

# Operating Flexibility Metrics and Resource Planning with Renewables

Antonio Alvarez<sup>1</sup> and Gary L. Schultz\*<sup>2</sup>

<sup>1</sup>Pacific Gas and Electric Company

<sup>2</sup>Gary L. Schultz, PhD, LLC

September 19, 2013

Electric resources planning has long been an important area of focus for utility companies, regulators and other stakeholders. With conventional – better understood as controllable – resources, this meant building to a planning reserve, so that resources would be built to cover something like 120% of the forecasted peak load. The extra 20% (an arbitrary number used for illustration) would cover (with high probability) unexpected plant outages and uncertainty in the forecast.

Lately, however, more renewable generation is being connected to the grid, and is changing the nature of the resource planning problem. Conceptually, the old 20% needs to be re-visited. But it is less about determining a different quantity than it is about a qualitative change. The old planning reserves were based on an assumption that machines could generate except when they were out of service (either planned or unplanned). When considered as a fleet, the reliability characteristics of the machinery were a nice distribution because they comprised a large number of relatively independent random outage events. Uncertainty in renewables like wind and solar are much more related, and thus the necessary planning reserve becomes a complicated function of such things as time-of-day, season, and amount of wind, solar and flexible peaking capacity already on the grid

This talk will discuss some of the work that has been done in California. Flexibility metrics will be compared and contrasted with the reliability metrics that are familiar in the industry. We will propose a category of flexibility metrics that we claim are useful for this problem. Our usefulness argument is based on interpreting the flexibility metric as a sufficiently easy recourse problem in a two-stage stochastic optimization context. We will give a detailed description of how the planning problem is a huge multi-time-scale model (with important spatial characteristics) and talk about how one might actually solve important instances of the problem.

---

\*Gary@GaryLSchultz.com