Evaluating the temperature performance of Danish building typologies in district heating networks

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[1]AffaldVarme Aarhus
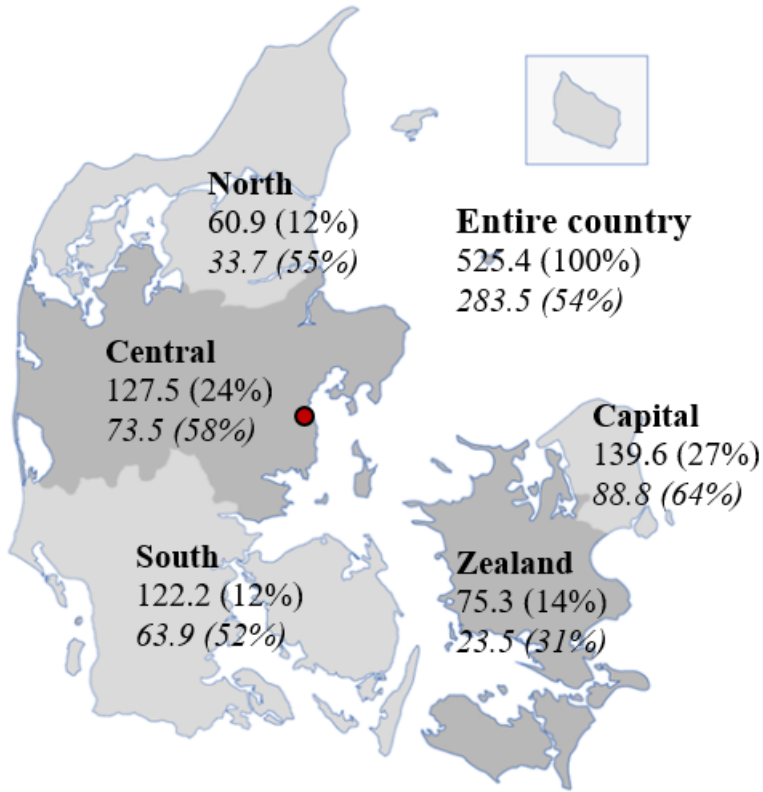*[2]Department of Engineering, Aarhus University*

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District heating utilities may divide the expenses of operating and maintaining their heating systems among the customers based on:

1) The size of the customers' substation,

2) how much heating the customers consume in a year, and

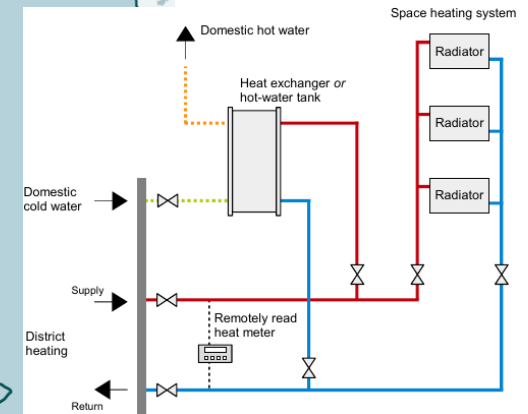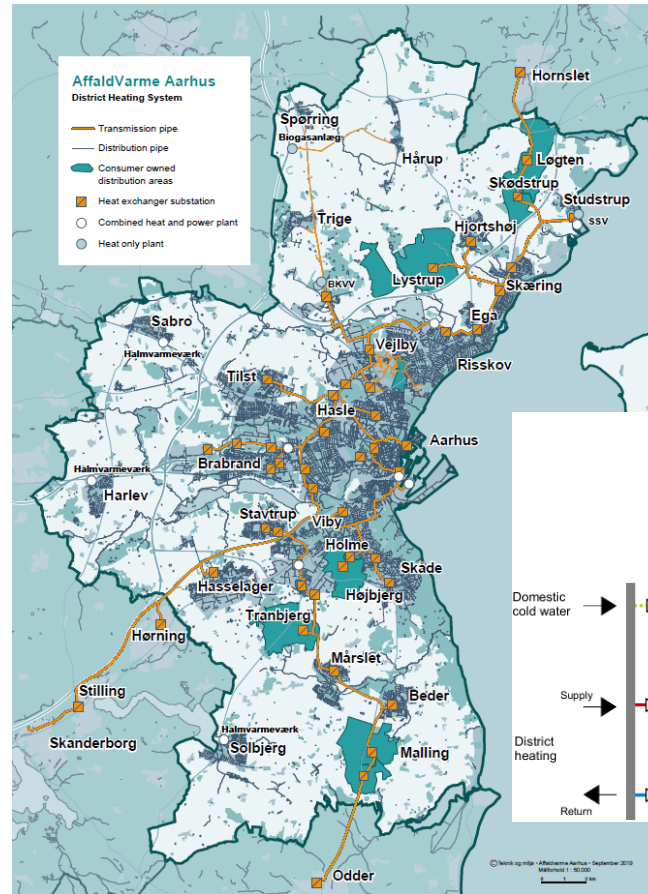3) the efficiency at which the customers make use of the circulated water before returning it to the grid.

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North
60.9 (12%)
33.7 (55%)

Entire country
525.4 (100%)
283.5 (54%)

Central
127.5 (24%)
73.5 (58%)

Capital
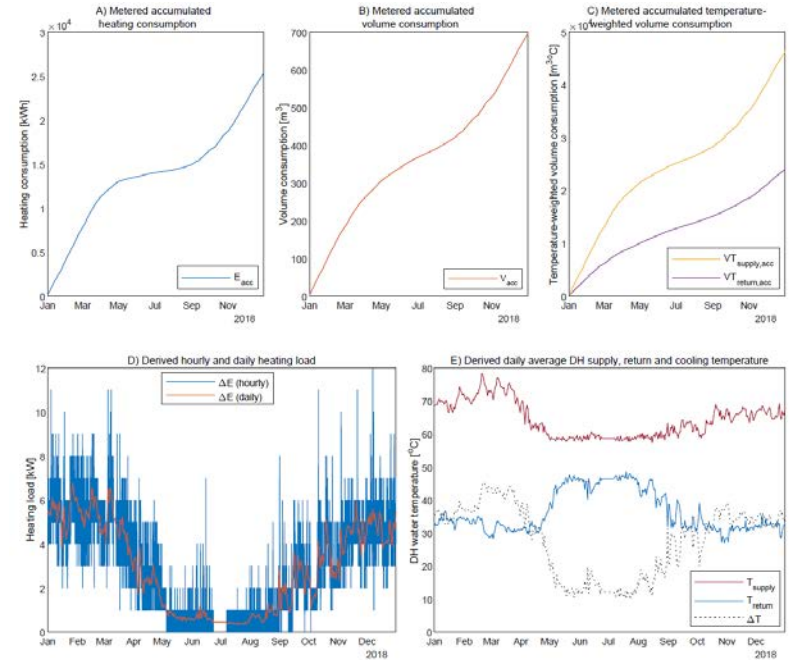139.6 (27%)
88.8 (64%)

South
122.2 (12%)
63.9 (52%)

Zealand
75.3 (14%)
23.5 (31%)

Normal: Building area in region [mill. m²] . % of Entire country.
Italic: Building area of region supplied by DH. % of Region.

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District Heating System

— Transmission pipe
— Distribution pipe
Consumer owned distribution areas
Heat exchanger substation
Combined heat and power plant
Heat only plant

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Hourly data

Table 1. Parameters extracted from heat meters.

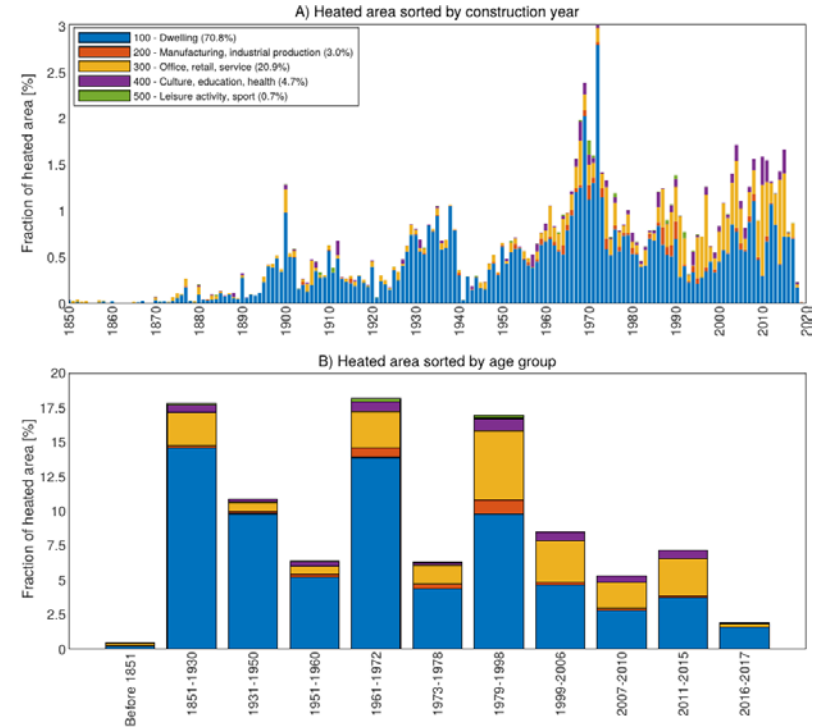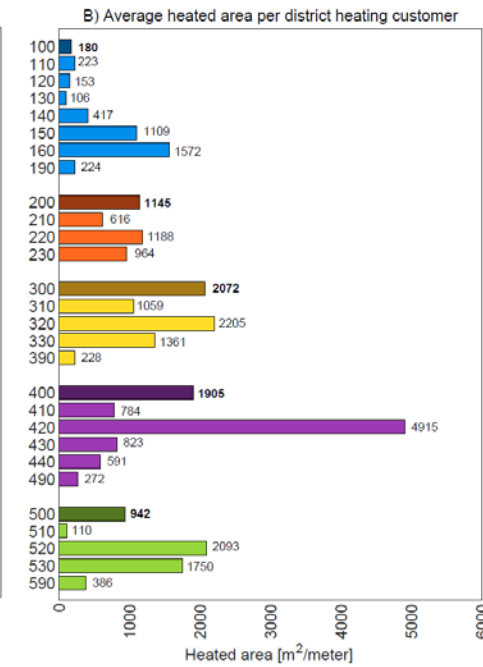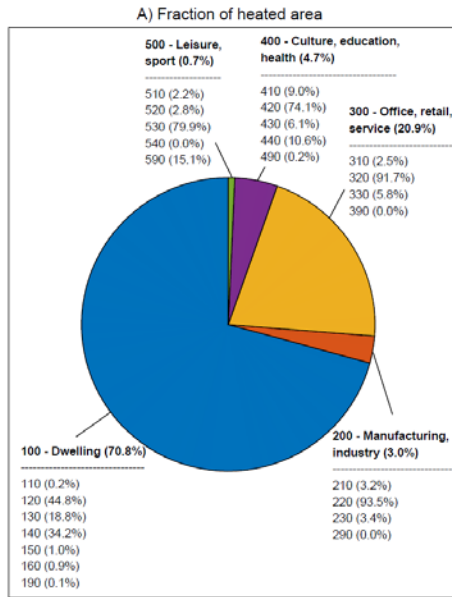| Parameter	Symbol	Unit	Reading resolution, d	Standard reading uncertainty, δ
Accumulated heating energy consumption	E	kWh	1 kWh	0.2890 kWh
Accumulated volume consumption	V	m³	0.01 m³	0.0029 m³
Accumulated supply temperature-weighted volume consumption	VT_{supply}	m³ °C	1 m³ °C	0.2890 m³ °C
Accumulated return temperature-weighted volume consumption	VT_{return}	m³ °C	1 m³ °C	0.2890 m³ °C

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Table 2. The number of imported heat meters.

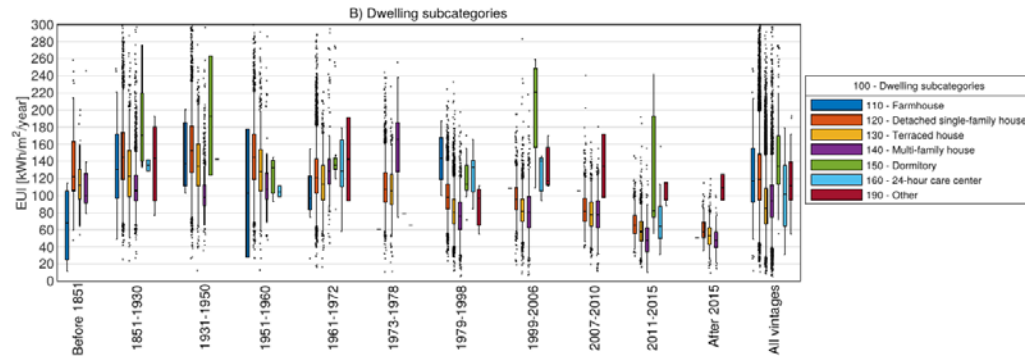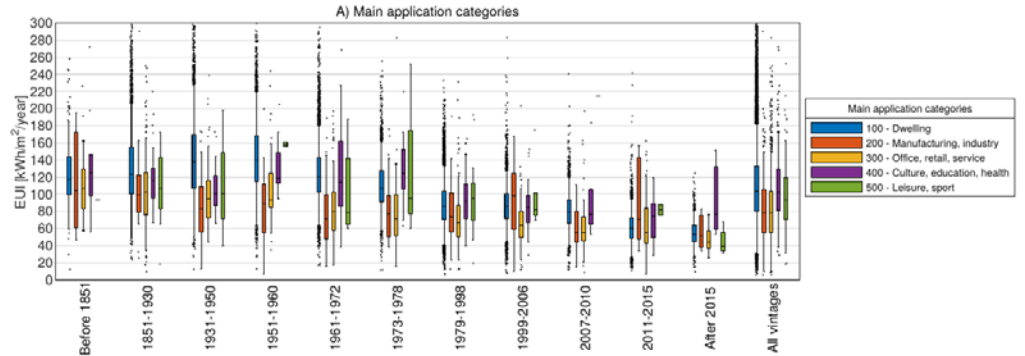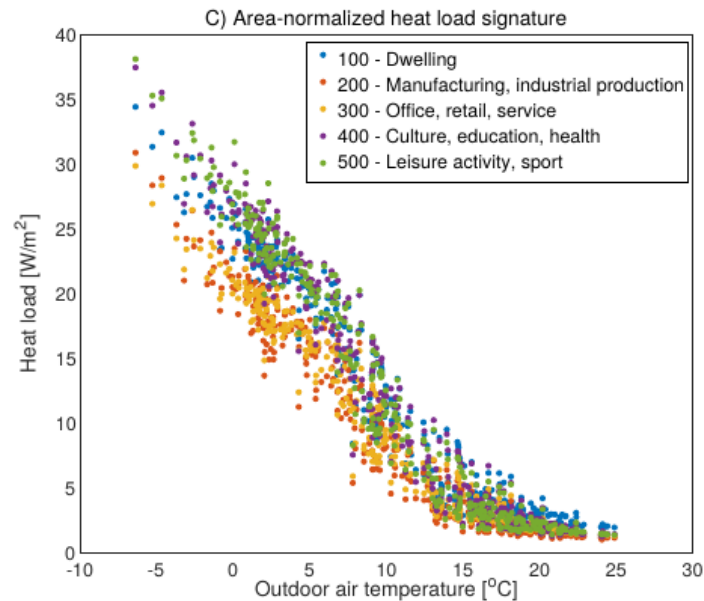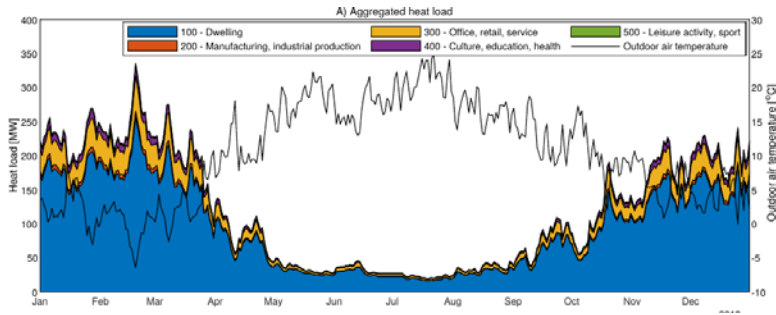| Data processing	No. of meters/datasets
Datasets extracted from servers	59 005 (100%)
Datasets discarded during preprocessing	4835 (8.2%)
No data in the period	*3462 (5.9%)*
Sudden stop in recordings	*12 (0.0%)*
Too large data gaps	*802 (1.4%)*
Failure to aggregate all meters on address	*559 (1.0%)*
Datasets discarded during building data pairing	8582 (14.6%)
Building data unavailable for meter address	*0 (0.0%)*
Building data inconsistent with meter data	*2942 (5.0%)*
Building application category not relevant	*1 (0.0%)*
The building has supplementary heating installations	*5639 (9.6%)*
Datasets discarded during post-processing	245 (0.4%)
Extremely low (EUI < 5 kWh/m^2/year)	*12 (0.0%)*
Extremely high (EUI > 300 kWh/m^2/year)	*233 (0.4%)*
Total number of discarded datasets	13 662 (23.2%)
Total number of valid datasets	45 343 (76.8%)

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A) Fraction of heated area

B) Average heated area per district heating customer

A) Heated area sorted by construction year
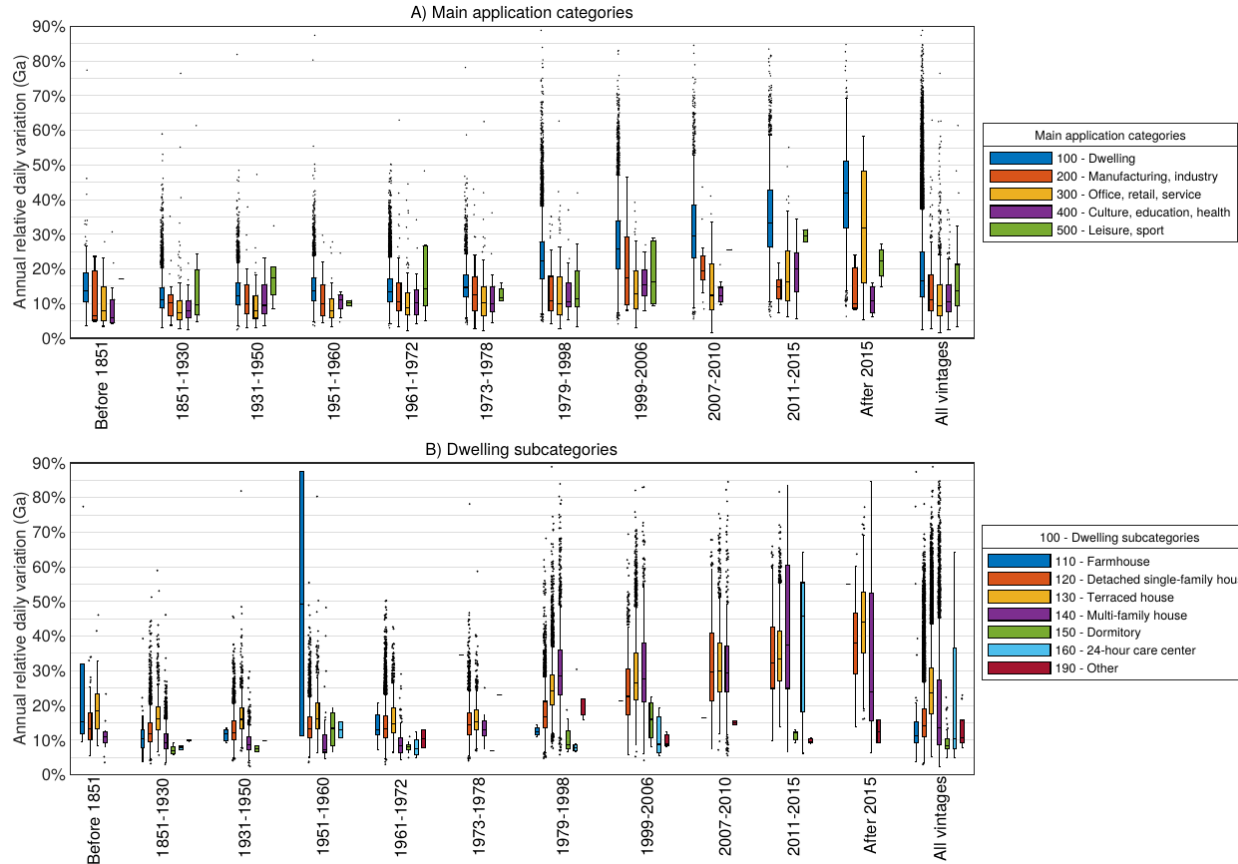
B) Heated area sorted by age group

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Accumulated heat load and consumption 2018
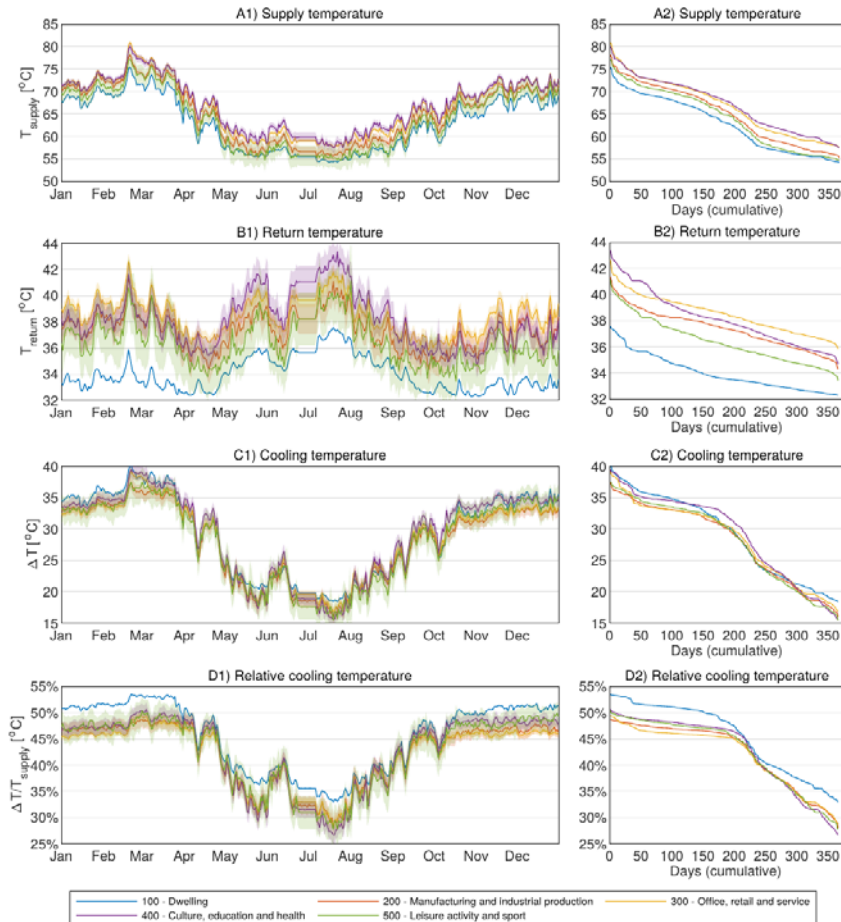

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Daily variations in heat load and consumption
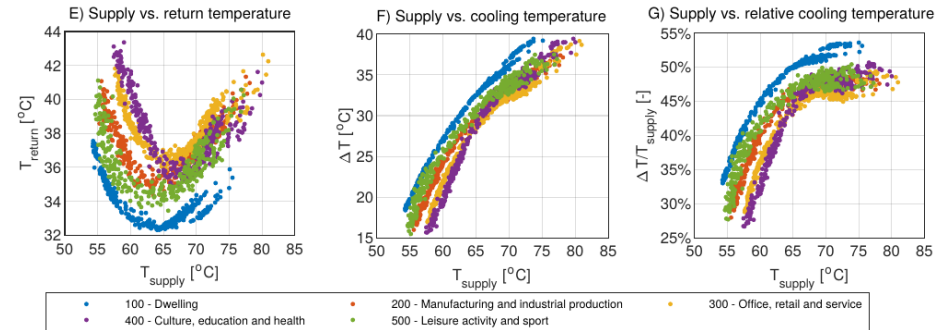
Supply and return temperatures

Considerations for end-user billing

Today, billing is partially based on annual average cooling

It might be fairer to differentiate billing based on type of building and relative cooling?

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Read more in the preprint paper

"District heating energy efficiency of Danish building typologies"

https://www.researchgate.net/publication/342353978_District_heating_energy_efficiency_of_Danish_building_typologies

Thank you!

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