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Effects of decreasing DHW supply temperatures for the efficient energy supply of buildings using low-temperature supply concepts - Extrapolation to Germany

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4DH
4th Generation District Heating Technologies and Systems

Background and motivation

- Decreasing energy demand of buildings leads to increasing relevance of domestic hot water (DHW) preparation in the total building energy usage

- Low-temperature supply systems provide new possibilities as they facilitate the efficient use of renewable energy sources (RES)

Motivation: Against the targets of the energy transition, it is important to identify and quantify possible optimization and saving potentials in (centralized) DHW preparation

Focus and main targets

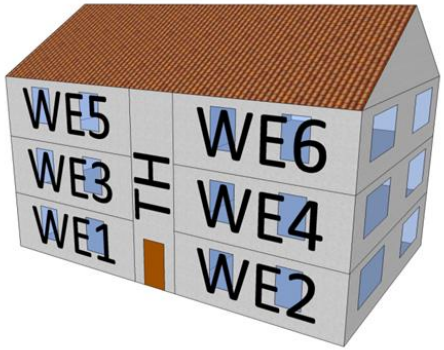
4DH
4th Generation District Heating Technologies and Systems

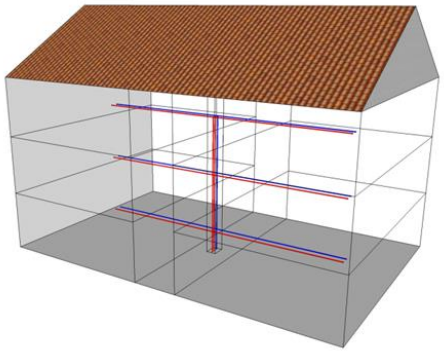
Overall target: Investigation and quantification of decreasing DHW supply temperatures in building energy supply by simulation study

- Quantification of lowering the energy demand and the DHW temperature level in buildings of different energy classes
- Investigation of increasing the share of renewable energies
- Estimation of the potential savings of energy demand and greenhouse gas (GHG) emissions for the heat supply in Germany

Introduction of the model and varying parameters

Centralised DHW supply with different temperatures in a multi-family house





Building age class	No. of flats * person/ flat	Space heating	Heat generator	Storage	DHW generator	DHW temp. level
< 1978 (WSchVo77)	2 flat x 2 pers. 2 flat x 4 pers. 2 flat x 6 pers.	Radiator	Low temperature natural gas boiler	DHW storage	Storage principle	60°C 55°C 50°C
1978-1994		Radiator	Low temperature natural gas boiler	DHW storage	Storage principle	
New buildings (kfW 70)		Floor heating	Low temperature natural gas boiler	DHW storage	Storage principle	
			Heat pump	Buffer storage (heating side)	Centr. continious flow principle	
			Heat pump + solar thermal	Buffer storage (heating side)	Centr. continious flow principle	

WE= residential units → Number of flat

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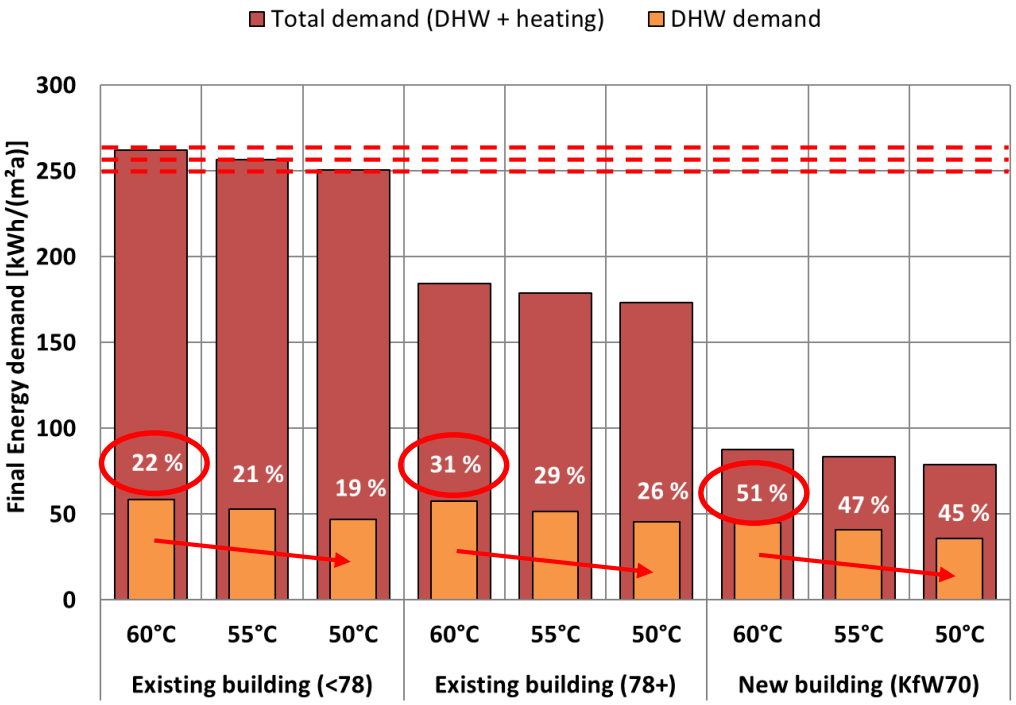
Quantification of lowering energy demand

Variation of the building age class and the DHW temperatures



"Conventional" energy supply: Condensing boiler using natural gas

- Total energy demand drops slightly by lowering the DHW temperature level
- DHW share in the energy demand increases proportionately with the improvement of the building energy standard
- When the DHW temperature level is lowered, however, the proportion of DHW drops significantly
- Saving potentials (at 10 K reduction): up to 4.5 % in buildings stock and up to 10 % in buildings with high energy standard

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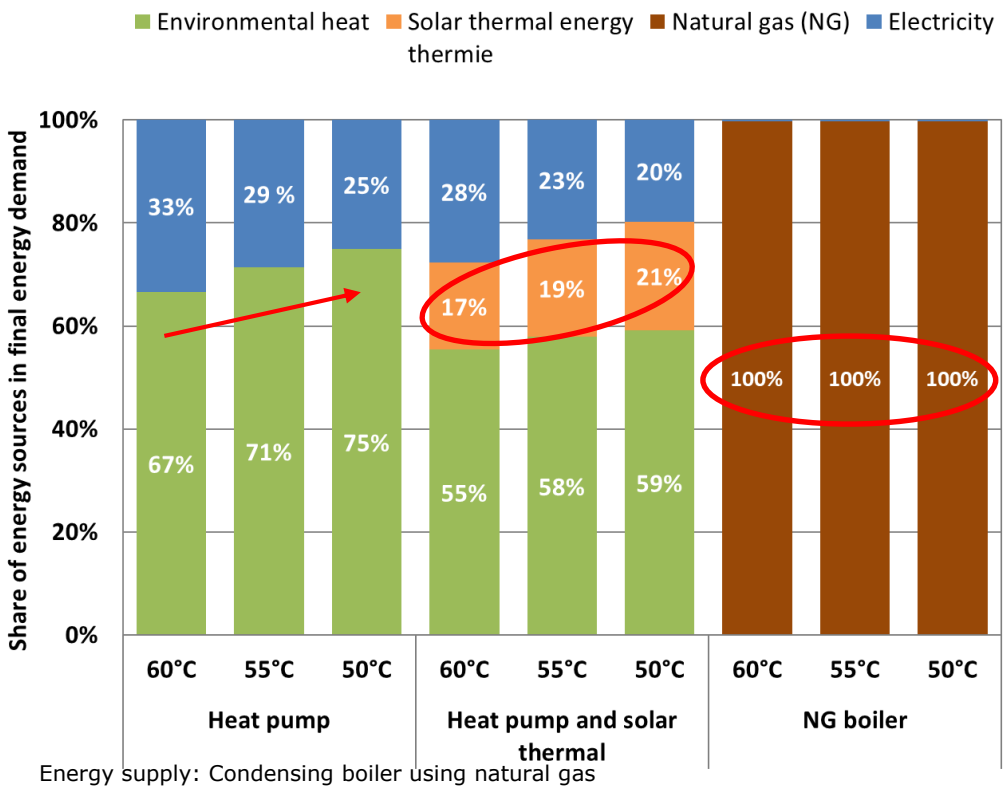
Potentials for increasing share of renewables

Investigation of increasing the share of renewable energies

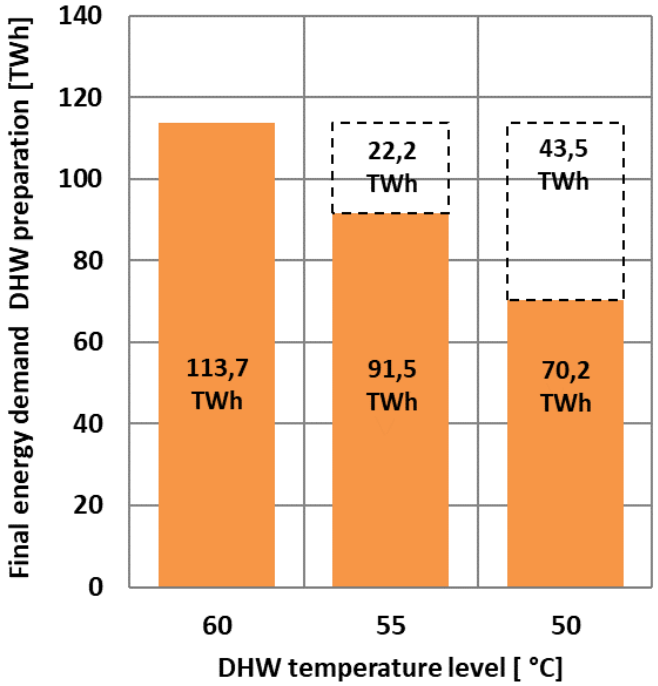


Energy supply: Condensing boiler using natural gas

- Increased efficiency due to longer clocking times and more favorable operating points (e.g. COP)
- Low supply temperature allows the combination of several renewable energy producers
- Combustion technologies offer little potential for optimization or savings

Extrapolation to German building stock

Saving potentials for energy demand



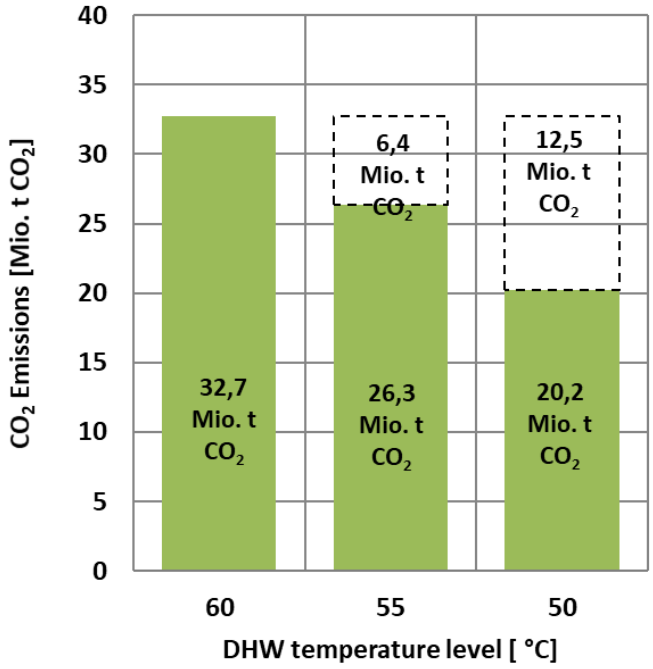
Energy source: 53.6% gas; 28.6% oil; 14.9% DH; 2.9% electricity

Reference year: 2015; Data sources: BDEW, UBA

- Lowering the DHW temperature level by 5 K reduces energy demand by 20% (4% of sector demand)
- When lowering the DHW temperature level by 10 K, reduces energy demand by 40% (7% of sector demand)
- Saving potentials due to lower heat losses in the DHW distribution
- Further increase in efficiency possible with increasing use of regenerative producers

Extrapolation to German building stock

Saving potentials for CO_2 emissions



Energy source: 53.6% gas; 28.6% oil; 14.9% DH; 2.9% electricity

Reference year: 2015; Data sources: BDEW, UBA

- Temperature reduction of 5 K leads to saving potential of 10% and reduction of 10 K leads to 20% saving potential for CO_2 emissions
- Taking into account already installed renewable-supplied heat generators, an additional 2 mio.t/a CO_2 could be saved when lowering by 5 K.
- Lowering the DHW supply temperature offers relevant GHG savings potential and is thus a further step in achieving the climate goals (energy transition targets)

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Conclusions

Lowering the DHW temperature level...

- ... makes an important contribution to a change energy sources in the heating sector
- ... increases the energy saving potential, as the increasing use of regenerative energy sources becomes possible
- ... allows a significant reduction in the greenhouse gas emissions of the buildings, makes a decisive contribution to the energy transition

Aspects of drinking water hygiene (e.g. Legionella issues) have always to be taken into account when analysing DHW preparation

Partners of joint research project – Scientists and Sponsors

Coordinator Technical University Dresden

Partners

GEWV	TU Dresden, Professorship of Building Energy Systems and Heat Supply
IHPH	University of Bonn University Hospital, Institute for Hygiene and Public Health
IWW	IWW Water Centre Mülheim
IMMH	TU Dresden, Institut for Medical Microbiology and Hygiene
IEE	Fraunhofer Institute for Energy Economics and Energy System Technology IEE Kassel

Sponsors

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Joint research project 03ET1234 A bis D

Energie efficiency and hygiene in drinking water installations

im context IEA-DHC Annex TS1 „Low Temperature District Heating for Future Energy Systems“

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