Technische Hochschule Ingolstadt

Institut für neue Energie-Systeme

Using the MATLAB Reinforcement Learning Toolbox for energy system control of a multi-family building modelled in MATLAB CARNOT

CARNOT user meeting 2023

Michael Bachseitz 23.06.2023

Agenda

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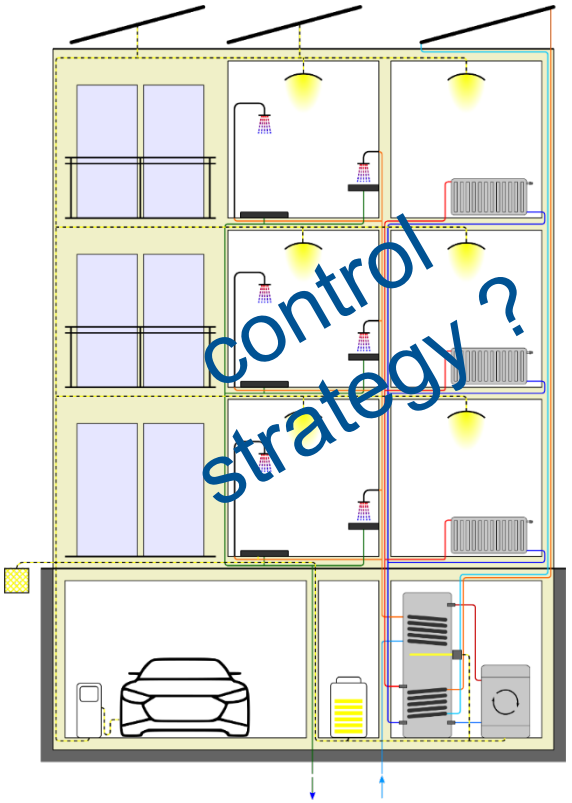
- Project introduction
- Building energy system model
- Introduction on Reinforcement Learning
- First test of MATLAB RL toolbox
- Outlook

Work package 7: Decentralised energy management

- Project objective:
  Development of “intelligent” control strategies for energy systems in multi family buildings

- Challenges:
  - Integration of renewable energy systems
  - Coupling the sectors heat, electricity & e-mobility
  - Consideration of signals from the electricity grid
  - Using of artificial intelligence and/or forecasts
- Opportunities and potentials:
  - Increasing self-sufficiency and self-consumption
  - Demand driven energy supply
  - Grid supportive behaviour of the building (energy system)



Building energy system model

Multi-family building in MATLAB CARNOT

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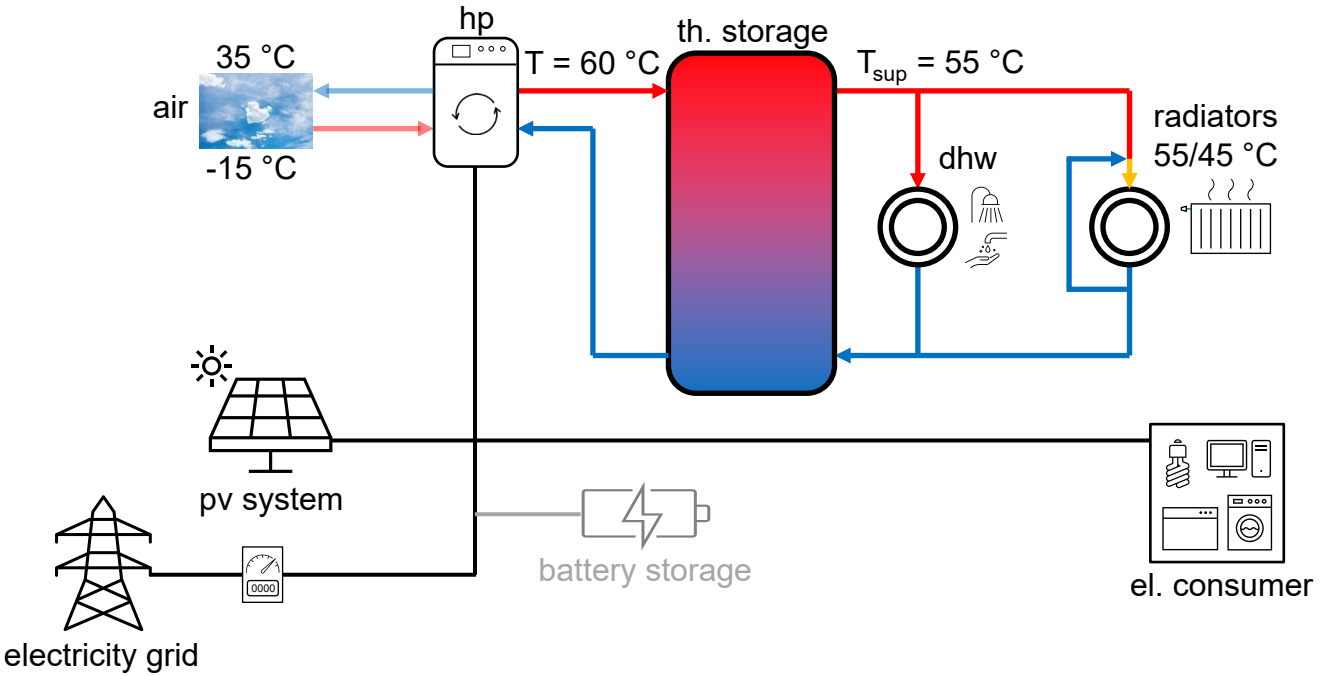
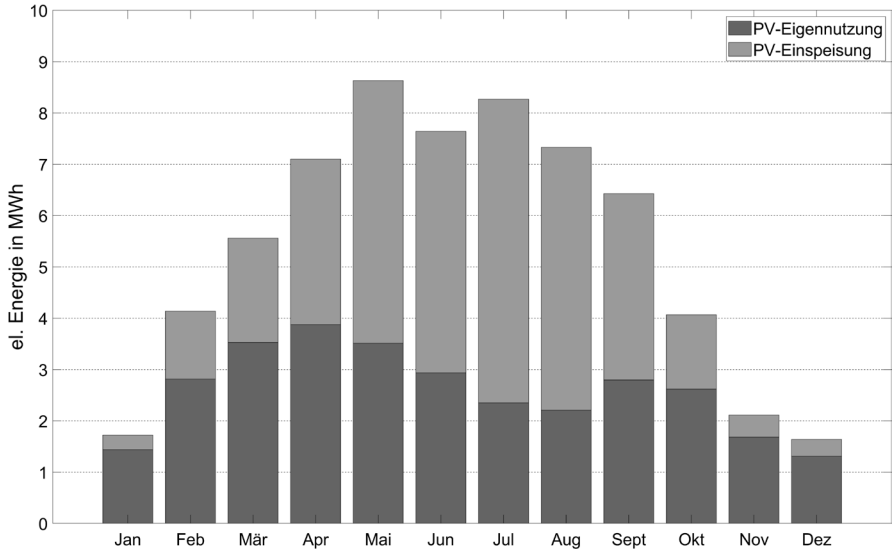
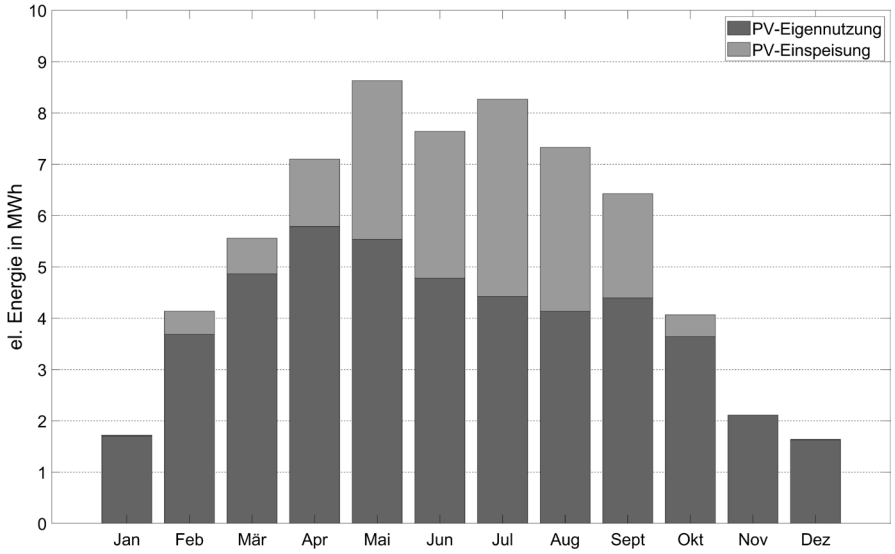
- IWU building typology class E (covering ca. 19 % of MFB in Germany) conventional refurbishment, radiators as heat transfer system
- PV system 65 kW_p, south oriented, slope 30°
- Optional battery storage 65 kWh



Simulation results: Conventional heat pump control strategy

	without battery storage	with battery storage
Self-consumption rate in %	48,1	72,2
Self-sufficiency in %	16,7	25,1





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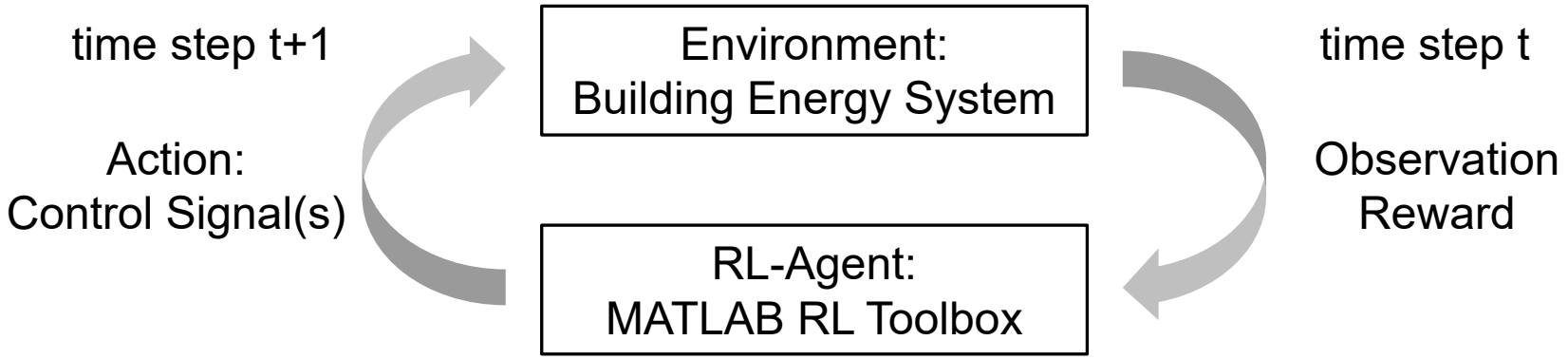
(Deep) Reinforcement Learning
Artificial Intelligence method used for system control.



Advantages:

- High adaptability e.g., to user behaviour
- RL learns optimal policy/control strategy by interaction with environment
- No model of environment (building energy system) necessary

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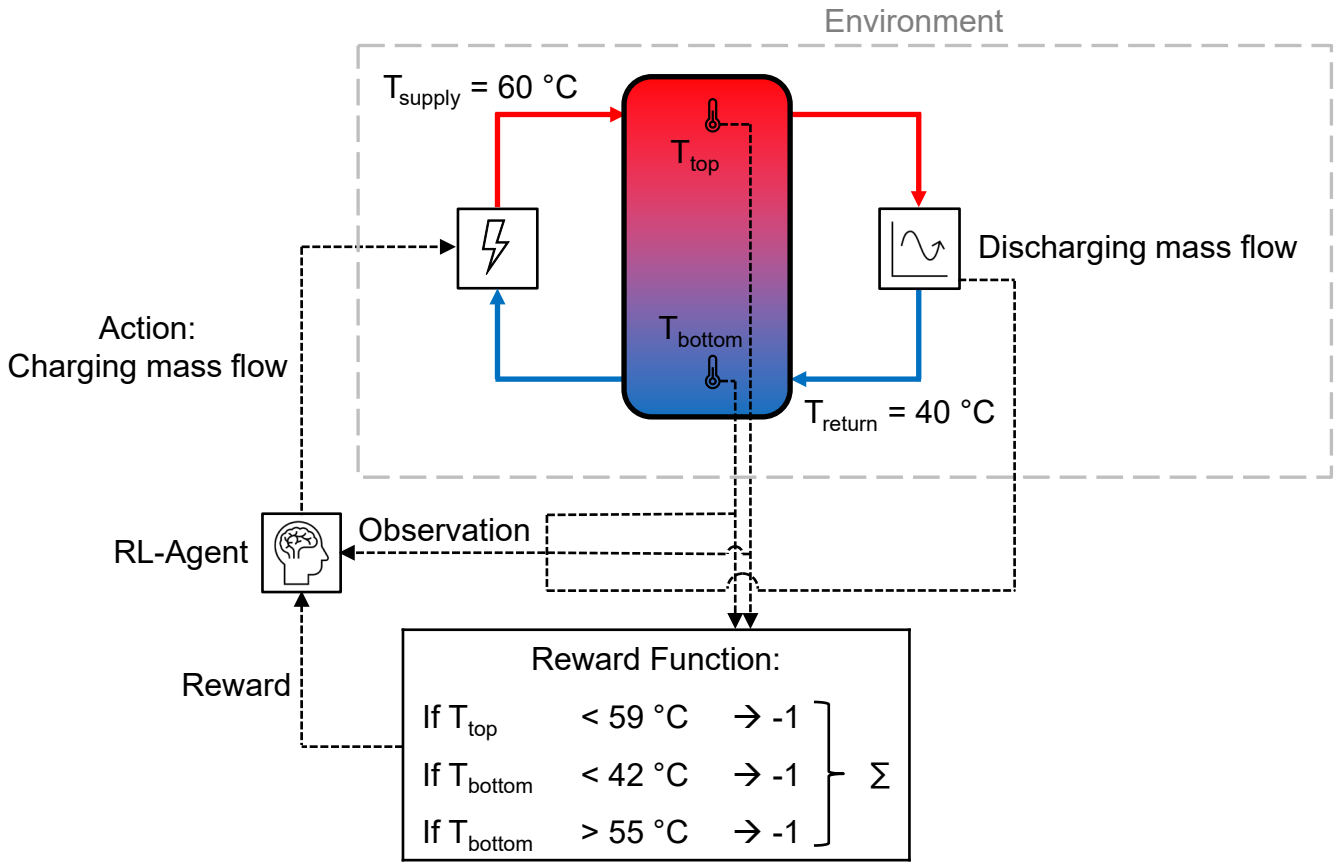
Charging a thermal storage



First test of MATLAB RL toolbox

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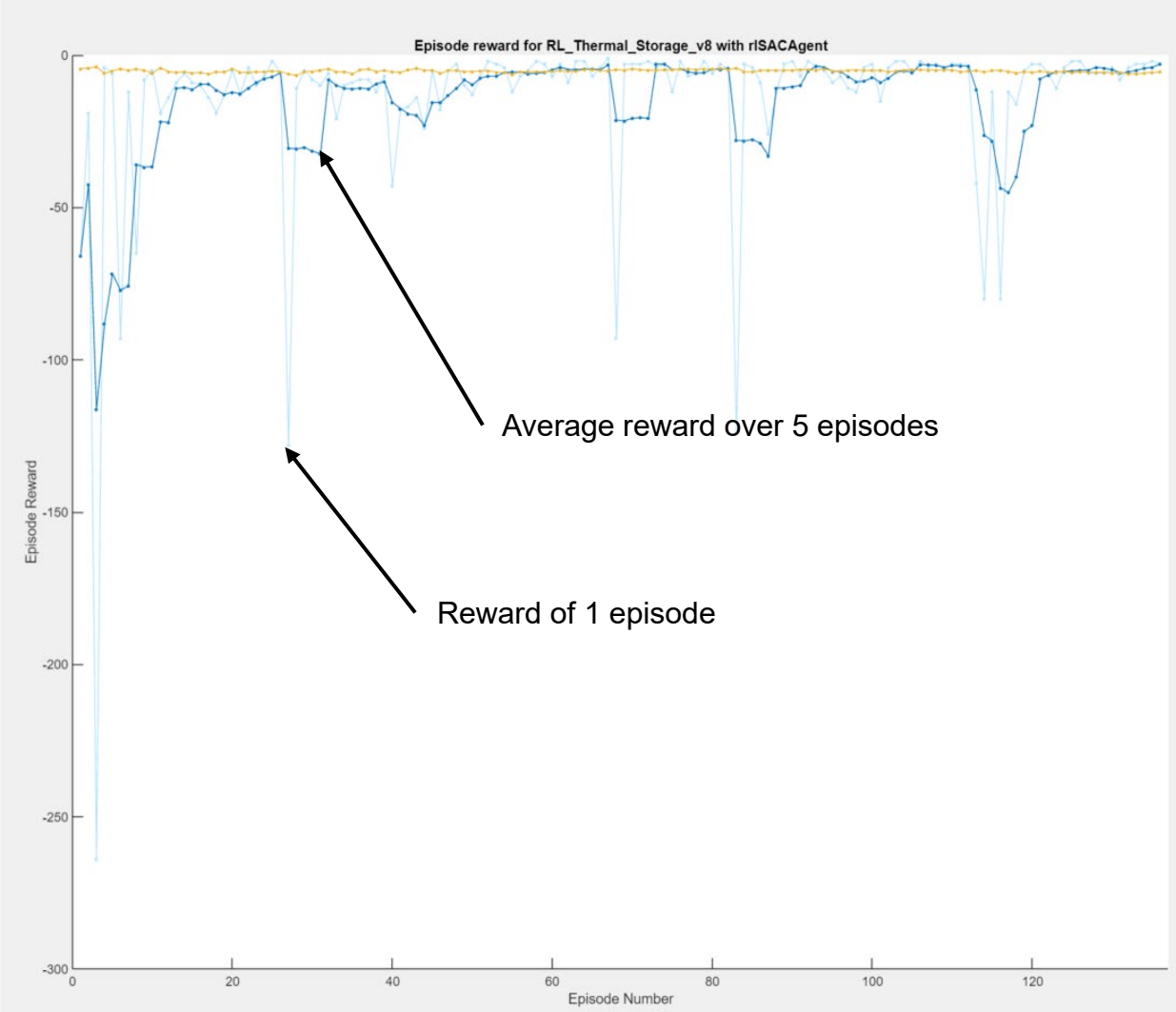
Training RL-Agent:

Random initial storage temperatures and discharge mass flows for each episode.

Improving policy after each episode.



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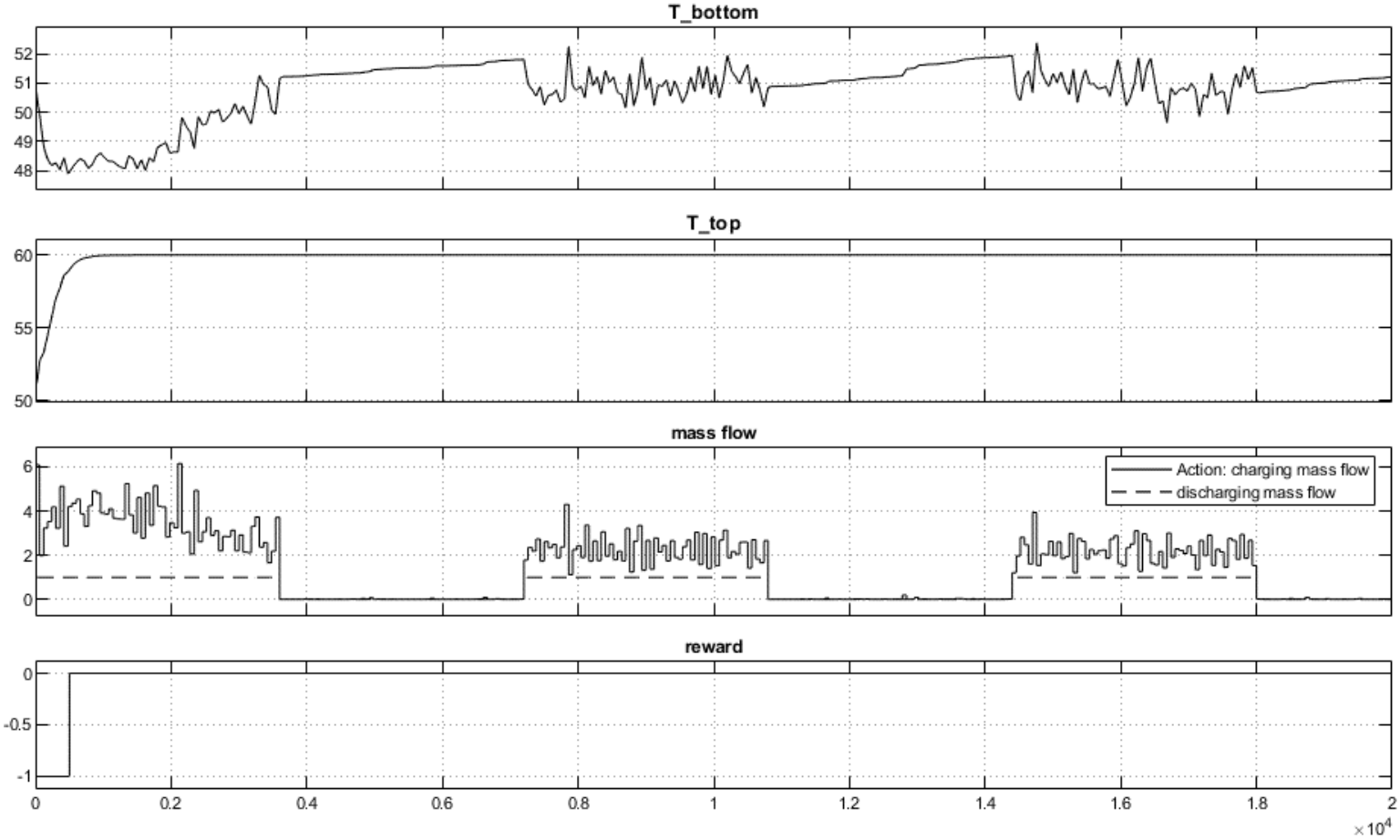
Simulating RL-Agent



Outlook

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Using RL toolbox for heat pump control:

- Maximization of self-consumption and self-sufficiency
- Consideration of signals from the electricity grid e.g., electricity prices → grid supportive operation

Highly interested in knowledge exchange!

Thank you very much for your attention!

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Acknowledgement

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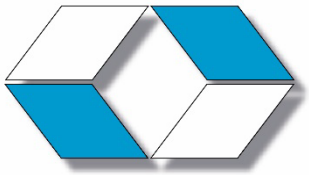

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