NeurIPS 2020 Workshop

- Tackling Climate Change with Machine Learning -

Towards Optimal District Heating in China with Deep Reinforcement Learning

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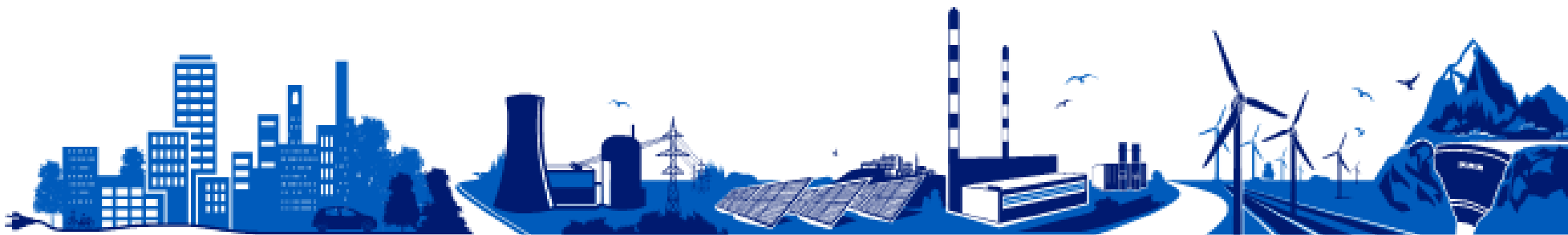
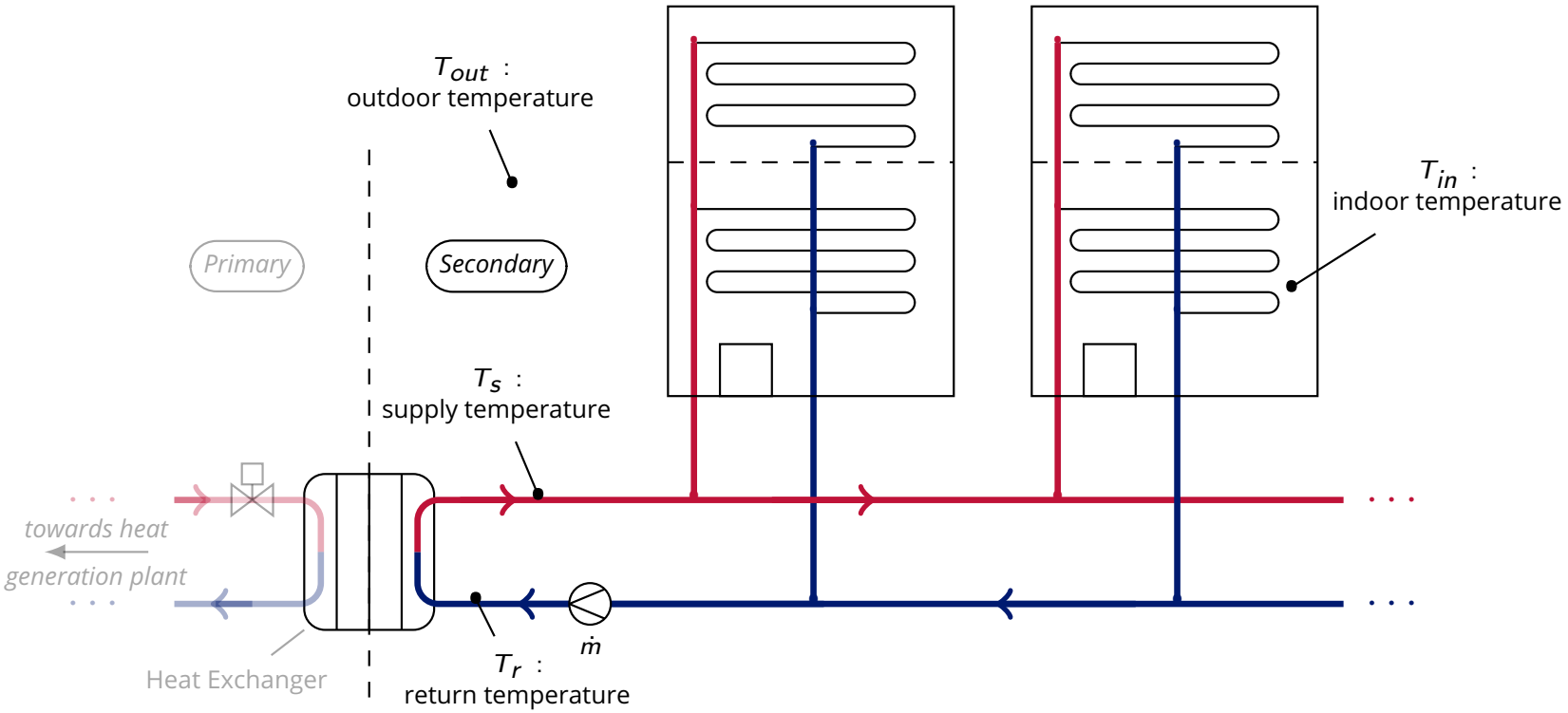


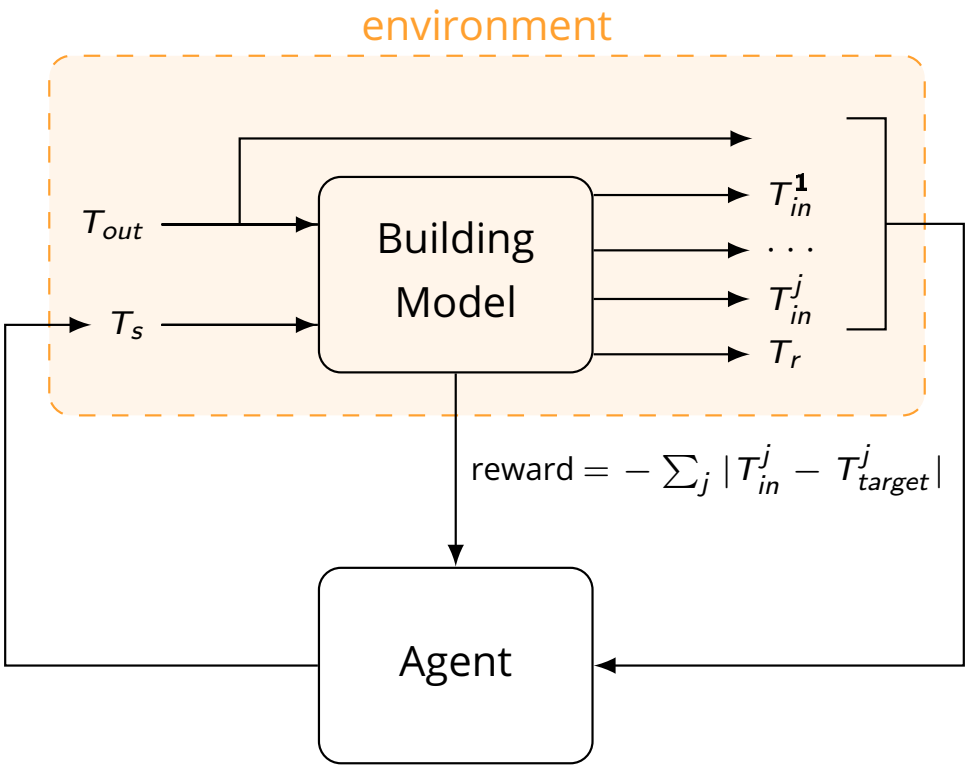
District Heating system - secondary network



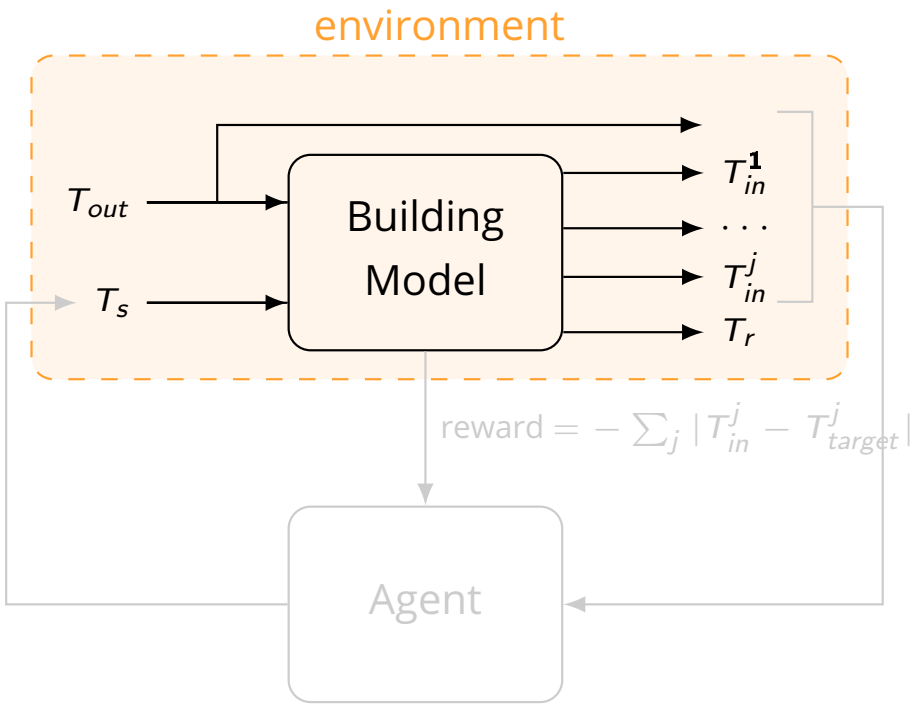
Main hypotheses

- unique central heat production unit
- focus on secondary network
- 10 measurements of T_{in} representative of the network

Approach - A reinforcement learning framework



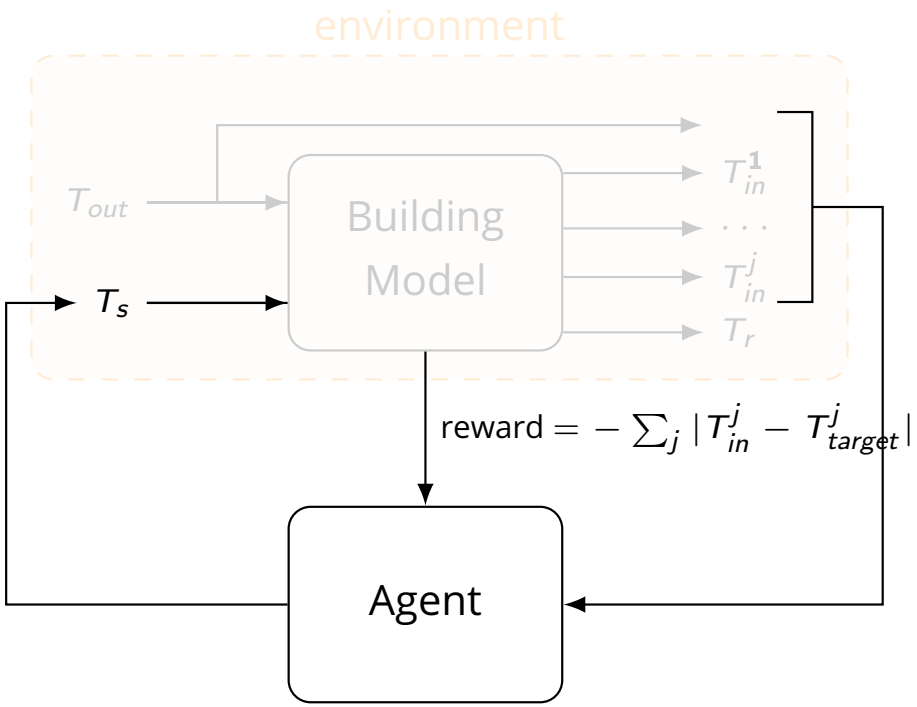
Approach - A reinforcement learning framework



The Environment

- Architecture: stacks two LSTM layers (32 units)
- Inputs: past 5 days of weather + T_s
- Trained on simulated data from expert model in Dymola
- 1-step ahead MAE: 0.110 °C

Approach - A reinforcement learning framework

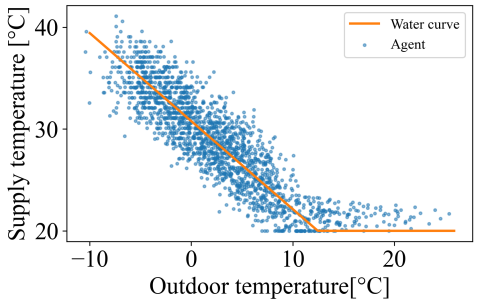


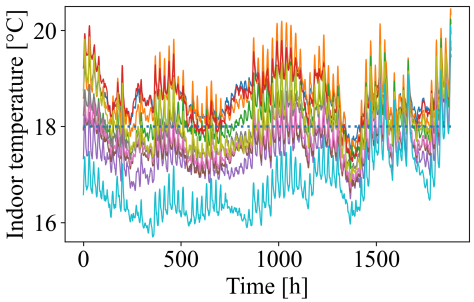
The Agent

- Deep Reinforcement Learning $\rightarrow$ DQN
- State: past 24h T_{in}, T_{out}, T_s and time of the day
- Goal: minimize deviation from target temperature
- Agent 1: bounded discrete increments from last T_s
- Agent 2: bounded discrete increments from baseline T_s
- Random weather file / episode (7 locations)

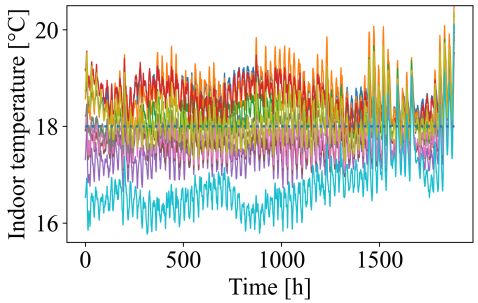
Some results

	MAE (°C)	std T_{in} (°C)	Energy gain (%)	CO_2 saved (g/m^2)
Baseline	0.599	0.755	0	0
PID	0.584	0.742	0.95	215
Agent 1	0.549	0.699	2.15	486





Baseline



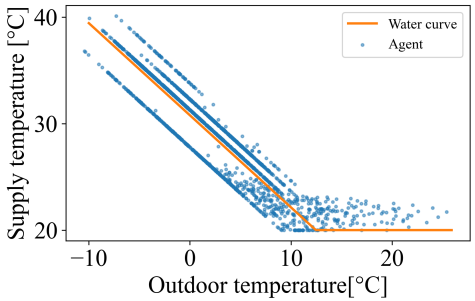
Agent 1

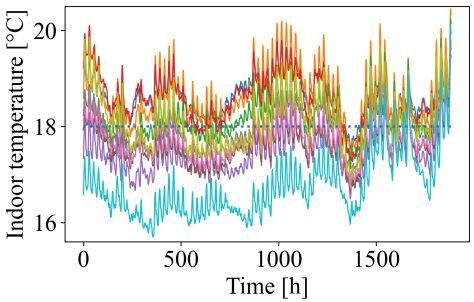
Main observations

- Baseline: $T_s^b = \alpha + \beta T_o$, $\alpha, \beta = \min \sum_t -r_t$
- Robust Baseline ↔ Environment with little flexibility
- Night mode: energy ↘ 6.6%
- Future work: finetune on operation data & deploy

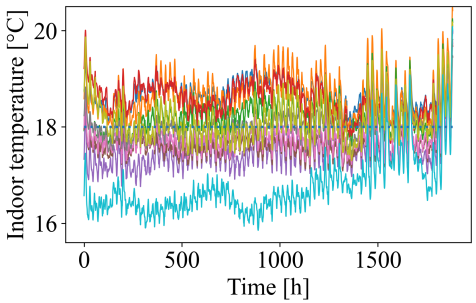
Some results

	MAE (°C)	std T_{in} (°C)	Energy gain (%)	CO_2 saved (g/m^2)
Baseline	0.599	0.755	0	0
PID	0.584	0.742	0.95	215
Agent 2	**0.545**	**0.692**	**2.19**	**495**





Baseline



DQN Agent

Main observations

- Baseline: $T_s^b = \alpha + \beta T_o$, $\alpha, \beta = \min \sum_t -r_t$
- Robust Baseline ↔ Environment with little flexibility
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Thank you for watching

More questions? adrien.le-coz@edf.fr