

Energy Efficiency Strategies for Retrofitted Buildings

Digital business conference Croatia

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Facilitator

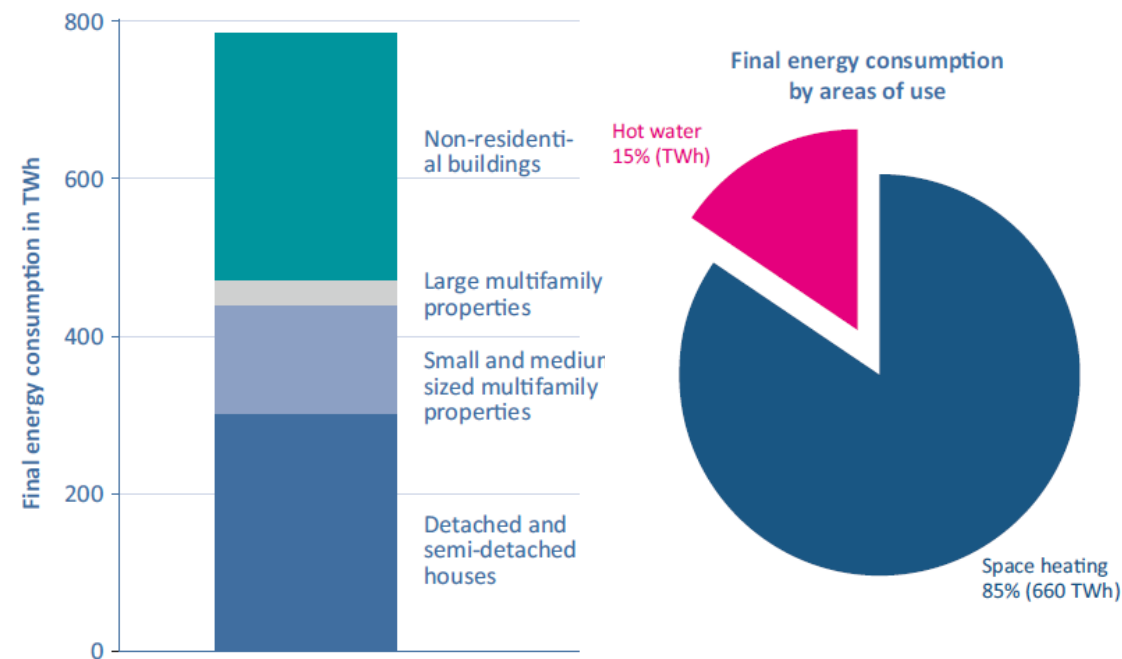
Status quo: Energy supply in the building sector

final energy consumption in buildings

- equates to around 32 % of total FE consumption
- accounts for almost 20 % of all GHG emissions
- was reduced by 20 % between 2002-2010, but stopped falling from 2010 on
- non-residential buildings' share is 37%

targeted doubling of the rate of refurbishment is not yet evident

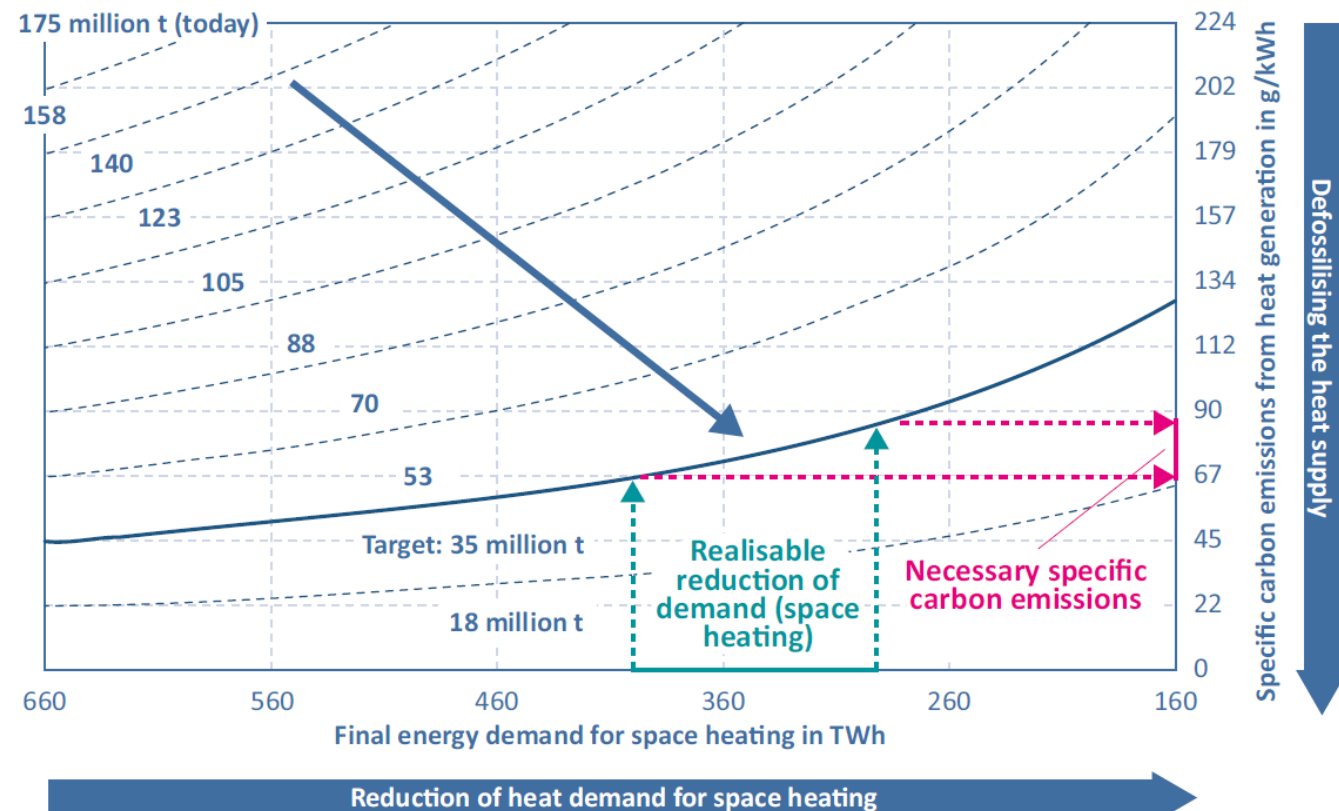
federal government's energy efficiency targets will not be achieved using the strategies that have been agreed upon so far



Aim: Energy supply in the building sector virtually carbon-neutral building stock by 2050

reduction of CO₂ to a max. of 20 % of its present value

- reducing the space heating requirements using insulation is realistically limited to around 45 to 60 % of today's value
- specific heating supply emissions must be reduced to about 1/3 of today's values



Challenges: Transformation for the energy supply in the building sector

Space heating demand

- increasing the renovation rate (>2 %) and deep-retrofit is crucial
- systems with a low temperature level facilitate the use of heat pumps and solar thermal energy
- novel solutions for medium-sized family properties and detached houses are necessary
- use of environmental heat sources is key measure
- innovative approach involves refurbishment of the production line → by using the industrial production method, buildings could be refurbished in only few days and at relatively low cost.
- higher comfort requirements and individual control of room parameters

Operation

- performance gap: mismatch of designed and measured performance
- inappropriate monitoring and optimization of components and systems
- interoperability between buildings and the energy system necessary

Transformation of the building sector:

Five pillars of a smart built environment

efficient buildings and healthy indoor environment

- improvement of the building shell, use of high-efficient components, optimization of technical systems including storages

dynamic operability

- control of the entire energy flow, through connected technical building systems and other appliances inside the building

energy-system-responsive buildings

- answer the needs of the electricity, district heating and cooling grids and the broader energy system

renewable energy uptake

- use of renewable energy sources, participate in electricity markets with demand response and energy storage capacity

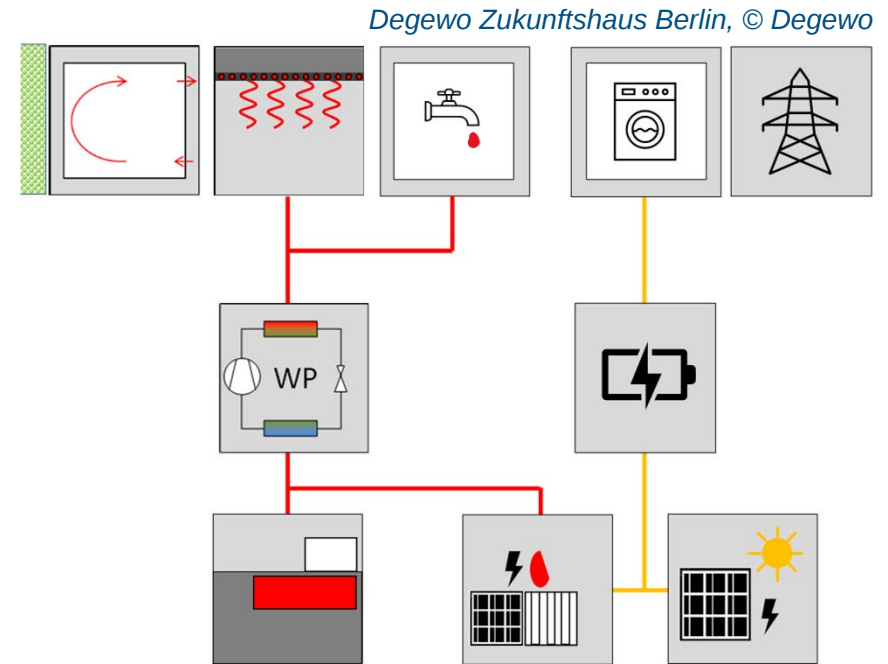
dynamic and self-learning control systems

- building automation, fault detection, building-information modeling

(I) Energy efficient buildings

Achieving Net Zero-Energy Buildings

- deep retrofit of the entire building shell
- controlled ventilation (CO₂, humidity)
- heat recovery system
- heating with low temperatures using radiant systems
- use of environmental heat sources at the building site (solar thermal systems, heat pumps)
- integration of photovoltaics
- high share of self-consumption of solar power
- integration of thermal and electrical storages
- Monitoring and energy management system



2 Heat pumps

- high temperature $27\text{kW}_{\text{therm}}$, low temperature $43\text{kW}_{\text{therm}}$
- multisource: ground storage 950m^2 , 121 solar collectors $87\text{kW}_{\text{therm}}$

121 Hybrid solar Collectors

- thermal heat ($87\text{kW}_{\text{therm}}$) and electrical power ($31,5\text{kW}_p$)

216 PV modules

- electrical power ($73,2\text{kW}_p$)

64 decentral ventilation units

- $100\text{ m}^3/\text{h}$ air, with heat recovery

(II) Dynamic Operability

Monitoring, analysis, optimization

building

- empowers occupants with control over the energy flow, through connected technical building systems and other appliances inside the building

requirements

- monitoring of all thermal and electrical energy use, thermal comfort, air quality, operation hours
- visualization, feedback and benchmarking
- BIM → information about components available
- IoT → standardized data acquisition

outlook

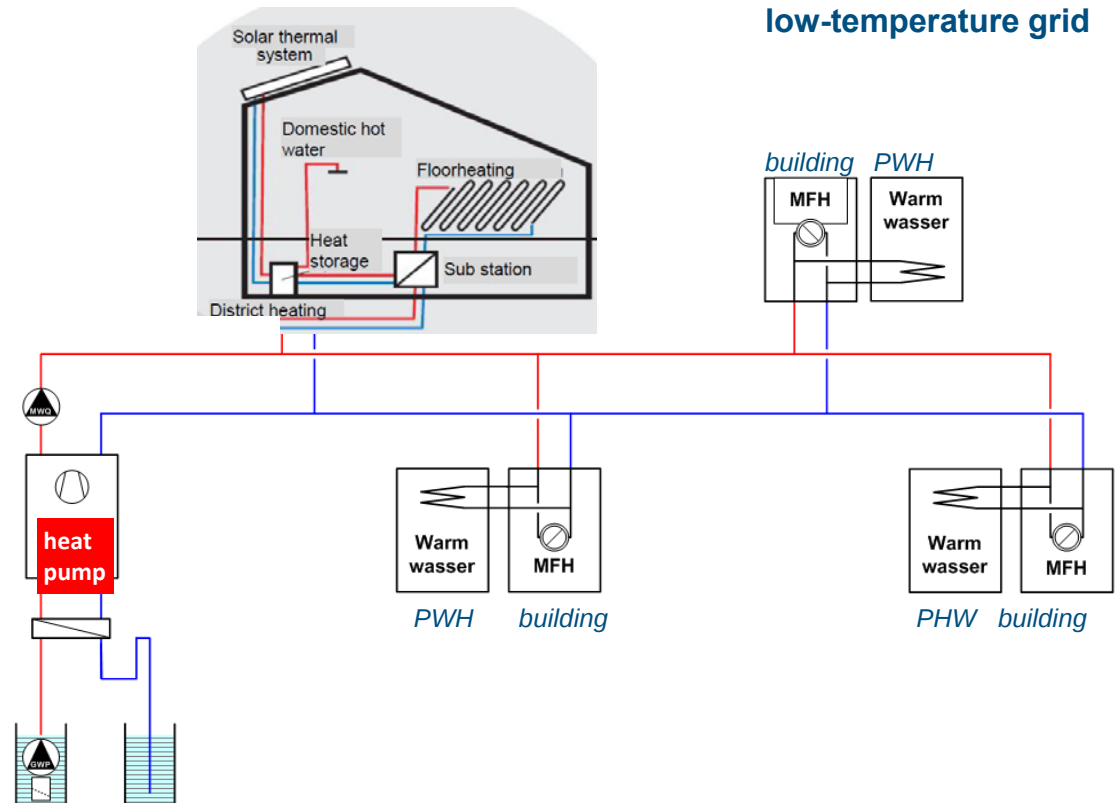
- response to requirements of electrical grid

(III) Energy-system-responsive Buildings

Optimized performance at district level

buildings

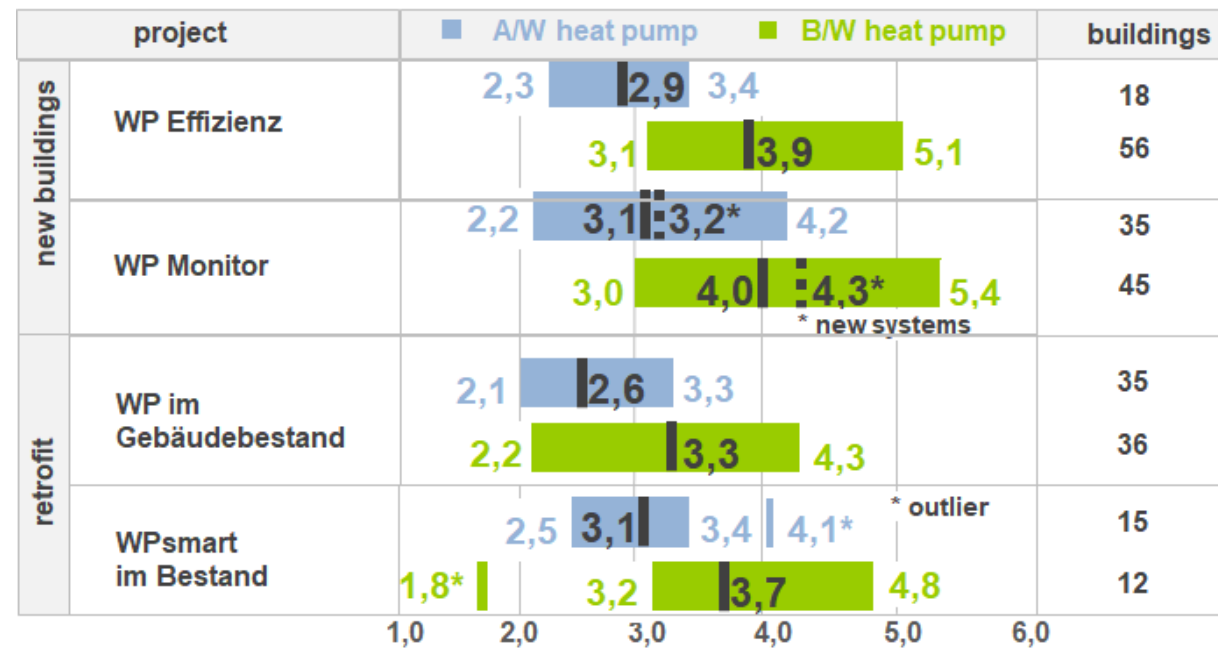
- answer the needs of the electricity, district heating and cooling grids and the broader energy system
- key role in balancing the grid
- are a prosumer
- participate in heat market with demand response and building energy storage capacity
- urban heat networks operating at low temperatures using environmental heat sources



(IV) Renewable Energy Uptake

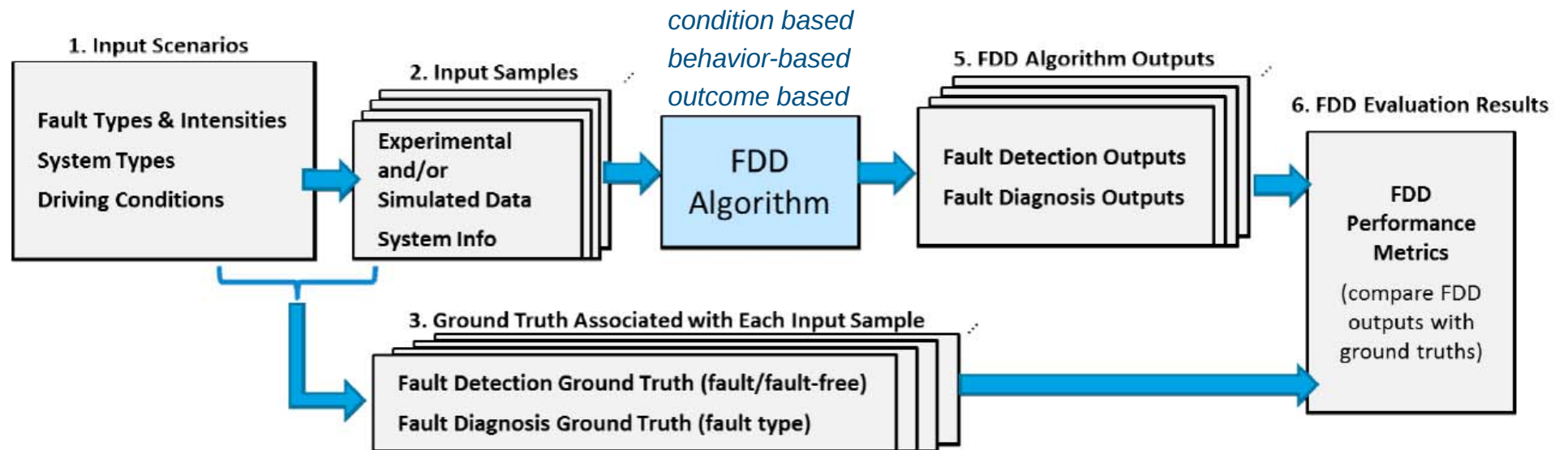
Using heat pump systems and radiant heating

- heat pumps will be the dominant heating technology
- there will be areas of the building sector in which the installation of electric heat pumps will prove difficult to implement → gas and hybrid heat pumps, solar thermal energy and combined heat and power plants should also be pursued
- heating grids play an important, especially in urban agglomerations → 20 and 35 % of all buildings are supplied via heating grids



(V) Dynamic and Self-learning Control Systems

Fault detection and diagnosis (FDD)



Conclusion

- exploit energy efficiency potential of building and technical systems
- harness on-site environment heat sources
- decarbonize the heating generation
- maximize the on-site or nearby production of electricity from renewable sources
- enable thermal and electrical energy-storage capacities in buildings
- incorporate demand response capacity in the building stock
- empower end-users via smart meters and controls
- integrate continuous monitoring and fault detection
- foster business models aggregating micro energy-hubs

Thank you for your attention!

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