# DEVELOPING AN EMS FOR OPTIMIZED HVAC CHILLER OPERATION AT UQ

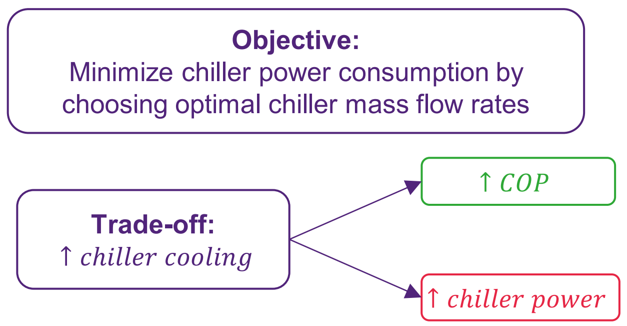
**Laura Musgrave – Supervised by Prof Tapan Saha and Dr Arnab Battacharjee**

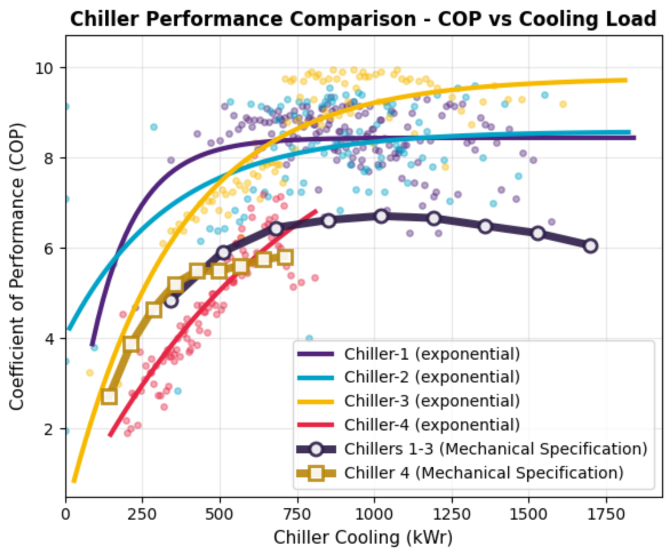
[1] J. Achiam. "Spinning Up in Deep Reinforcement Learning," 2018; [2] Wang, Y., et al. "Timexer: Empowering transformers for time series forecasting with exogenous variables," in *Advances in Neural Information Processing Systems*, 2024. [3] E. Salari, A. Askarzadeh. "A new solution for loading optimization of multi-chiller systems by general algebraic modeling system," in *Applied Thermal Engineering*, vol. 84, pp. 429-436, 2015.

## Context & Motivation

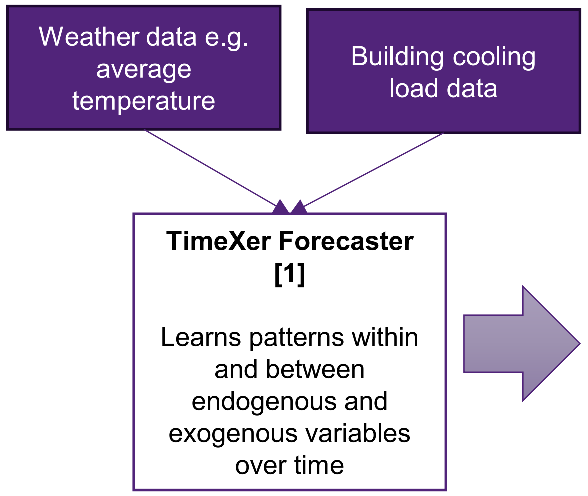
Large building systems such as UQ have great potential for reducing their energy consumption, particularly in the category of heating, ventilation and air-conditioning (HVAC) which constitutes 26% of AEB's total energy consumption. Predictive and adaptable control techniques can ensure unnecessary power consumption is minimized [3].

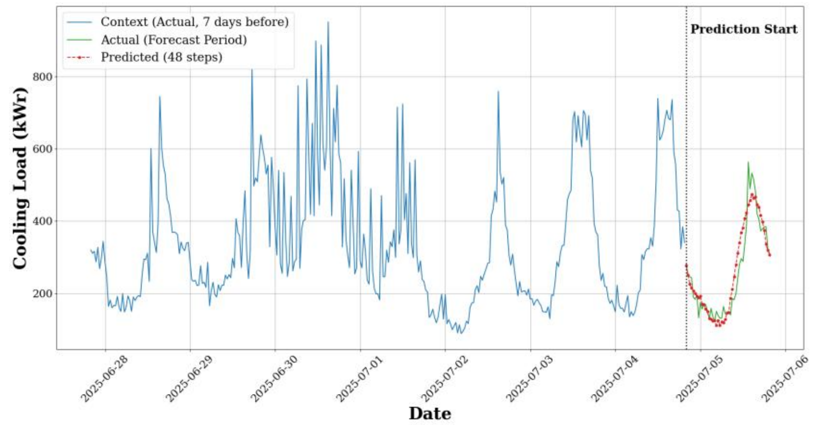
## Problem Overview




## Building Cooling Load Forecasting

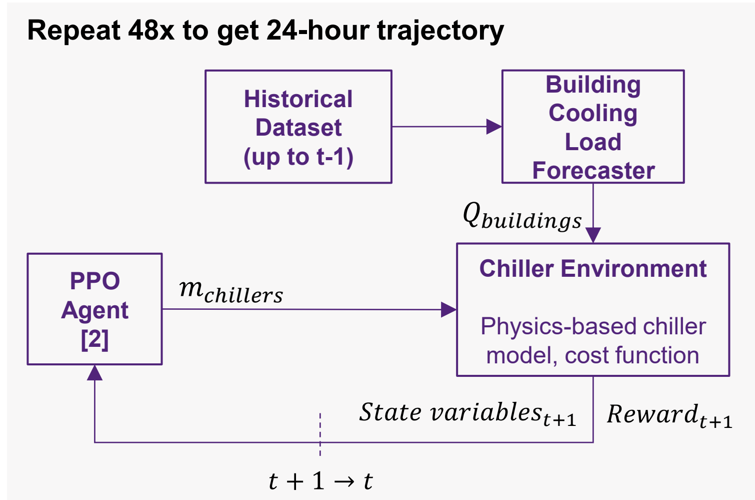



| Normalized MSE | Normalized MAE |
|---|---|
| 0.23478 | 0.32428 |

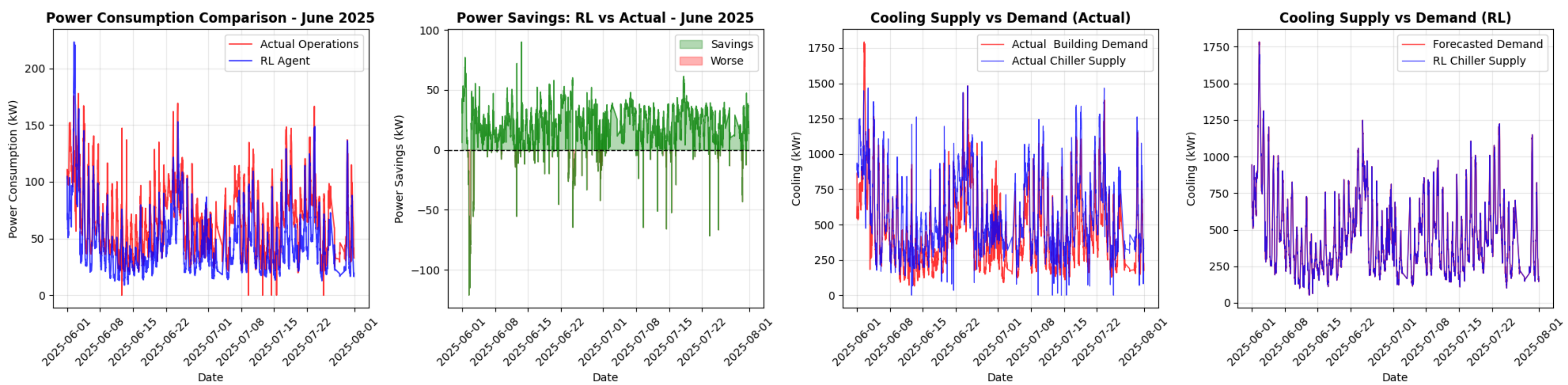
## Optimization Algorithm

At every 30-min step $k$ in optimization horizon:



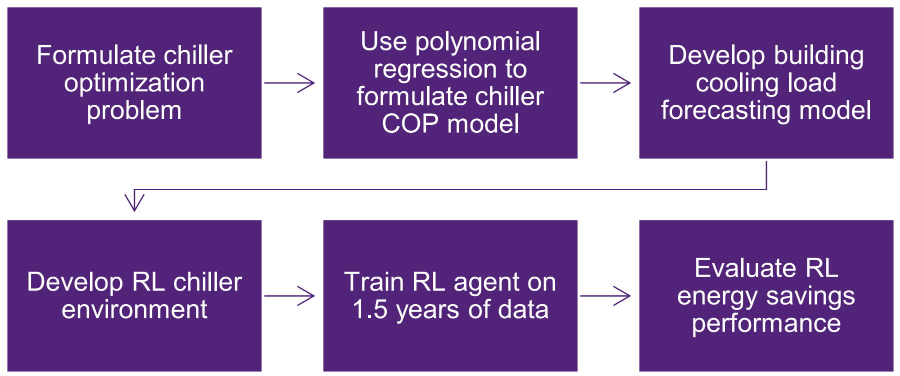

Apply first action in trajectory to the real environment.

## Results Analysis




| Savings Summary |
|---|
| Average: 18.9 kW |
| Total: 25.9 MW |
| Percentage: 28 % |

## Project Workflow




## Strengths & Limitations

- Through more accurate demand-following and improved COPs during operation, the RL controller achieves power savings of 28% compared to rule-based control
- Comparison with data of the rule-based operation shows that the RL environment promotes accurate operating behaviour
- Although minimized, constraint satisfaction was not guaranteed through this control method

## Future Works

- Integrating other campus building loads for full campus energy management
- Incorporating renewable energy sources such as the grid-scale battery for peak load management
- Implementation of safe-RL techniques to further promote constraint satisfaction

CRICOS 00025B • TEQSA PRV12080

School of Electrical Engineering and Computer Science

**Acknowledgements**

I would like to acknowledge Neil Brown and Qamar Syed Muhammad from the UQ Property and Facilities Division for providing critical data and knowledge for this project.
I would also like to acknowledge Dr Arnab Battacharjee for his invaluable contributions, and Professor Tapan Saha for his continuing support and guidance.

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