# Abstract

The increasing penetration of distributed energy resources, electrification of transport and rapid urbanization poses new challenges to the power grid. Building energy systems through demand response(DR) programs are estimated to have high potential in mitigating the problems rising due to the intermittent demand peaks. Reinforcement learning (RL) due to their adaptability in learning optimal policies can be helpful in aiding the ever changing building dynamic systems to effectively participate in DR programs.

In this work, an application of model free RL for load shaping at district level is investigated. The district considered in this study consists of nine simulated diverse types of buildings with thermal storage tanks. At first, the working of the RL algorithm, Soft actor critic (SAC) is analysed for a single agent and the findings are extended to multi- agent systems. A centralized controller is then trained on one year of simulated data with the objective of achieving coordination among the buildings in controlling their respective storage tanks to shape the demand curve. The results in terms of load shaping metrics upon evaluation show that, relative to a manually optimized rule based controller(RBC), the central controller is able to minimize the ramping by 38%, average daily peak by 17%, annual peak demand by 4%, the net electricity demand by 1% and the increased the load factor by 10 %. Then it's adaptability to new data is checked by testing the controller on a 5 year real weather data, by the fifth year the controller is able to have an improvement over RBC by 7%. To assess the working of the centralized controller, a system of decentralized controller is trained for the same objective under the same training conditions as the centralized one. Preliminary results show that the decentralized setting is able to deliver results as better as the centralized setting within very few episodes of training.