Multi-agent Energy Sharing in Zero Energy Communities

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With advances in self-sustainability, energy users are becoming more self-sufficient due to usage of self-produced energy from renewable sources. Buildings that partially or entirely rely on renewable sources are increasing. If the net energy usage of such buildings over a period of one year is zero, they are called as zero energy buildings (ZEB). A collection of such ZEBs forms a zero energy community (ZEC). Absolute net zero status is difficult to achieve and hence the term *nearly* ZEC (nZEC) is used in practice. We address the problem of energy sharing in such a community. This is different from conventional energy sharing between buildings as the focus is on improvement of community energy status instead of reducing losses due to transmission and/or storage, or economic gains. We model this problem in a multi-agent environment and propose a deep reinforcement learning (DRL) based solution. Each building is represented by an intelligent agent that learns over time the appropriate behaviour to share energy. We evaluate our solution in a self-made multi-agent simulation built using osBrain. Results indicate that, with time agents learn to collaborate and learn a policy comparable to the optimal policy in most cases, which in-turn improves the nZEC's energy status. When compared this with a no-energy-sharing environment an improvement of approximately 40 kWh with 3 houses during winter and over 60 kWh with 4 houses during summer over 3 days in the overall community's energy balance was found. Similarly, with 10 houses an improvement of approximately 97 kWh during Winter and 156 kWh during Summer was found. Buildings with no renewables preferred to request energy from their neighbours rather than the supply grid. Energy distribution amongst peers introduced a greater deficit in batteries of buildings, which indirectly contributed higher renewable energy storage.