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Quantum Computing Approach to Future Real-Time Control of Buildings and Cities

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Buildings contribute to more than 70% of overall U.S. electricity usage and greenhouse gas emissions. The future building control optimizes more connected devices and renewable energy equipment, which requires a rapid and accurate response. It also poses the challenge of solving non-linear problems with discrete variables in real time. In one study, we developed a novel optimization using quantum annealing for MPC of rooftop units in buildings. Our approach demonstrated significant improvements in computational speed from hours to seconds by considering day-ahead demand response signals. Our findings highlight the potential of quantum computing in solving large-scale non-linear discrete optimization problems for building energy systems. The other research presented a new framework for building-to-grid integration. We developed MPC for a commercial distribution grid for cost reduction. With similar solutions to traditional algorithms, quantum computing reduced computational time to less than 1.1%. We proved its potential to solve large-scale discrete optimization problems for urban energy systems.