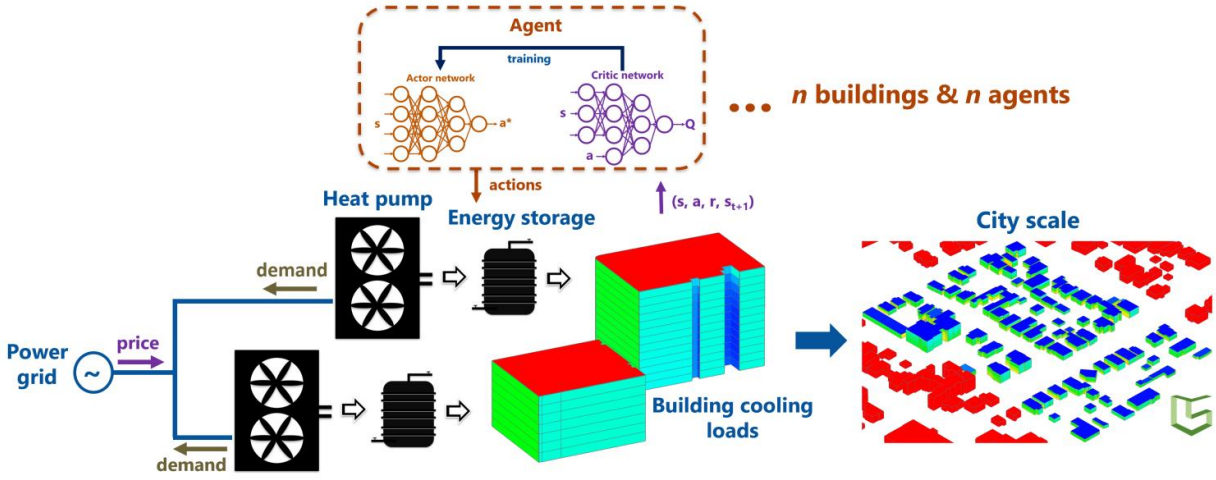
Deep Reinforcement Learning for Coordinating Energy communities



This project will be developed in collaboration with the Intelligent Electrical Power Grids (IEPG) group and the Interactive Intelligence (II) group, under the supervision of Dr. Jochen Cremer (J.L.Cremer@tudelft.nl), and Dr. Luciano Cavalcante Siebert (L.CavalcanteSiebert@tudelft.nl).

Scope: This thesis project will focus on the coordination of energy communities with reinforcement learning

Problem definition: Energy communities aim at balancing their own energy demand and generation to reduce congestion of the grid. Community participants have individual constraints and objectives, and little information are known about the other participants. However, the community balancing objective is known to the participants and minimal information can be exchanged between participants while preserving their privacy. The problem is that when each participant aims for the same objective symmetric responses can be expected resulting, if no coordination is present, in mismatches in the balance (e.g. rebounce effect). Hence, you will develop novel decentralised control methods where individual agents coordinate and focus on individual objectives at the same time.

Methodology: Multi-agent reinforcement learning (MARL)'s outstanding methodological advantage is learning from a dynamic environment with the objective of maximizing a local reward. You will investigate novel MARL techniques that aim at balancing cooperation and competition to the application of coordinating energy communities.

Research objectives:

- Learn about Deep Reinforcement Learning, Actor-Critic, cooperative Deep Reinforcement Learning, and other AI methods for coordination
- Develop a testing model environment for coordinating energy communities (e.g., based on Pecan street)
- Develop a novel cooperative Reinforcement Learning approach to coordinate energy communities (e.g., through incentive based demand response)
- Investigate the developed approach on specific use cases, e.g., sustainability impact, carbon reductions or reducing network congestions
- Communicate findings to scientific community

Industry relevance/partner: You will learn highly relevant technical skills on AI, neural networks, and sustainable energy systems. The developed methods can be used for distribution system operators (DSOs) and energy community managers, municipalities, and behavior analytics.

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