MONASH University

MONASH ENGINEERING

Faculty of Engineering

ASPIRE Summer Research Program 2026-2027

Project Title: Coordinating Zone Heating Under an Energy Budget with a Digital Twin

Supervisor(s): Prof. Hai L. Vu, Usman Sarwar

Department: Civil and Environmental Eng.

Email: hai.vu@monash.edu

Website profile of project supervisor: https://www.monash.edu/engineering/lehaivu

Objective

Investigate how multiple AI agents, each managing one building zone, can coordinate their heating demands through a shared digital twin when a building operates under an energy or carbon budget. Using the MIL smart building testbed's IoT and BMS data, the project will build a small multi-agent system and quantify how coordinated heating control compares with conventional independent zone control on energy use and comfort.

Project Details

As buildings electrify, they operate under constraints such as peak demand charges, limited heat-pump capacity, and time-varying grid carbon intensity. Under these conditions, zones making individually rational heating decisions can be collectively inefficient. For example, all demanding heat on a cold morning when plant load and grid carbon are highest. This project investigates a multi-agent architecture to address this. Each of two to three zones is assigned a lightweight agent that observes local occupancy and temperature via IoT sensors and submits heating requests. A digital twin acts as coordinator, holding what no single zone can see plant capacity and load from the BMS, zone thermal models, and a time-varying energy/carbon budget derived from grid carbon data and a simulated solar profile. Each cycle, the twin simulates the aggregate effect of competing requests and returns allocations; agents then adapt, learning to pre-heat earlier when the budget permits. The study runs on replayed cold-week testbed data, ensuring reproducibility without live BMS control. Evaluation compares coordinated and uncoordinated control across total energy, peak demand, carbon-weighted consumption, and comfort.

Project Timeline

TASK	1	2	3	4	5	6	7	8	9	10
Literature review										
Testbed & BMS familiarisation										
Construct energy & heat budget signal										
DT core: Build zone thermal model										
Develop zone agent request logic										
Develop twin arbitration mechanism										
Experimentation										
Final report and demo										

Prerequisites

Strong Python programming proficiency is required, along with enrolment in an engineering, computer science, or related degree. Completed units in machine learning, optimisation, or control systems are desirable. This project suits a student comfortable with AI/ML tools, simulation and quantitative analysis.