



TEMADAG OM LAVTEMPERATUR- FJERNVARME 12. NOVEMBER 2015

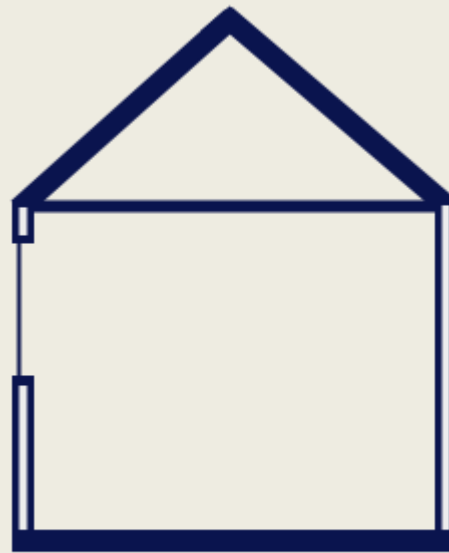
Dorte Skaarup Larsen

Hvordan kan vi levere:



Rumopvarmning

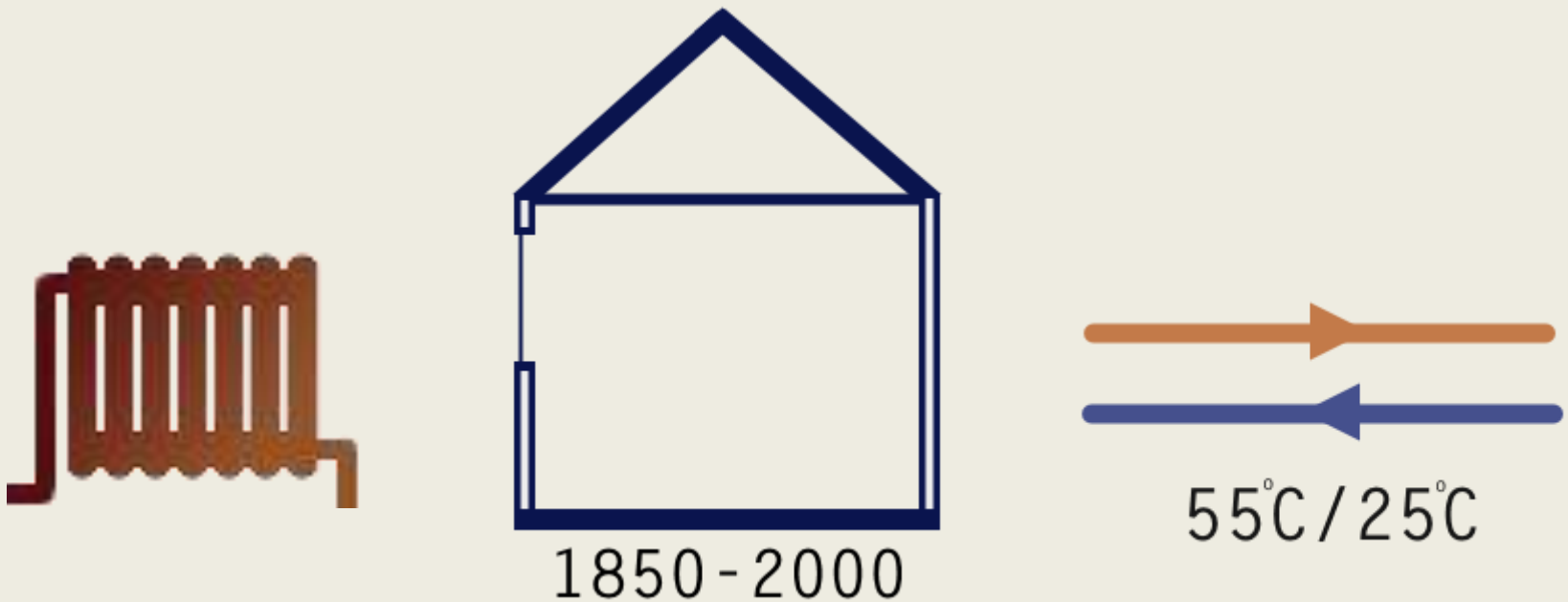
Hvordan kan vi levere:



1850 - 2000

Rumopvarmning til eksisterende bygninger

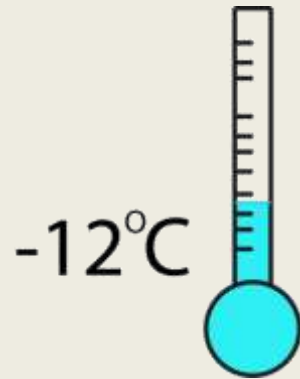
Hvordan kan vi levere:



Rumopvarmning til eksisterende bygninger ved brug af lavtemperatur-fjernvarme

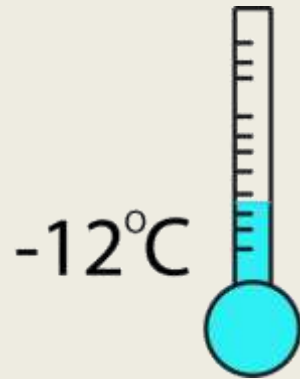
Derfor kan det lade sig gøre:

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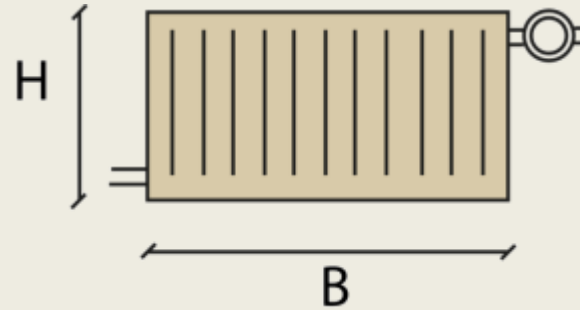


Dimensioneringsmetode

Derfor kan det lade sig gøre:

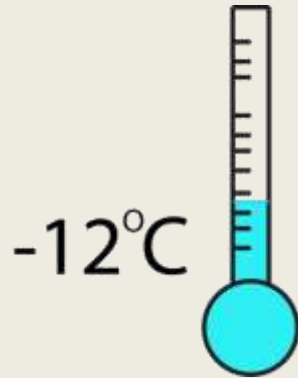


Dimensioneringsmetode

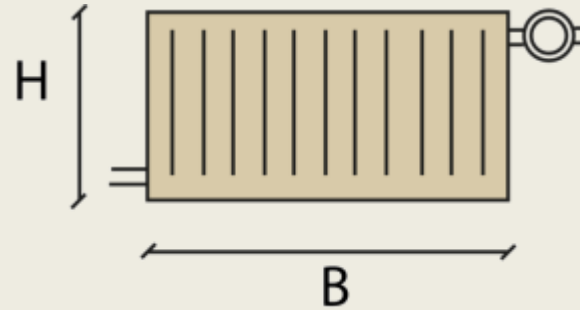


Tilgængelige størrelser

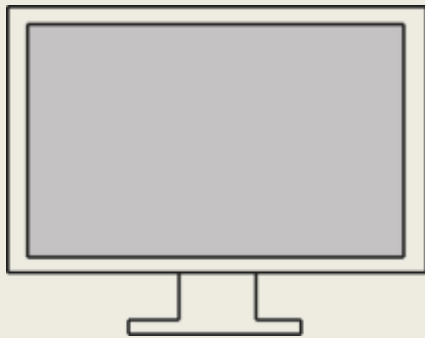
Derfor kan det lade sig gøre:



Dimensioneringsmetode

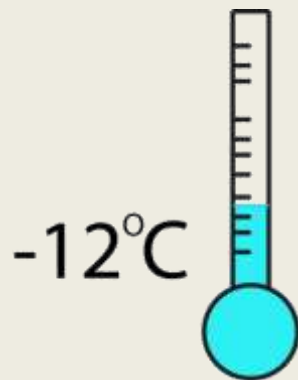


Tilgængelige størrelser

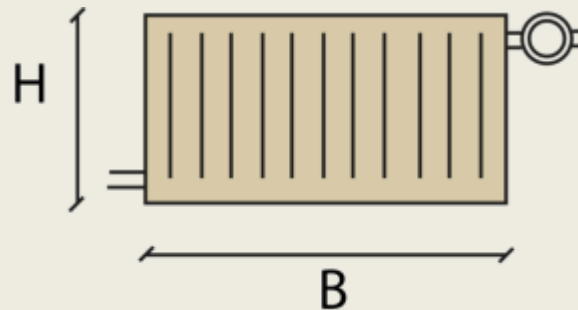


Varmetilskud fra udstyr

Derfor kan det lade sig gøre:



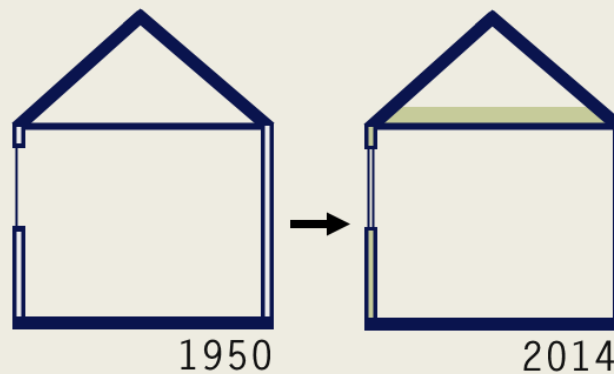
Dimensioneringsmetode



Tilgængelige størrelser



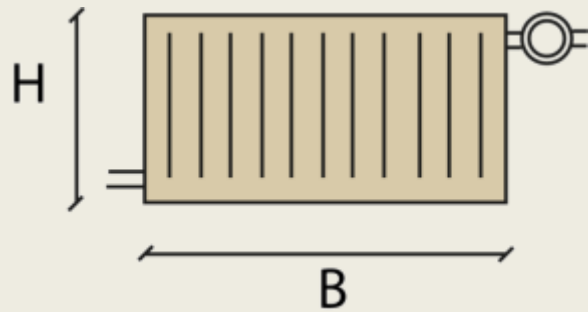
Varmetilskud fra udstyr



Energirenovering

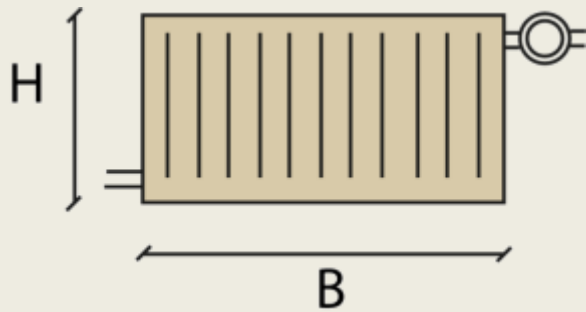
Erfaringer med lavtemperatur-fjernvarme og
overdimensionerede radiatorer

Erfaringer med lavtemperatur-fjernvarme og overdimensionerede radiatorer

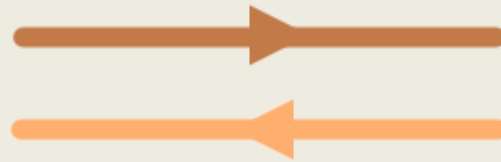


Ofte overdimensionerede

Erfaringer med lavtemperatur-fjernvarme og overdimensionerede radiatorer



Ofte overdimensionerede



60°C / 45°C

Returen følger ikke altid med ned

UDKAST AF STUDIER

- Endnu ikke færdige

Typer af huse gennem tiden

Typer af huse gennem tiden



Typer af huse gennem tiden



Opførelsesår	Andel opvarmede m ² fra byggeperiode [%]
Før 1850	3%
1851-1930	27%
1931-1950	10%
1951-1960	8%
1961-1972	22%
1972-1978	13%
1979-1998	11%
1999-2006	4%
Efter 2006	2%

Typer af huse gennem tiden



Opførelsesår	Andel opvarmede m ² fra byggeperiode [%]	Anddel af huse med fjernvarme [%]
Før 1850	3%	15%
1851-1930	27%	32%
1931-1950	10%	43%
1951-1960	8%	48%
1961-1972	22%	51%
1972-1978	13%	54%
1979-1998	11%	57%
1999-2006	4%	51%
Efter 2006	2%	58%

Typer af huse gennem tiden



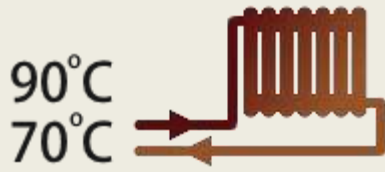
Opførelsesår	Andel opvarmede m ² fra byggeperiode [%]	Anddel af huse med fjernvarme [%]
Før 1850	3%	15%
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1951-1960	8%	48%
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1972-1978	13%	54%
1979-1998	11%	57%
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Efter 2006	2%	58%

Typer af huse gennem tiden



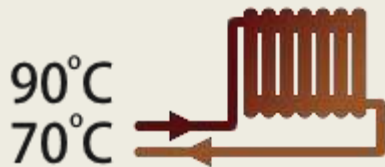
Opførelsesår	Andel opvarmede m ² fra byggeperiode [%]	Anddel af huse med fjernvarme [%]
Før 1850	3%	15%
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1961-1972	22%	51%
1972-1978	13%	54%
1979-1998	11%	57%
1999-2006	4%	51%
Efter 2006	2%	58%

Typer af huse gennem tiden

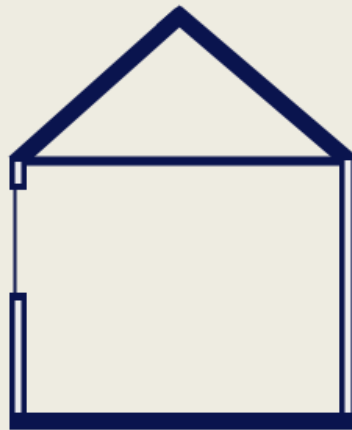


Temperatursæt

Typer af huse gennem tiden

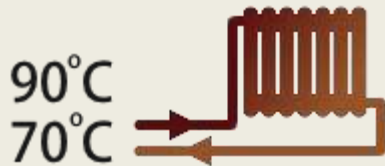


Temperatursæt

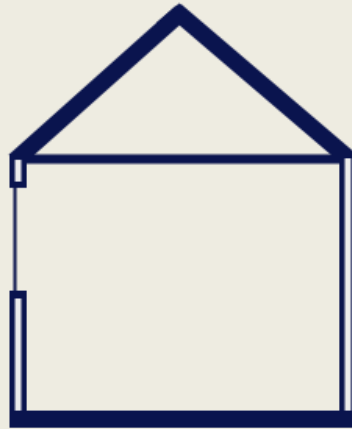


Oprindelige konstruktioner

Typer af huse gennem tiden

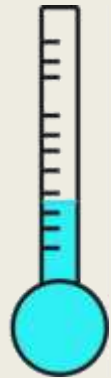


Temperatursæt



Oprindelige konstruktioner

-15°C



Dimensioneringsmetode

Typer af huse gennem tiden

Originale konstruktioner

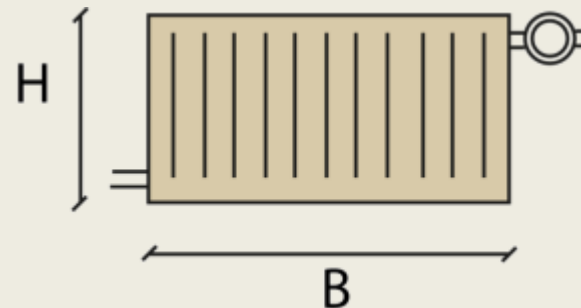
Construction period	Ydervæg	Tag	Vinduer
1931-1950	Hulmur	0 mm	1 lags
1951-1960	Hulmur	100 mm	1 lags

Typer af huse gennem tiden

Originale konstruktioner

Construction period	Ydervæg	Tag	Vinduer
1931-1950	Hulmur	0 mm	1 lags
1951-1960	Hulmur	100 mm	1 lags

+ 5%



Overdimensionering

Typer af huse gennem tiden

Originale konstruktioner

Construction period	Ydervæg	Tag	Vinduer
1931-1950	Hulmur	0 mm	1 lags
1951-1960	Hulmur	100 mm	1 lags

Nuværende konstruktioner

Construction period	Ydervæg	Tag	Vinduer
1931-1950	Hulmur	0 mm	2 lags termo
1951-1960	Hulmur efterisoleret	100 mm	2 lags termo

Typer af huse gennem tiden

Originale konstruktioner

Construction period	Ydervæg	Tag	Vinduer
1931-1950	Hulmur	0 mm	1 lags
1951-1960	Hulmur	100 mm	1 lags

Nuværende konstruktioner

Construction period	Ydervæg	Tag	Vinduer
1931-1950	Hulmur	0 mm	2 lags termo
1951-1960	Hulmur efterisoleret	100 mm	2 lags termo

Energirenovering

Construction period	Ydervæg	Tag	Vinduer
1931-1950	Hulmur efterisoleret	100 mm	2 lags lavenergi
1951-1960	Hulmur efterisoleret	250 mm	2 lags lavenergi

Typer af huse gennem tiden

Originale konstruktioner

+



Varmetilskud fra udstyr og personer

Typer af huse gennem tiden

Originale konstruktioner

+



Varmetilskud fra udstyr og personer

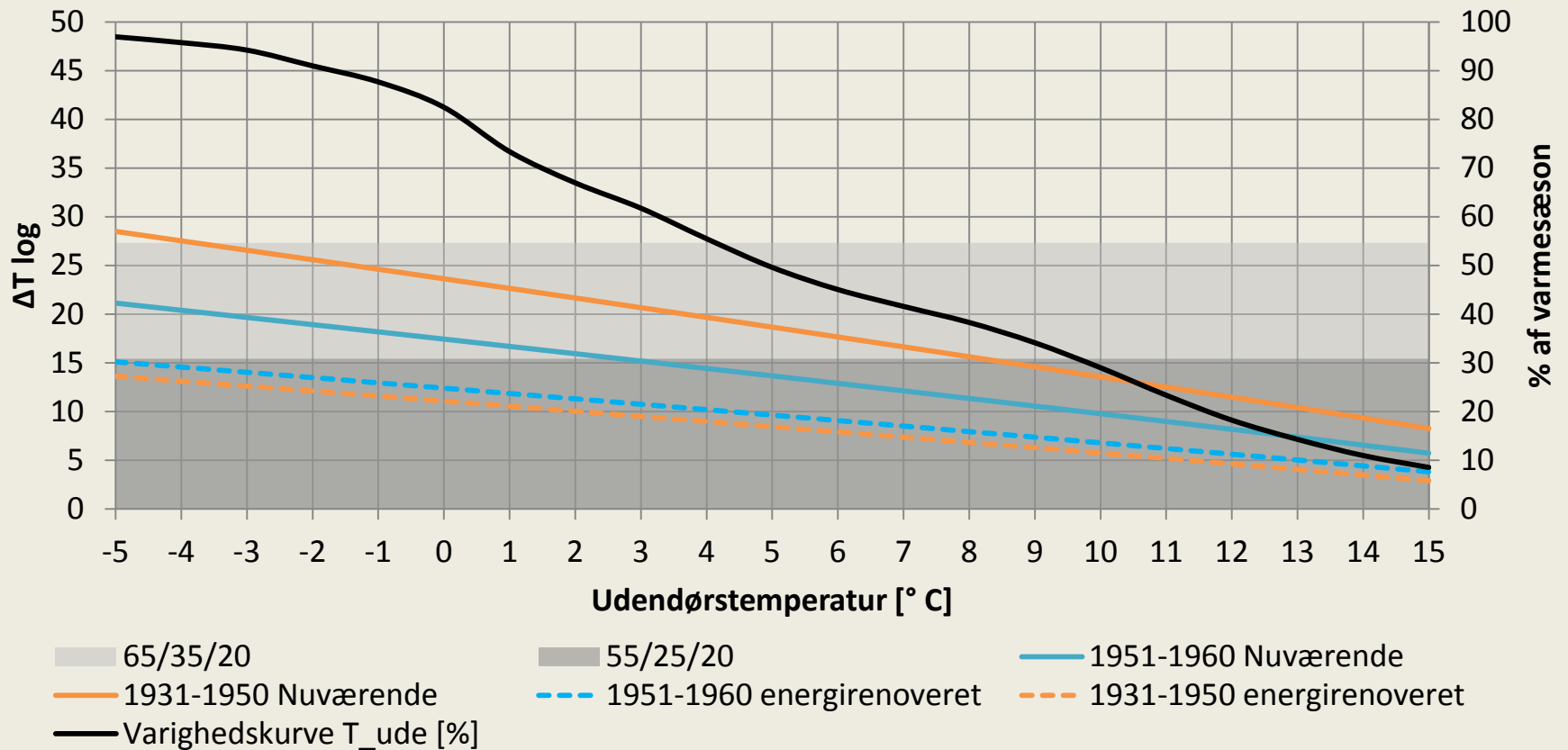
+



Variierende udetemperaturer

Typer af huse gennem tiden

Nuværende konstruktioner og energirenoveret



Typer af huse gennem tiden



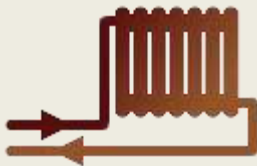
Opførelsesår	Andel opvarmede m ² fra byggeperiode [%]	Anddel af huse med fjernvarme [%]
Før 1850	3%	15%
1851-1930	27%	32%
1931-1950	10%	43%
1951-1960	8%	48%
1961-1972	22%	51%
1972-1978	13%	54%
1979-1998	11%	57%
1999-2006	4%	51%
Efter 2006	2%	58%

Typer af huse gennem tiden

80/60°C

80/40°C

70/40°C



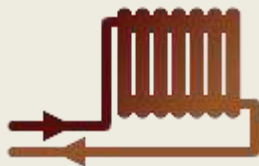
Temperatursæt

Typer af huse gennem tiden

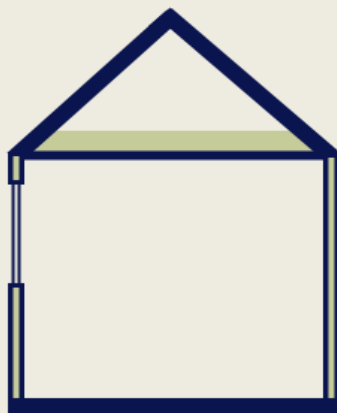
80/60°C

80/40°C

70/40°C



Temperatursæt



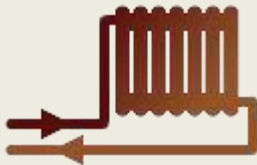
Oprindelige konstruktioner

Typer af huse gennem tiden

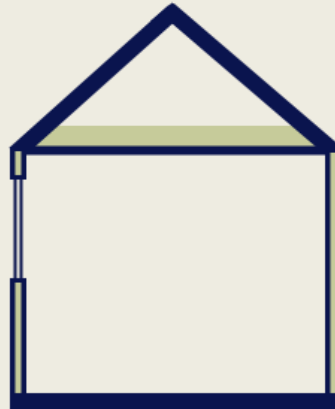
80/60°C

80/40°C

70/40°C

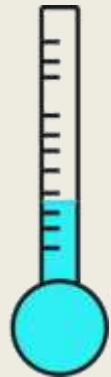


Temperatursæt



Oprindelige konstruktioner

-12°C



Dimensioneringsmetode

Typer af huse gennem tiden

Originale konstruktioner

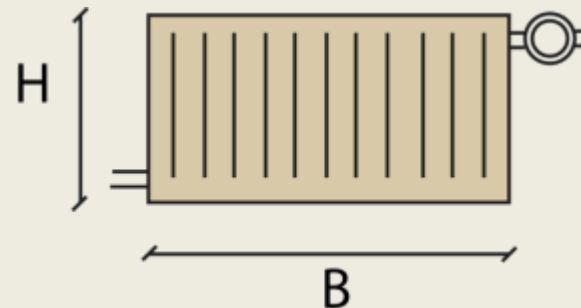
Opførelsesår	Temperatursæt	Ydervæg	Tag	Vinduer
1961-1972	80/60	80 mm	100 mm	2 lags termo
1972-1978	80/40	80 mm	100 mm	2 lags termo
1979-1998	70/40	120 mm	200 mm	2 lags energi

Typer af huse gennem tiden

Originale konstruktioner

Opførelsesår	Temperatursæt	Ydervæg	Tag	Vinduer
1961-1972	80/60	80 mm	100 mm	2 lags termo
1972-1978	80/40	80 mm	100 mm	2 lags termo
1979-1998	70/40	120 mm	200 mm	2 lags energi

+ 5%



Overdimensionering

Typer af huse gennem tiden

Originale konstruktioner

Opførelsesår	Temperatursæt	Ydervæg	Tag	Vinduer
1961-1972	80/60	80 mm	100 mm	2 lags termo
1972-1978	80/40	80 mm	100 mm	2 lags termo
1979-1998	70/40	120 mm	200 mm	2 lags energi

Nuværende konstruktioner

Opførelsesår	Temperatursæt	Ydervæg	Tag	Vinduer
1961-1972	-	80 mm	100 mm	2 lags termo
1972-1978	-	80 mm	100 mm	2 lags termo
1979-1998	-	120 mm	200 mm	2 lags energi

Typer af huse gennem tiden

Originale konstruktioner

Opførelsesår	Temperatursæt	Ydervæg	Tag	Vinduer
1961-1972	80/60	80 mm	100 mm	2 lags termo
1972-1978	80/40	80 mm	100 mm	2 lags termo
1979-1998	70/40	120 mm	200 mm	2 lags energi

Nuværende konstruktioner

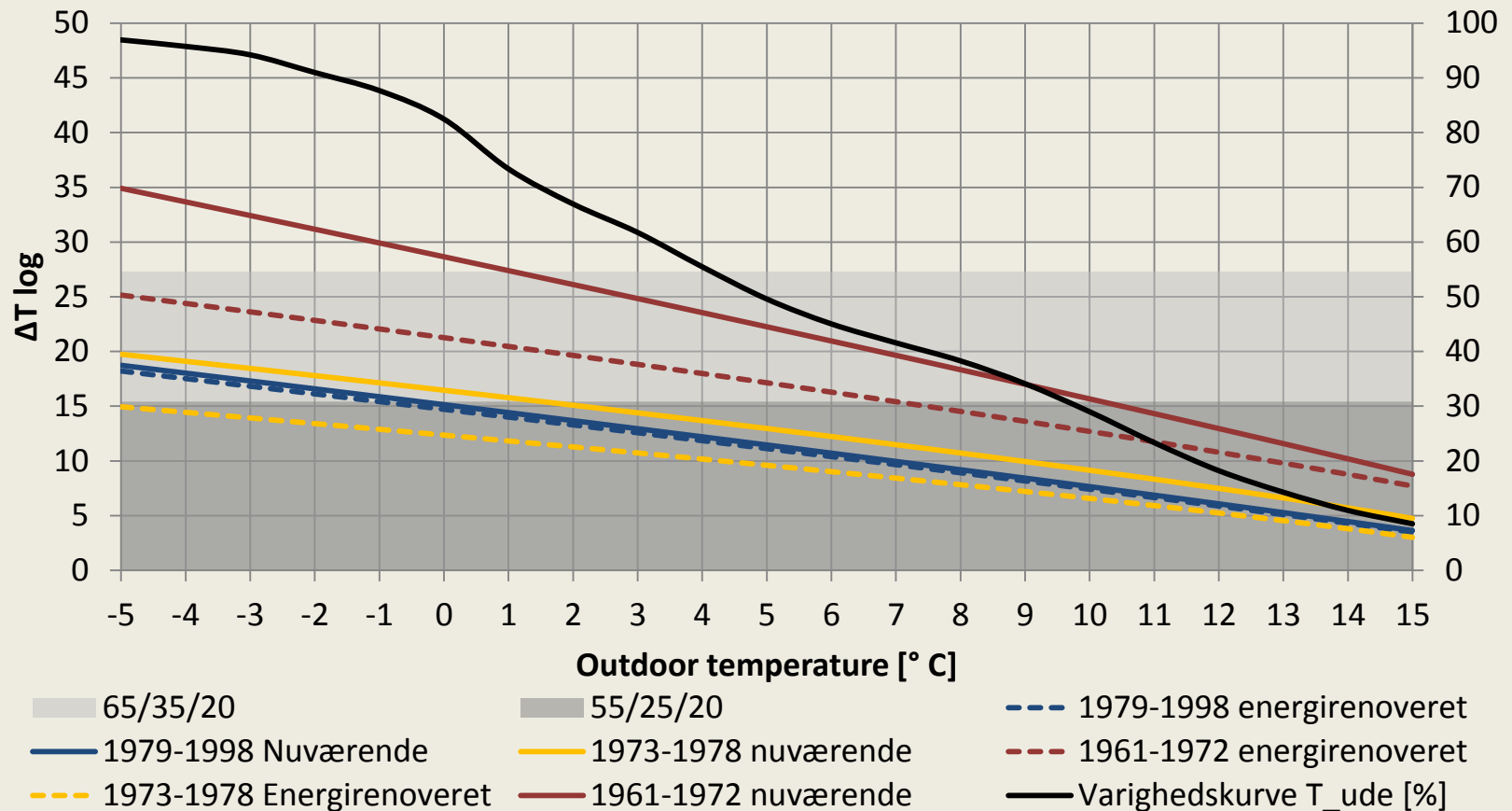
Opførelsesår	Temperatursæt	Ydervæg	Tag	Vinduer
1961-1972	-	80 mm	100 mm	2 lags termo
1972-1978	-	80 mm	150 mm	2 lags termo
1979-1998	-	120 mm	200 mm	2 lags energi

Energirenoveret

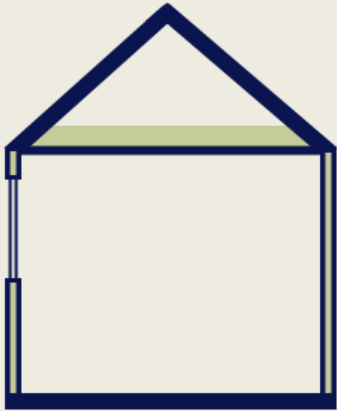
Opførelsesår	Temperatursæt	Ydervæg	Tag	Vinduer
1961-1972	-	80 mm	250 mm	2 lags lavenergi
1972-1978	-	80 mm	250 mm	2 lags lavenergi
1979-1998	-	120 mm	300 mm	2 lags lavenergi

Typer af huse gennem tiden

Nuværende konstruktioner og energirenovering

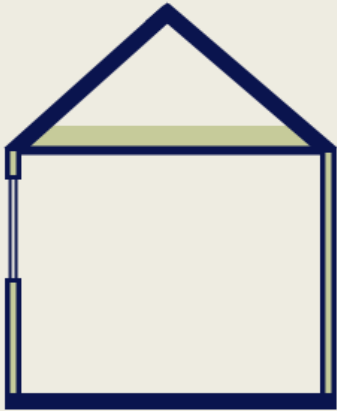


Typer af huse gennem tiden - opsummering

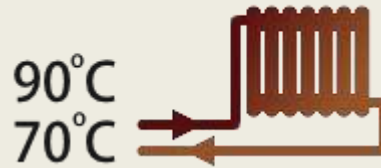


Mulighed for renovering

Typer af huse gennem tiden - opsummering

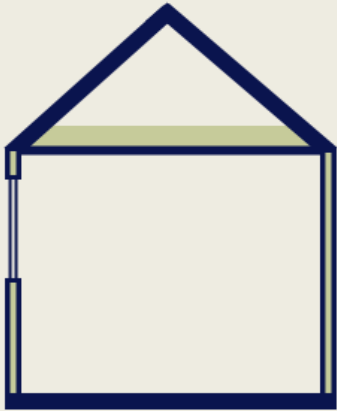


Mulighed for reovering

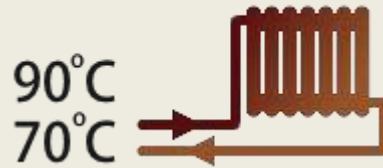


Temperatursæt

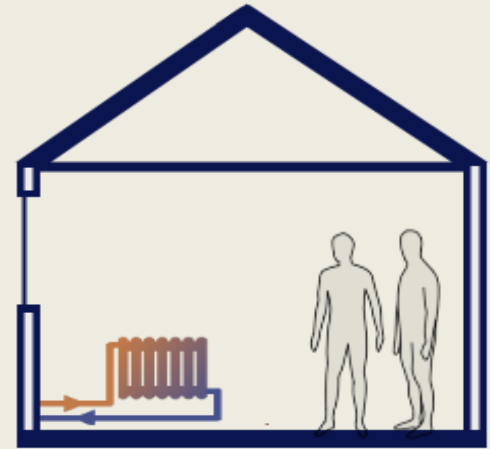
Typer af huse gennem tiden - opsummering



Mulighed for reovering



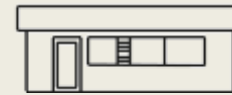
Temperatursæt



Styring, komfort og adfærd

Case studier

Case studier



1980'erne

Bjerringbro



Direkte tilslutning

Bjerringbro



46°C

Direkte tilslutning

Ned til 5 °C

Bjerringbro



Direkte tilslutning

46°C

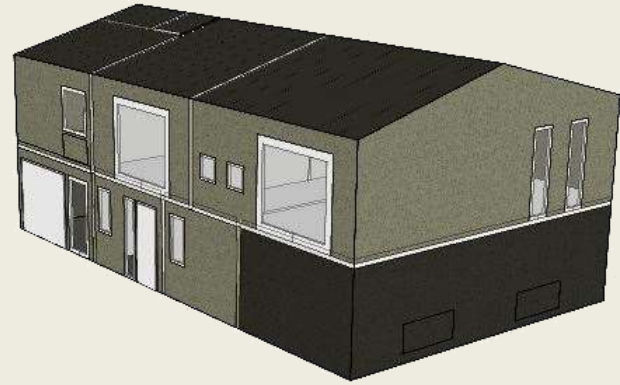
Ned til 5 °C

+1°C

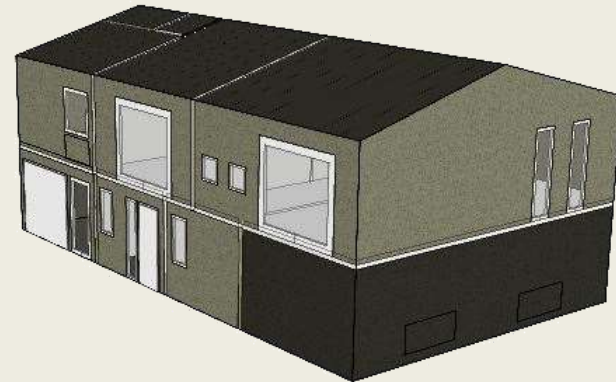
Pr. grad lavere udetemp.

Simuleringer

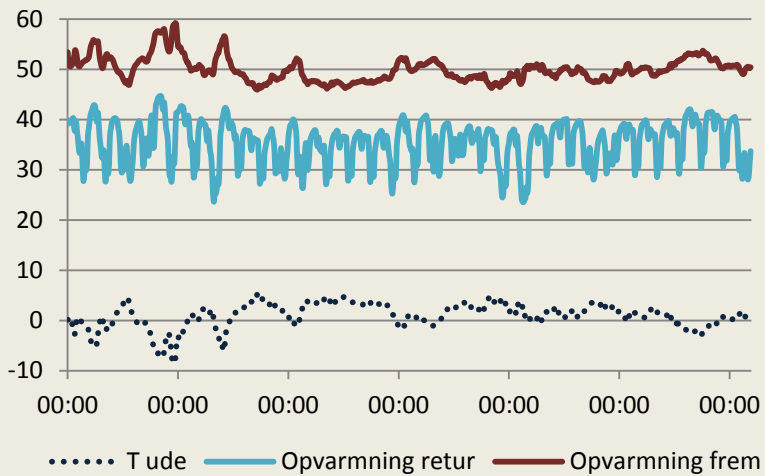
Simuleringer



Simuleringer



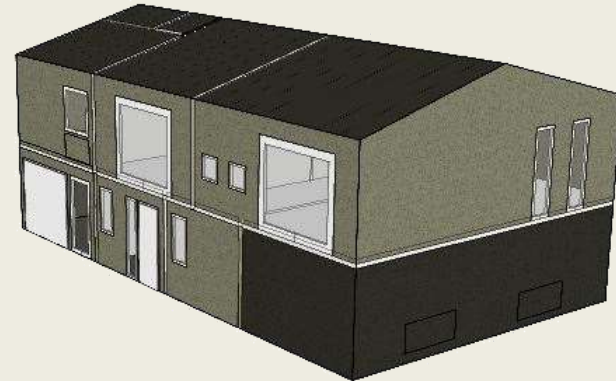
Januar - HUS 1



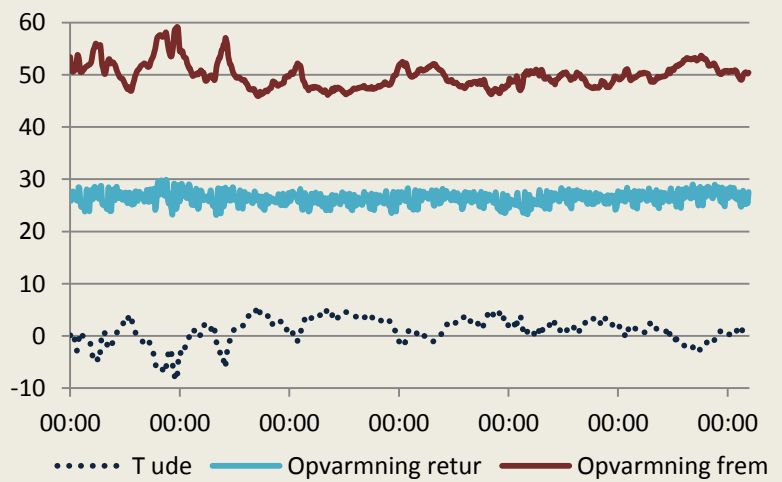
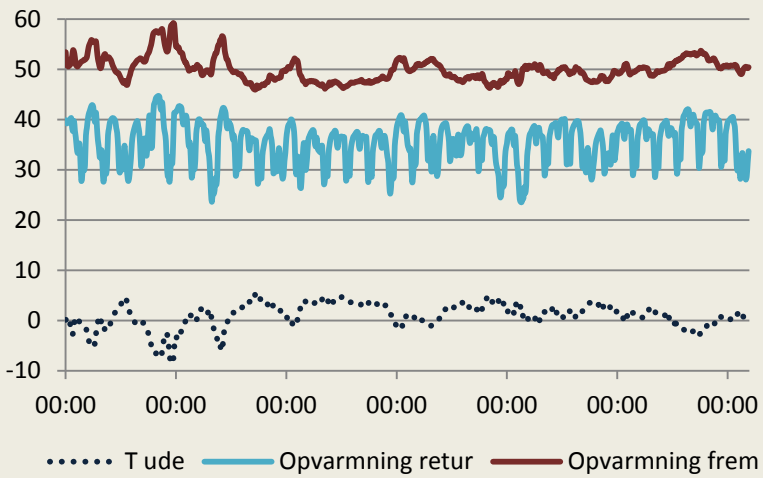
Simuleringer



Januar - HUS 1



Januar - HUS 2

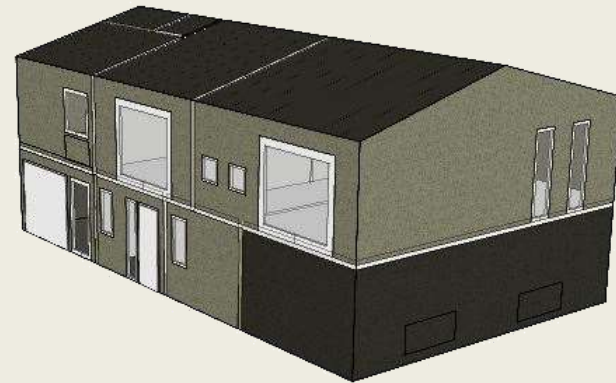


Målinger

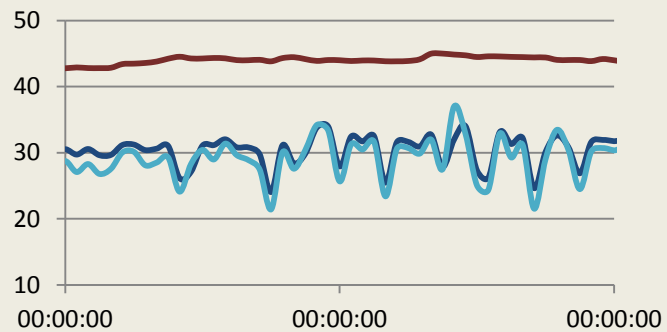
Målinger



Målinger

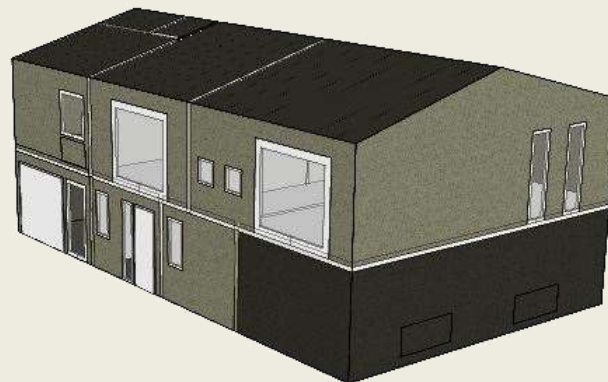


HUS 1 - Februar

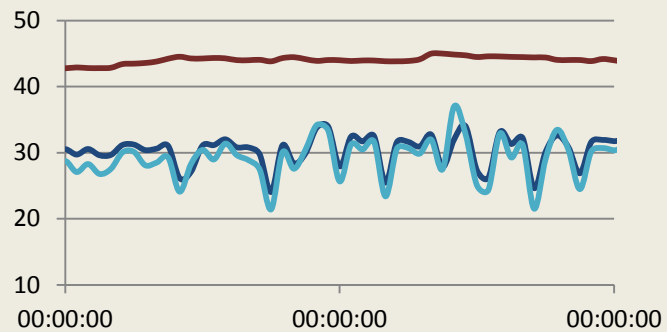


— Fjernvarme frem — Fjernvarme retur
— Opvarmning retur

Målinger

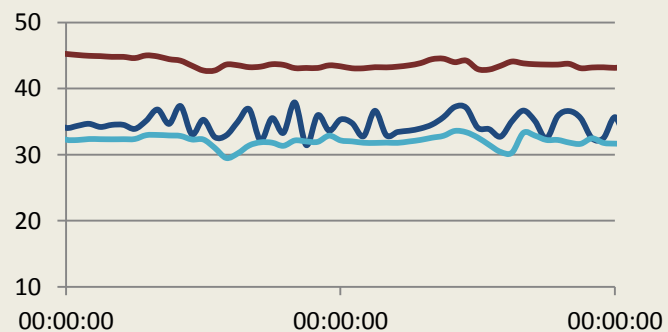


HUS 1 - Februar



— Fjernvarme frem — Fjernvarme retur
— Opvarmning retur

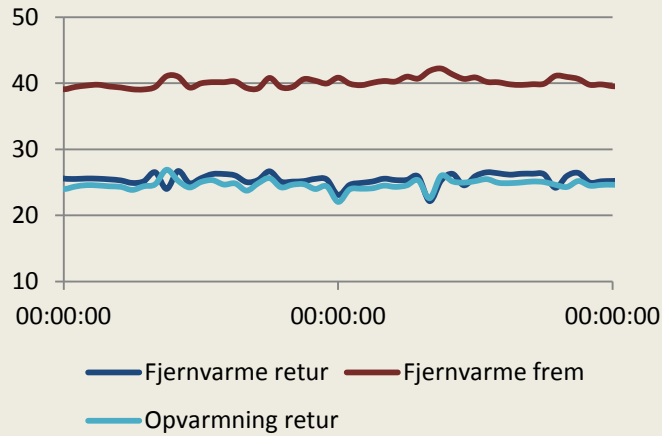
HUS 3 - Februar



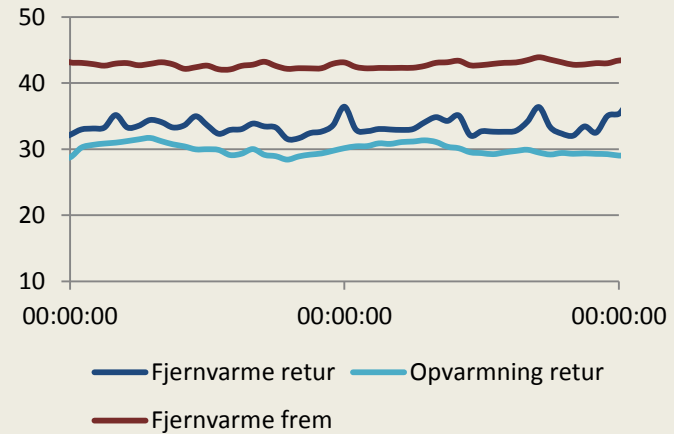
— Fjernvarme frem — Fjernvarme retur
— Opvarmning retur

Målinger

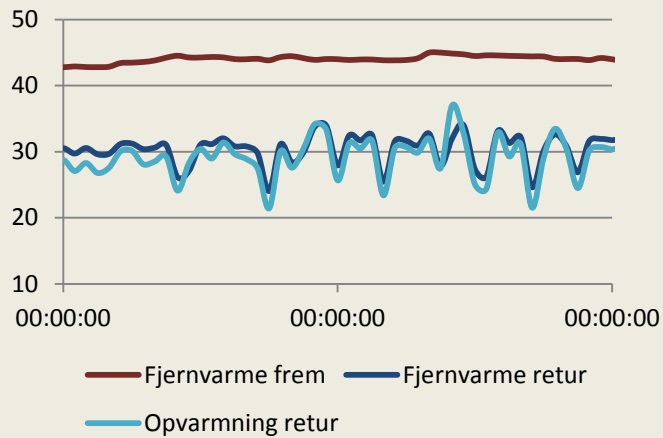
HUS 1 - Maj



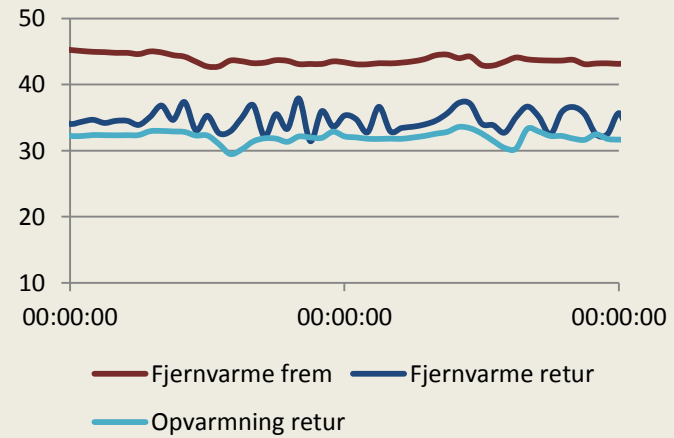
HUS 3 - Maj



HUS 1 - Februar



HUS 3 - Februar



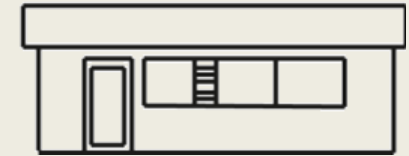
Opsummering Bjerringbro

Opsummering Bjerringbro



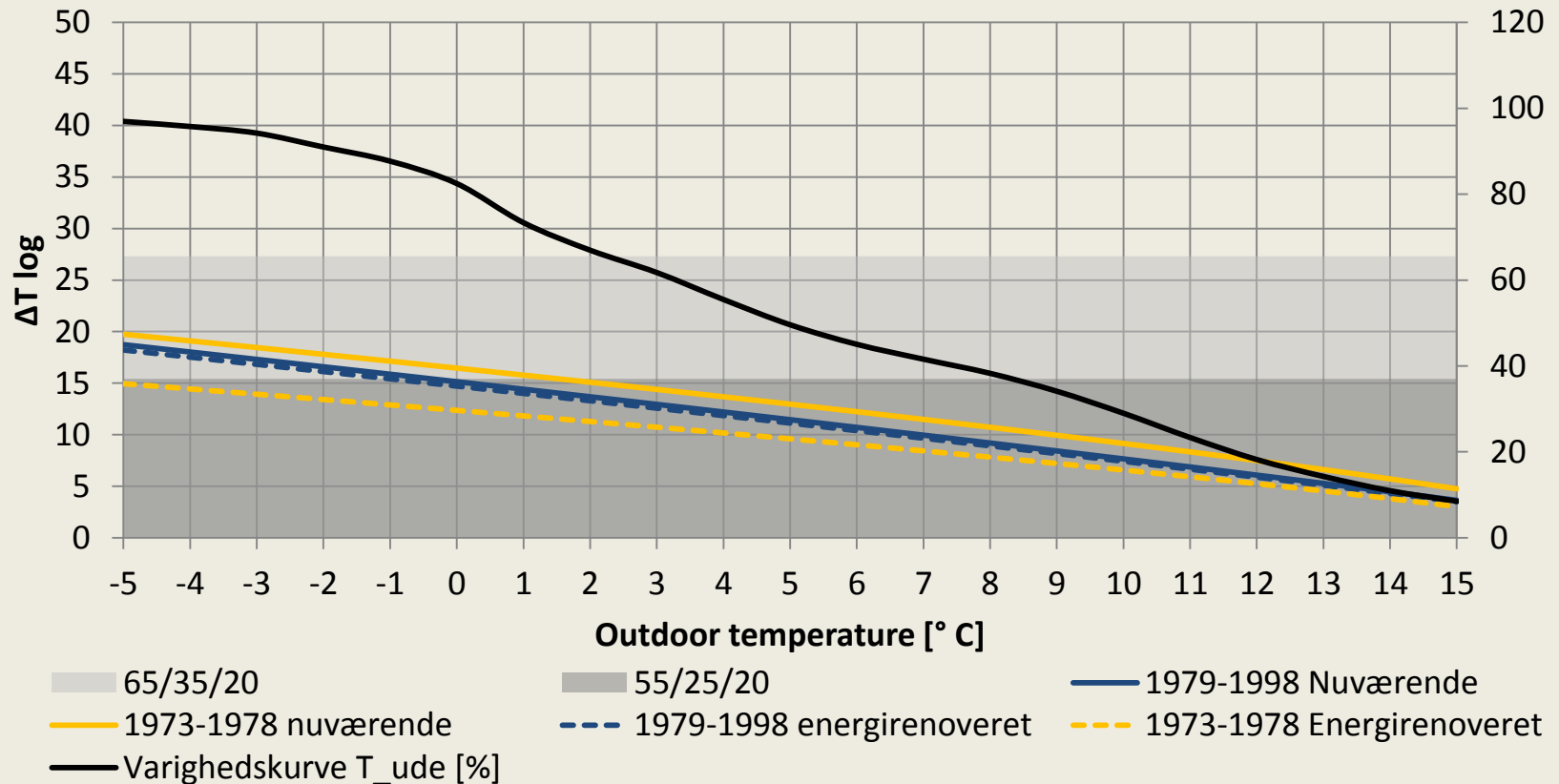
45°C / 30°C

Opsummering Bjerringbro

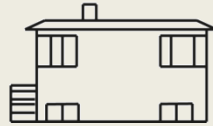


1980'erne

Huse fra 1980'erne



Case studier



1930'erne

Gentofte

Gentofte



Indirekte tilslutning

Gentofte



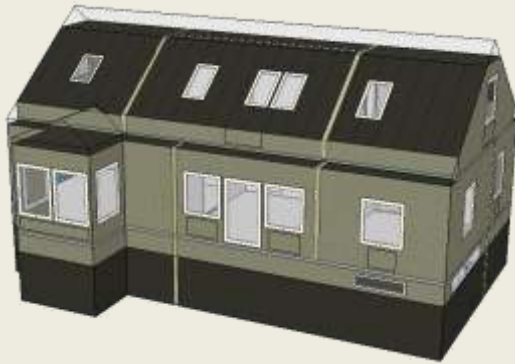
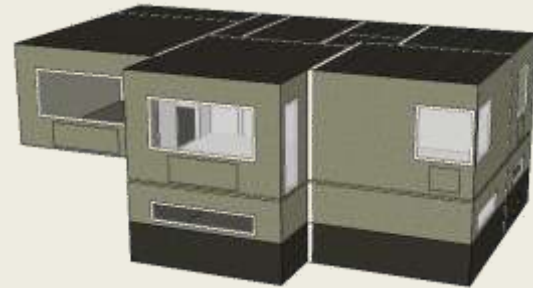
Indirekte tilslutning

55°C

Så længe som muligt

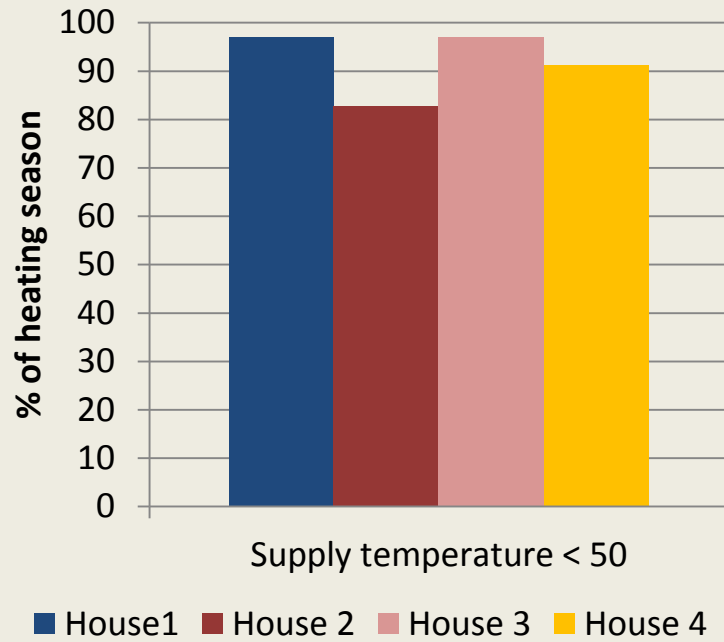
Simuleringer

Simuleringer



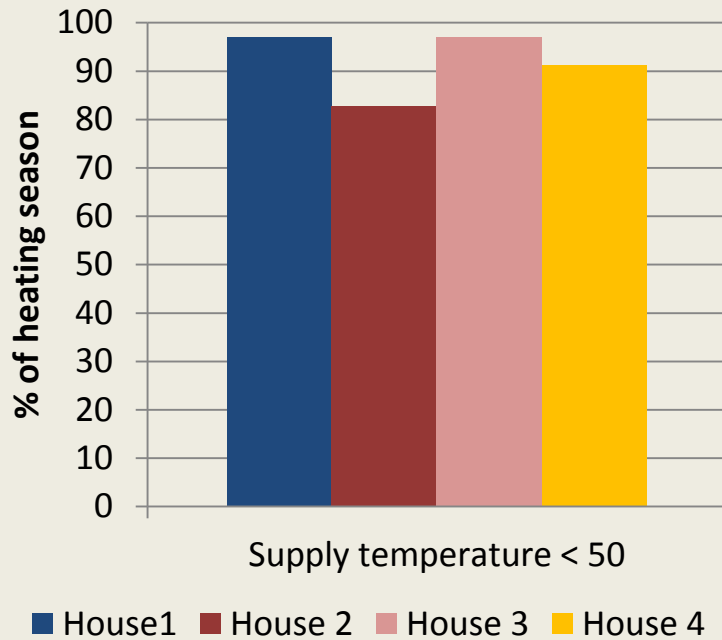
Simuleringer

Supply temperatures

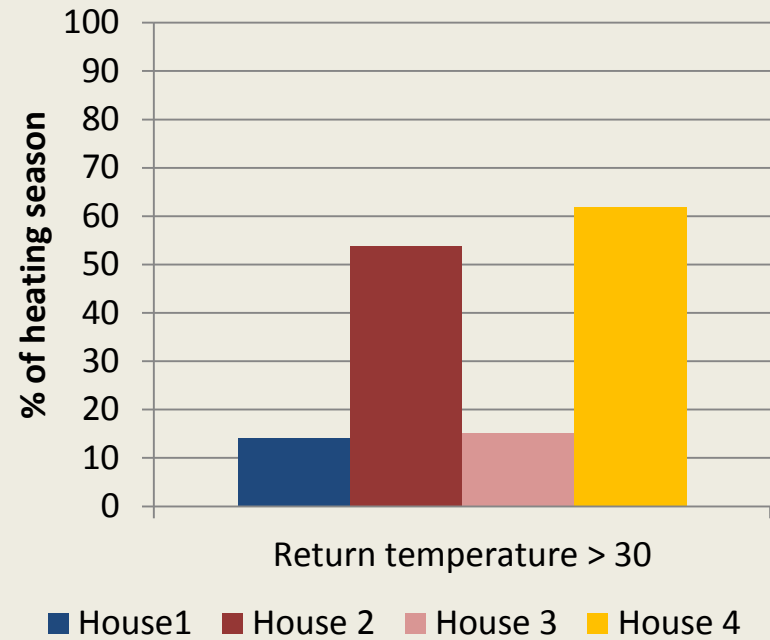


Simuleringer

Supply temperatures



Return temperatures



Målinger

Målinger



Målinger



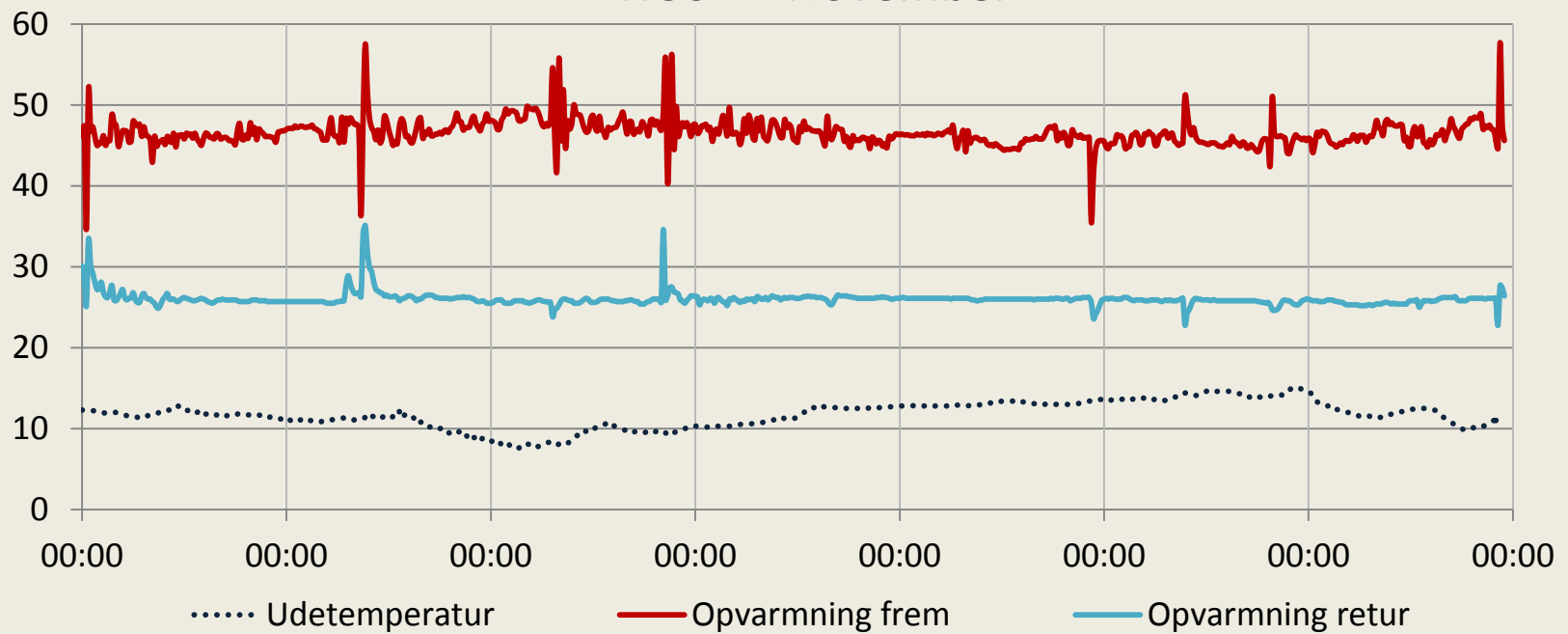
Målinger

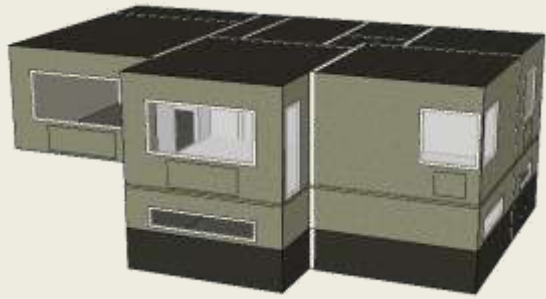


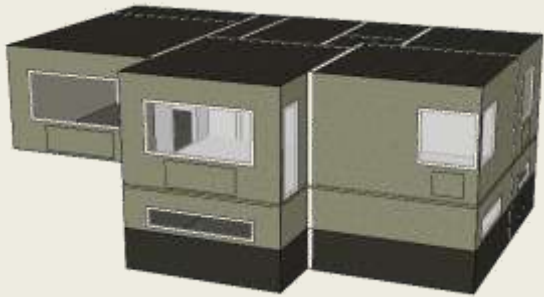




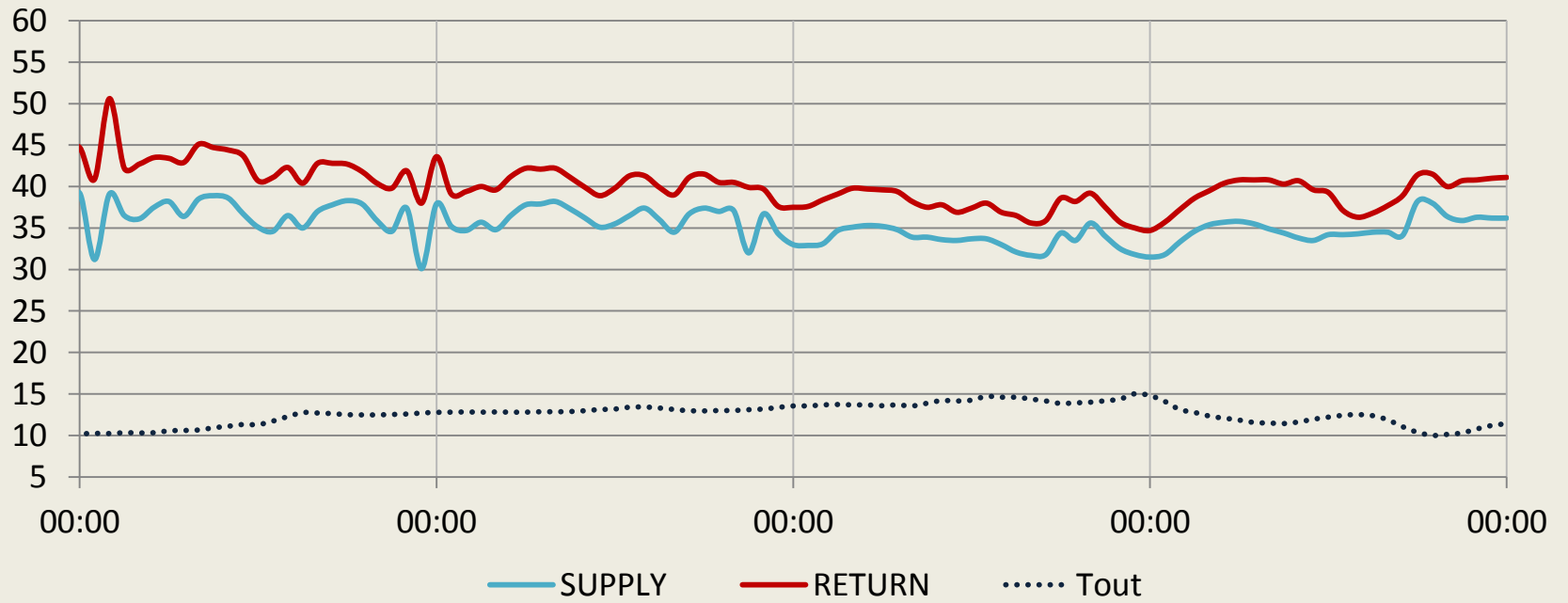
HUS 1 - November

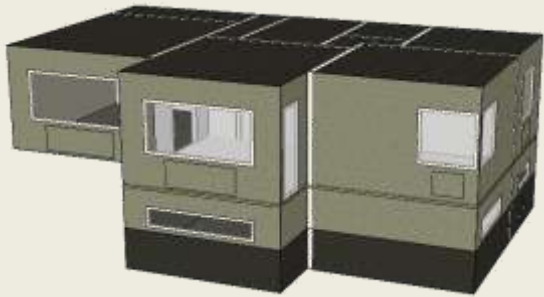




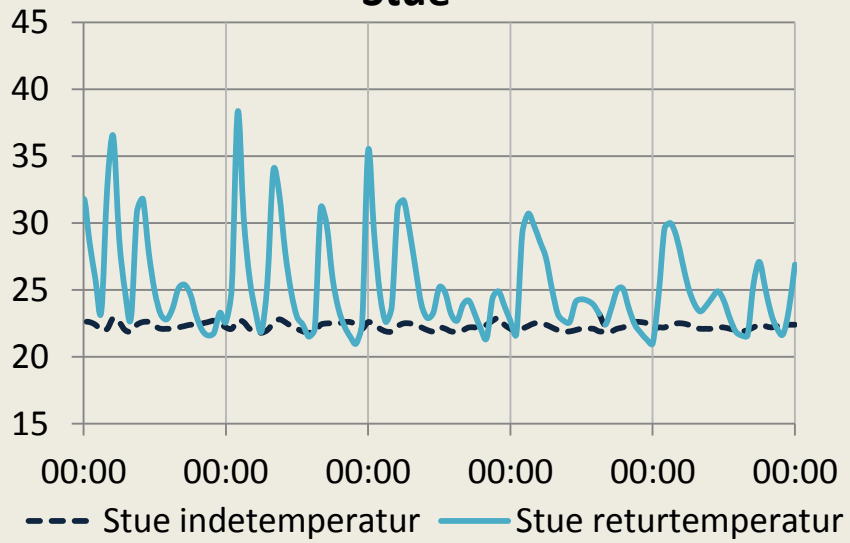


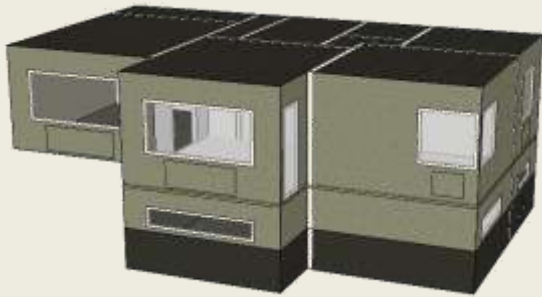
HUS2 - November



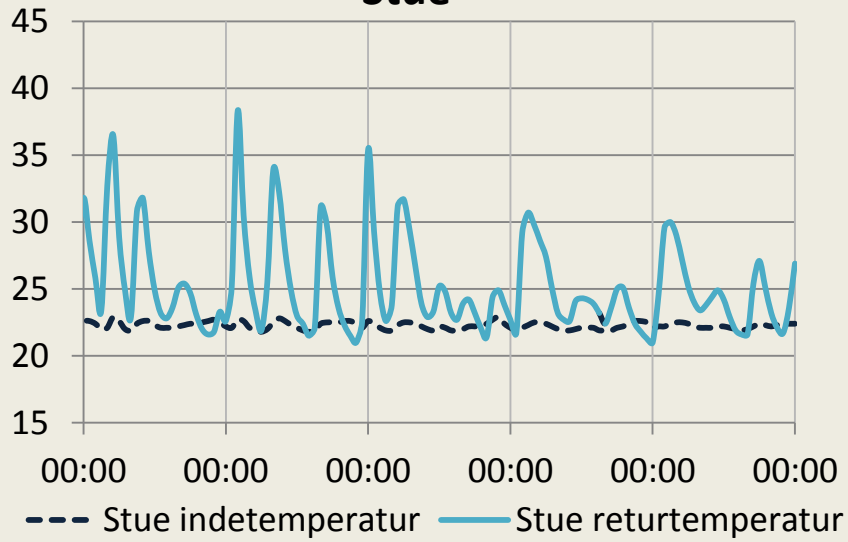


Stue

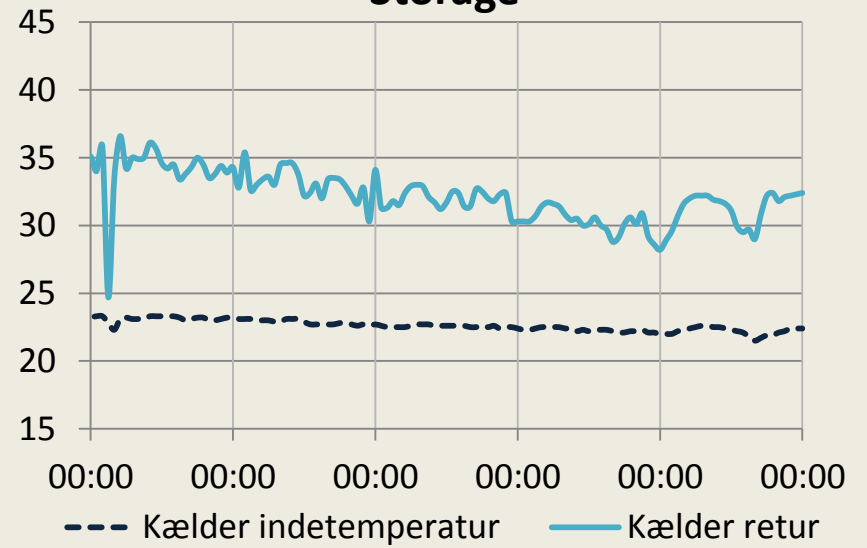


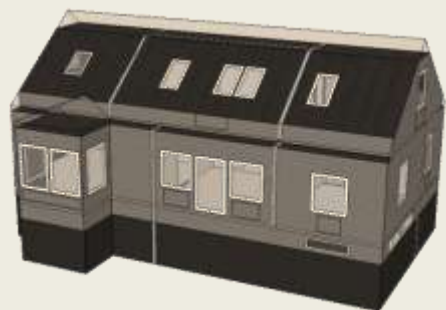


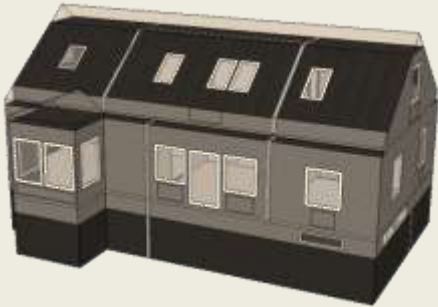
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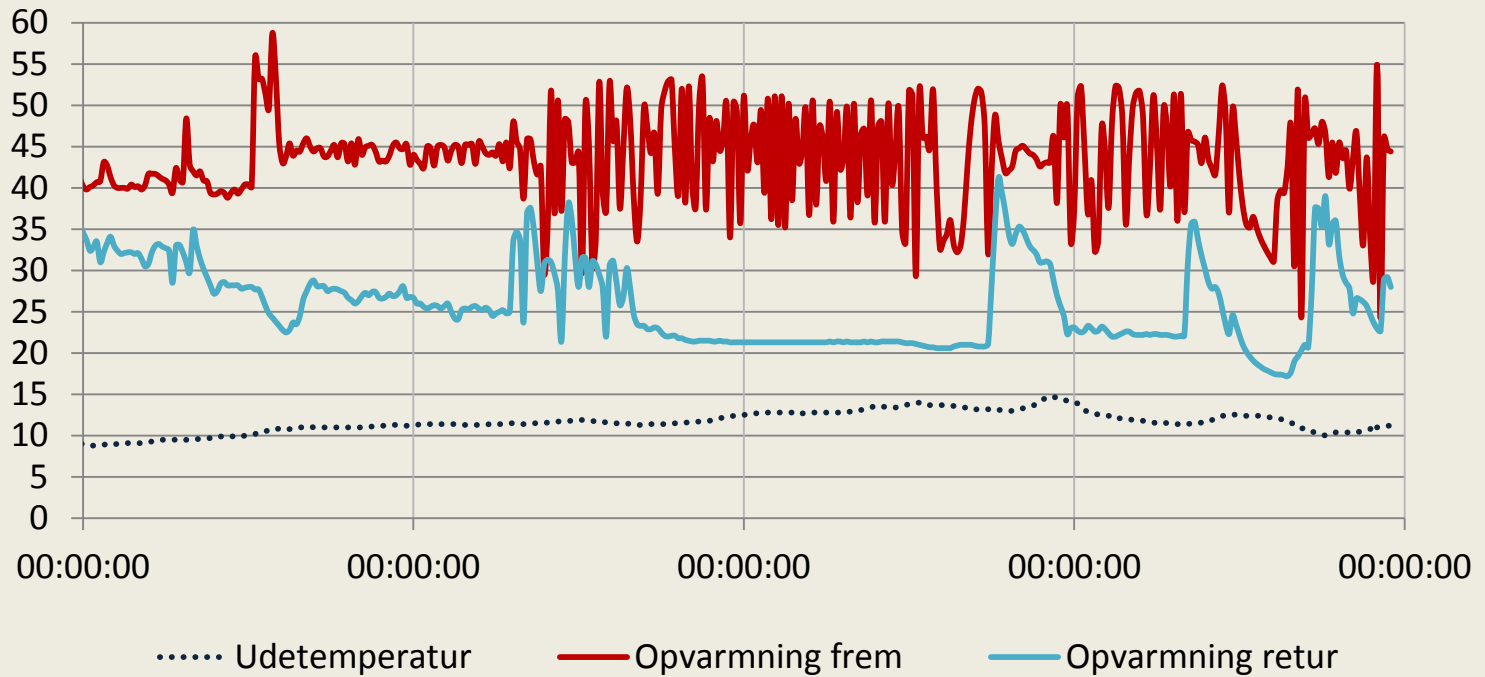
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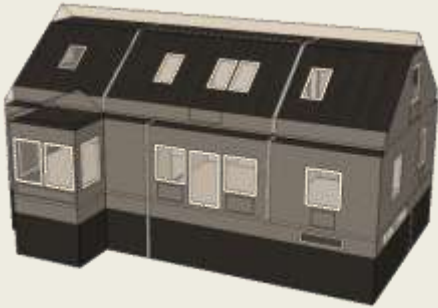




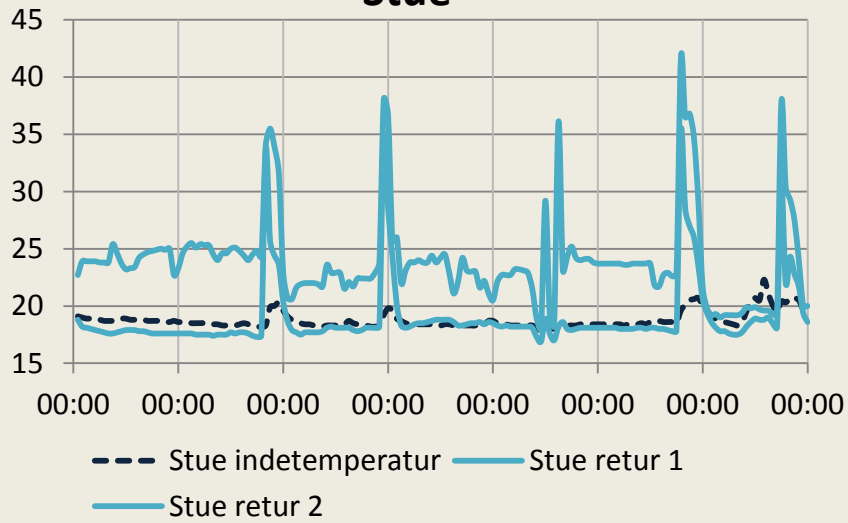


HUS 3 - November

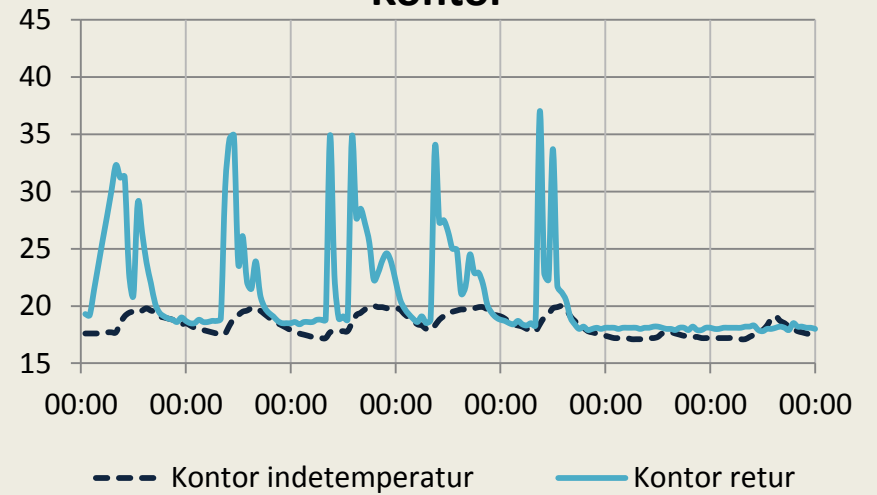




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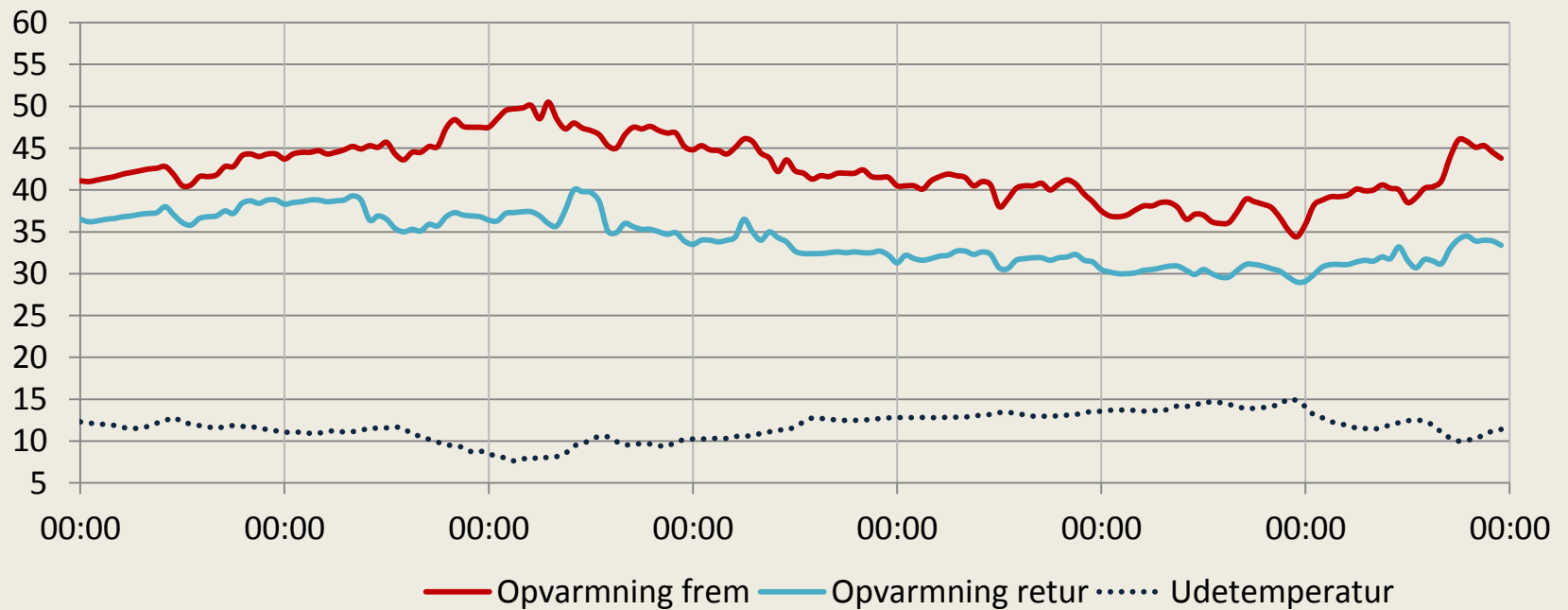
Kontor





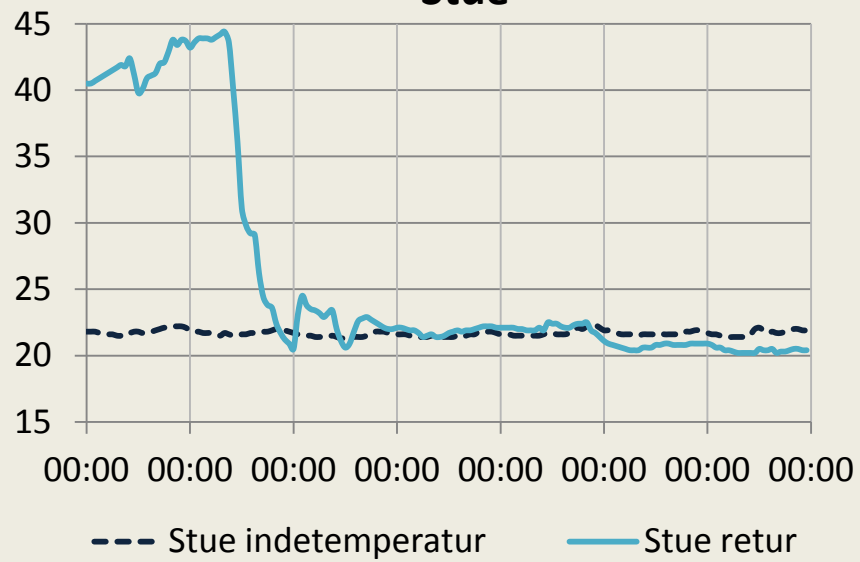


HUS 4 - November



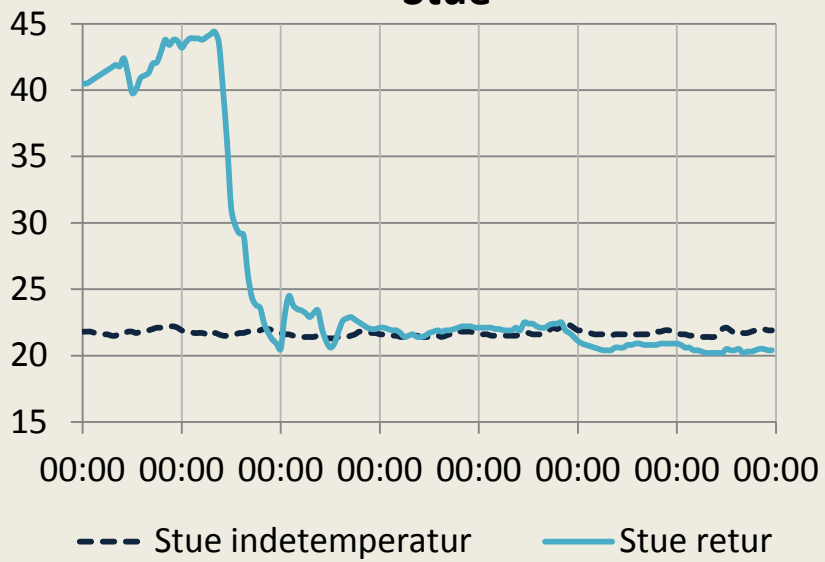


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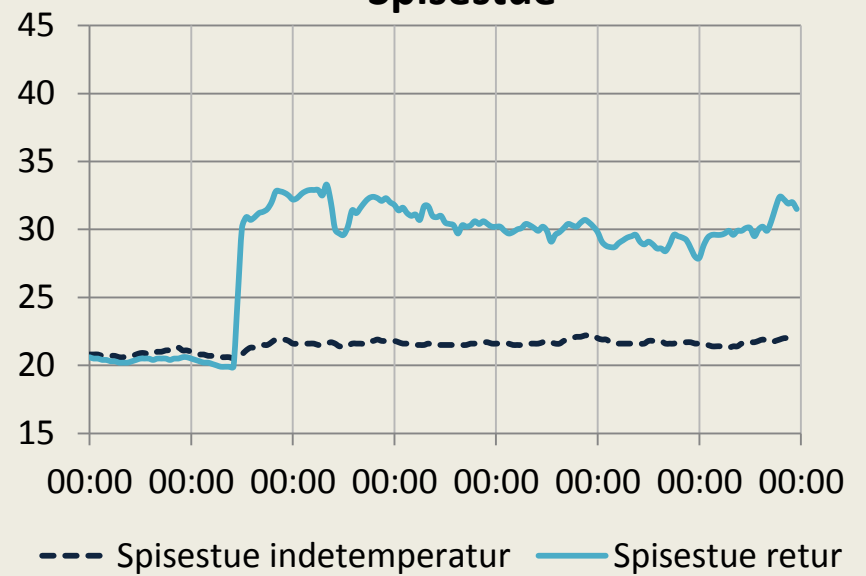




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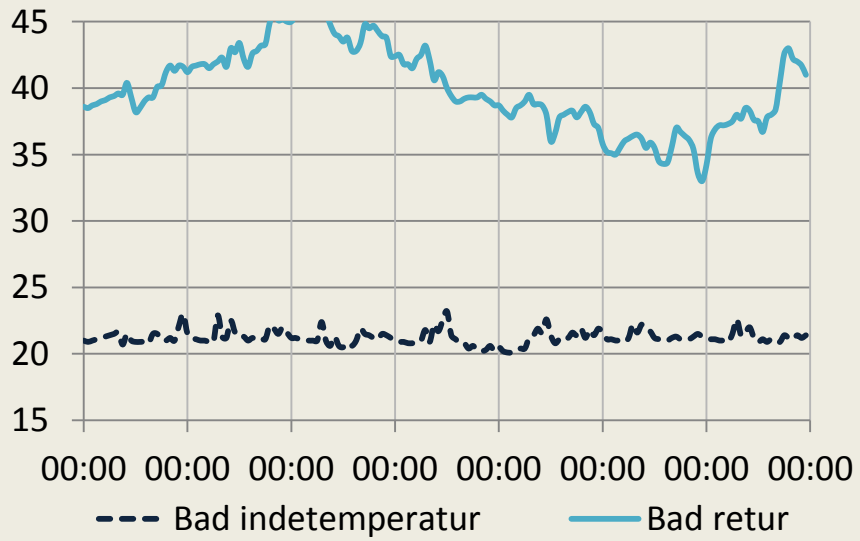


Spisestue





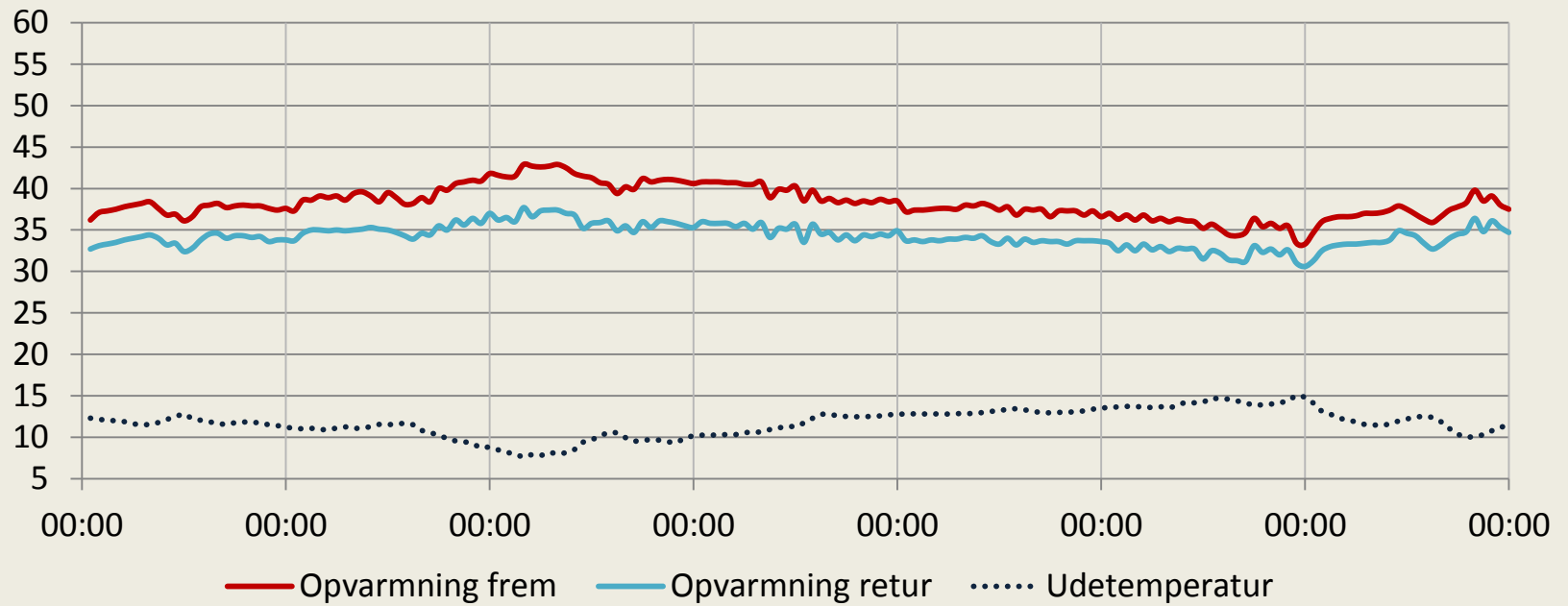
Bad





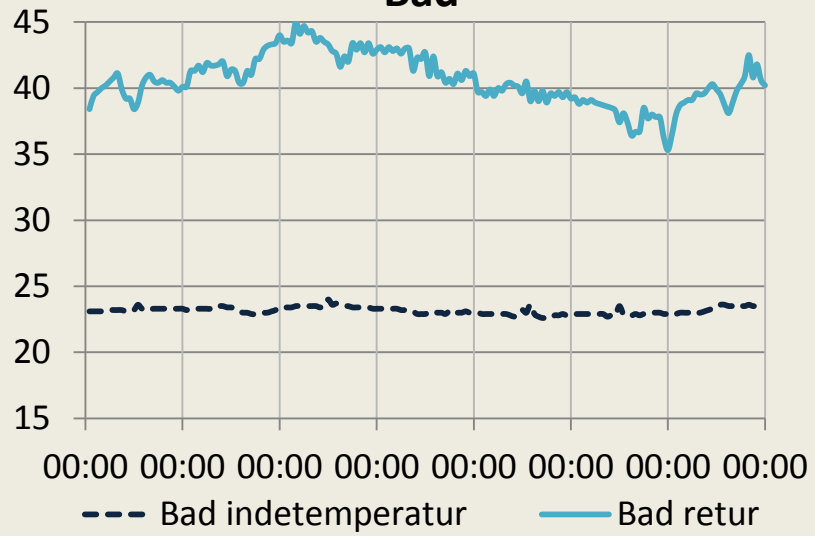


HUS 5 - November



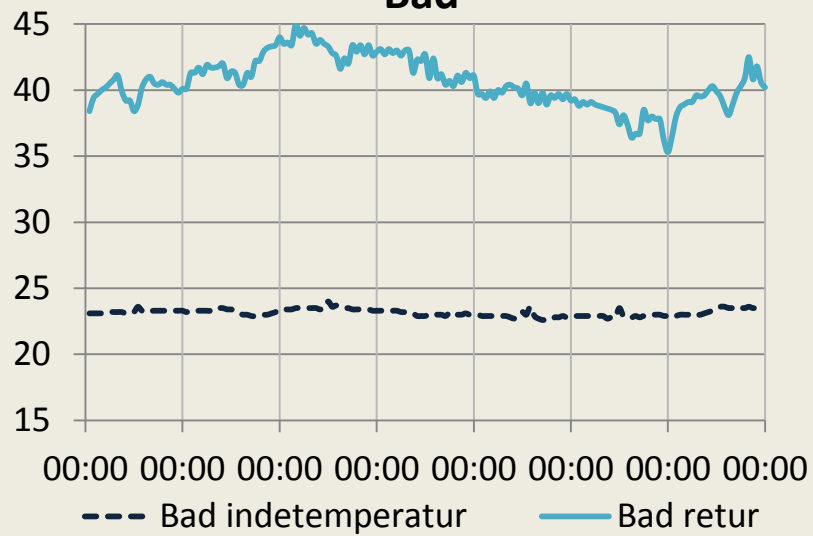


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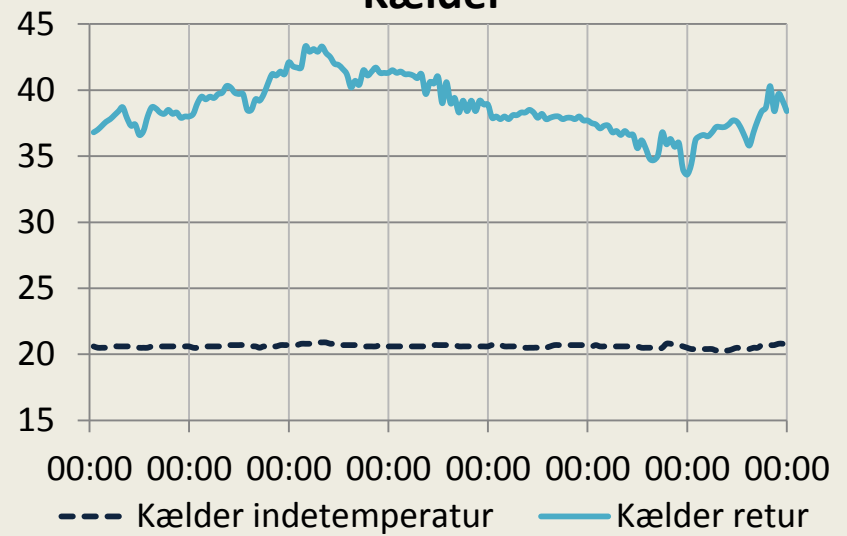




Bad



Kælder



Opsummering Gentofte

Opsummering Gentofte



50°C / ?

Opsummering Gentofte



50°C / ?



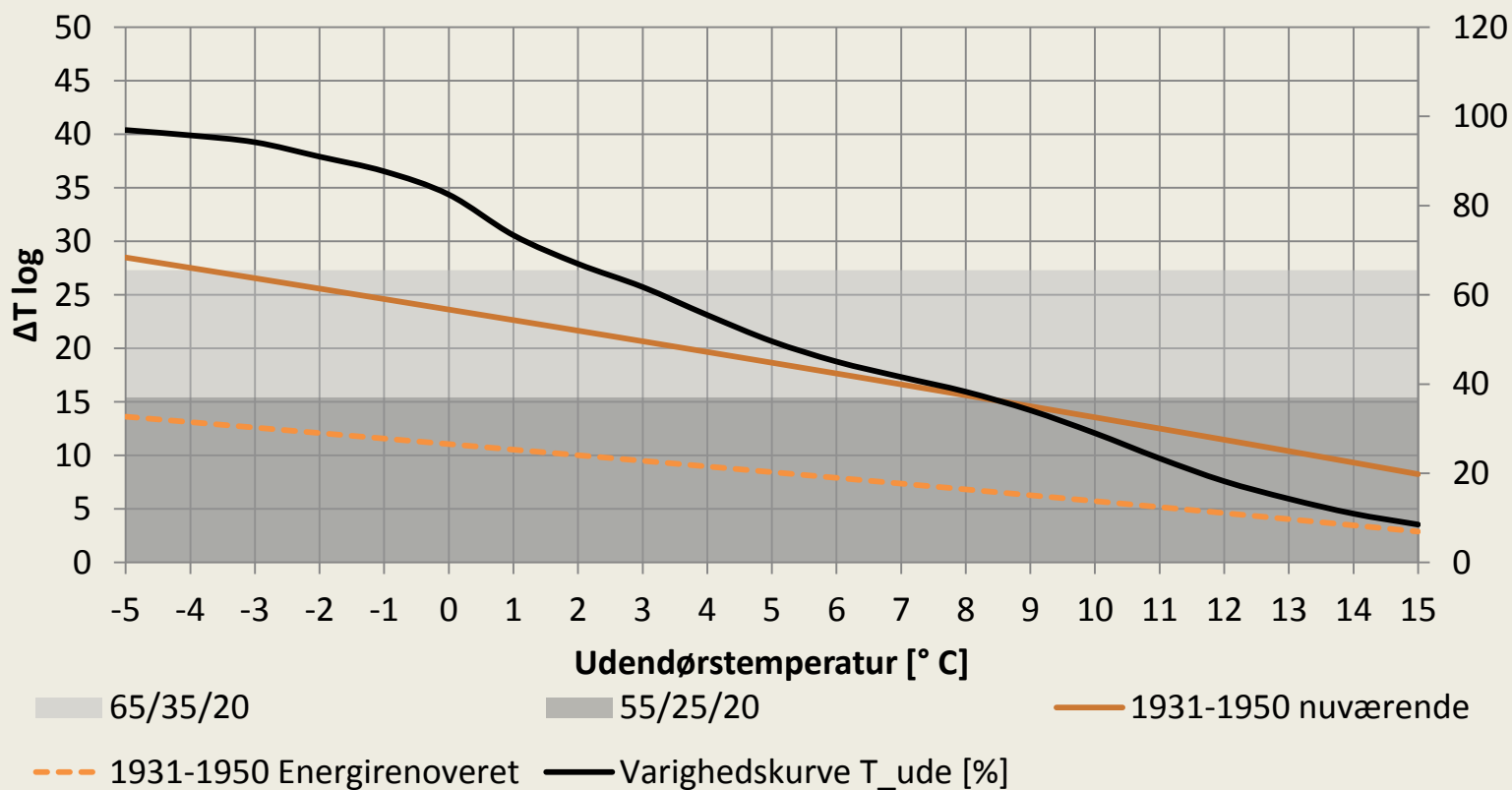
Styring kan forbedres

Opsummering Gentofte



Huse fra 1930'erne

1930'erne

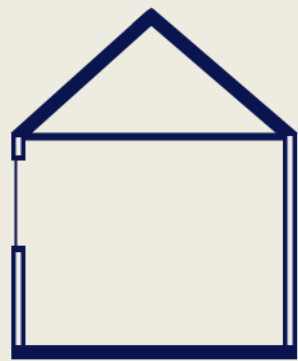


Opsummering

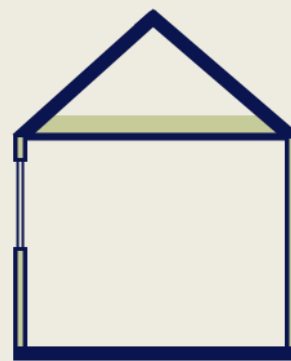
Opsummering



Opsummering

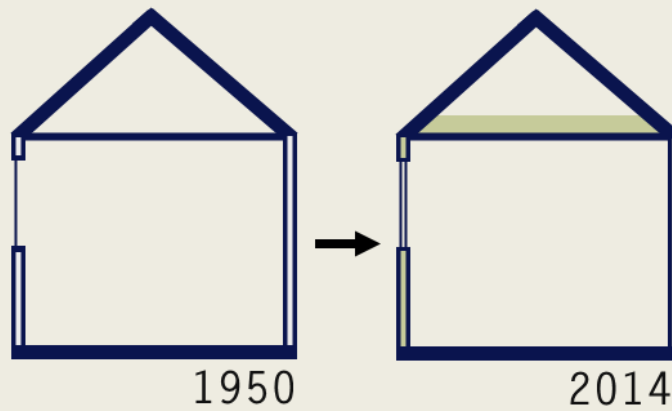


1950



2014

Opsummering



HOUSE 1	
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Spørgsmål og kommentarer?

