

# A Reinforcement Learning Framework for AI-Driven Control of Validated White-Box Building Models

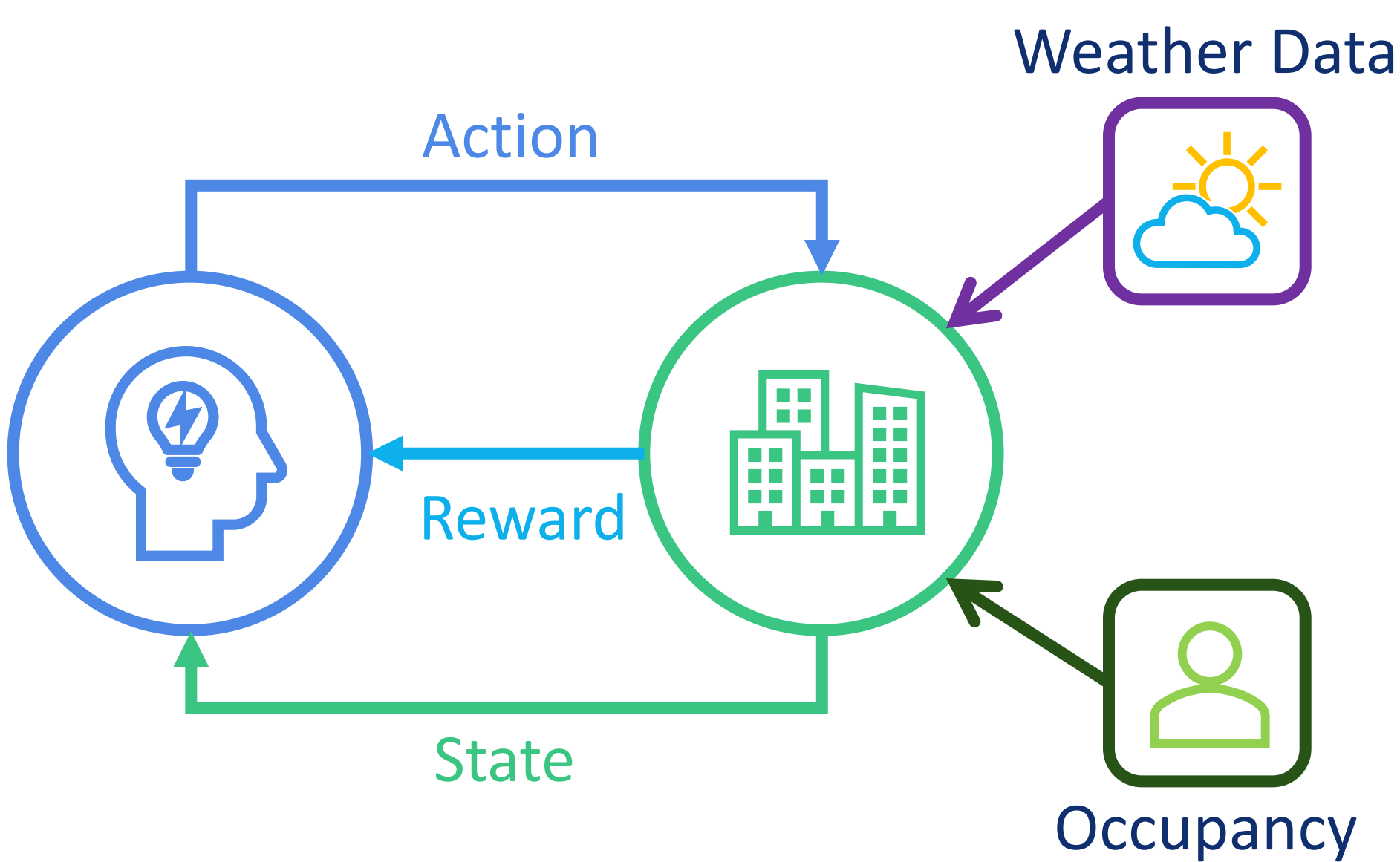
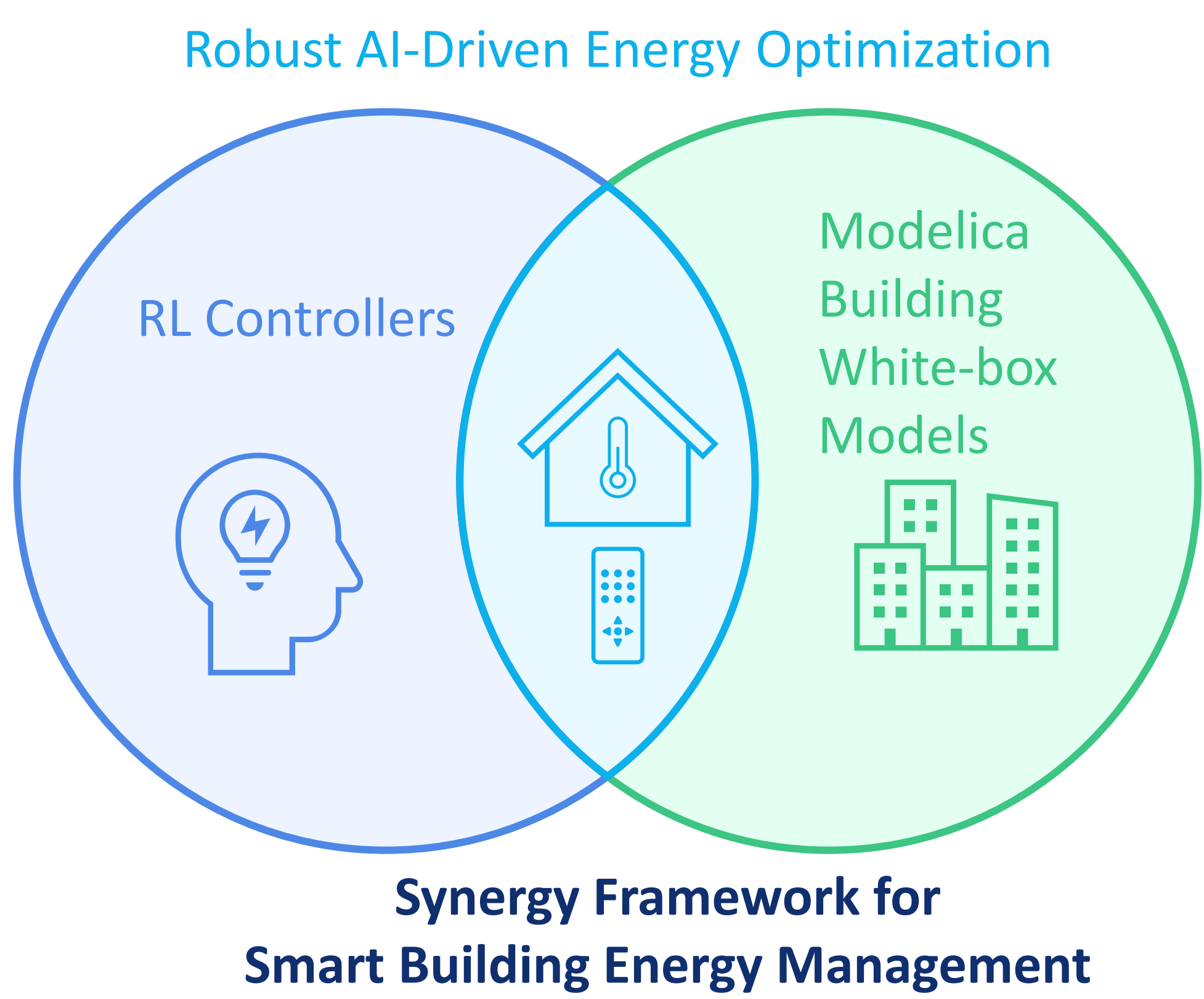
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## Introduction & Motivation

- Buildings accounts for ~40% of global energy use;
- High-fidelity **simulation** are essential before deployment;
- Reinforcement Learning (RL) offers promising AI-driven control for building systems instead of fixed rule control;
- Combines RL agents with Modelica-based white-box building models;
- Supports real-time closed-loop interaction between control and simulation.

## Framework

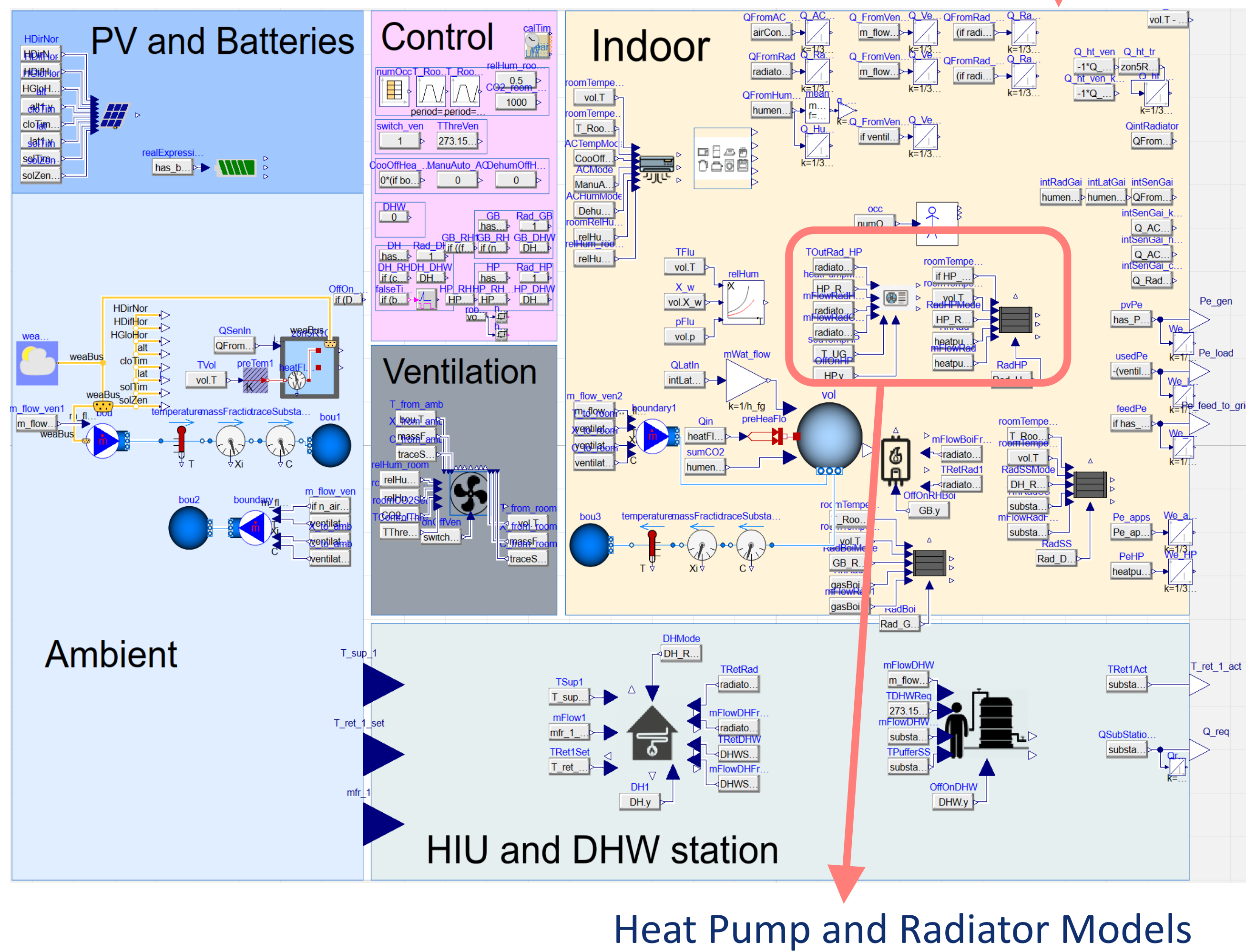
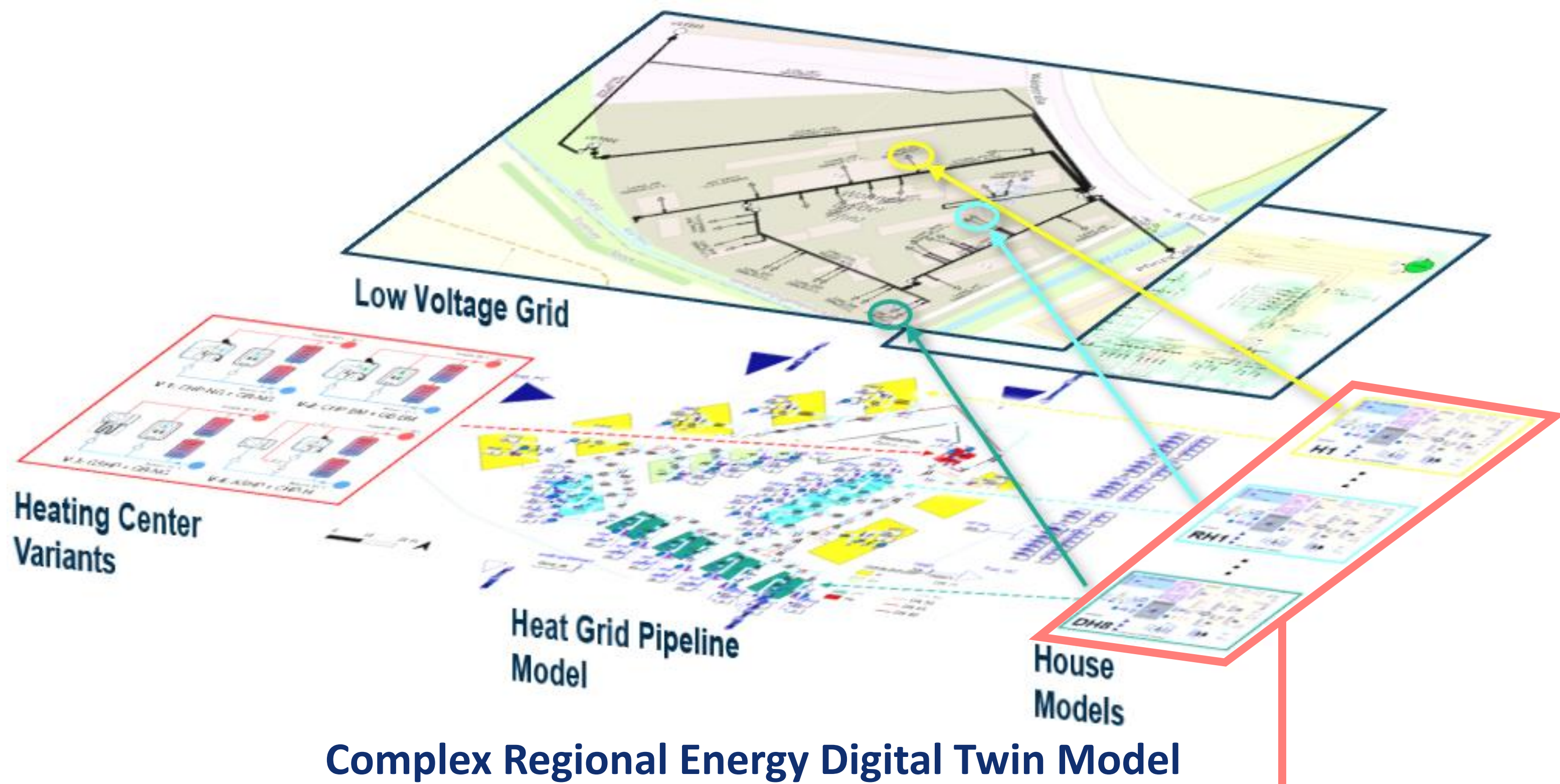


## Control Strategies & Algorithms

- State:**
  - weather Data, temp\_room, m\_flow, occupancy;
  - m\_flow\_min & max (water flow rate limitation);
  - building configuration parameters (U-values, floor area, etc);
- Action:**
  - water flow rate (continous);
- Reward balances energy efficiency, comfort, and operational constraints;
- Goal:** minimize the heating cost over time;
- PPO, SAC, DDPG methods align with the building model.

## Preliminary Results

- Fixed Building parameters;
- Building model verified with comparison of the real world building data.



## Conclusion

- ✓ Modular framework bridging RL with validated simulations;
- ✓ Real-time interaction using verified white-box models;
- ✓ Synthetic data generation for training.

## Future Work

- ✓ Modelica model for experimental houses from the Living Lab Energy Campus (LLEC);
- ✓ Validating by comparing simulation outputs with real-world data;
- ✓ Deploy trained agents in real-world buildings;
- ✓ Extend framework to generalized building models (transfer learning) and grid scenarios.

## REFERENCES

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