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# MIJNWATER HEERLEN



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OPZuid Europees Innovatieprogramma Zuid-Nederland

Life

# 5e generatie urban energy grids

Thermische energie uitwisselnetten (10° - 50°C)
Warmte- en Koude levering

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# TKI Urban Energy

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KoWaNet
https://www.kowanet.nl/

- Handboek -> Technisch ontwerp
- Decision support tool -> multi stakeholder NCW
- Wakowiki voor initiatiefnemers
  - ❑ Juridisch
  - ❑ Organisatorisch
  - ❑ Financieel
- Implementatie -> casussen


ENERGYGO

BSH

TU Delft

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# Definitie 5GDHC principes

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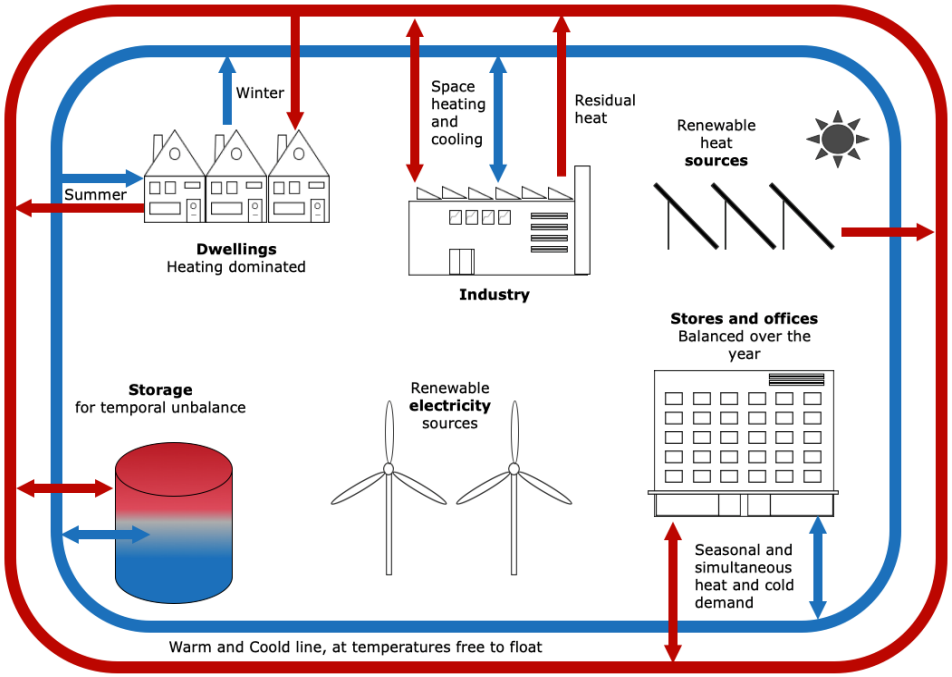
*5th generation DHC is an urban thermal energy grid for heating and cooling based on the following 5 principles :*




## 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-graded sources for low-graded 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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# Decentrale installaties verbonden

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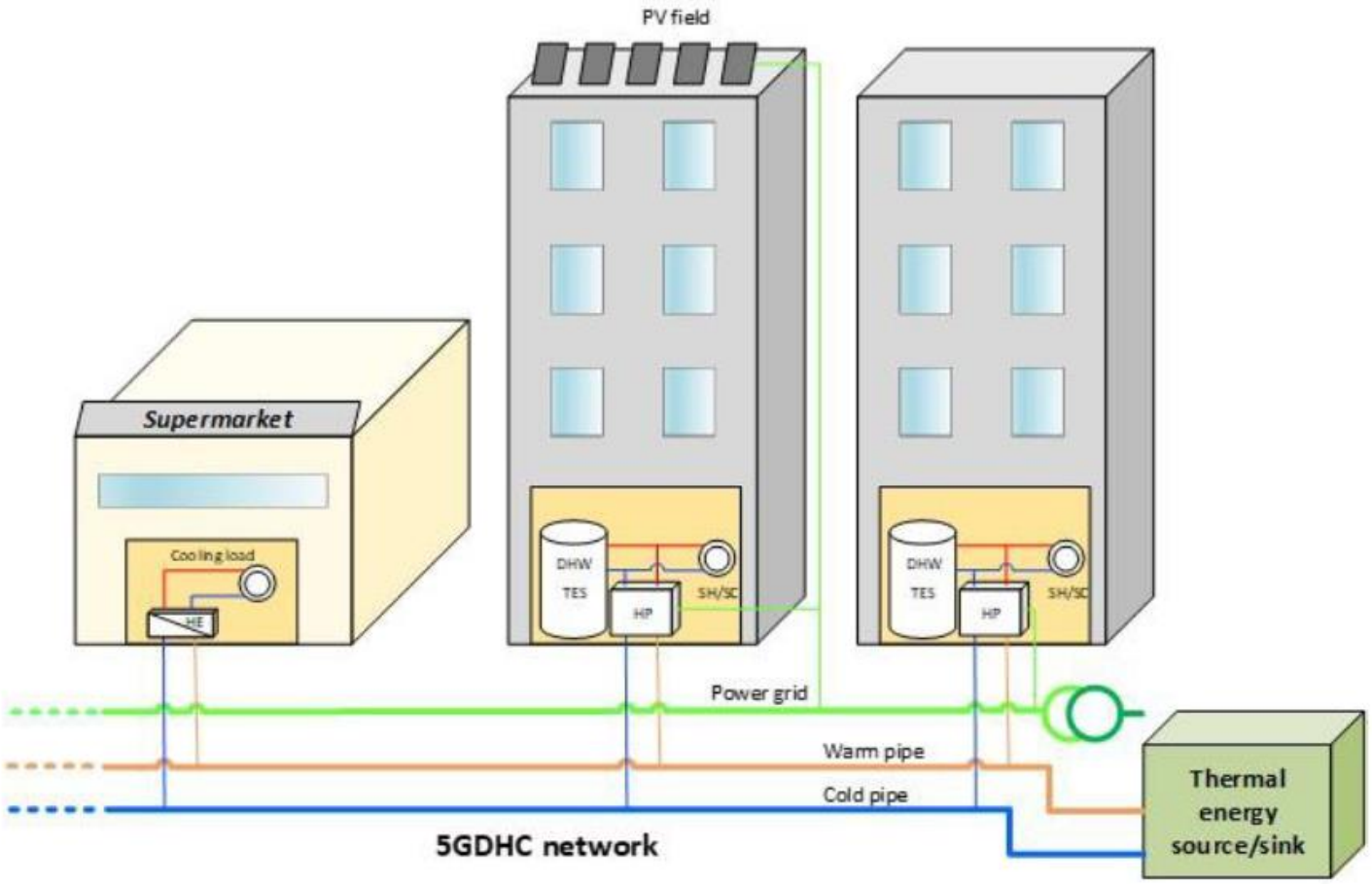


Source: Simone Buffa etal "Fifth-Generation District and Cooling Substations: Demand…Control, Energies, August 2020

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# Aggregatieniveau's

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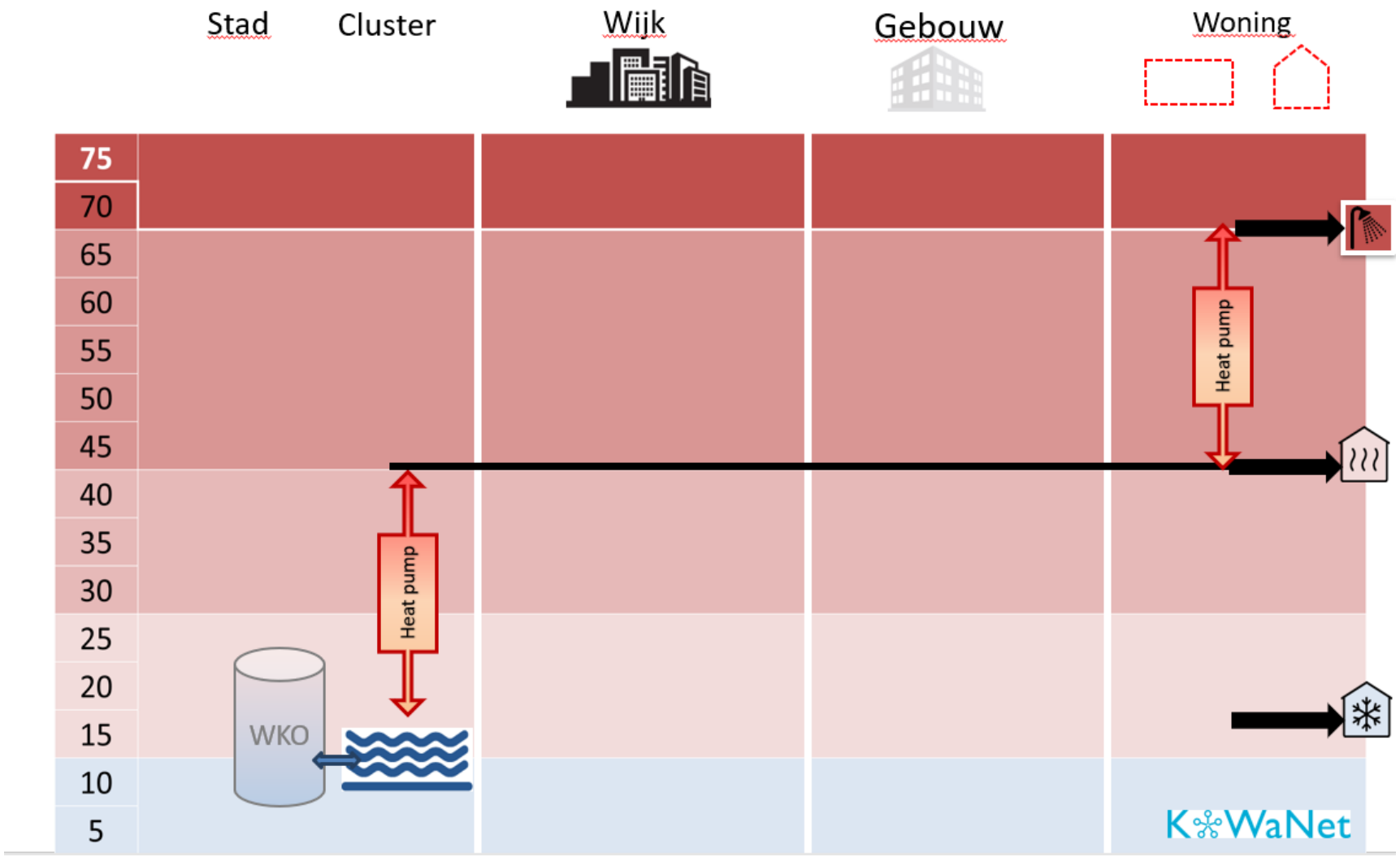


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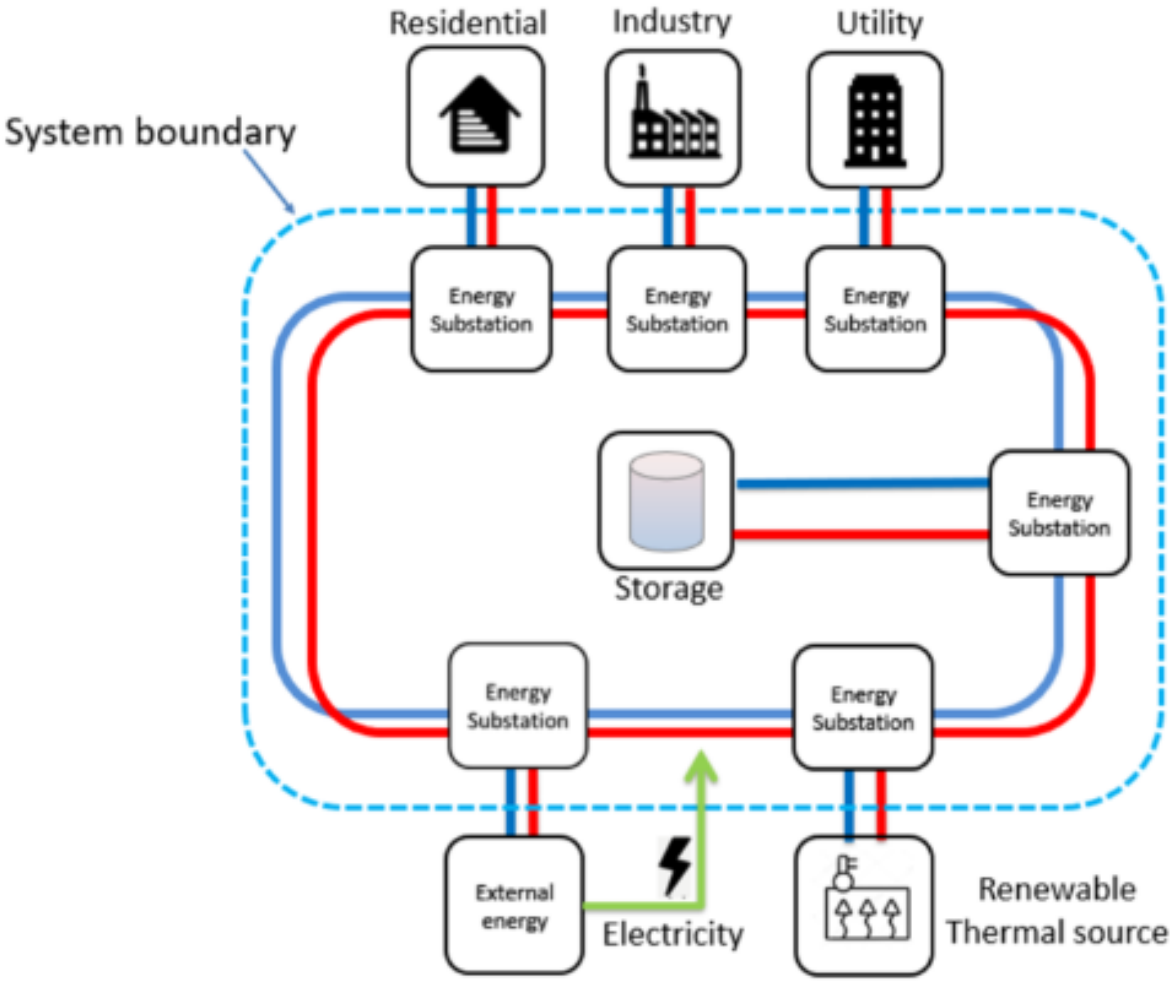
# System Boundary thermal





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# System Boundaries
## electricity/$CO_2$

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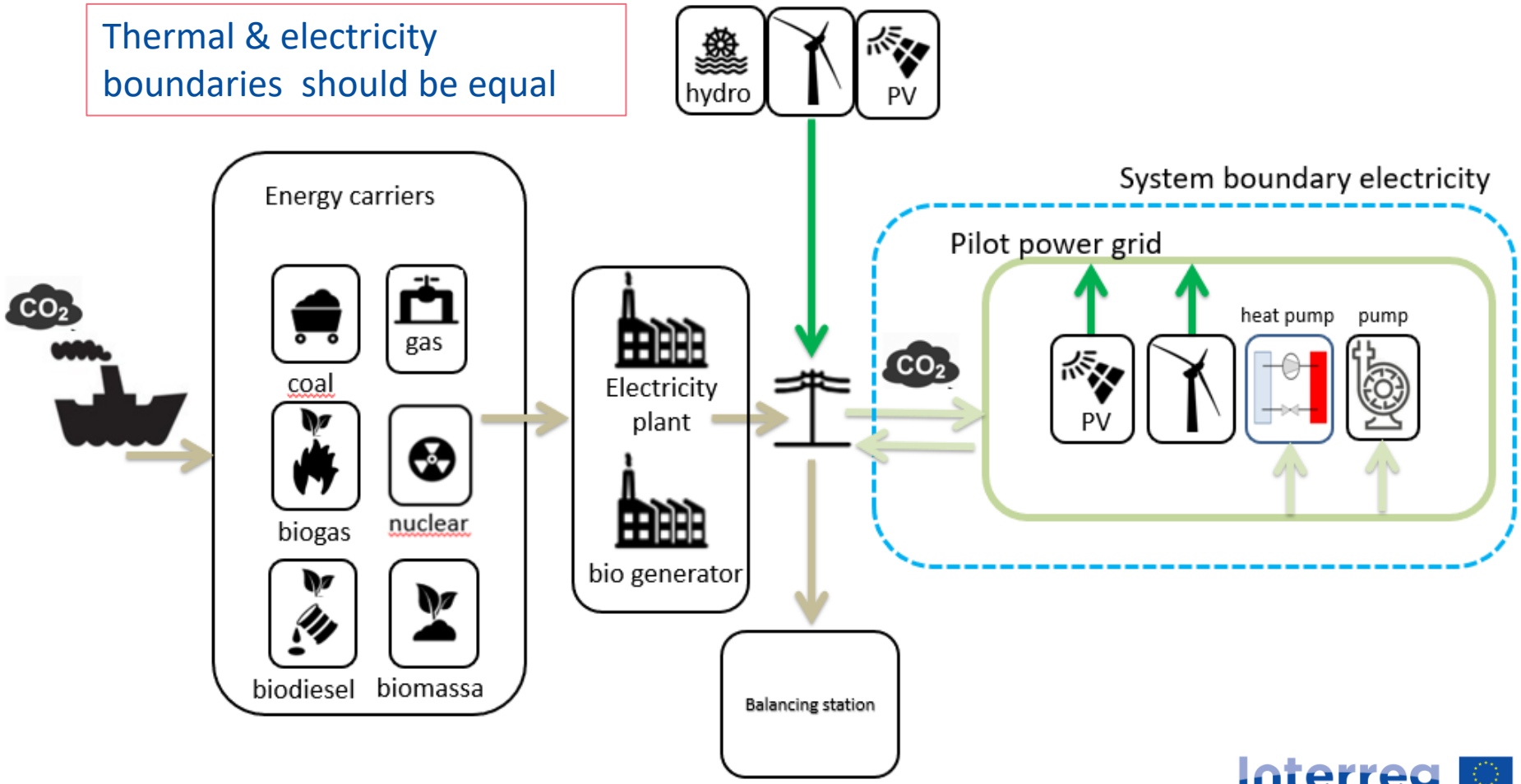
Thermal & electricity boundaries should be equal



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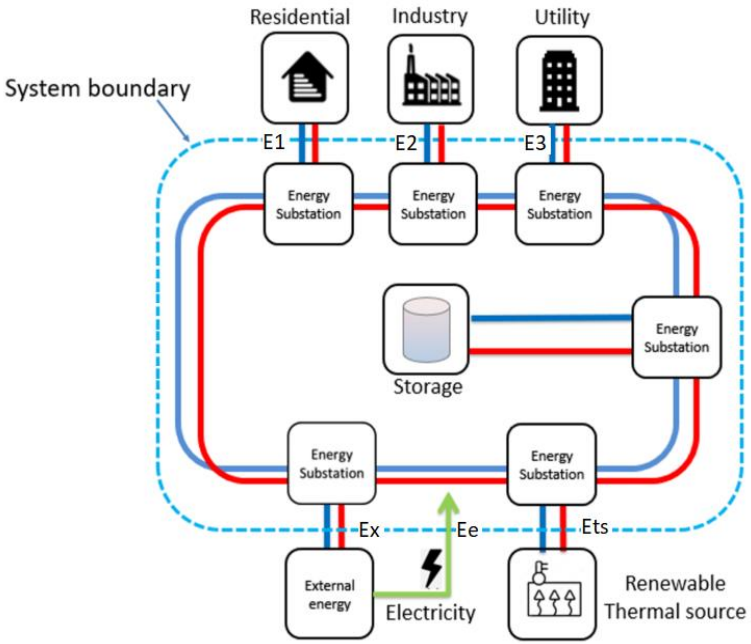
# Energy Exchange factor






$$Total\ energy\ demand\ \left(E_{demand}\right) = E_1 + E_2 + E_3$$

$$Energy\ exchange\ Factor\ (EF) = \frac{E_{demand} - E_{supply}}{E_{demand}} x\ 100\%$$

$$Total\ supplied\ energy\ (E_{supply}) = E_{ts} + E_x + E_e$$



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# Monitoring

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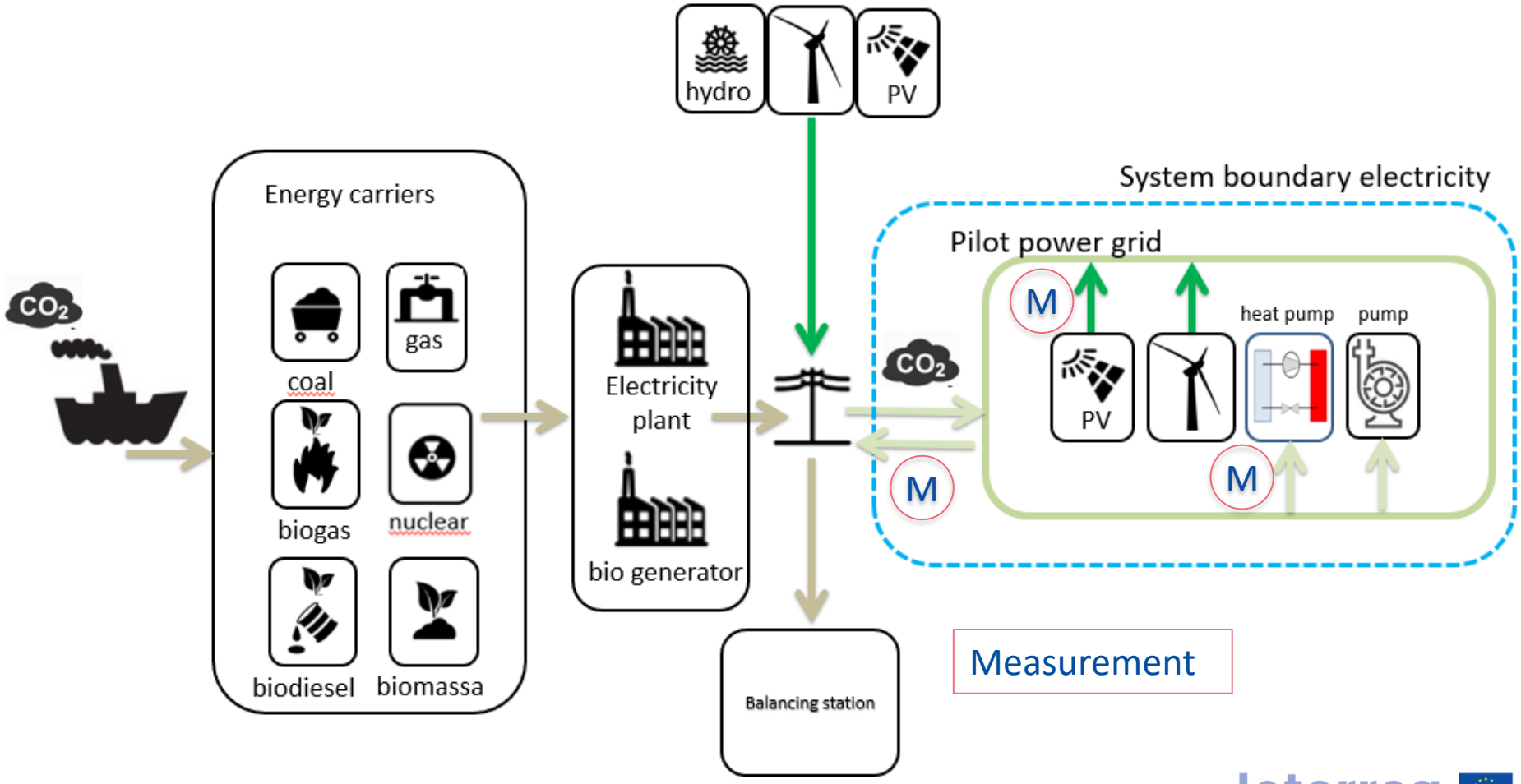


Measurement



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# Network performance

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| System sources (external from network) | - | MWh/year |
|---|---|---|
| Total energy input | | |
| - Electricity | | $MWh_e$ /year |
| - Thermal (cold and heat) | | $MWh_{th}$ /year |
| - high grade solid fuel | | $MWh_{th}$ /year |
| - high grade liquid fuel | | $MWh_{th}$ /year |
| - high grade gas | | $MWh_{th}$ /year |
| - high temperature waste energy (>50°C) | | piece |
| Locally produced/used energy | | |
| - electricity | | % |
| - low grade heat | | % |
| - low grade cold | | % |

| Ranking of preferable energy sources used | - | MWh/year |
|---|---|---|
| 1. Reuse of thermal energy, by exchange between heating and cooling demands | | $MWh_{th}$ /year |
| 2. Ambient thermal sources from soil, water, air, and low temperature solar heat | | $MWh_{th}$ /year |
| 3. Higher temperature renewable sources like Geothermal, Solar heat | | $MWh_{th}$ /year |
| 4. Higher temperature industrial waste heat, otherwise rejected in the environment | | $MWh_{th}$ /year |
| 5. Renewable electricity from local sources like wind, sun | | $MWh_e$ /year |
| 6. Electricity use at times of renewable overproduction, e.g. when spot price is low | | $MWh_e$ /year |
| 7. Electricity mix from the external grid | | $MWh_e$ /year |
| 8. High temperature heat from burning biofuels, biogas, biomass | | $MWh_{th}$ /year |
| 9. High temperature heat from burning fossil fuels | | $MWh_{th}$/year |

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# Mijnwater praktijk

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**50.000 m²** multifunctioneele ontwikkeling volledig vermarmd en gekoeld met 5GDHC

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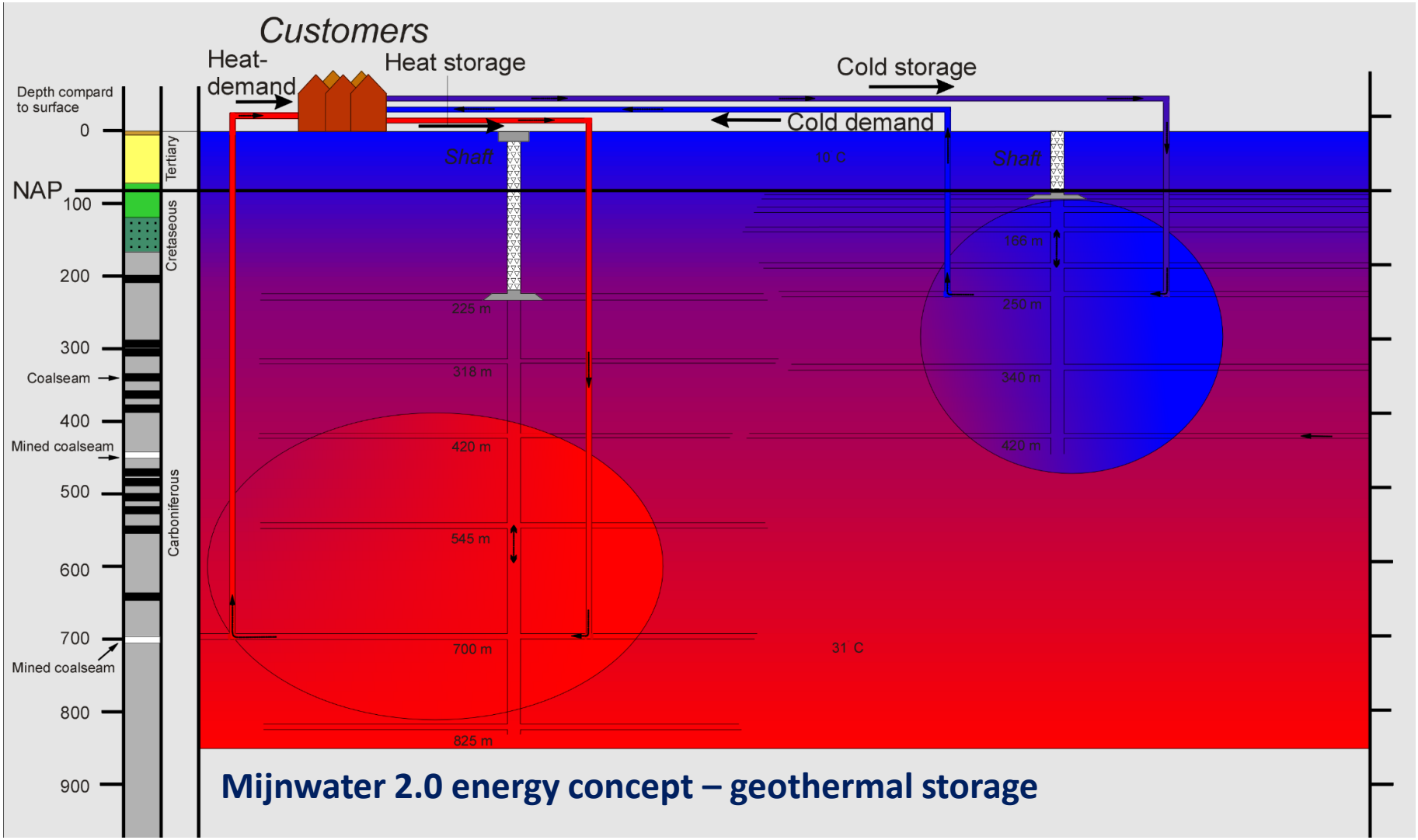
# Gebruik geothermie en opslag






**Mijnwater 2.0 energy concept – geothermal storage**



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# Actual grid layout Heerlen






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# Mijnwater LT ontwikkelingen

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# 5GDHC concept in Heerlen

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250.000 m² served floor area

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

industry

< 25-28 °C

electricity

Due to high temperature constant source the COP of Heat Pumps is 2-4 times higher than on ground water or outside air

Industry surplus

local green generation

dwellings

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

(shallow) Geothermal

commercial

> 16-18 °C

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

Including data centres, shops, etc.

Seasonal heat storage

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

MT Heat storage

MT Cold storage

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

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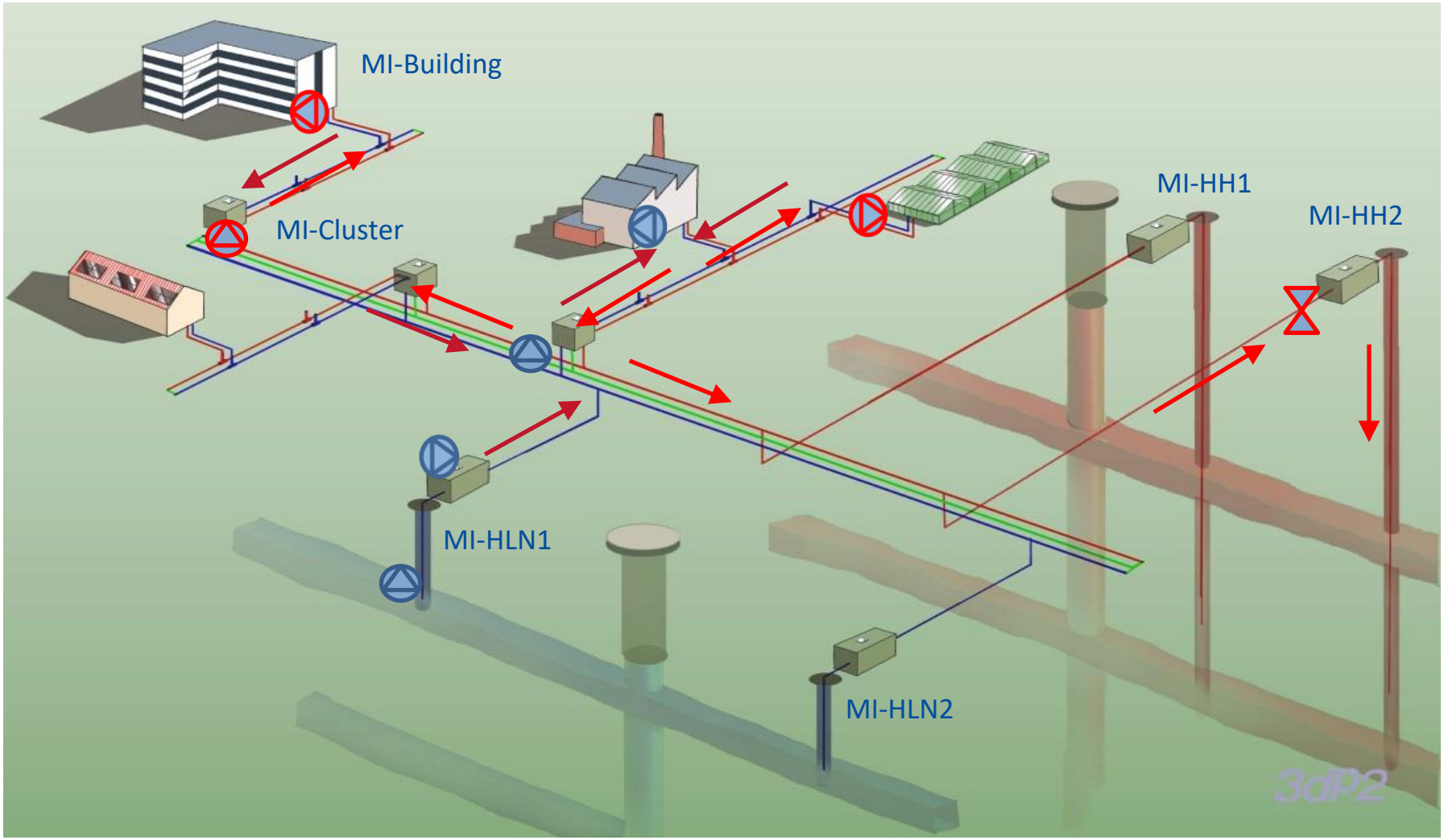
# Vraaggestuurd uitwisselnetwerk





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# Renovatieconcept

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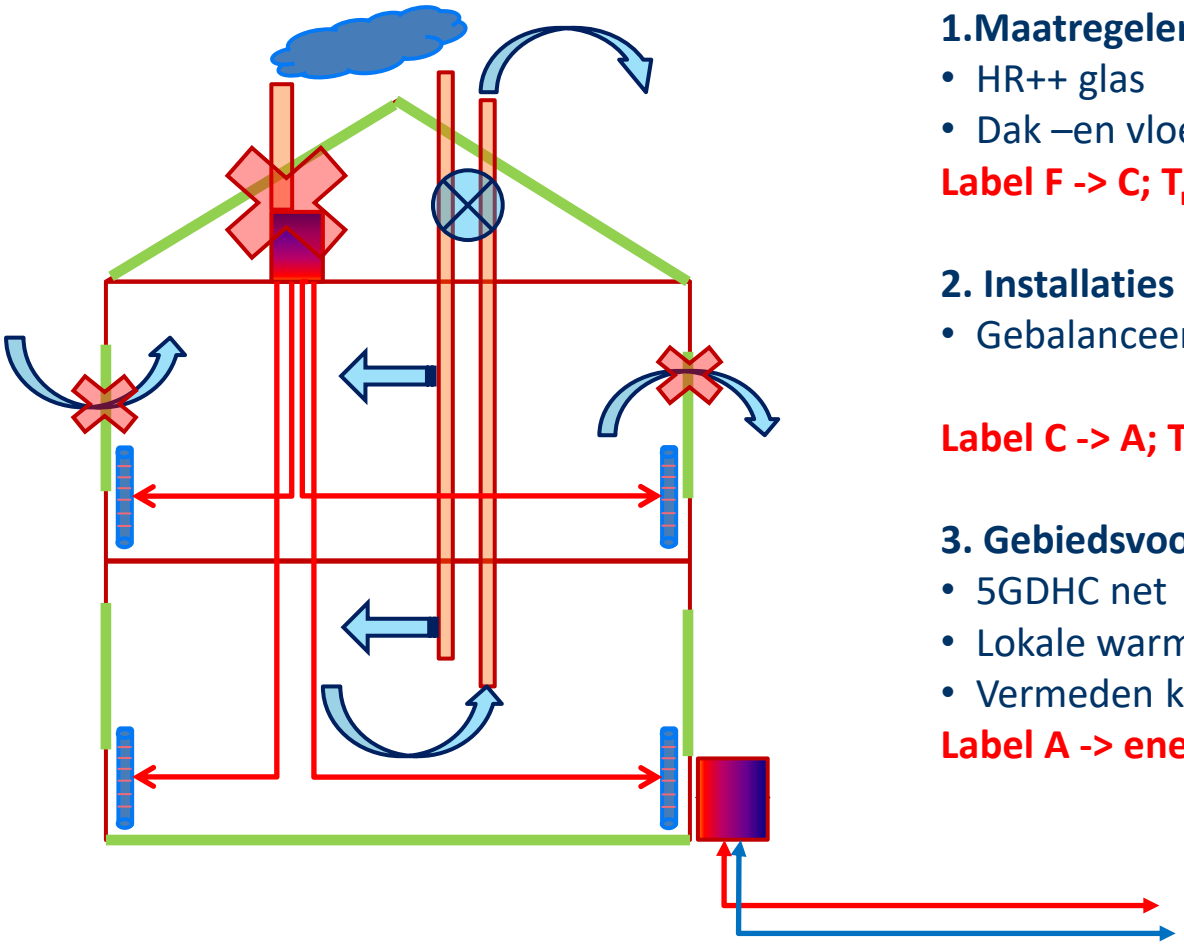

**1.Maatregelen schil**

- HR++ glas € 5.000,-
- Dak –en vloerisolatie € 4.000,-

**Label F -> C; $T_{radiator}$ van 90 -> 70 ºC**

**2. Installaties**

- Gebalanceerde ventilatie met WTW € 5.000,-

**Label C -> A; $T_{radiator}$ van 70 -> 50 ºC**

**3. Gebiedsvoorziening**

- 5GDHC net € 15.000,-
- Lokale warmtepomp € 5.000,-
- Vermeden kosten CV - € 2.500,-

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

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# Urban Energy Strategy

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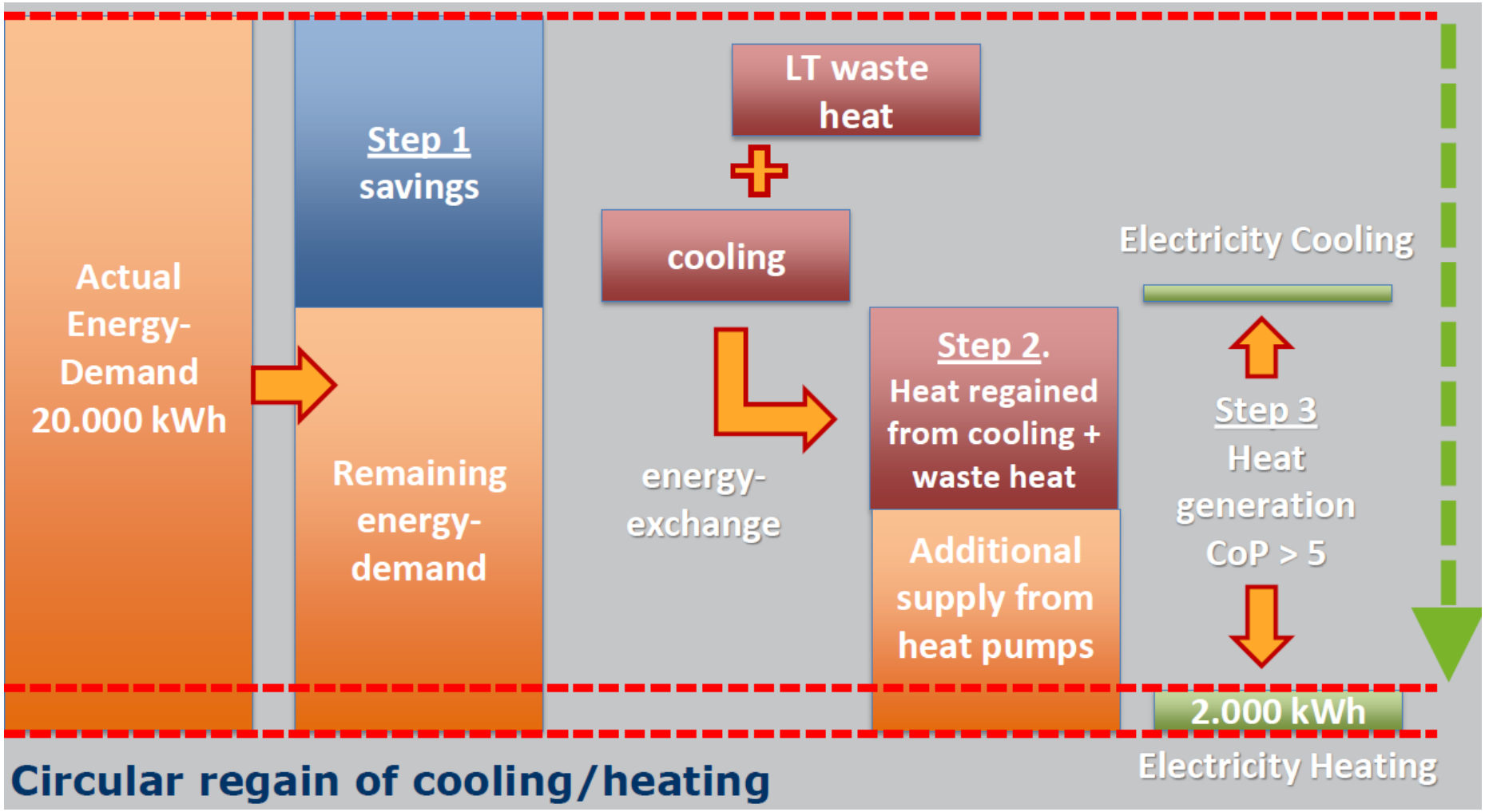




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# Decentrale energie centrales

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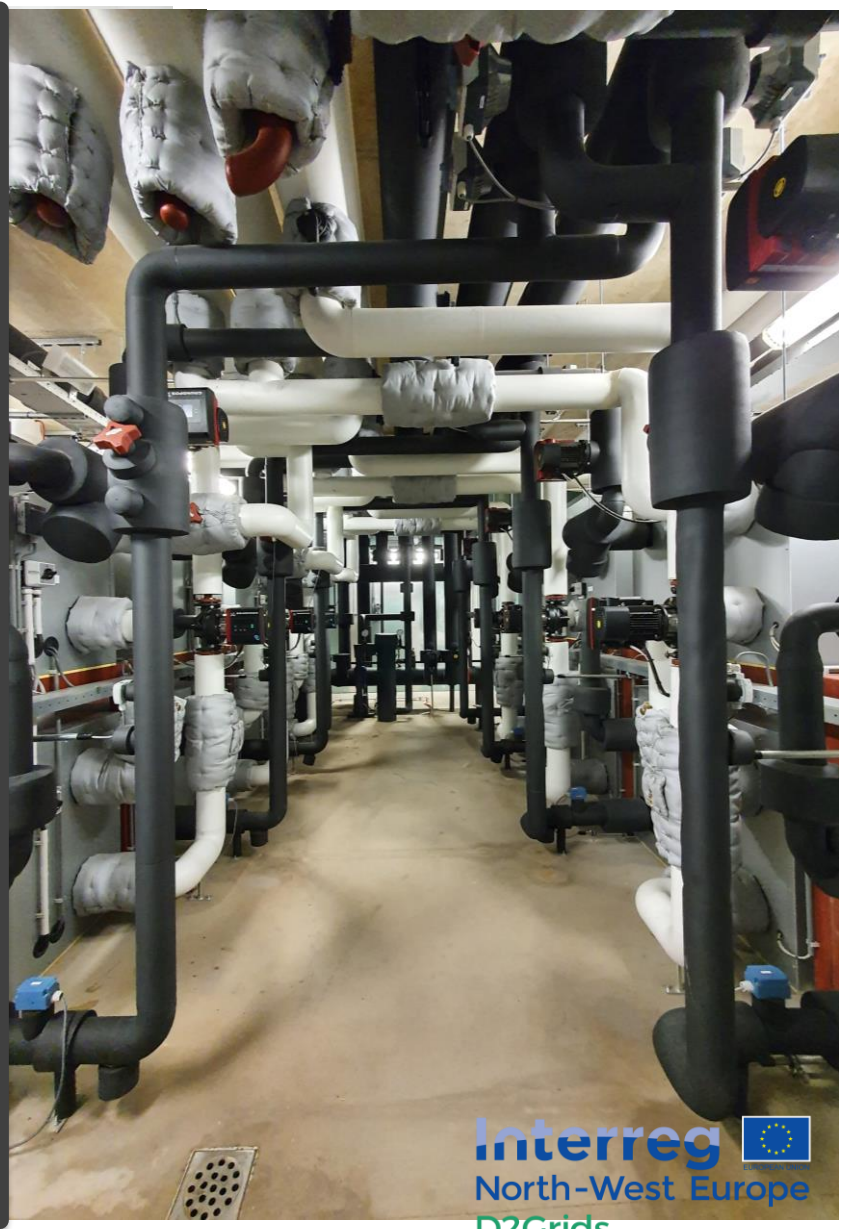

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# Prefab energie uitwisselstations





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# Mijnwater 5GDHC

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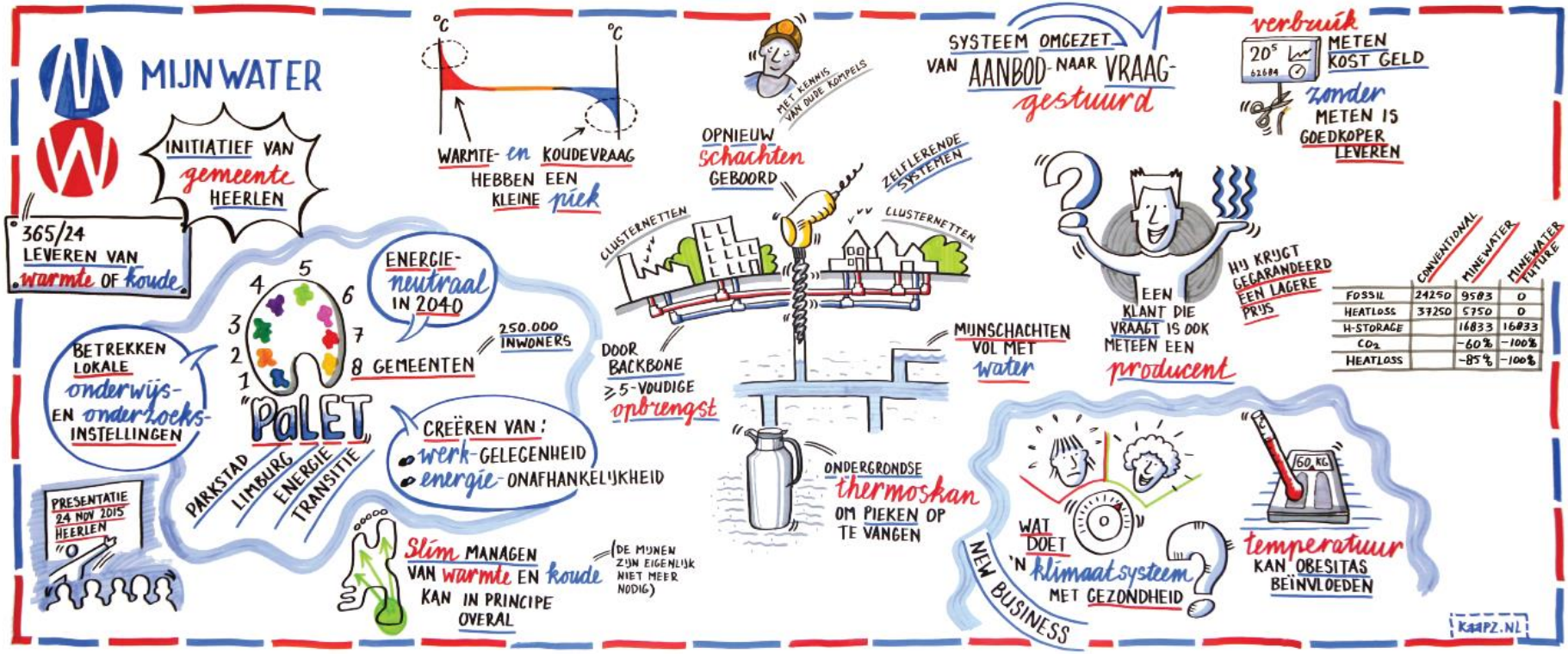


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