# Common-Cause Failure in Wind Turbines: An Initial Analysis

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## Abstract

It is well recognised that long-term planning and management of renewable energy resources is subject to severe uncertainty. For a large part, this uncertainty is due to the complex relationships between social, economic, and environmental systems, including availability, usage patterns, demographic evolution, global warming, just to mention a few. Traditionally, this uncertainty is encoded via a probability distribution. However, when modelling large systems such as, say, community-scale renewable energy systems, a concern is that the probability distribution used to encode uncertainty may make use of more information than is actually available. Using imprecise probabilities [1], less information is required, and sensitivity is less of an issue, as it can deal with partial probability specifications. In addition, it allows for robust decisions to be made [4], and also enables policy makers to identify areas where additional information is required in order to reach an optimal decision.

We consider common cause failure of components in wind turbines. It is well known that, for proper economic planning and management of wind turbine fleets, one must separate between common (e.g. wind speed) and independent (e.g. material properties) causes of uncertainty [5]. In an initial exploratory study of this problem, we limit ourselves to a simple model and investigate the so-called alpha factor model [3] for common cause failures, which employs a multinomial model for observed failures, with a conjugate Dirichlet prior.

The alpha factor model readily extends to allow for severe prior uncertainty regarding common cause failures, along very similar lines to the imprecise Dirichlet model [6]. In this approach, one specifies a lower or upper probability (or both) for each category, along with a learning parameter, which determines how quickly the prior distribution learns from data. For our application, the prior is not near-vacuous, and interestingly, in this case, the choice of learning parameter has received little attention so far. Whence, we focus in particular on choosing values for the learning parameter, and find that—unlike the near-vacuous case—it is mandatory to pick an interval for the learning parameter, rather than a single value, for good performance of the posterior bounds. The approach is compared with that of [2].

**Keywords.** renewables, wind, planning, decision, robustness, common-cause, Dirichlet

## References

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