Interreg North-West Europe D2Grids

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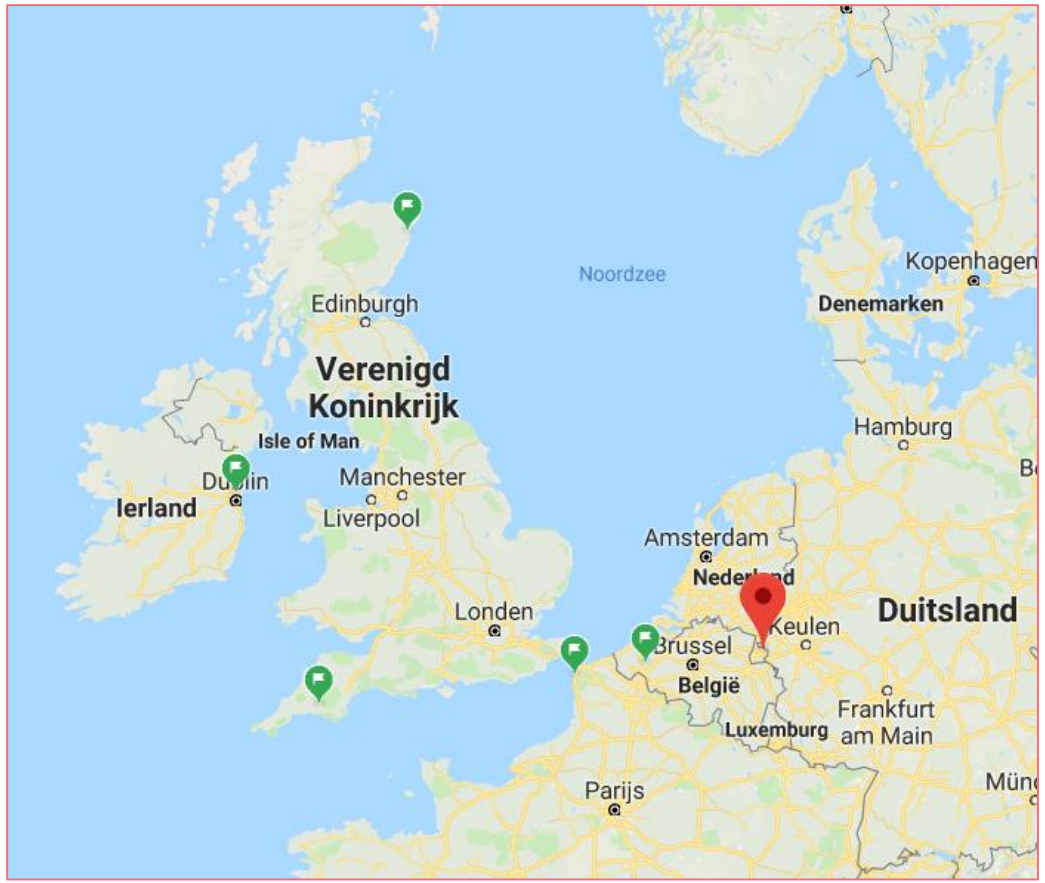

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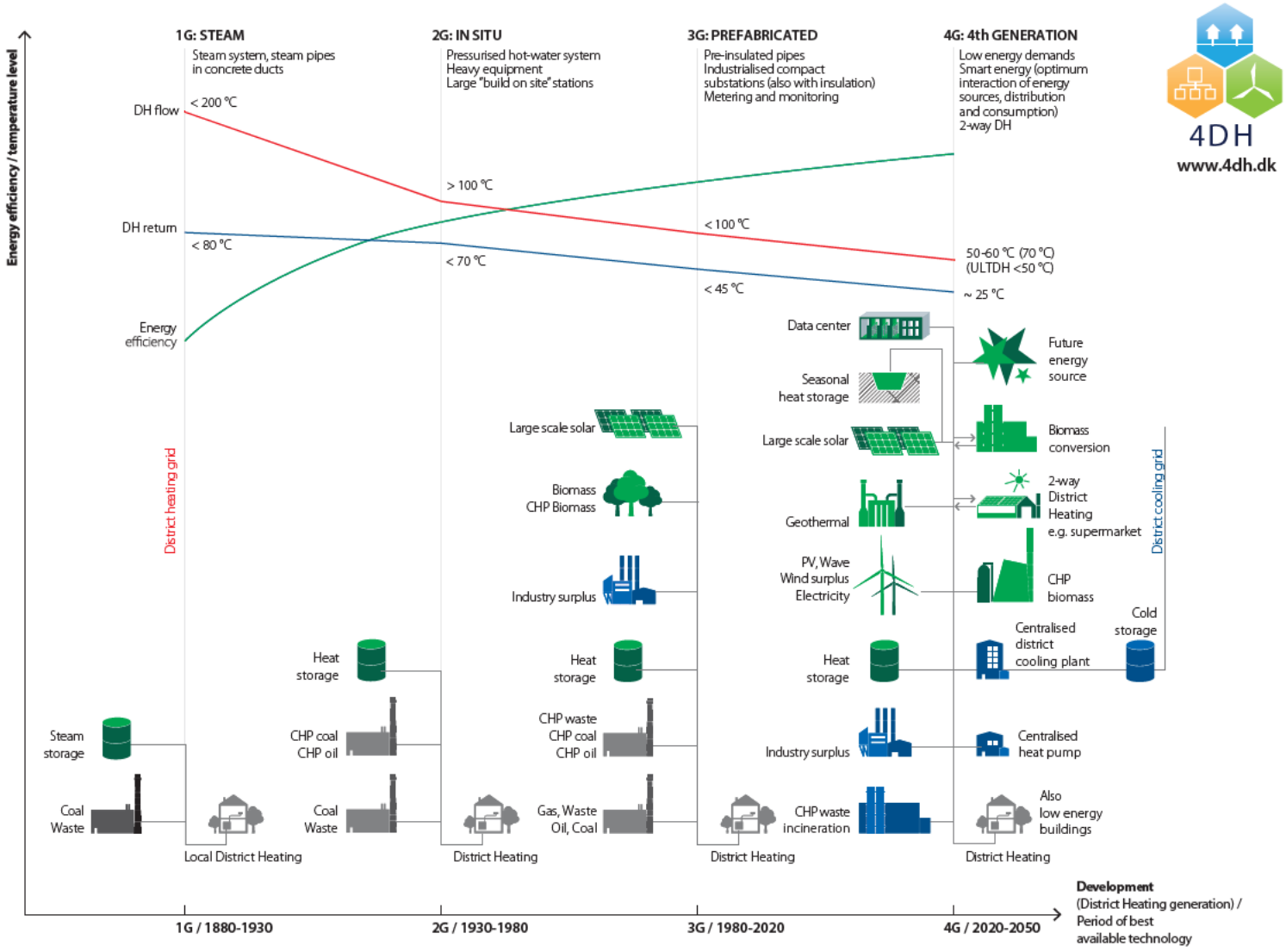
Interreg North-West Europe HeatNet NWE

OPZuid Europees Innovatieprogramma Zuid-Nederland

Life

Heating Grids Evolution



4DH
www.4dh.dk

We see in the development of grids a huge focus on central plants and generating energy in a greener way

which means:

- Dependant on weakest point in the grid
- Not flexible to enduser modifications
- 24/7 need for delivering heat 'at the front door' with large efficiency losses
- No cooling supply integrated

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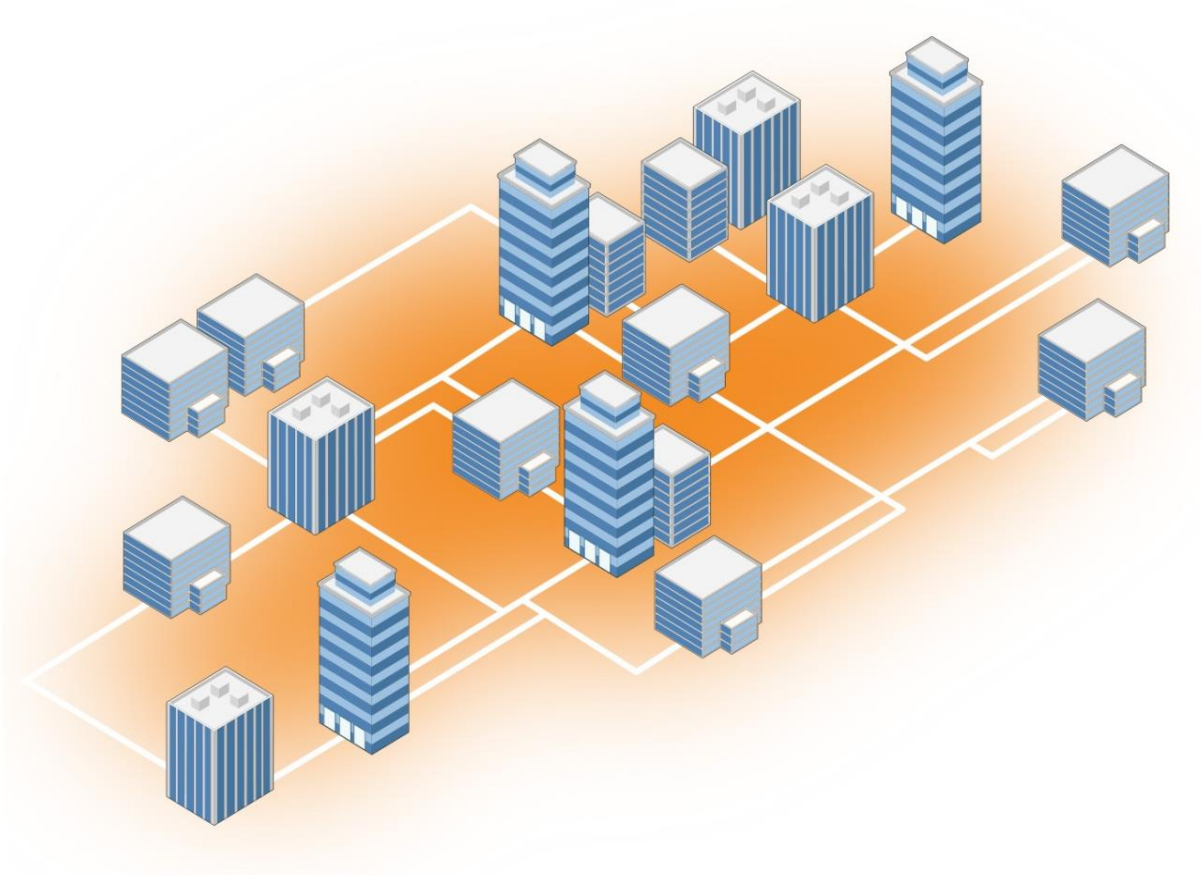
DECENTRALIZED NETWORK = CLOUD



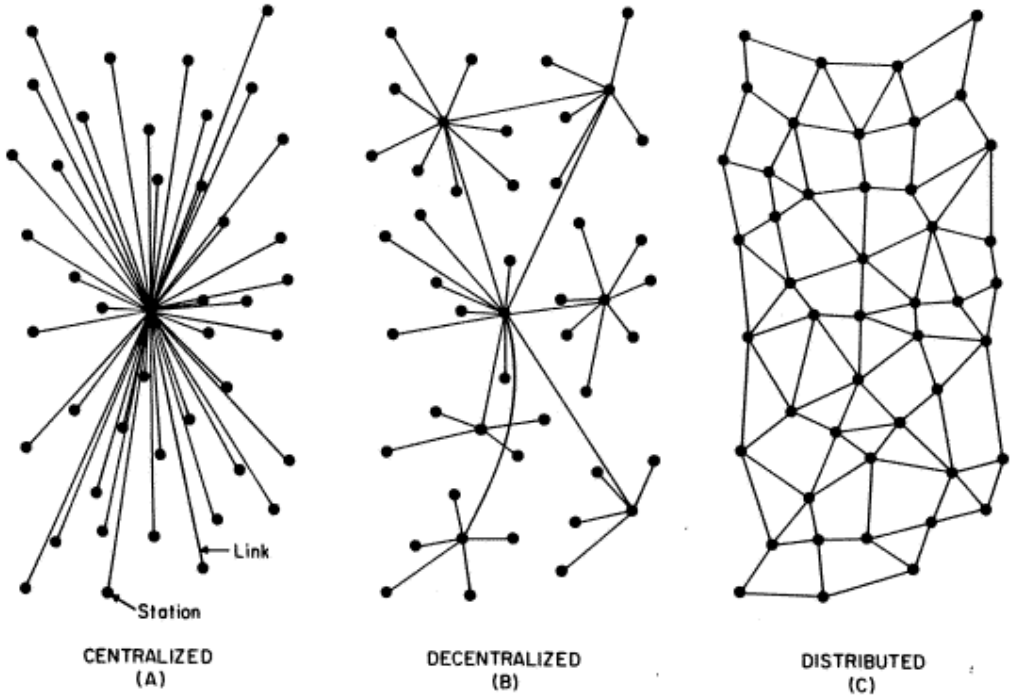


FIG. 1 — Centralized, Decentralized and Distributed Networks

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5GDHC concept in Heerlen

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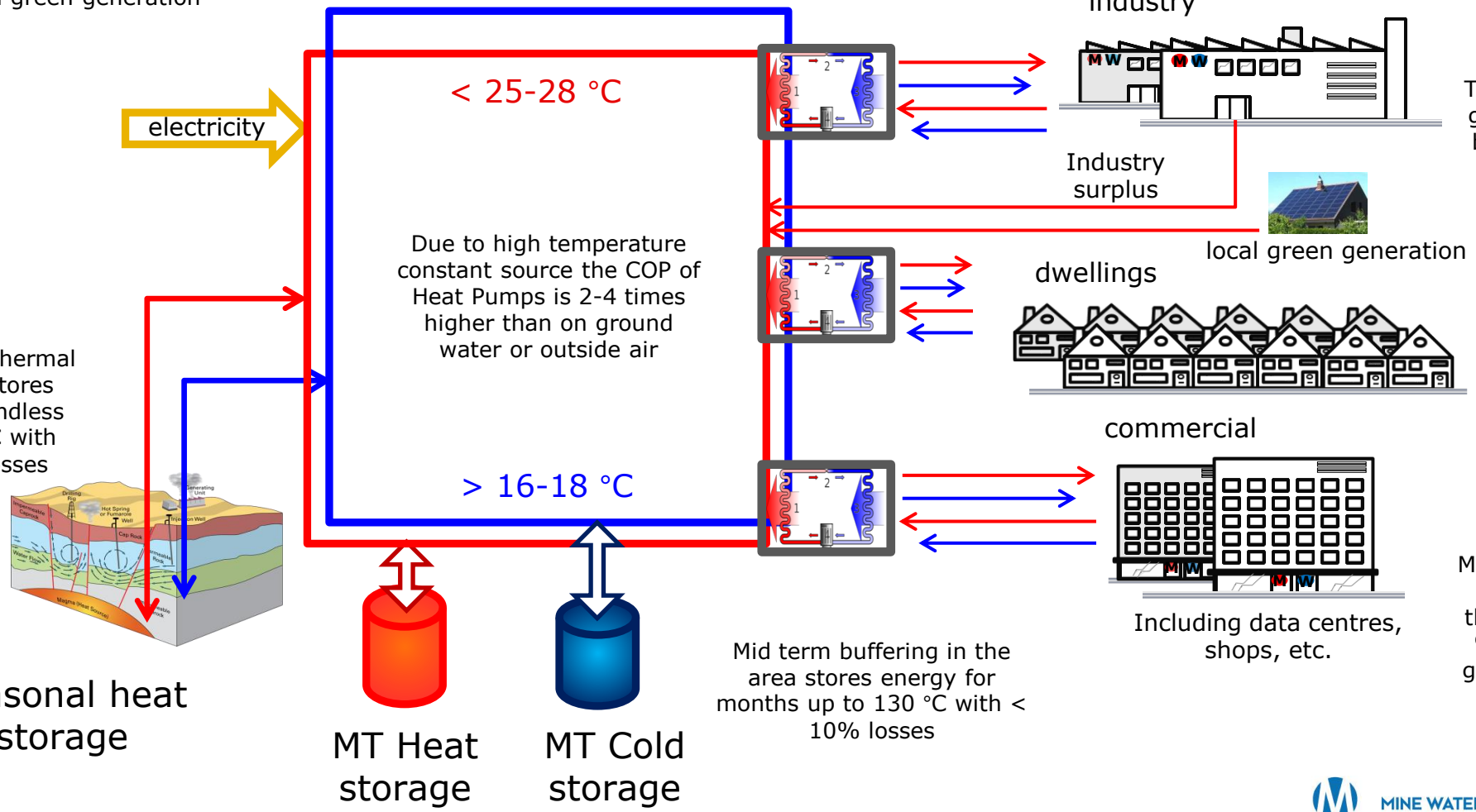
The only needed external energy is electricity (gasless solution) which can be derived from green generation

Due to low temperature grid gains from datacentres, greenhouses, solar collectors, etc. are utilisable leaving from 28 °C



The gains from green generation are 10 % better utilisable due to sharing between mutiple users

Shallow geothermal buffering stores energy unendless up to 30 °C with minimal losses

Mid term buffering in the area stores energy for months up to 130 °C with < 10% losses

Modern buildings need 35 % cooling energy (in thermal flow) against 65 % heating energy. The grid enables exchange of these flows in time.

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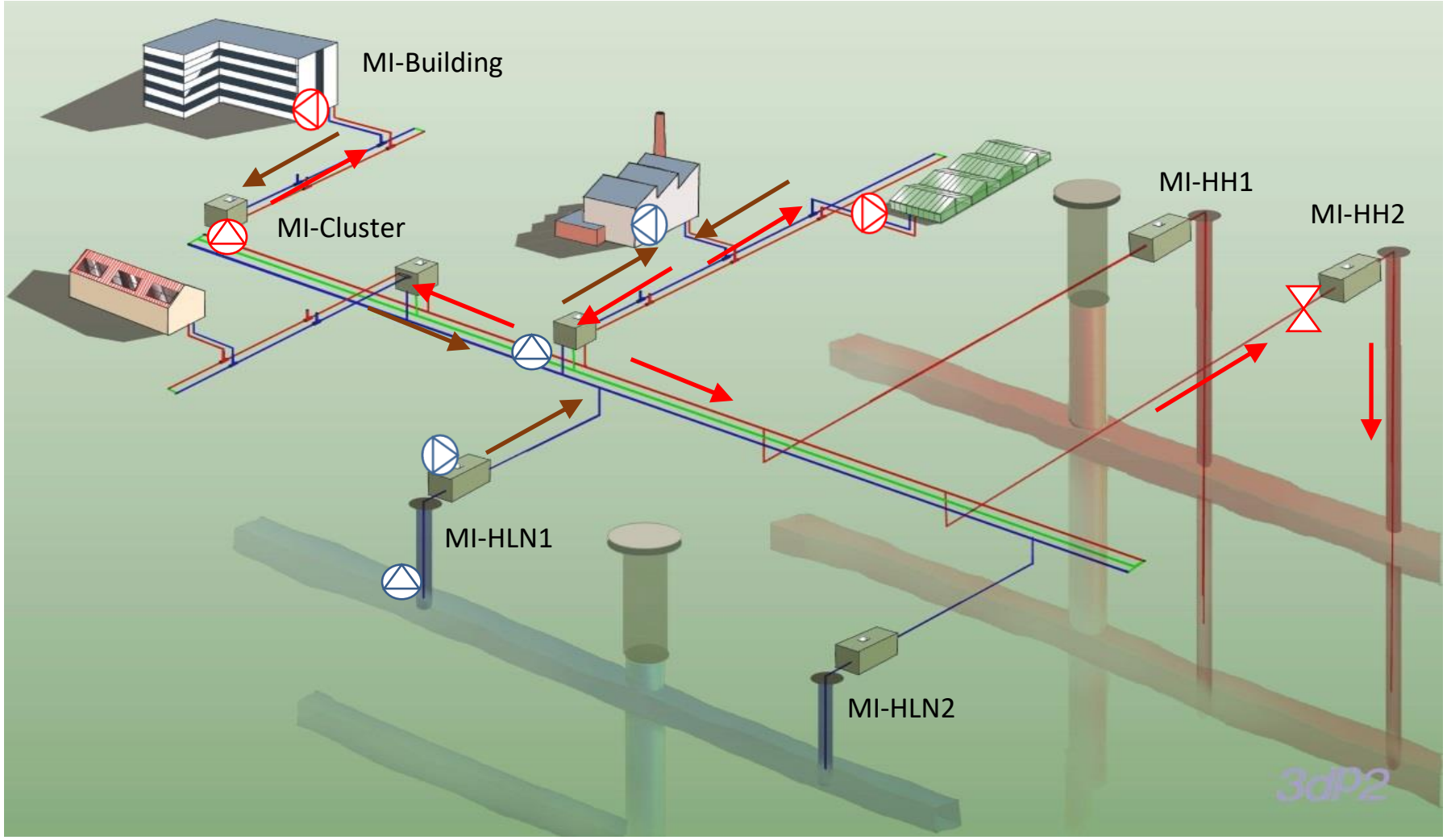
Decentral demand driven twin pipe system



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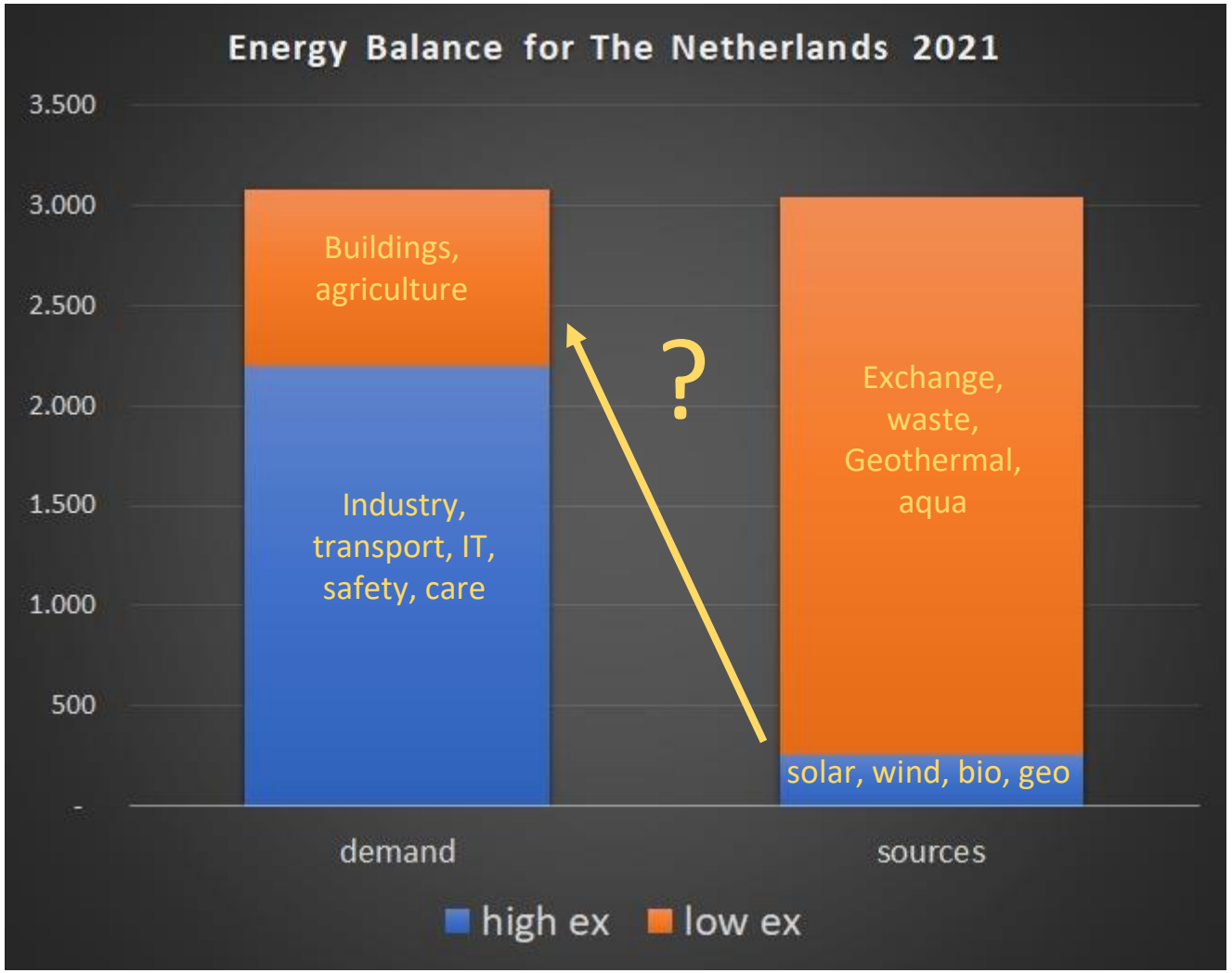
High and low graded energy



- We can distinguish high graded and low graded energy
- All fossils are (very) high graded
- High grade green sources are limited, because of spatial restrictions, timing, costs, time, raw materials ??
- Huge availability of low graded waste heat and low graded sources
- A limited share of demand can be supported by low grade

About 25% of the total energy demand is low-value energy (to be fed with exchange, residual heat, waste heat), the remainder is high-quality energy

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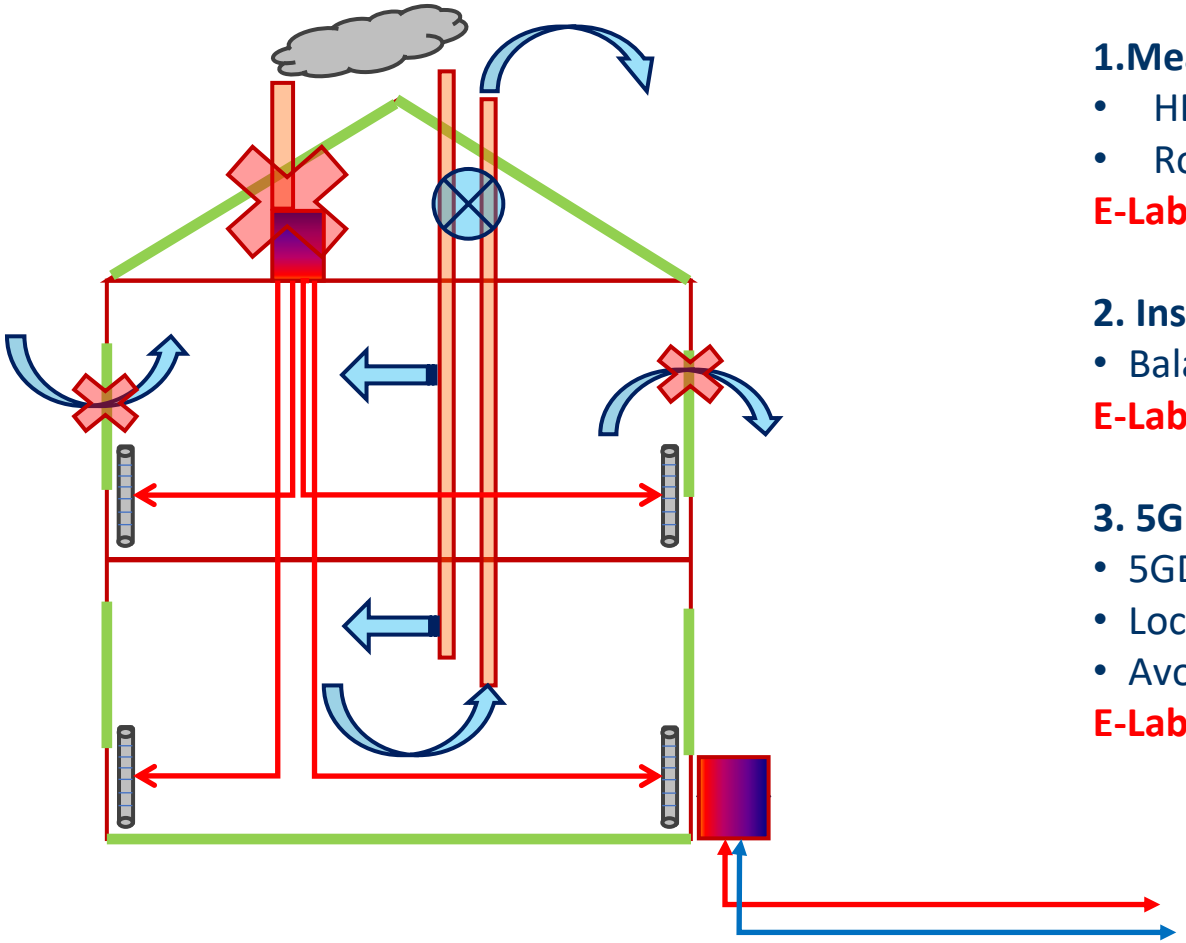
Housing renovation approach



1.Measures building envelope

- HE++ glazing € 5.000,-
- Roof/underfloorinsulation € 4.000,-

E-Label F -> C; $T_{radiators}$ 90 -> 70 ºC

2. Installations

- Balanced venting with HR € 5.000,-

E-Label C -> A; $T_{radiators}$ 70 -> 50 ºC

3. 5GDHC-Grid connection

- 5GDHC grid € 15.000,-
- Local heatpump € 5.000,-
- Avoided costs gas boiler - € 2.500,-

E-Label A -> energy neutral (A^{++++})

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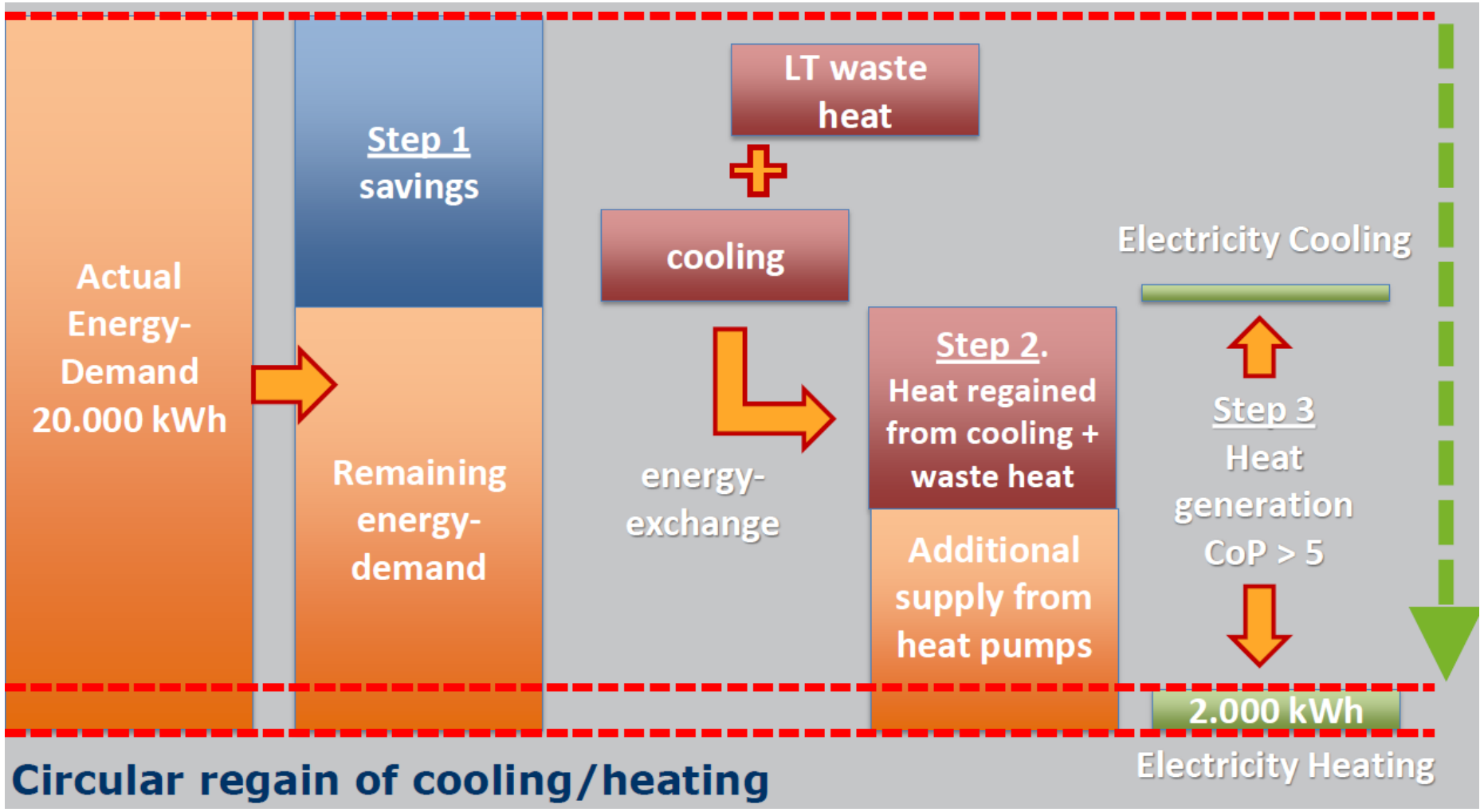
Urban Energy Concept



- 90% energy demand reduction potential via circular use & reuse and high-efficiency
- Especially advantageous for high-density, urban areas
  - 2,000 kWh= 10 PV panels

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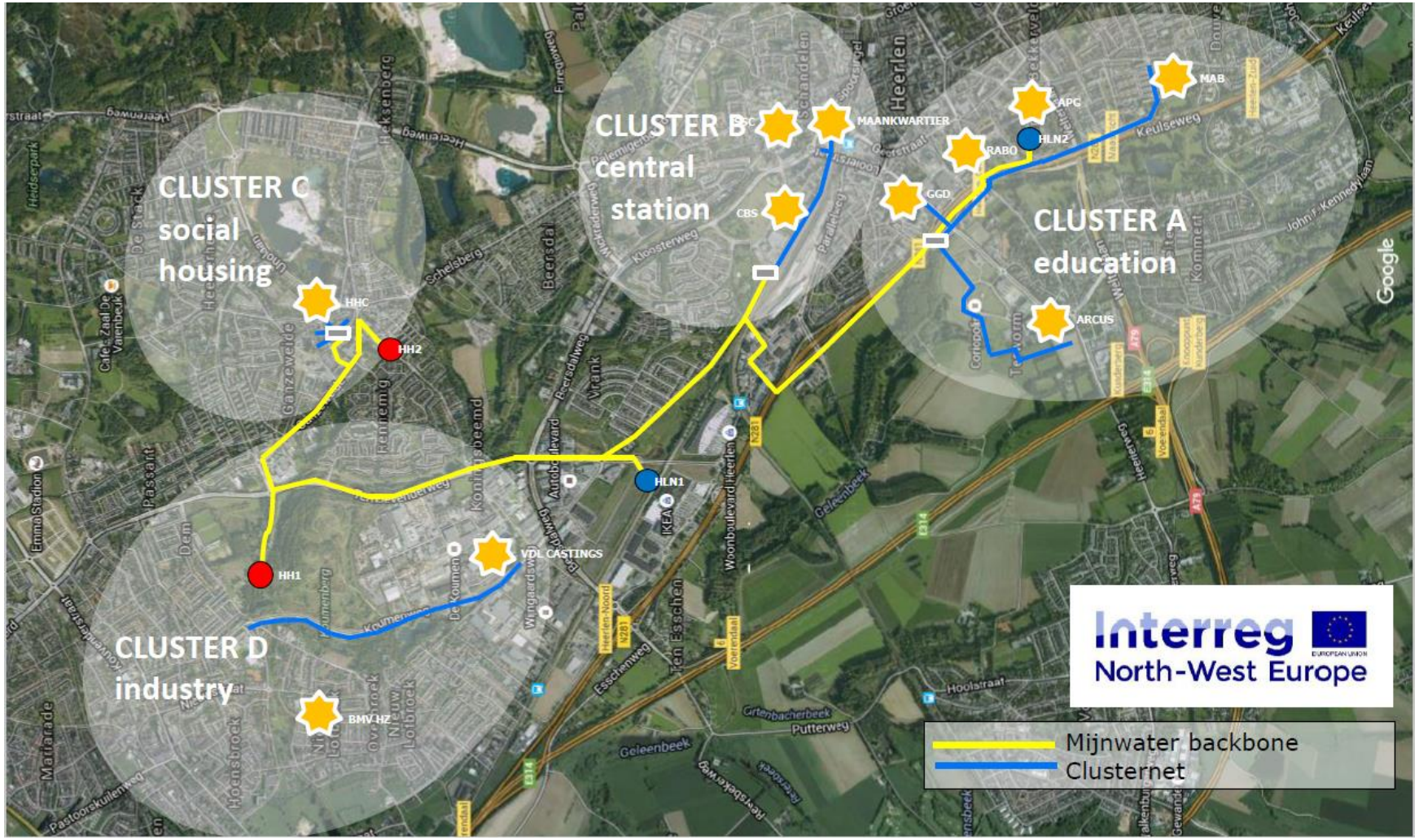
Actual grid layout Heerlen



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Mijnwater 5GDHC connected

- Central Station
- Offices
- Supermarket
- Parking
- 100 dwellings
- Hotel

50.000 m² multifunctional development in the centre of Heerlen

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Prefabicated energy exchange stations

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Decentral energy substations

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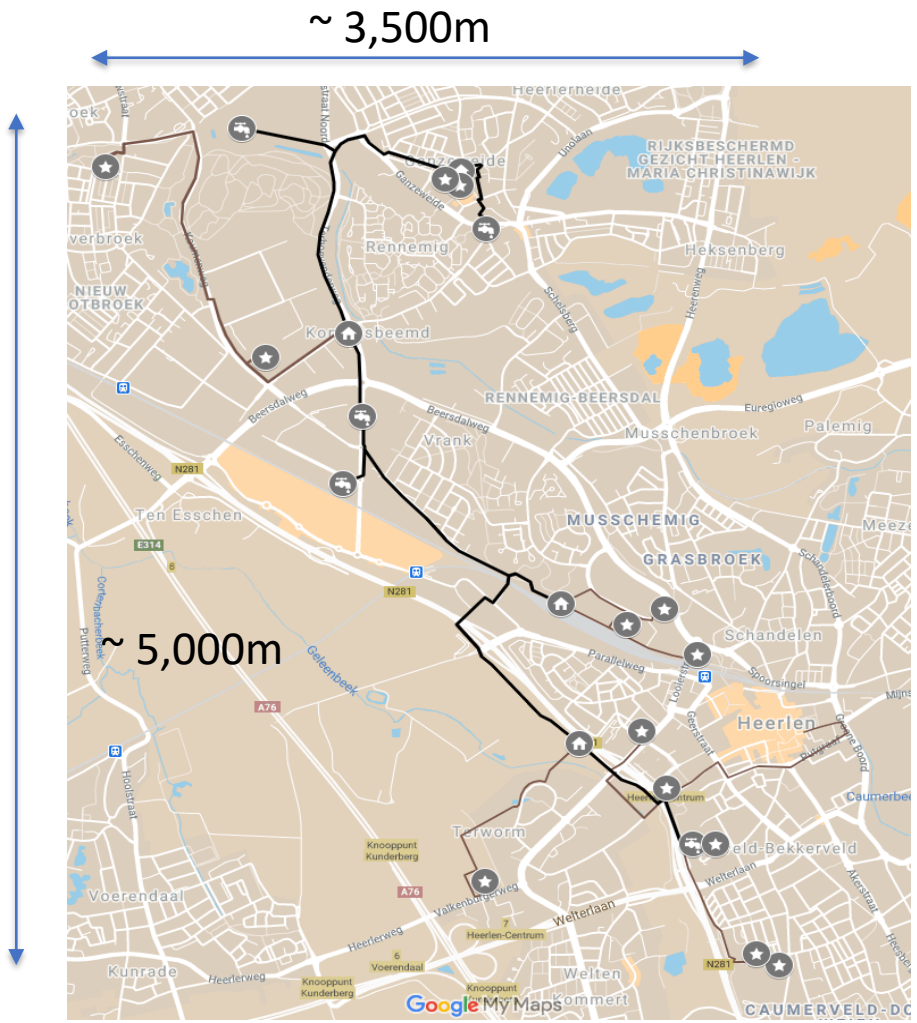
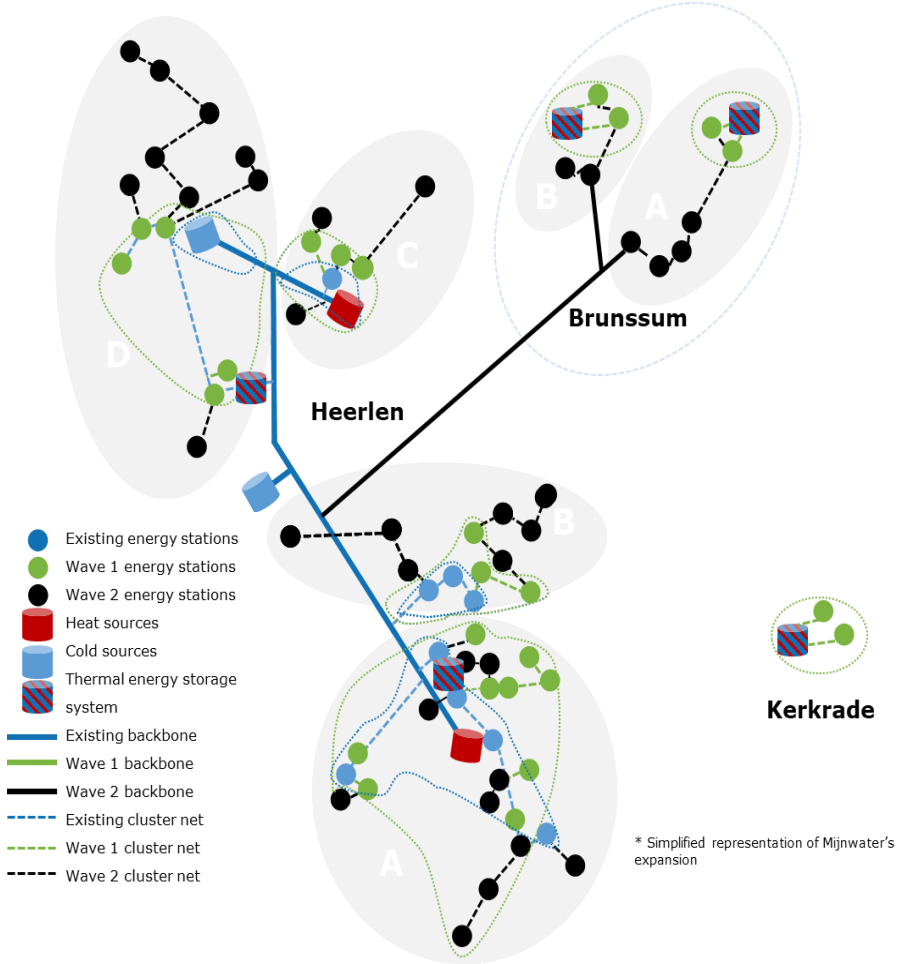
Mijnwater LT developments





Investment portfolio of M€ 300 = 15.000 dwellings

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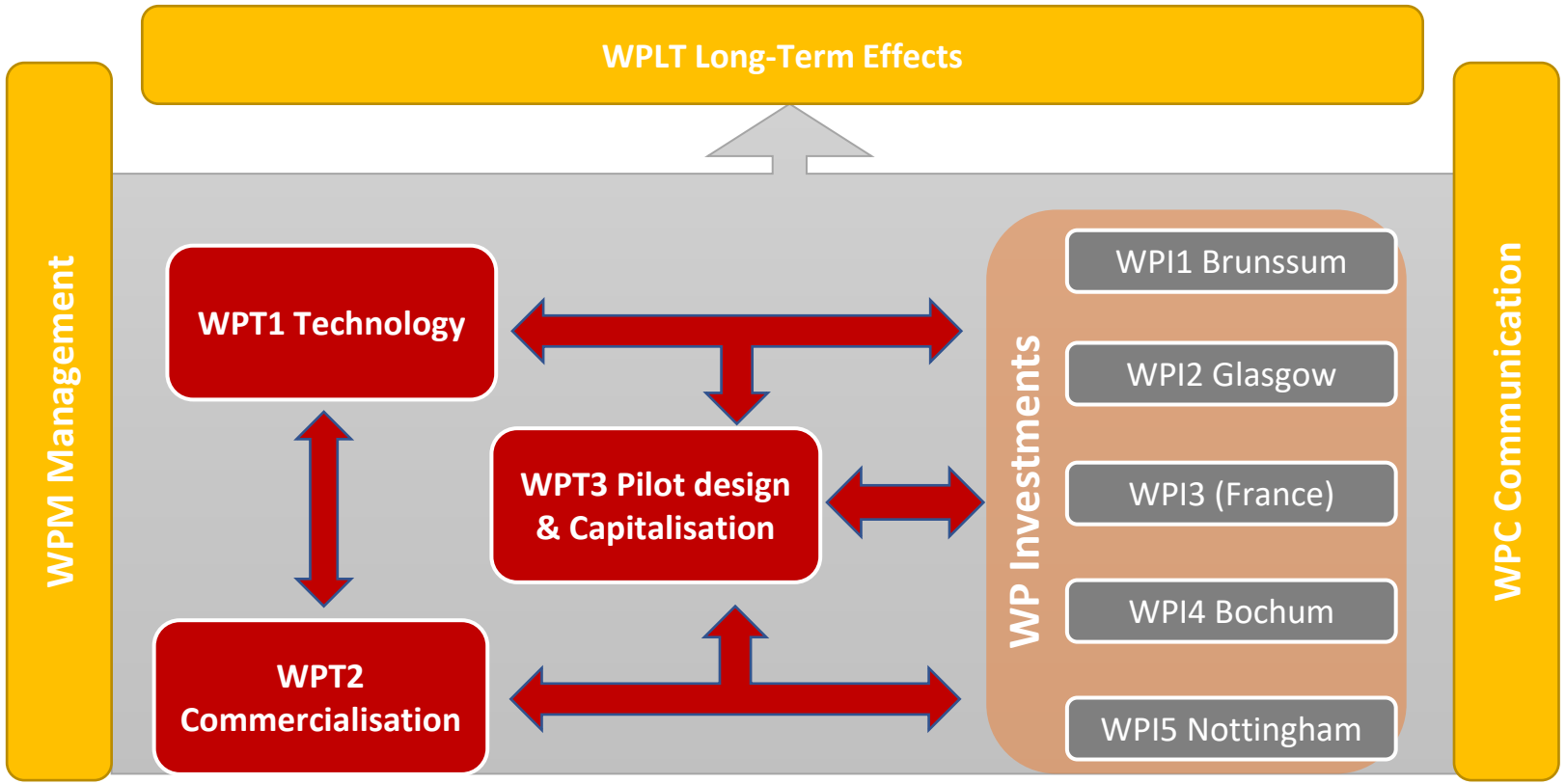
Interreg-NWE D2Grids Project

Budget M€ 24,0 EDRF M€ 14,4



Increasing the share of renewable energy by accelerating the roll-out of demand-driven smart grids delivering low temperature heating and cooling to NWE cities https://5gdhc.eu/

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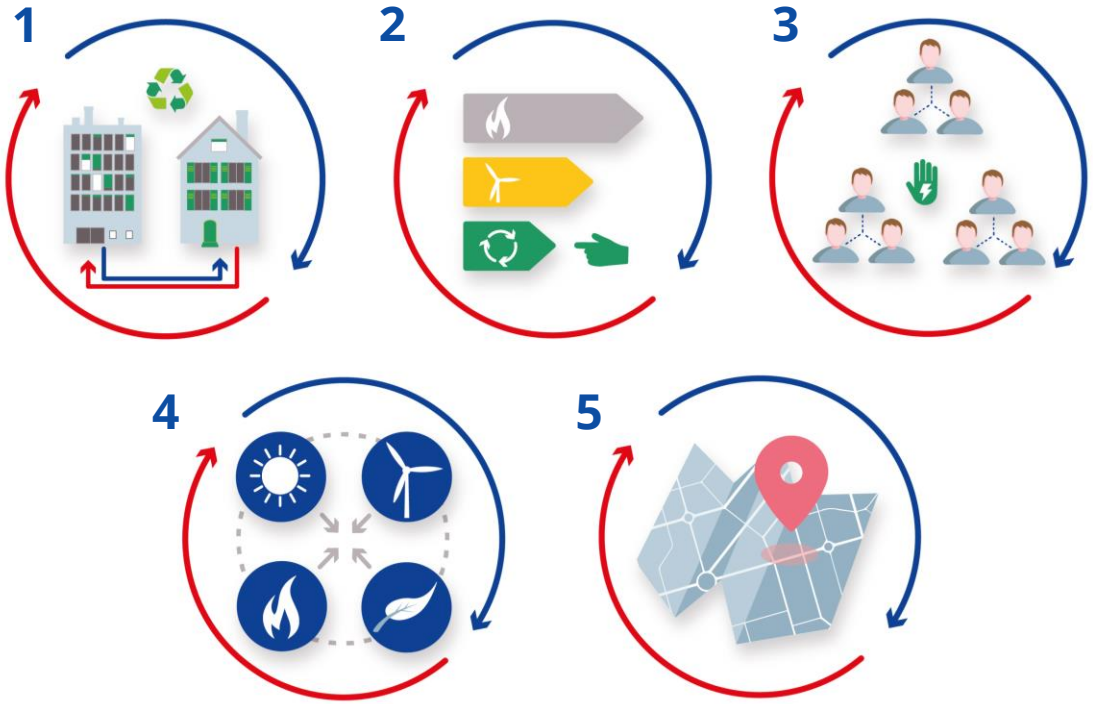
Definition 5GDHC principles

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 first at the scale of the building, then within the neighborhood and finally at the city level.

2/ Using low-grade sources for low-grade demand
In 5GDHC we match the supply with the requested qualitylevel 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.

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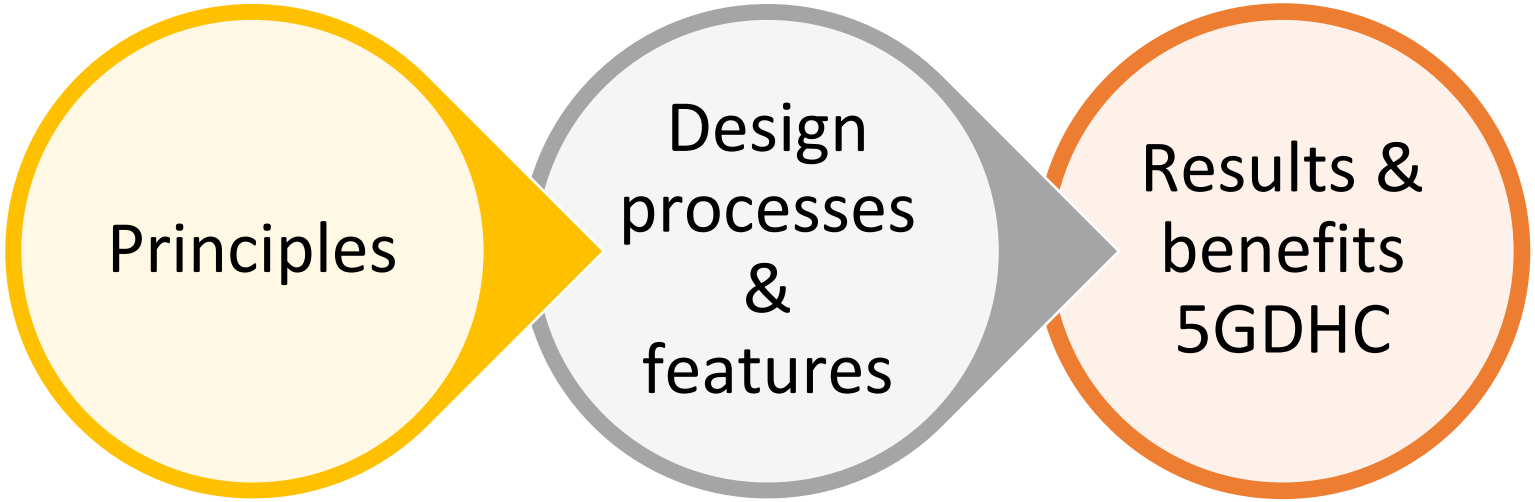
Why <u>principles</u> and not key defining features (like technologies) ?



1. It is easy to find consensus on the principles, e.g. "this is the right thing to do"
2. The principles give a easy approach for discussing solutions o a high level

- Principles do not stand alone; completed by system boundaries and assessment criteria (KPI's)
- Principles give flexibility to let 5GDHC concept adapt to future tech innovations & optimizations
- Principles show what the *results* can be by implementing certain design processes and features

5GDHC assesment

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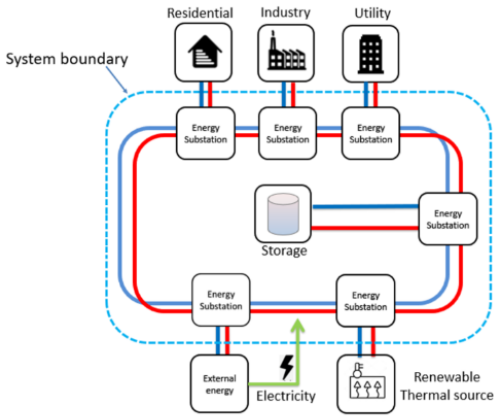
Principles

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

- Eext = f(Eref) ..... 100% ..... 20% ..... -10%
- Etot = a*Ehh + b*Eh + c*E0 + ... k*Ell
- Eext = f(D=0)
- E,ext,peak = f(Eaverage)
- Etot = a*E10km +b*E50km + c*E250km +d*Eglobal

Improvement options

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

weighfactor

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

5gDHC label

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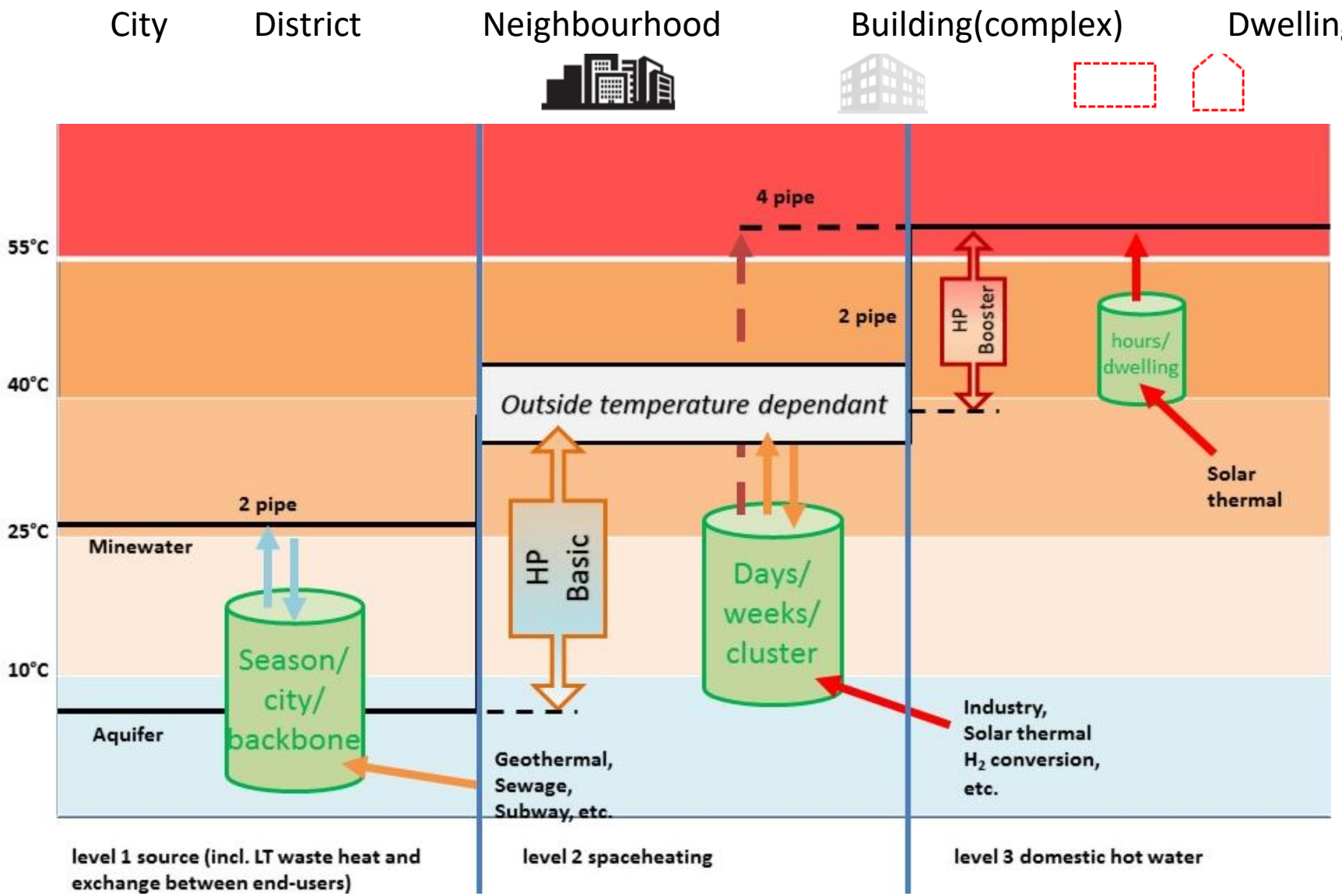
MULTI SOURCE, MULTI LEVEL STORAGE SYSTEM



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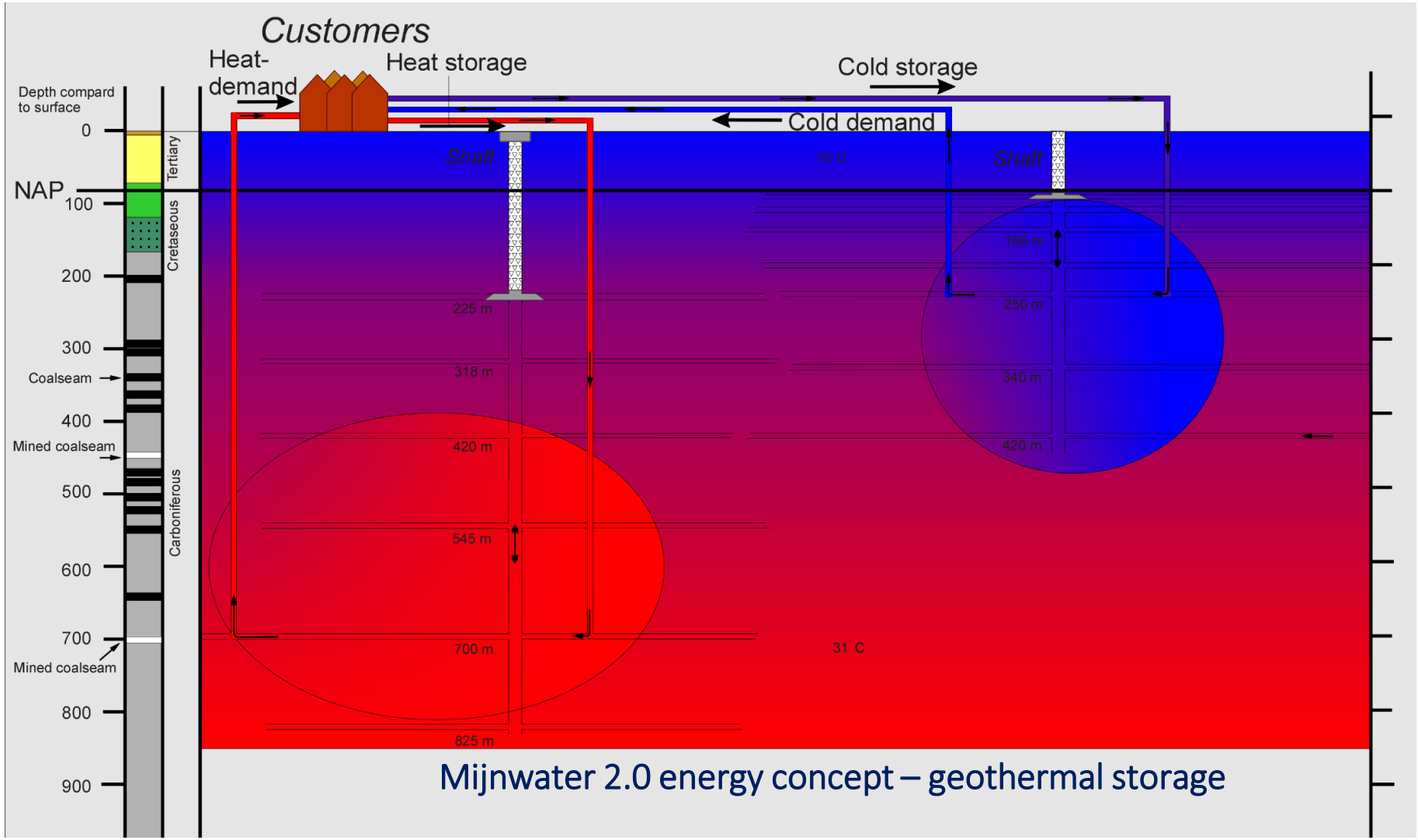
Use of geothermal sources and storage



Mijnwater 2.0 energy concept – geothermal storage

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Background of the project

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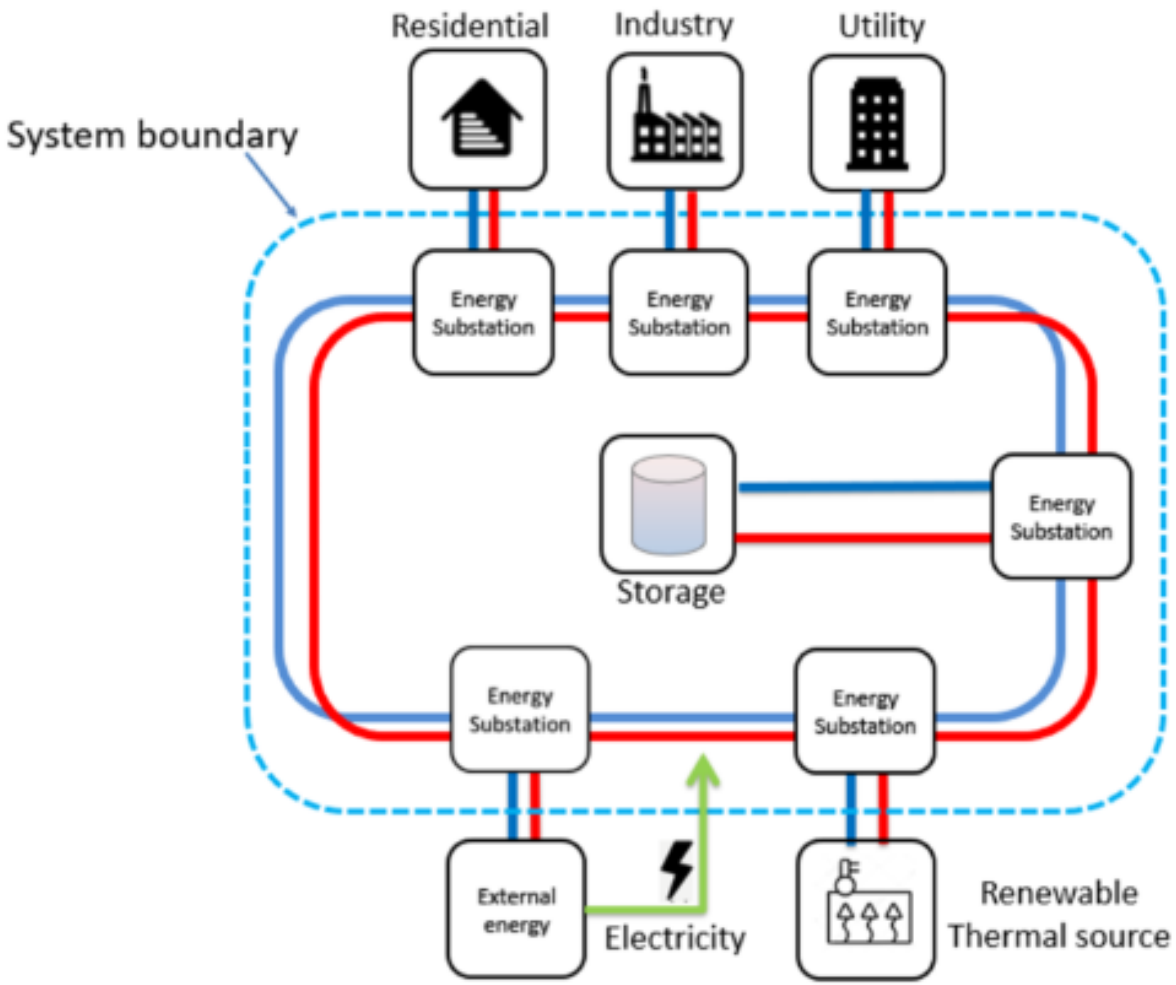
- Mijnwater B.V.'s „**prototype system" in Heerlen**
  - ✓ Access to low-temperature geothermal heat + Integration of waste-heat
  - ✓ Warm & cold storage in flooded mineshafts
  - ✓ Connecting buildings / clusters of buildings via a distributed grid

- Principles of **5th generation district heating and cooling** (5GDHC) have been formulated
  - ✓ 1) low exergy grid utilizing low temperature heat sources;
  - ✓ 2) closed thermal energy loops ensuring hot and cold exchange among clusters of buildings;
  - ✓ 3) ensuring integration and synergy between thermal and electricity grids

System Boundary thermal



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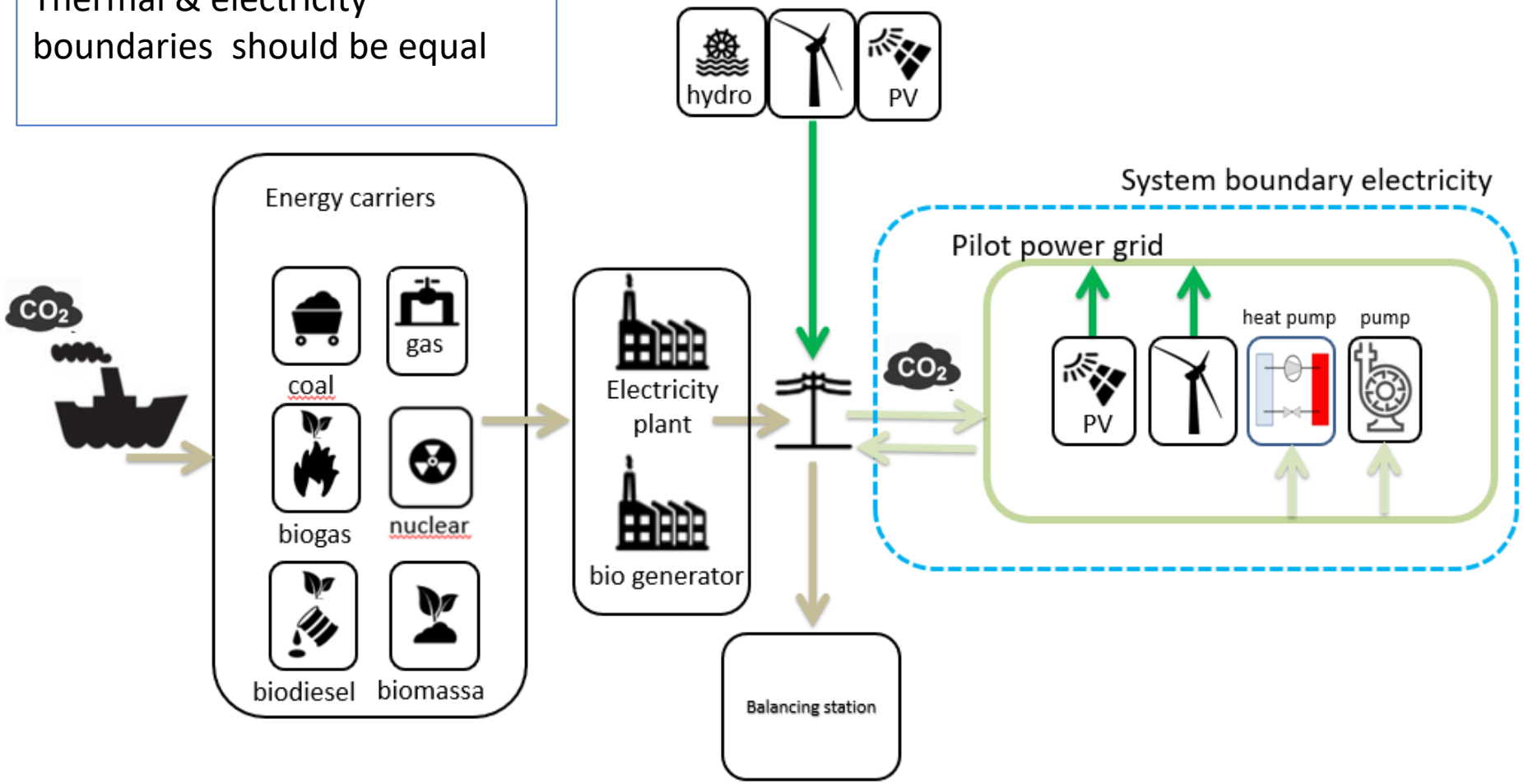
System Boundaries electricity/CO_2

Thermal & electricity boundaries should be equal



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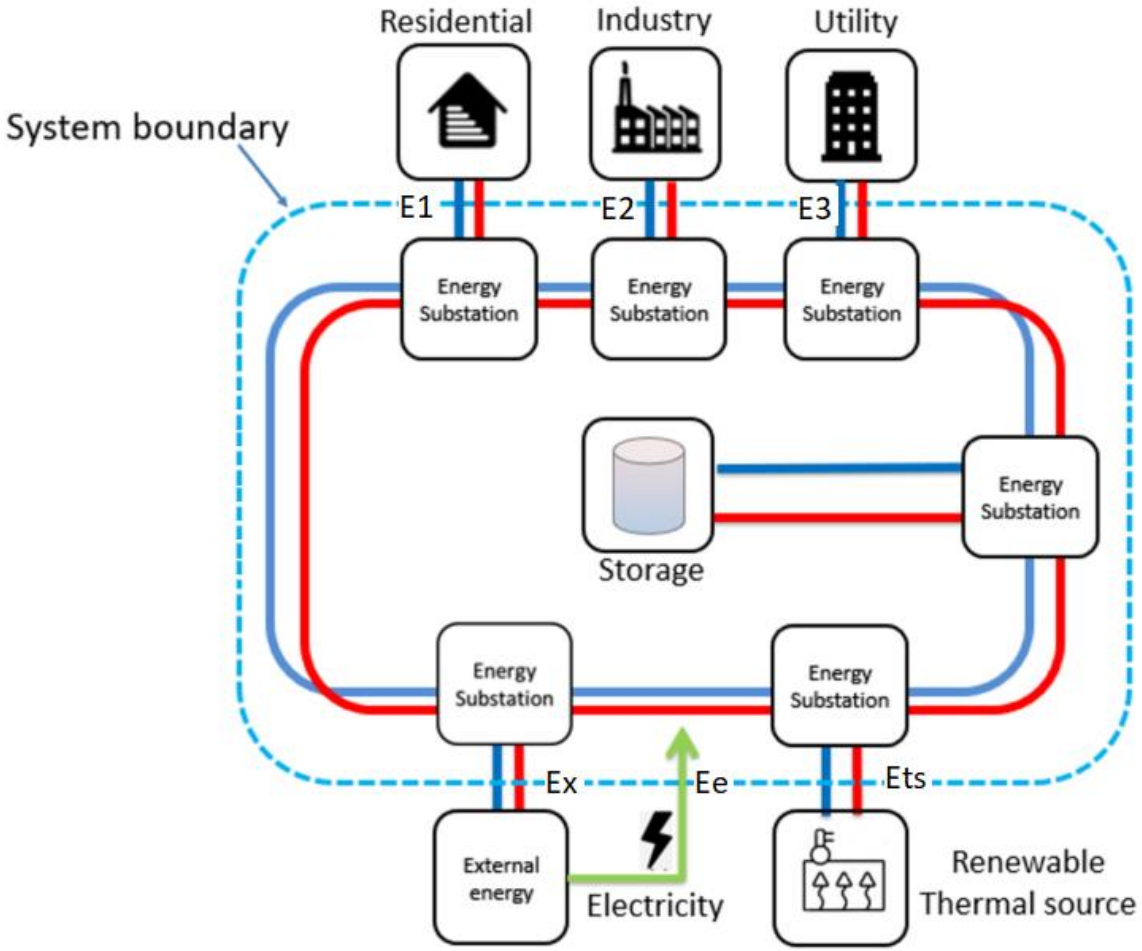
An integrated approach of energy flows



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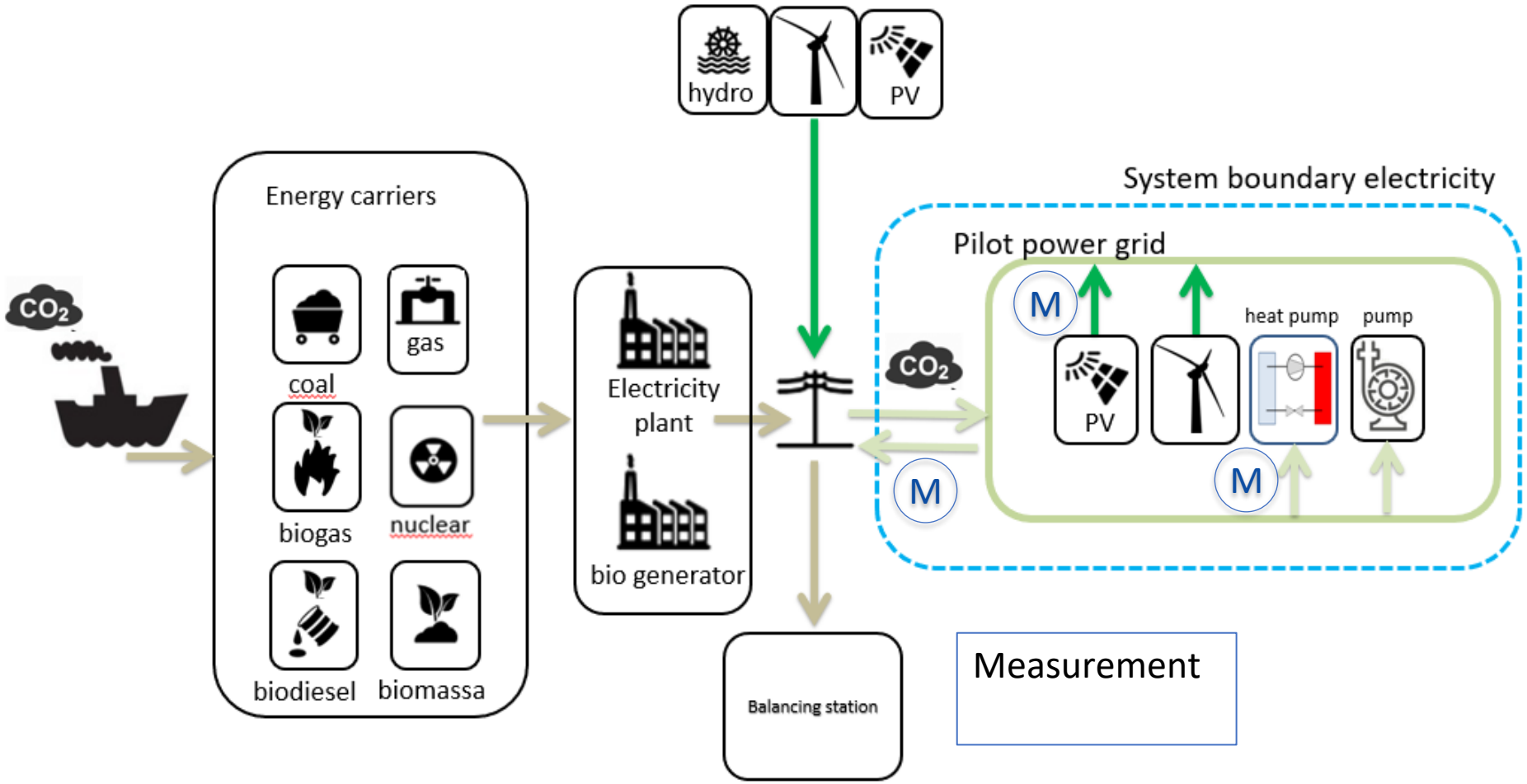
Monitoring



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