Resource Adequacy Markets

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Resource Adequacy Markets

1. Energy-only markets pay suppliers a premium for operating during scarcity events
2. Capacity markets compensate generators for being available to deliver electric energy
3. Resource procurement requirements instruct LSEs to procure capacity (sort of MISO)

Resource Adequacy Markets

- All resource adequacy markets are struggling
  1. During Uri, Texas saw 30 GW of outages
  2. During Elliott, 57 GW of cleared capacity was unable to deliver electric energy

Thesis: Resource adequacy markets do not consider sources of incompleteness.

- Credit risk
- Harmonization with other regulations (gas curtailment rules)
- Accreditation overcompensates resources that underperform and undercompensate resources that overperform

Energy Markets

- Generators compensated for providing the services the grid needs when they are needed
- But market power issues requires price / offer cap

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Texas Extreme Weather Modeling

- "Extreme" scenario modeled with peak demand at 67.2 GW and 14 GW of outages
- Uri saw demand forecasts as high as 76.8 GW with 30 GW of outages
- ERCOT expected to experience 2.3 GW of unserved energy per year
  - Suggests 400 years worth of supply-related outages during event

Generator Performance

Figure 1: Generation performance vs forecast and extreme capacity scenarios (Feb 2021)

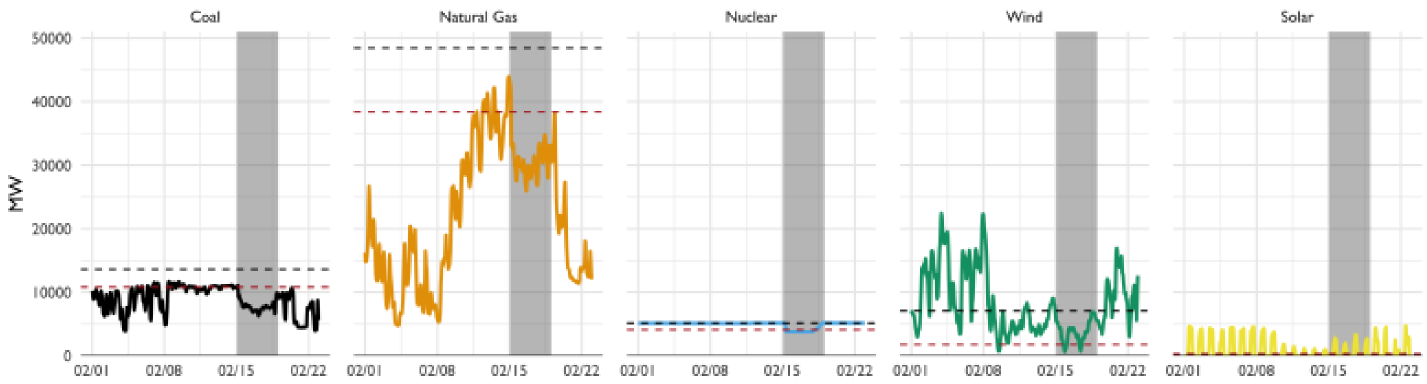

Figure notes: Forecast capacity from Winter 2020/21 Seasonal Assessment of Resource Adequacy shown in BLACK dashed lines. Extreme case capacity from Winter 2020/21 Seasonal Assessment of Resource Adequacy shown in RED dashed lines. Period of load shed represented by grey shaded areas from Feb 15 1:00am through Feb 19 1:00am.

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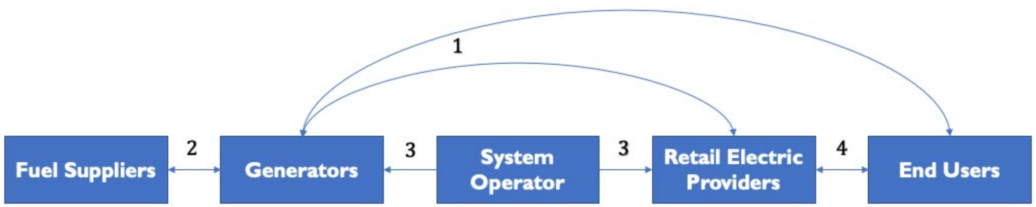
Revenues Available During Uri

- 1 GW generator that operated throughout Uri would have received ~$930 million.
- It costs ~$960 million to build a 1 GW combined-cycle natural gas plant
- The lifespan of such a plant is 40 years.

Winter Storm Uri

- Incomplete markets leads to higher risk premia for investors and
-



Links in the electricity supply chain

Insolvency Risk

Counter-Party	$ Total
BRAZOS ELECTRIC POWER CO OP INC (CP)	1,879,463,067.12
EAGLES VIEW PARTNERS LTD (CP)	1,152,199.09
ENERGY MONGER LLC (CP)	8,884,306.97
ENTRUST ENERGY INC (CP)	296,572,193.16
GBPOWER LLC (CP)	20,317,380.39
GRIDDY ENERGY LLC (CP)	30,040,559.01
GRIDPLUS TEXAS INC (CP)	1,480,209.39
HANWHA ENERGY USA HOLDINGS CORP DBA 174 POWER GLOBAL (CP)	50,177,024.93
ILUMINAR ENERGY LLC (CP)	42,755,452.68
MQE LLC (CP)	13,713,333.81
POWER OF TEXAS HOLDINGS INC VIRTUAL (CP)	16.29
RAYBURN COUNTRY ELECTRIC COOPERATIVE INC (CP)	641,500,254.15
VOLT ELECTRICITY PROVIDER LP (CP)	6,441,092.62
Total	2,992,497,089.61

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this Court. Specifically, the reduction or disallowance of ERCOT's Claim in this proceeding will directly affect other market participants. Moreover, it would be seen as effectively resetting the February energy prices, which could lead to a domino effect of other market participants filing bankruptcy to seek similar relief. Worse still, because direct and derivative financial transactions have relied upon the February pricing, resetting such prices could have catastrophic effects on the U.S. financial system. These facts support the Court abstaining from taking up the ERCOT Claim.

--Brief on behalf of the Texas PUC,
In Re Brazos Electr. Power Coop

Gas Curtailment

Until such time as the Commission has specifically approved a utilities curtailment program, the following priorities in descending order shall be observed:

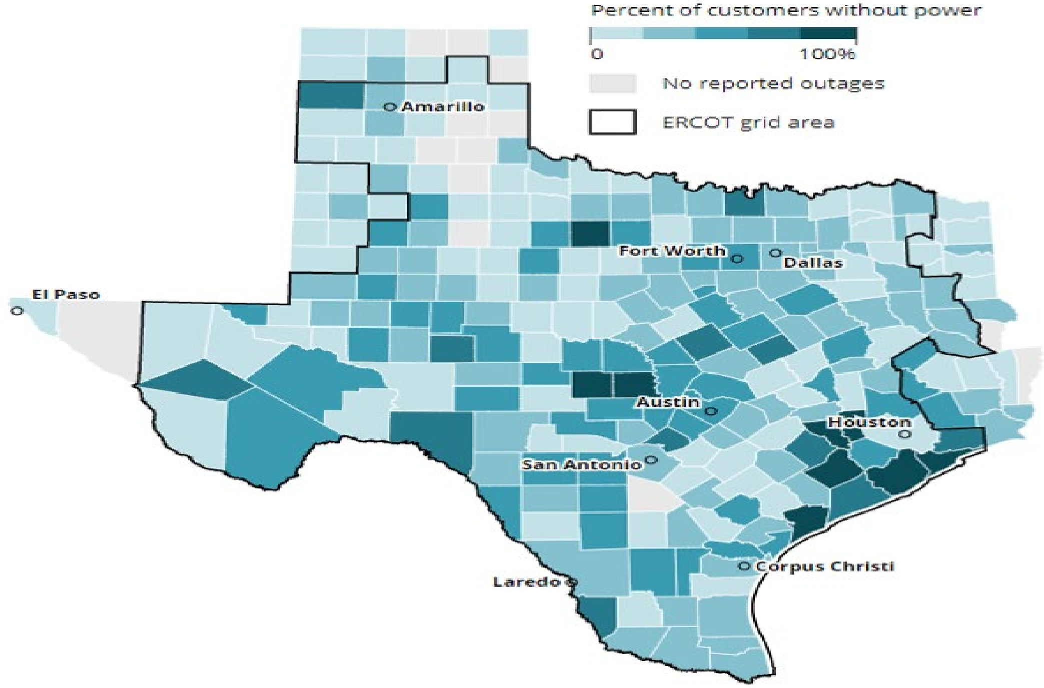
a. Deliveries for residences, hospitals, schools, churches and other human needs customers.

b. Deliveries of gas to small industrials and regular commercial loads. . . .

c. Large users of gas for fuel or as a raw material where an alternate cannot be used and operation and plant production would be curtailed or shut down completely when gas is curtailed. . .

Retail Markets

- Rolling blackouts needed for system reliability
- Not compensated for that reliability benefit



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Capacity Markets

- Generators commit to provide a service, often years in advance
- Compensated for availability, not for sale of energy

Capacity Markets

- Overpay resources that underperform
  - In 2018, PJM resources could have profited off capacity markets despite not meeting any capacity obligations
  - After Winter Storm Elliott, 24% of the PJM's generating capacity was unexpectedly offline, with gas-fired power plants making up ~70% of the unplanned outages
  - In 2014, ISO-NE $674 mm in capacity payments to resources that met an average of 17% of their capacity obligations

Capacity Markets

- "It is time to reconsider whether capacity constructs, certainly those in large, multi-state RTOs, are still capable of performing the important duties expected of them"—Commissioner Mark Christie

- "Markets may not provide sufficient incentives for resource owners to invest proactively in energy supply arrangements. . . . When the risk of a reserve shortage are low, the incentive PFP creates for performance are significantly muted—too muted for it to be financially beneficial for the generator to incur the up-front costs of arranging fuel"—ISO-NE

Capacity Markets

But we are already moving past capacity markets!

- Reliability-must-run agreements are increasing
- Subsidies to resources with specific characteristics

Problems with Capacity Markets

- Bankruptcy places implicit cap on nonperformance penalties
- Penalties for nonperformance too small
- Penalties create an incentive for correlated failures
- Accreditation overcompensates poorly performing resources and undercompensates resources that perform well

Capacity Markets

Planning Parameters

Capacity market supply sell offers

Load forecast

Base Residual Auction

Capacity Payments

Total Capacity Costs

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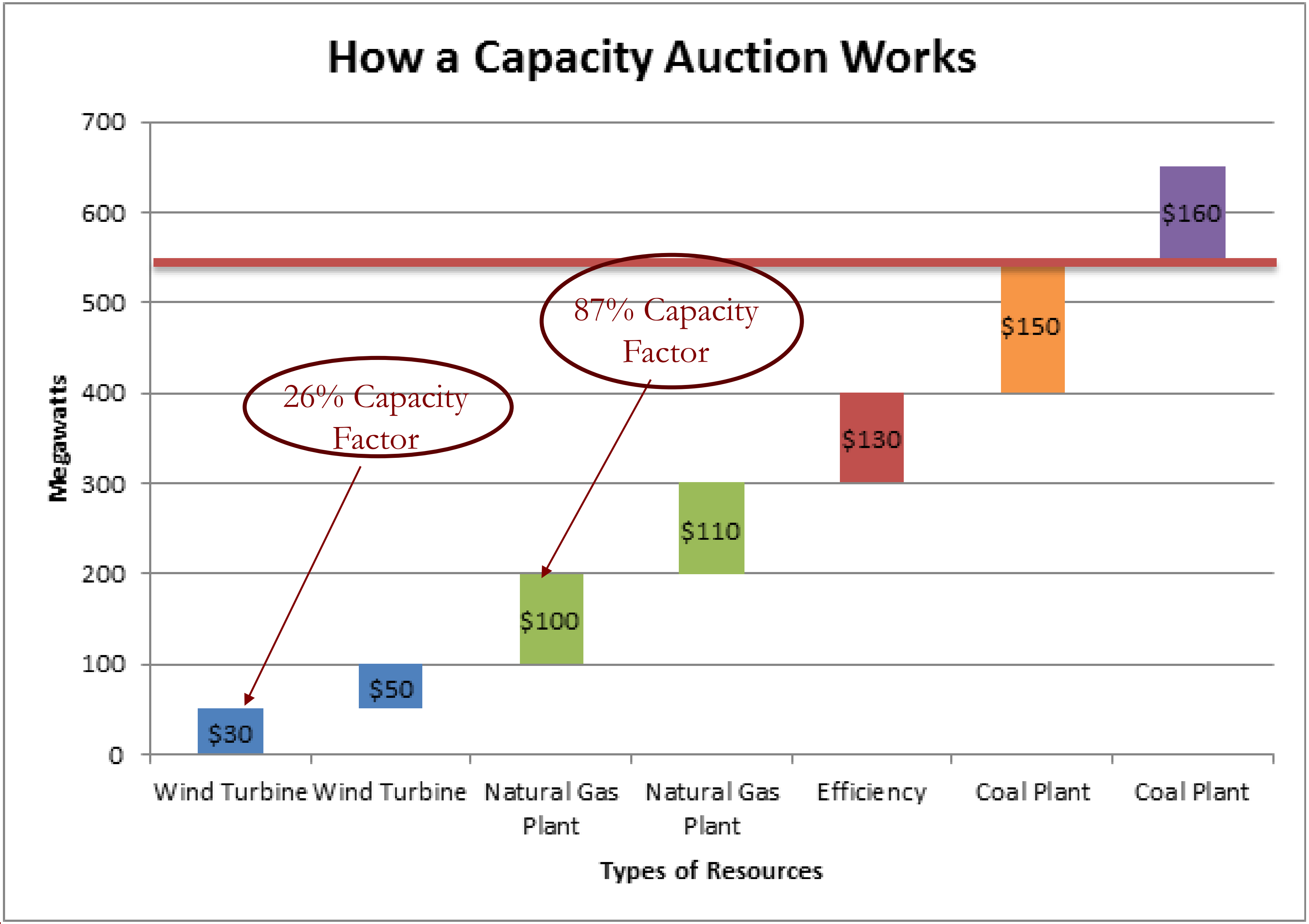
How a Capacity Auction Works
700
600
500
400
300
200
100
0
Megawatts
$30
$50
$100
$110
$130
$150
$160
26% Capacity Factor
87% Capacity Factor
Wind Turbine
Wind Turbine
Natural Gas Plant
Natural Gas Plant
Efficiency
Coal Plant
Coal Plant
Types of Resources

PJM Capacity Markets

- Two-tier settlement process:
  - Resources that clear the capacity auction receive Capacity Base Payment (multiply Capacity Supply Obligation by clearing price)
  - Capacity Performance Payment determined by measuring Capacity Supply Obligation by a Balancing Ratio
    - Balancing ratio calculated by dividing total load and reserve requirement in assessment interval by total Capacity Supply Obligation of all resources in the delivery area

PENALTIES LOWER WHEN FAILURES ARE CORRELATED!

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Credit Risk

"Under **current market rules, energy prices could rise to roughly $3,700/MWh based on existing reserve penalty factors, or as high as $5,700/MWh under stacking provisions based on existing transmission penalty factors, if left unchecked**. These prices would result in daily energy costs of roughly $11 billion, and $17 billion, respectively, under peak winter conditions. **Such market conditions would likely lead to market-participant, retail-customer, and municipal bankruptcies**, high market-risk premiums, and rapid loss of investor confidence in PJM markets"—Organization of PJM States

Credit Risk

- Capacity markets shift counterparty credit risk from retailers to wholesalers
  - Heritage Power (2,920 MW in PJM) filed for bankruptcy
  - PJM reached a settlement to reduce penalties
- Stop-loss provisions set an upward limit on monthly and annual non-performance penalties

Credit Risk

4. On December 23-24, 2022, Winter Storm Elliott brought precipitous temperature drops and powerful winds in the PJM region which, while driving up electricity demand, also led to a high level of generation outages.[7] Throughout the storm, PJM implemented a number of Emergency Actions to help maintain reliability, thereby triggering a significant amount of PAIs, resulting in penalties that totaled approximately $1.8 billion.[8]

--185 FERC ¶ 61,204, P. 4. (Dec. 19, 2023)

11. Section 3.1 of the Settlement provides that PJM will reduce the total assessed penalties incurred during Winter Storm Elliott by 31.7%. Section 3.3 specifies that if any seller defaults or otherwise fails to pay its full penalties as revised, plus any applicable interest, such seller shall continue to owe the full amount originally assessed.

--Id. at 11

Stop-Loss Provisions

- Yearly stop-loss: "[T]he maximum yearly Non-Performance Charge is 1.5 times the modeled LDA Net CONE ($/MW-day in installed capacity terms) . . .

- Monthly stop-loss: Capacity supply obligation times auction starting price

--PJM Manual 18: PJM Capacity Market, 8.4

Penalties Too Low

- Non-performance penalties based on resources' availability during performance assessment intervals (PAIs)
  - PAIs are hours in which PJM declares an emergency (thirty hours)
  - Too many hours of not-genuine scarcity
  - Resources can reduce penalties by operating when conditions are tight but not during genuine emergencies
- Failures during extreme weather events tend to be correlated
  - Yet penalty calculated based on balancing ratio, in which PJM takes a resource's expected availability and divides by that class of generators' expected availability
  - The result is the penalties are lower when failures are correlated

Accreditation a blunt instrument

- Do not consider correlated failures
- Look at historic performance
- Take too-large sample of performance hours, leading to too-high estimate of resource availability

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Penalties Too Low

- Too many scarcity hours: Non-performance charge = "LDA Net CONE ($/MW-day in installed capacity terms) for which the resource resides times number of days in the Delivery Year] divided by **30 divided by the number of Real-Time Settlement Intervals in an hour**.
- Penalties decline when failures correlated: Balancing Ratio = (total amount of Actual Performance for all generation and storage resources + net energy imports + total Demand Response Bonus Performance + total PRD Bonus Performance effective with 2022/2023 Delivery Year) / total amount of generation and capacity storage resources committed in UCAP

MISO

- 2004: MISO began phasing in resource adequacy approach designed to complement state mechanisms as a majority of MISO members operate within traditionally regulated cost-of-service utility constructs.
- 2008: MISO implemented monthly Voluntary Capacity Auction to allow LSEs to efficiently buy and sell residual capacity.
- 2011-12: MISO transitioned to annual Planning Resource Auction (PRA), which established seven Local Resource Zones. In 2018, MISO added tariff provisions to incorporate External Resource Zones, as well.

MISO

- Has expressed concern that not enough capacity will enter the auction
- Has proposed requiring LSEs to procure more capacity (at least half) outside the capacity auction

MISO

- Fixed Resource Adequacy Plan (FRAP): Identifies resources that and LSE has ownership or contractual rights that will be relied upon to meet the LSE's Planning Reserve Margin Requirement
- If LSE does not procure all needed reserve margin through FRAP, can pay capacity deficiency charge or procure additional reserves through Planning Reserve Auction (PRA)

MISO Resource Adequacy Hours

- RA Hours (RAH) are determined seasonally and at a subregional level
- RAH based on emergency events, **the tightest operating margin hours (65 hours per season)**, and a maximum operating margin threshold established at 25 percent.
- New approach to begin in 2028/2029 PRA:
  - Step 1: Measure a resource's expected marginal contribution to reliability using Resource Class-level performance during the loss of load expectation ("LOLE") analysis. Includes a Monte Carlo probabilistic simulation using 30 years of correlated load and weather data
  - Step 2: Use historical resource-level performance (deterministic approach) during Tier 1 and Tier 2 RA hours currently employed under MISO's Tariff to accredit individual resources within their respective Resource Class.

MISO Credit Risk

- Capacity resources must submit offers to energy market (unless excused)
- If a resource fails to perform, TO "shall assess the owner of such Capacity Resource the costs that were otherwise incurred to replace the energy from the deficient Capacity Resource at the time that the Capacity Resource is called upon by the Transmission Provider and does not respond."
- Capacity Replacement Non-Compliance Charges will be calculated as follows: the amount of ZRCs that failed to be replaced multiplied by the sum of the ACP and the daily CONE value (1/365 times CONE)

MISO Credit Risk

- "Upon the occurrence of a Default, the Transmission Provider shall initiate a filing with the Commission to terminate the Market Participant Agreement but shall not terminate the Market Participant Agreement until the Commission so approves any such request."
- (I have not found evidence of this occurring)

MISO Timeline

Jan. 2000; Docket No. RT01-87-000	Filing to gain certification as RTO. MISO raises concerns that withdrawals from numerous TOs may make it ineligible to qualify as RTO unless FERC refuses to approve withdrawals.
Nov. 2000; Docket No. ER01-123-000	Filing protesting withdrawal of Dynegy (and six other) TOs from MISO. MISO expresses concern that withdrawal "will undermine reliability." MISO asks that FERC establish the public interest criteria governing the withdrawal of a public utility from an ISO. FERC refused to do this, instead ordering a settlement, in a Jan. 24, 2001. The settlement negotiations are confidential.
May 2001; Docket No. ER01-123-002.	FERC approves a settlement allowing Illinois Power, ComEd, and Ameren to leave MISO in exchange for a $60 million fee (the departing companies' share of MISO's start-up costs). Also provides a three-year transition period during which the parties will work with MISO and PJM to produce a joint transmission rate.

Outage Rate in Capacity Markets

EFOR = Forced Outage Rate (unplanned outages)
EAF = Equivalent Availability Factor (planned + unplanned outages)

Table 5-32 EFORd and EAF by unit type: 2012 through 2021

	Unit Types															
	Coal		Combined Cycle		Combustion Turbine		Diesel		Hydroelectric		Nuclear		Other		All	
Year	EFORd	1-EAF	EFORd	1-EAF	EFORd	1-EAF	EFORd	1-EAF	EFORd	1-EAF	EFORd	1-EAF	EFORd	1-EAF	EFORd	1-EAF
2012	10.1%	22.6%	4.5%	13.9%	8.3%	7.8%	4.8%	7.0%	4.5%	10.9%	1.8%	8.9%	9.0%	21.3%	7.2%	16.0%
2013	10.9%	23.5%	2.6%	13.4%	11.1%	11.2%	6.6%	7.6%	3.7%	12.5%	1.0%	7.2%	10.9%	20.3%	7.6%	16.3%
2014	12.2%	24.9%	4.6%	15.3%	16.5%	12.6%	15.0%	16.4%	4.0%	15.4%	1.8%	8.0%	13.3%	28.1%	9.6%	18.2%
2015	9.4%	22.3%	3.0%	14.6%	9.2%	9.4%	9.0%	10.7%	5.5%	15.4%	1.5%	7.9%	13.2%	28.4%	7.0%	16.5%
2016	9.4%	22.7%	3.5%	15.3%	5.6%	9.9%	6.9%	8.1%	3.9%	13.8%	1.8%	8.2%	9.2%	25.8%	6.0%	16.3%
2017	11.4%	25.7%	2.7%	13.8%	5.4%	9.2%	7.0%	8.3%	3.4%	11.5%	0.5%	6.3%	13.7%	20.6%	6.5%	16.0%
2018	11.0%	26.8%	2.1%	12.1%	6.2%	9.3%	6.7%	10.4%	3.5%	13.6%	0.8%	6.0%	9.2%	21.0%	6.1%	16.0%
2019	10.1%	25.9%	2.7%	14.2%	5.3%	10.3%	7.6%	10.9%	2.0%	12.5%	0.6%	6.8%	9.2%	23.8%	5.5%	16.5%
2020	8.6%	23.4%	3.9%	13.8%	4.3%	9.6%	7.7%	9.7%	5.7%	13.9%	1.4%	6.8%	19.5%	22.2%	6.3%	15.3%
2021	11.8%	31.5%	3.8%	14.8%	5.5%	11.5%	11.6%	13.4%	10.7%	19.0%	1.1%	6.7%	17.3%	21.7%	7.3%	18.3%
Average	10.5%	24.9%	3.3%	14.1%	7.7%	10.1%	8.3%	10.3%	4.7%	13.9%	1.2%	7.3%	12.4%	23.3%	6.9%	16.5%

Solutions

- Hedging Requirements
- Margin requirements
- Fix silly rules