Modeling and calibration of the energy systems of a high-rise building

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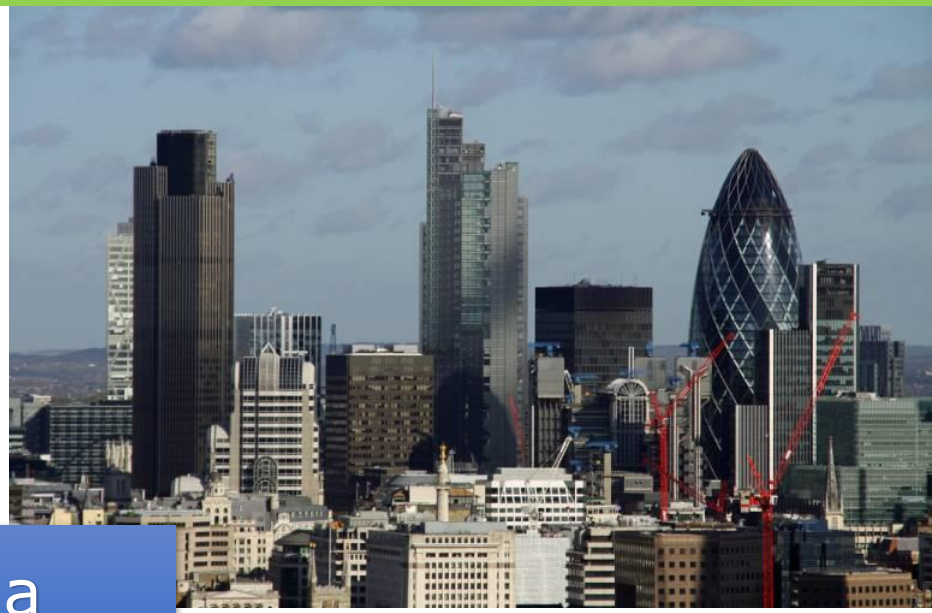
1. Introduction

High–rise building represent about 15 to 25 % of the total building sector.

Modeling an accurate HVAC systems in high-rise buildings is complex mission.



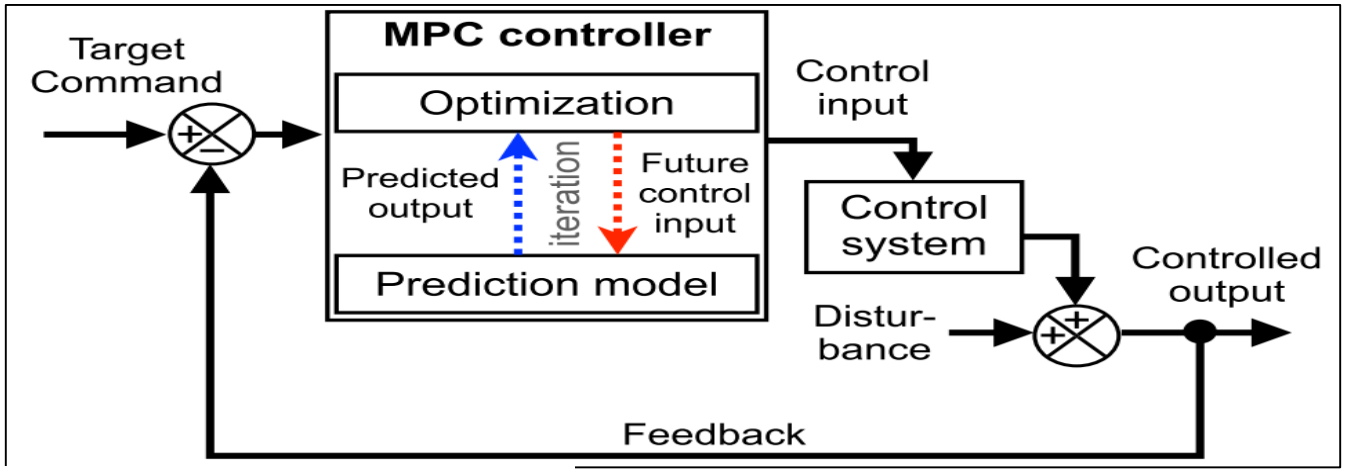
We are developing a calibrated, detailed model of a case study building to facilitate the study of advanced control strategies in high rise buildings.

This building energy model was developed in EnergyPlus and calibrated with measured data from BAS.

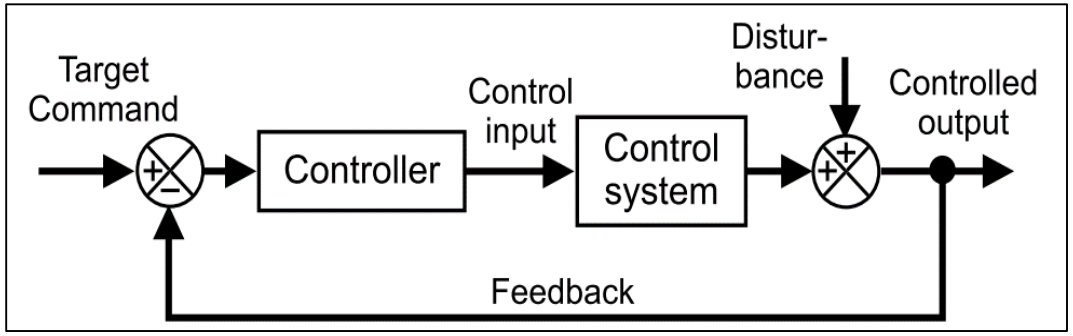
This energy model will serve as a sandbox for developing and testing advanced control strategies

2. Motivation: Model Predictive Control (MPC)

Model Predictive Control (MPC) VS traditional control methods



Model Predictive Control system



Feedback control system

MPC Features

- Improved energy efficiency and cost savings.
- Increased occupant comfort and satisfaction.
- Enhanced building automation and control.
- Reduced environmental impact.

3. Case Study Building

UdeS Longueuil campus is consist of 19 floors with total area of 54,000 m2, 3 Chillers with total cooling capacity of 3100 KW, cooling towers, pumps, etc.

All rooms have been modeled as per ASHRAE requirements for each application.

The building has been divided into 5 thermal zones per floor.

Cooling load demand for the summer season (June to September) has been calculated.

UdeS Longueuil campus.

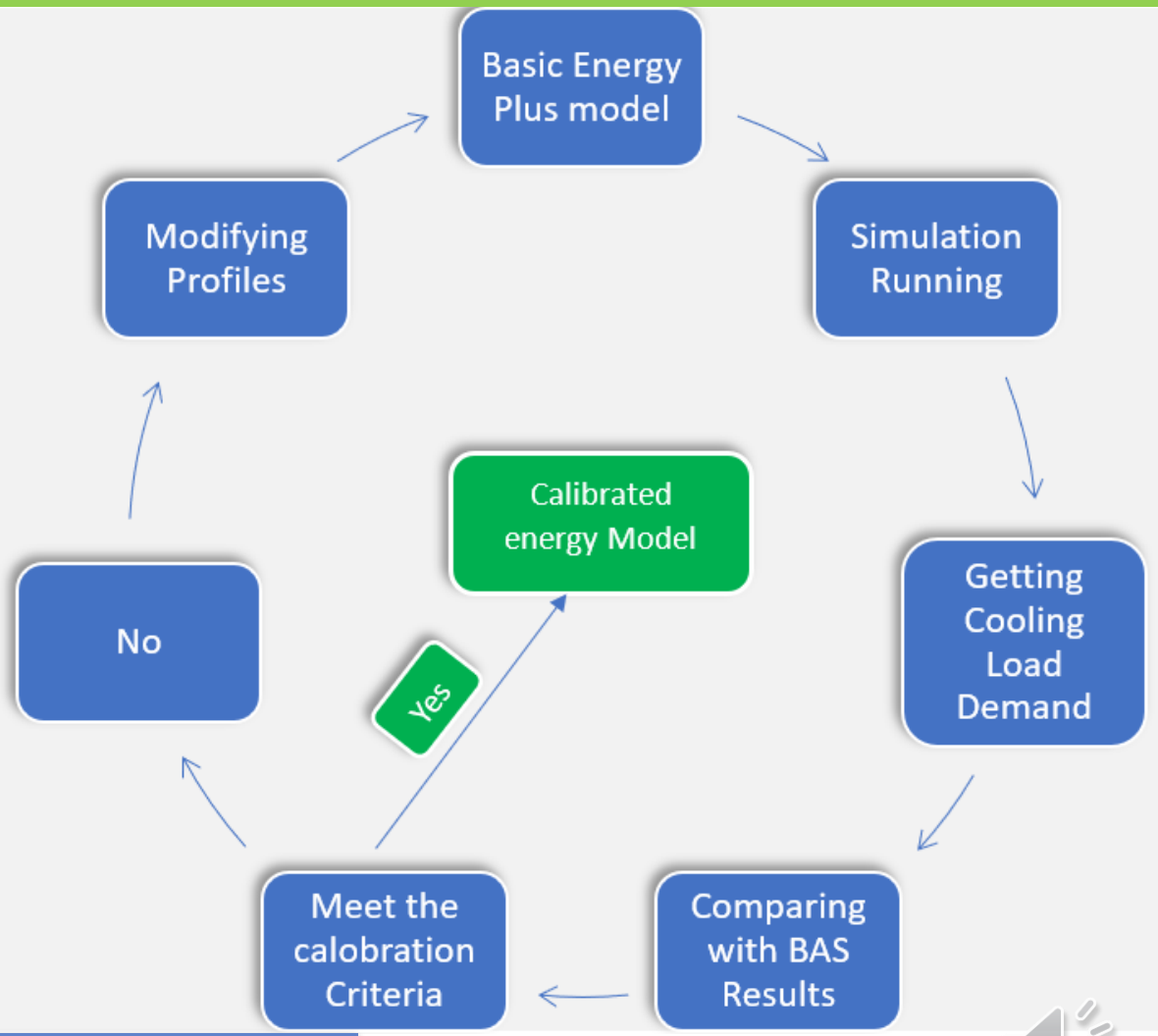
4. Calibration Methodology

Measured cooling load demand for the same period has been collected from the BAS.

Calibration process has been conducted as per ASHRAE Guideline 14.

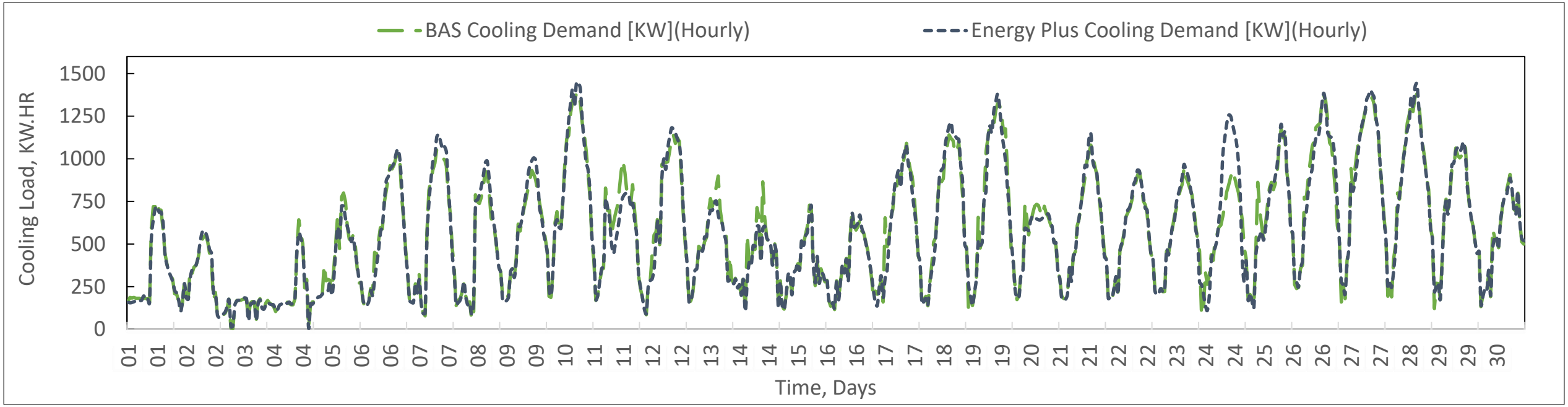
Criteria of (MBE & CV RMSE) has been selected.

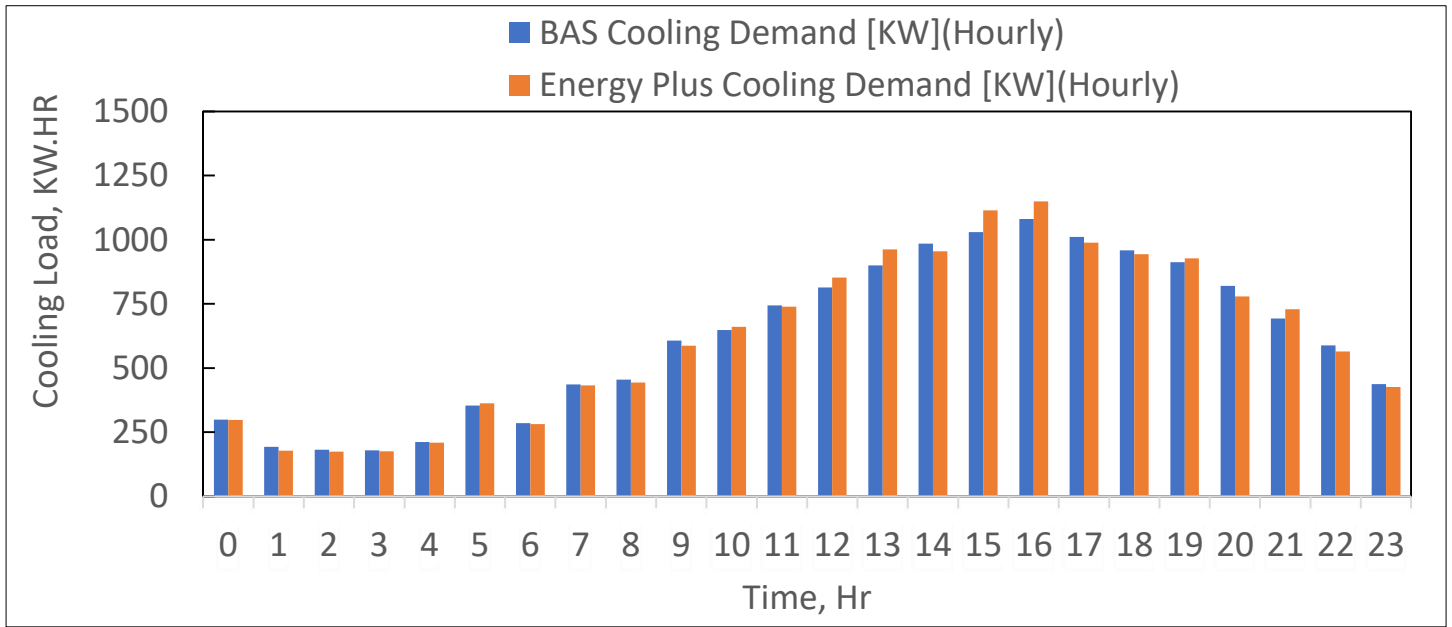
Iterative adjustments were made to operational profiles until reaching satisfactory accuracy



Calibration process Flow diagram

5. Results





Comparison between BAS data and calibrated energy model for June 2019.

Comparison between BAS data and calibrated energy model for 21st June 2019

Table 1. Calibration Results for the summer season, 2019.

Month	CV(RMSE)	MBE	Month	CV(RMSE)	MBE
June	12%	0.4%	**August**	27%	3.2%
July	22%	-2.2%	**September**	10%	1.1%

6. Conclusion and Future Work

Calibrating energy models for HVAC systems in high-rise buildings is a challenging task.

CALIBRATED ENERGY MODEL

The success of the calibration process for energy model against BAS data demonstrates the robustness of the energy model.

The calibrated energy model will be the base of applying MPC for more energy efficient systems.

Thank You For Your Attention !

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