



Model predictive control energy management in building with battery and thermal storage

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Content



Motivation

- 39% of total EU CO₂ emissions originate from heat & electricity production [1]
- Kyoto protocol
- EU 2020 climate & energy package:
 - 20% cut in greenhouse gas emissions (compared to 1990)
 - 20% of EU energy from renewables
 - 20% improvement in energy efficiency [2]



Model predictive control

- Set of controlling methods

- Anticipatory tool

- Integral parts:

- Cost function
- Current state

- Dynamics (process model)

- Constraints

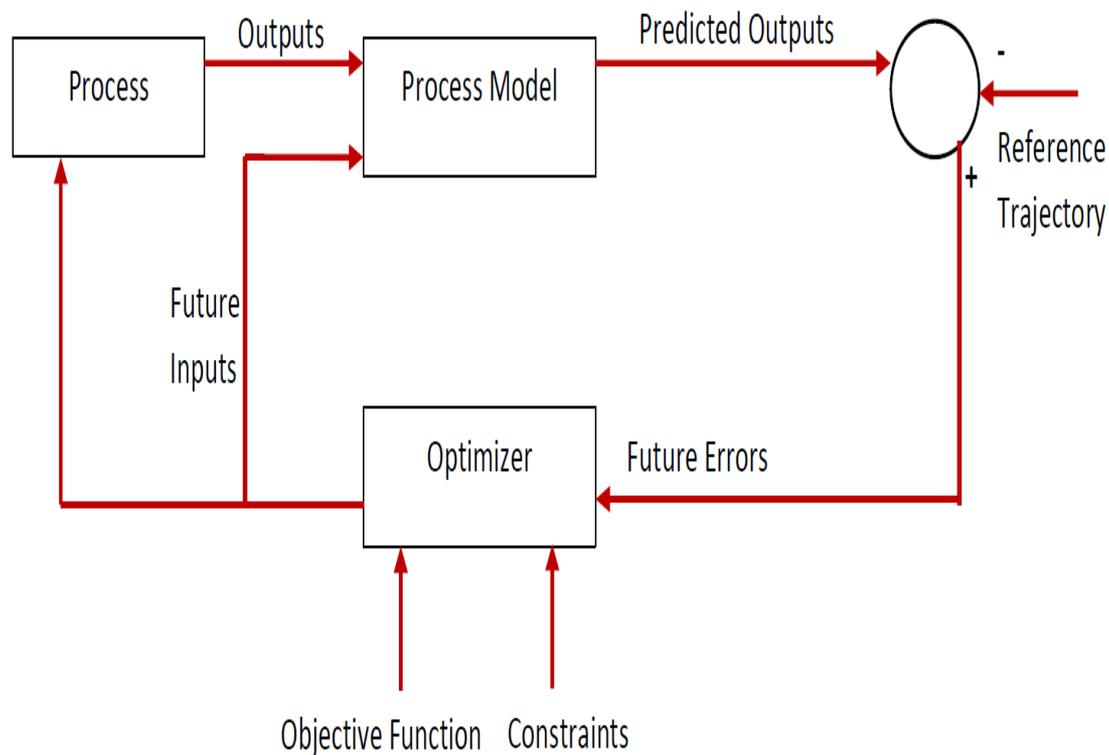


Figure 1 – MPC control flow [3]



MPC in the case of energy management for buildings

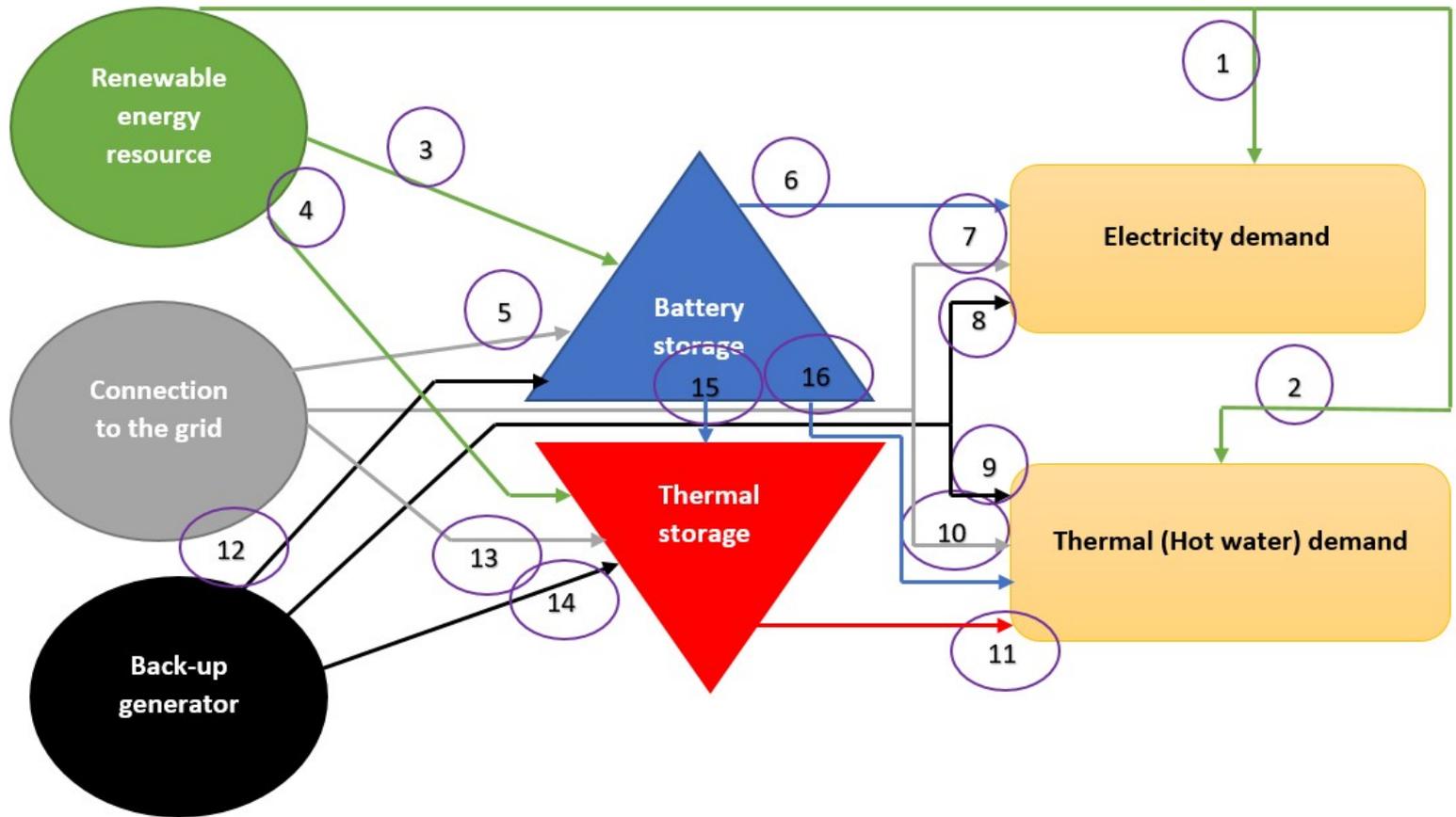


Figure 2 – Energy flow in buildings



MPC in the case of energy management for buildings cont'd

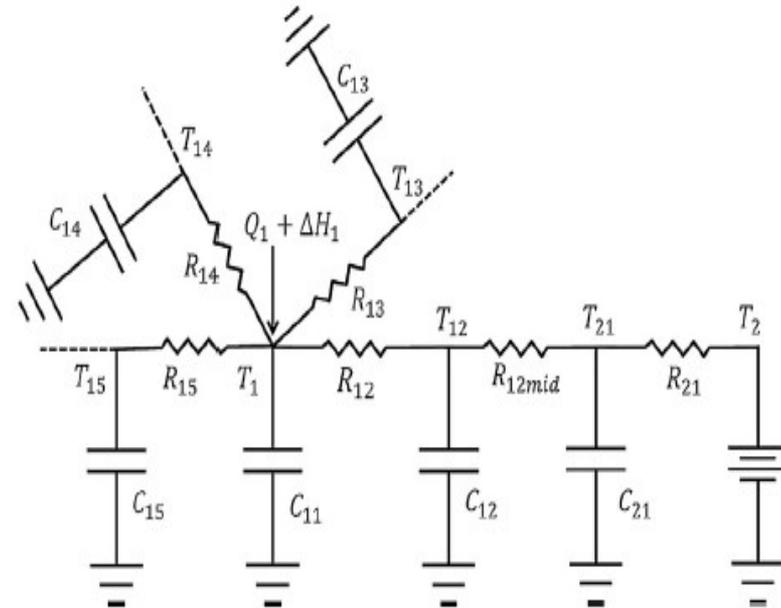


Figure 3 – RC Network Model [4]



Overview of a MPC usage simulation

- Maximizing power delivery from the renewable energy supply while obeying constraints
- Use of „penalties” in the objective function
- Comparison with non-predictive algorithm

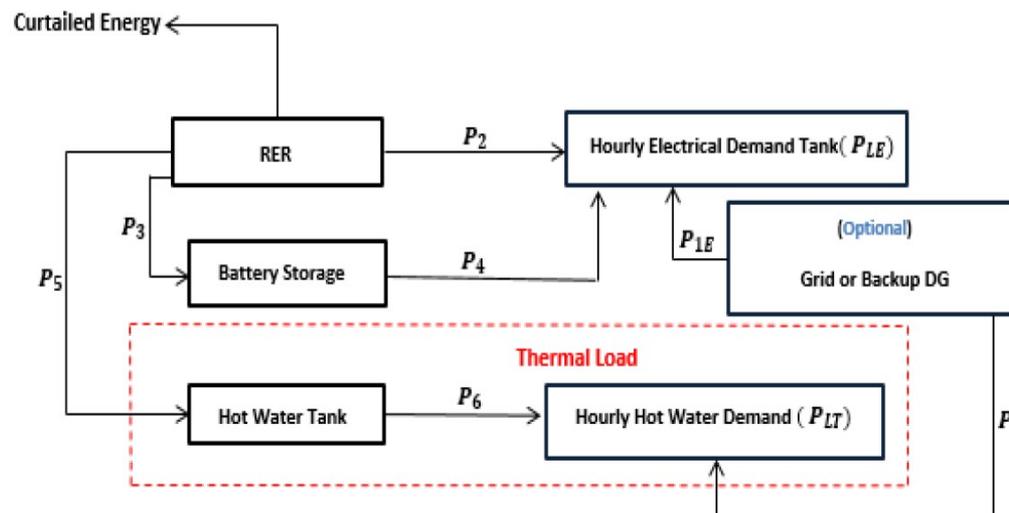


Figure 4 – Microgrid Block Diagram [3]

	Non-Predictive	MPC
Renewable energy penetration	88.60%	92.60%
Curtailed Power	38.40%	34.60%

Table 1



Conclusion

- PID and rule-based control used in a much greater extension

MPC

PROS

Outperforms conventional methods

Future savings

CONS

High investment costs

Mathematical burden

Reliability of predictions



Thank You for Your
attention!



Literature

[1] C. A. Balaras, A. G. Gaglia, and E. Georgopoulou, “building stock , energy consumption , emissions and potential energy European residential buildings and empirical assessment of the Hellenic building stock , energy consumption , emissions and potential energy savings,” no. March 2007, 2018.

[2] “2020 climate & energy package | Climate Action.” [Online]. Available: https://ec.europa.eu/clima/policies/strategies/2020_en. [Accessed: 15-Jun-2018].

[3] I. Aldaouab, M. Daniels, and R. Ordóñez, “Model Predictive Control Energy Dispatch to Optimize Renewable Penetration for a Microgrid with Battery and Thermal Storage,” 2018.

[4] A. Mirakhorli and B. D. P. D, “Occupancy behavior based model predictive control for building indoor climate — A critical review,” *Energy Build.*, vol. 129, pp. 499–513, 2016.