The load duration curve is constructed from hourly system production data, which is arranged in descending order of magnitude. The units are MW on the y-axis and hours on the x-axis. From the curve we can estimate the amount of time that demand was above various thresholds. Do they estimate a load duration curve and then

The loss of load expectation (LOLE) is defined as the number of periods in which demand exceeds the available capacity.

1. Literature

Decentralized GEP approach, whereby each GENCO establishes its own multi-year generation expansion plan to maximize its profit (i.e., electricity price minus plant costs) through a mixed integer problem using genetic algorithm solution methods (Pereira and Saraiva 2011). The global level of the model performs checks on whether global constraints are met (i.e., prevent over investment in a technology, reliability, etc.). If constraints are violated then a new set of individual plans is created whereby each GENCO use updated estimates of the fuel and electricity prices, as well as capacity factors that are modeled in a systems dynamic model. Changes to these factors would result in changes to individual GENCO profits and subsequently, investment decisions. If a proper price signal cannot be sent in the systems dynamic model then two alternatives are used: imposing minimum investment capacities or incorporate a capacity term in the objective function (Pereira and Saraiva 2011). Some models modify the objective function to include energy not served at the value of lost load.

A centralized, multi-period, multi-objective generation expansion planning model that incorporates sustainable energy sources is developed (Aghaei et al. 2013). Reliability is evaluated using the Z-method. The Z-method calculates the surplus of available generation at each hour i of time period t. The surplus is a random variable with 'resource adequacy expressed as the ratio of the expected surplus to the standard deviation of the surplus in the time period t (Aghaei et al. 2013).

$$\begin{aligned} S_{it} &= R_{it} - L_{it} \\ \bar{S}_t &= \bar{R}_t - \bar{L}_t \\ Z_t &= \frac{\bar{S}_t}{\sigma_{S_t}} \end{aligned} \tag{1}$$

$$
\begin{aligned}
\bar{S}_0 &= \bar{R}_0 - \bar{L}_0 \\
&= \sum_{n \in N_{exs}} [(1-q_n) \cdot X_{n0} \cdot p_{n0}] - \bar{L}_0 \\
\bar{S'}_t &= \bar{R'}_t - \Delta L_t \\
&= \sum_{n \in N_{exs}} [(1-q_n) \cdot X_{nt} \cdot p_{nt}] - \Delta L_t \forall t \in T \\
\Delta L_t &= \bar{L}_t - \bar{L}_0 \forall t \in T \\
\bar{S}_t &= \bar{S}_0 + \bar{S'}_t \forall t \in T \\
\sigma^2_{S_0} &= \sum_{n \in N_{exs}} [q_n \cdot (1-q_n) \cdot X_{n0} \cdot p^2_{n0}] \\
\sigma^2_{R'_t} &= \sum_{n \in N_{exs}} [q_n \cdot (1-q_n) \cdot X_{nt} \cdot p^2_{nt}] \\
\sigma_{S_t} &= \sqrt{(\sigma^2_{S_0} + \sigma^2_L) + \sigma^2_{R'_t}}
\end{aligned}
\tag{2}
$$

The objective function (one of the several objective functions) then maximizes the following:

$$
max f_3 = \sum_{t \in T} Z_t \tag{3}
$$

References

Aghaei, Jamshid et al. (2013). "Multiobjective generation expansion planning considering power system adequacy". In: *Electr. Power Syst. Res.* 102, pp. 8–19. ISSN: 0378-7796. DOI: 10.1016/j.epsr.2013.04.001.

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