**Options for Incorporating Reliability Risk Assessment in ERCOT Resource Adequacy Reports**

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| **#** | **Description** | **Pros** | **Cons** | **Comments** |
| 1 | Create a heat map or similar graphical tool that shows the frequency of “Capacity Available for Operating Reserves” falling within ranges for each hour of a given season. This tool is intended to show the hours with the most supply reliability risk. | * A useful tool to help with messaging on energy assurance risk. (Resource adequacy for all hours.)
* A simple method to help target further statistical analysis of higher-risk hours.
* Multiple seasonal heat maps and associated trend statistics can reveal hourly shifts in supply reliability risk as the resource mix continues to change.
* Can be used to determine if the off-seasons are beginning to experience reliability risks.
 | * Somewhat time-consuming to extract data from the LFC system.
 | Sample for a summer season with made-up numbers is shown below (red at the top is good; red at the bottom is bad): |
| 2 | Modify the current wind/solar peak average capacity contribution methodologies to use the highest 20 seasonal Net Peak Loads rather than Gross Peak loads | * Resulting values more closely align with ELCC values reflected in the reserve margin studies.
* Historical capacity factor data is still used, which is more transparent to Market Participants than substituting with model-based ELCCs.
 | * A discrepancy between the CDR and Reserve Margin study still exists, and that discrepancy is expected to widen as renewables penetration increases.
* A historic-only approach does not capture the impact of future generation shifting the peak net load hour.
* Not consistent with the Peak Load Forecast, which is based on a single peak load hour.
* Requires an NPRR.
 | * Summary results for Connor Anderson’s methodology impact analysis (SAWG 12/13/2019) are shown in the tables below:

* The limitations of using historical data could be addressed by creating a hybrid approach where forecast-based ELCCs are used to adjust the capacity contribution values (see Option 3 below).
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| 3 | Replace current peak average capacity contributions for resources with Effective Load Carrying Capability (ELCC) values. | * Fully eliminates the discrepancy between capacity contributions reported in the CDR, SARA and ELCCs.
* Use of ELCCs for multiple years properly reflects the declining marginal reliability benefit of wind and solar.
* Will capture the interplay between solar and battery storage of various durations as capacity of both types are being added to the system.
 | * ELCC is complicated to explain and less transparent than an approach that only uses an historical capacity factor approach. For example, storage ELCCs will be sensitive to modelling assumptions for storage operation (if providing energy, AS, both) and duration.
* Requires an NPRR.
* Not consistent with the Peak Load Forecast, which is based on a single peak load hour.
 | Estimate ELCC values for multiple years to account for changing values as wind/solar penetration increases. |
| 4 | Develop a probabilistic version of the CDR that reports a probability distribution of Reserve Margins for each year, similar to the summer SARA Probabilistic Model. | * A probabilistic approach enables the quantification of forecast likelihoods.
* If done as a separate product from the conventional CDR, then no NPRR is necessary.
 | * Significant increase in workload until automated tools and process efficiencies can be implemented.
* Having two separate reports complicates the resource adequacy narrative.
 | * The probability distributions would cover the high-risk hours of the annual peak load day, with the distribution tails indicative of combined high Net Load conditions and lower-than-expected new online capacity.
* Based on experience with the summer Probabilistic SARA model, limit the risk variables to a small number:
* Load
* Wind
* Solar
* Planned project capacity
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| 5 | Modify the conventional CDR as follows: Based on an analysis of historical Net Load and a Net Load forecasting approach, determine which hour has the most supply reliability risk. Determine the Reserve Margin for that hour based on the corresponding load forecast and appropriate capacity counting rules. | * While an NPRR is required, this approach entails minimal changes to the CDR report itself.
 | * An NPRR is expected to be much more complicated than the ones for options 2 and 3 above due to the supporting analysis required.
* There may be no single hour that clearly has more supply reliability risk than other hours. This situation would require averaging calculations for two or more hours or implementing a “tie breaker” criterion. Either approach complicates the exercise.
 | This appears to be the approach suggested by Bill Barnes (NRG). |
| 6 | Run a probabilistic reliability risk/production cost model like SERVM for multiple years, and calculate Reserve Margins directly from model inputs and outputs. | * This approach fully incorporates reliability risks and resource ELCCs for Reserve Margin estimation.
* Accounts for resource “portfolio” reliability impacts and benefits (e.g., increasing renewables/battery penetration, reliability synergies associated with wind/solar output correlations during high-risk hours, etc.)
* If tightly coordinated, there should be no comparability issues with respect to the CDR and the Reserve Margin studies.
 | * May be impractical due to the workload and time commitments for vetting by stakeholders. (Could be alleviated by only preparing one CDR per year.)
* An NPRR would be complex complex, and an OBD may be needed.
* There could be considerable contractor support costs, at least initially.
 | * To align with the planning reserve margin concept, the thermal outage modeling would be turned off so the model is just using the seasonal max sustained capabilities in line with the CDR. Model runs with outage modeling turned on show the incremental reserve margin amount needed to cover thermal outage risk.
* The model could be run for forecast years 1 through 3, with extrapolation used to forecast subsequent CDR line item values.
* Reported RMs for multiple hours would use 50th percentile values of the output variable distributions. Other percentile values representing extreme outcomes, along with additional risk assessment statistics, can also be reported as supplemental information.
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