



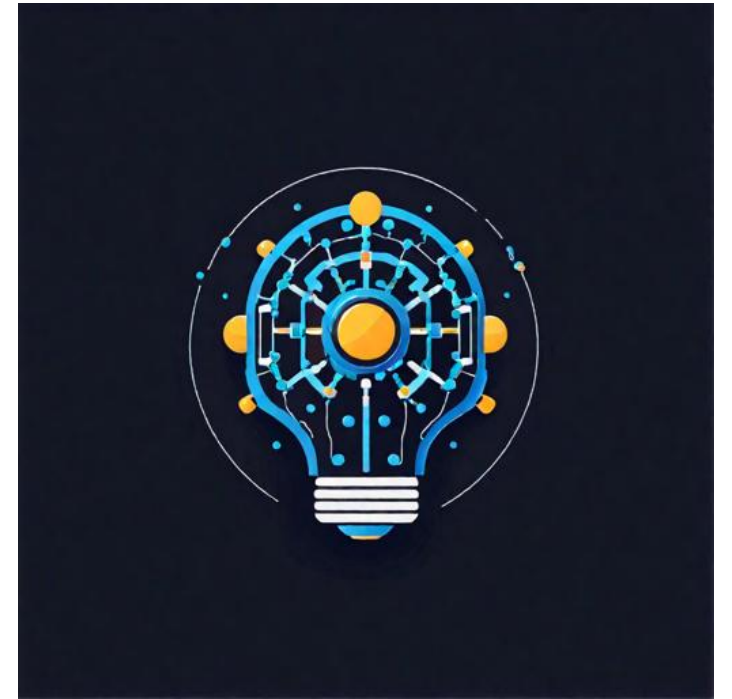
# **Removing the Artificial from Artificial Intelligence: Scalability Requirements and Examples of AI in Building Operations**

Jayson Bursill, Ph.D., P.Eng.

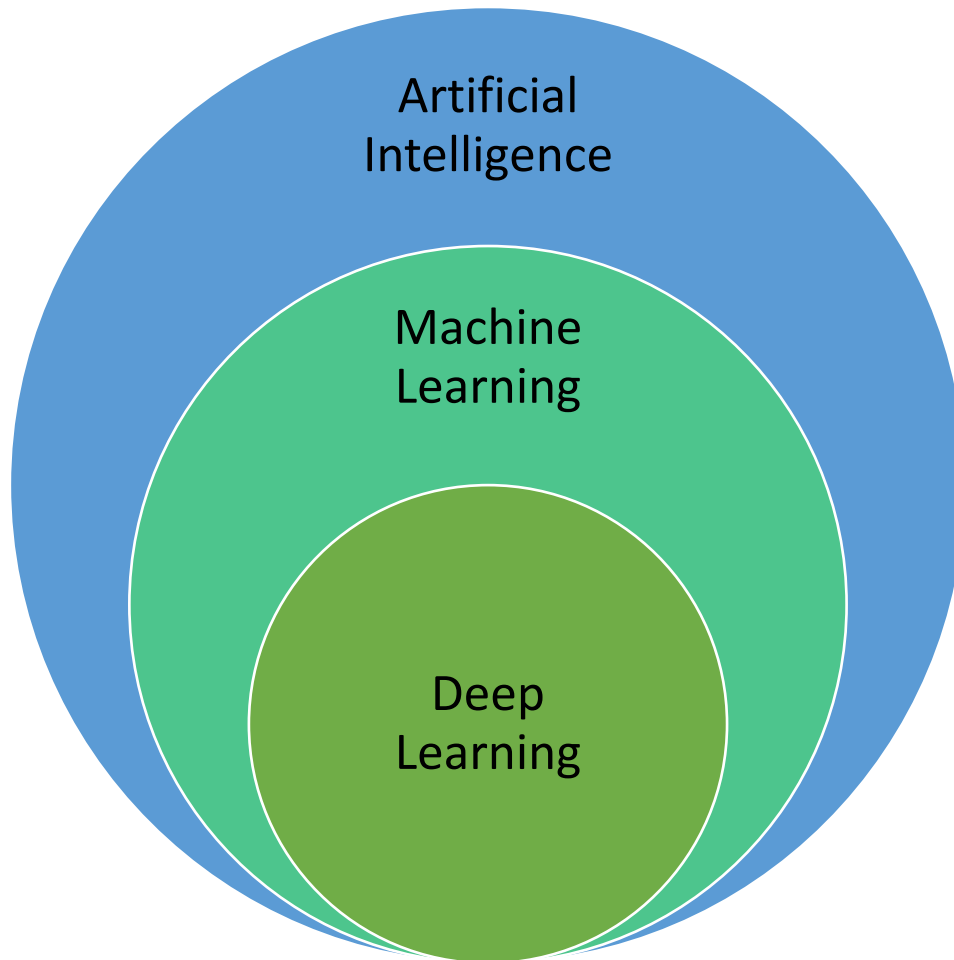
[jbursill@deltaww.com](mailto:jbursill@deltaww.com)

# Outline/Agenda

- Defining Artificial Intelligence, Machine Learning, and Deep Learning
- Hype Cycles of Artificial Intelligence
- Brief Background of Generative AI
- Scalability Requirements
  - Interoperability
  - Normalization
  - Configuration
- Machine Learning Applications
  - Sensor Fusion
  - Predictive Control
  - BAS with Large Language Model



# What is “AI”?



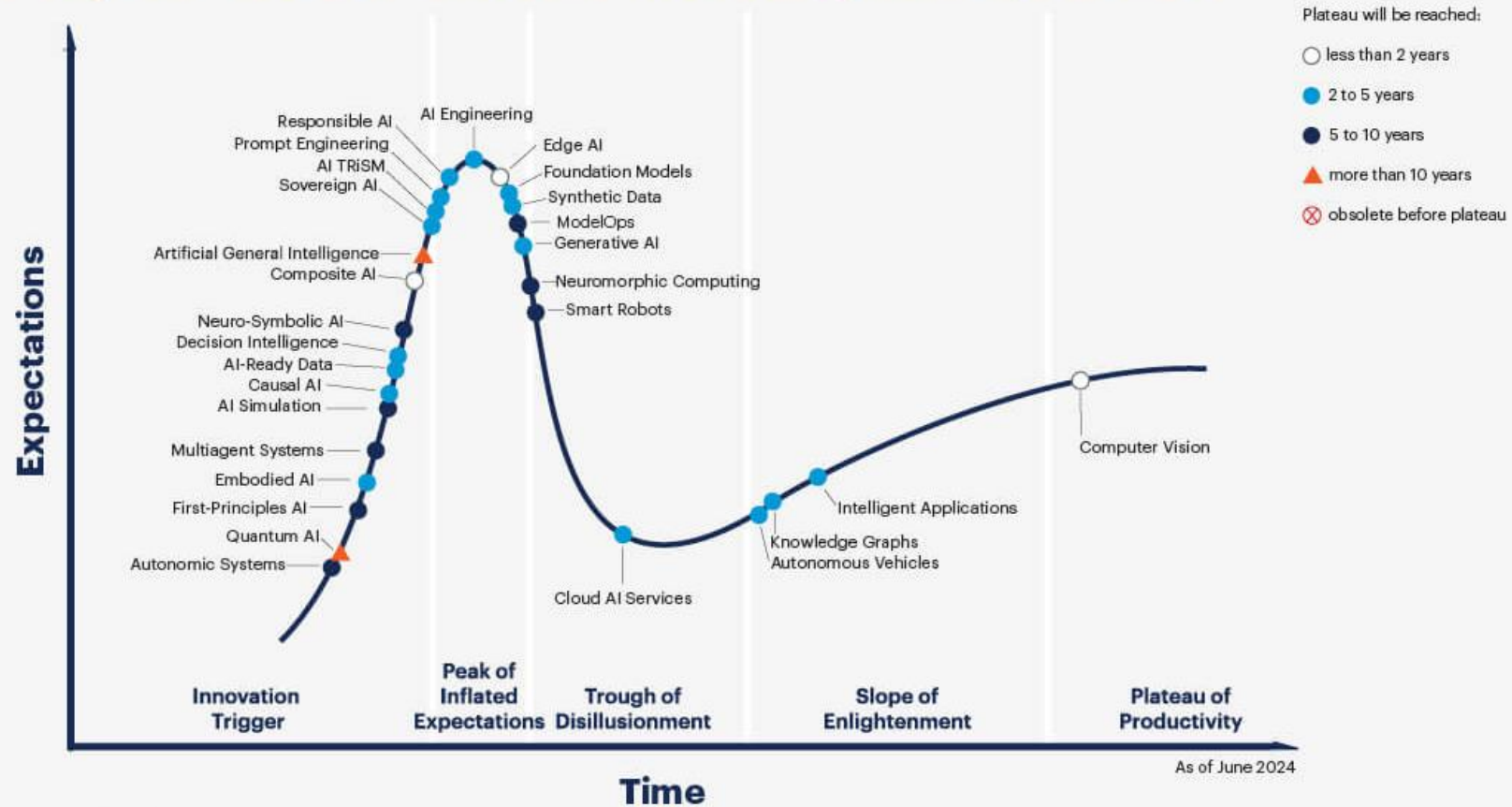
Ability of machine to imitate intelligent human behavior

Application of artificial intelligence that allows a system to learn and improve using data

Application of machine learning that uses complex algorithms and usually artificial neural net-based models

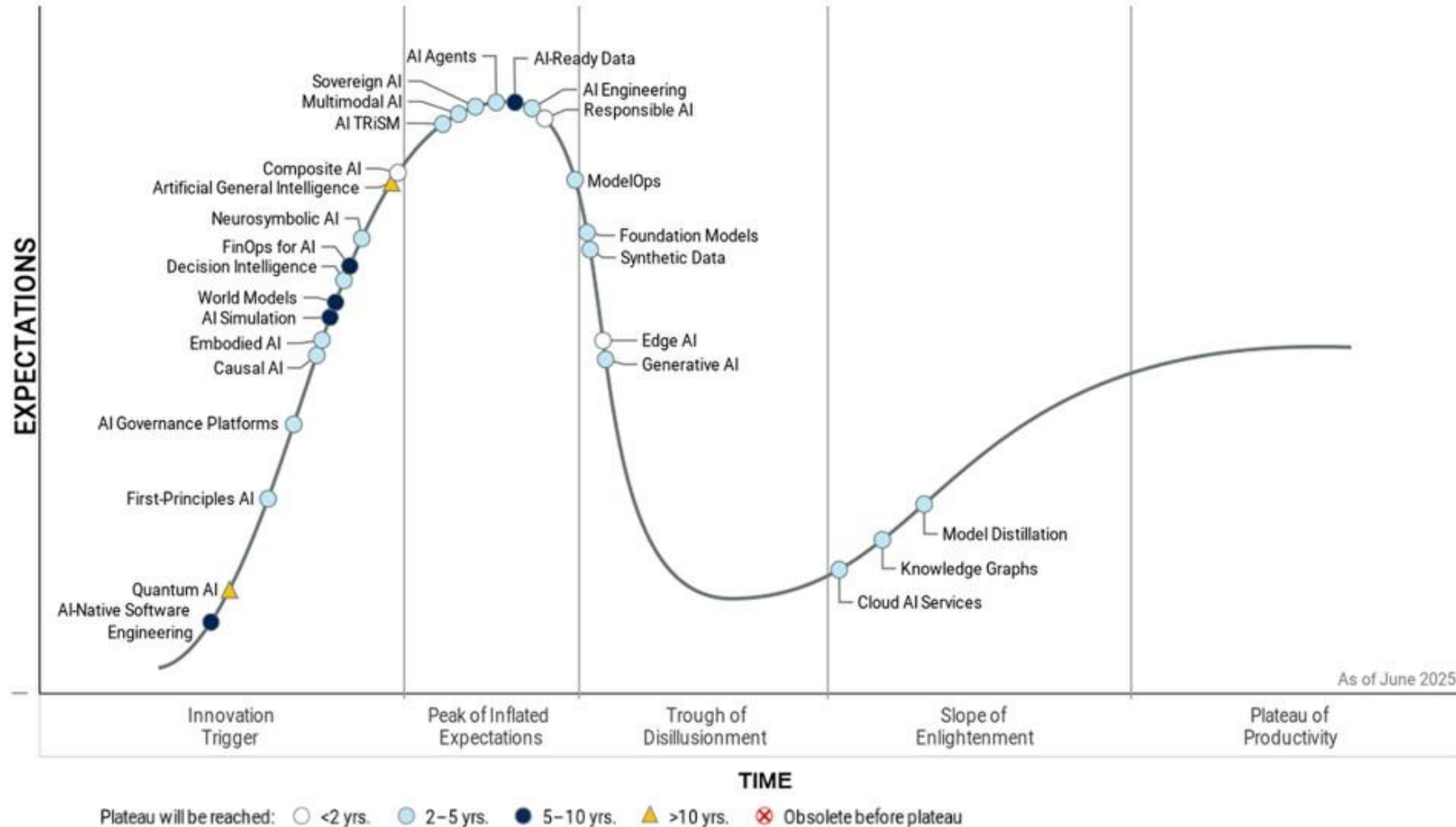
# AI Hype Cycle – 2024

## Hype Cycle for Artificial Intelligence, 2024



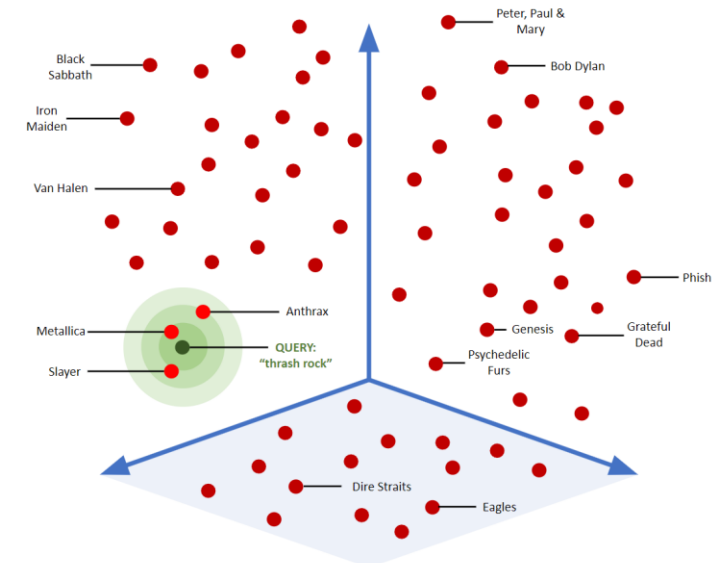
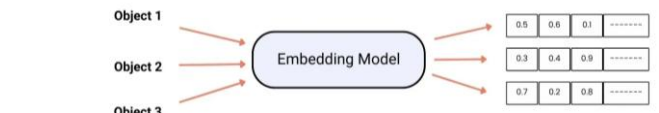
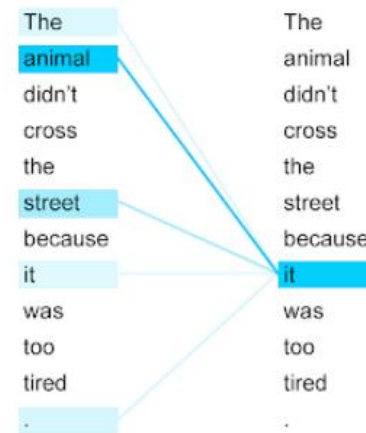
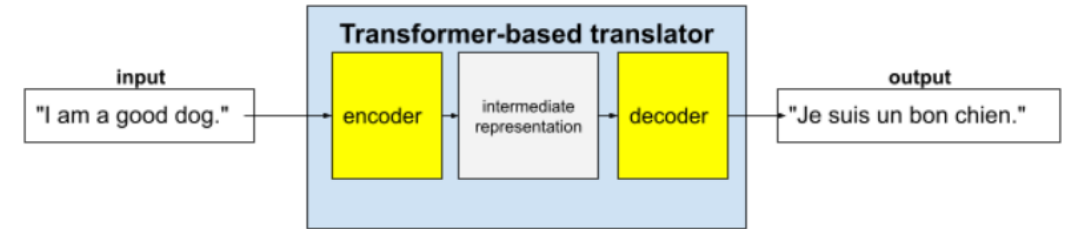
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# AI Hype Cycle – 2025



# What is a Transformer and Why Use One?

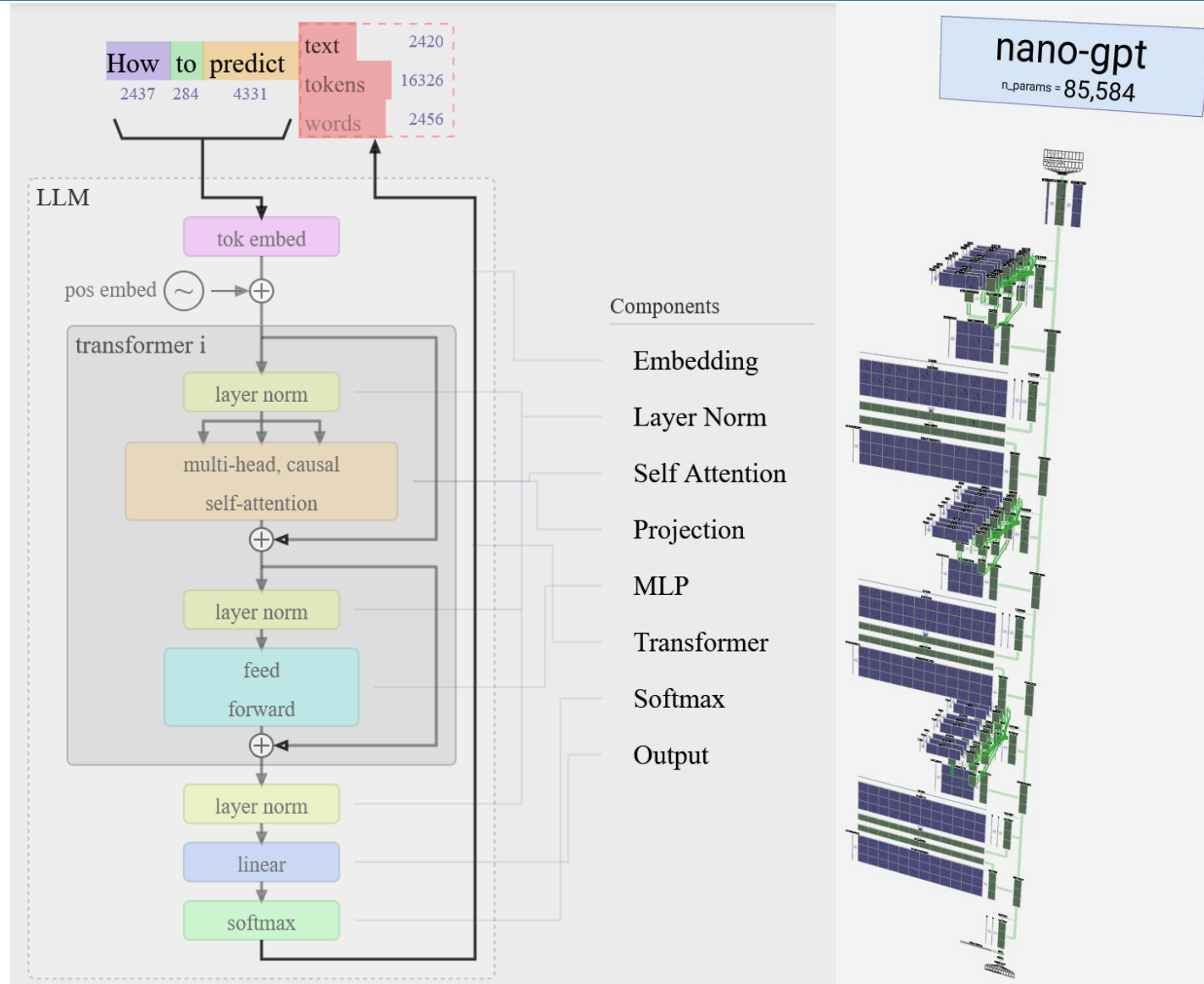
- Internally composed of deep learning (artificial neural network models) and self-attention
  - Self-attention: "How much does each other token of input affect the interpretation of this token?"
  - Can contain several trillion or more parameters
- Interacts with embedded data, often via vector databases
- Why do this?
  - Handles large sequences and patterns well
  - Handles natural language well



# LLM Architecture Visualized

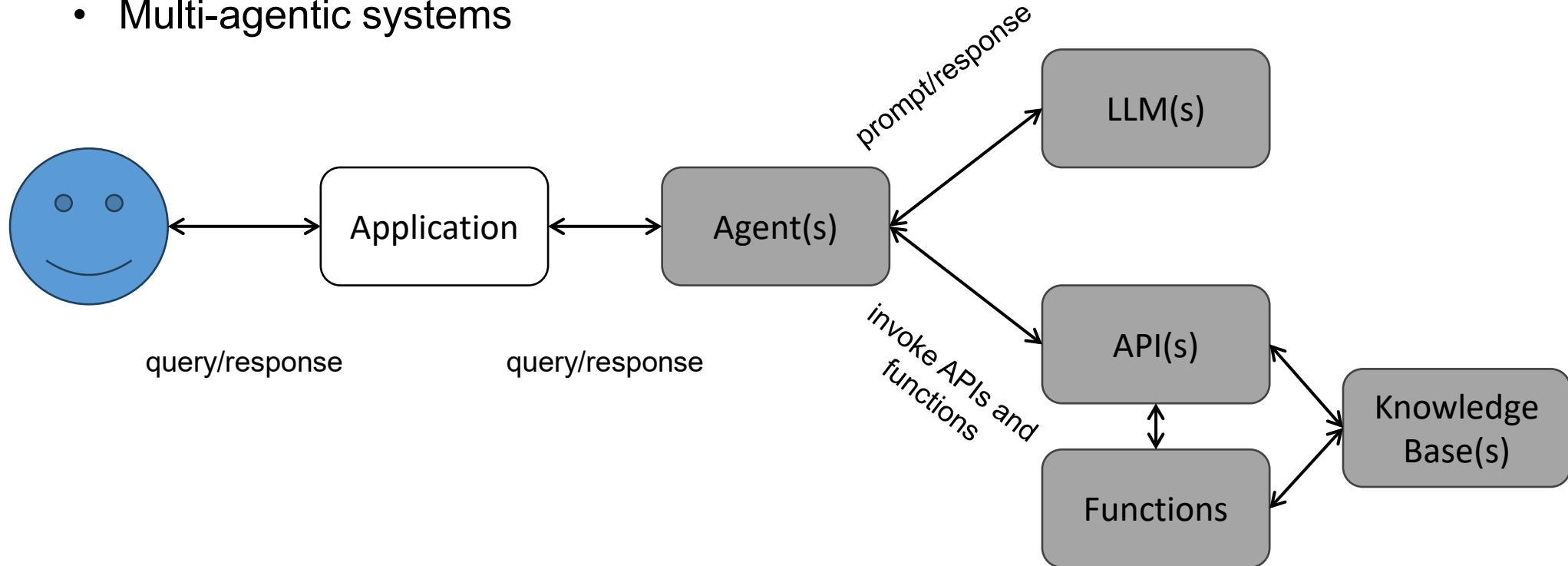
- **LLM Definition: Transformers** trained using primarily text data to understand, manipulate, and generate **natural language**
- **nano-gpt example:**
  - Trained to reproduce GPT-2 with less parameters
  - ~86k parameters
  - 6 MLP layers
  - 6 attention heads
  - Written in PyTorch (~300 lines)
  - Trained over 4 days with 8x A100 40GB GPUs
- **Other, larger LLMs:**
  - GPT-2: 124M parameters
  - GPT-3: 175B parameters
  - GPT-4: 1.8T parameters

Adapted from: <https://bbycroft.net/llm>



# Agentic AI

- Important Agentic AI considerations:
  - Function calling
  - Knowledge bases via API (e.g., databases, documents)
  - Model context protocol
  - Multi-agentic systems

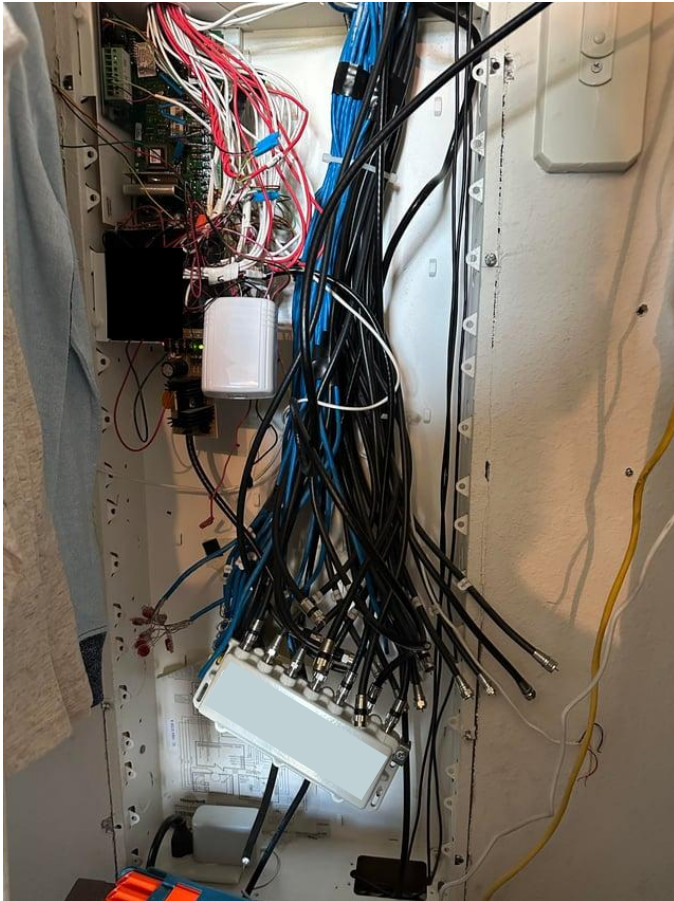


# How Can Algorithms be Scaled in Buildings?

- **We need to “remove the Ph.D. from the loop”**
- Machines need to identify systems
- Machines need to tune system models
- Optimization constraints and parameters need to be presented in an operator-intuitive fashion
- Implementation should begin with simple problems that are common (in this case, bottom-up)
- Implementation should be compatible with contemporary supervisory control (e.g., ASHRAE Guideline 36)



# Challenges when Connecting BAS to Other Things (Including AI Systems)



---

Point Label

---

Comfort1 Supply Flow

AHUB2\_Airflow

B1L8-P4-SAF37-FLOW

NAE-01/FC-1.FD-90

A\_L1\_CZ.CZONE-AHU SA-FLOW

Ac'Ahu306'OaFI

AV422

# Standards Enabling AI in Building Controls

## Sequence

- ASHRAE Guideline 36: High Performance Sequences of Operation for HVAC Systems
- Other sequences from application engineers
- Other sequences

## System

- ASHRAE Standard 135: BACnet
- Application Programming Interfaces (API)
- Other protocols

## Syntactics

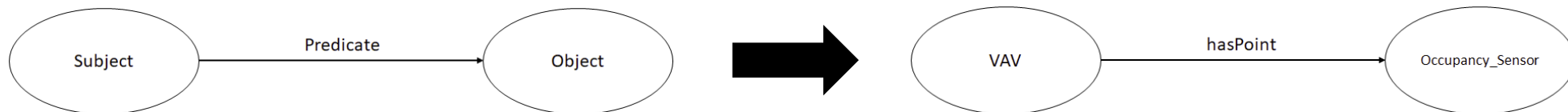
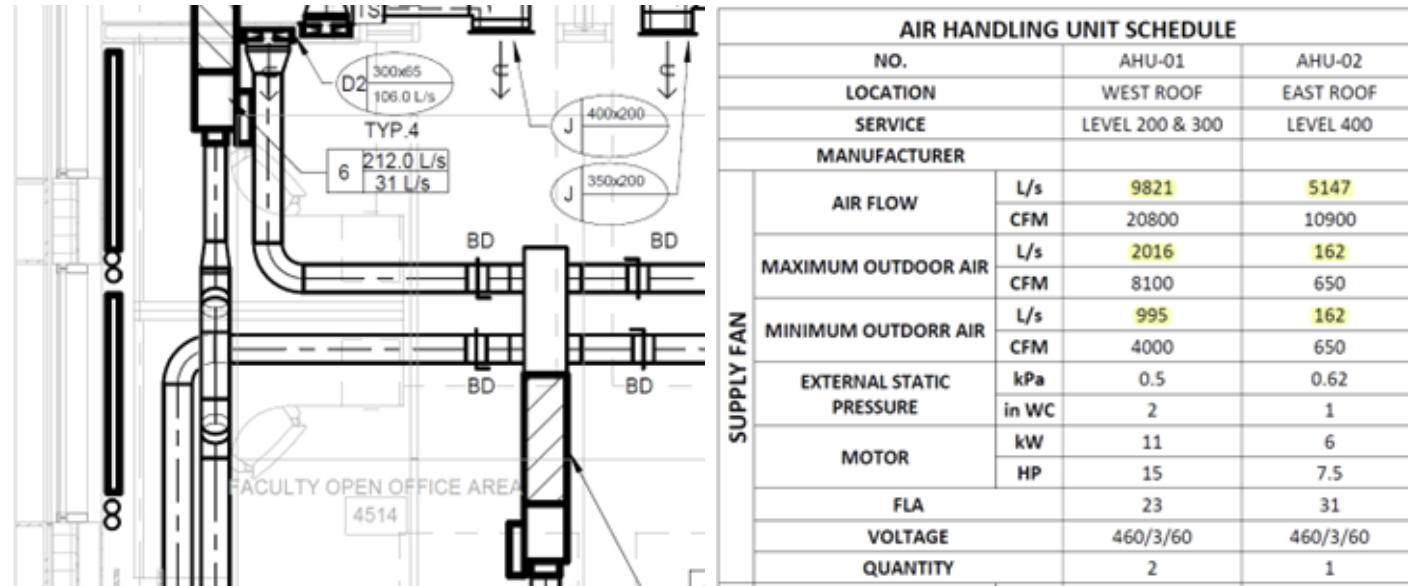
- ASHRAE Standard 223: Semantic Data Model for Buildings
- Brick
- Haystack
- Other ontologies

## Structure

- ASHRAE Standard 231: Control Description Language
- Other schemas

# Data Sources

- Building data:
  - BIM architecture and equipment schedules
  - BAS specs
  - Physical I/O
  - Parameters (AV, BV, MV)
  - Algorithms (e.g., guidelines or templates)
- Public metadata libraries/ontologies:
  - Brick/ RealEstateCore (based on Semantic Web)
  - Haystack (based on markers)

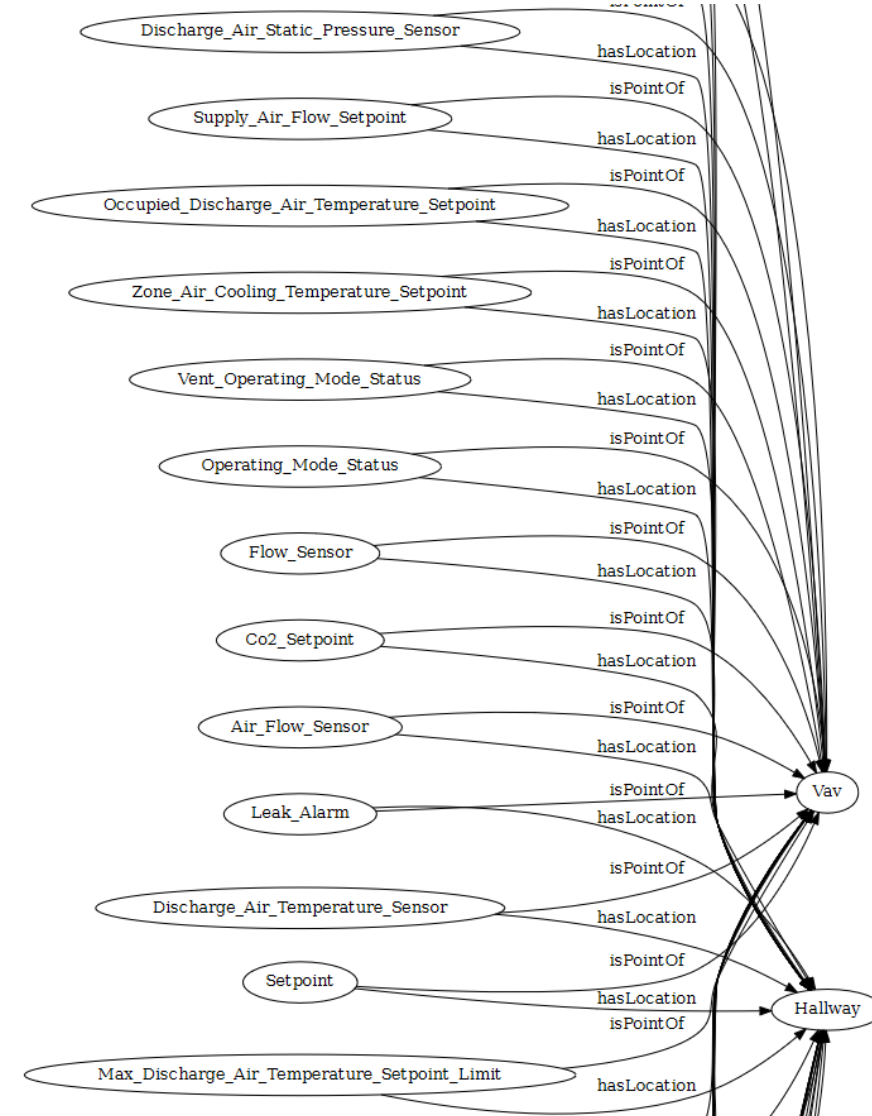


# Metadata Approaches and the Power of Ontology

Select SiteName

Search filter:    AND()

#	Point ID	Point Name	<input type="text" value="Point Brick (v1.2)"/>	<input type="text" value="Equipment Brick (v1.2)"/>	<input type="text" value="Location Brick (v1.2)"/>	User-Defined Tag
	test.1100.analog-input.3	DAT	<input type="text" value="discharge_air_temperatu"/>	<input type="text" value="vav"/>	<input type="text" value="hallway"/>	<input type="text" value="ZN_A"/>
	test.1100.analog-input.7	RMT	<input type="text" value="zone_air_temperature_s"/>	<input type="text" value="thermostat"/>	<input type="text" value="private_office"/>	<input type="text" value="RM_101"/>
	test.1100.analog-value.1	AHU SAT	<input type="text" value="air_temperature_setpoir"/>	<input type="text" value="ahu"/>	<input type="text" value="room"/>	<input type="text" value="A1"/>
	test.1100.analog-value.9	DAT - RMT Heat Active Setpoint Differential Max Setpoint	<input type="text" value="discharge_air_temperatu"/>	<input type="text" value="vav"/>	<input type="text" value="hallway"/>	<input type="text" value="ZN_A"/>
	test.1100.analog-value.10	DAT Active Setpoint	<input type="text" value="occupied_discharge_air_"/>	<input type="text" value="vav"/>	<input type="text" value="hallway"/>	<input type="text" value="ZN_A"/>
	test.1100.analog-value.11	DAT Low Limit Setpoint	<input type="text" value="min_discharge_air_temp"/>	<input type="text" value="vav"/>	<input type="text" value="hallway"/>	<input type="text" value="ZN_A"/>
	test.1100.analog-value.12	DAT Max Setpoint	<input type="text" value="max_discharge_air_tem"/>	<input type="text" value="vav"/>	<input type="text" value="hallway"/>	<input type="text" value="ZN_A"/>
	test.1100.analog-value.43	Outside Air Temperature	<input type="text" value="outside_air_temperature"/>	<input type="text" value="ahu"/>	<input type="text" value="mechanical_room"/>	<input type="text" value="A1"/>
	test.1100.analog-value.56	RMT Cool Active Setpoint	<input type="text" value="zone_air_cooling_tempe"/>	<input type="text" value="vav"/>	<input type="text" value="hallway"/>	<input type="text" value="ZN_A"/>
	test.1100.analog-value.57	RMT Cool Max	<input type="text" value="zone_air_cooling_tempe"/>	<input type="text" value="vav"/>	<input type="text" value="hallway"/>	<input type="text" value="ZN_A"/>

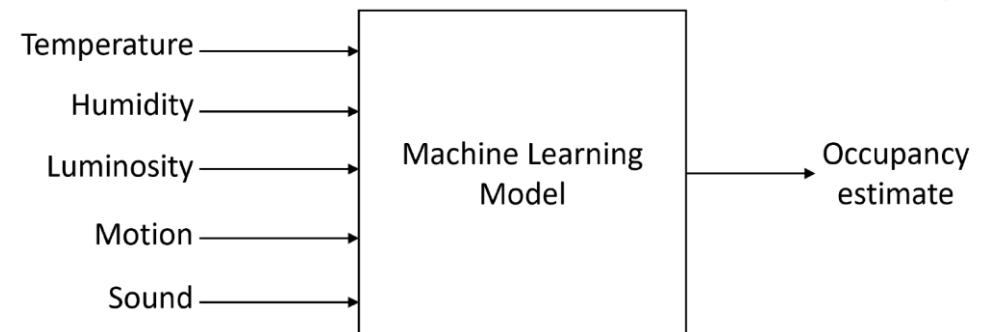
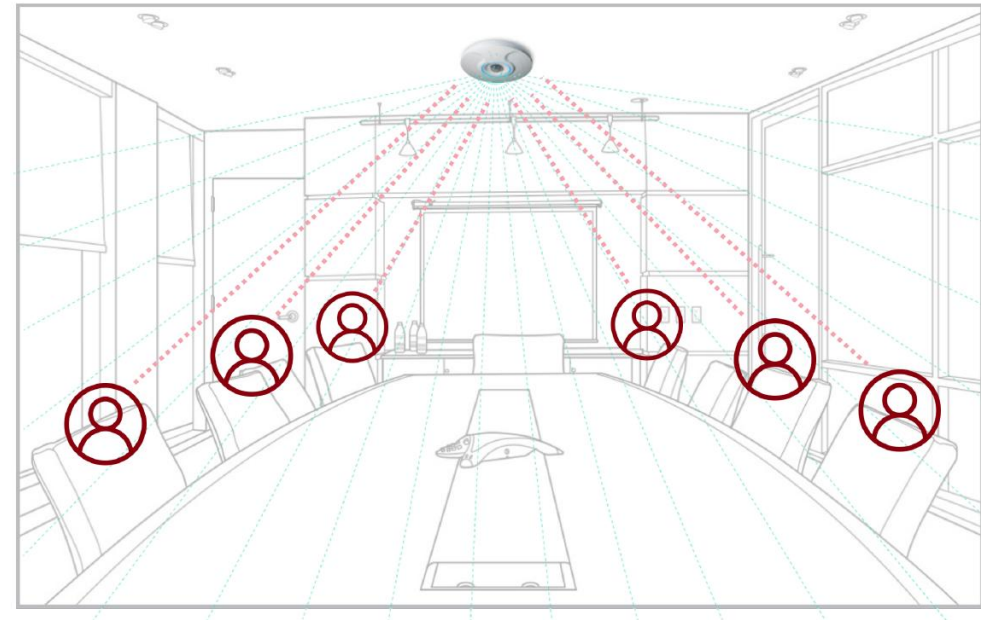


# AI Applications

# AI Applications – Occupancy Sensor Fusion

- How can occupancy be estimated without a camera?

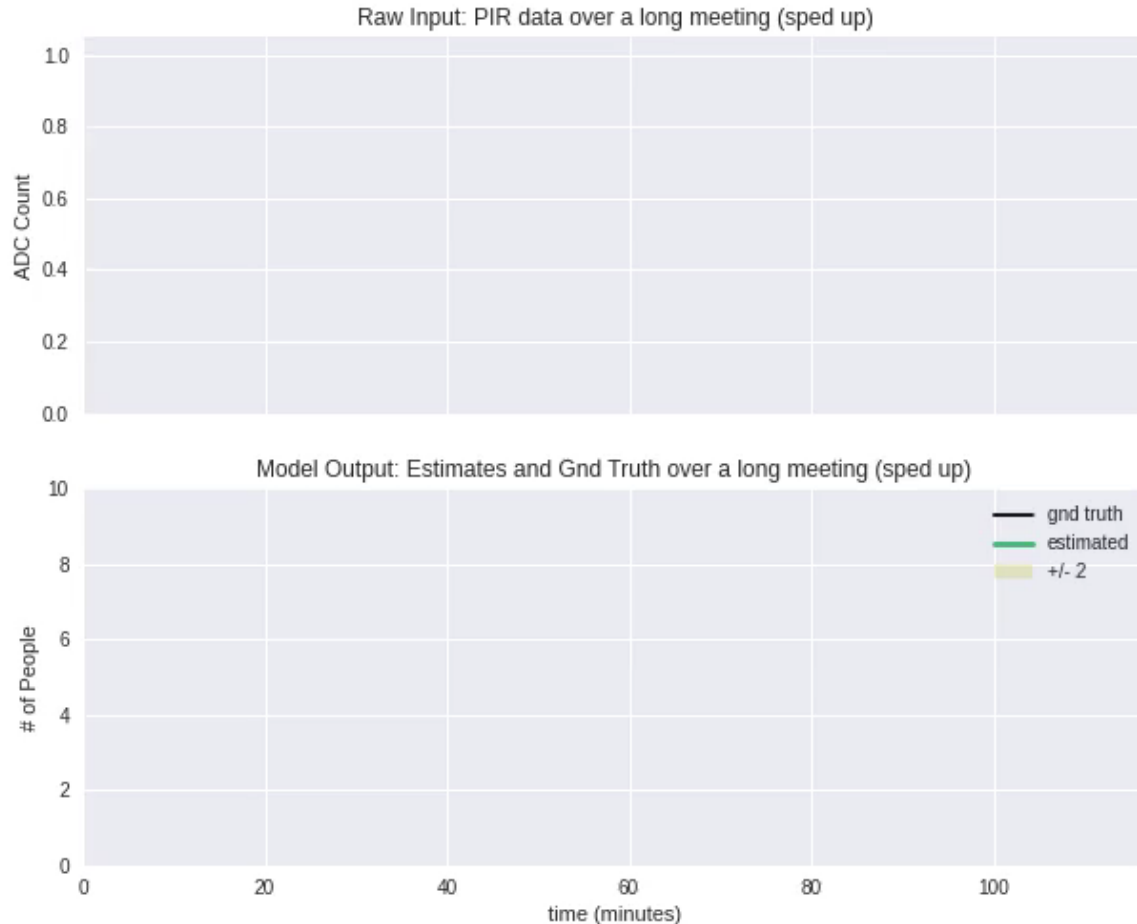
Sensor	Description
Composite Temperature	The estimated occupant temperature based on air temperature and IR temperature.
Relative Humidity	The occupant height adjusted relative humidity computed from an onboard RH sensor and the composite temperature.
Luminosity	Light intensity measured from an onboard light and color sensor.
PIR Sensor	Standard PIR sensor
Microphones	Two digital MEMs microphones



$$MAE = \frac{1}{n} \sum_{i=1}^n |y_i - x_i|$$

$$PW2 = \frac{n_{error < 2}}{n_{total}}$$

# AI Applications – Occupancy Sensor Fusion



## Estimated Occupancy (4143813.AV40)

3

Control Signal	3	at Priority 13
Control Source	4143813	
COV Minimum Increment	1	
Auto Value	0	
Reliability	No Fault Detected	

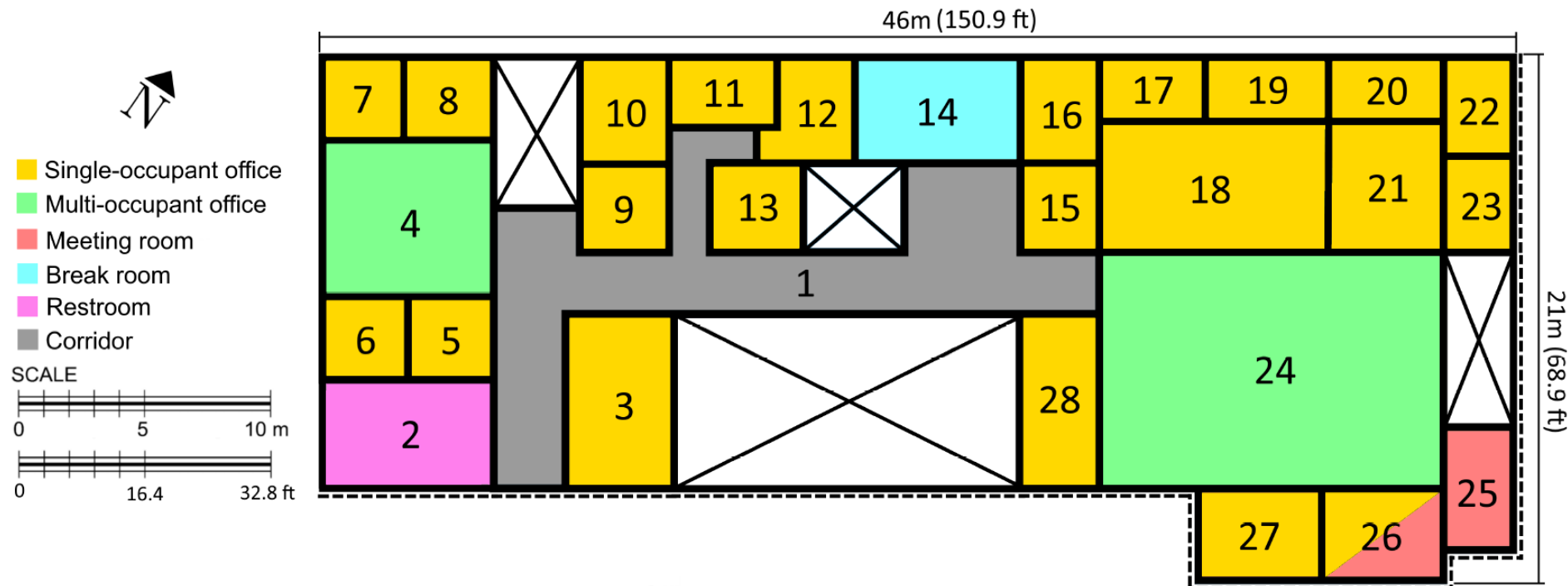
### Configuration

Name	Estimated Occupancy
Units	(No Units)
Default Value	0
Reliability Evaluation Inhibit	<input type="checkbox"/>
Commissioned	<input type="checkbox"/>
Manual Override at	<input checked="" type="radio"/> Priority 5 <input type="radio"/> Priority 8
COV Minimum Increment	1
Fixed Point	<input checked="" type="checkbox"/>
Decimal Places	0

- Privacy preserving, self-contained, approximate-people-counting solution
- Uses machine learning model to estimate # of occupants from a noisy PIR sensor
- Approximate but useful, close enough for most applications
- 86% of meetings contain 6 or less occupants

# Predictive Control Case Study Building

- Dedicated VAV AHU for 4<sup>th</sup> floor (top floor) living lab
- One room per zone cooling-only VAV with wall mounted radiant heating
- Located in Ottawa, ON, Canada



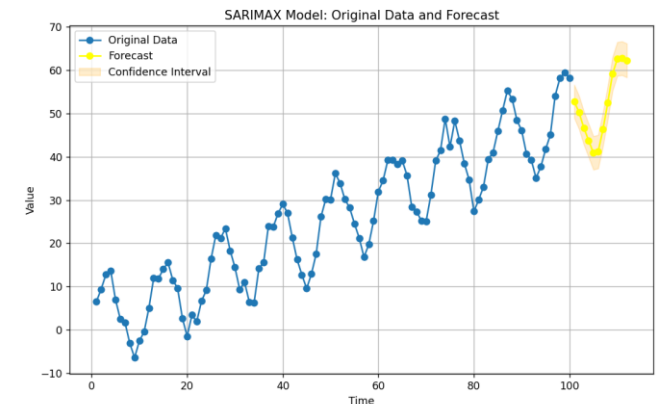
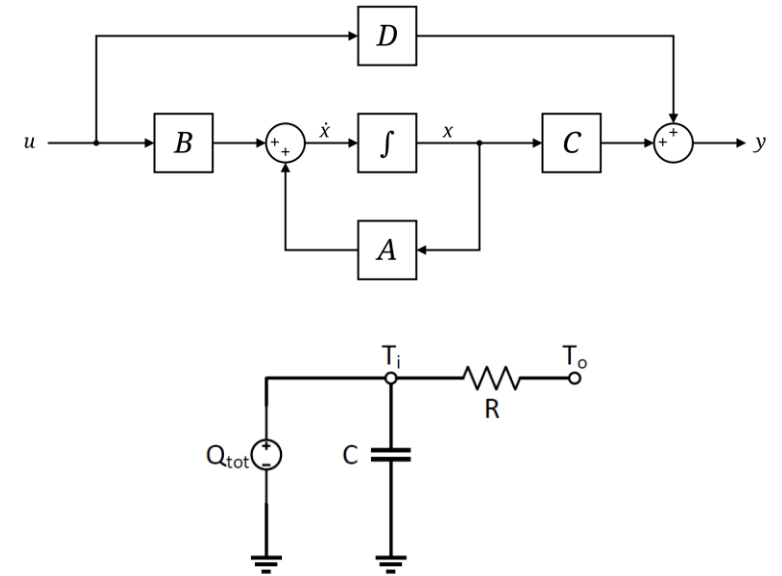
# MPC Algorithm Considerations Explored

Optimization – Simultaneous for Energy and Thermal Comfort Using:

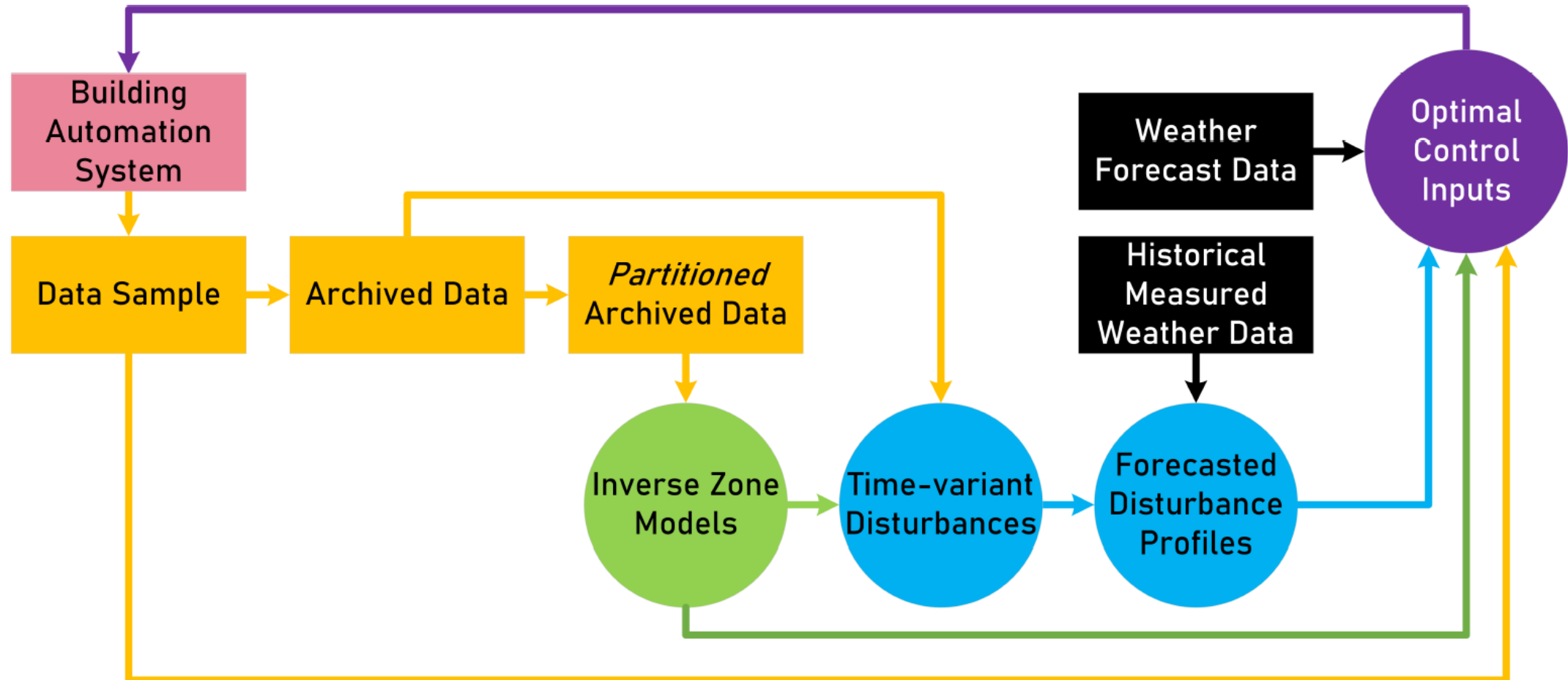
- Minimum Energy Trajectory Inputs
  - Zone Air Flow
  - Zone Discharge Air Temperature
  - Zone Air Temperature
- Thermal Comfort Inputs
  - Indoor Air Temperature
  - Indoor Air Temperature Setpoint

Models:

- State-space
- Lumped Capacitance
- Seasonal Autoregressive Integrated Moving Average with Exogenous Regressors (SARIMAX)

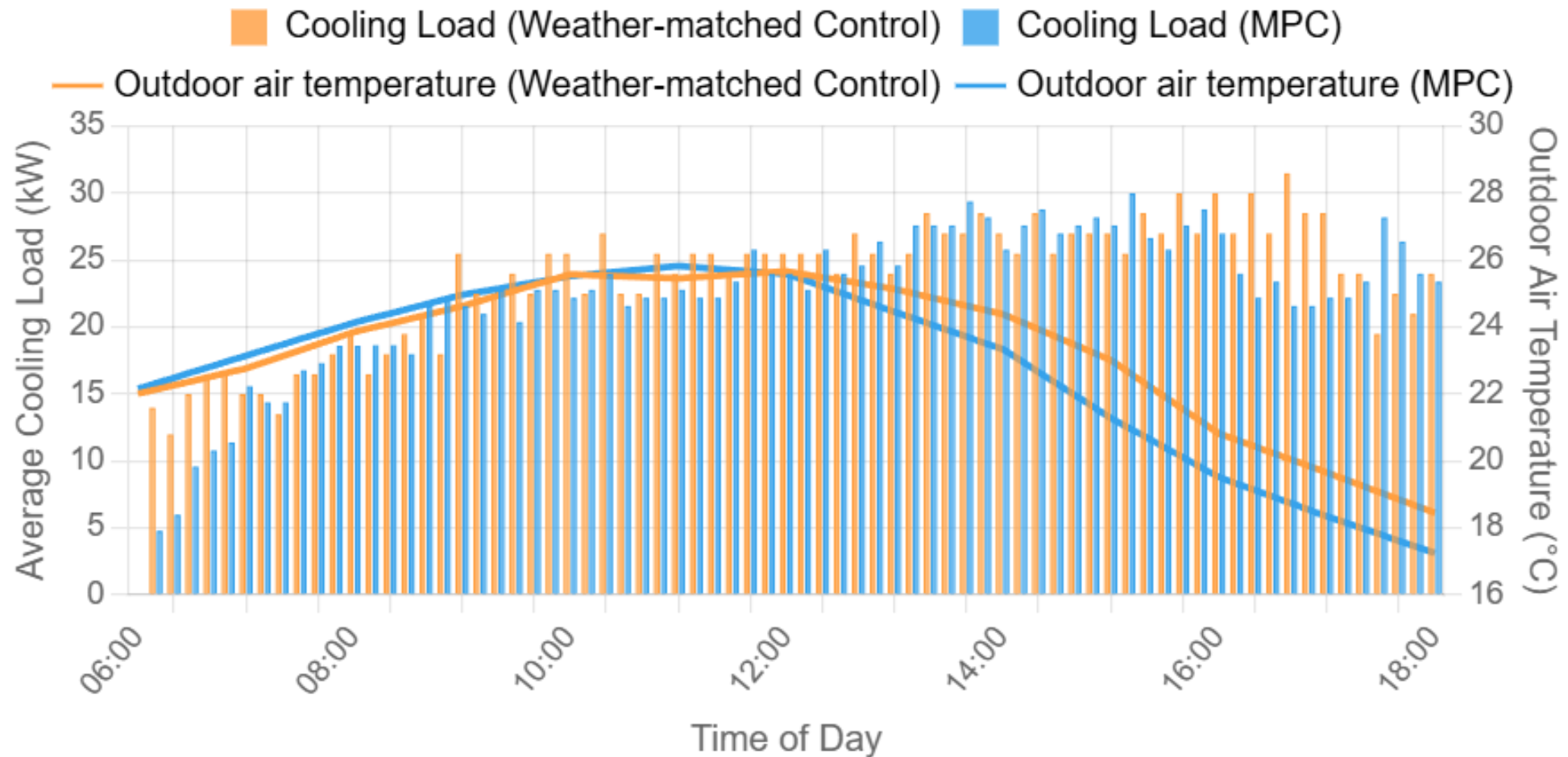


# Cloud Supervisory Control Diagram



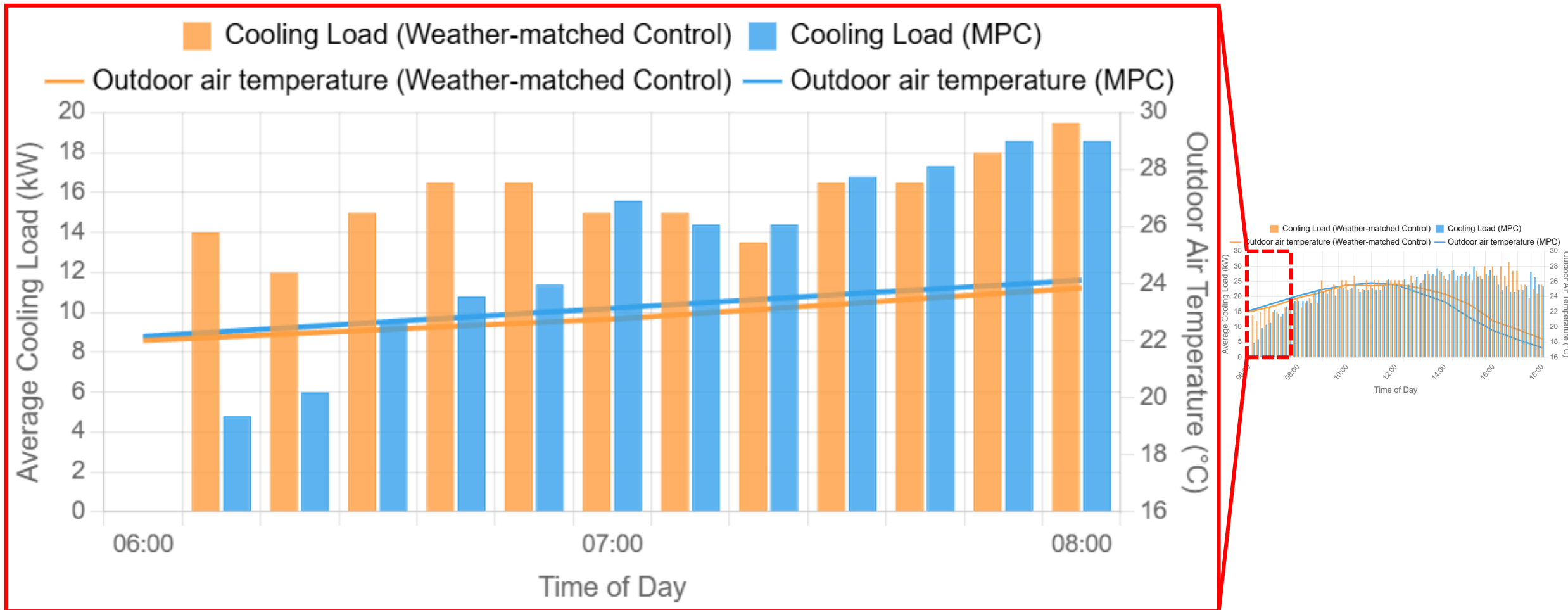
# Results – Cooling Season

- Daily average cooling energy use during operating hours (6 am – 6 pm) reduced by **4.6%**



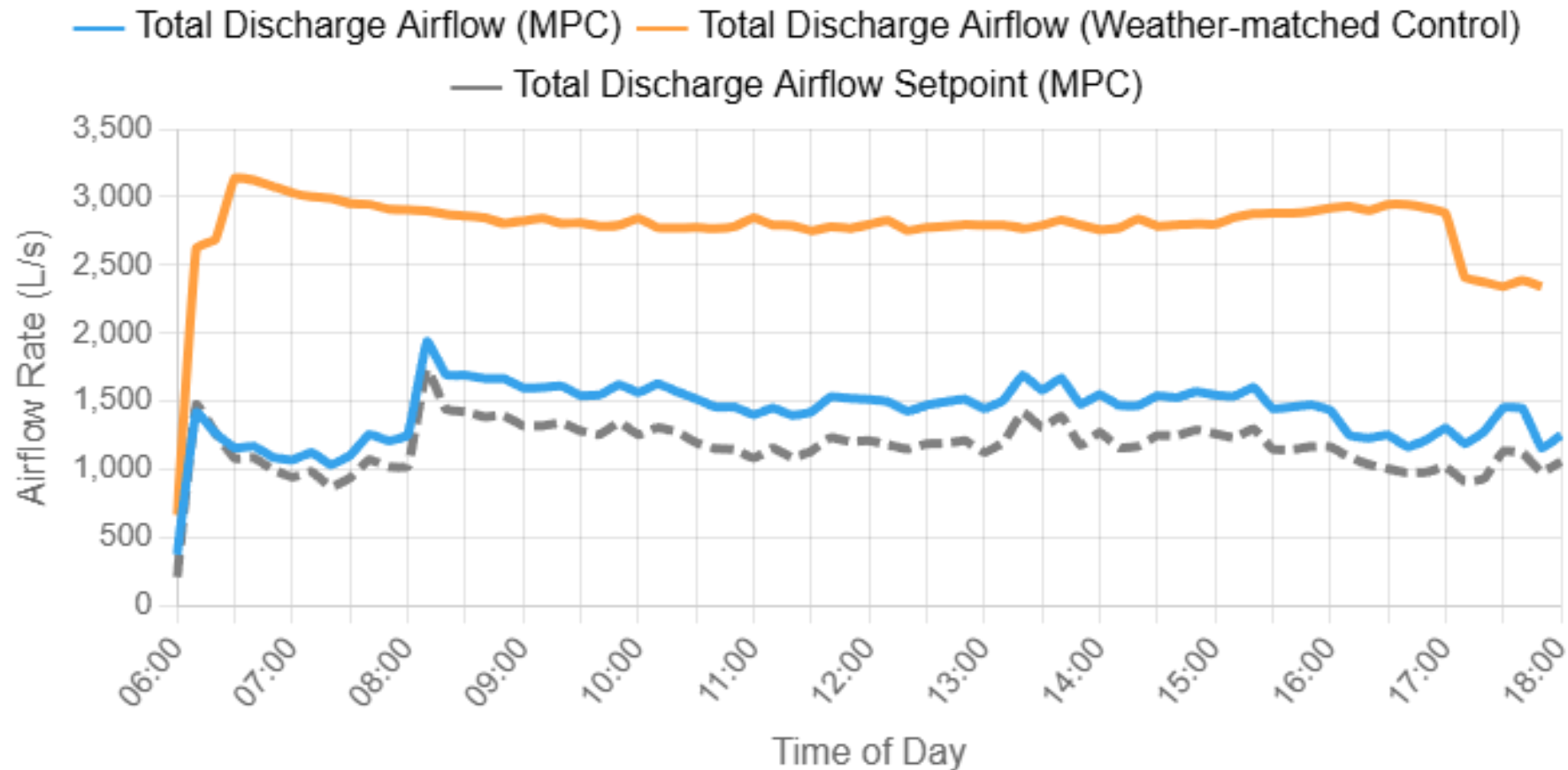
# Results – Cooling Season

- Early-morning start-up loads (6 am – 8 am) reduced by **15.8%**



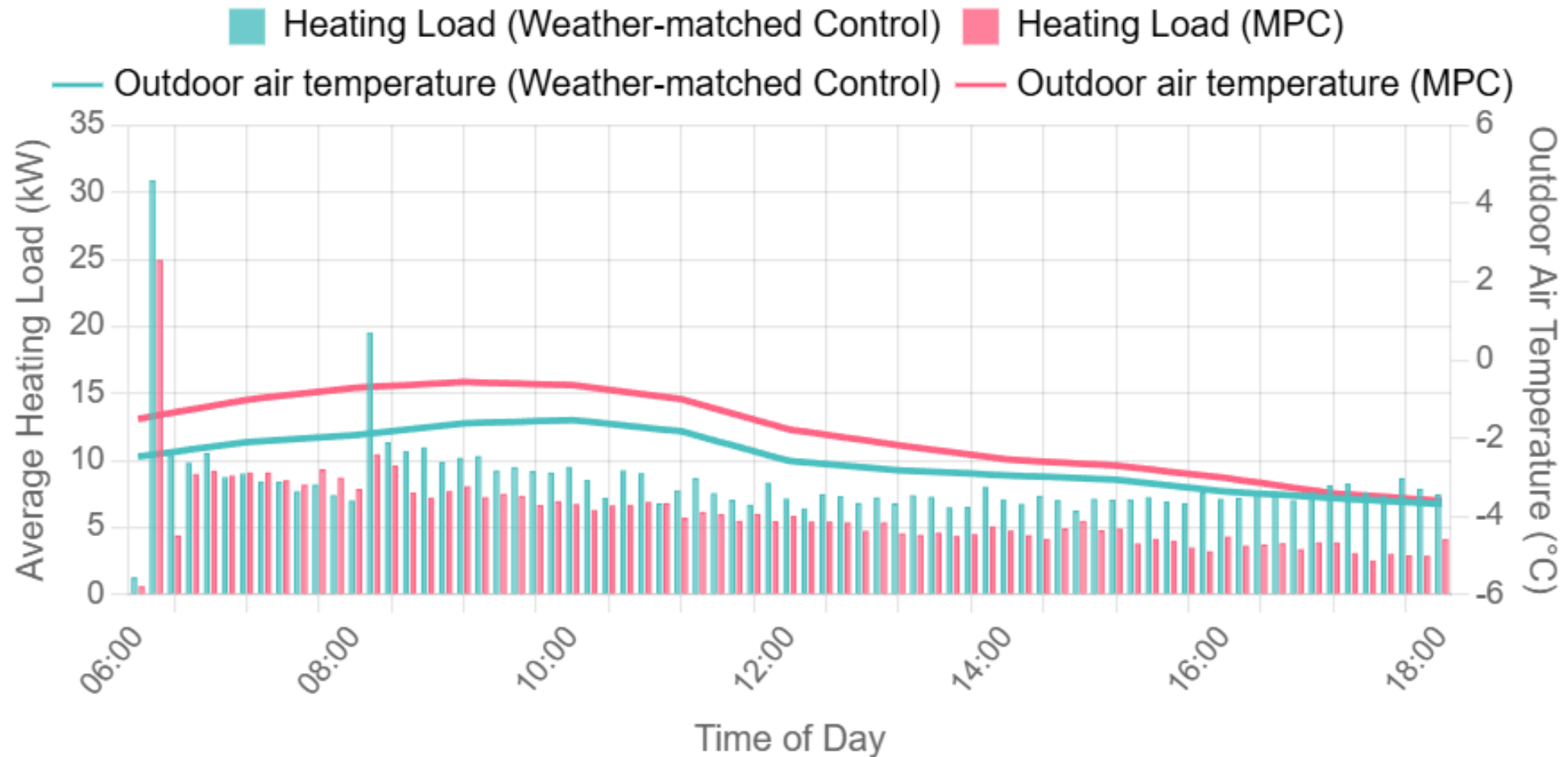
# Results – Cooling Season

- Total discharge airflow rate aggregated across all zones decreased by **52.5%** during the MPC period.
- Leaky or miscalibrated VAV dampers account for an additional **26.4%** unrealized reduction.



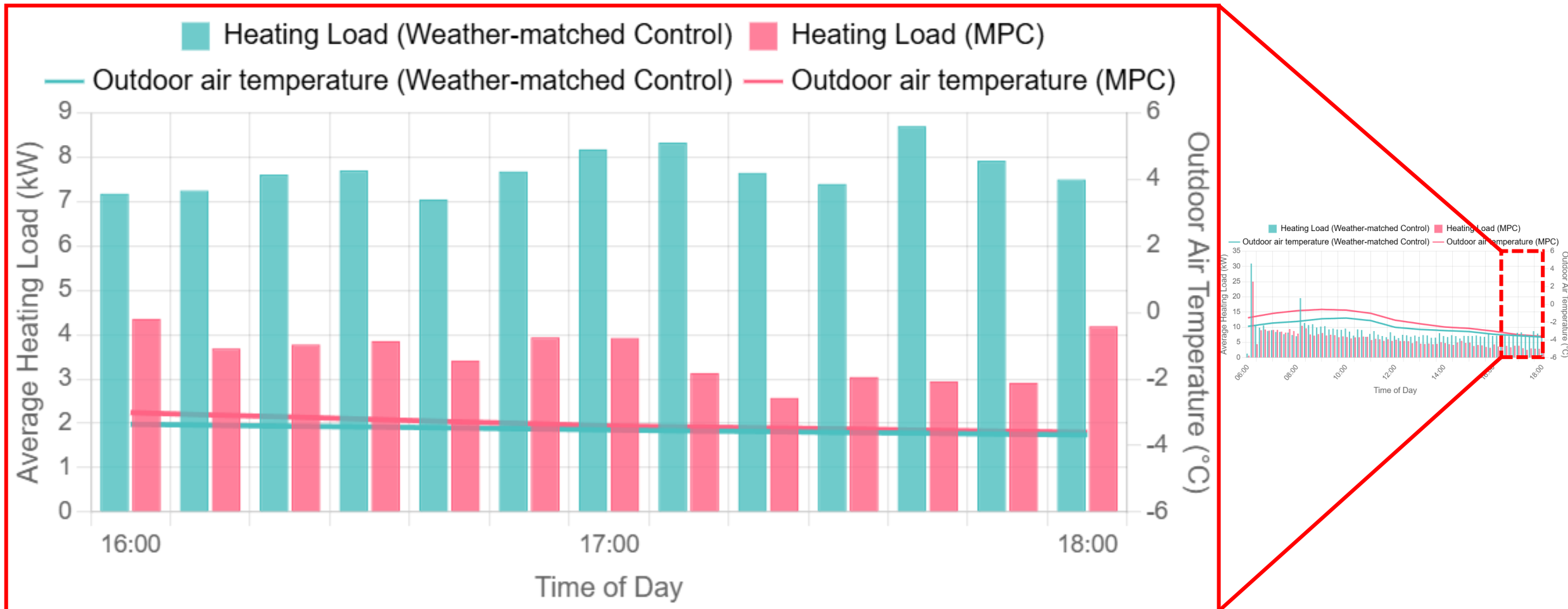
# Results – Heating Season

- Daily average heating energy use during operating hours (6 am – 6 pm) reduced by **28.7%**



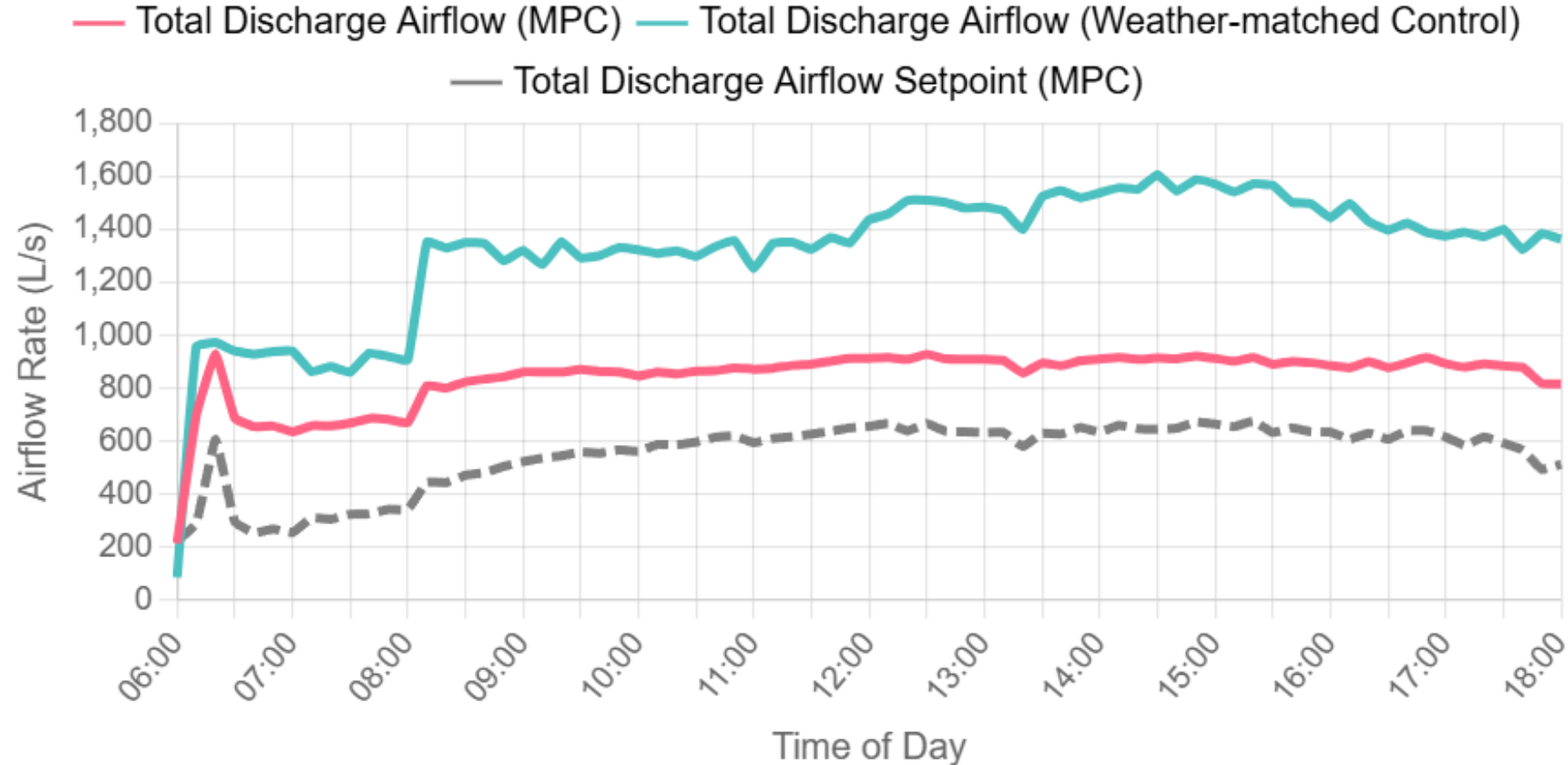
# Results – Heating Season

- Late-afternoon period loads preceding end-of-occupancy (4 pm – 6 pm) reduced by **54.3%**



# Results – Heating Season

- Total discharge airflow rate aggregated across all zones decreased by **36.6%** during the MPC period.
- Leaky or miscalibrated VAV dampers account for an additional **52.4%** unrealized reduction.



# MPC Results Summary

- Simple lumped capacitance models with active parameter estimation can be rapidly deployed at the zone level
- Differences in ambient conditions between MPC and control testing periods did not impact the results significantly
- Leaky dampers increased measured energy use from MPC target

	Cooling	Heating
MPC Energy Savings (All Day)	4.6%	28.7%
MPC Energy Savings (Startup)	15.8%	54.3%
MPC Airflow Rate Reduction	52.5%	36.6%

# Generative AI Disclaimer

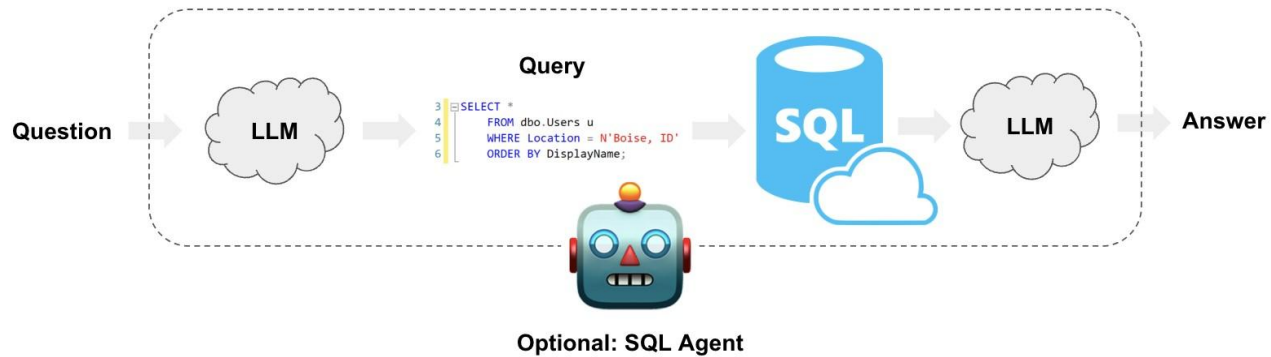


Please note that the use of generative artificial intelligence (AI) using large language models (LLM) in analysis is subject to the following conditions:

- **Accuracy:** While generative AI strives to provide accurate and insightful data analysis, it is not infallible. The results should be cross-verified for accuracy.
- **Data Sensitivity:** Generative AI may not fully comprehend the sensitivity or context of the data it analyzes. Users are responsible for ensuring the appropriateness of the data used.
- **Bias:** AI models may unintentionally incorporate biases present in their training data. Users should be aware of potential bias in the results.
- **Interpretation:** The interpretation of the results generated by AI requires expertise in the relevant field. Misinterpretation of the results can lead to incorrect conclusions.
- **Responsibility:** The user assumes full responsibility for any decisions or actions taken based on the results generated by the AI.

*“It’s almost like talking to real people.”* – Someone at ASHRAE

# Early LLM Example



- Tools:
  - BOT Framework
  - GPT 4 Turbo JSON API and Function Calling
  - Building data via BACnet API

The screenshot shows a chat interface with a user and an LLM. The LLM's response is highlighted in green. The chat history includes:

- User: I have found the relevant information in the file you provided:  
Site: Virtual Site  
Controller ID: 102204  
Object Name for Air Temperature Sensor: analog-input,101001  
Using this information, I will now retrieve the current temperature in room RM4514.  
17:47:29
- LLM: 

```
get_raw_data {"site":"Virtual Site","controller":"102204","object":"analog-input,101001"} {"status_code": 200, "description": "success", "response": {"$base": "Object", "display
```
- User: please get me the current temperature  
17:48:20
- LLM: 

```
get_raw_data {"site":"Virtual Site","controller":"102204","object":"analog-input,101001"} {"status_code": 200, "description": "success", "response": {"$base": "Object", "display
```
- User: The current temperature in room RM4514 remains at 21.93°C.  
17:48:30
- User: what is the value 1 hour ago  
17:48:40
- LLM: 

```
get_raw_data_record {"site":"Virtual Site","controller":"102204","object":"analog-input"} {"$base": "List", "1": {"$base": "Sequence", "timestamp": {"$base": "DateTime", "value
```
- User: One hour ago, the temperature in room RM4514 was also 21.93°C. The temperature has been consistent.  
17:49:00

what is the current temperature reading of the thermostat in room 2504  
20:27:49

```
get_raw_data {"site": "Virtual Site", "controller": "102106", "object": "analog-input,10100": {"status_code": 200, "description": "success", "response": {"$base": "Object", "display": "22.1219°C"}}
```

The current temperature reading of the thermostat in room 2504 is 22.1219°C.  
20:28:07

what is the record in the last 7 days?  
20:28:31

```
get_raw_data_record {"site": "Virtual Site", "controller": "102106", "object": "analog-input": {"$base": "List", "1": {"$base": "Sequence", "timestamp": {"$base": "DateTime", "value": "2024-02-08T12:00:00"}, "value": "22.1219°C"}, "2": {"$base": "Sequence", "timestamp": {"$base": "DateTime", "value": "2024-02-12T12:00:00"}, "value": "22.1219°C"}}
```

The record that was retrieved only contains data entries for February 8th and February 12th, 2024. Throughout these times, the temperature readings were consistently logged as 22.1219°C, with all status flags indicating a 'fault' condition. It seems that the available data does not cover the entire requested 7-day period, and the records provided may not reflect any variations that occurred during this time.  
For a continuous 7-day trend, more comprehensive data collection and record retrieval would be necessary to ensure all variations within that timeframe are captured accurately.  
20:28:51

generate a report in pdf, briefly describe the trends, and give some advice for administration  
20:29:39

The report describing the temperature trends and providing advice for administration has been generated. You can download it using the following link:  
[Download Room 2504 Temperature Report PDF](#)  
20:30:21

**DOWNLOAD**

message



# Early LLM Example (cont.)

## Temperature Reading Report for Room 2504

### Report Summary

This report provides an overview of the temperature readings in Room 2504 from the system's records.

### Trend Analysis:

The available data shows consistent temperature readings of 22.1219°C throughout the observed time frame (February 8th and 12th, 2024). All log entries indicate a 'fault' status, suggesting that the readings may not fully represent actual conditions.

### Advice for Administration:

- Given the consistent 'fault' status flags, it is imperative to conduct an immediate inspection of the temperature sensors and associated equipment in Room 2504 to ensure they are operating correctly.
- Implement a more rigorous monitoring and maintenance schedule for the HVAC systems to prevent potential failures and ensure accurate temperature readings.
- Consider incorporating redundant temperature sensors for critical areas like Room 2504 to provide a fallback option in case of sensor malfunctions, enhancing reliability.

# Greenfield Autotagging During System Configuration

- Template-driven using **public ontologies**
- Rich metadata (including BACnet data) and native semantic data models
- Application-specific constraints
- Multi-agent hierarchy
- Significant RAG
  - Knowledge bases on application-specific configurations
  - Functions/Tools for processes that require a rigid deterministic structure



# Greenfield Autotagging in Action

**Chat** Reset Chat

**SYSTEM**  
Talk to the assistant here!

Submit a prompt to the assistant...

**SEND**

**Model Status** Refresh

Equipment	Locations	Relationships							
<table><tr><td>Alias</td><td>Type</td></tr></table>	Alias	Type	<table><tr><td>Alias</td><td>Type</td></tr></table>	Alias	Type	<table><tr><td>Subject</td><td>Predicate</td><td>Object</td></tr></table>	Subject	Predicate	Object
Alias	Type								
Alias	Type								
Subject	Predicate	Object							

**Point List** Refresh

Point Name	Assigned Device #	URI	Point Type	Equip Type	Equip Alias	Location Type	Location Alias
------------	-------------------	-----	------------	------------	-------------	---------------	----------------

# Greenfield Autotagging in Action

**Chat** Reset Chat

**SYSTEM**  
Talk to the assistant here!

**USER**  
I'd like to model a building with two floors (Ground\_Floor and Second\_Floor) with a mechanical room (RM\_2000) on the second floor.  
There are also 3 Zones on the ground floor (RM\_1001 to RM\_1003) as well as a washroom (RM\_1006).

**ASSISTANT**  
I have registered the following components for your building model:

**Locations:**

- **Building**
  - **Ground\_Floor**
    - RM\_1001
    - RM\_1002
    - RM\_1003
    - RM\_1006 (Washroom)
  - **Second\_Floor**
    - RM\_2000 (Mechanical Room)

**Relationships:**

- The **Building** has parts comprising **Ground\_Floor** and **Second\_Floor**.
- The **Ground\_Floor** contains **RM\_1001**, **RM\_1002**, **RM\_1003**, and **RM\_1006**.
- The **Second\_Floor** contains **RM\_2000**.

Please let me know if there are any more components you'd like to add, or if you'd like to proceed to assemble the model.

Submit a prompt to the assistant...

I

**SEND**

**Model Status**

Equipment	
Alias	Type
Building	Building

Locations	
Alias	Type
Building	Building
Ground_Floor	Level
Second_Floor	Level
RM_2000	Room
RM_1001	Room
RM_1002	Room
RM_1003	Room
RM_1006	Washroom

Relationships		
Subject	Predicate	Object
Building	rec:hasPart	Ground_Floor
Building	rec:hasPart	Second_Floor
Ground_Floor	rec:hasPart	RM_1001
Ground_Floor	rec:hasPart	RM_1002
Ground_Floor	rec:hasPart	RM_1003
Ground_Floor	rec:hasPart	RM_1006
Second_Floor	rec:hasPart	RM_2000

**Point List**

Point Name	Assigned Device #	URI	Point Type	Equip Type	Equip Alias	Location Type	Location Alias
------------	-------------------	-----	------------	------------	-------------	---------------	----------------

# Greenfield Autotagging in Action

**Chat** Reset Chat

**SYSTEM**  
Talk to the assistant here!

**USER**  
I'd like to model a building with two floors (Ground\_Floor and Second\_Floor) with a mechanical room (RM\_2000) on the second floor.  
There are also 3 Zones on the ground floor (RM\_1001 to RM\_1003) as well as a washroom (RM\_1006).

**ASSISTANT**  
I have registered the following components for your building model:

**Locations:**

- **Building**
  - **Ground\_Floor**
    - RM\_1001
    - RM\_1002
    - RM\_1003
    - RM\_1006 (Washroom)
  - **Second\_Floor**
    - RM\_2000 (Mechanical Room)

**Relationships:**

- The **Building** has parts comprising **Ground\_Floor** and **Second\_Floor**.
- The **Ground\_Floor** contains RM\_1001, RM\_1002, RM\_1003, and RM\_1006.
- The **Second\_Floor** contains RM\_2000.

Please let me know if there are any more components you'd like to add, or if you'd like to proceed to assemble the model.

**USER**

Submit a prompt to the assistant...

**SEND**

**Model Status**

Equipment	
Alias	Type
Building	Building

Locations	
Alias	Type
Building	Building
Ground_Floor	Level
Second_Floor	Level
Room101	Room
Room102	Room
Room103	Room
Room106	Washroom
Room200	Room

Relationships		
Subject	Predicate	Object
Building	rec:hasPart	Ground_Floor
Building	rec:hasPart	Second_Floor
Ground_Floor	rec:hasPart	Room101
Ground_Floor	rec:hasPart	Room102
Ground_Floor	rec:hasPart	Room103
Ground_Floor	rec:hasPart	Room106
Second_Floor	rec:hasPart	Room200

**Point List**

Point Name	Assigned Device #	URI	Point Type	Equip Type	Equip Alias	Location Type	Location Alias
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# Greenfield Autotagging in Action

**Chat** Reset Chat

**SYSTEM**  
Talk to the assistant here!

**USER**  
I'd like to model a building with two floors (Ground\_Floor and Second\_Floor) with a mechanical room (RM\_2000) on the second floor.  
There are also 3 Zones on the ground floor (RM\_1001 to RM\_1003) as well as a washroom (RM\_1006).

**ASSISTANT**  
I have registered the following components for your building model:

**Locations:**

- **Building**
  - **Ground\_Floor**
    - RM\_1001
    - RM\_1002
    - RM\_1003
    - RM\_1006 (Washroom)
  - **Second\_Floor**
    - RM\_2000 (Mechanical Room)

**Relationships:**

- The **Building** has parts comprising **Ground\_Floor** and **Second\_Floor**.
- The **Ground\_Floor** contains RM\_1001, RM\_1002, RM\_1003, and RM\_1006.
- The **Second\_Floor** contains RM\_2000.

Please let me know if there are any more components you'd like to add, or if you'd like to proceed to assemble the model.

**USER**

Submit a prompt to the assistant...

**SEND**

**Model Status**

**Equipment**

Alias	Type
AHU_01	4.6 Multiple Zone VAV Air-Handling Unit
VAV_01	VAV-Reheat_Type4-Basic
VAV_02	VAV-Reheat_Type4-Basic
VAV_03	VAV-Reheat_Type4-Basic
EF_01	4.9 General Constant Speed Exhaust Fan

**Locations**

Alias	Type
Building	Building
Ground_Floor	Level
Second_Floor	Level
Room101	Room
Room102	Room
Room103	Room
Room106	Washroom
Room200	Room

**Relationships**

**Point List**

Point Name	Assigned Device #	URI	Point Type	Equip Type	Equip Alias	Location Type	Location Alias
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# Greenfield Autotagging in Action

**Chat** Reset Chat

**Relationships:**

- Room200 is the location of AHU\_01.
- AHU\_01 feeds VAV\_01, VAV\_02, and VAV\_03.
- Room101 is fed by VAV\_01.
- Room102 is fed by VAV\_02.
- Room103 is fed by VAV\_03.
- Room106 is the location of EF\_01.

Would you like to add more components or proceed to assemble the model?

**USER**  
change VAV2 to be cooling only

**ASSISTANT**  
The VAV unit has been changed as follows:

- VAV\_02 is now a Cooling Only VAV Terminal Unit.

The existing relationships indicating that AHU\_01 feeds VAV\_02 and that Room102 is fed by VAV\_02 were already present, so no new relationships were added.

Would you like to proceed to assemble the model now?

**USER**  
assemble the model

**ASSISTANT**  
The model has been successfully assembled without any errors. It is now ready for serialization.

Would you like to finalize and commit the assembled model, make any further changes, or serialize the model (note that serializing now will lack external point references)?

Submit a prompt to the assistant...

I

SEND

**Model Status** ↻

Equipment	
Alias	Type
AHU_01	4.6 Multiple Zone VAV Air-Handling Unit
VAV_01	VAV-Reheat_Type4-Basic
VAV_03	VAV-Reheat_Type4-Basic
EF_01	4.9 General Constant Speed Exhaust Fan
VAV_02	4.1 VAV Terminal Unit - Cooling Only

Locations	
Alias	Type
Building	Building
Ground_Floor	Level
Second_Floor	Level
Room101	Room
Room102	Room
Room103	Room
Room200	Room
Room106	Bathroom

Subject	Predicate	Object
Building	rec:hasPart	Ground_Floor
Building	rec:hasPart	Second_Floor
Ground_Floor	rec:hasPart	Room101
Ground_Floor	rec:hasPart	Room102
Ground_Floor	rec:hasPart	Room103
Ground_Floor	rec:hasPart	Room106
Second_Floor	rec:hasPart	Room200
Room200	rec:isLocationOf	AHU_01
Room106	rec:isLocationOf	EF_01

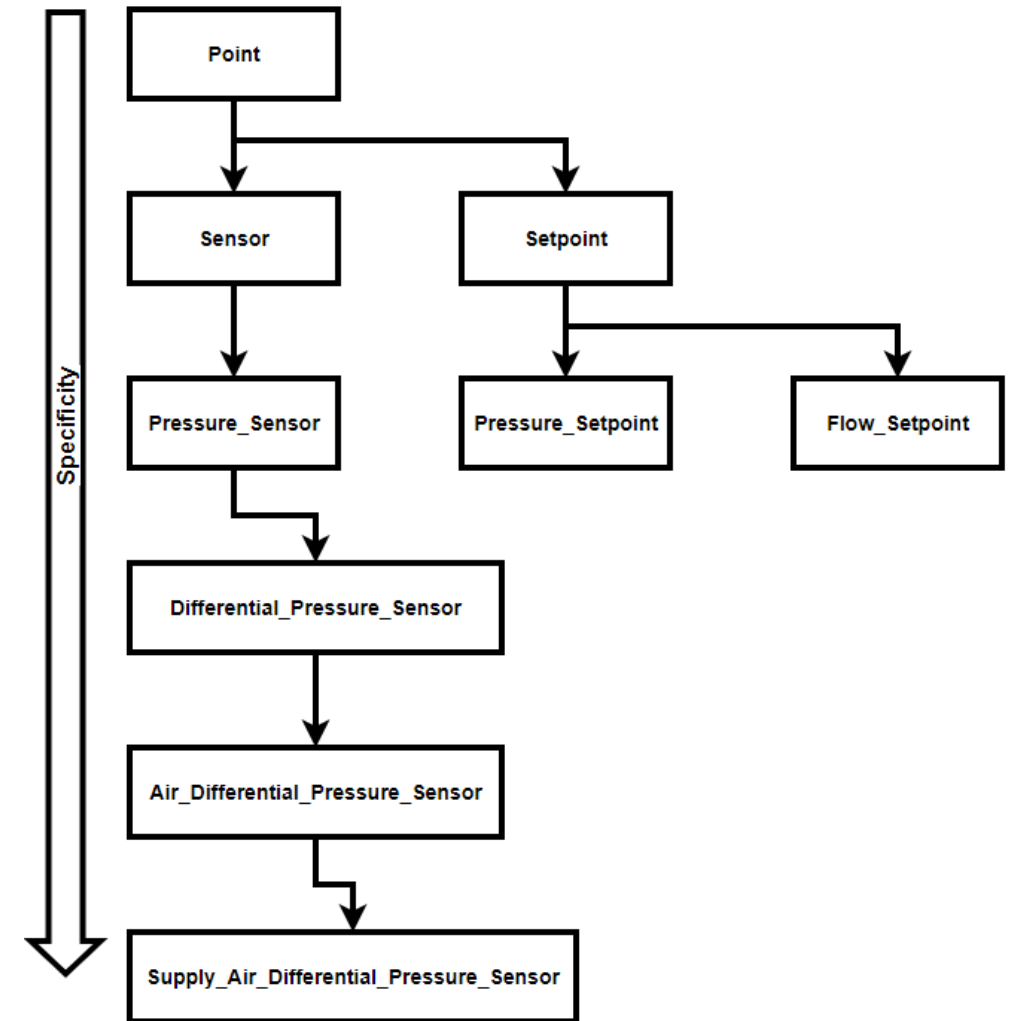
**Point List** ↻

Point Name	Assigned Device #	URI	Point Type	Equip Type	Equip Alias	Location Type	Location Alias
AHU_01_RATS	106		Return_Air_Temperature_Sensor				
AHU_01_SA_FAN_STATUS	106		Fan_Status				
AHU_01_SA_FAN_SS_CMD	106		Start_Stop_Command				
AHU_01_SA_FAN_FQC_CMD	106		Frequency_Command				
AHU_01_FLTR_DPS	106		Filter_Differential_Pressure_Sensor				
AHU_01_MATS	106		Mixed_Air_Temperature_Sensor				
AHU_01_HC_VLV_POS_CMD	106		Valve_Position_Command				
AHU_01_OATS	106		Outside_Air_Temperature_Sensor				
AHU_01_DMP_POS_CMD	106		Damper_Position_Command				

# What About Legacy Data?

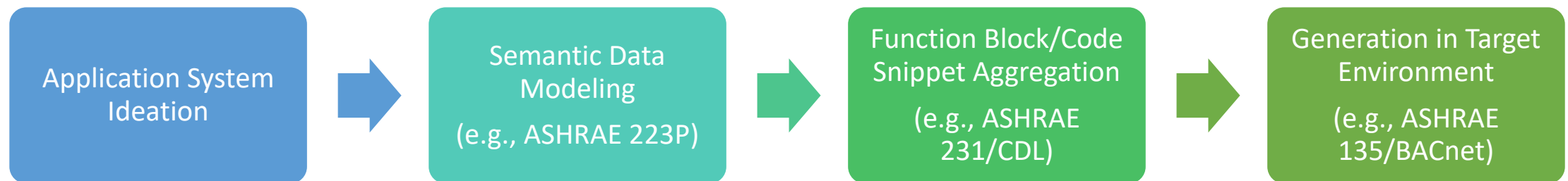
## Tree-of-Thought Deductive Reasoning

- “Brownfield” autotagging of BAS assets with ontology classes already has publicly available heuristic solutions.
- LLMs can be guided in multi-shot ontology classification processes.
  - However, zero-shot is 60%-80% accurate depending on quality of underlying metadata.



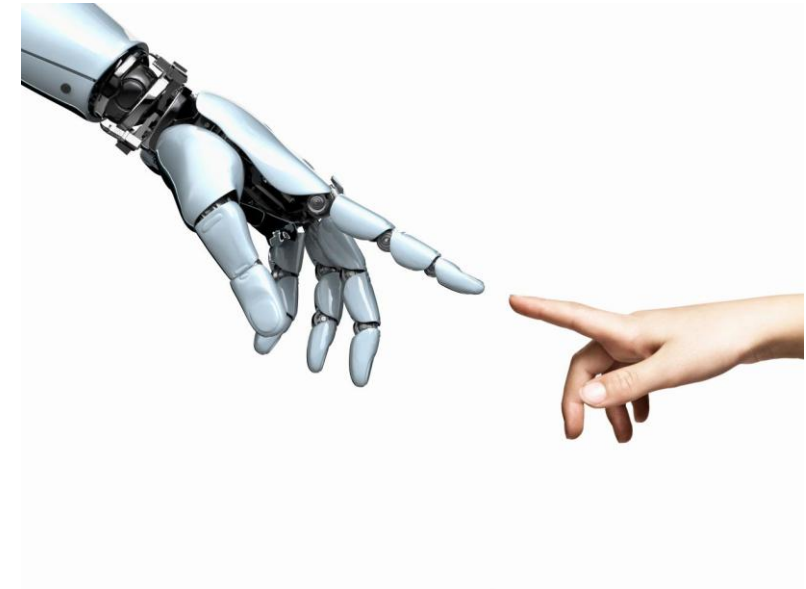
# What Can We Do When Semantic Data Models are Embedded in Typical Workflows?

- Rapidly configure control graphics and graphical user interfaces (GUI)
- Rapidly configure analytics from public (or semi-public) libraries
- Improve single-pane-of-glass data aggregation from multiple protocols and application programming interfaces (API)
- Provide normalized context with ontological definitions of the assets in a system to LLM-powered AI systems



# Conclusions

- Scaling AI in the field requires significant forethought during all phases of design and integration
- Semantic interoperability concepts can improve the success of AI in the field
- Applications constrained to single standardized devices and processes have the most success in the current environment
- MPC provides a multi-objective packaged software-based solution that can overlay on typical points lists
- More complex system-level applications will see higher uptake and success as structured metadata is leveraged in more AI problems for automated/semi-automated deployment
- LLMs can efficiently act as brokers for natural language regardless of the structure (or lack thereof) of underlying data
- Validation of the AI application with “ground-truth” data is essential to reliability



# Questions

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