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Investigation of strategy for low-temperature operation of radiator system, by using data from existing digital heat cost allocators, in a multi-family apartment building

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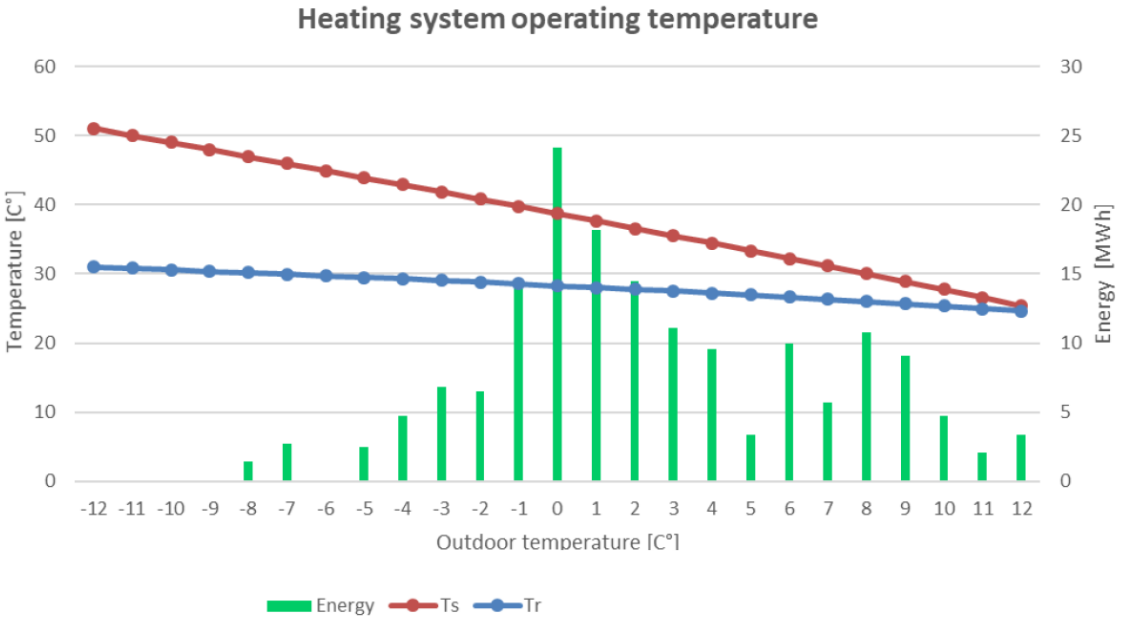
Background

- Potential for quick and cheap implementation of Low Temperature District Heating by improving the operation of heating systems in buildings



- Potential reduction of **supply** temperature: 26 °C
- Potential reduction of **return** temperature: 11 °C

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Aim

Investigation of a strategy to lower the operating temperatures of radiators:

- by stimulating the use of all radiators with a minimum supply temperature used
- by securing the correct function of all radiators
- problems or inefficient use of radiators can be located by using data from existing electronic heat cost allocators
- these data can be made available as part of a service package for addressing all the problems in the system

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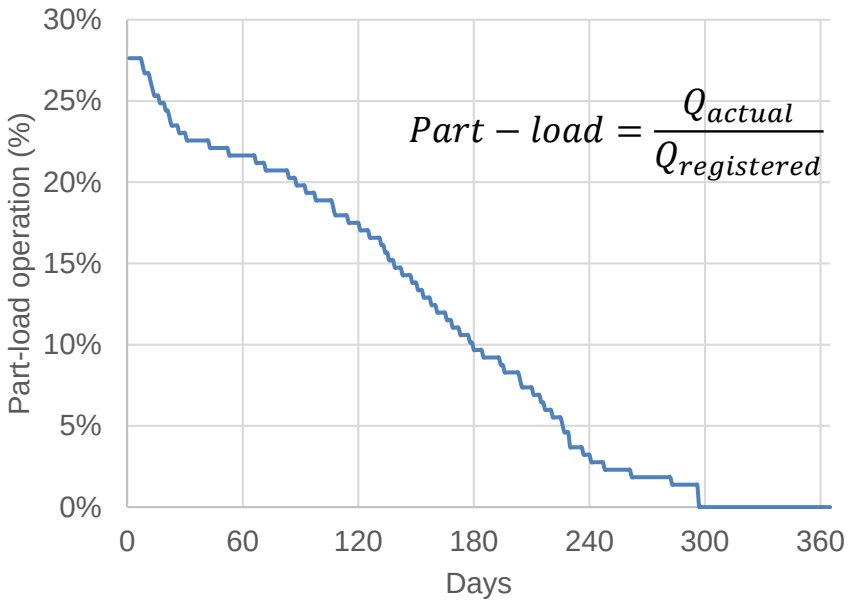
Case study description and data collection

- Multi-family apartment building from 1970, located in Viborg, Denmark
- 42 apartments with 235 radiators on three floors
- Electronic heat cost allocators on each radiator
- TRVs with pre-setting and pressure balancing valves in each riser
- Registered reference heat output of the radiator system at 90/70/20 °C: 296 kW



Daily average part-load operation during 2018

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Electronic heat cost allocators

- Devices mounted in each radiator
- Cost allocation of the total energy used for heating to the different flats
- Mandatory use since 2020 according to EU directive
- Remotely readable (data saved in online databases)
- Registration of the individual radiator size and heat capacity based on a reference temperature set

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Use of heat cost allocators to detect the actual number of radiators in use

- They can indicate if radiators are in use or not
- Calculation of actual heat output and part-load operation of each radiator (90/70/20 °C)
- Data downloaded for the two-day period: 12 & 13/2/2020 (outdoor temp: 3 °C)
- The part-load operation of the system was 20 % (data from energy meter)
- **30% of the radiators were not in use in the two days**

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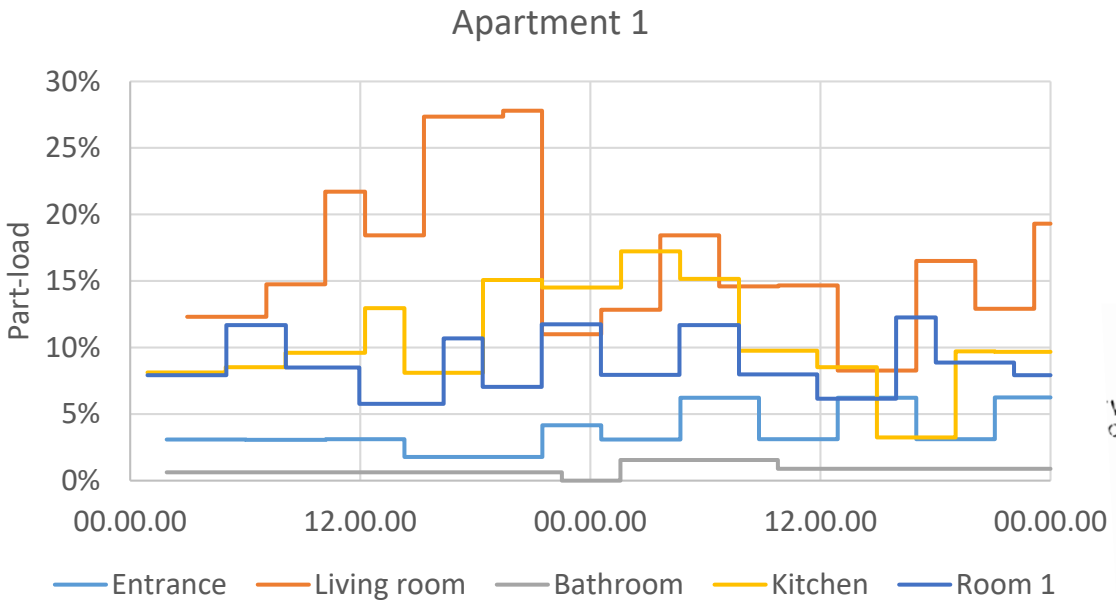
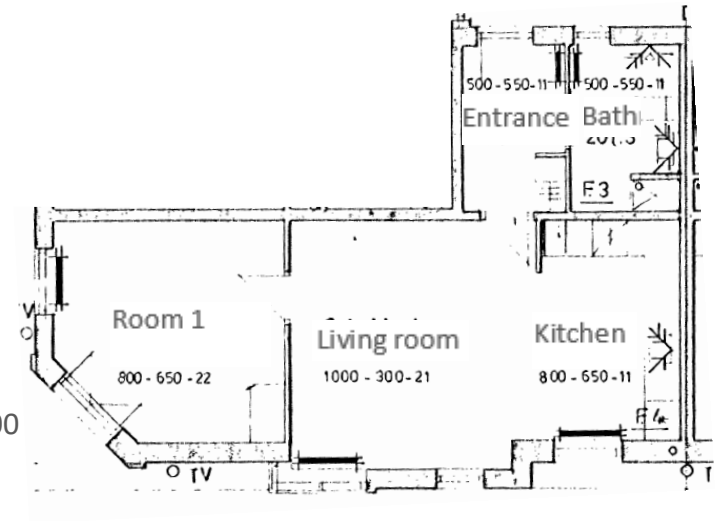
Use of heat cost allocators to detect the actual number of used radiators

- The radiators are not operating in an even way (different individual part-load operation)
- Several radiators were turned down during the night-time





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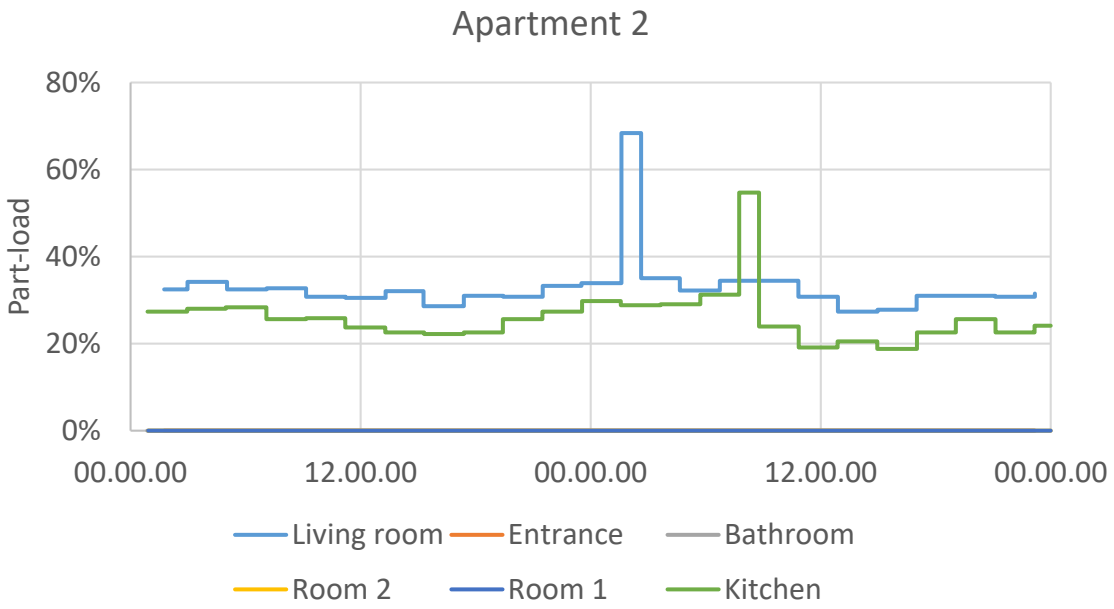
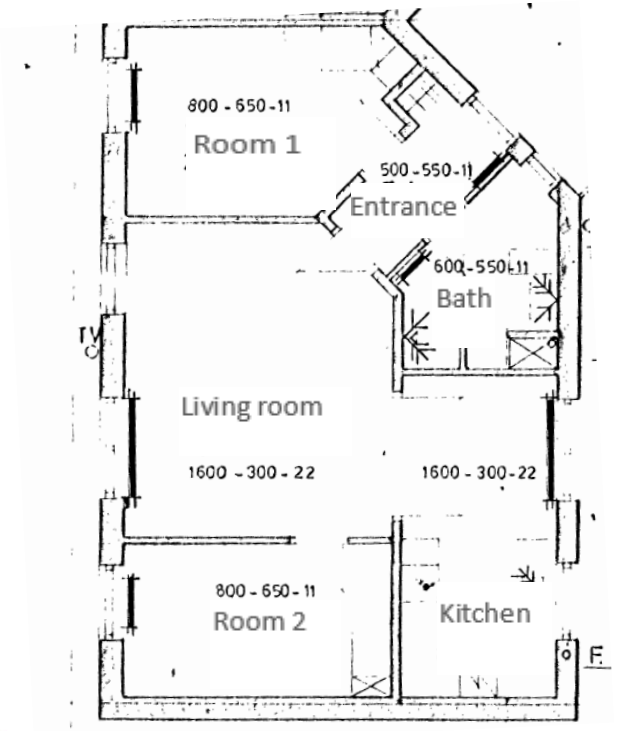
Use of heat cost allocators to detect the actual number of used radiators

- Only two of the six radiators are used with high part-load





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Calculation of minimum supply temperature to stimulate the use of all radiators

- Thermal/hydraulic model of the radiator system was created
- *Model inputs*: radiator heat output, supply temperature
- *Model outputs*: return temperature, system mass flow, system pressure drop
- The minimum supply temperature is selected based on the maximum mass flow rate of the existing pump

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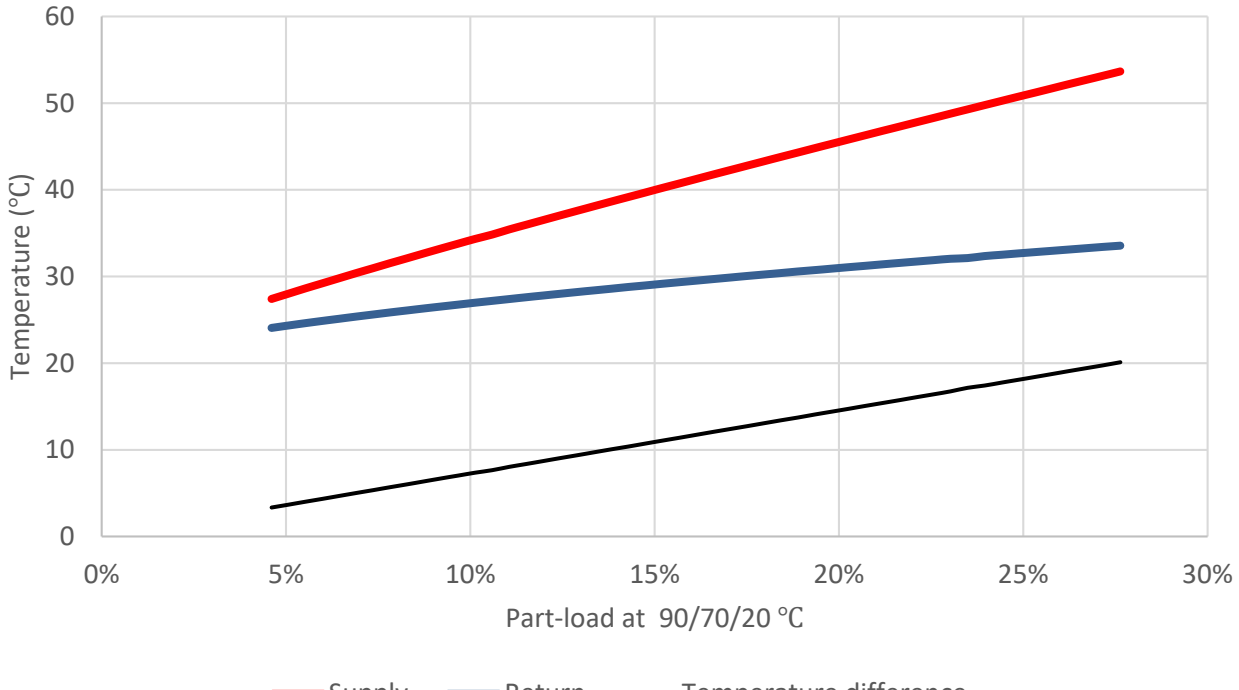
Minimum supply temperature to stimulate the use of all radiators



- Energy weighted average **supply** temp: 44 °C
- Energy weighted average **return** temp: 30 °C

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Investigation of hydraulic balancing problems

- ✓ Hydraulic balance under minimum supply temperature
- ✓ The required heat for the flat is delivered only if all the radiators are used
- ✓ If only few of the radiators are used, the delivered heat is not sufficient for the flat

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Conclusions

- The model analysis shows that this strategy can work
-  Minimum supply temperature
  use of all radiators in each flat 
- Electronic heat cost allocators can be used continuously as a tool to monitor the radiators
- The existing hydraulic balancing in the system make this strategy a robust solution
- This strategy will be tested in the actual heating system this heating season

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