

The planning of a CO₂ emission-free precinct.

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15.02.2023



Bundesministerium
für Wirtschaft
und Klimaschutz



MITTELSTAND
GLOBAL
ENERGY SOLUTIONS
MADE IN GERMANY

As part of a symposium on

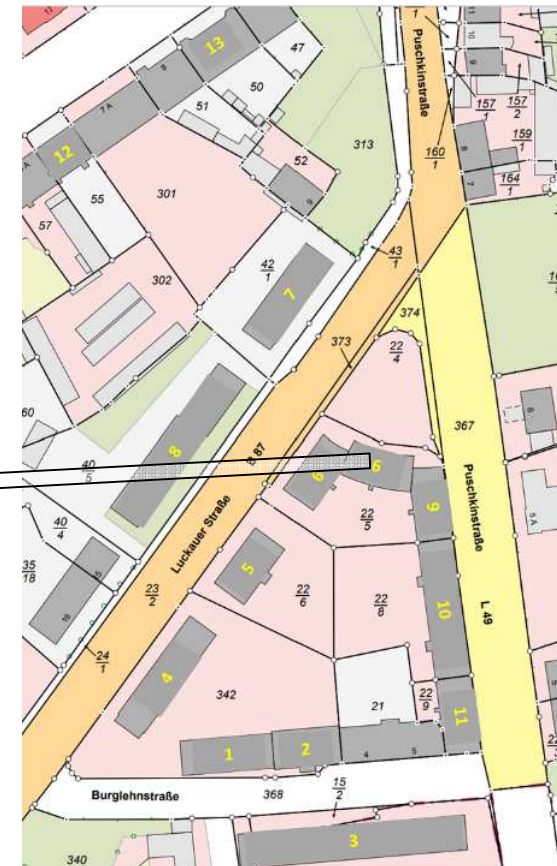
*„Energy efficiency in buildings focused on
solar rooftop panels and self-sufficiency.“*



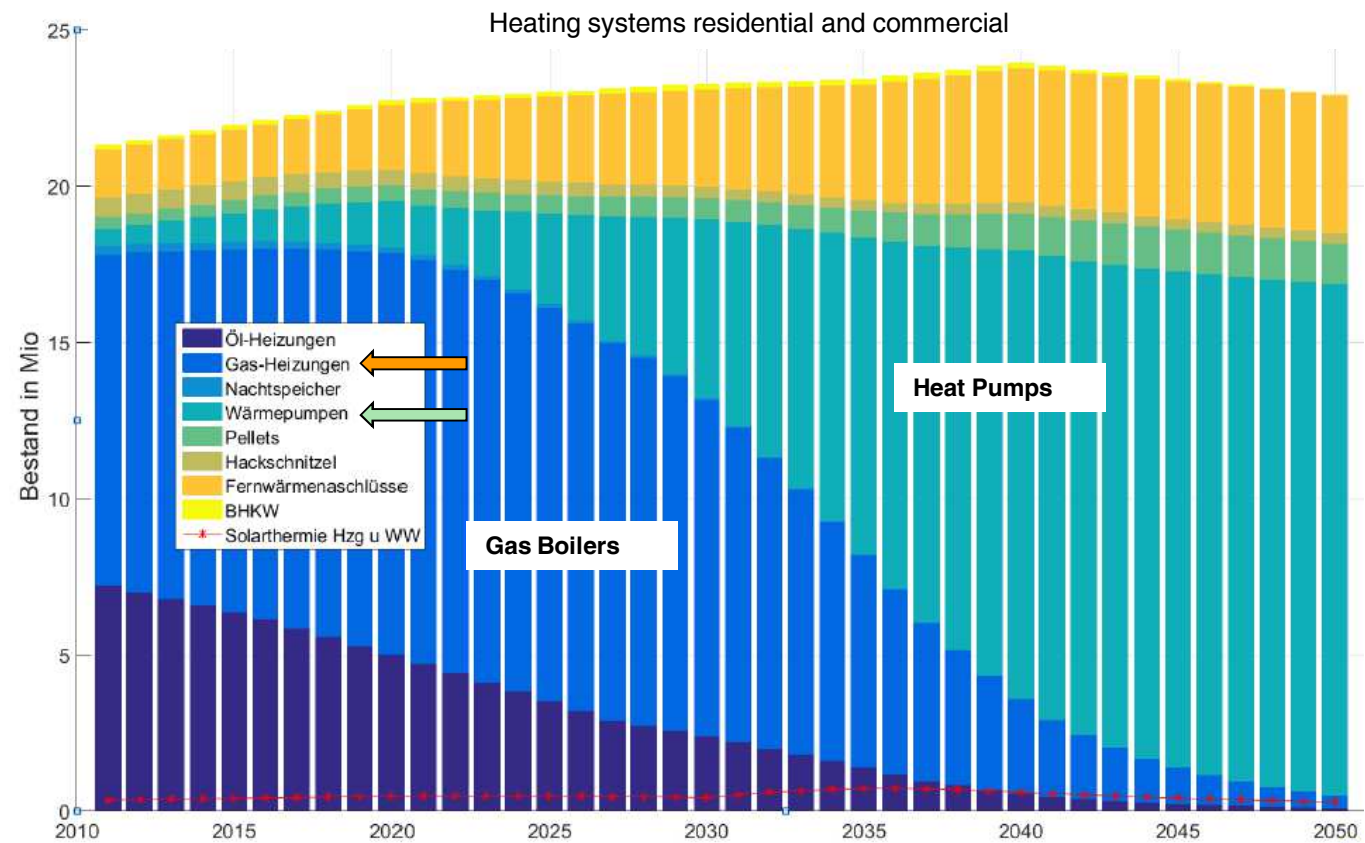
The Precinct

Key facts:

- _ 13 apartment blocks (heritage-listed)
- _ Diverse blocks (1930, 1960, 1970)
- _ 160 apartments (up to 63 m² in size)
- _ Heating: gasboilers from 1996



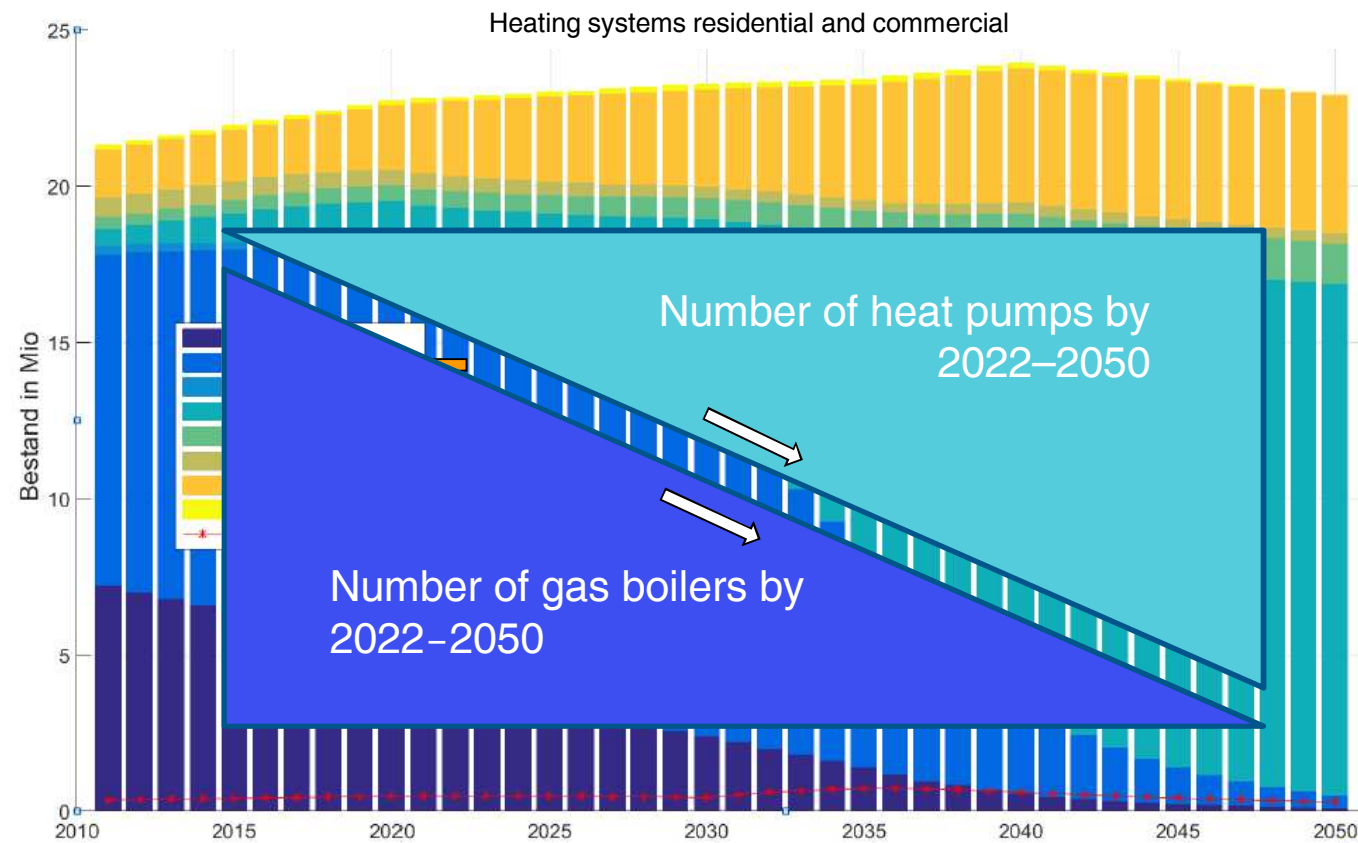
Sector coupling: Heat pumps for buildings



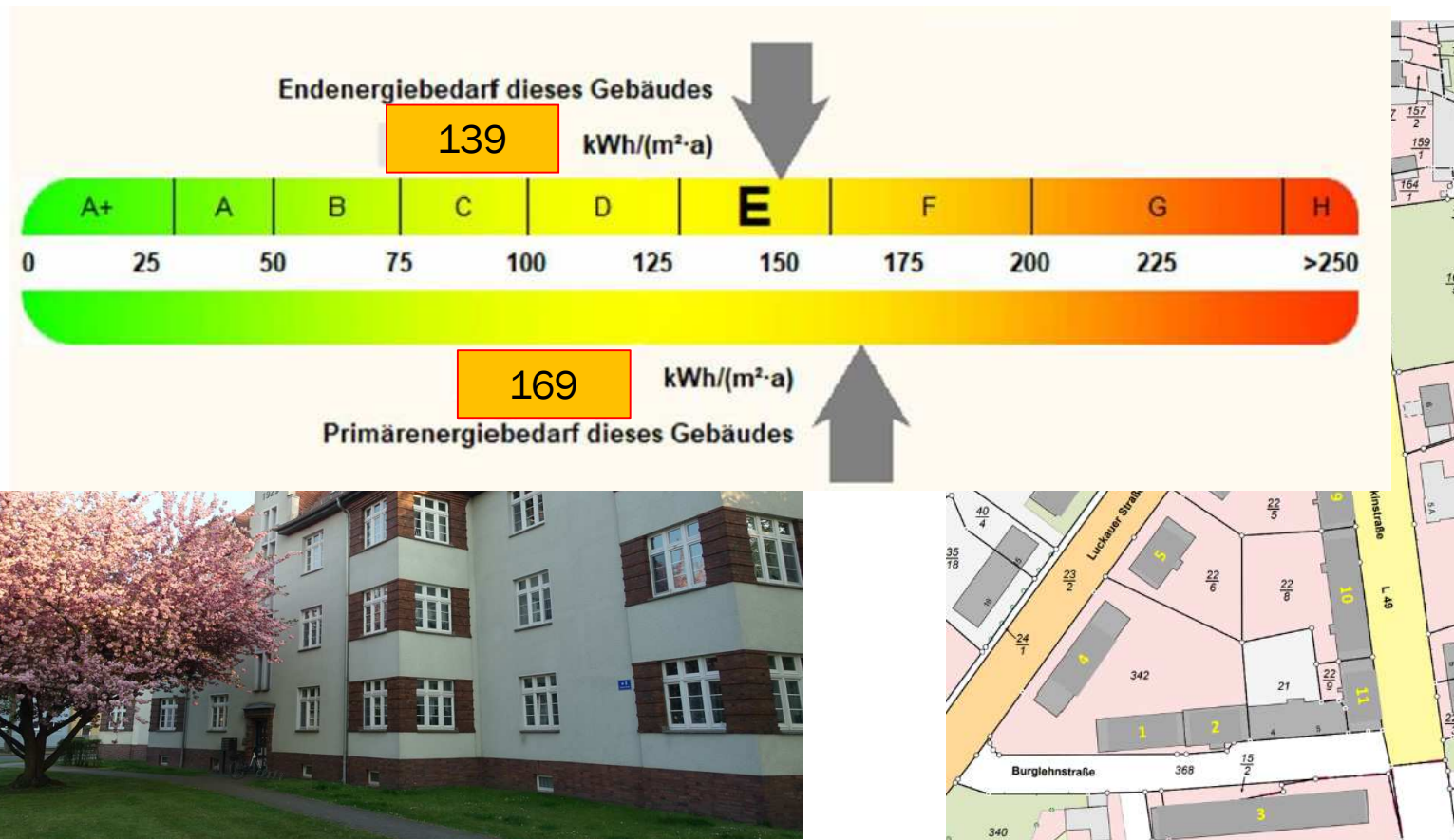
www.langfristszenarien.de



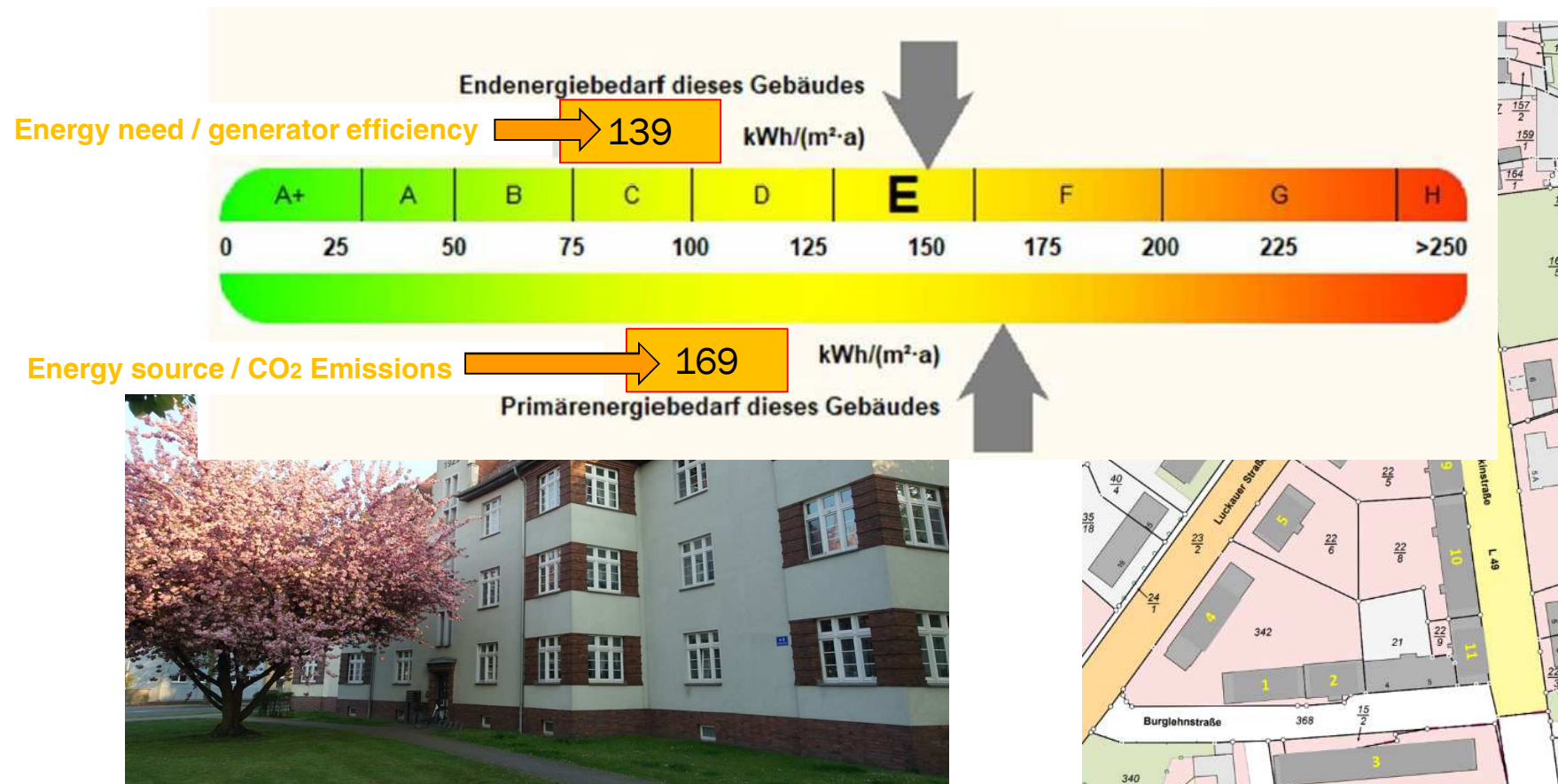
Sector coupling: Heat pumps for buildings



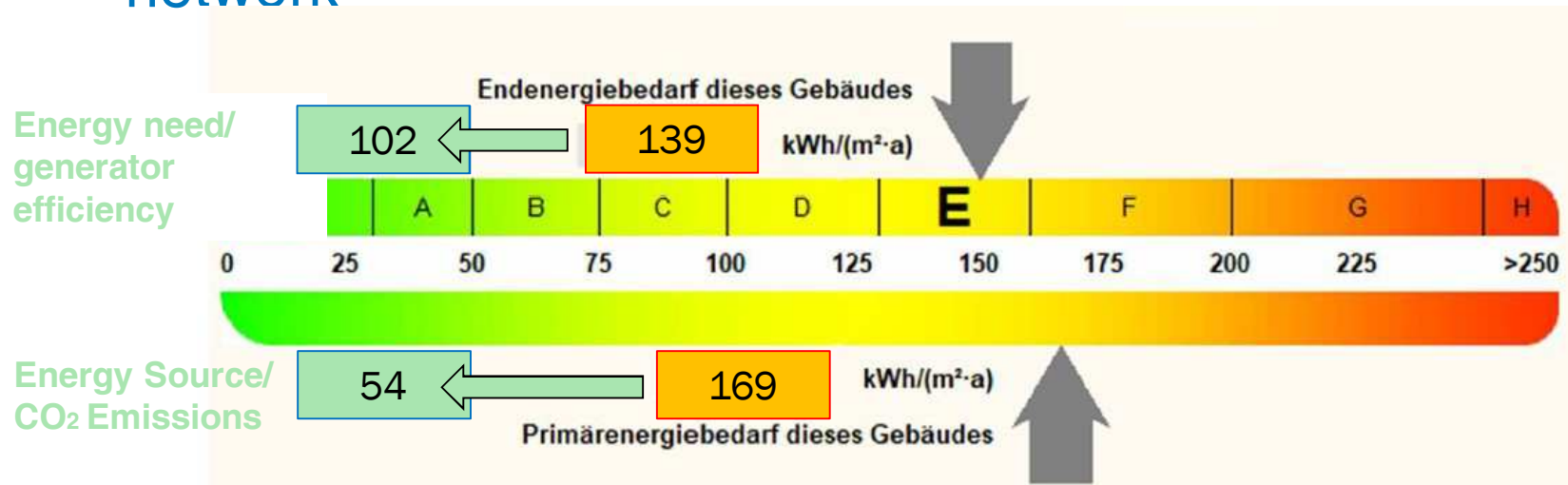
Energy Pass of the 13 buildings (partially renovated)



Energy efficiency of the 13 buildings (partially renovated)



Phase 1 of renovation: Changing the energy source/-network



Actions: Heat pumps (JAZ 3,0 / combined with gas boilers, Building of a local LowEx district network to produce and consume heat and electricity

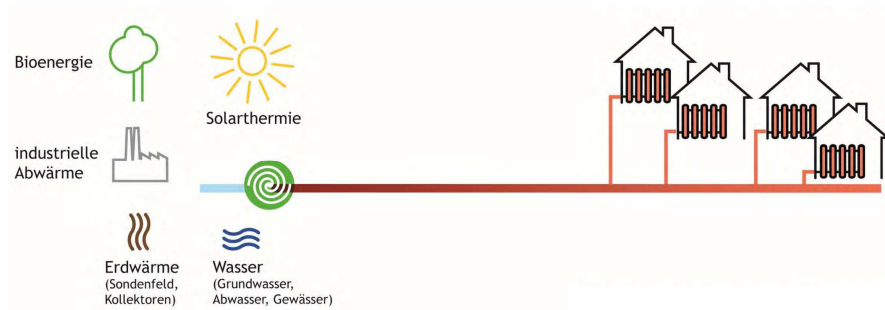
→ PEF in the network 0,52

→ More green electricity in the German grid (now: PEF 1,8)!



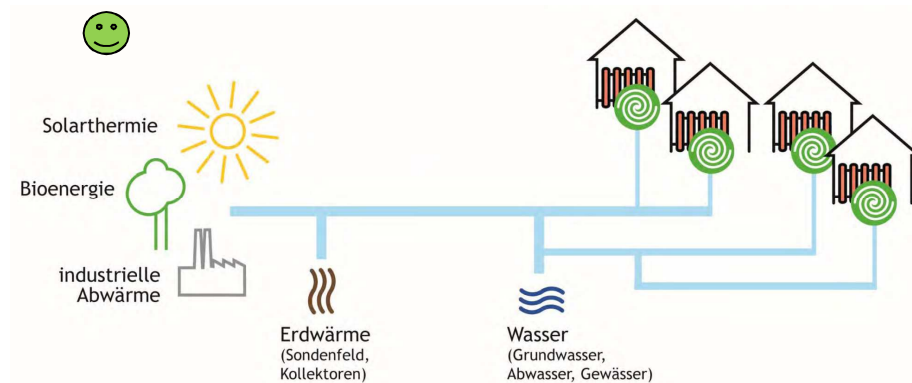
Warm and LowEx Network

Warm district network



- Central location of heat pump
(System temperature ~ 50° C)

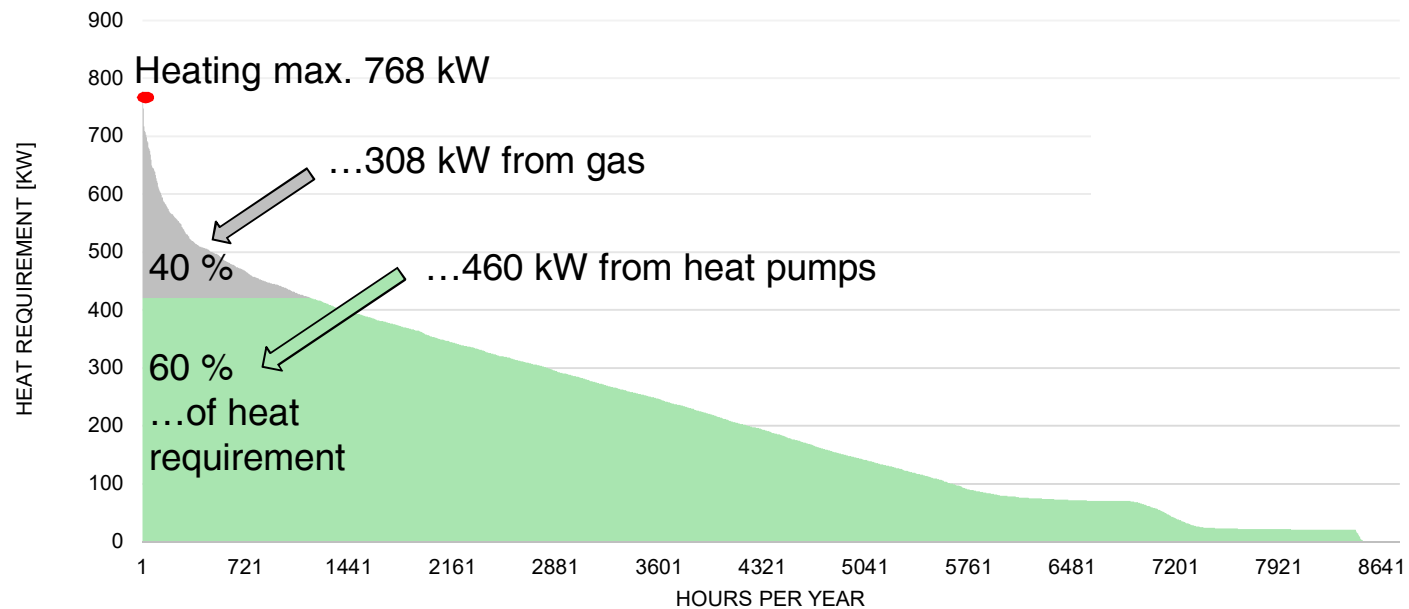
LowEx district network



- Decentralized location of heat pumps (and gas boilers)
(System temperature ~ 7° C)



Maximum heat requirement (kW)



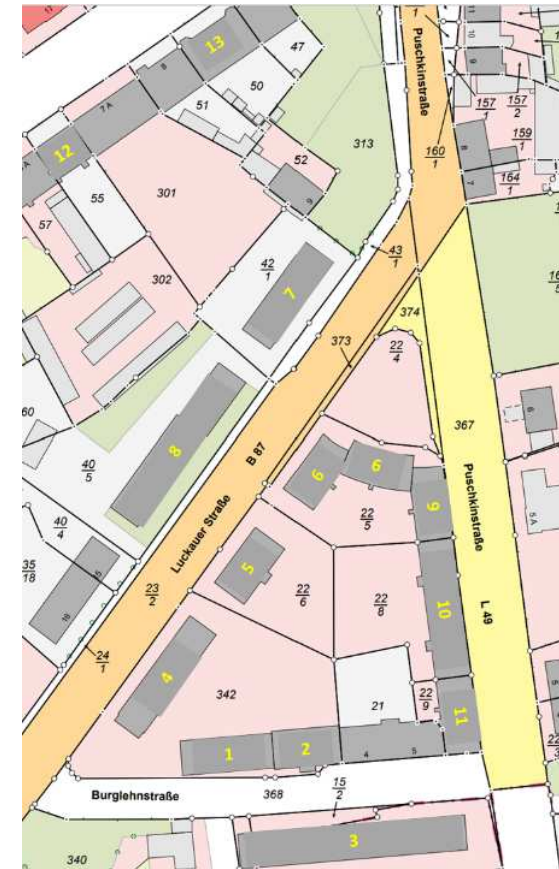
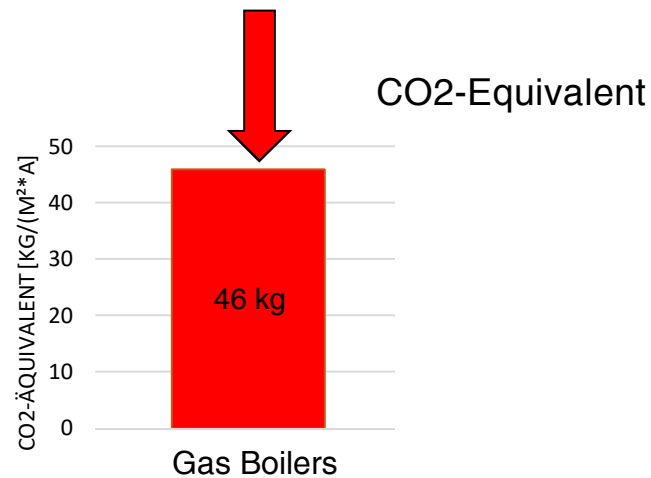
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CO₂ Emissions with Gas Boilers (Status Quo)

Energie balance:

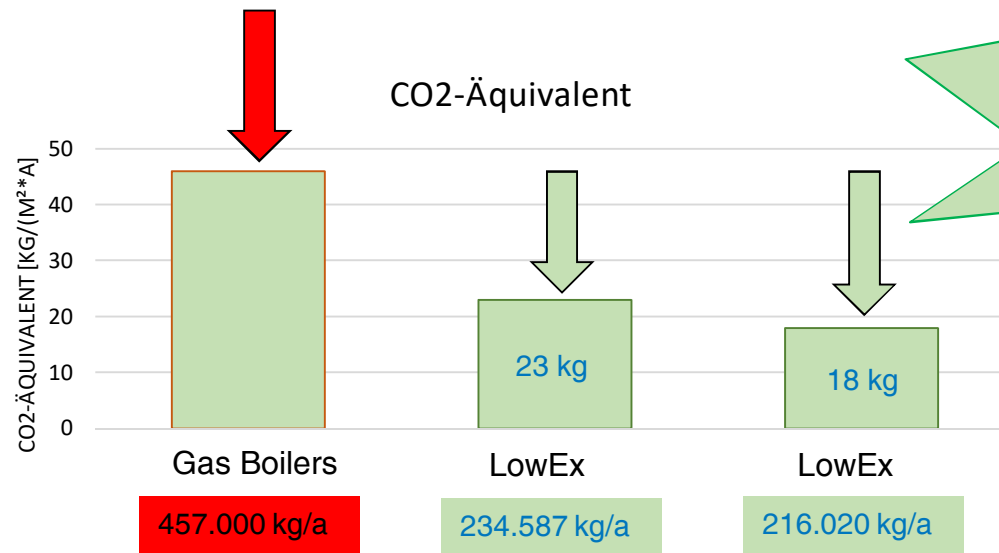
_ Max. heat requirement:	768 kW
_ Total heat requirement p/yr:	1.370.000 kWh
_ Hot water requirement p/yr :	330.000 kWh/a
_ CO ₂ -Emissions:	457.000 kg/a
_ CO ₂ -Equivalent:	46 kg/(m ² *a)



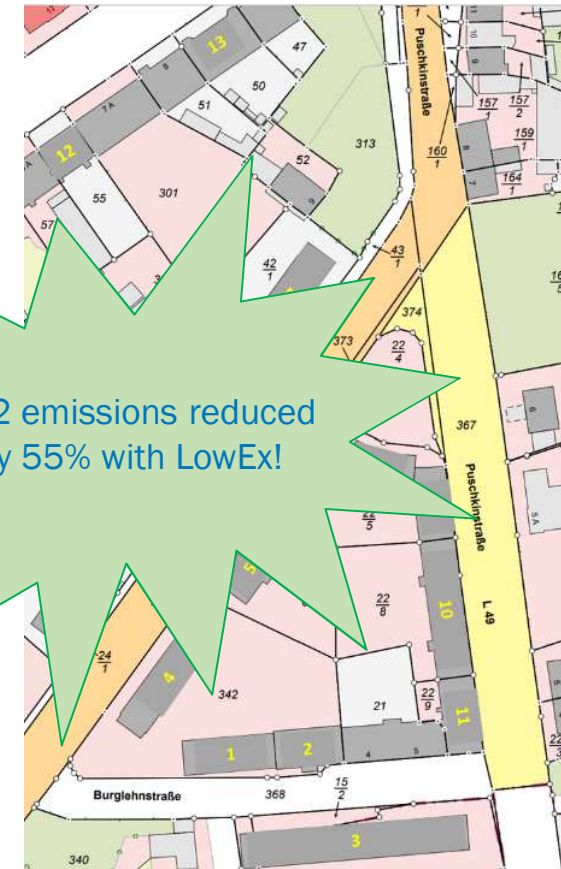
CO₂ Saved via LowEx District Heating Network

Energie balance:

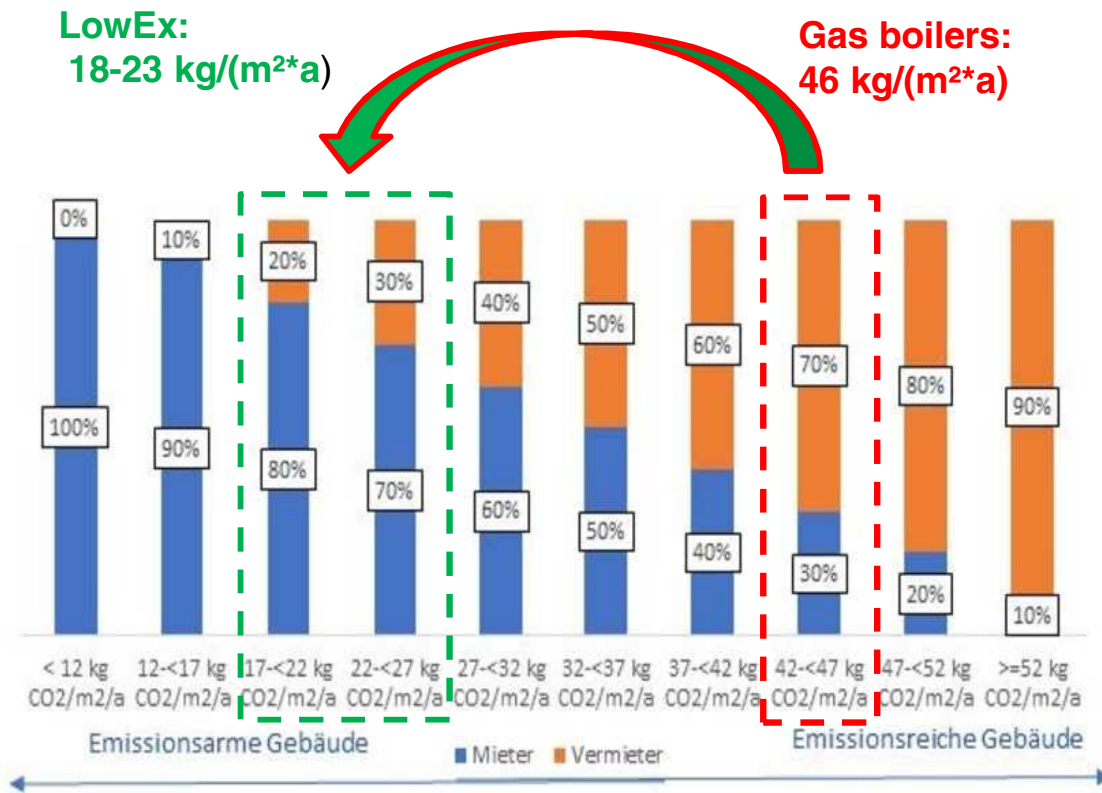
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CO₂ emissions reduced
by 55% with LowEx!



CO₂-Price for Property Management (as of 25.11.2022)

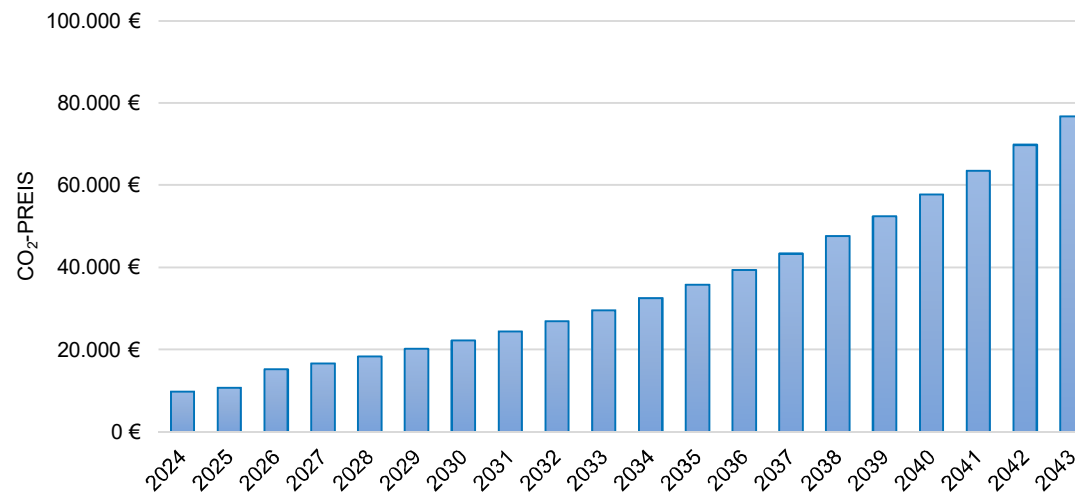


CO₂-Price for Property Management (as of 25.11.2022)

Accumulated CO₂-Price over 20 years with gas*: 715.000 €

→ Costs for LowEx combined with gas boilers*: 20.000 €

→ Costs using 100% green electricity: 0 €

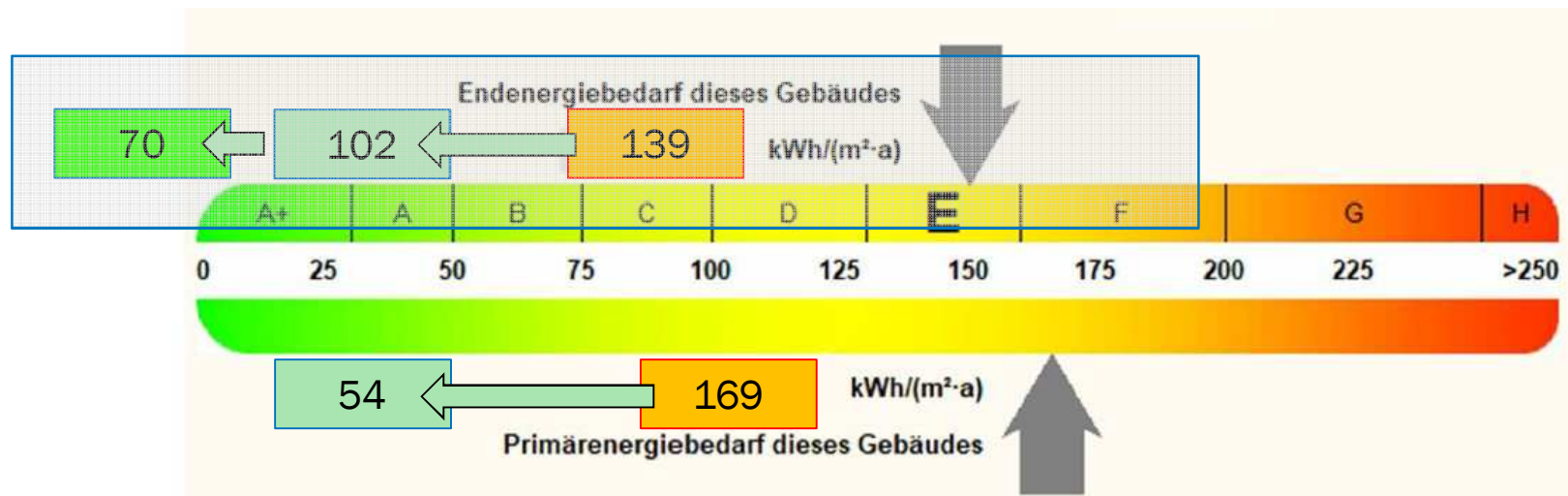


* Assumed annual increase: 10 %

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Phase 2 of Renovation: Lowering Heat Consumption



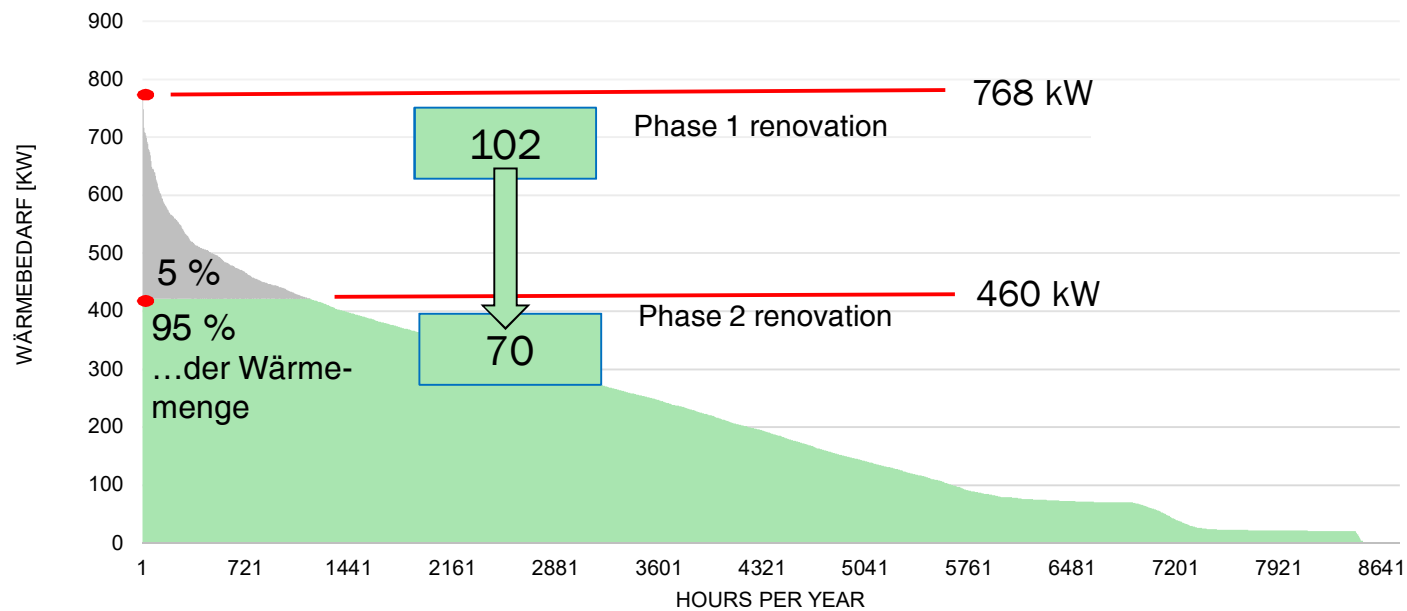
Actions: Building insulation, new windows, air ventilation with heat recovery

→ Energy usage reduced to **70** kWh/(m²·a)

→ Can be rolled out across all 13 buildings, one by one by 2045



Annual energy requirement (kW)

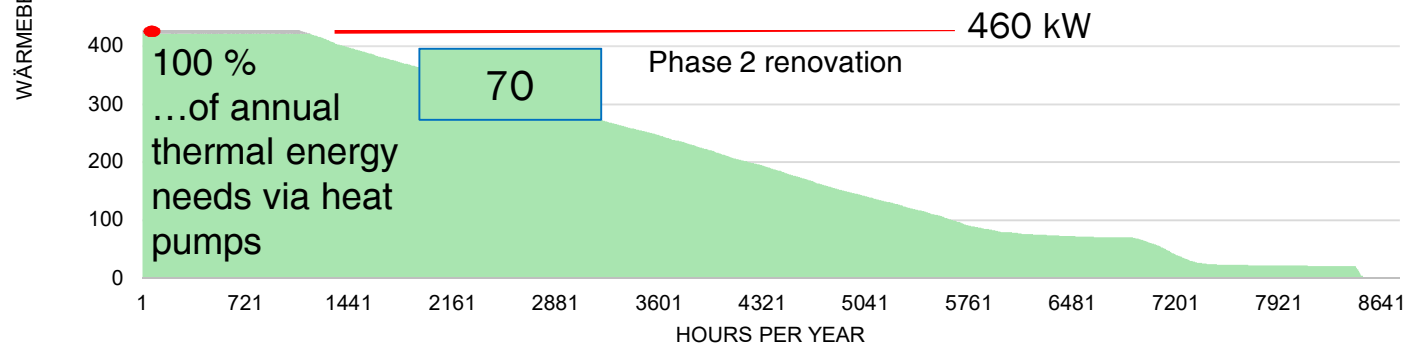


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Achieving CO₂-Neutrality

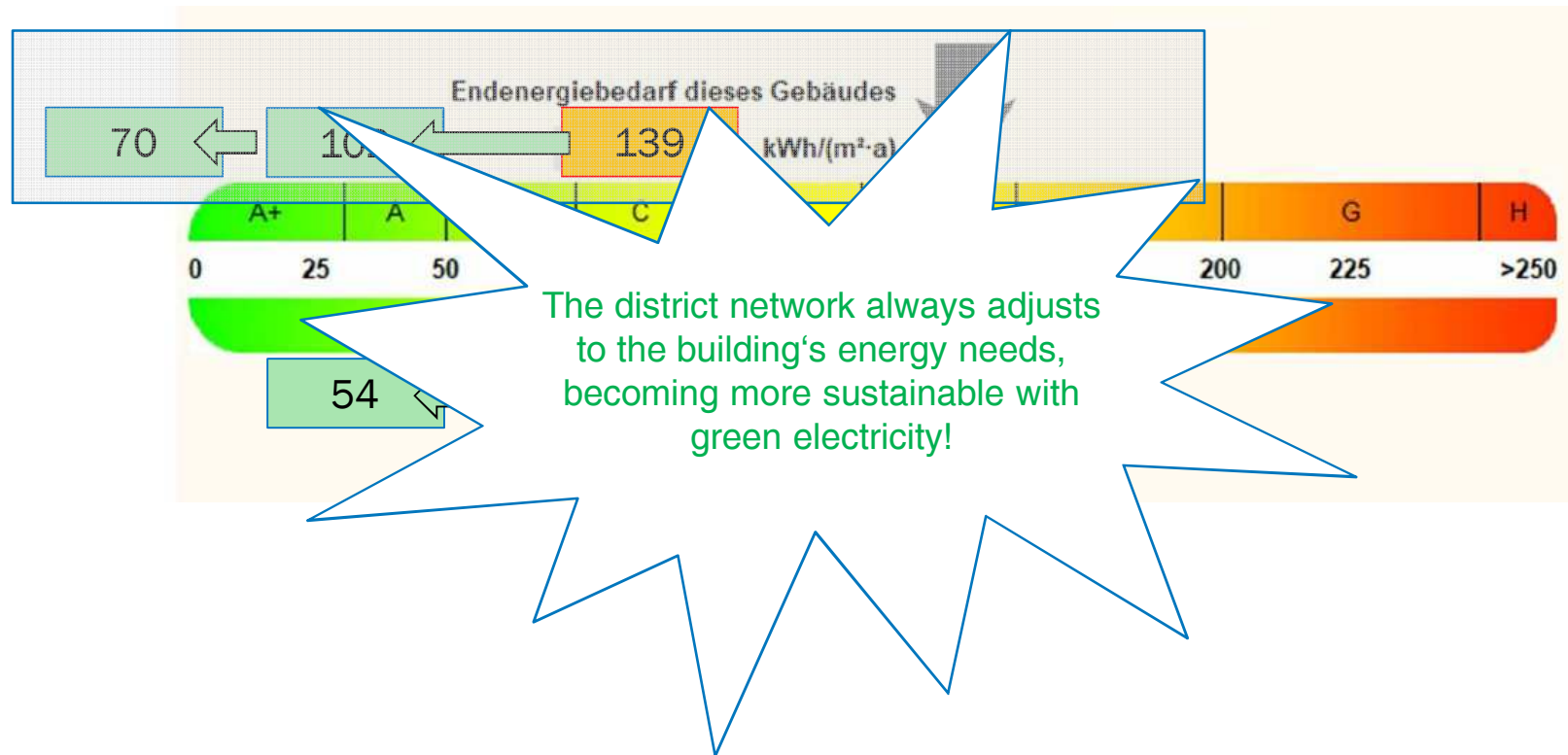
- PEF gets closer to zero in LowEx district network by 2030:
 - _ 80% green electricity in Germany! By 2045 100%!
 - _ More PV on Roof Tops!
- Emissions reach net zero at the latest in 2045!



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Phase 2 of Renovation: Lowering Heat Consumption



Atum's Energy Management:

(energy assessment and analysis, project management, subsidies)



enisyst: Intelligence for steering and managing energy streams



Frey-BGW: Engineering for geothermal and hydrological energy



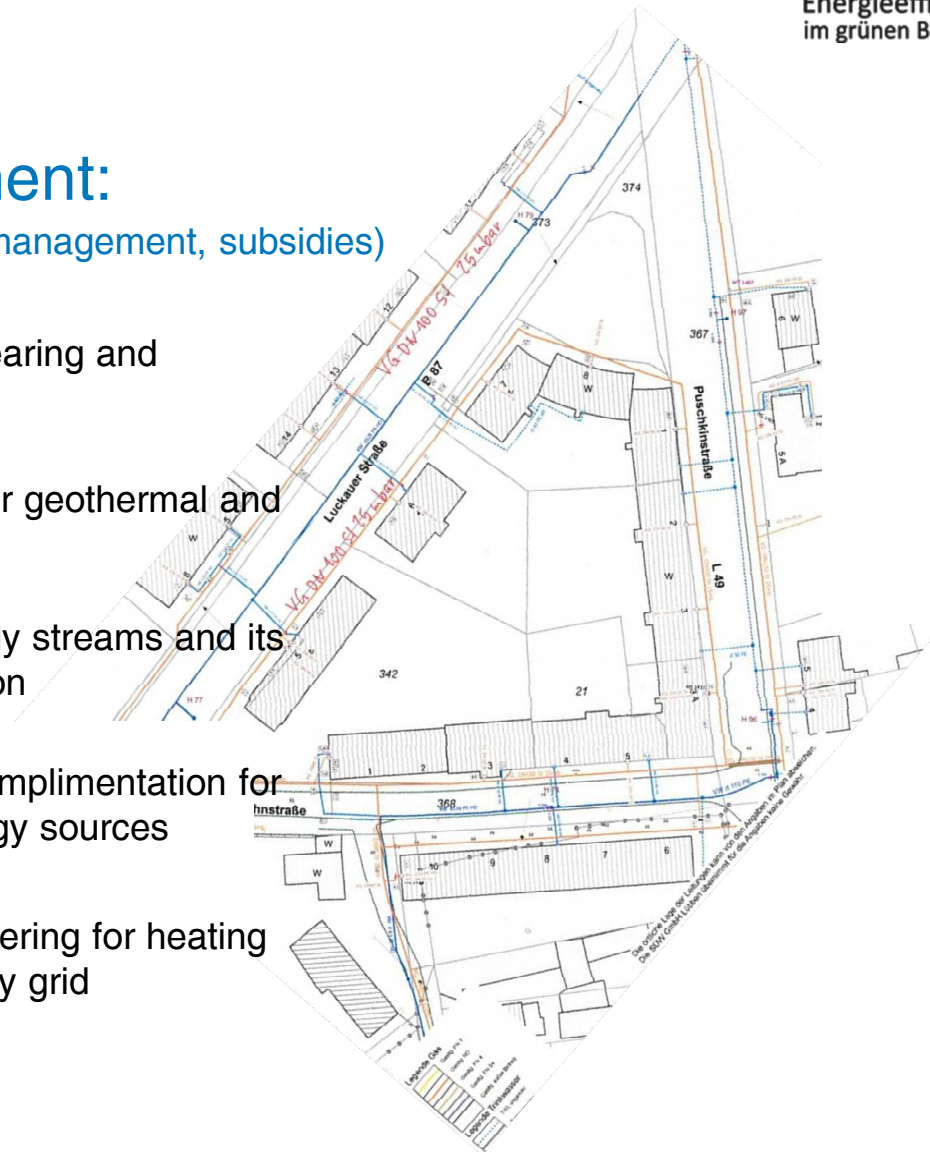
Nuffer: Simulation of energy streams and its production and consumption



MEFA: Equipment and its implimentation for geothermal and solar energy sources

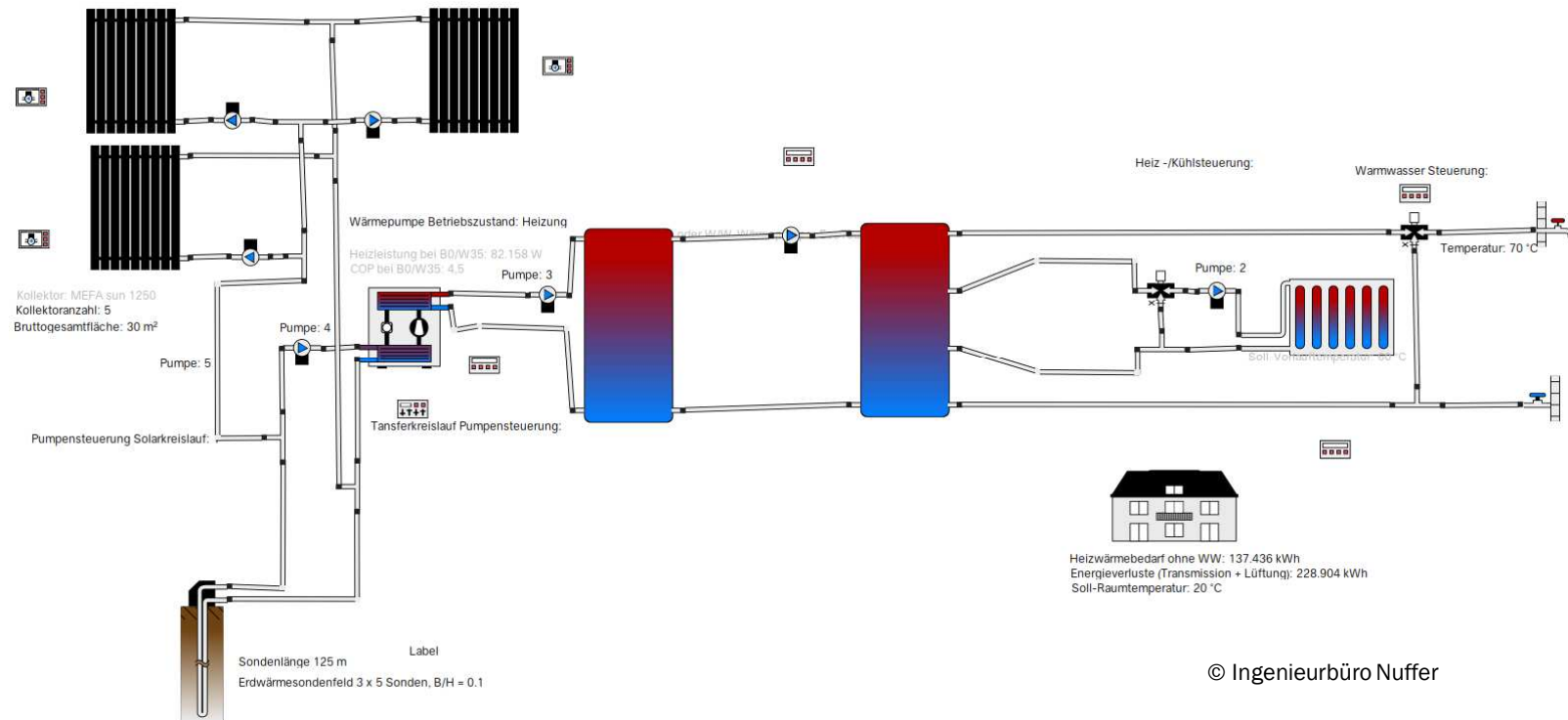


RUHL TecConsult: Engineering for heating systems and LowEx energy grid

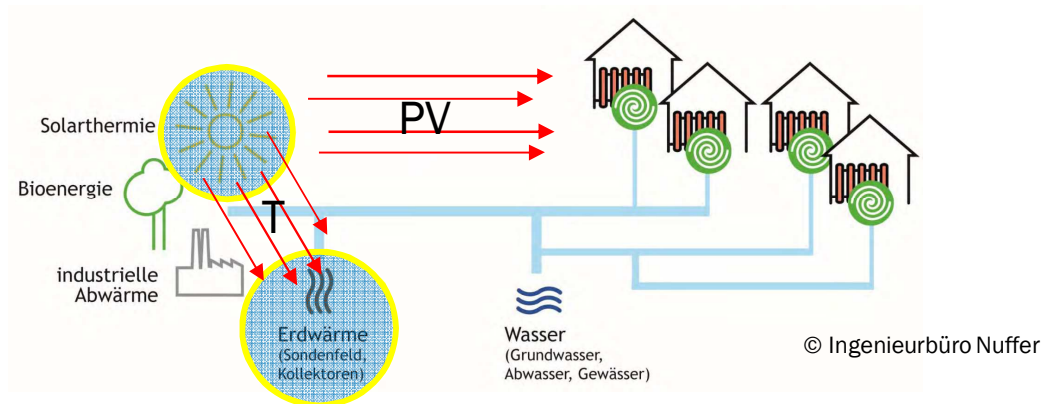


Methodology

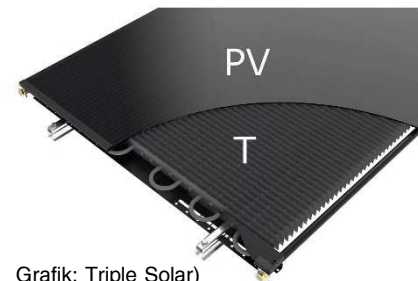
Simulation in Polysun using 6 variations of the energy grid



Energy generation strategy (solar (PVT) / geothermal)



- _ PV-Thermal: Regeneration of geothermal during summer
- _ Geothermal: seasonal storage



Grafik: Triple Solar)



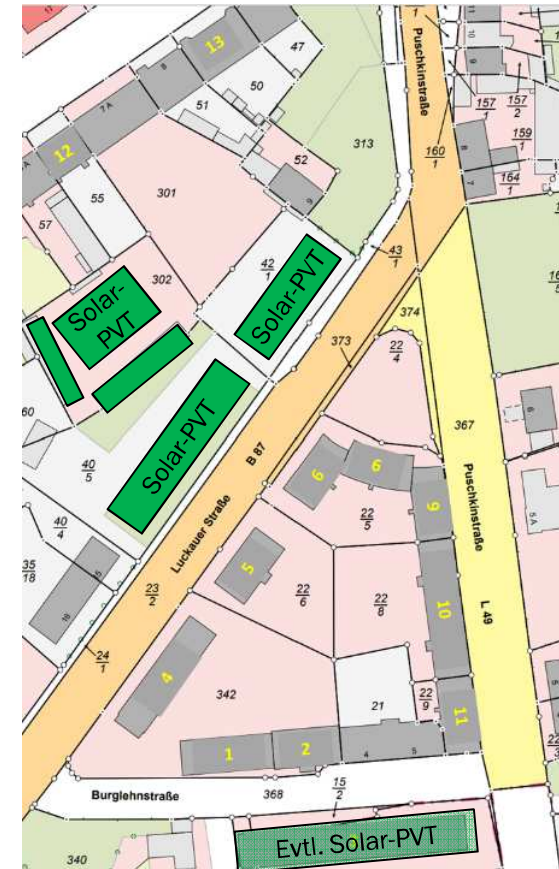
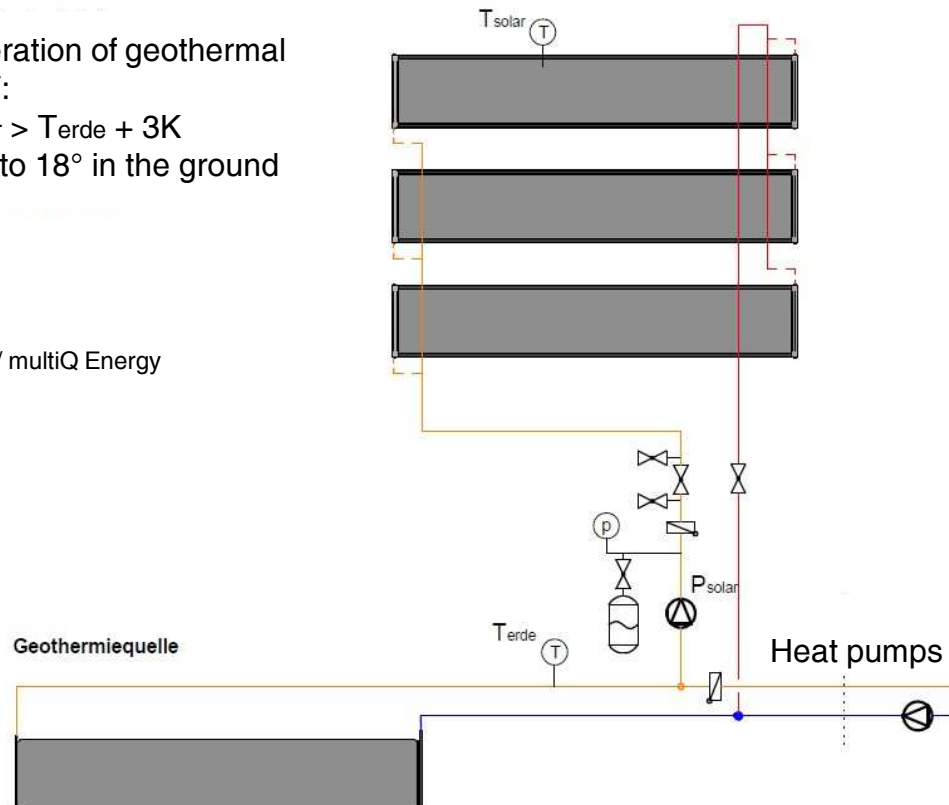
Energy generation strategy (solar (PVT) / geothermal)

Regeneration of geothermal
via PVT:

→ $T_{\text{solar}} > T_{\text{erde}} + 3\text{K}$

→ Up to 18° in the ground

© MEFA / multiQ Energy



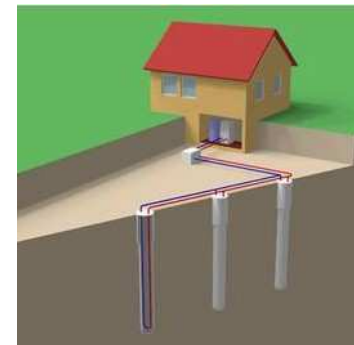
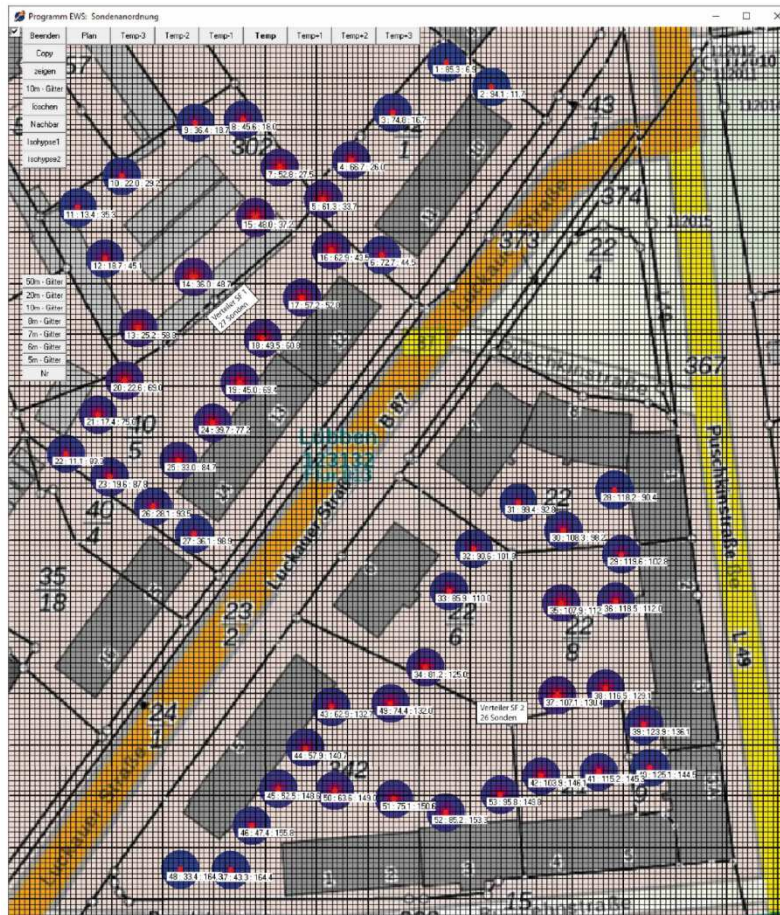
PVT Overview (planned PV capacity: 203 kWp)



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Overview of Geothermal Absorbers (89 + 33 pipes)

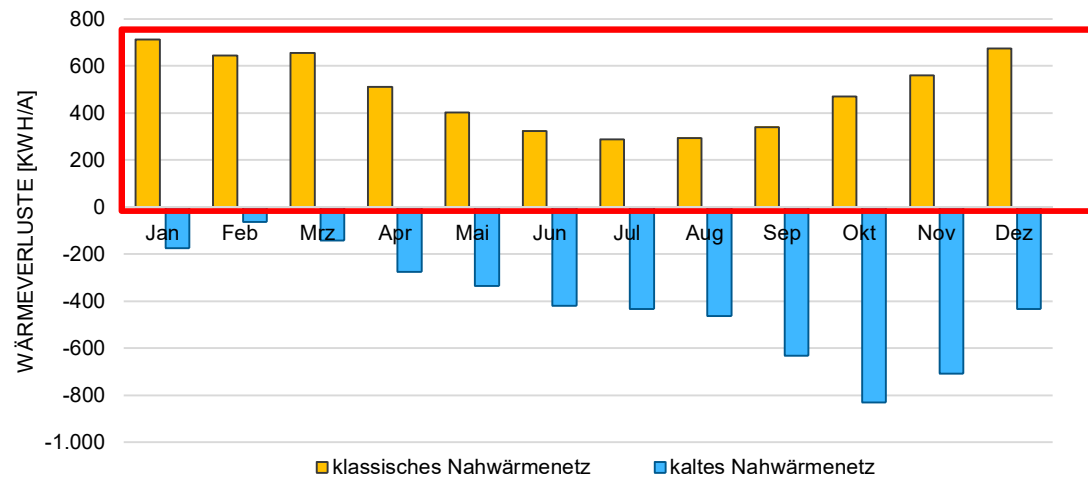


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Energy efficiency of district heat network

Warm district heat network (50°C): ca. 60.000 kWh heat loss per year

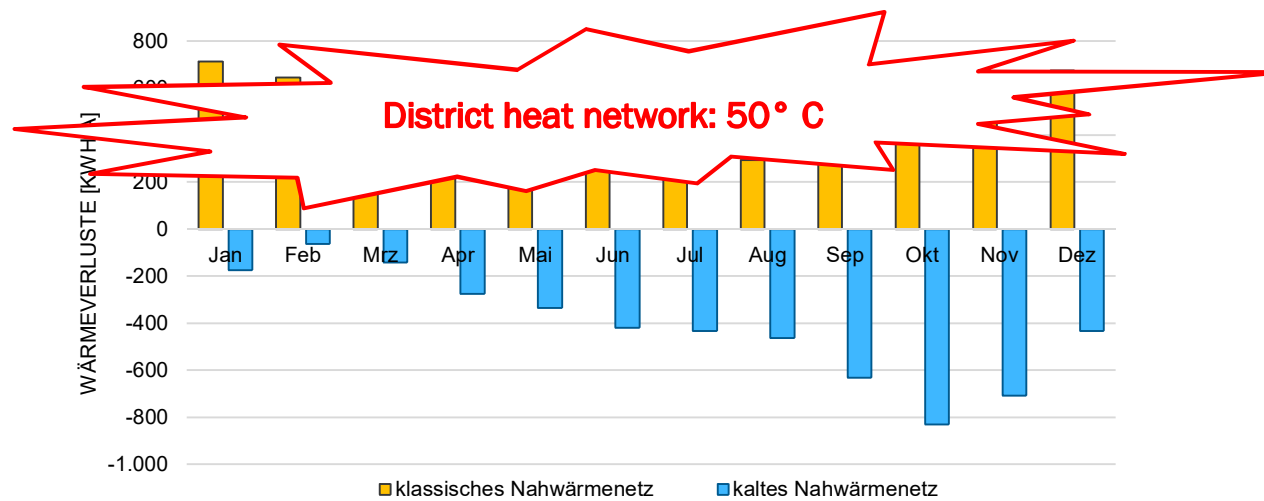


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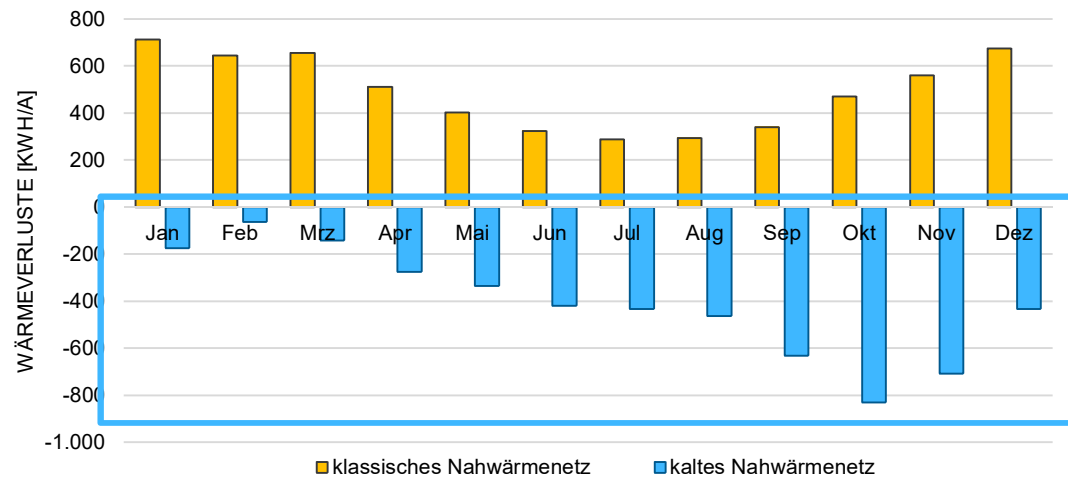


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Energy efficiency of district heat network

LowEx network (7°C): ca. 50.000 kWh heat gain per year

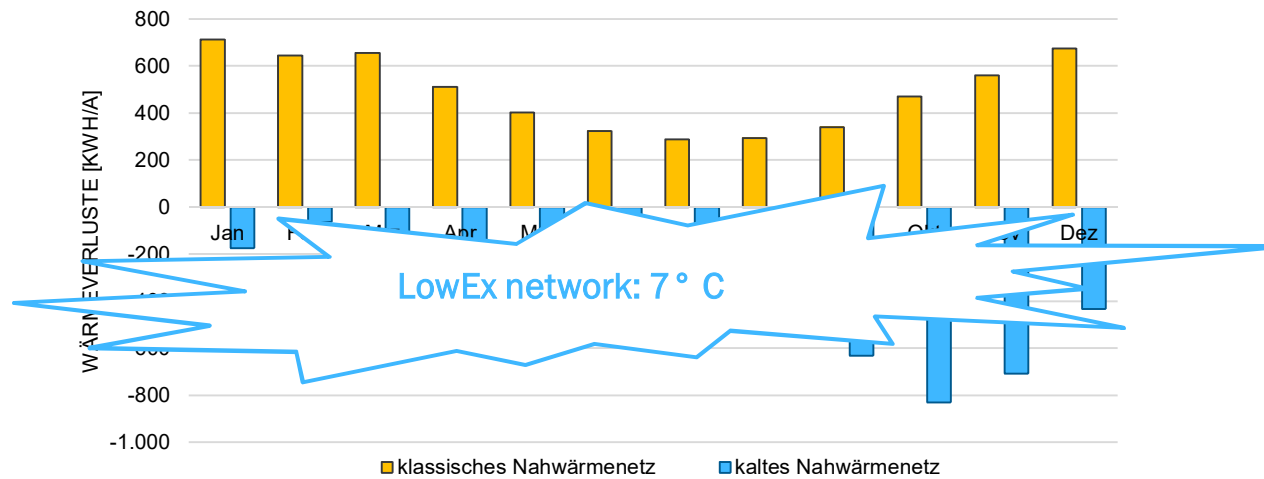


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Energy efficiency of district heat network

LowEx network (7°C): ca. 50.000 kWh heat gain per year



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Costs of LowEx Network with PV-gen.electricity for tenants

Planning

- _ Energy management: 23 K €
- _ Geothermal planning: 17 K €
- _ Building and network simulation: 8 K €
- _ Planning services (building and network): 255 K €
- _ Digital infrastructure for demand and supply of energy: 30 K €

= 333 K €

Hardware:

- _ Heat sources (PVT and geothermal absorbers): 1.1 M €
- _ LowEx network (planning, electricals, pipes, excavation): 771 K €
- _ Technical equipment in buildings (heat pumps, gas boilers, storage, installation, electricals, radiators): 2.42 M €

= 4.29 M €

All figures are gross including 19% tax



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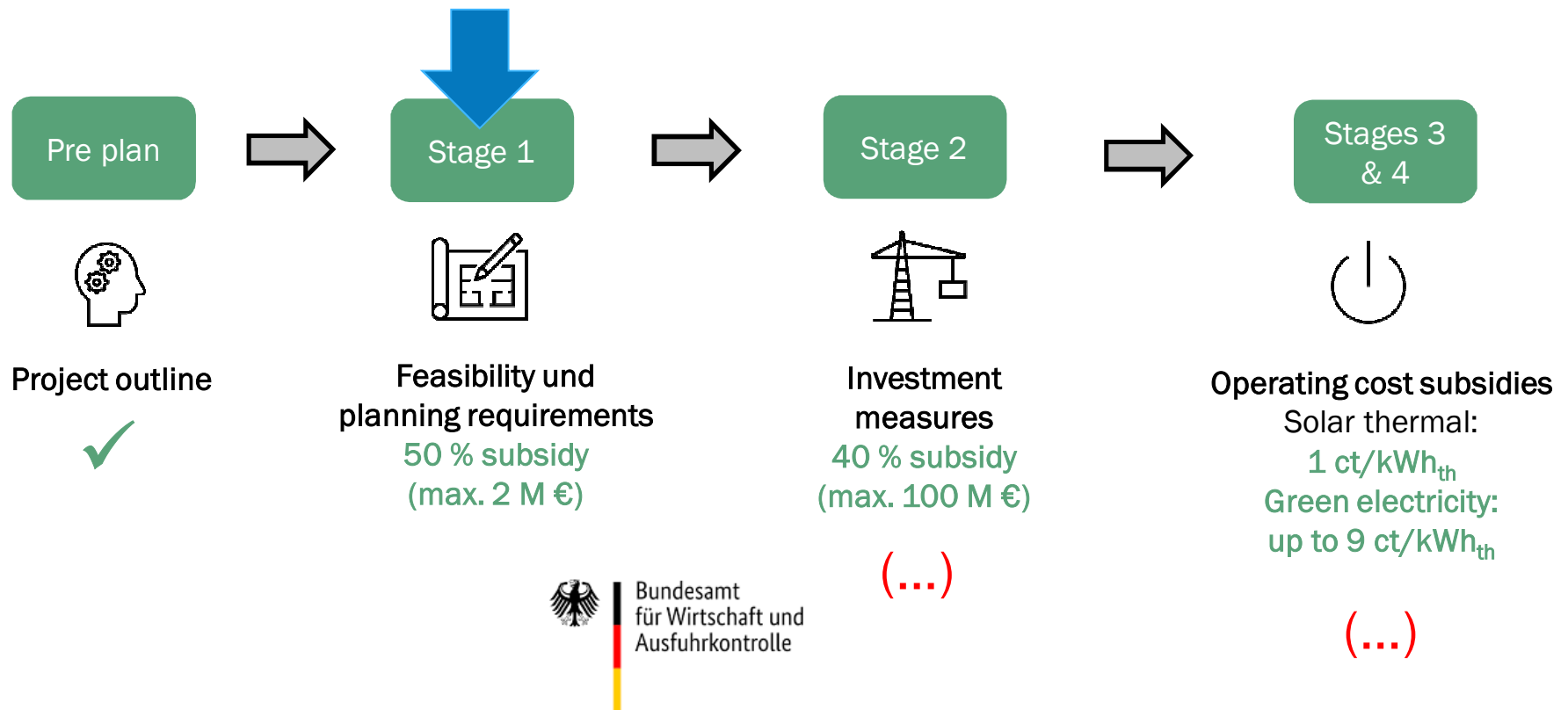
= 4.29 M €

In comparison, costs of gas boilers: 1.5 M € for 13 buildings All figures are gross including 19% tax



Government subsidies for LowEx networks: *Bundesförderung für effiziente Wärmenetze (BEW)*

Effective as of 15.09.2022 / up to a maximum of 3 B €



Significance for the Clean Energy Transition (Decarbonization):

- _ Planning scale from building to precinct.
- _ Strategic planning approach
- Complex adjustment between building's exterior and heating!
- _ National grid must be renewed to enable distribution of PV and wind-generated electricity
- _ Energy transition is high-tech with high costs
- _ Government funding is essential
- _ Building owners move from gas consumers to energy generators.
- *Energy in buildings will become a viable business case!*



Thank you for your attention 😊

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