

SEBUT

Case: Kolding Storcenter

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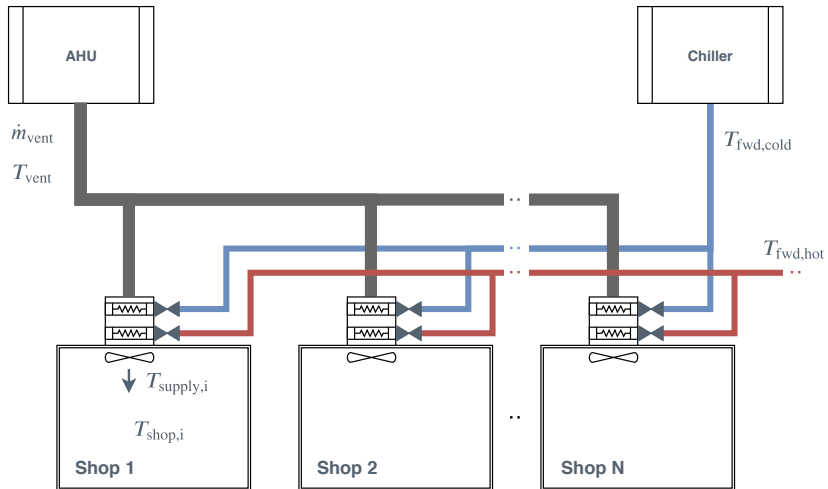
Agenda



- ▶ HVAC & eksisterende styring
- ▶ Ny styringsstrategi
- ▶ Implementation & Demo
- ▶ Resultater
- ▶ Konklusion & perspektiv

Kolding Storcenter

HVAC



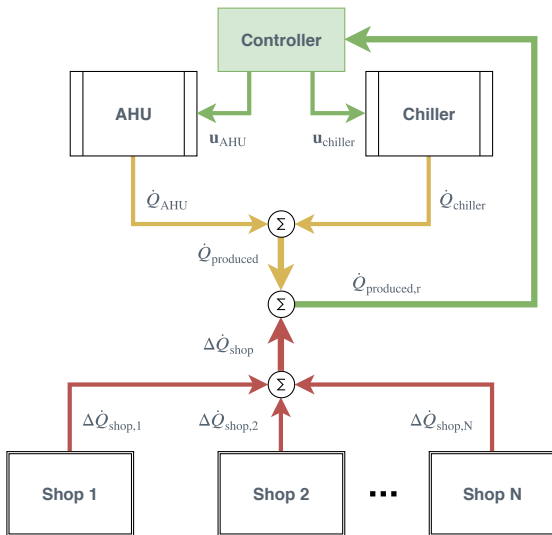
Model Predictive Control er state-of-the-art, men meget tidskrævende grundet tungt modellerings arbejde.

Vi har dog stadig brugt MPC for at udforske andre styringsstrategier.¹ I stedet forslår vi en **hierarkisk kontrolstrategi**, hvis formål er at *koordinere produktion og efterspørgsel*.

¹Nonlinear Model Predictive Control for Energy Efficient Cooling in Shopping Center HVAC, Petersen et al., CCTA2019.

Ny styringsstrategi

Diagram



$$\Delta \dot{Q}_{\text{shop}} = \dot{m}_{\text{vent,nom}} c_{p,\text{air}} \sum_i^N e_i \quad (1)$$

$$\dot{Q}_{\text{produced,r}} = \dot{Q}_{\text{produced}} + \Delta \dot{Q}_{\text{shop}} \quad (2)$$

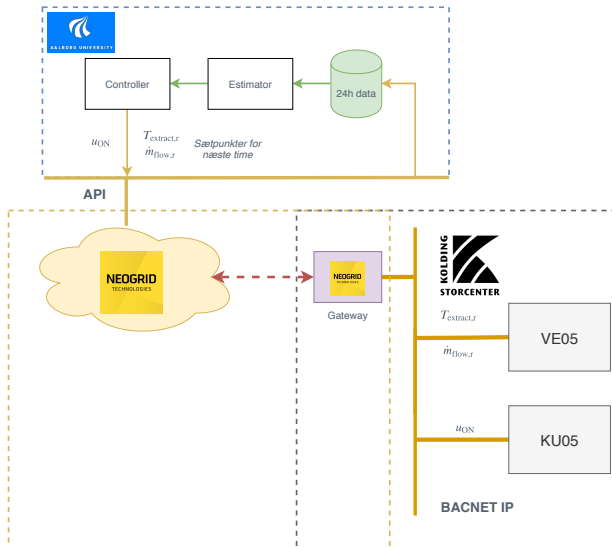
$$\min_{\mathbf{u}} J = q_d (\dot{Q}_{\text{produced,r}} - \dot{Q}_{\text{produced}}(\mathbf{u}))^2 + q_c P(\mathbf{u}) \quad (3)$$

Vi:

1. Estimerer køle/varme efterspørgsel (baseret på fejl-signal).
2. Beregner nyt sætpunkt for leveret køling/opvarming.
3. Løser optimerings-problem for *billigste* drift og finder nye sætpunkter.

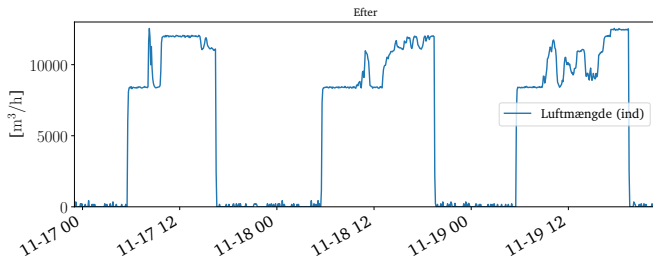
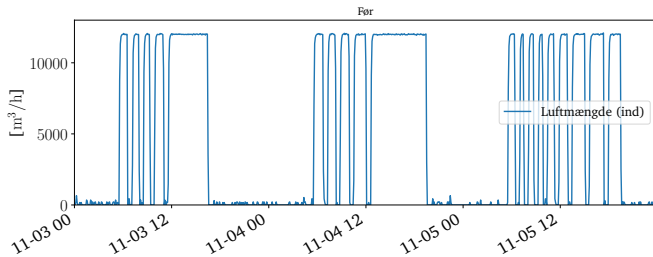
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Implementation + Demo



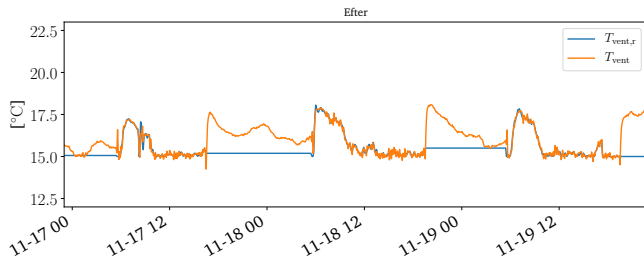
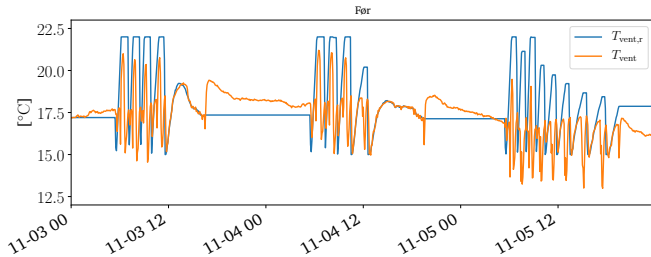
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Resultater



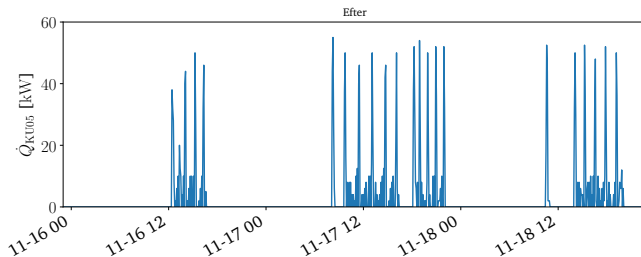
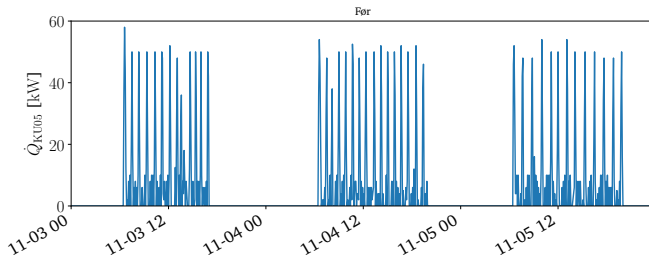
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Resultater



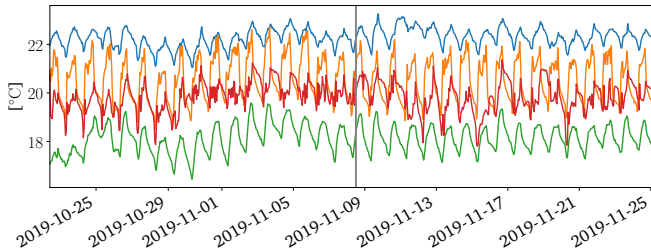
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Resultater



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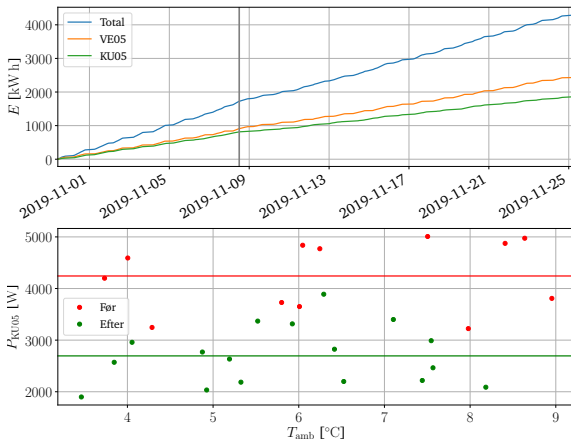
Resultater



$\Delta RMSE \approx 0.3 \text{ } ^\circ\text{C}$ (I forhold til sætpunkter)

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Resultater



Elforbrug²: KU05 ↓ 30 %, VE05 ↓ 10 %, total ↓ 20 %³

²Sammenligning, gennemsnit før og under

³Kan vi først rigtig sige noget om, hvis vi gennemfører en mere struktureret test.

- ▶ Let implementerbart
- ▶ Let skalerbart
- ▶ Genbrugeligt?
- ▶ Mærkbare besparelser
- ▶ Endnu mere der ikke er høstet endnu
 - ▶ Prædiktion, Læring