

## **Forecasting Design Day Demand Using Extremal Quantile Regression**

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Extreme events occur rarely, making them difficult to predict. Extreme cold events strain natural gas systems to their limits. Natural Gas distribution companies need to be prepared to satisfy demand on any given day that is at or warmer than an extreme cold threshold. The hypothetical day with temperature at this threshold is called the Design Day. To guarantee Design Day demand is satisfied, distribution companies need to determine the demand that is unlikely to be exceeded on the Design Day.

We approach determining this demand as an extremal quantile regression problem. We review current methods for extremal quantile regression. We implement a quantile forecast to estimate the demand that has a minimal chance of being exceeded on the design day. We show extremal quantile regression to be more reliable than direct quantile estimation. We discuss the difficult task of evaluating a probabilistic forecast on rare events.

Probabilistic forecasting is a quickly growing research topic in the field of energy forecasting. Our project contributes to this field in three ways. First, we forecast quantiles during extreme cold events where data is sparse. Second, we forecast extremely high quantiles that have a very low probability of being exceeded. Finally, we provide a real world scenario on which to apply these techniques.