

## ABSTRACT

Multi-timescale electricity markets are proposed to improve traditional electricity markets. Heavy load customers, such as data centers, can significantly benefit from the multi-timescale electricity markets by purchasing some of the needed electricity ahead of time at cheaper rates. However, the strategy to procure the electricity for data centers in multi-timescale markets is a challenging problem, especially when real world dynamics, such as spatial diversity of data centers and uncertainties of renewable energy, IT workload, and electricity price, are taken into account. In this paper, we develop an energy procurement system to provision geo-distributed data centers in multi-timescale markets. We propose two algorithms. The first one provides provably optimal cost minimization, while the other one achieves near optimal performance with limited prediction. Data analysis is conducted with real world traces of renewable energy, electricity prices, and the workload demand to generate necessary input for our algorithms. Case studies highlight the benefits of the proposed algorithms in cost savings.