



**SUREFIT**

Sustainable solutions for affordable  
REtroFIT of domestic buildings

# The energy saving and CO<sub>2</sub> reduction potential of Finnish building stock with cost optimal deep renovation

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**SUREFIT WORKSHOP**

**Thursday 15th December 2022 9am (GMT) on Webex**



This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 894511.

# Overview of the presentation

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- Targets for low carbon buildings
- The effectiveness of different energy saving measures
- CO<sub>2</sub> reduction potential in buildings and the Finnish building stock

# Target for low carbon built environment

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- EU-targets: significant reduction of CO<sub>2</sub>-emissions
  - 40% by 2030
  - 80% by 2050
- 55 % reduction in greenhouse gases from 1990 levels by 2030 (fit to 55)
- REPowerEU: A plan to rapidly reduce dependence on Russian fossil fuels and fast forward the green transition



# Research questions of existing apartment buildings

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- How much can emissions be reduced in Finnish buildings of different age groups?
- What are the cost-optimal and maximum performance solutions?
  - Minimize LCC and emissions using optimization
- What is the potential of CO<sub>2</sub> reduction in Finnish building stock

How much it is possible to reduce emissions in old apartment buildings?

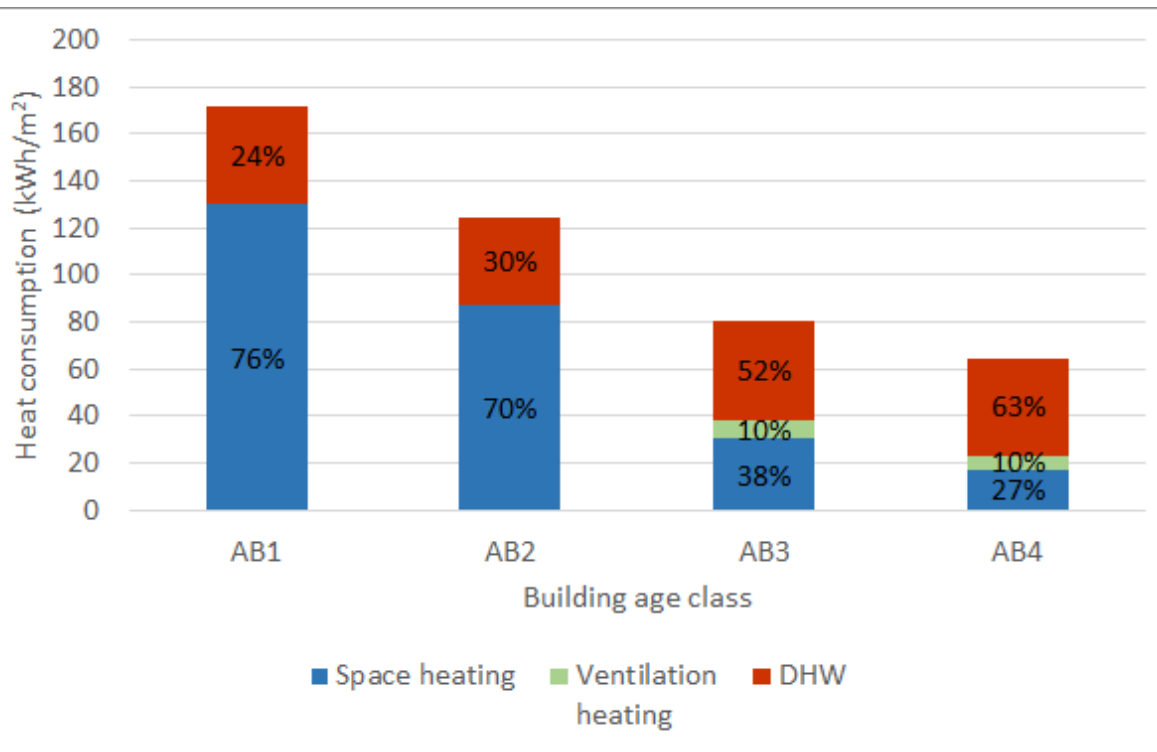
# Building information: Apartment Buildings in Finland

AB1: <1976 – Mechanical exhaust ventilation, no heat recovery

AB2: 1976-2002 – Mechanical exhaust ventilation, no heat recovery

AB3: 2003-2009 – Mechanical supply-exhaust ventilation, heat recovery

AB4: 2010< – Mechanical supply-exhaust ventilation, heat recovery

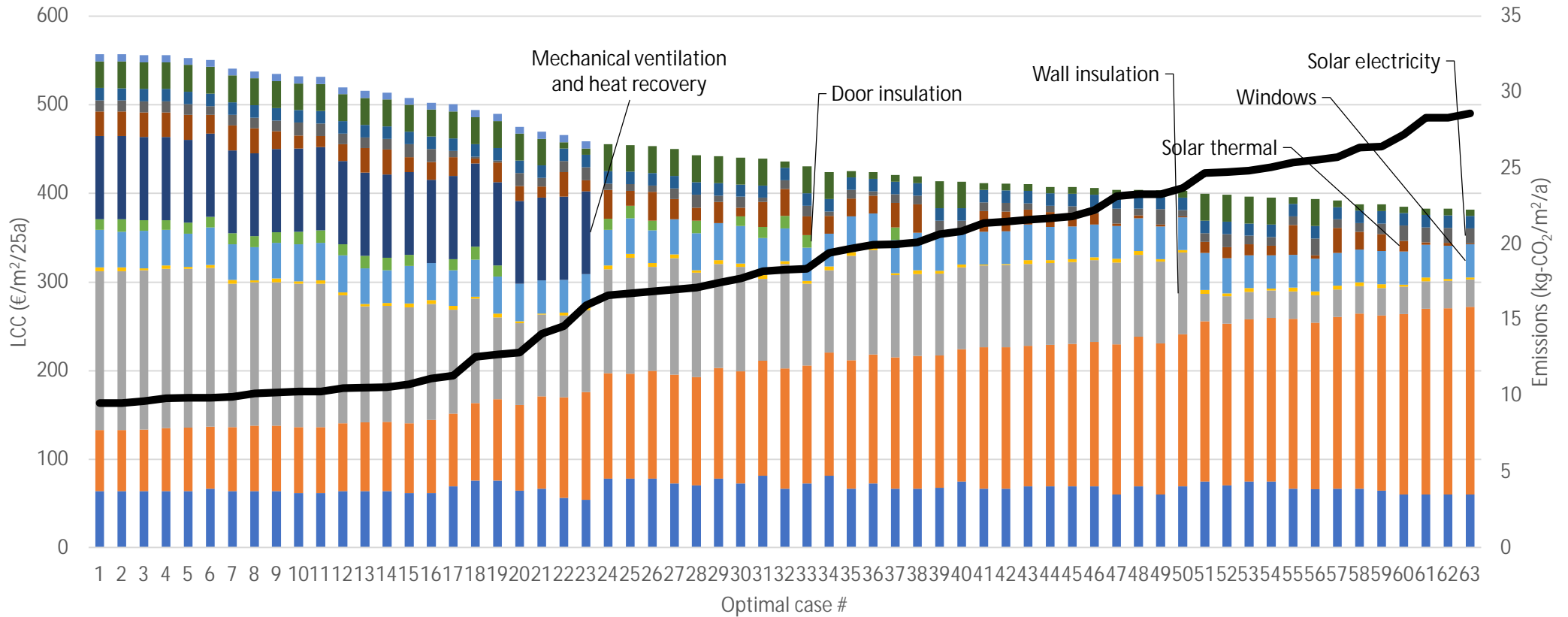


## Heating system options in retrofitting:

- District heating (as before)
- GSHP + electric boiler
- EAHP + district heating

# Apartment buildings before 1976 – District heating, optimal solutions

District heating emissions 176 (kg-CO<sub>2</sub>/MWh)  
 Elect. monthly varied emissions 81-173 (kg-CO<sub>2</sub>/MWh)

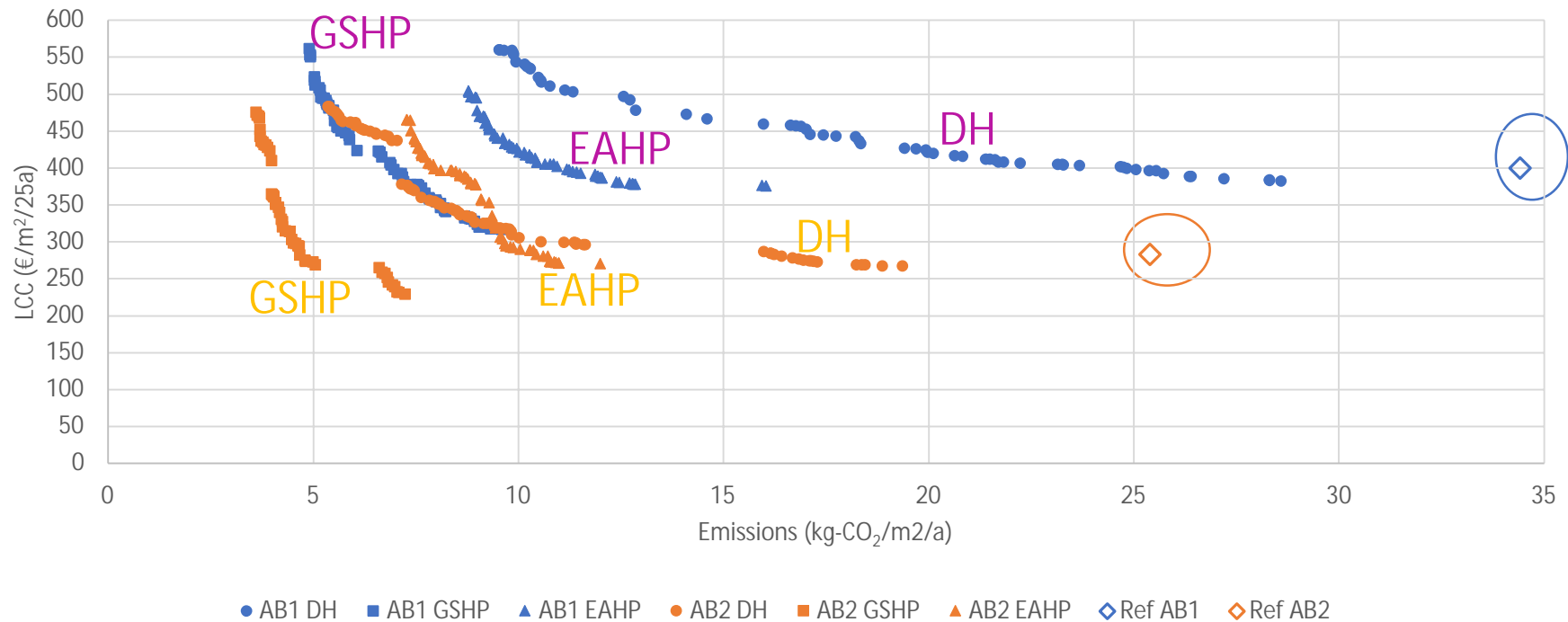


- Electricity import
- DH import
- Walls
- Roof
- Windows
- Doors
- Ventilation HR
- ST
- PV
- HP
- DH system
- Sewage HR
- DBV
- Radiators
- Emissions

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# Emissions vs. LCC in two age groups of apartment buildings

AB1: apartment building built before 1976  
 AB2: apartment building built 1976-2002



Elect. monthly varied emissions  
 District heating emissions

81-173 (kg-CO<sub>2</sub>/MWh)  
 176 (kg-CO<sub>2</sub>/MWh)

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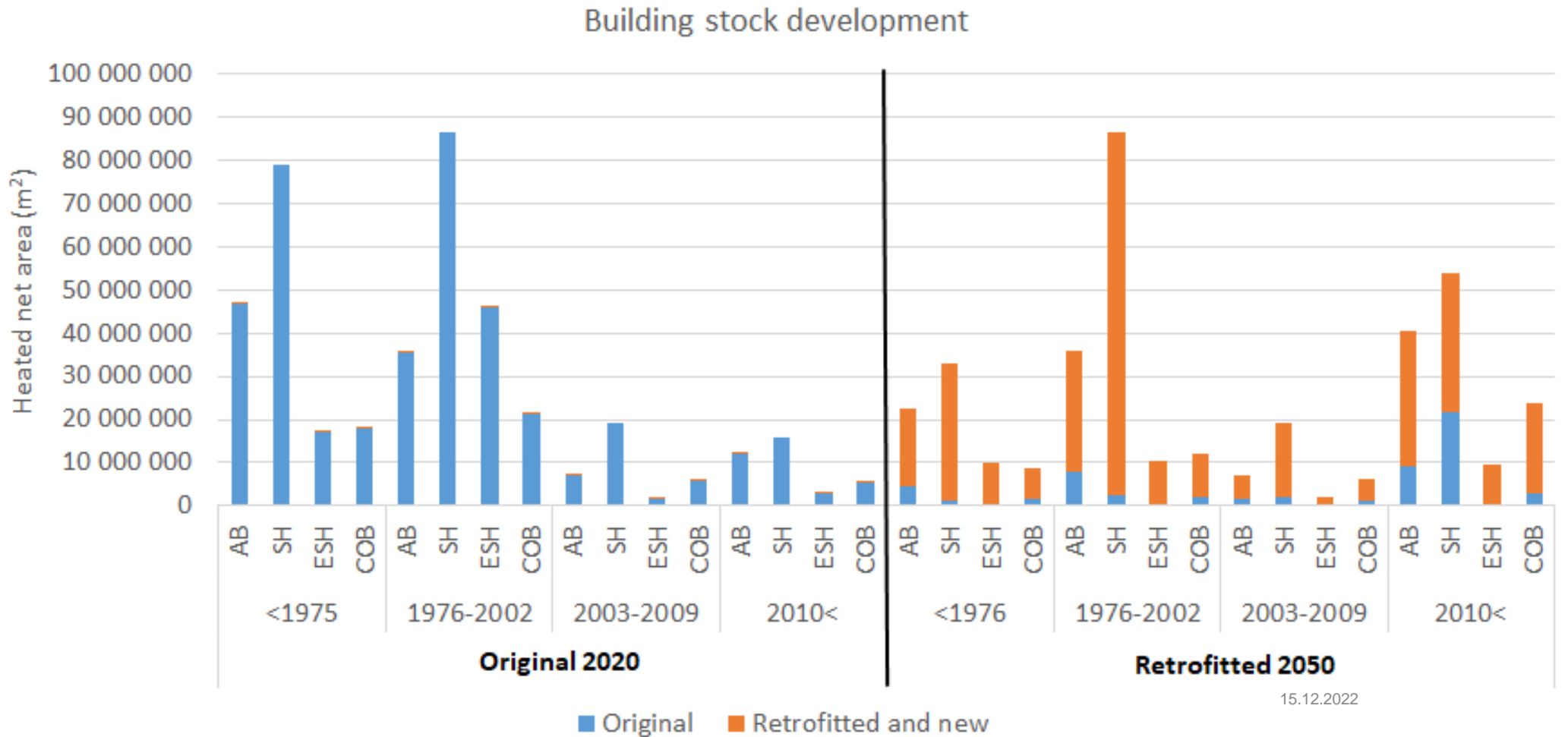


	(kg-CO <sub>2</sub> /m <sup>2</sup> /a)	(kg-CO <sub>2</sub> /m <sup>2</sup> /a)	(%)	(€-LCC/kg-CO <sub>2</sub> /m <sup>2</sup> /a)	(€/m <sup>2</sup> /25a)	(€/m <sup>2</sup> )	U-values (W/m <sup>2</sup> K)				(m <sup>2</sup> )	(kW <sub>p</sub> )	(kW <sub>th</sub> )		(°C)	
Solution type	Emissions	Emission reduction	Relative reduction	Reduction cost	LCC	Investment cost	Walls	Roof	Doors	Windows	ST	PV	HP	Ventilation	Radiators	Sewage HR
Apartment building (AB1) with district heating (DH)																
a	9.5	24.9	72	6.41	559	498	0.1	0.06	1	0.6	125	25	0	HR+DBV	70/40	Active HR
b	16.0	18.4	54	3.21	459	339	0.36	0.08	2.2	0.8	55	30	0	HR+DBV	70/40	Passive HR
c	24.7	9.7	28	0.07	400	156	0.81	0.08	2.2	0.7	55	30	0	No HR	70/40	Active HR
d	28.6	5.8	17	-3.04	382	122	0.81	0.1	2.2	0.8	5	35	0	No HR	70/40	Passive HR
Apartment building (AB1) with a ground-source heat pump (GSHP) and electric backup heating																
a	4.9	29.5	86	5.46	561	545	0.1	0.06	0.7	0.6	145	20	115	HR+DBV	45/35	Passive HR
b	5.5	28.9	84	2.70	478	443	0.23	0.1	0.7	0.8	0	35	115	HR+DBV	45/35	Passive HR
c	7.0	27.4	80	-0.10	397	296	0.36	0.08	0.7	0.7	60	35	110	No HR	45/35	Active HR
d	9.6	24.8	72	-3.37	316	155	0.81	0.13	2.2	0.8	0	30	135	No HR	70/40	Passive HR

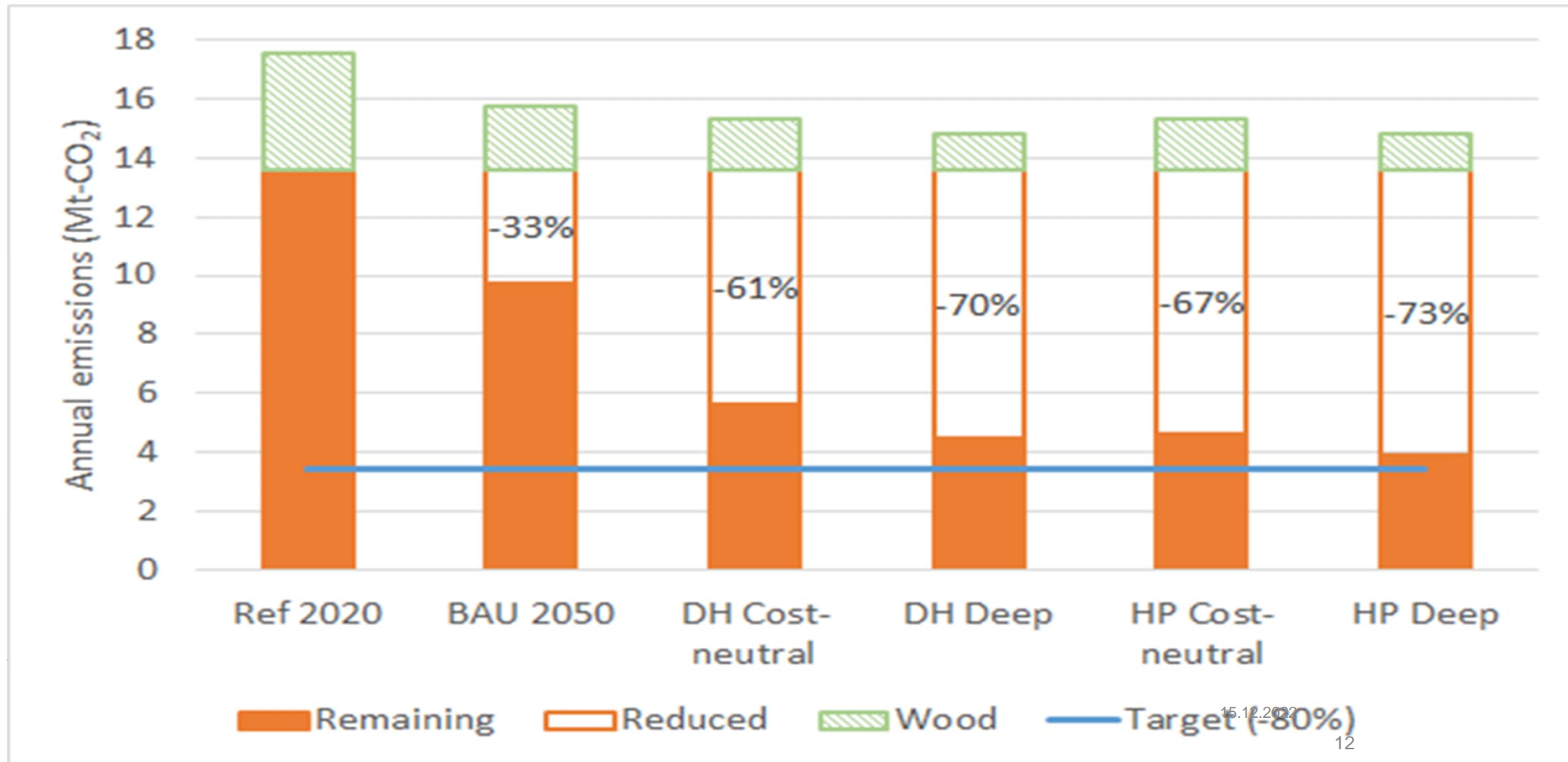
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# Emission reduction potential in the Finnish building stock

# Development of Building Stock



# Emission reductions in the scenarios



# Conclusions

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- Deep energy renovation reduces significantly energy demands
- Emissions can be reduced up to 70-80% in cost neutral way
- Lowest emissions with the heat pump retrofitting cases