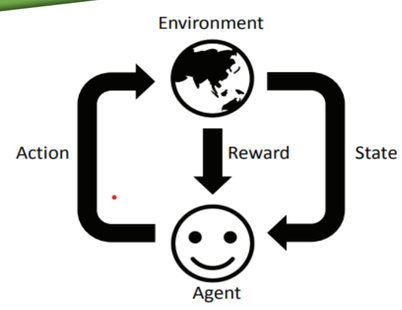
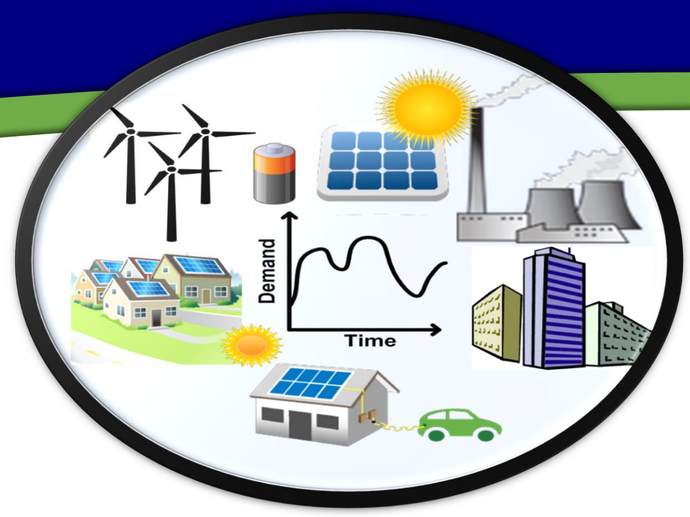
Energy Demand Forecasting for Residential Buildings using Reinforcement Learning

Beksy Saji George
Supervisor: Dr. Lei Shi
Masters in Data Science ,South-East Technological University, Carlow

Contact Details : beksysgeorge@gmail.com
+353 892192004





1. Introduction

- Current electricity systems are not prepared to deal with the consequences of climate change, which might cause uncertainty during high demand periods.
- Renewable energy and Smart Microgrids can assist to reduce global warming and grid instability.
- To use on-site solar energy efficiently, demand-side flexibility must be carefully handled.
- In this study, we explore multi-agent reinforcement learning to create a dynamic pricing policy that reduces community power costs and increases self-sufficiency while recognizing emergent social-economic behaviours.

2. Research Objective

- Study aims to evaluate P2P energy trading approach using dynamic pricing mechanism to buy and sell energy based on real-time supply and demand conditions.
- Approach aims to promote on-site solar energy utilization, reduce emissions, and improve grid stability.

3. Literature Review

- Forecasting energy consumption is critical for attaining energy efficiency in buildings.
- Statistical models, machine learning algorithms, and hybrid approaches have all been used to anticipate energy consumption.
- Key issues in energy demand forecasting include data availability, data quality, and model complexity.
- Future research should concentrate on increasing data collection and quality, developing hybrid forecasting systems, and including external elements into models such as weather and occupancy.

4. Methodology

- Collect data on energy consumption, production, and real-time supply and demand.
- Design a multi-agent system framework to enable communication and cooperation.
- Define reinforcement learning approach for dynamic pricing mechanism.
- Train the reinforcement learning model using collected data and MAS framework.
- Conduct data-driven simulations to validate effectiveness of proposed approach.
- Analyze simulation results to identify strengths, weaknesses, and opportunities for improvement.

5. Next Step

- Work on the imbalanced dataset.
- Create and deploy reinforcement models.
- Train and test a variety of algorithms, and then evaluate their accuracy.
- Using more weather data in order to anticipate energy demand accurately.
- Utilize metrics to evaluate models(RMSE, MAE, MSE or Accuracy, Precision, Recall and F1 Score).
- Analyze and visualize the outcomes.

6. Technologies

scikit learn, python, TensorFlow, NumPy, SciPy, pandas, matplotlib

7. References

- https://www.wur.nl/en/project/Energy-demand-forecasting-for-urban-systems-1.htm
- https://www.flaticon.com/free-icons/energy-consumption
- Lee, S. & Choi, D-H. (2021). Reinforcement Learning-Based Energy Management of Smart Home with Rooftop Solar Photovoltaic System, Energy Storage System, and Home Appliances. Energies, 14(15), 4542.
- Li, C., Ding, Z., Zhao, D., Yi, J., & Zhang, G. et al. (2018). Building Energy Consumption Prediction: An Extreme Deep Learning Approach. Energies, 11(6), 1396.
- Zhang, X. M., Grolinger, K., Capretz, M. A. M., & Seewald, L. et al. (2017). Forecasting Residential Energy Consumption: Single Household Perspective. In 2017 IEEE International Conference on Smart Computing (SMARTCOMP) (pp. 1-6). IEEE.