



MINE WATER, A BASIS FOR SUSTAINABLE ENERGY

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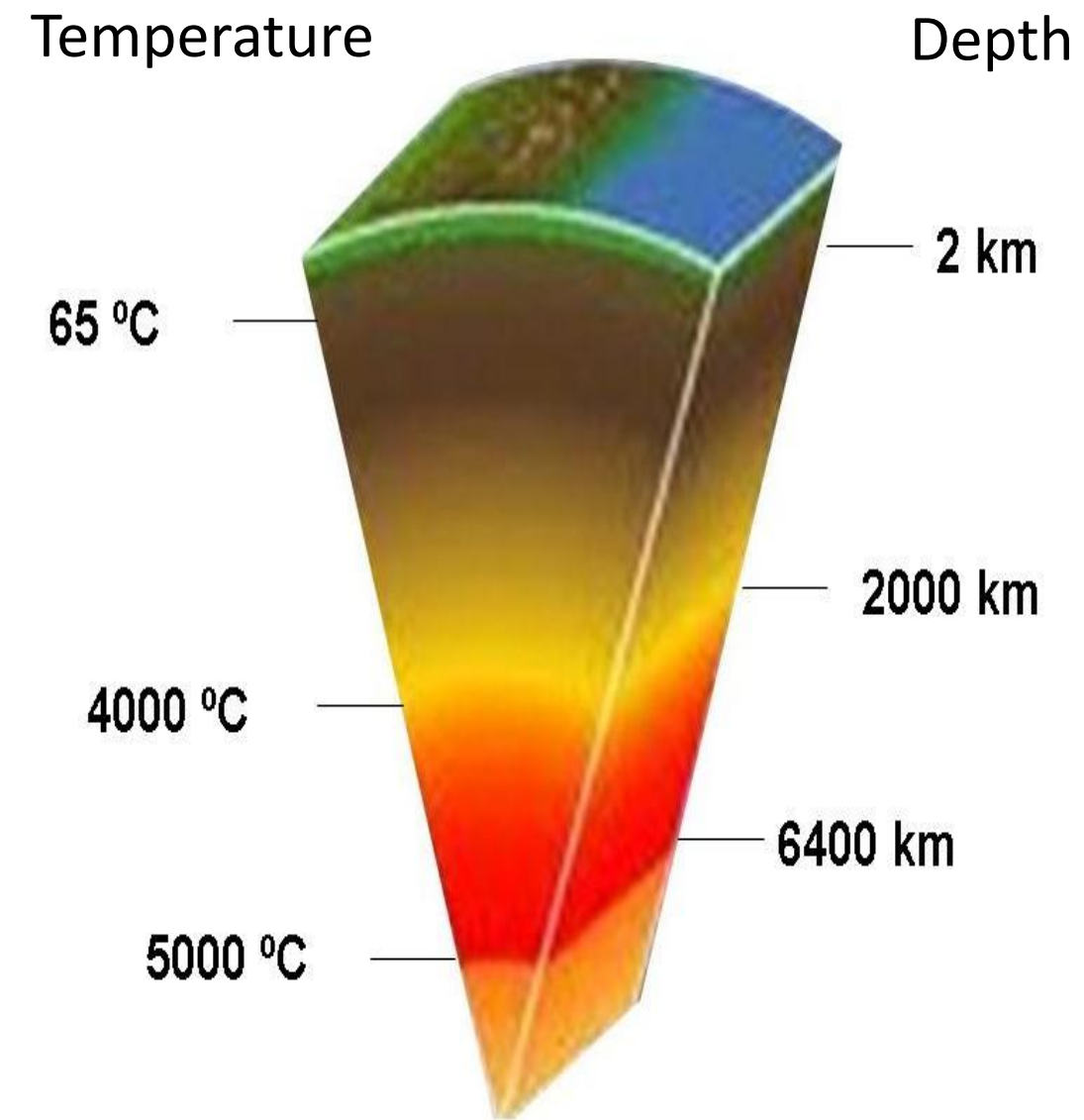
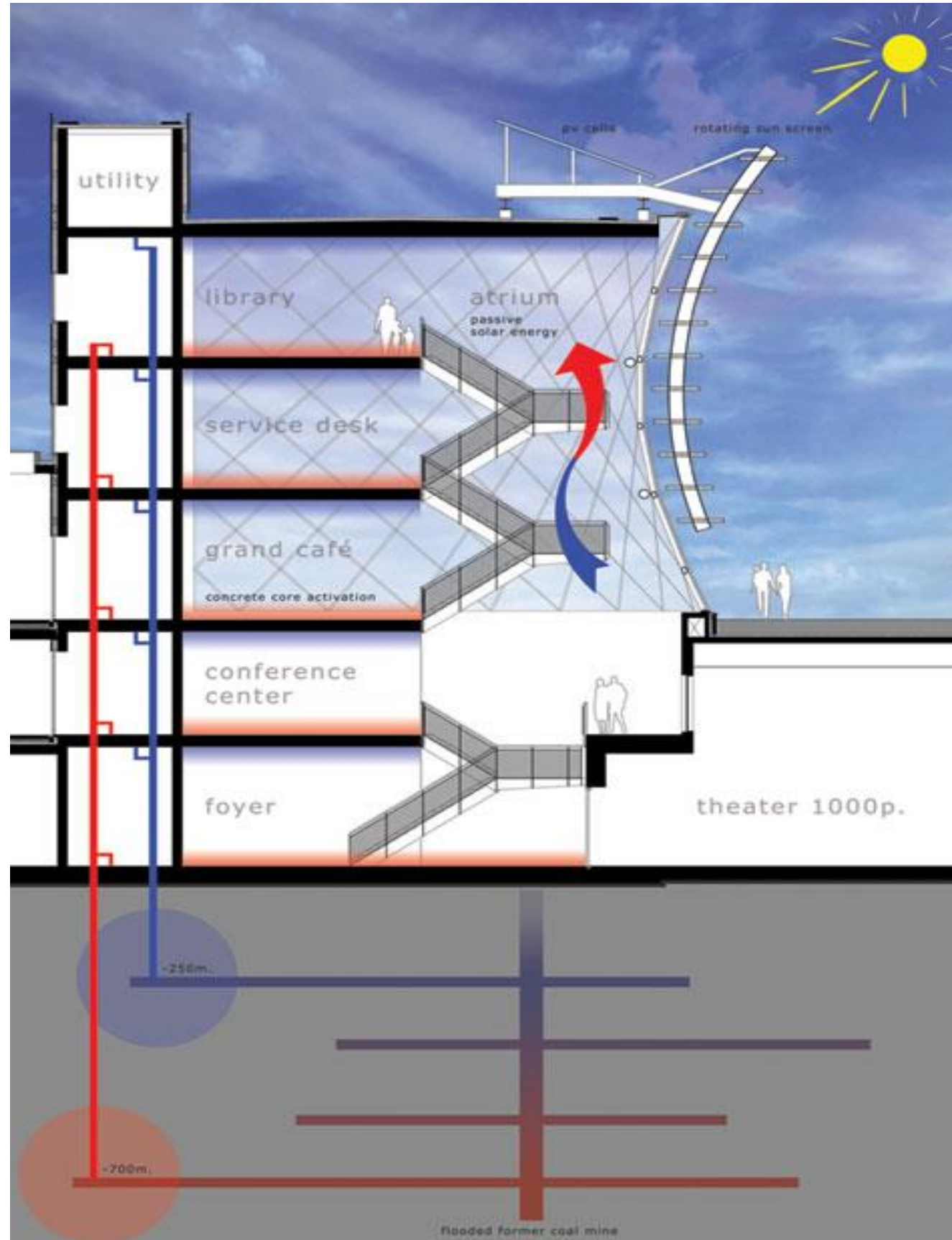
MIJNWATER HEERLEN



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MIJNWATER HISTORY



shallow geothermal heat

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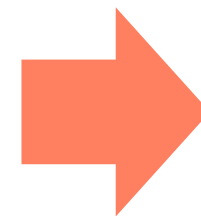
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Underground reservoir: 8 million m³ water

HOW MUCH IS 1L (MINE)WATER?



1 litre = 14 kWh ($\Delta T=12$)

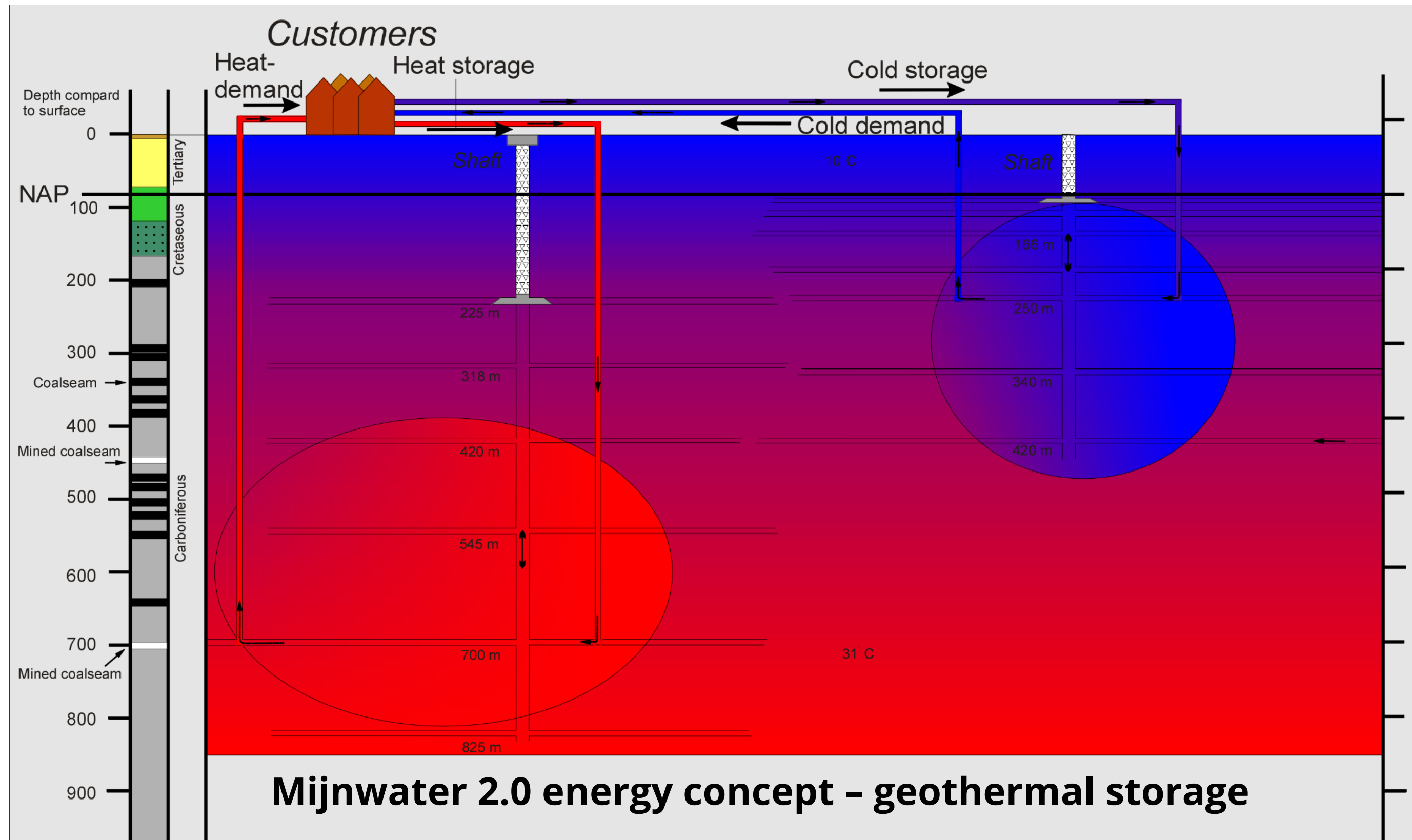
5,7 m³ water = 1 Tesla

Cost (water) = € 1,30/m³

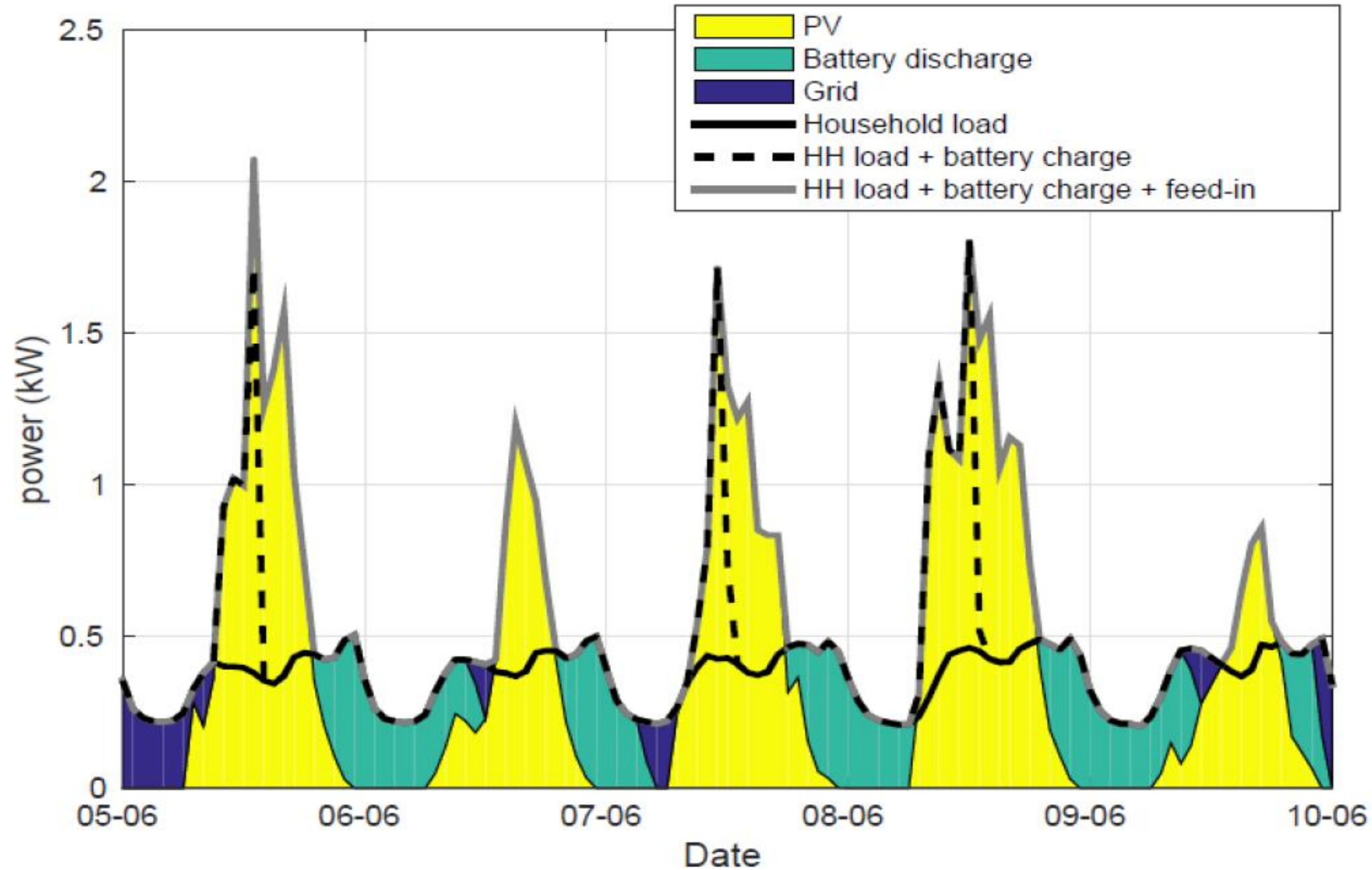
Life cycle ∞ cycles

Mine water reservoir Heerlen = 1,4 miljoen Tesla's

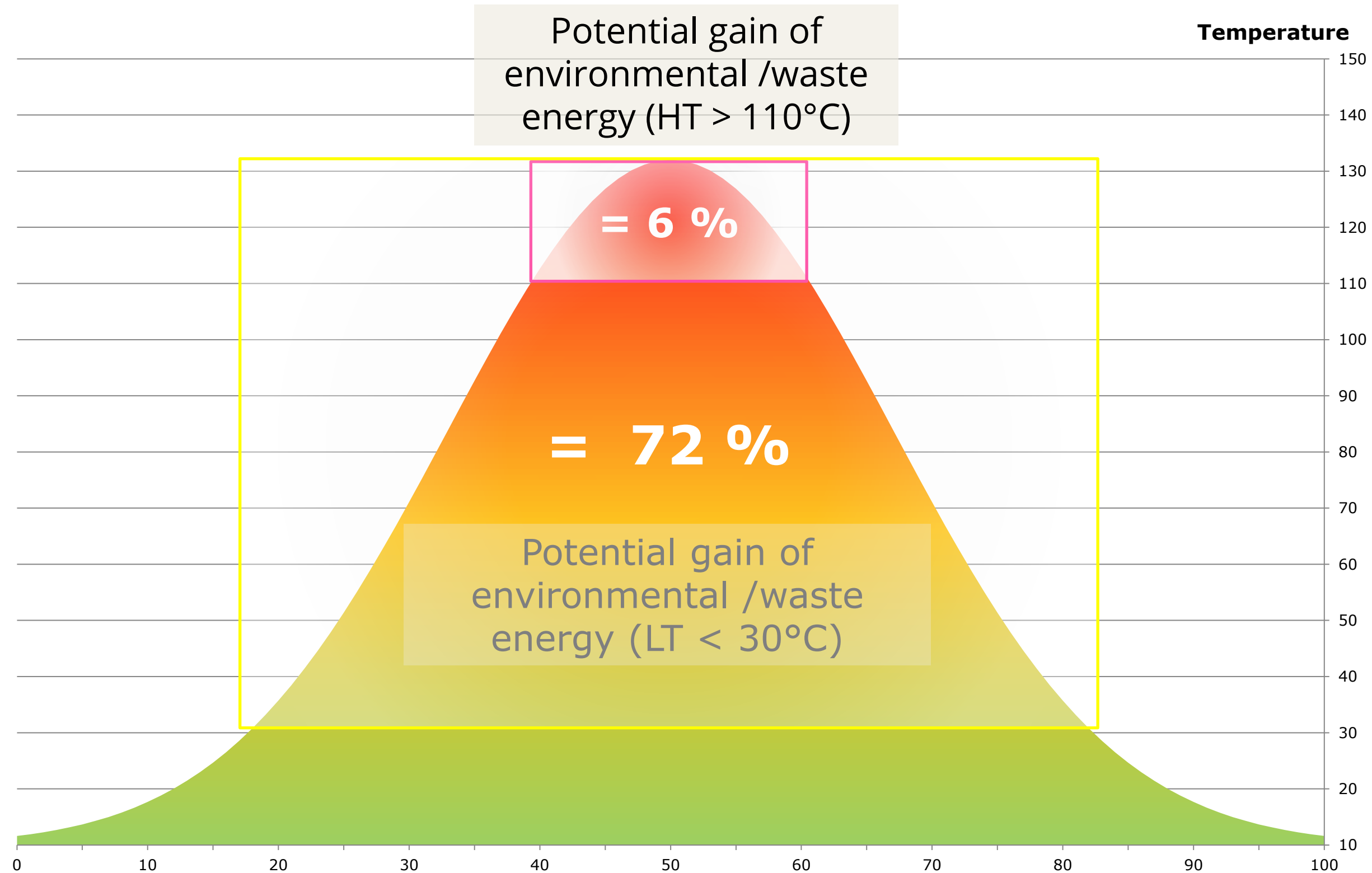
GEO THERMAL ENERGY AND STORAGE



FLUCTUATING SOURCES



RECOVERABLE ENERGY AS FUNCTION OF TEMPERATURE OF GRID



WE DISCOVERED THAT...



Waste heat is being dumped in surface water and in the air on a major scale ...

Amount of residual heat > heat demand of buildings

WE DISCOVERED THAT...



35% of urban thermal energy is needed for cooling, which could be reused during winter

Emission of energy into the air leads to warming (UHI), sound pollution (fans, HP); fine dust (bio-combustion)

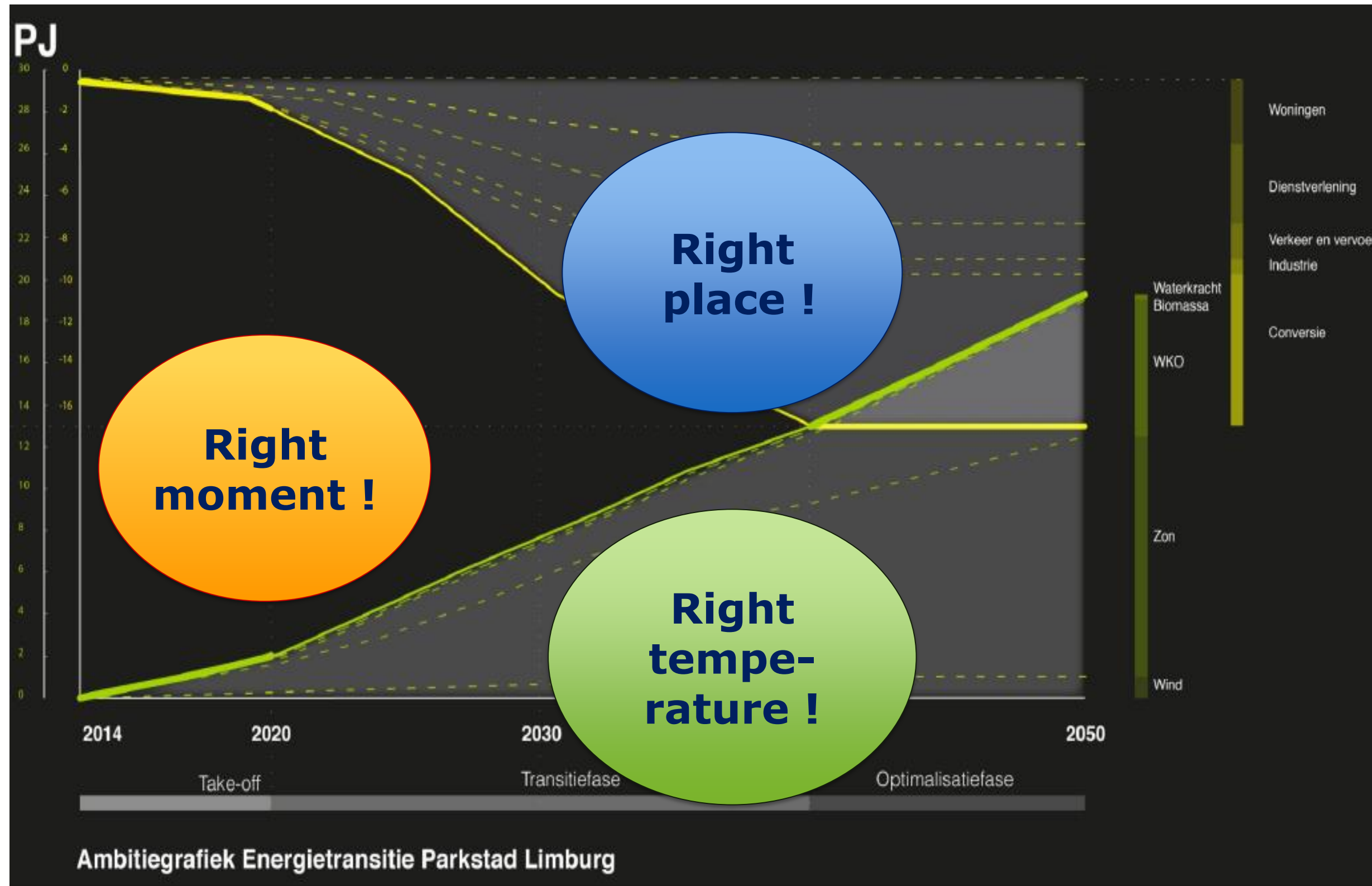
Heat islands:
+ 5 to 8 °C

REGIONAL ENERGY STRATEGY



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5TH GENERATION URBAN ENERGY GRIDS

Thermal energy exchange networks (10° - 50°C)
Delivery of heat & cold



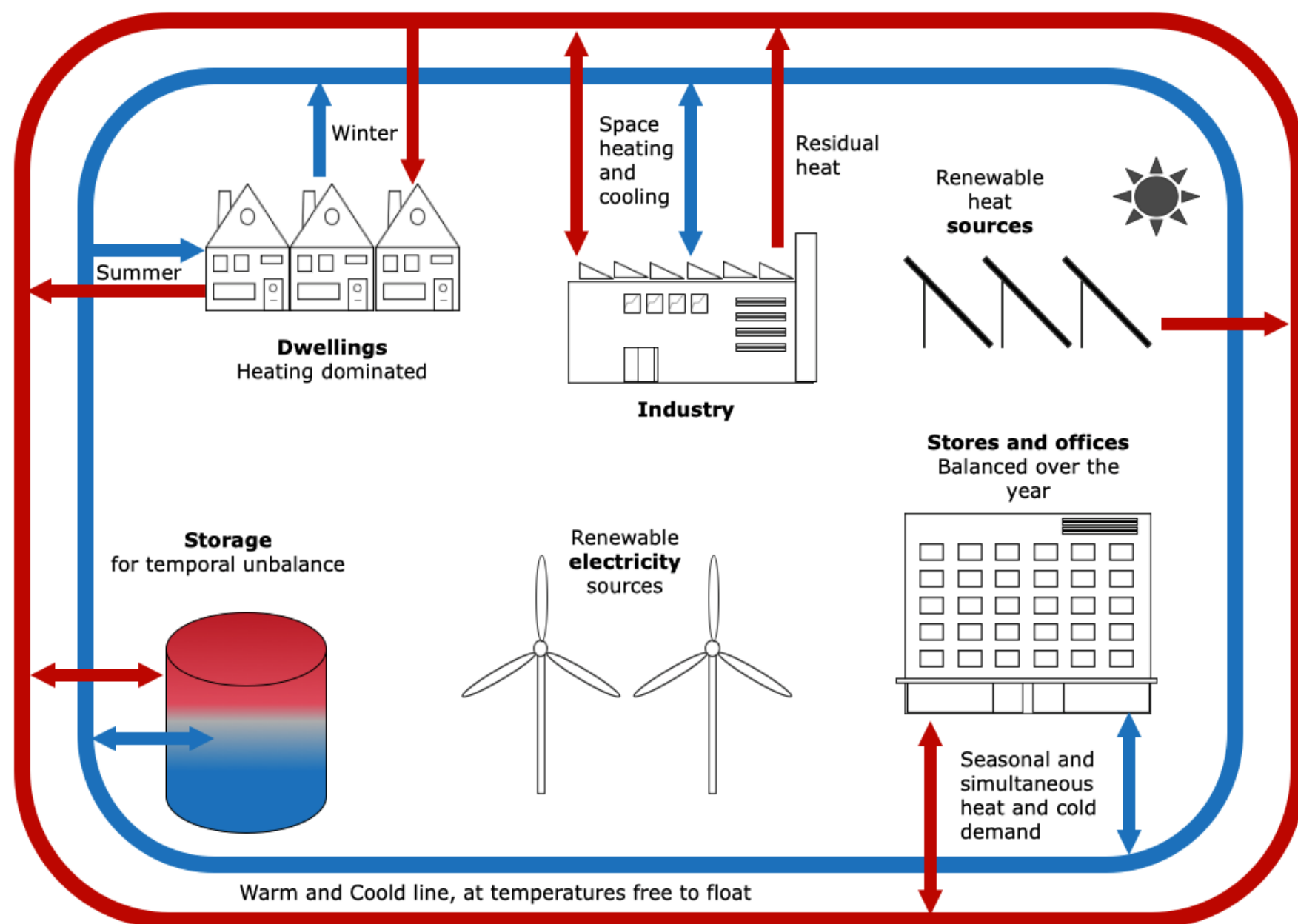
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DEFINITION OF 5GDHC PRINCIPLES

5th generation DHC is an urban thermal energy grid for heating and cooling based on the following 5 principles



1 Closing the energy loop

An optimized system allowing exchange of heat and cold between end users. To prevent waste, energy exchange occurs firstly on the scale of the building, then within the neighbourhood and finally on city level.

2 Using low-graded sources for low-graded demand

In 5GDHC we match the supply with the requested quality level of the demand.

3 Decentralized & demand-driven energy supply

Circulating energy within the system only when and where needed, as close as possible to the end-user

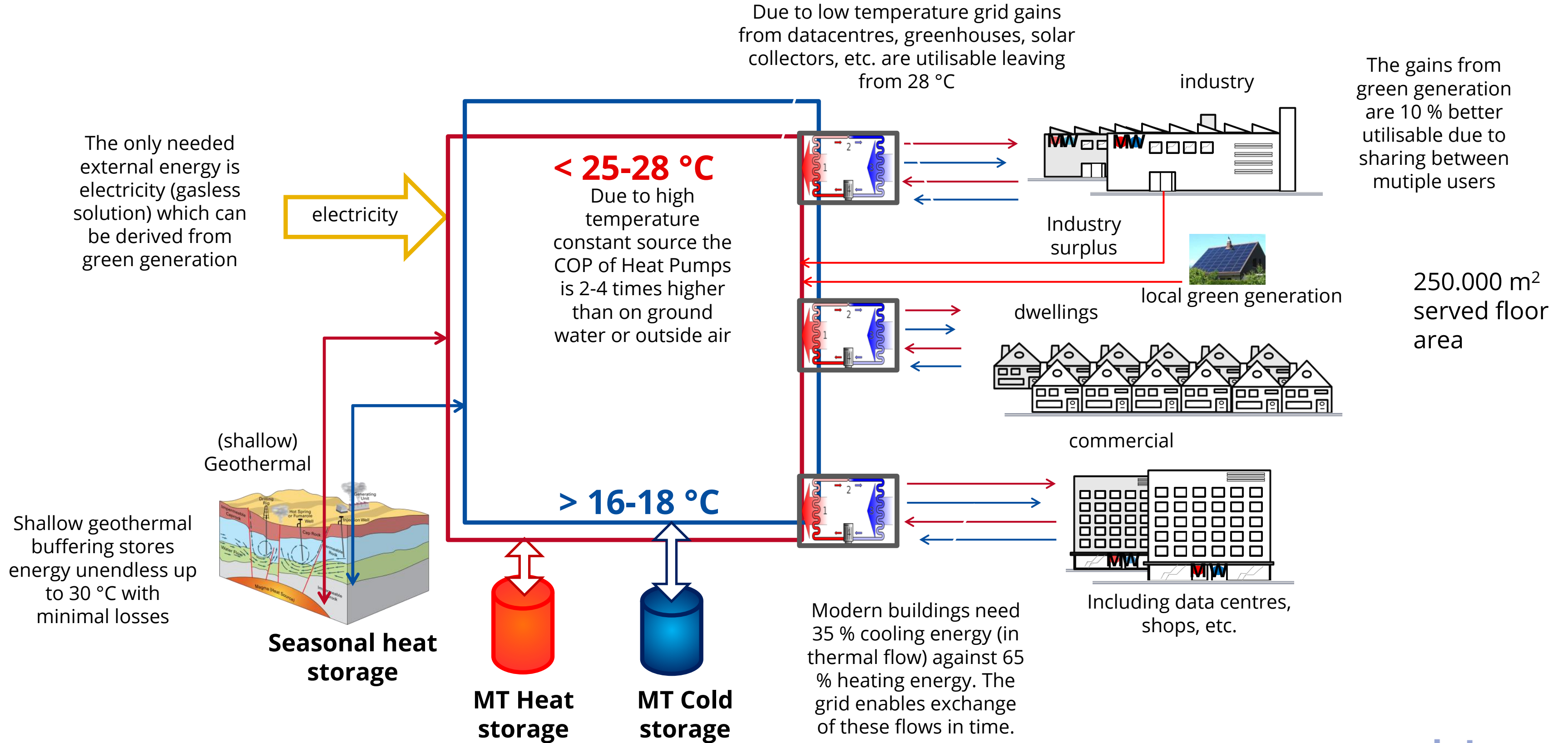
4 An integrated approach of energy flows

Connecting heating and cooling to other energy flows (power grid, hydrogen conversion, solar plants, etc.) to avoid energy waste across sectors and reduce peak loads.

5 Local sources as a priority

Avoiding big investments and energy loss during transport, while stimulating the local economy.

5GDHC CONCEPT IN HEERLEN

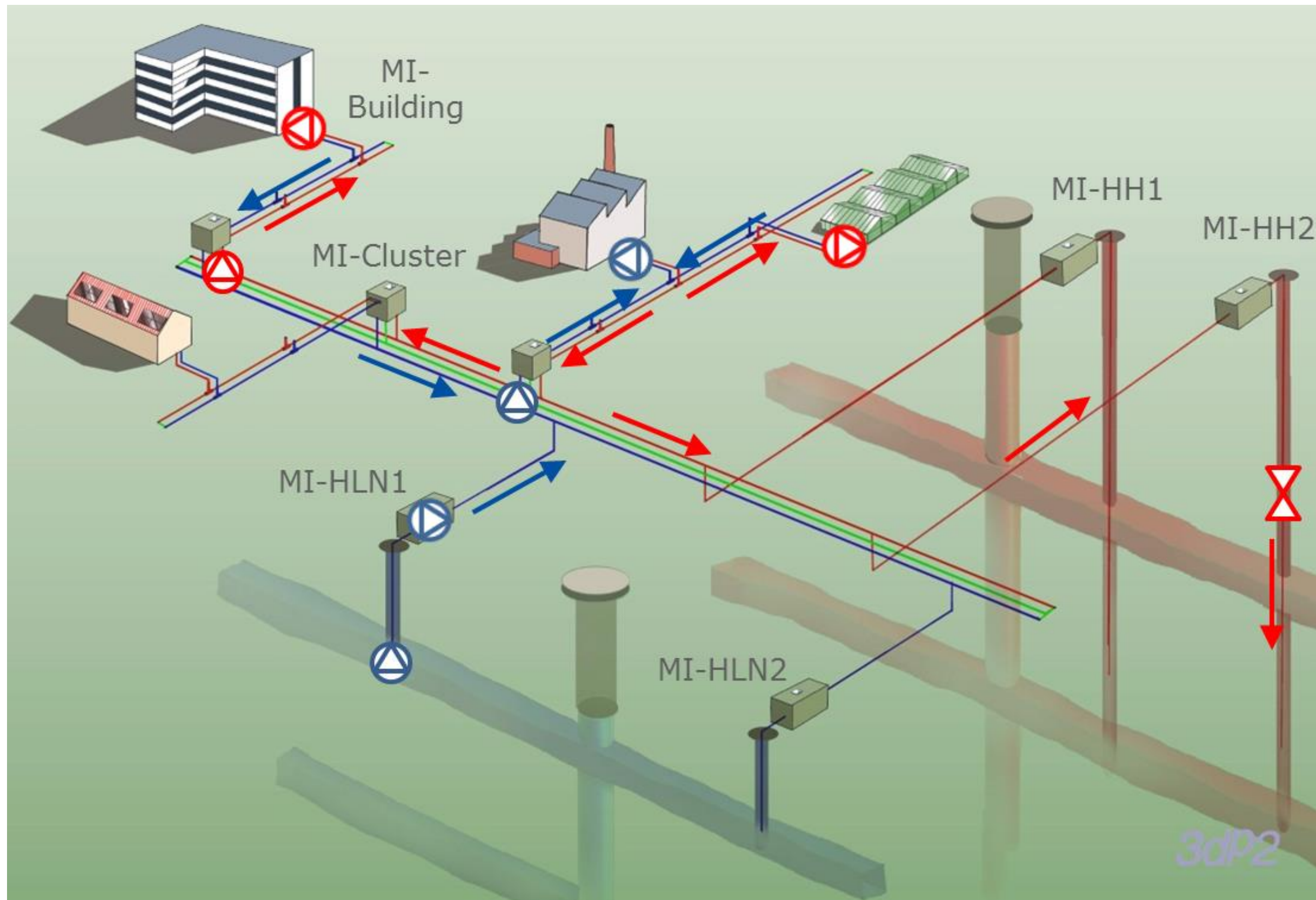


DEMAND-DRIVEN EXCHANGE NETWORK



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DECENTRALIZED NETWORK = CLOUD

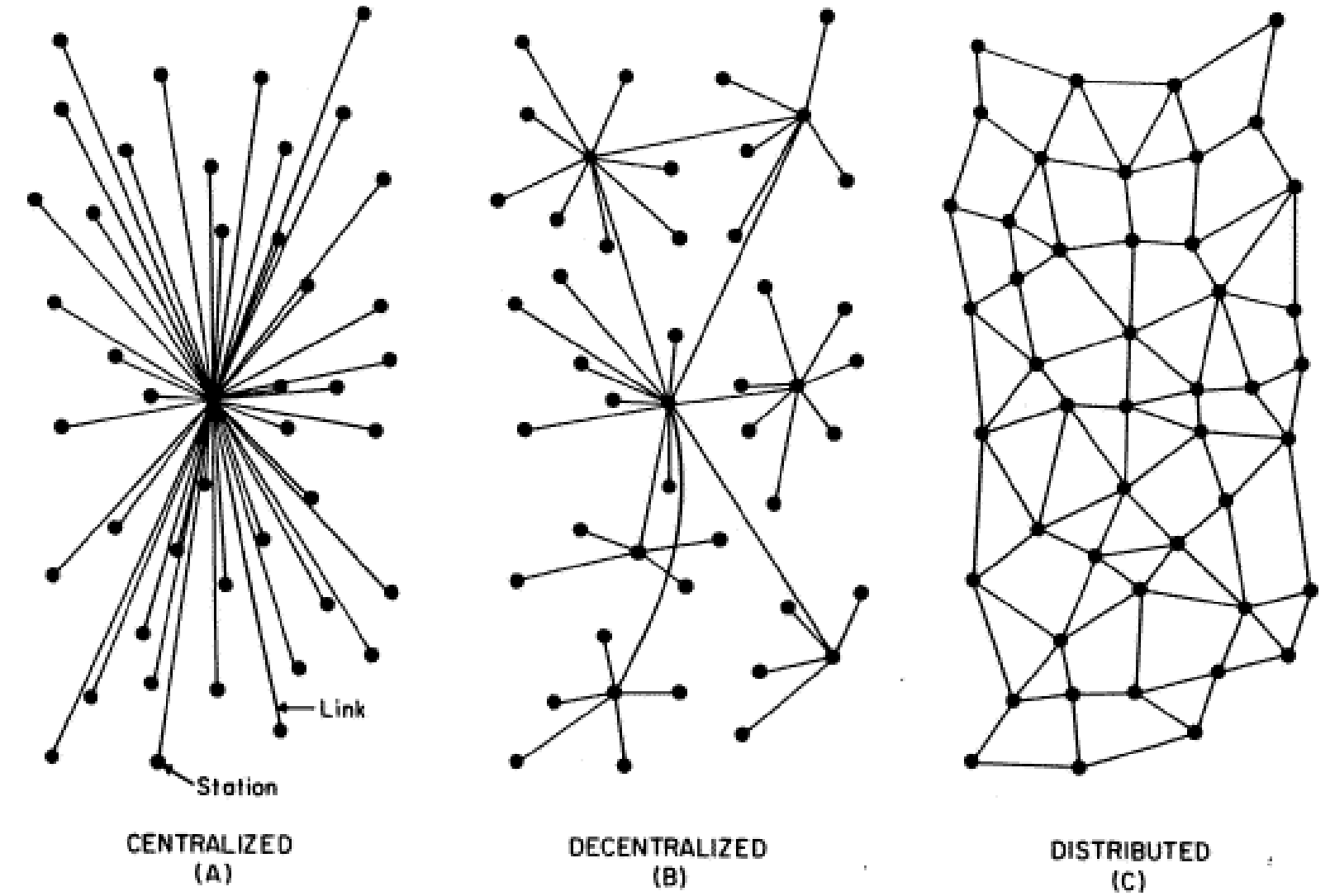
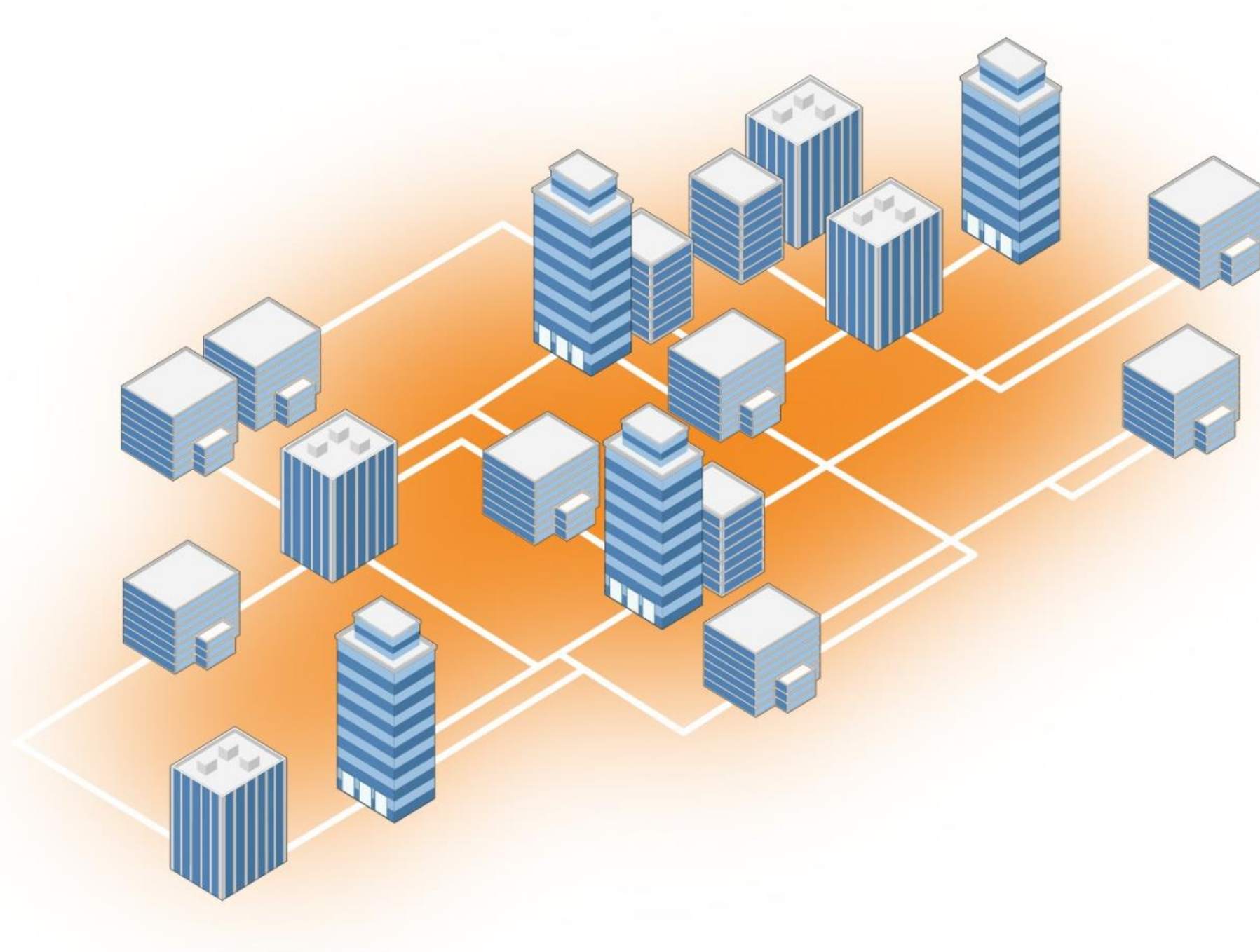
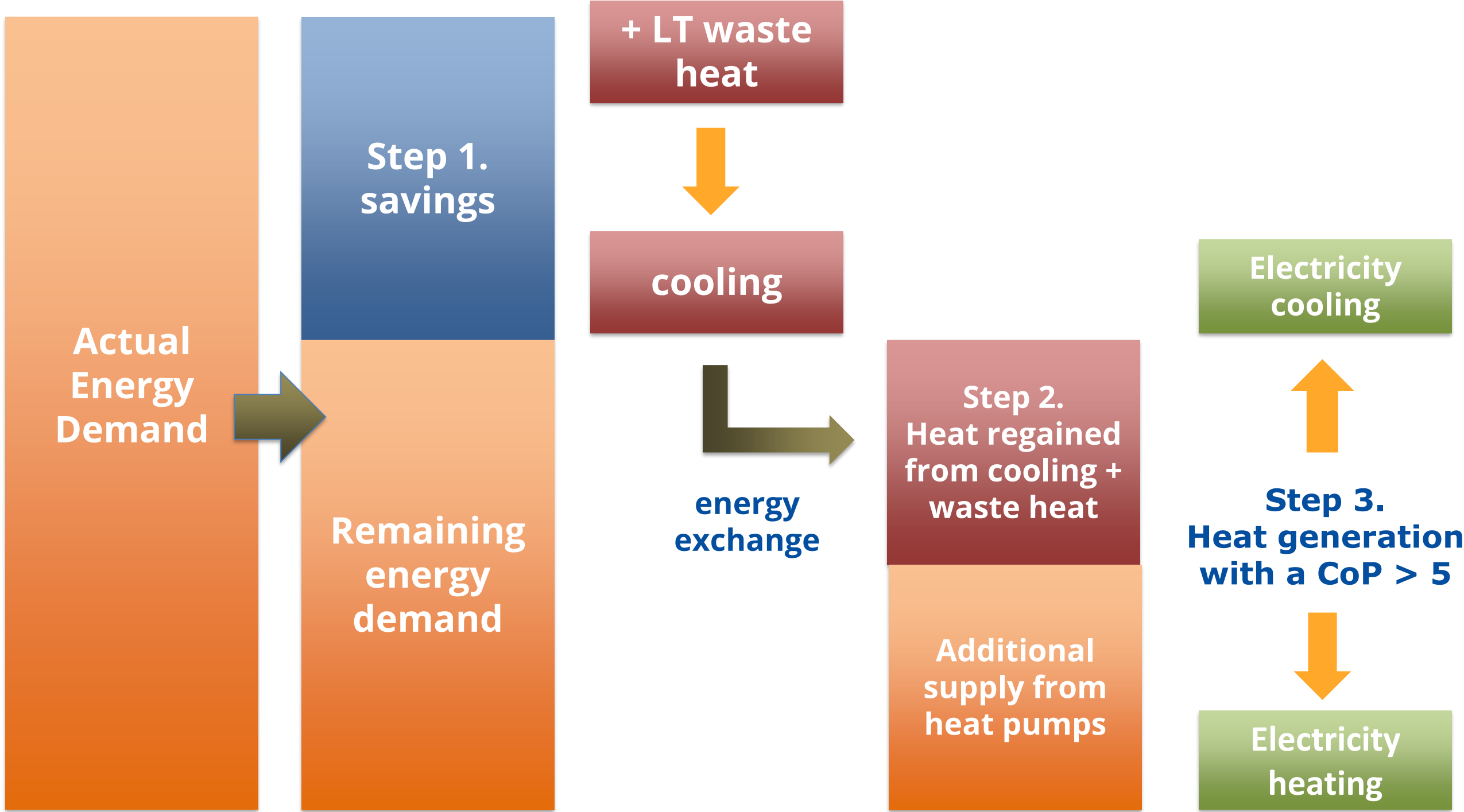


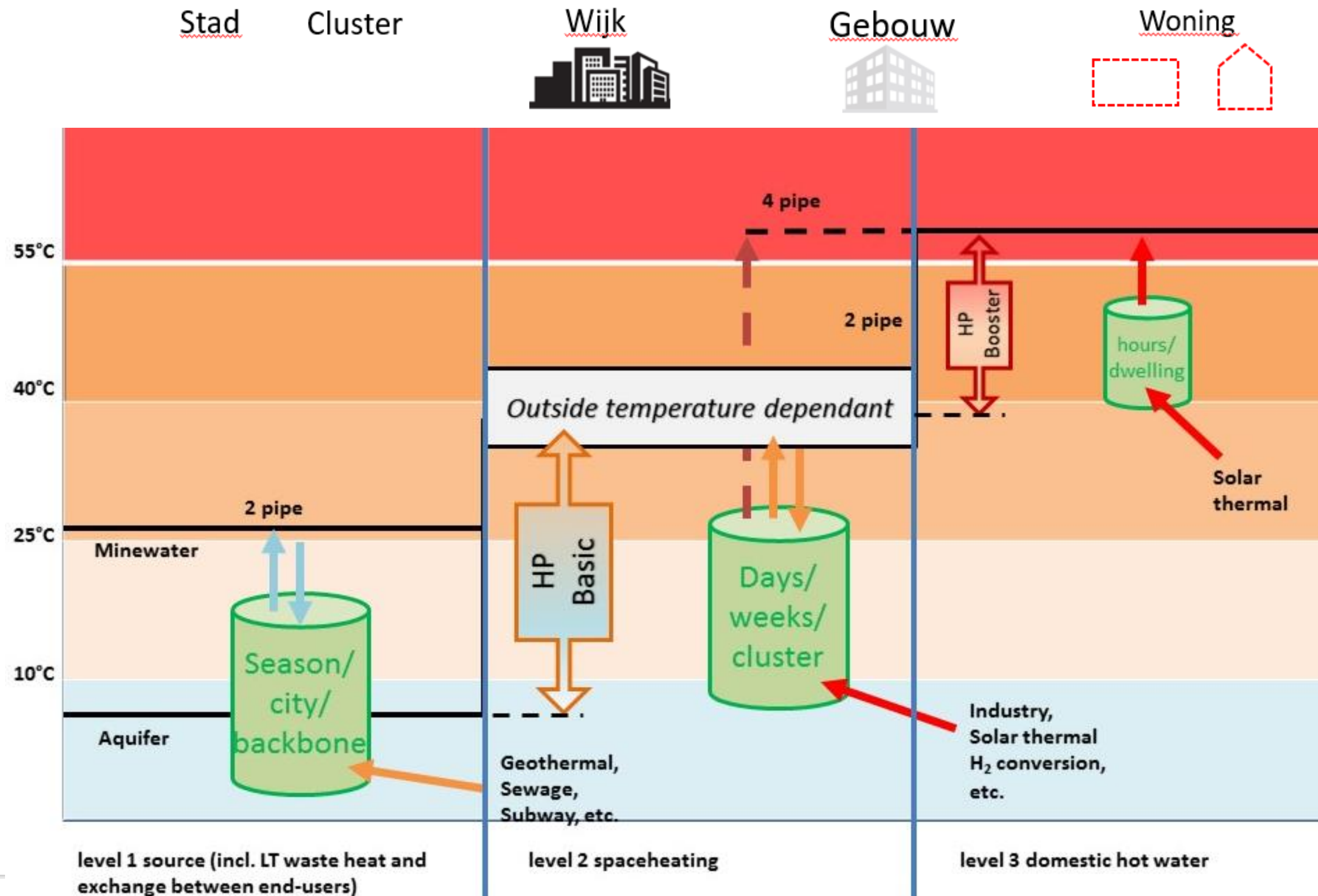
FIG. 1 – Centralized, Decentralized and Distributed Networks

REDUCE THE NEED FOR GREEN SOURCES

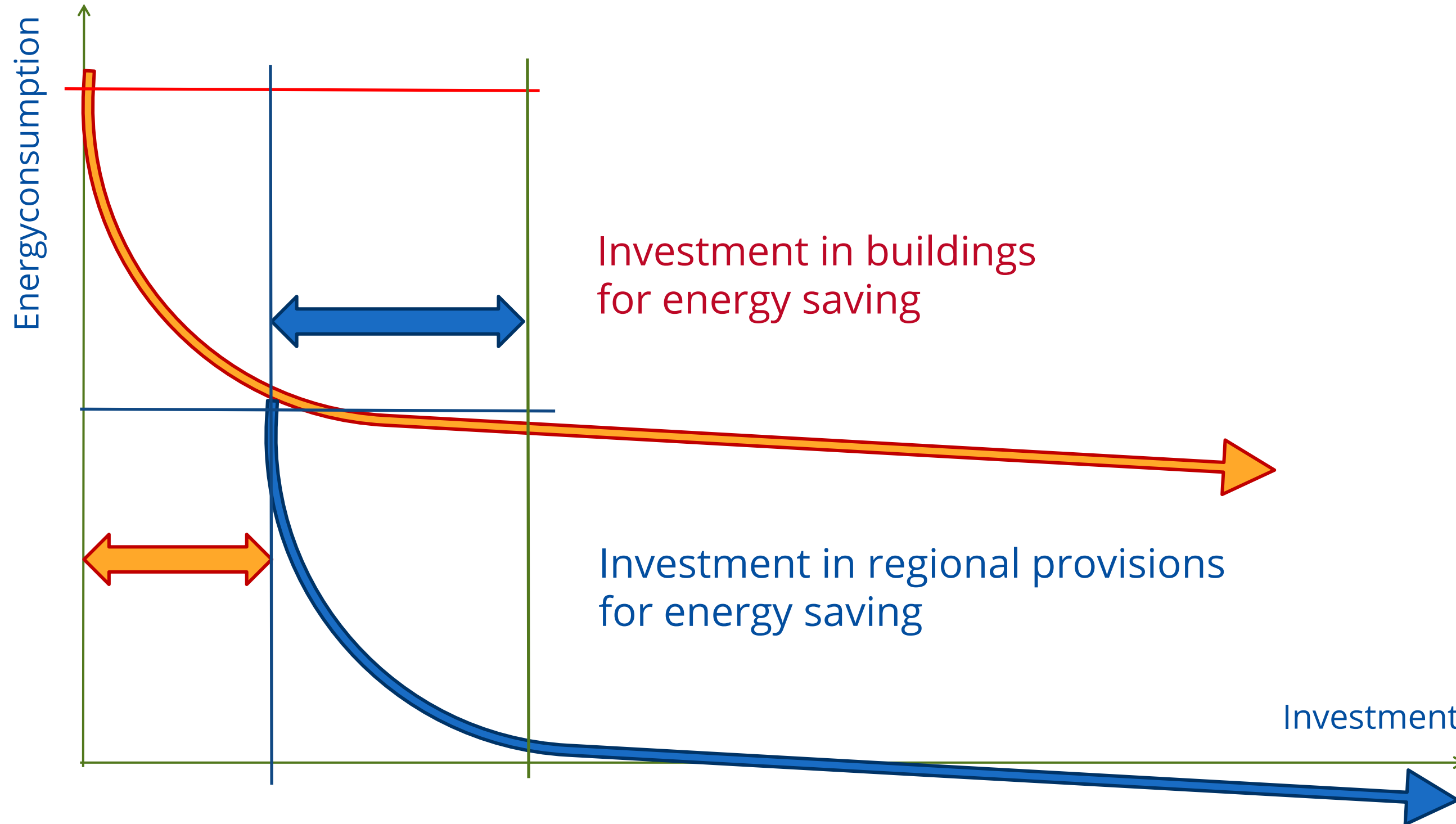


Circular recovery of cooling/heating

LEVELS OF CONGLOMERATION

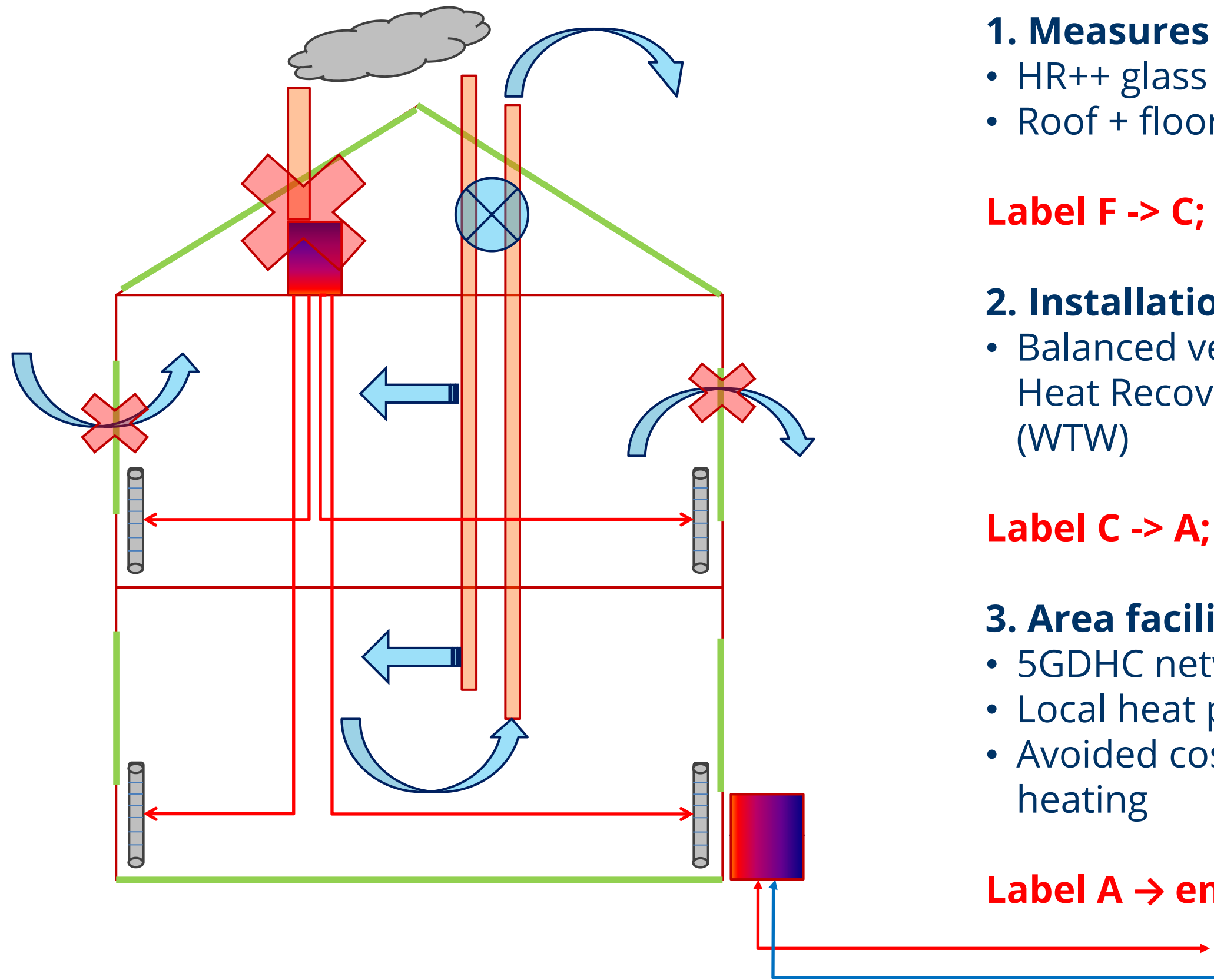


BRIDGE SPLIT INCENTIVES



Optimize efficacy on each level

RENOVATION CONCEPT



1. Measures outer shell

- HR++ glass € 5.000
- Roof + floor insulation € 4.000

Label F -> C; $T_{\text{radiator}} 90 \rightarrow 70 \text{ }^\circ\text{C}$

2. Installations

- Balanced ventilation Heat Recovery System (WTW) € 5.000

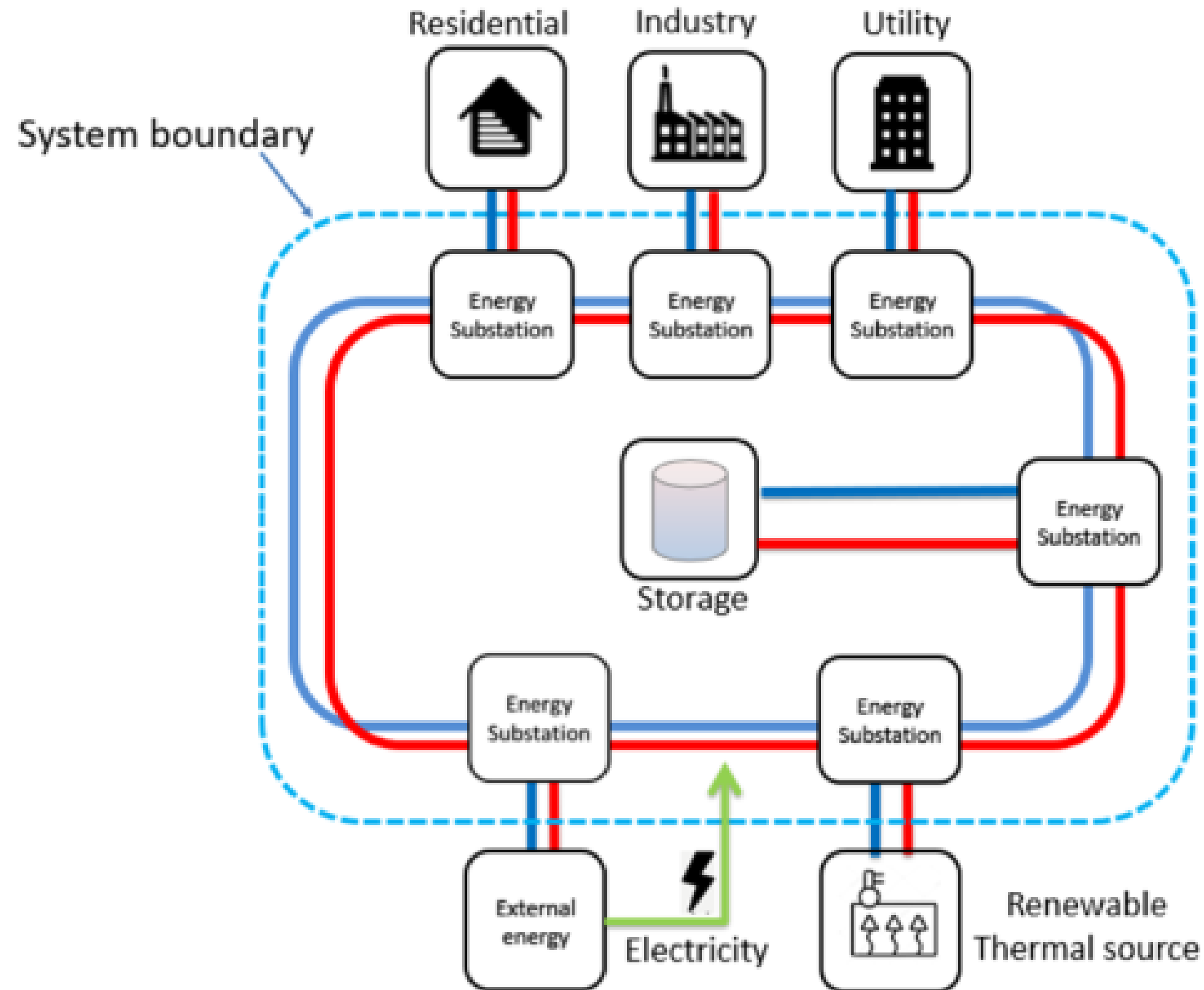
Label C -> A; $T_{\text{radiator}} 70 \rightarrow 50 \text{ }^\circ\text{C}$

3. Area facilities

- 5GDHC network € 15.000
- Local heat pump € 5.000
- Avoided cost central heating - € 2.500

Label A -> energy neutral (A⁺⁺⁺⁺)

SYSTEM BOUNDARY THERMAL

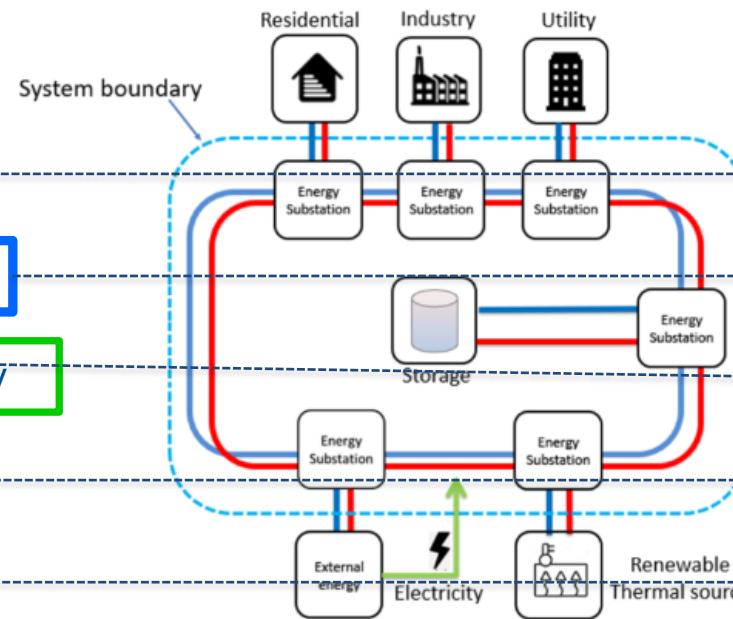


5GDHC ASSESSMENT

Principles

- 1 Closing the energy loop
- 2 Low-graded sources for low-graded demand
- 3 Decentralized & demand-driven energy supply
- 4 An integrated approach of energy flows
- 5 Local sources as a priority

System boundary



KPI's

- $E_{ext} = f(E_{ref}) \dots 100\% \dots 20\% \dots -10\%$
- $E_{tot} = a \cdot E_{hh} + b \cdot E_h + c \cdot E_0 + \dots k \cdot E_{ll}$
- $E_{ext} = f(D=0)$
- $E_{,ext,peak} = f(E_{average})$
- $E_{tot} = a \cdot E_{10km} + b \cdot E_{50km} + c \cdot E_{250km} + d \cdot E_{global}$

Improvement options

- Technology guidelines
- Datamining and analysis
- Smart control
- Key features, like multilevel storage, multisource

Weigh factor

- 25%
- 30%
- 10%
- 20%
- 15%

5gDHC label

MIJN WATER IN PRACTICE



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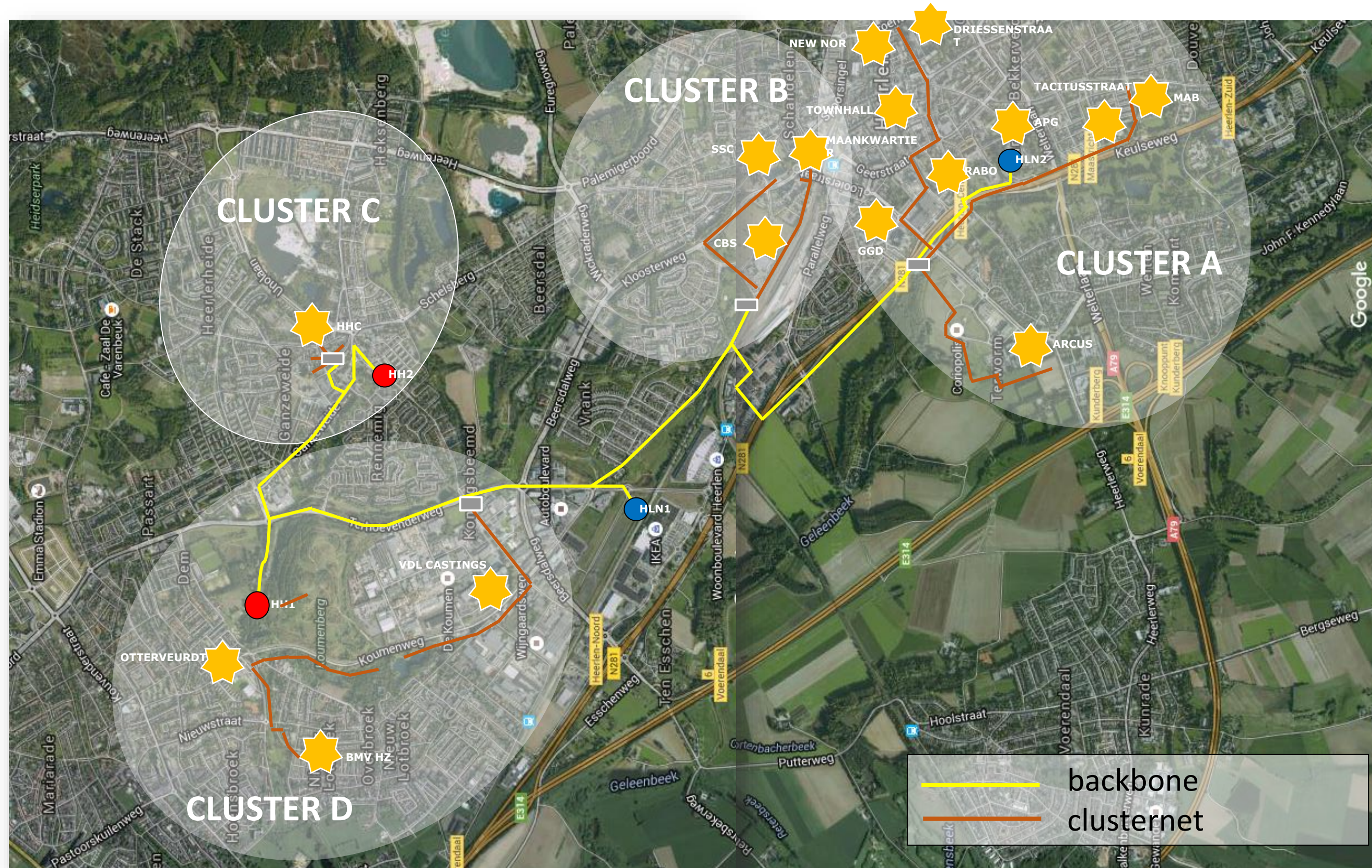
50.000 m² multifunctional development, heated and cooled with 5GDHC

ACTUAL GRID LAYOUT HEERLEN



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EXAMPLES OF CONNECTIONS

250.000 m2 of heated and cooled floor area



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Gen Coel HHC



New office CBS



Rabobank Parkstad



APG Heerlen



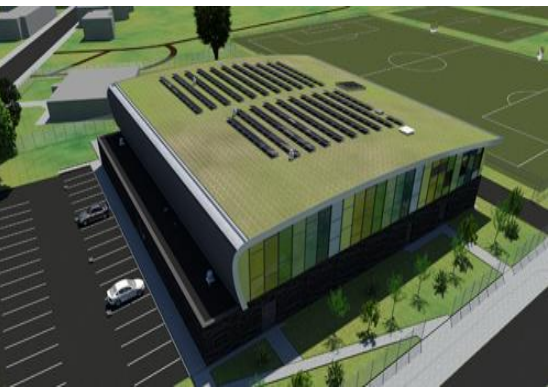
Arcus College



Maankwartier



GGD Heerlen



MAB Bekkerveld



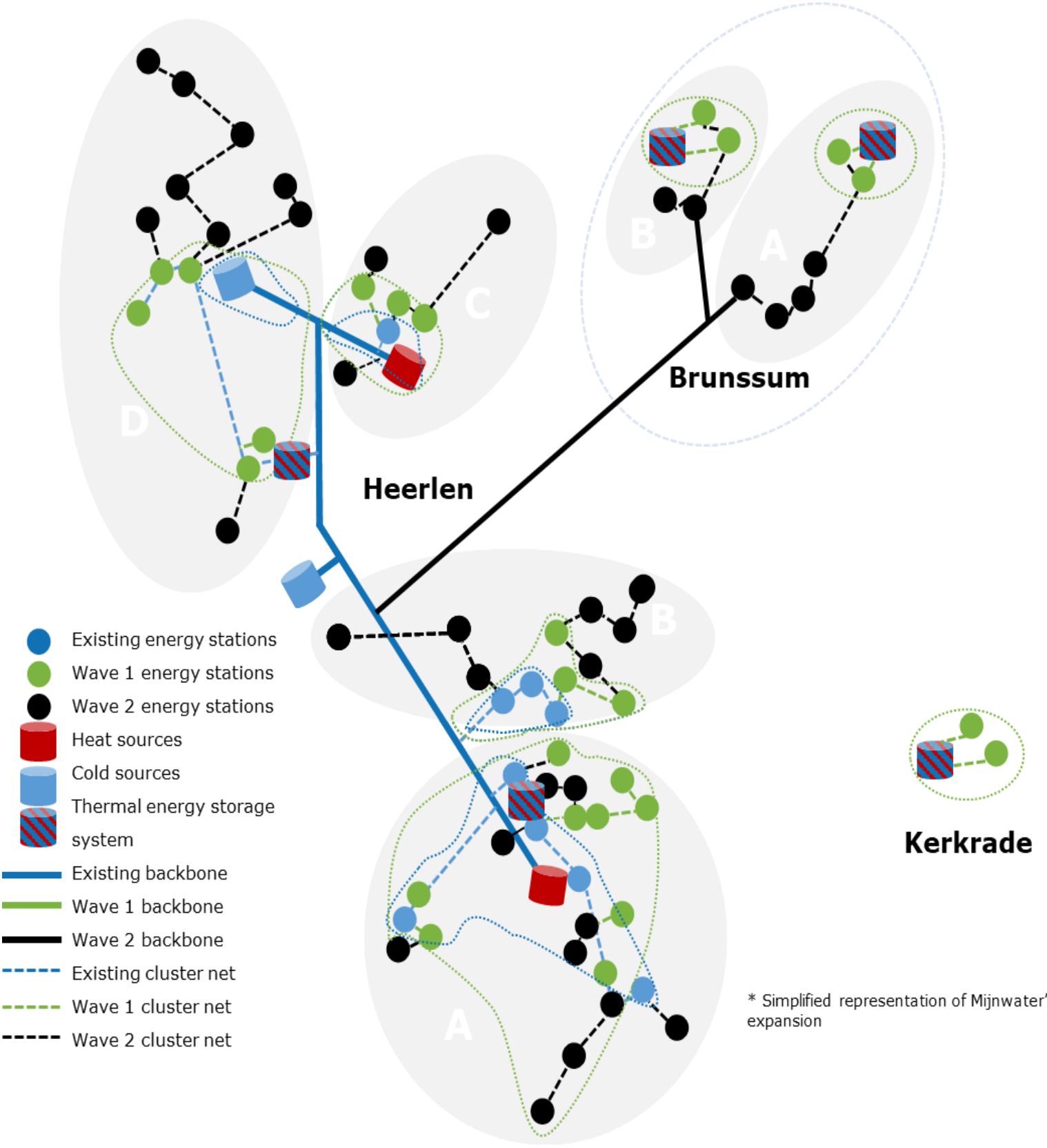
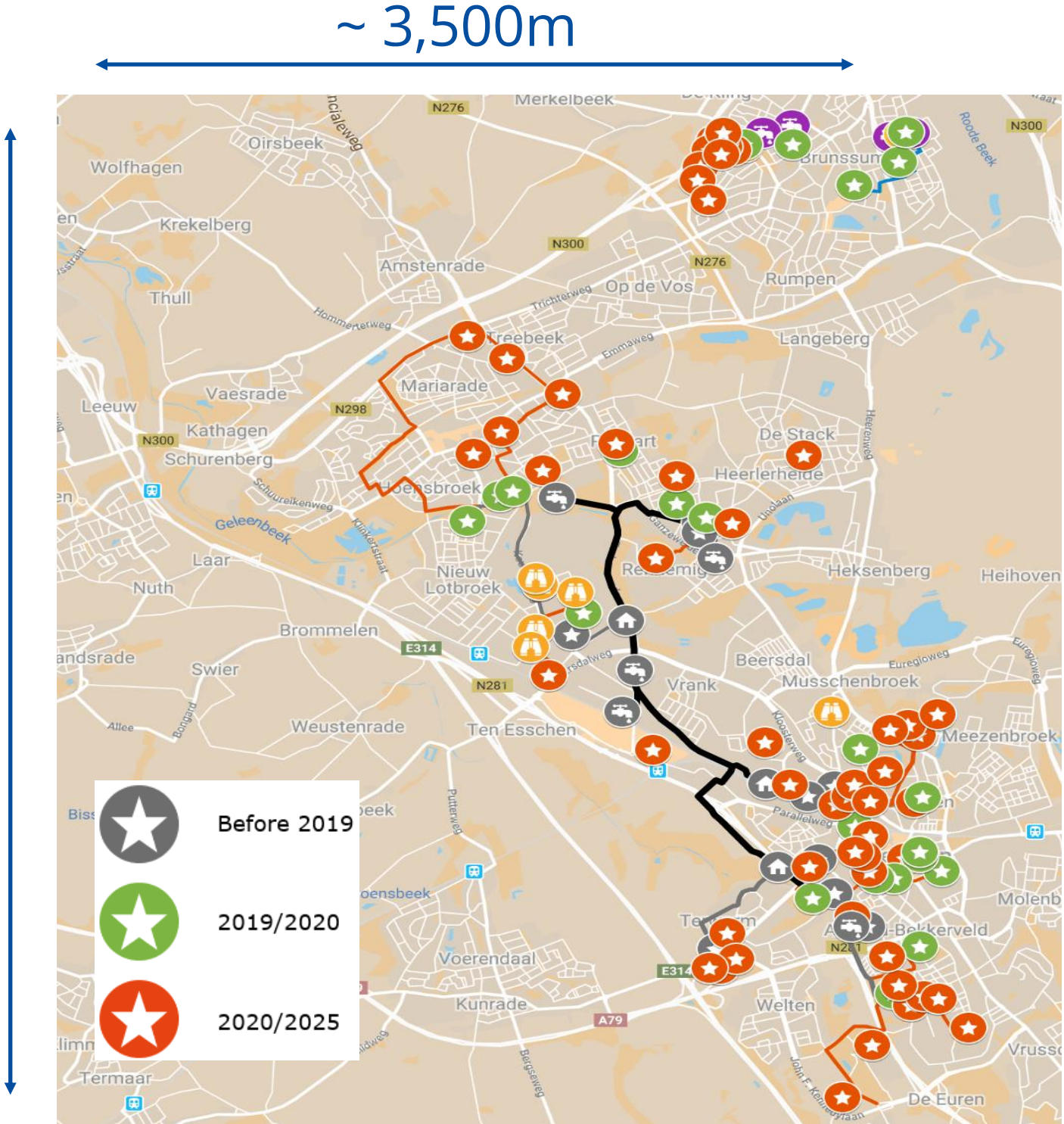
Shared services center

MINE WATER LONG TERM DEVELOPMENT



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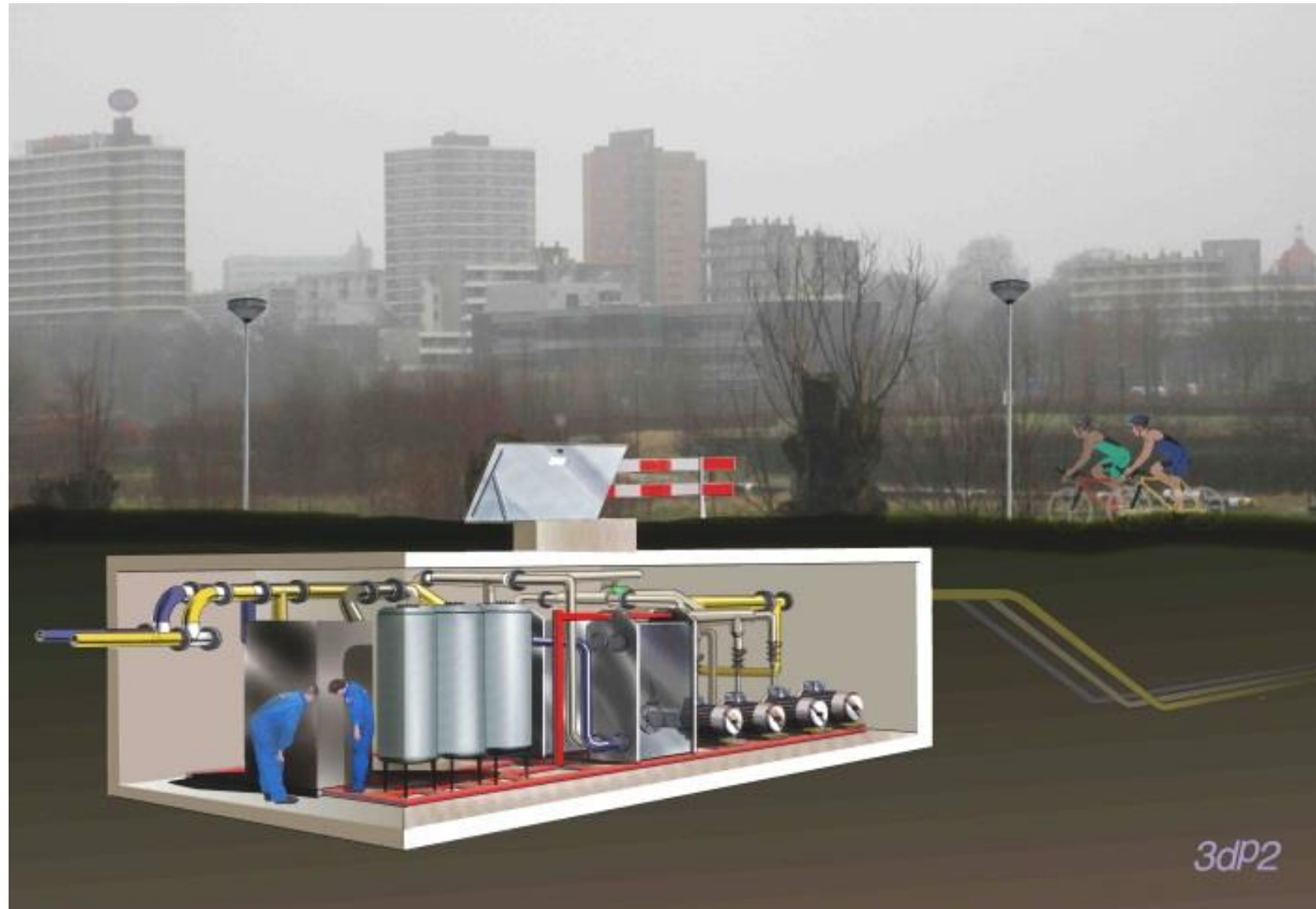
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* Simplified representation of Mijnwater's expansion

CLUSTER BASEMENTS

Energy exchange between cluster and mine water grid



PREFAB ENERGY EXCHANGE STATIONS



DECENTRALIZED POWER STATIONS



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TRESPASSING LOCAL BARRIERS

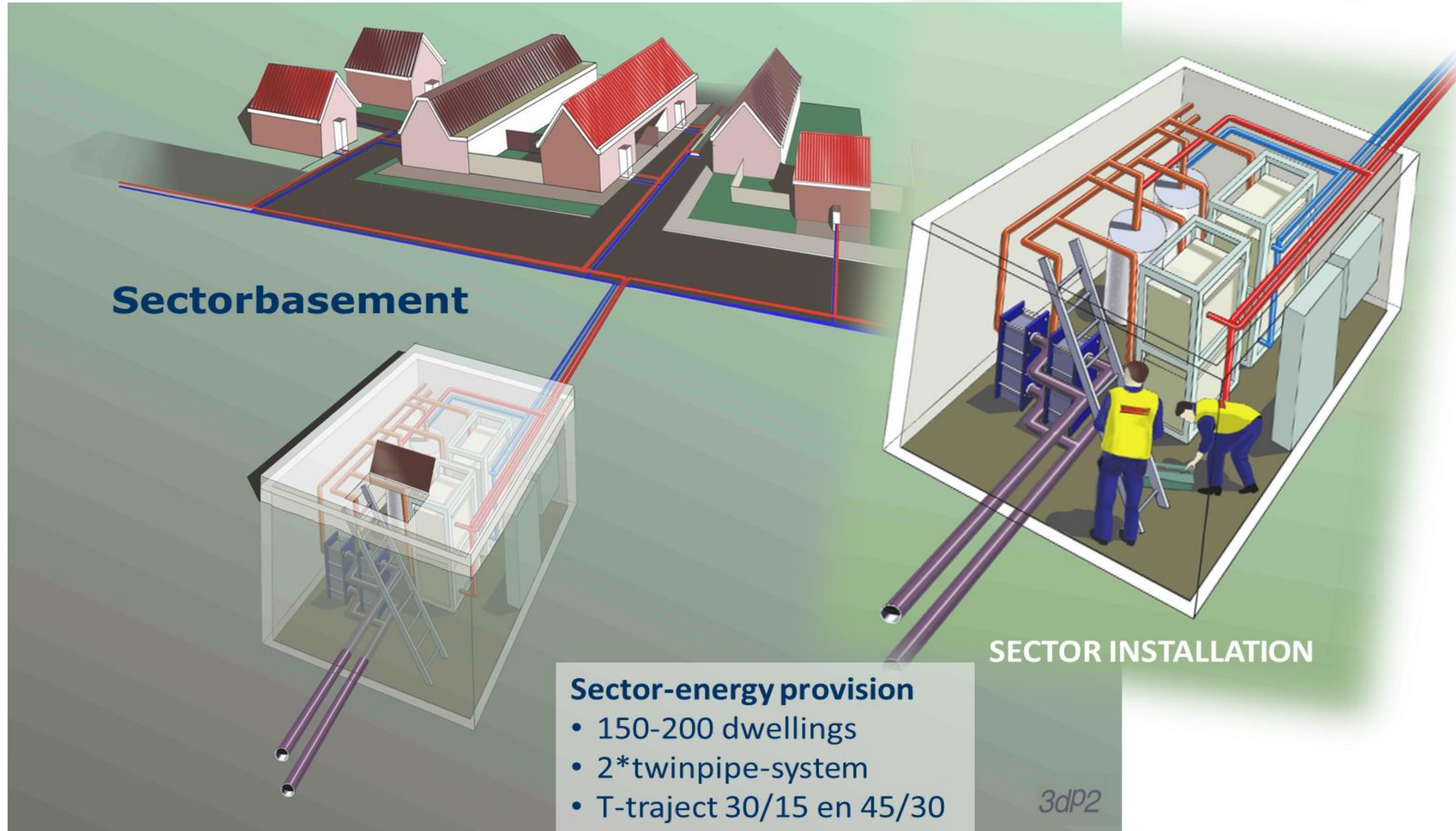


SECTOR NETWORKS



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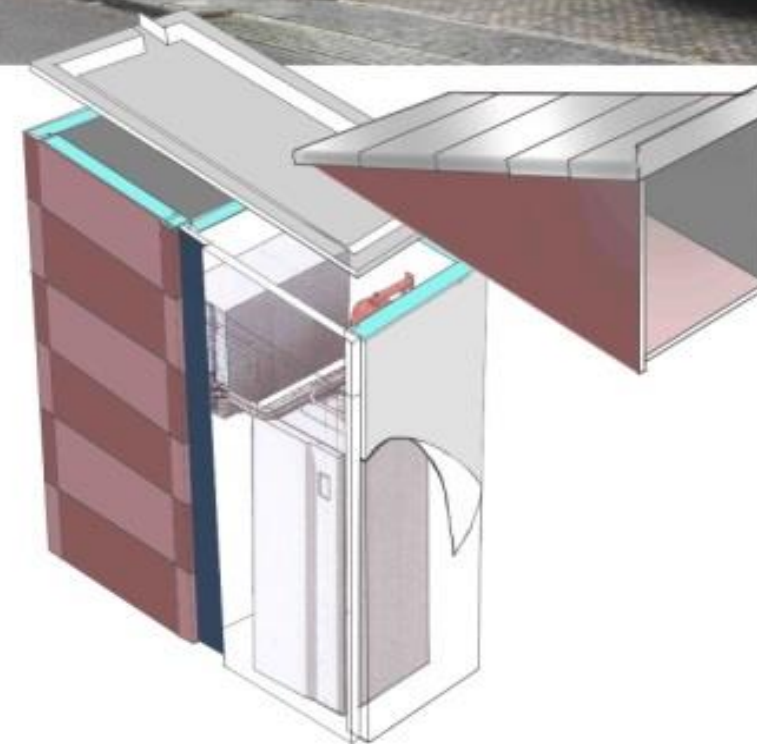


SECTOR NETWORKS



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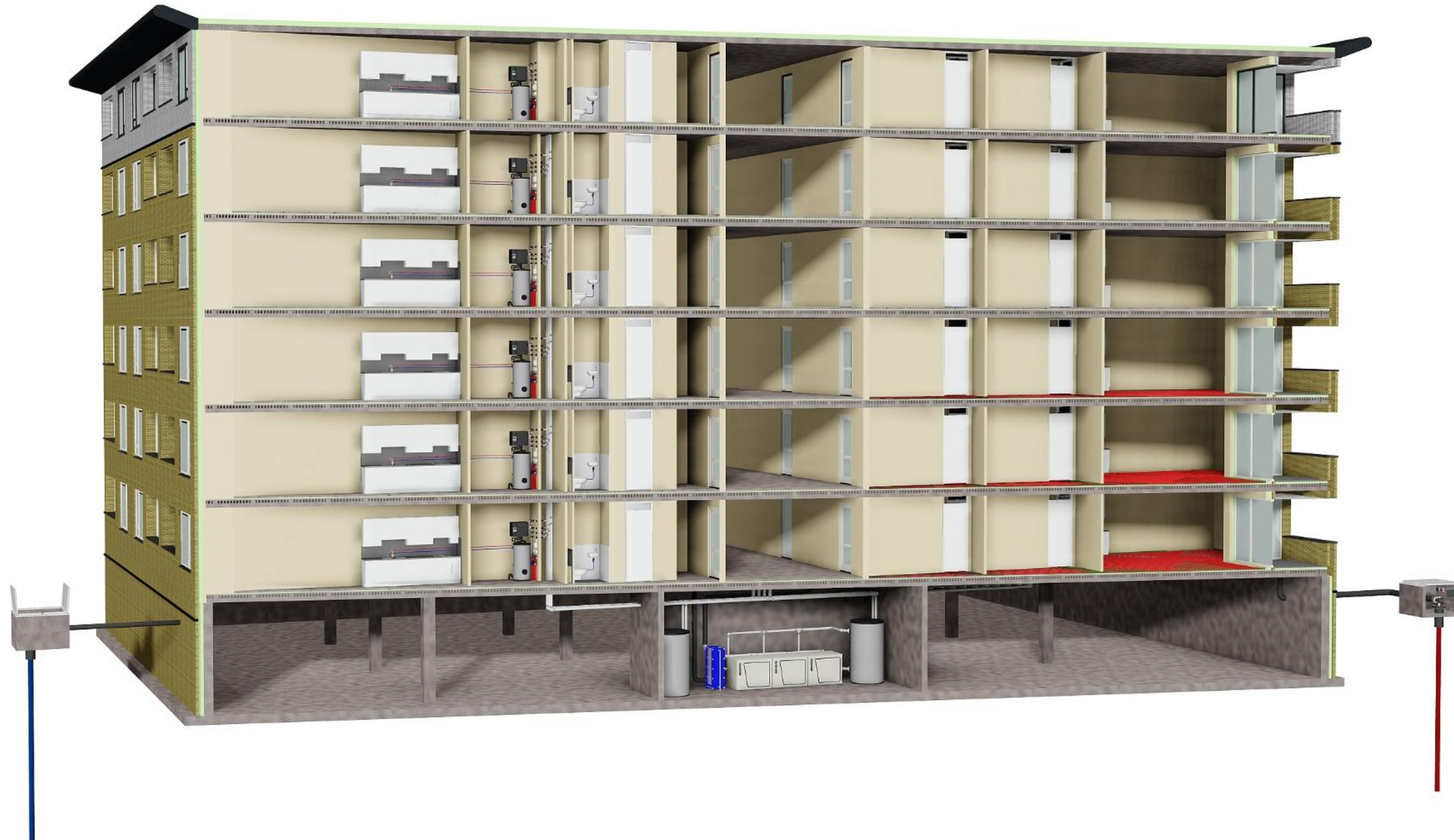
3dP2

APARTMENT BUILDING

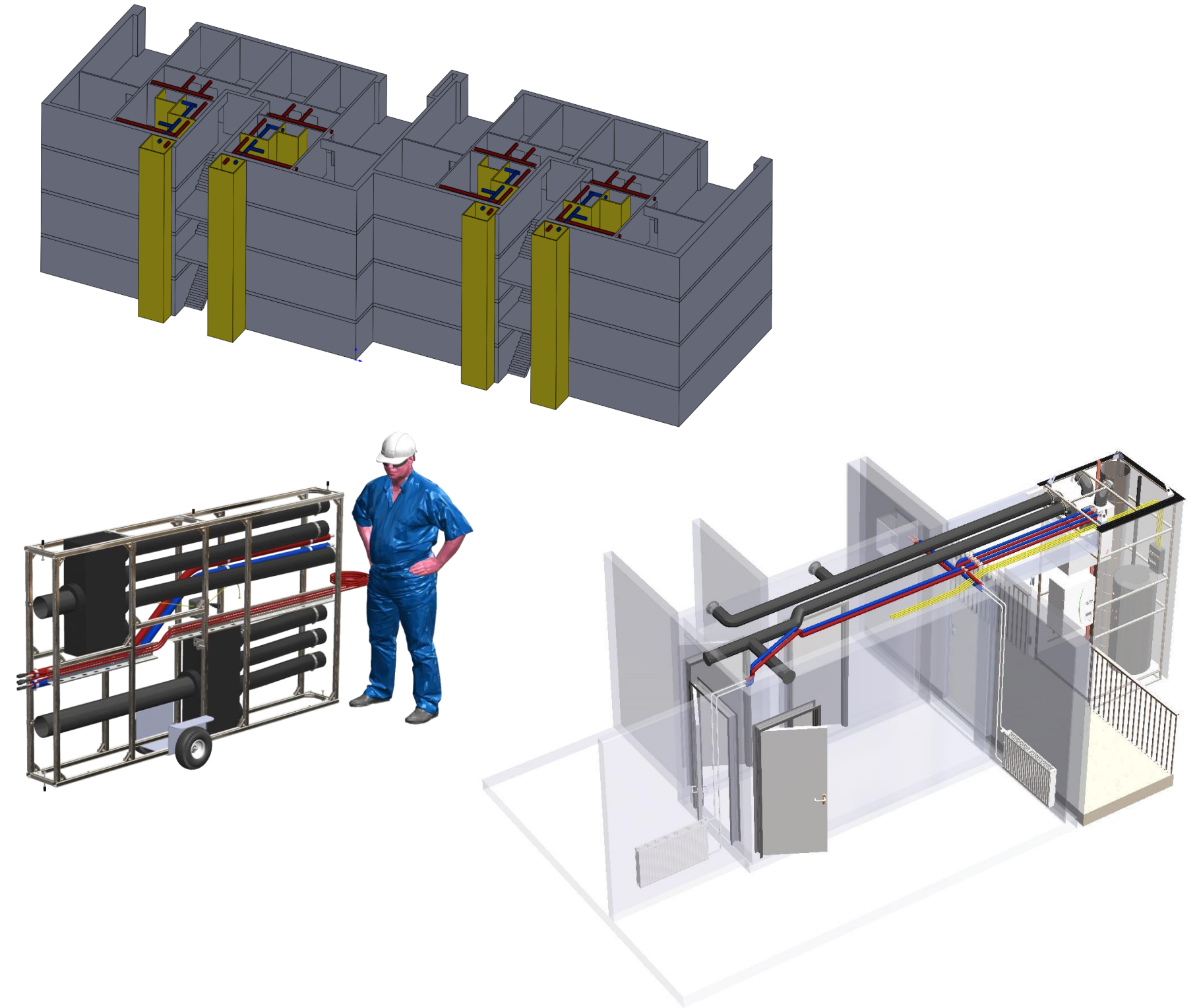


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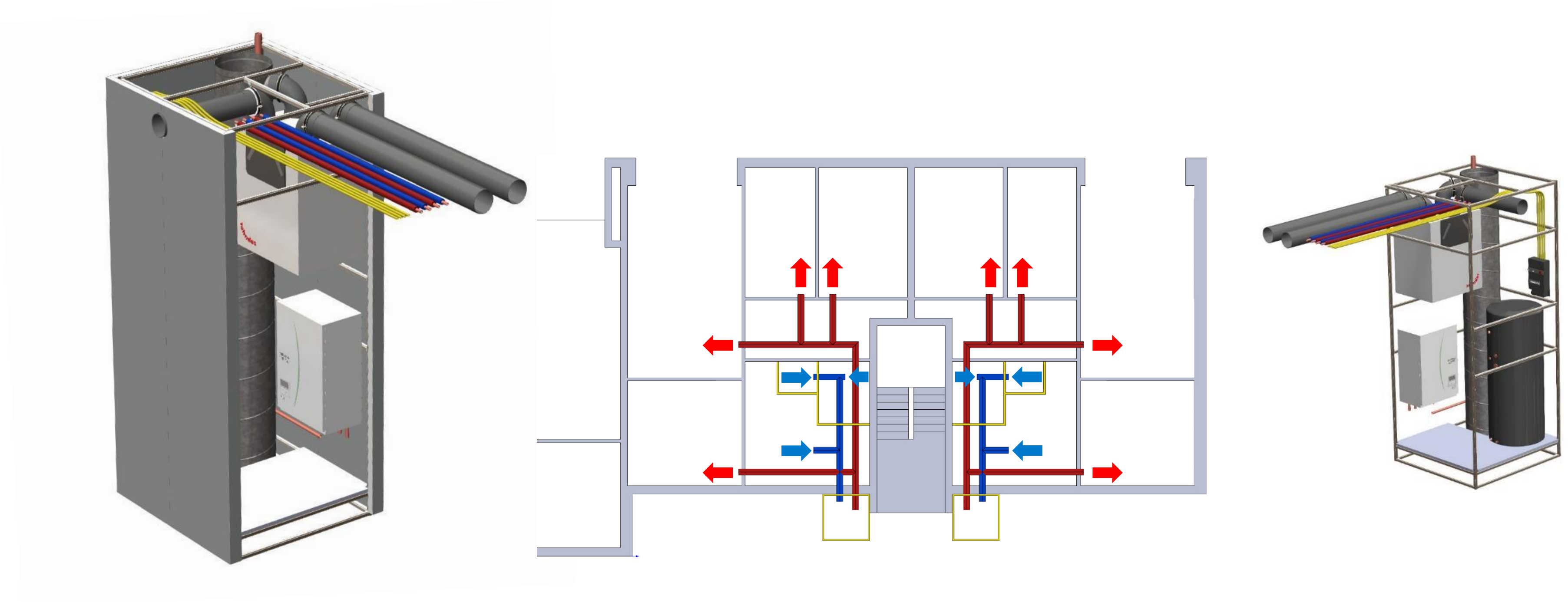
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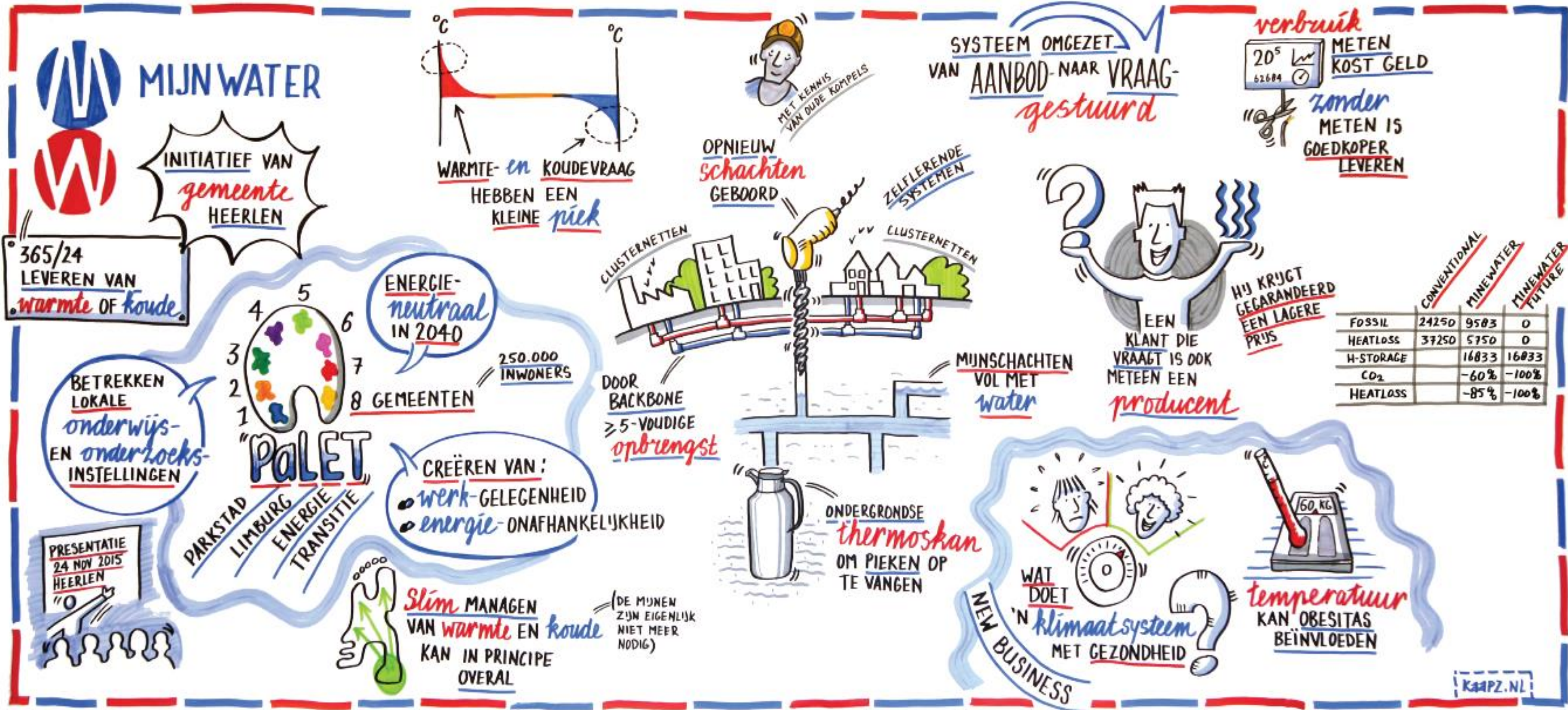


PREFAB CONNECTION MODULES



PLUG AND PLAY RENOVATION







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THANK YOU