

Stop Guessing, Start Optimizing:

How Decision-Focused Learning Makes HVAC Smarter and Cheaper

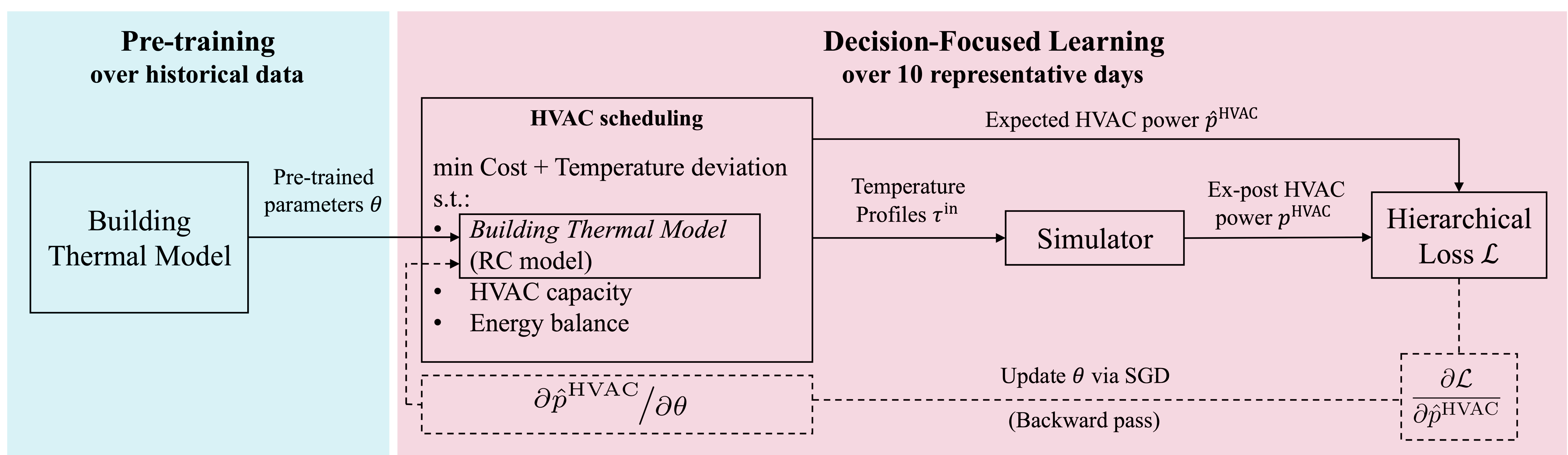
HVAC control matters: space heating = 2/3 of home energy!

? **Did you know?** Nearly two-thirds (64%) of all household energy in Europe goes to space heating—by far the largest single use.

⚡ **The Challenge:** As homes switch from fossil fuels to electric heating and add solar panels or batteries, the power grid faces huge new peaks and complexity.

💡 **The Opportunity:** Smarter, more relevant control of Heating, Cooling and Air Conditioning (HVAC) to *save money* and turn every HVAC decision into a *grid-friendly action*, easing renewable integration.

Our Solution: Decision-Focused Learning (DFL) for HVAC Management System



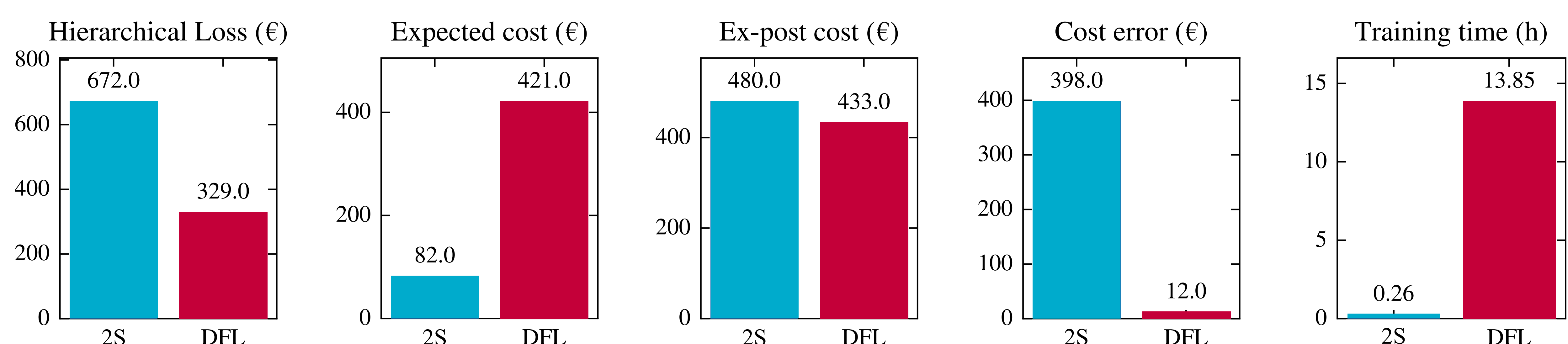
1. **Taks-agnostic learning:** Pre-train on historical data for a solid start.
2. **Decision-focused learning:** Fine-tune by simulating real control decisions, updating the model to minimize real-world errors (i.e., *end-to-end learning*).
3. **Hierarchical Loss**—Loss prioritizing building-wide accuracy, then floor, then zone and bypassing the need for differentiable simulator => *Works with black-box systems*

Realistic Test: 15-Zone Office, Denver, CO

Setup:

- 3-floor building office with 5 zones per floor, EnergyPlus simulation
- Time-of-use tariff day/night
- 10 representative days

Results:



- **Two-Stage (2S):** Training on historical data only (conventional approach)
- **Decision-Focused Learning (DFL):** The proposed approach

😄 **Energy bill reduced by 10%!**

💰 **No more nasty billing surprises!**

🕒 **Computational time to be improved**

Want More?

Full paper



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