$4.31	$2.07	$2.07	
FINANCIAL SETTLEMENTS						
Generator Payment						TOTALS
Energy Payment	$1,903	$15,325	$0	$12,375	$0	$29,603
Systemwide Reserve Payment	$723	$1	$0	$0	$0	$724
Local Reserve Payment	$326	$1	$0	$0	$0	$327
Load Payouts	$0	-$22,500	-$10,600	$0	$0	-$33,100
Congestion Rent						$3,498

- **The simulation uses the inputs established in prior slides to create a set of:**
  - Optimal Generator schedules
  - Generator LBMPs and LMORPs
  - DAM settlements

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TCC/DAM Flows

Proposed Flow-Based DAMCR Allocations	L1	L2	L3	L4	L5	L6	L7	L8	L9
Line Flow - Energy Only									
DAM Energy Schedules on DAM Topology									
Base Case (1a)	70.5	13.0	-33.5	15.0	119.0	66.0	-104.0	53.0	0.0
Contingency 1 - L1 F/O L2 (1b)	76.1	0.0	-26.0	18.7	120.8	60.4	-102.1	60.4	0.0
Contingency 2 - L6 F/O Gen D (1c)	84.4	-53.9	19.5	-10.1	54.9	155.2	-64.9	-100.3	0.0
TCC Rights on TCC Topology									
Base Case (2a)	70.7	-0.9	-56.9	-17.6	110.0	54.5	-127.6	55.5	53.1
Contingency 1 - L1 F/O L2 (2b)	70.5	0.0	-57.2	-17.7	110.0	55.0	-127.7	55.0	52.8
Contingency 2 - L6 F/O Gen D (2c)	89.2	-74.6	5.7	-43.4	40.0	157.7	-83.4	-117.7	45.7
Line Flow - Reserve Only									
DAM Reserves on DAM Topology									
Contingency 1 - L1 F/O L2 (3a)	-0.1	0.0	0.1	0.2	0.0	-0.2	0.2	0.2	0.0
Contingency 2 - L6 F/O Gen D (3b)	84.9	151.3	113.4	56.8	28.3	-85.2	28.5	113.5	0.0

- **The simulation uses shift factors and schedules to determine the flows that the ideal set of Gen/Load schedules would create on each modeled transmission line**
  - These flows are separated out by constraint type – reserves and Energy
    - Base case flows are a product of Energy schedules
    - Contingency flows are a product of Energy and reserve schedules
  - Base case flows do not consider reserve schedules because reserves are only converted to Energy in response to a contingency – they will not be deployed, and will therefore not affect flows, under the base case conditions

Energy Scheduling and Settlement Outcomes

DAM Binding Constraints (Energy Only)										
Base Case										
Constraint Shadow Price	$0.00	$0.00	$0.00	$0.00	$0.00	-$40.65	$0.00	$0.00	$0.00	
Line Congestion Value (To-From) (4a)	$4.76	-$9.89	$1.83	$7.69	$10.62	$22.34	-$2.93	-$11.72	$12.45	
Incremental Flow (DAM - TCC) (4b) = (1a)-(2a)	-0.227	14.0	23.4	32.7	9.0	11.5	23.7	-2.5	-53.1	
DAMCR By Line (4c)= (4a)*4(b)	-$1	-$138	$43	$251	$95	$256	-$69	$29	-$661	-$195
Contingency 1 - L1 F/O L2										
Constraint Shadow Price	-$2.89									
Line Congestion Value (To-From) (5a)	$1.79	$1.24	$1.10	-$0.41	$0.28	$0.14	-$0.69	$0.14	$1.38	
Incremental Flow (DAM - TCC) (5b) = (1b)-(2b)	5.589	0.0	31.2	36.5	10.8	5.4	25.6	5.4	-52.7	
DAMCR By Line (5c)= (5a)*(5b)	$10	$0	$34	-$15	$3	$1	-$18	$1	-$73	-$56
Contingency 2 - L6 F/O Gen D										
Constraint Shadow Price						-$3.83				
Line Congestion Value (To-From) (6a)	$0.45	-$0.93	-$0.93	$0.73	$2.11	$2.11	-$1.38	$0.00	$1.17	
Incremental Flow (DAM - TCC) (6b) = (1c)-(2c)	-4.713	20.8	13.8	33.4	14.9	-2.5	18.5	17.4	-45.7	
DAMCR By Line (6c)=(6a)*(6b)	-$2	-$19	-$13	$24	$31	-$5	-$26	$0	-$54	-$63
Total DAMCR by Line - Energy (4c)+(5c)+(6c)	$7	-$157	$64	$260	$130	$252	-$113	$30	-$788	-$315

- **The simulation determines constraint shadow prices as an output of the market clearing optimization**
  - These shadow prices directly inform the determination of Congestion values
- **The simulation determines pre- and post-contingency facility flows based on the output of the market clearing optimization**
  - These flows directly inform DAMCR and DAMCR residual determinations
- **The simulation then calculates total DAMCR residuals relating to Energy schedules in red**

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Reserve Scheduling and Settlement Outcomes

DAM Binding Constraints (Reserve Only)										
Contingency 1 – L1 F/O L2										
Constraint Shadow Price	-$2.89									
Line Congestion Value (To-From) (7a)	$0.55	$0.00	$0.00	-$0.41	$0.14	$0.14	-$0.55	$0.00	$0.14	
Incremental Flow (DAM – TCC) (7b) = (3a)-0	-0.1	0.0	0.1	0.2	0.0	-0.2	0.2	0.2	0.0	
DAMCR By Line (7c) = (7a)*(7b)	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Contingency 2 – L6 F/O Gen D										
Constraint Shadow Price						-$3.83				
Line Congestion Value (To-From) (8a)	$0.45	-$0.93	-$0.93	$0.73	$2.11	$2.11	-$1.38	$0.00	$1.17	
Incremental Flow (DAM – TCC) (8b) = (3b)-0	84.9	151.3	113.4	56.8	28.3	-85.2	28.5	113.5	0.0	
DAMCR By Line (8c)= (8a)*(8b)	$38	-$141	-$106	$41	$60	-$180	-$39	$0	$0	-$327
Total DAMCR by Line – Local Reserve (7c) + (8c)	$38	-$141	-$106	$41	$60	-$180	-$39	$0	$0	-$327

- The simulation repeats the processes described on Slide 15 to determine DAMCR settlements pertaining to reserve schedules

Calculating DAM Congestion Residuals

DAM Congestion Rent Residual

$$\mathrm{DAMCR}_{l,t} \coloneqq \mathrm{DAMCR}_{l,t}^{\mathrm{Base}} + \mathrm{DAMCR}_{l,t}^{\mathrm{Ctg}} + \mathrm{DAMCR}_{l,t}^{\mathrm{Reserve}}$$

Incremental Flow – Base Case (Energy)

$$\mathrm{DAMCR}_{l,t}^{\mathrm{Base}} \coloneqq \lambda_{l,t}^{\mathrm{PreCtgDAM}} \cdot \left(f_{l,t}^{\mathrm{PreCtgDAM}} - f_{l,t}^{\mathrm{PreCtgTCC}}\right)$$

Incremental Flow – Contingency Case (Energy)

$$\mathrm{DAMCR}_{l,t}^{\mathrm{Ctg}} \coloneqq \sum_{ctg \in C} \lambda_{l,t,ctg}^{\mathrm{PostCtgDAM}} \cdot \left(f_{l,t,ctg}^{\mathrm{PostCtgDAM}} - f_{l,t,ctg}^{\mathrm{PostCtgTCC}}\right)$$

Incremental Flow – Contingency Case (Reserves)

$$\mathrm{DAMCR}_{l,t}^{\mathrm{Reserve}} \coloneqq \sum_{ctg \in C} \lambda_{l,t,ctg}^{\mathrm{PostCtgDAM}} \cdot f_{l,t,ctg}^{\mathrm{PostCtgDAM}}$$

$$\forall\, l \in L, t \in T, ctg \in C$$

Indices and Sets	
l, L	Line index and set
t, T	Time index and set
ctg, C	Contingency index and set
Superscripts	
Base case	Base case
Ctg	Contingency Case
Reserve	Reserve deployment case
Pre(Post)CtgDAM	Pre(post)-contingency DAM
PreCtgTCC	Pre-contingency TCC auction model
Variables	
λ	Congestion Value
f	Power flow
DAMCR	DAM Congestion Rent residual

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Recap

- The MMU's simulation uses a set of pre-defined inputs in determining TCC and DAM flows and Congestion values across a small transmission network model
- The simulation determines incremental DAM flows across each line under base case and N-1 topologies, multiplying this value by the calculated Energy/reserve Congestion values to yield total DAMCR residuals per transmission facility
- Responsible entity (TO or Incremental TCC holder) then pays/receives the resulting DAMCR residual, per facility

2026 Net Congestion Rent Assignment Project

2026 Net Congestion Rent Assignment Evaluation Project

- **NYISO plans to propose a dedicated "Net Congestion Rent Assignment Evaluation" project as part of the 2026 Project Prioritization process**
- **The modeling required to evaluate the MMU's Net Congestion Rent assignment proposal is expected to be significant**
  - NYISO will need to the construct relevant models, collect/create and store necessary datapoints, and process, analyze, and interpret modeling results to measure the potential market impacts arising from the MMU's proposal
  - The 2025 Operating Reserve Supplier Cost Recovery project was not provisioned for this task
- **Modeling could possibly consist of:**
  - Offline DAM simulation,
  - TCC power flow simulation, and/or
  - Development of a new tool/functionality to perform data analysis

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TCC/DAM Modeling

- **The NYISO has compiled a preliminary list of data elements needed to model and evaluate the MMU's Net Congestion Rent assignment proposal**
  - Some of these datapoints do not currently exist or are not currently stored by NYISO's systems - NYISO would need to develop tools/methods to collect/create and/or store these datapoints
- **The modeling effort would use historical data to determine outcomes under the current market rules vs the MMU's proposed approach**
  - It is worth noting that the NYISO will not have historical reserve constraint information that can be used in directly predicting market outcomes within the context of Dynamic Reserves – these constraints will not exist until Dynamic Reserves is implemented
    - Forward-looking models to predict the outcomes of the MMU's proposal within the context of Dynamic Reserves would complicate the modeling effort further

Monthly Data	Currently Available?
Valid TCC Injections and Withdrawals (simulated)	Y
Historical List of Binding DAM Transmission Constraints - Base Case	Y
Historical List of Binding DAM Transmission Constraints - Per Contingency	Y
TCC Auction Flows - Base Case	Y
TCC Auction Flows - Post-Contingency	N
Actual Historic DAMCR Residual settlements per TO per hour	N
Unassigned Residual Responsibilities	N
Assigned Residual Responsibilities	N

Hourly Data	Currently Available?
Hourly DAM Flows Across All Facilities - Base Case	N
Hourly DAM Post-Contingency Flows Across All Facilities - Per n-1 topology	N
Hourly DAM Congestion Value Across All Faciliites - Base Case	N
Hourly DAM Congestion Values Across All Facilities - Per n-1 topology	N

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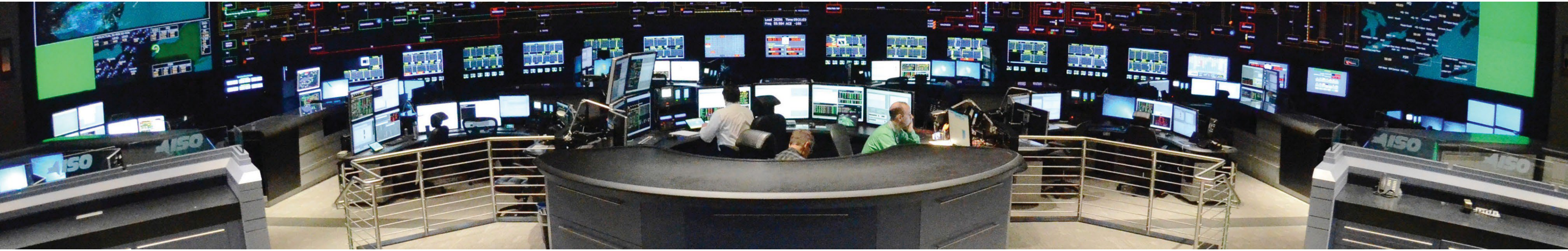
Questions?

Our Mission and Vision

Mission
Ensure power system reliability and competitive markets for New York in a clean energy future

Vision
Working together with stakeholders to build the cleanest, most reliable electric system in the nation



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