Preliminary ELCC Class Ratings for Period 2028/2029 through 2042/2043

The analysis for all Delivery Years (DYs) in the study period was performed by calibrating the system to meet PJM's LOLE criterion of 1 day in 10 years for the RTO, translated in annual terms as 0.1 days/year. This was accomplished by using a resource portfolio for each DY and iteratively changing the solved annual peak load until the system in each Delivery Year meets an LOLE of 0.1 days/year, consistent with the methodology used in the Reserve Requirement Study.

Please note that:

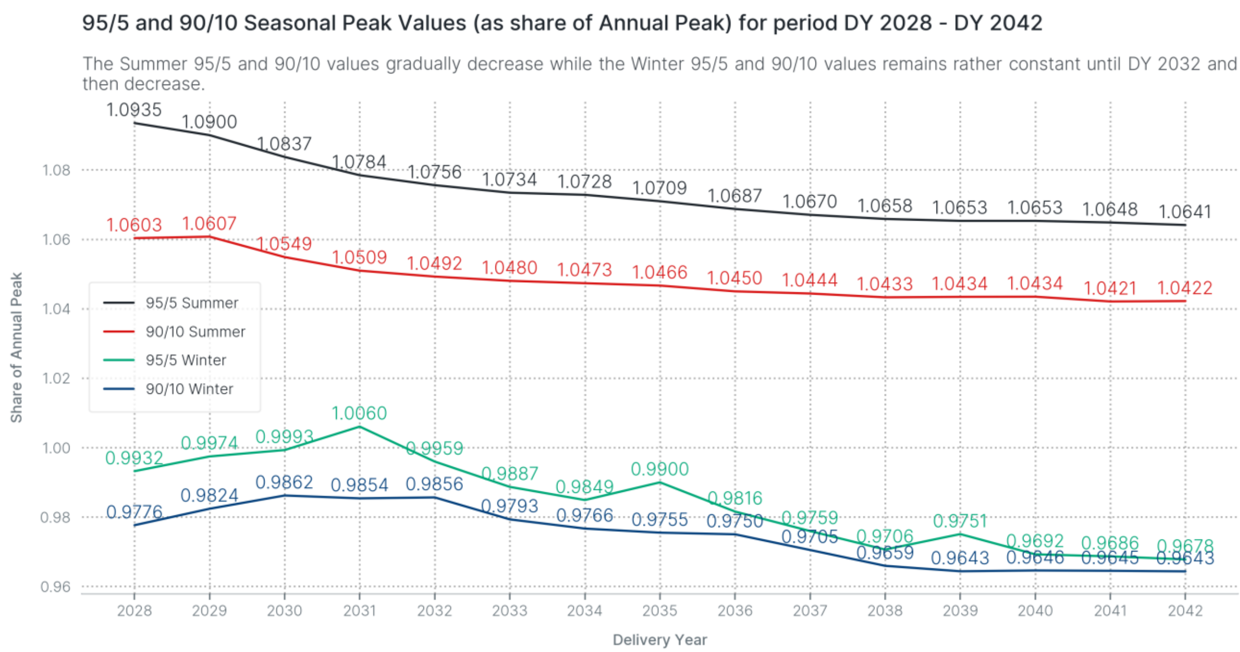
- The assumptions and projected resource portfolios used in this analysis and the resulting preliminary ELCC Class ratings will likely differ from the official results used in the auctions for such Delivery Years. This includes the run for the 2030/31 Delivery Year to be performed in December 2026/January 2027. For example, such a run will include a different projected resource portfolio (based on Notice of Intent from planned resources submitted for the 2030/31 BRA as well as potential new deactivations that may be announced closer to December 2026/January 2027) than the one used to determine the values shown in this document for 2030/31.
- The values for 2028/29 and 2029/30 included in this document are those resulting from the runs that were performed earlier in 2026 to post the planning parameters for the 2028/29 and 2029/30 Base Residual Auctions, respectively. The focus on this report is on the values for the period 2030/2031 through 2042/2043. Values for 2028/29 and 2029/30 are included for reference only.

Inputs

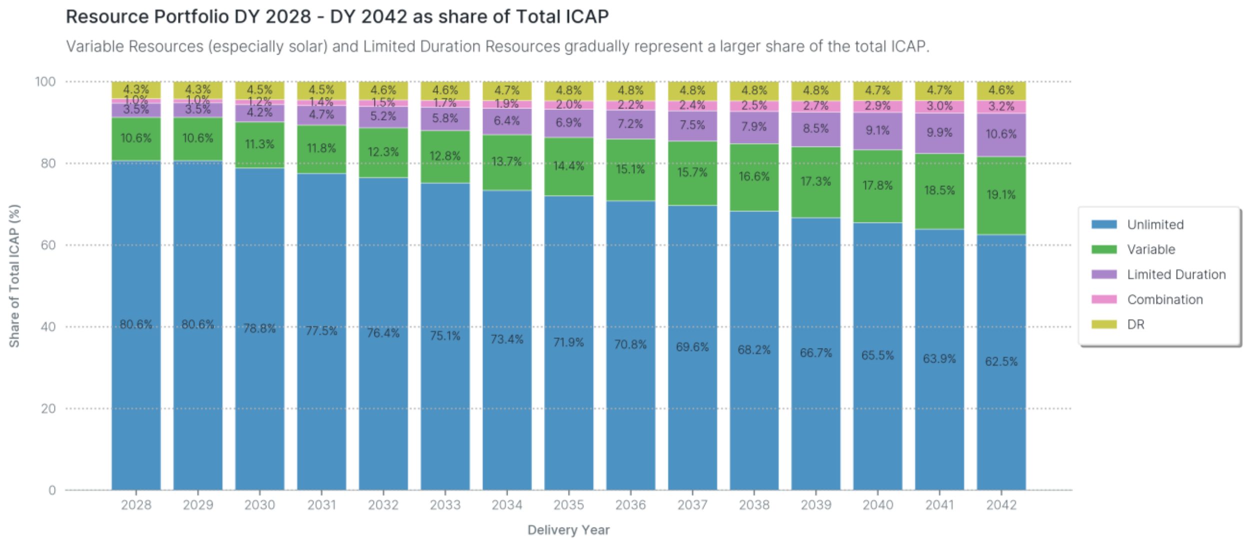
Most of the inputs included in the runs for delivery years in the period 2030/2031 through 2042/2043 are identical to those used in the 2029/30 BRA run. These include the temperature bins, the hourly time series of ambient derates for Unlimited Resources, the hourly time series of forced outages for Unlimited Resources, the hourly time series of output for Variables Resources. However, there are two inputs that are specific to each of the delivery years in the period 2030/2031 through 2042/2043.

1) Load Scenarios: the load scenarios for each of the delivery years were derived from the 2026 PJM Load Forecast. The graph below shows the 90/10 and 95/5 seasonal peak values for the delivery years (DY) in the period as a share of the respective 50/50 annual peaks. For the winter values, there is an increasing trend until DY 2032 and then a gradual decrease until DY 2042; for the summer values, there is a decreasing trend during the entire 15-year period. Consequently, the load scenarios put upward pressure on winter risk until DY 2032 and downward pressure thereafter.

Analysis of monthly extreme loads as a share of the respective 50/50 annual peaks (not shown in graph below) shows that October, November and April are the only months with an increasing trend during the entire 15-year period.

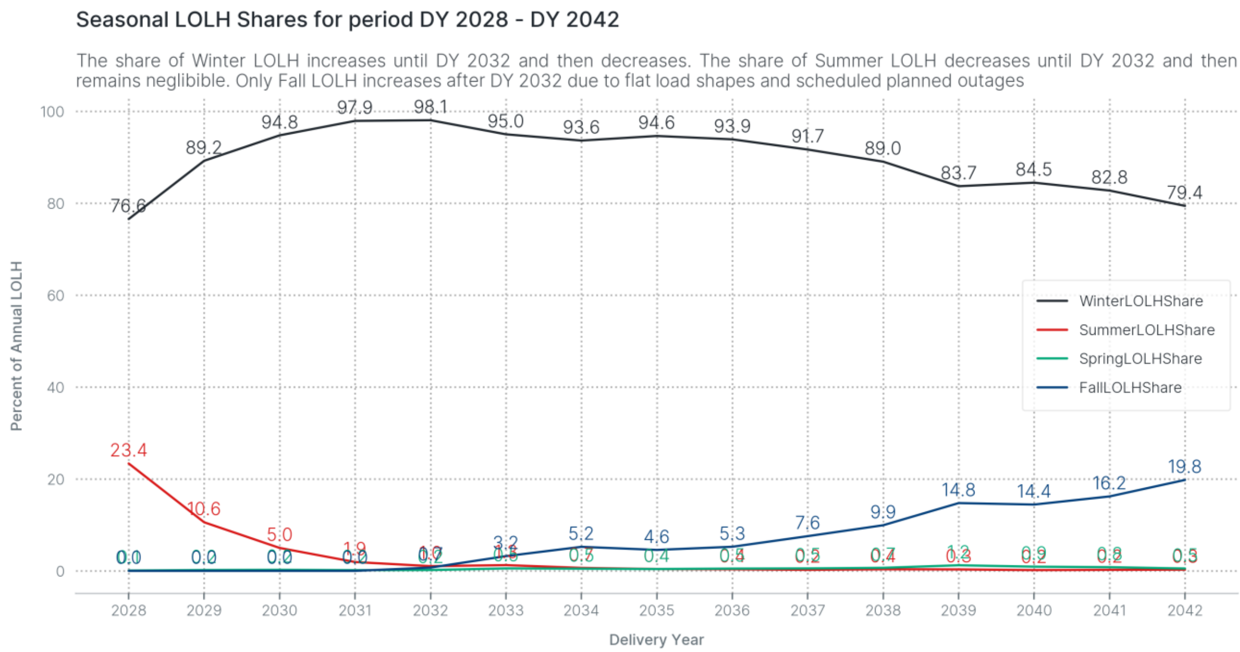


2) Resource Portfolios Scenarios: The resource portfolio for each Delivery Year was developed by starting with the resource portfolio used in the 2029/30 BRA and then using a forecast of resource additions and retirements produced by a vendor. The graph below shows that the ICAP share of Unlimited Resources decreases throughout the 10-yr period while the ICAP share of Variable Resources and Limited Duration Resources increases. The gradual change in resource portfolio throughout the study period puts upward pressure on winter risk for the PJM system as Unlimited Resources retire and are replaced by solar and short-duration storage resources, where such assets provide relatively lower performance during the extended periods of winter risk compared to shorter-duration summer risk periods.



Outputs

The seasonal Loss of Load Hour (LOLH) shares for each DY in the period are shown in the graph below. For this graph, the seasons were defined as including three months each. The share of winter LOLH increases in a manner consistent with the increases in extreme winter loads until DY 2032 and then gradually decreases. The share of summer LOLH decreases until DY 2032 and then remains negligible. The share of fall LOLH is negligible until DY 2032 and then gradually increases. The fall risk is driven by a combination of factors: planned and maintenance outages, resource portfolios with more Variable and Limited Duration Resources, forced outage patterns of Unlimited Resources that are higher than average for the season and an increasing trend in extreme loads in the month of October.

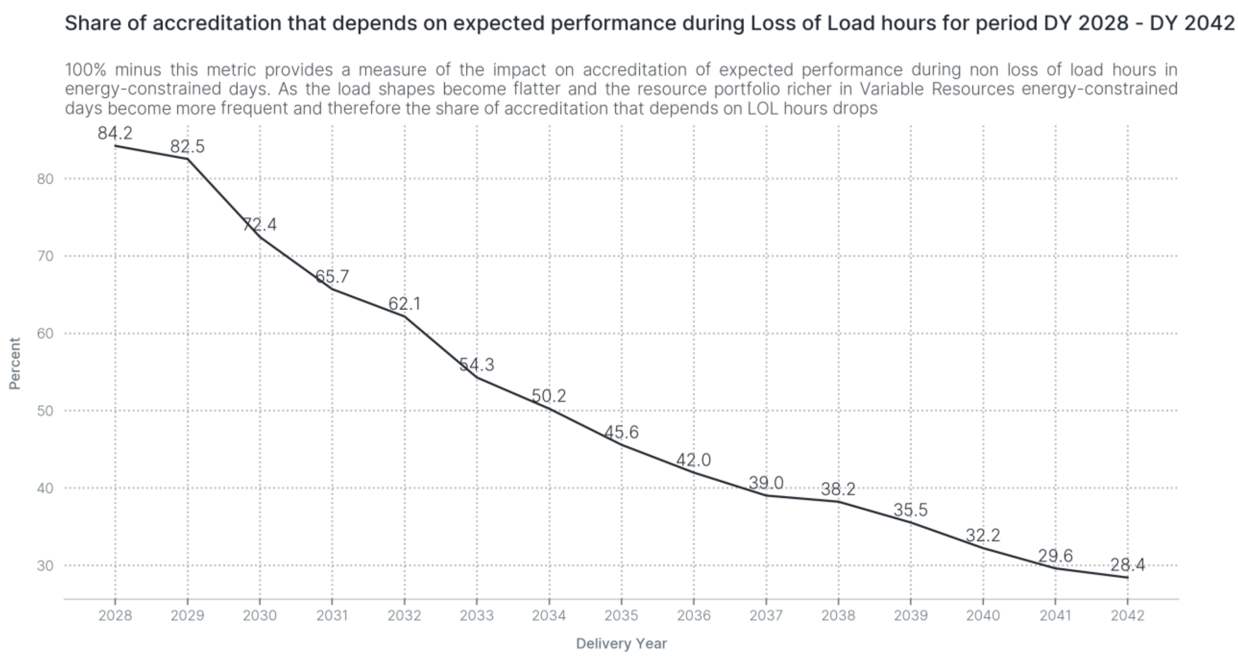


In addition to the trend of increasing winter and fall risk observed for the study period, there is another trend that has an impact on the ELCC Class Ratings. The ELCC Class Ratings are calculated based on the Expected Unserved Energy (EUE) reduction that a marginal addition of each class produces compared to the EUE reduction produced by a marginal addition of perfect capacity. An analysis of the EUE reduction produced by the marginal addition of perfect capacity shows that the EUE reduction is caused by: i) perfect capacity output during loss of load hours and ii) perfect capacity output during certain non-loss of load hours.

- The EUE reduction due to perfect capacity output during loss of load hours is simple to understand: if there was a loss of load hour in the base 1 in 10 case and the amount of unserved energy in the hour was, say, 1,000 MW, then after adding 100 MW of perfect capacity in that hour, the new unserved energy in the hour will be 900 MW.
- The EUE reduction due to output during certain non-loss of load hours, on the other hand, is less straightforward to understand because the EUE reduction is generated by perfect capacity output during non-loss of load hours that enables other resources, specifically storage (via charging or by delaying the storage deployment), to produce more output during loss of load hours. For example, when the model is simulating a multi-day polar vortex event, and storage is depleted by the end of the first day, if the load remains high overnight, storage will not be able to recharge and will face the second day of the event depleted. After adding a marginal amount of perfect capacity during, say, 2am-5am, the perfect capacity MWs will enable the

charging of storage resources (or the delay in the deployment of storage), and now the storage resources will be able to produce non-zero MWs during the second day of the polar vortex event, reducing the system EUE in a hour by more than 100 MW (i.e, the perfect capacity modeled in the hour plus an adder generated by the output of the enabled storage resources).

The graph below shows the share of the EUE reduction due to the addition of perfect capacity that is caused by output during loss of load hours. It can be observed that it starts very high at the beginning of the period (at more than 80%) while it gets reduced drastically as the system faces more winter risk and more energy-constrained days.



The above graph is relevant to understand the decrease in ELCC Class Ratings for ELCC Classes that are not modeled as able to charge storage (Demand Response and other Limited Duration Resources). In other words, the importance of enabling the charging of storage for accreditation purposes consistently increases as the system faces more winter risk and more energy-constrained events. This is an important point because, as noted in the resource portfolio discussion, Limited Duration resources (i.e., storage) gradually make up a larger share of the resource portfolio.

Another model output that is key to understanding the changes in some of the ELCC Class Ratings is the historical resource performance patterns that drive the system risk in each DY of the study period.

Change in Historical Performance Patterns (Days) driving Loss Of Load for period DY 2028 - DY 2042

Value shows share of loss of load hours in which performance from the historical day was sampled

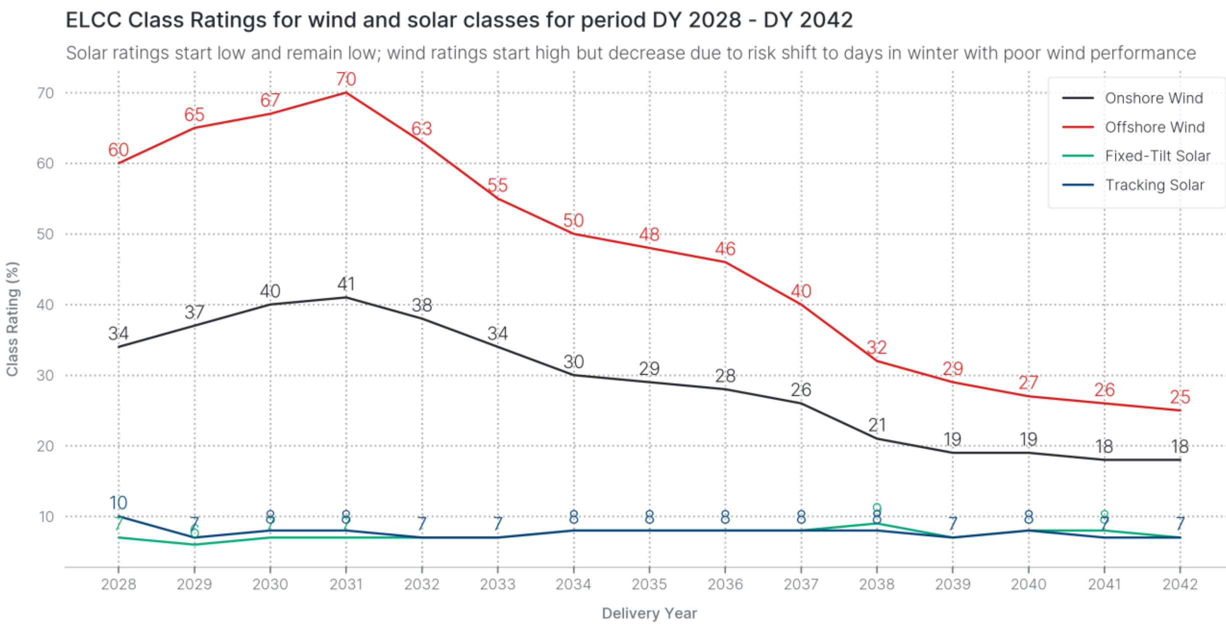
Performance Date \ Delivery Year	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042
2014-01-07	38.4%	45.1%	46.4%	50.2%	39.9%	36.7%	35.3%	34.4%	34.7%	30.0%	18.6%	15.5%	14.6%	11.7%	11.4%
2014-01-08	8.8%	12.5%	13.5%	11.7%	14.3%	15.5%	20.1%	22.6%	22.8%	22.3%	24.9%	24.1%	31.5%	30.1%	26.8%
2022-12-26	4.7%	4.8%	4.8%	3.2%	8.2%	12.4%	14.2%	15.3%	16.2%	21.8%	34.5%	35.4%	31.6%	32.9%	32.2%
2022-12-24	12.9%	14.4%	18.4%	19.7%	19.4%	16.4%	12.6%	11.3%	9.4%	7.4%	3.5%	2.7%	1.2%	1.1%	0.6%
2012-10-30	0.0%	0.0%	0.0%	0.0%	0.7%	3.2%	5.2%	4.4%	5.0%	7.3%	9.5%	14.3%	13.4%	14.9%	18.1%
2014-01-22	2.5%	2.4%	2.5%	2.3%	2.3%	2.1%	1.7%	2.3%	3.3%	3.1%	2.5%	1.8%	2.0%	2.4%	3.4%
2019-01-31	2.4%	2.3%	1.8%	1.7%	2.2%	2.6%	2.9%	2.4%	2.4%	2.7%	2.6%	2.4%	1.6%	1.7%	2.0%
2022-12-25	0.9%	2.5%	2.8%	3.5%	4.7%	2.7%	1.6%	2.3%	2.1%	2.0%	0.8%	0.2%	0.4%	0.4%	0.3%
2014-01-28	3.2%	3.1%	2.3%	2.2%	3.1%	3.6%	3.2%	2.4%	1.3%	1.1%	0.9%	0.8%	0.6%	0.5%	0.6%
2022-12-23	0.7%	0.7%	0.9%	1.3%	1.7%	1.2%	0.7%	0.3%	0.2%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%
2012-10-31	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.1%	0.1%	0.2%	0.2%	0.4%	0.5%	1.0%	1.2%	1.6%
2014-01-03	0.3%	0.1%	0.2%	0.3%	0.4%	0.5%	0.1%	0.1%	0.2%	0.2%	0.2%	0.2%	0.0%	0.0%	0.1%
2024-01-15	0.1%	0.1%	0.0%	0.0%	0.0%	0.2%	0.2%	0.3%	0.1%	0.1%	0.1%	0.3%	0.4%	0.5%	0.1%
2019-02-01	0.0%	0.1%	0.1%	0.1%	0.1%	0.0%	0.0%	0.1%	0.2%	0.1%	0.1%	0.0%	0.2%	0.4%	0.5%
2014-02-08	0.0%	0.1%	0.1%	0.1%	0.1%	0.0%	0.0%	0.1%	0.2%	0.2%	0.1%	0.1%	0.1%	0.2%	0.2%

As the resource portfolio changes in the study period, the performance patterns that drive risk in the model also change. For example, this occurs because classes that performed well (i.e. onshore wind) on 2014-01-07 did not perform as well on, say, 2014-01-08 (see Appendix for more background). As the wind share of ICAP increases in the resource portfolio, the historical performance pattern of 2014-01-07 will drive less risk in the model while the historical performance pattern of 2014-01-08 will drive more risk in the model. In other words, as onshore wind makes up a larger share of the resource portfolio in the future, the types of events in which winter risk is observed in the system tend to shift towards those days that see high correlated unavailability of the wind fleet.

ELCC Class Ratings

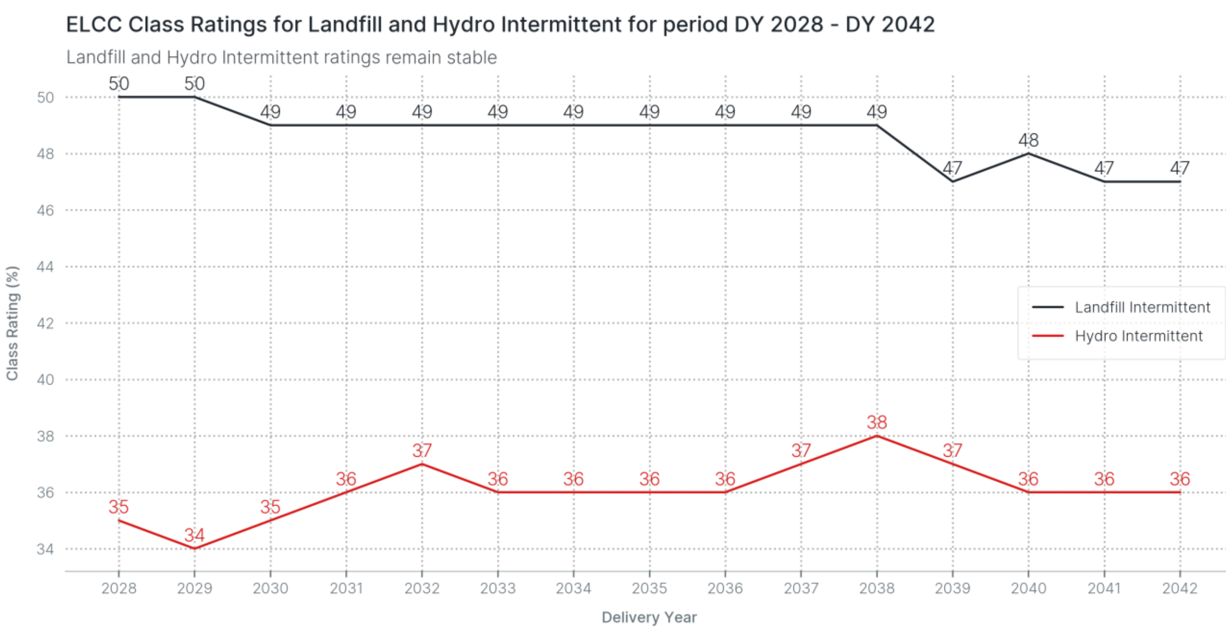
Wind and Solar Class Ratings

- The ratings for the two solar classes remain stable at low values during the entire period due to the high level of winter risk
- The ratings for the two wind classes decrease significantly due to a gradual shift in winter historical performance patterns driving the winter risk in the model (as shown in the above heatmaps)
- Solar Fixed ratings are slightly higher than Solar Tracking ratings in two years late in the study period due to better performance of Solar Fixed resources on 2022-12-26 (see Appendix), a performance pattern that, as shown in the histogram above, becomes more relevant late in the study period.



Landfill Intermittent and Hydro Intermittent Class Ratings

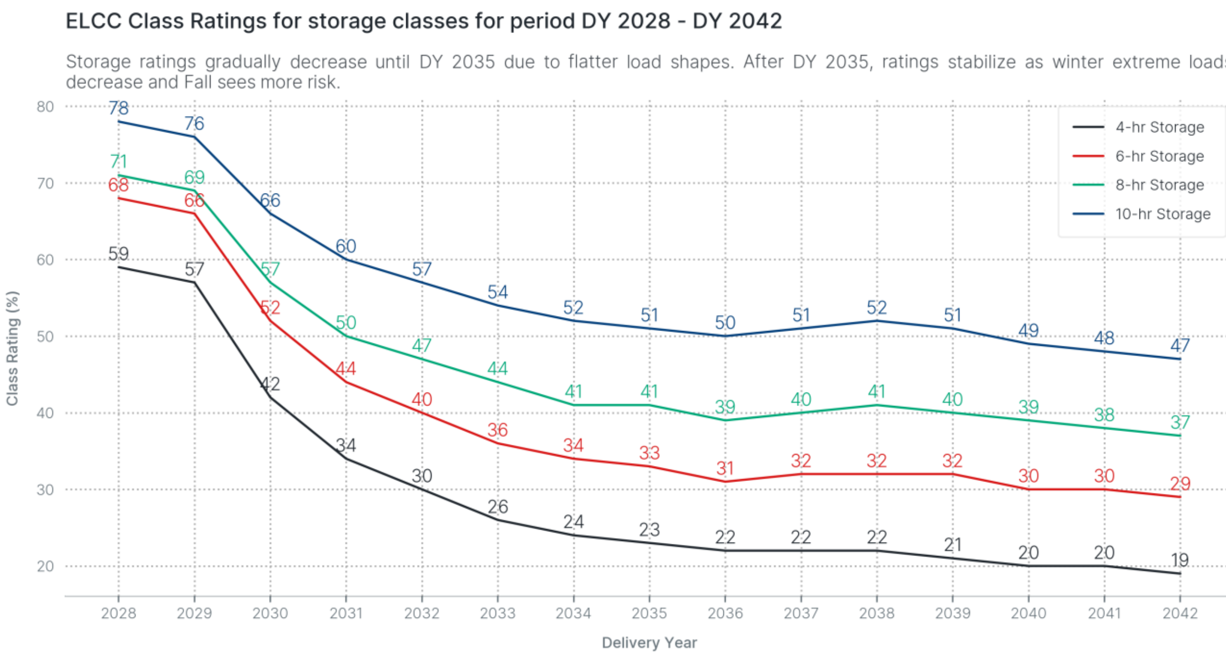
- The ratings for these two classes remain rather stable in the study period due to their output not being as volatile as that of other classes



Storage Class Ratings

- The ratings for the storage classes drop consistently throughout the study period due to increasing winter risk. Winter risk periods tend to last multiple hours due to flat load shapes and the protracted duration of Unlimited Resources' forced outages under cold weather, which is not conducive to sustained good performance by storage resources for the entire duration of the risk events. This is the main driver for the drop in ratings.

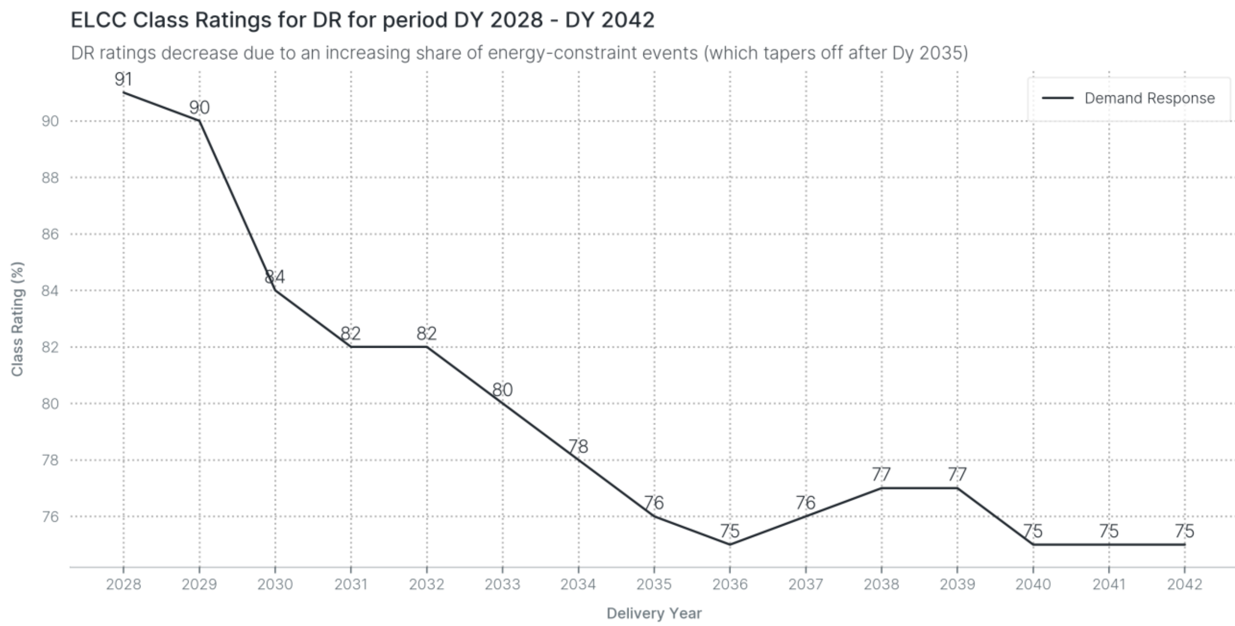
- In addition, storage resources cannot charge other storage resources during winter energy-constrained events in the model and, as shown in the graph in page 5, the ability to charge storage towards the end of the study period becomes more important for accreditation purposes.



Demand Response Class Ratings

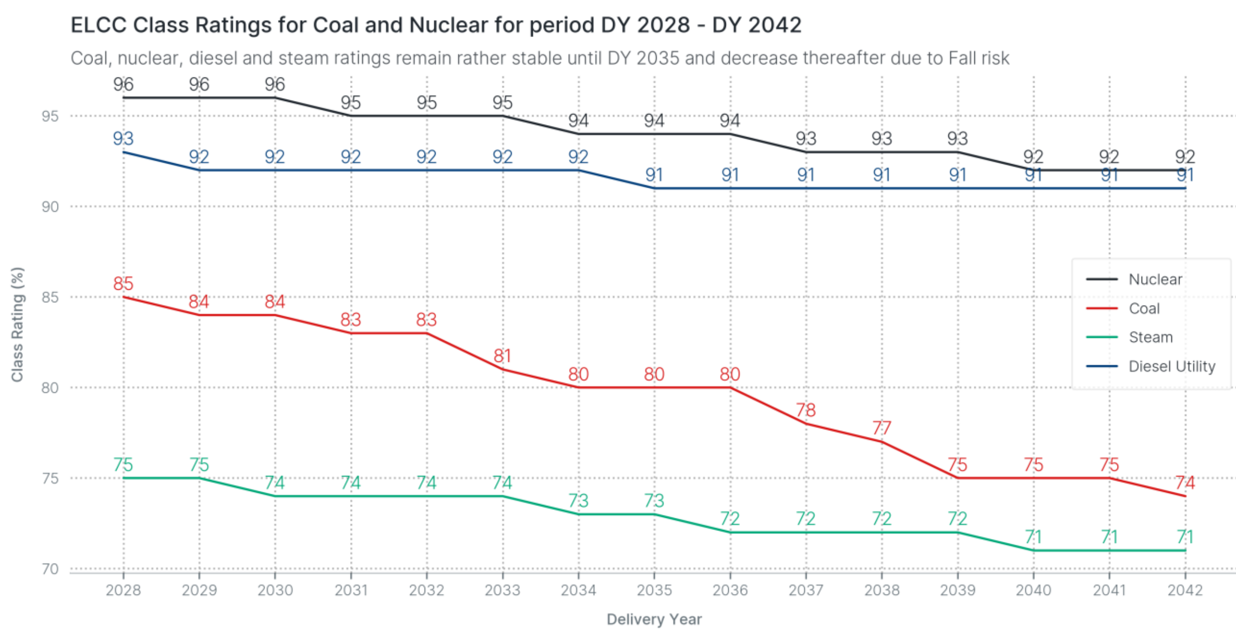
- The rating for the demand response (DR) class drops consistently until DY 2036 due to increasing winter risk. The reduction capability of DR in the winter period is assumed to be less than during the summer period[1]. As falls risk starts increasing (after DY 2036), the DR ratings stop decreasing.
- Similar to the storage case described above, DR resources are not assumed to be deployed to charge storage resources and, as shown in the graph in page 5, the ability to charge storage towards the end of the study period becomes more important for accreditation purposes.

[1] See Demand Response discussion in pages 25-27 in the 2025 ELCC/RRS Report available at https://www.pjm.com/-/media/DotCom/planning/res-adeq/elcc/2025-pjm-elcc-rrs.pdf



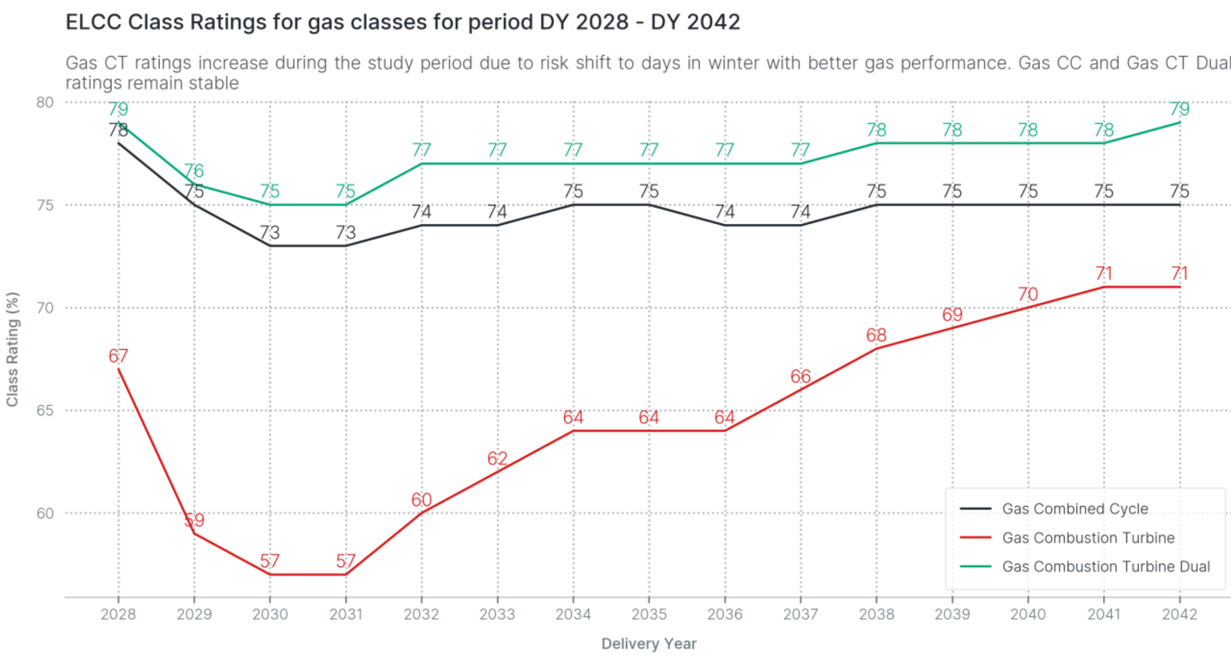
Nuclear, Coal, Steam and Diesel Utility Class Ratings

- The ratings for the Nuclear, Steam and Diesel Utility classes remain relatively stable until DY 2036 and decrease thereafter due to fall risk driven by planned and maintenance outages
- The rating for the Coal class consistently decreases as winter risk increases (at the beginning of the study period) and fall risk increases. The fall risk impacts the coal class significantly as coal resources have larger planned and maintenance outage needs.



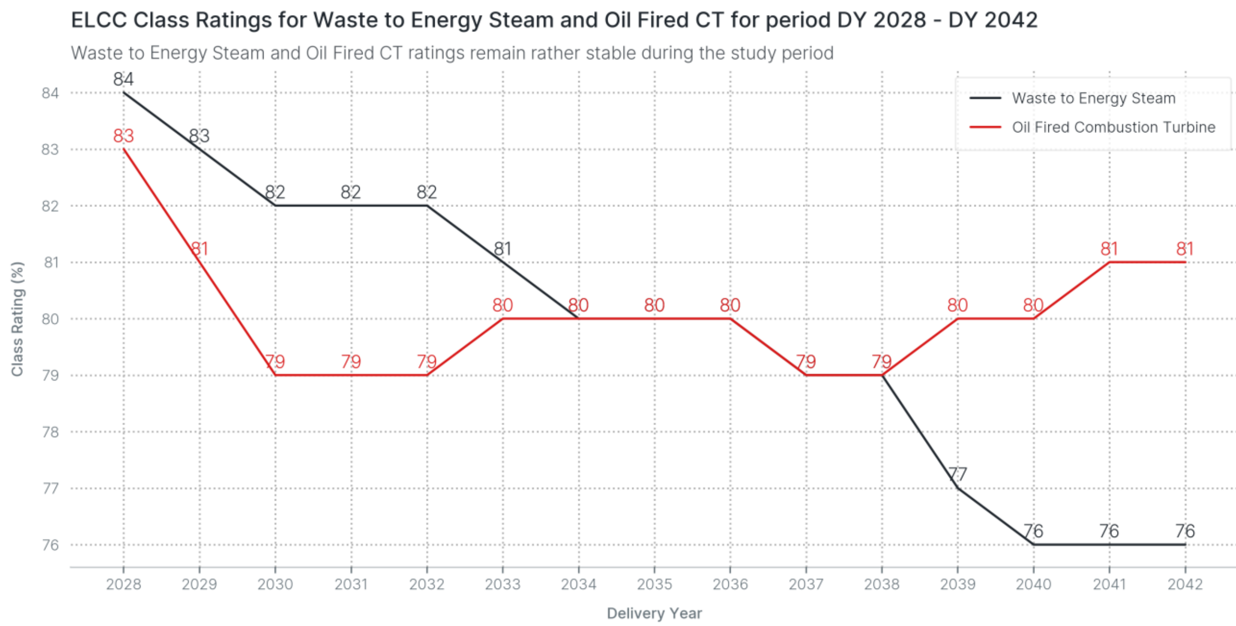
Gas Class Ratings

- The ratings for the gas classes see an initial decrease at the beginning of the study period due to increasing winter risk (and class membership in the specific case of the Gas Combustion Turbine in the change from DY 2027 to DY 2028), followed by an increase for Gas Combined Cycle and Gas Combustion Turbine Dual and a larger increase for Gas Combustion Turbine due to a gradual shift in winter historical performance patterns driving the winter risk in the model. The performance patterns that drive the risk towards the end of the study period show slightly better gas performance than the performance patterns that drive the risk at the beginning of the study period (see Appendix).



Oil-Fired CT and Waste to Energy Steam Ratings

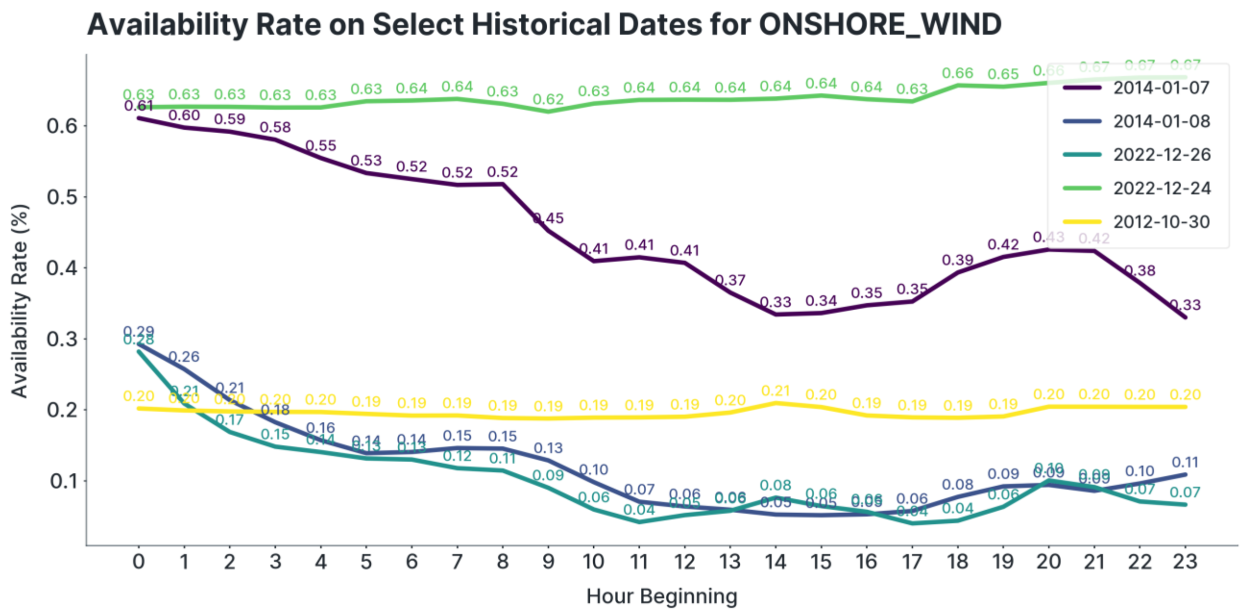
- The ratings for the Oil-Fired Combustion Turbine class tend to decrease due to the increasing fall risk (as discussed for other Unlimited Resources classes) but the drop is to a certain degree offset by the gradual shift in winter historical performance patterns driving the winter risk in the model.
- The ratings for the Waste to Energy Steam class consistently decrease as the fall risk increases and winter historical performance patterns driving the winter risk in the model shift (both negatively impact the class rating given the lower historical performance observed in those periods)

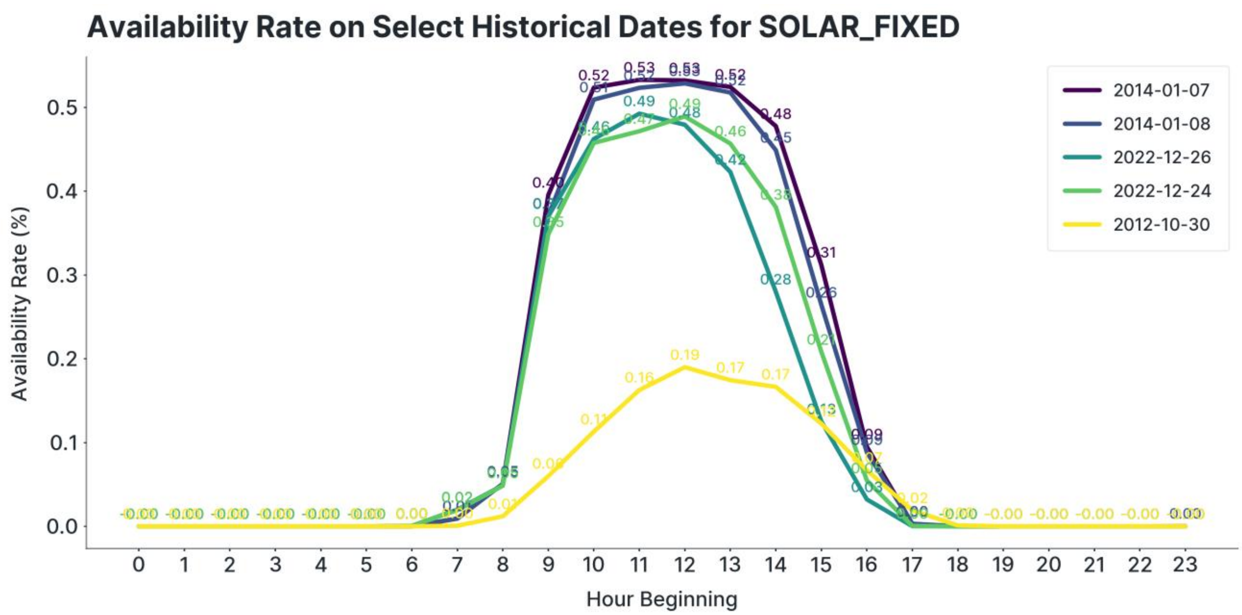


ELCC Class Ratings for Waste to Energy Steam and Oil Fired CT for period DY 2028 - DY 2042
Waste to Energy Steam and Oil Fired CT ratings remain rather stable during the study period
Waste to Energy Steam
Oil Fired Combustion Turbine
Class Rating (%)
Delivery Year
84
83
83
81
82
82
82
81
80
80
80
80
79
79
79
79
79
77
80
80
76
76
76
81
81
2028
2029
2030
2031
2032
2033
2034
2035
2036
2037
2038
2039
2040
2041
2042

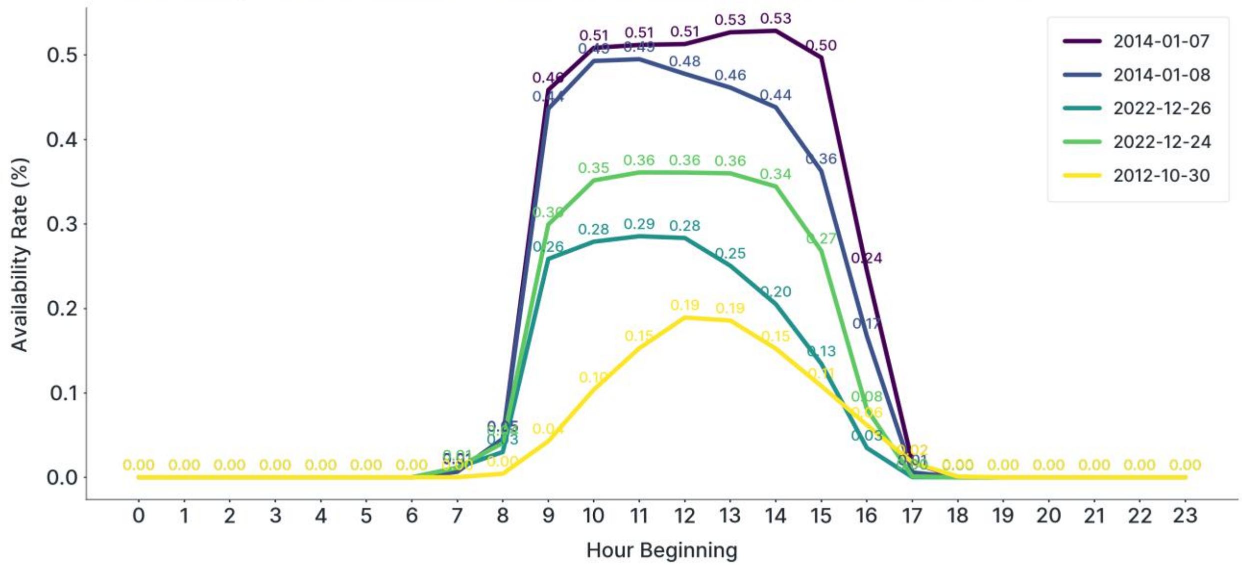
Appendix

Note: the graphs below show *Availability Rate* for Onshore Wind and the solar classes and *Forced Outage Rate* for unlimited resources classes.

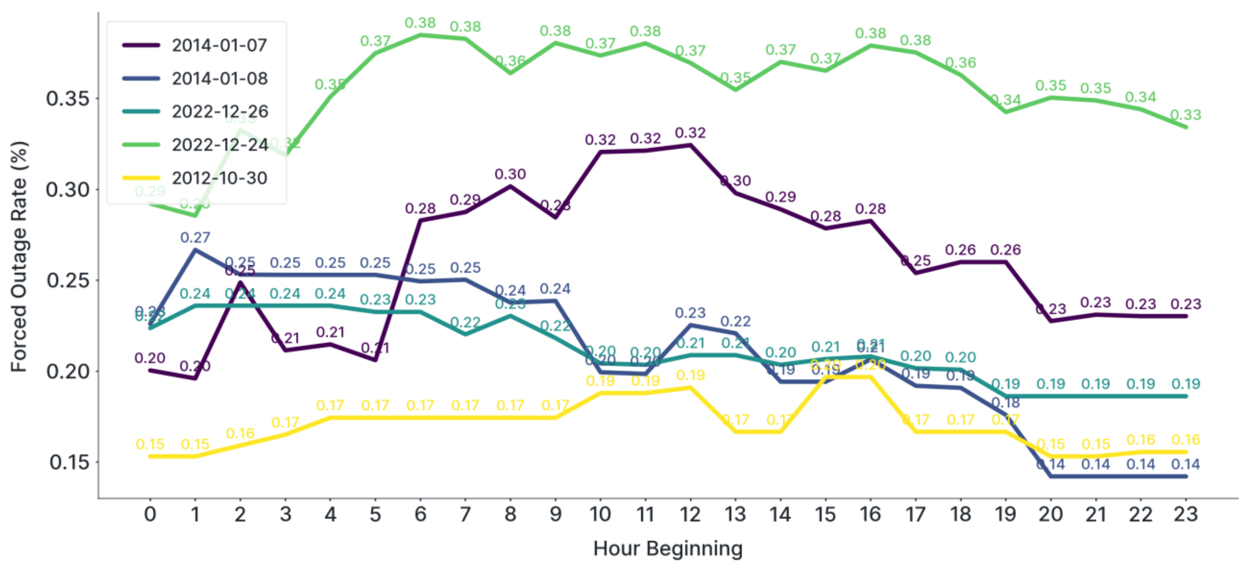




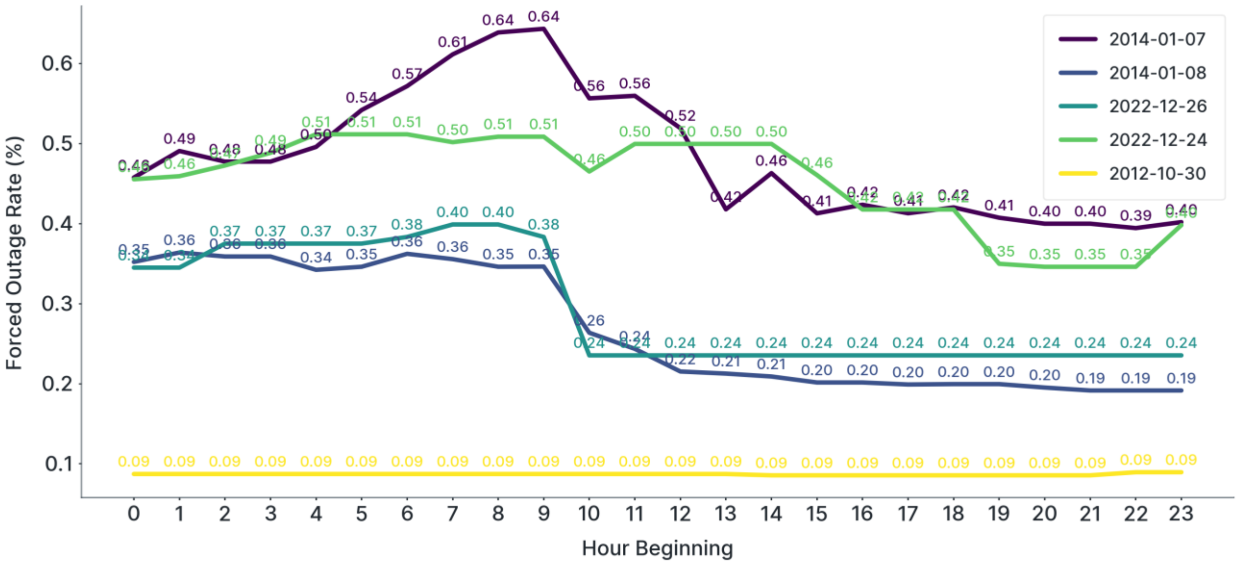
Availability Rate on Select Historical Dates for SOLAR_TRACKING



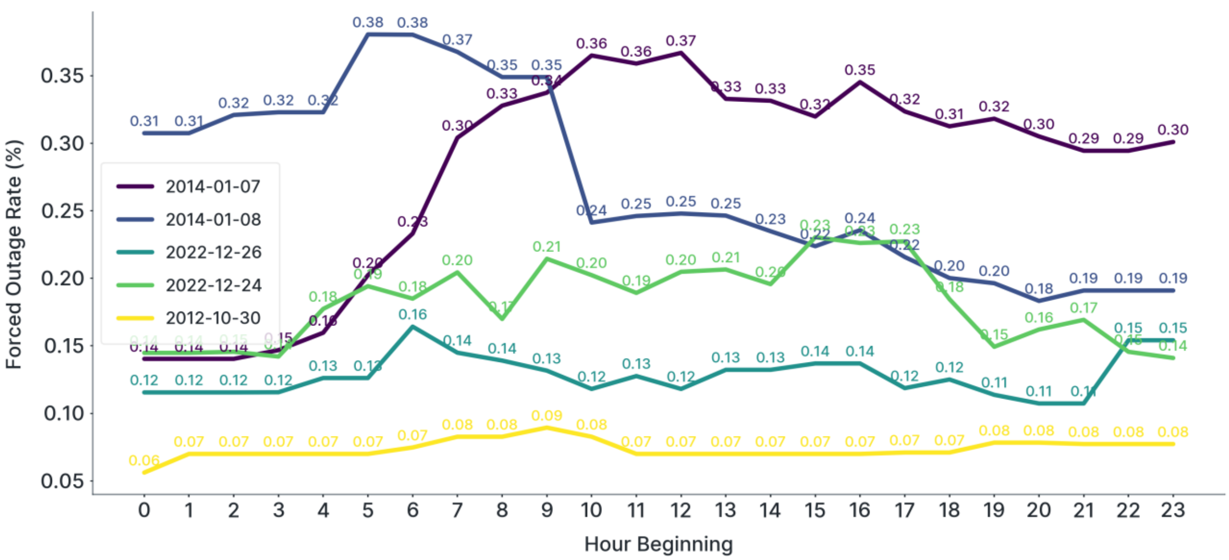
Forced Outage Rate on Select Historical Dates for Gas Combined Cycle

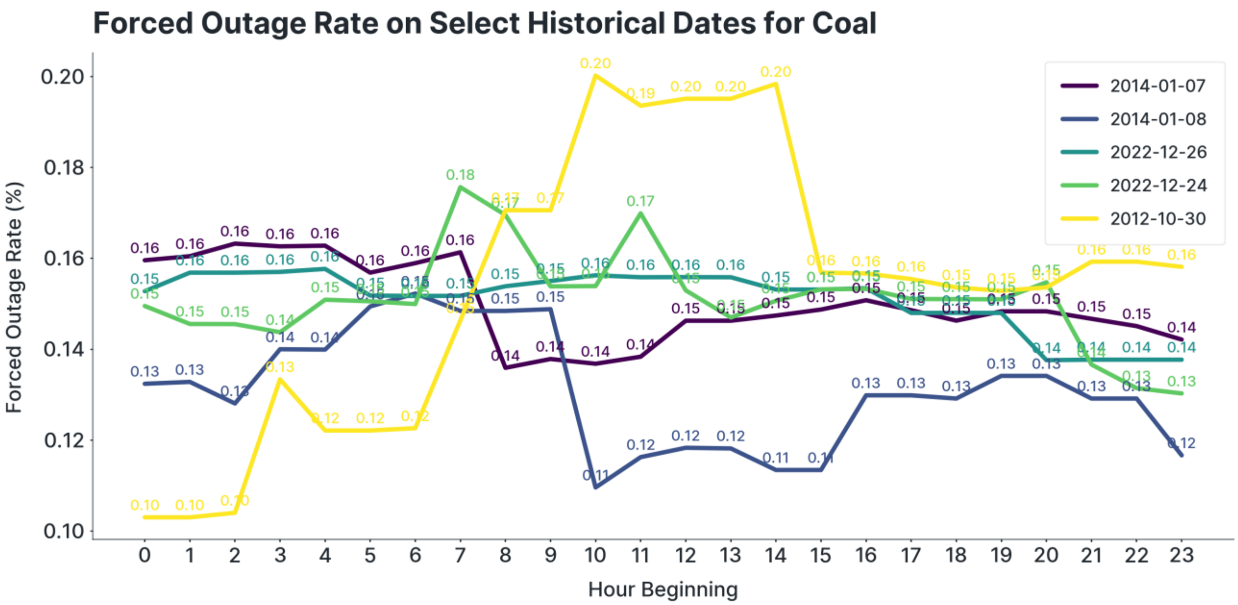


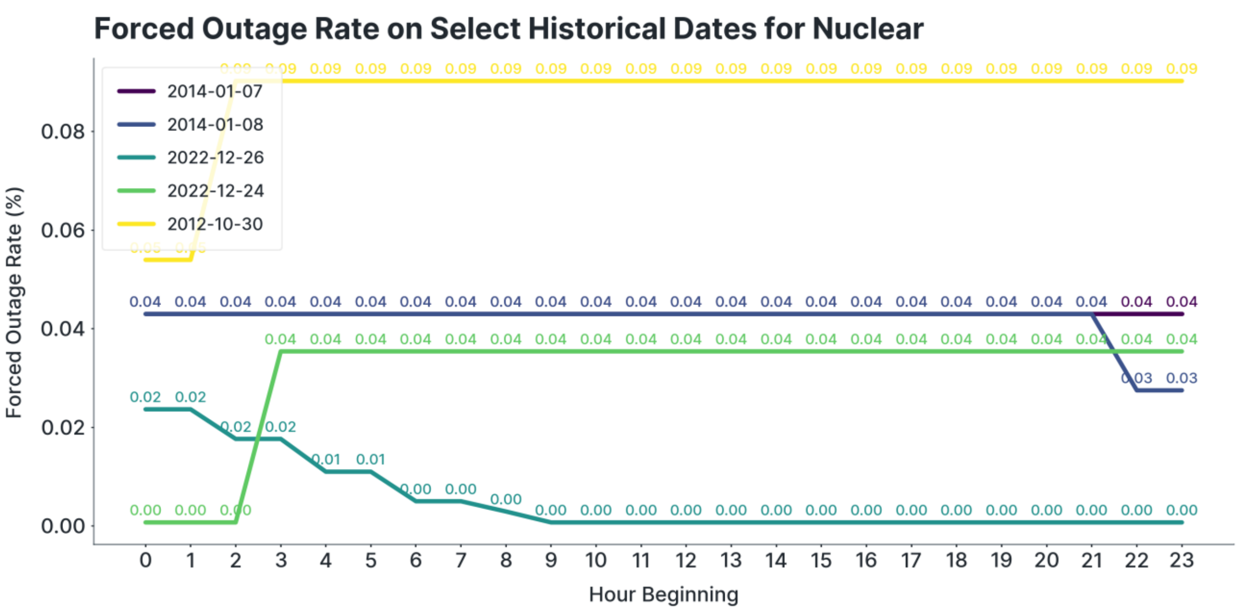
Forced Outage Rate on Select Historical Dates for Gas Combustion Turbine

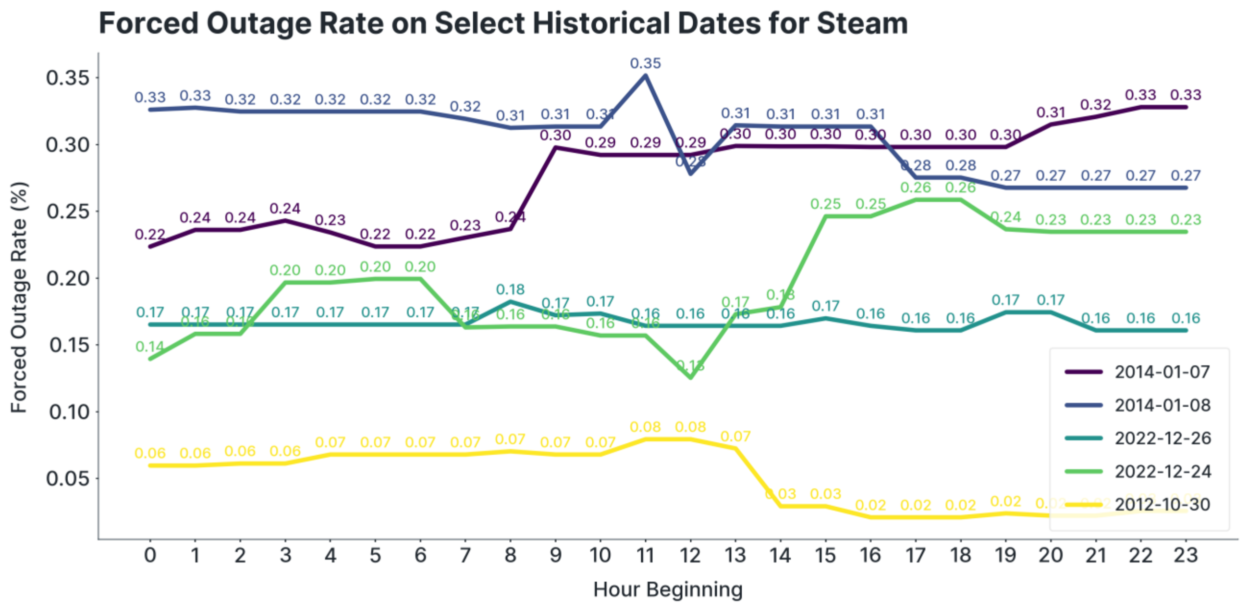


Forced Outage Rate on Select Historical Dates for Gas Combustion Turbine Dual




Forced Outage Rate on Select Historical Dates for Coal
Forced Outage Rate (%)
Hour Beginning
0.20
0.18
0.16
0.14
0.12
0.10
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23
2014-01-07
2014-01-08
2022-12-26
2022-12-24
2012-10-30


Forced Outage Rate on Select Historical Dates for Nuclear
Forced Outage Rate (%)
Hour Beginning
0.08
0.06
0.04
0.02
0.00
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23
2014-01-07
2014-01-08
2022-12-26
2022-12-24
2012-10-30


Forced Outage Rate on Select Historical Dates for Steam
Forced Outage Rate (%)
Hour Beginning
2014-01-07
2014-01-08
2022-12-26
2022-12-24
2012-10-30