Interreg North-West Europe D2Grids

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Tri-Es Consultancy B.V.
Sustainable Source Solutions

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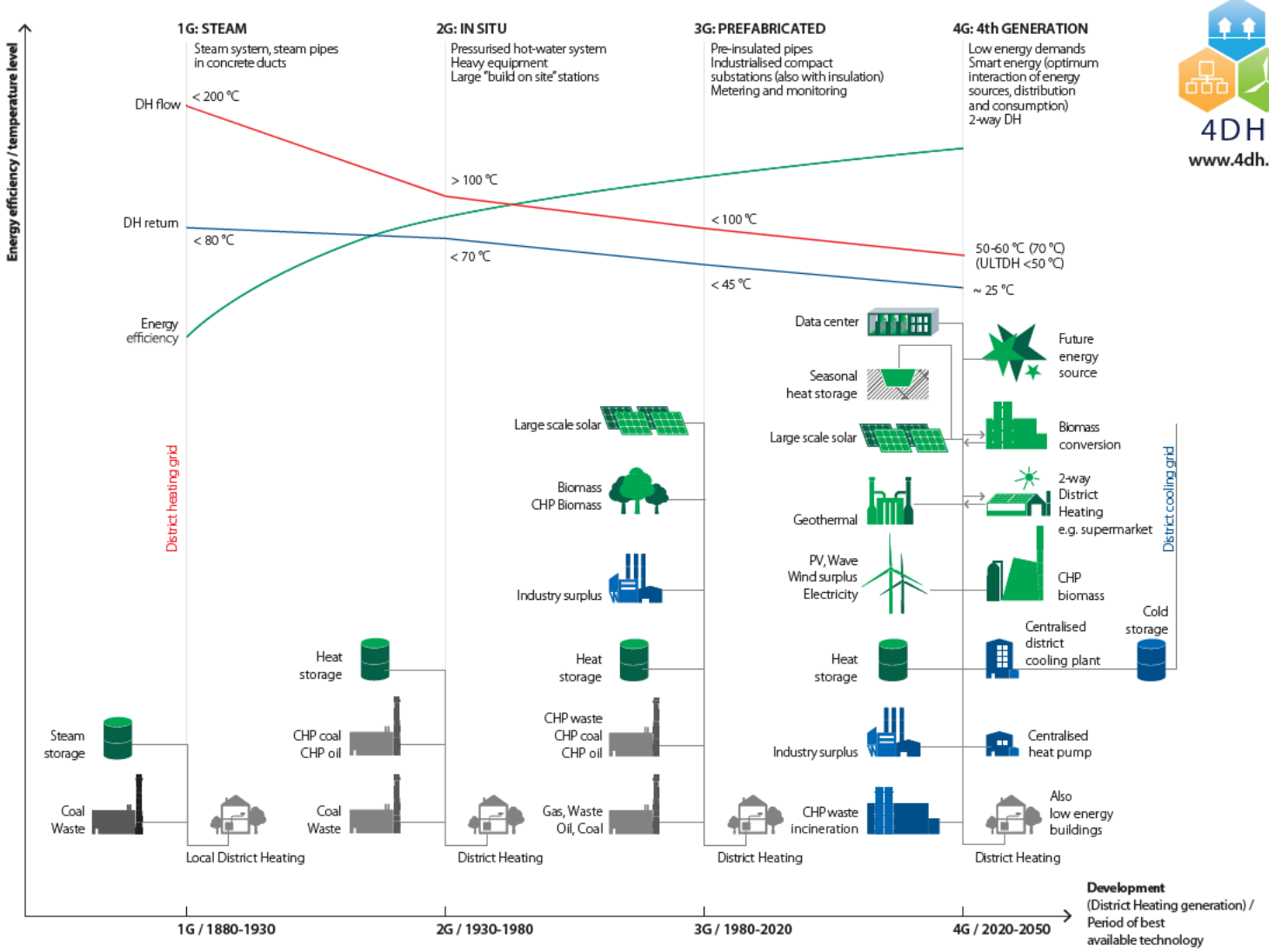
Interreg North-West Europe HeatNet NWE

OPZuid Europees Innovatieprogramma Zuid-Nederland

Life

Heating Grids Evolution



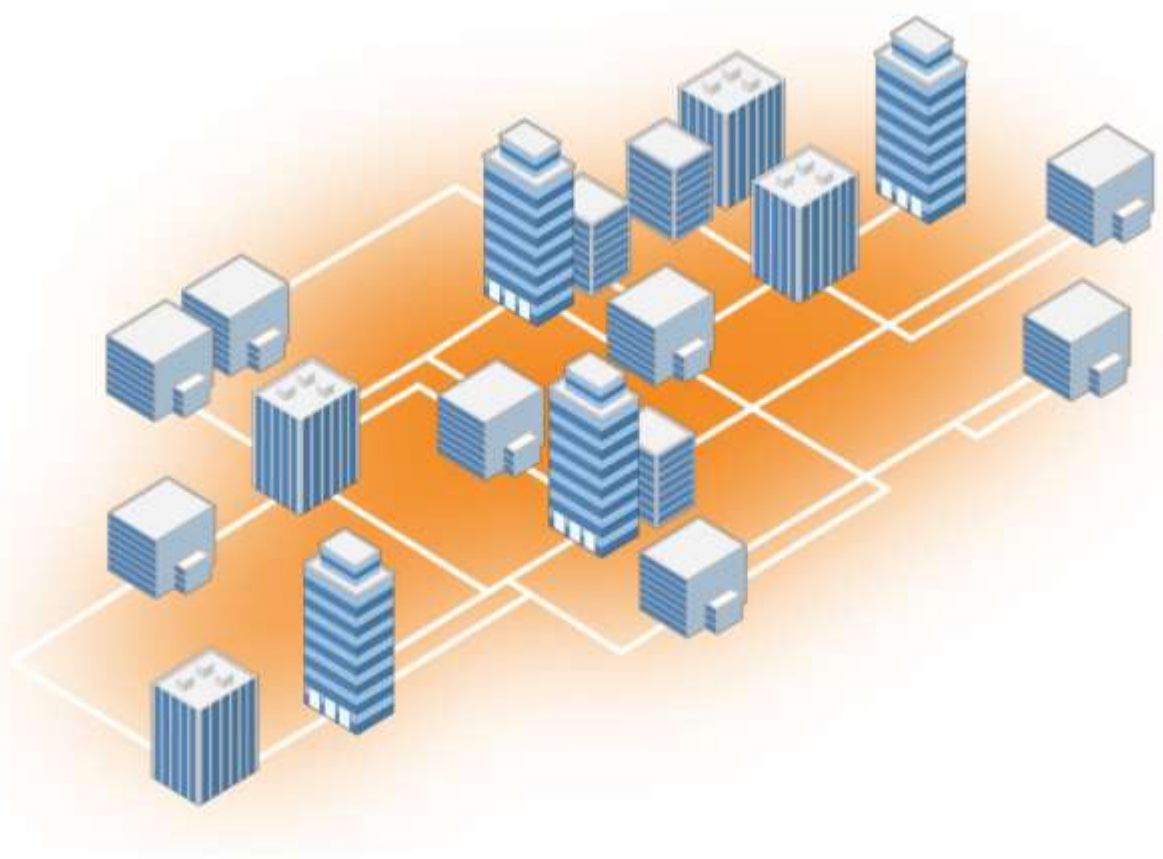
4DH
www.4dh.dk

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

DECENTRALIZED NETWORK = CLOUD



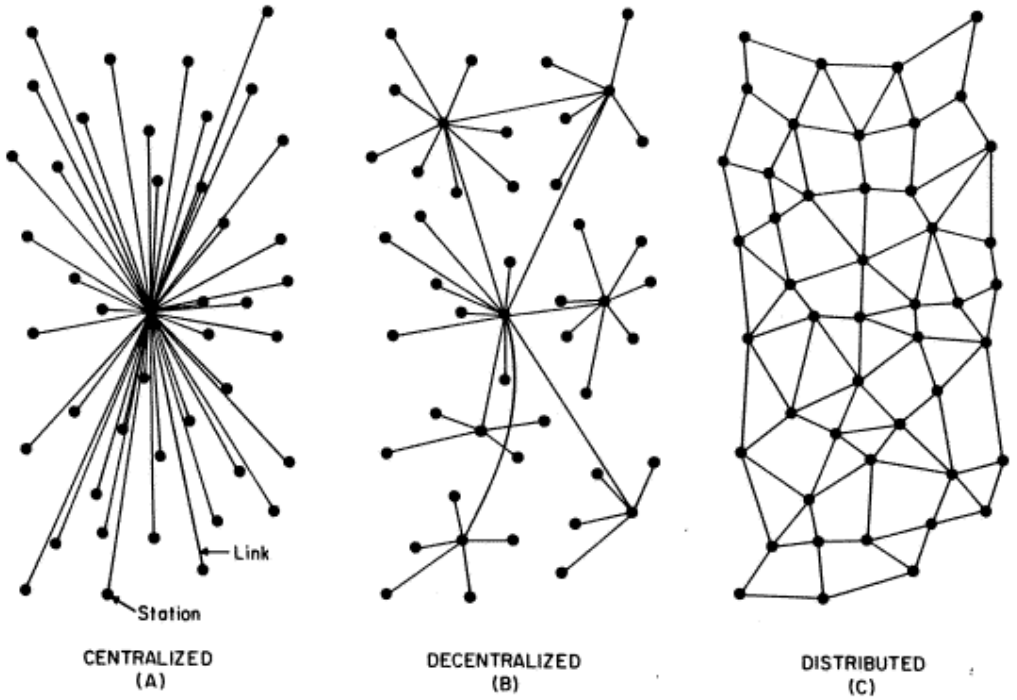
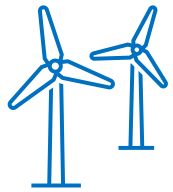


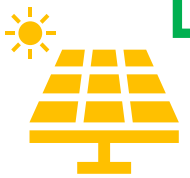
FIG. 1 — Centralized, Decentralized and Distributed Networks

5GDHC concept in Heerlen

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





electricity

16 °C

25 °C

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

25 °C

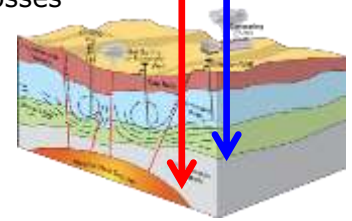
18 °C

14 °C

14 °C

28 °C

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



Seasonal heat storage

MT Heat storage

MT Cold storage

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

industry

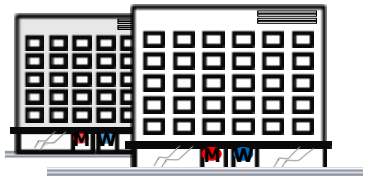
Industry surplus

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

local green generation

dwellings

commercial



Including data centres, shops, etc.

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

5GDHC Principles

urban thermal energy grid for heating&cooling based on the next 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

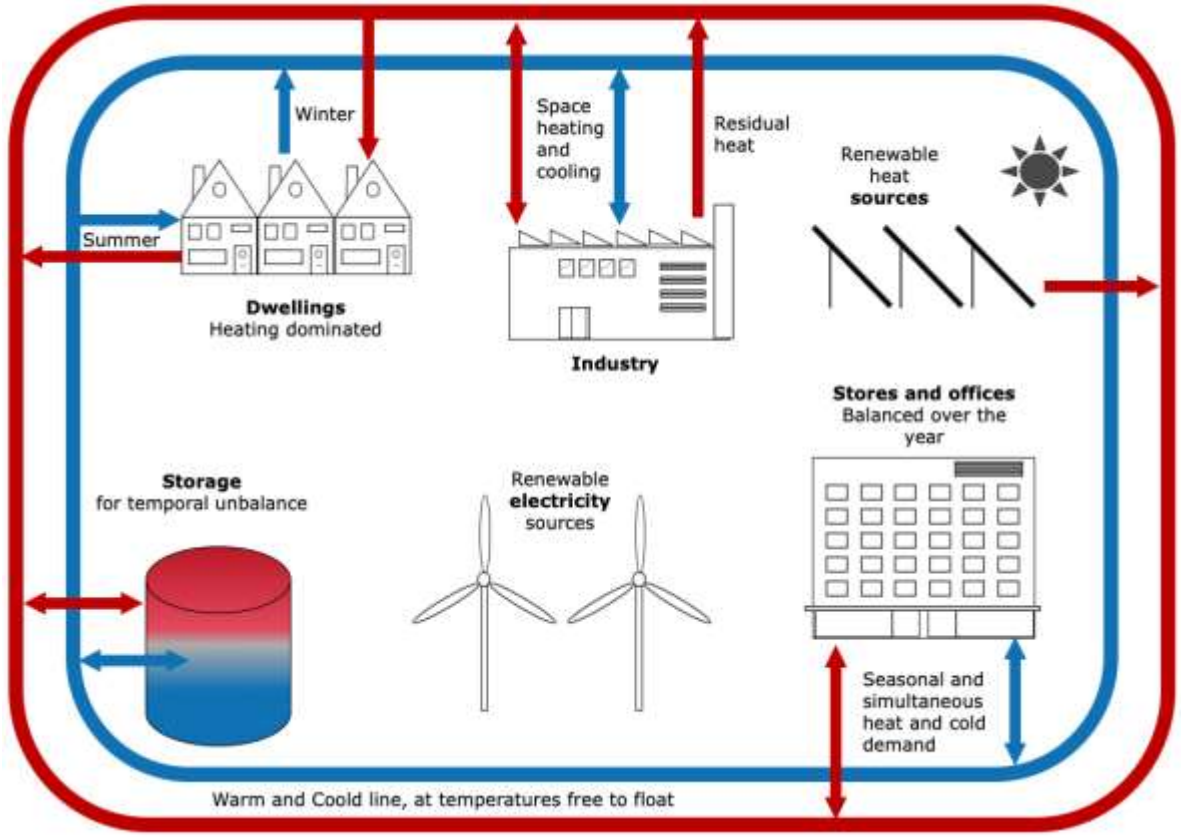
Circulating energy within the system only when and where needed, as close as possible to the end-user

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 assesment

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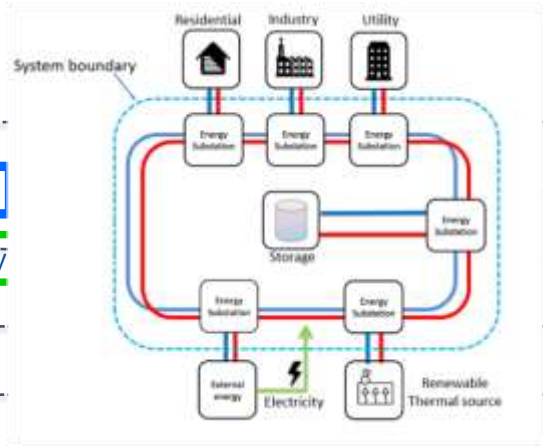
Principles

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

- **E**ext = f(**E**ref) ..... 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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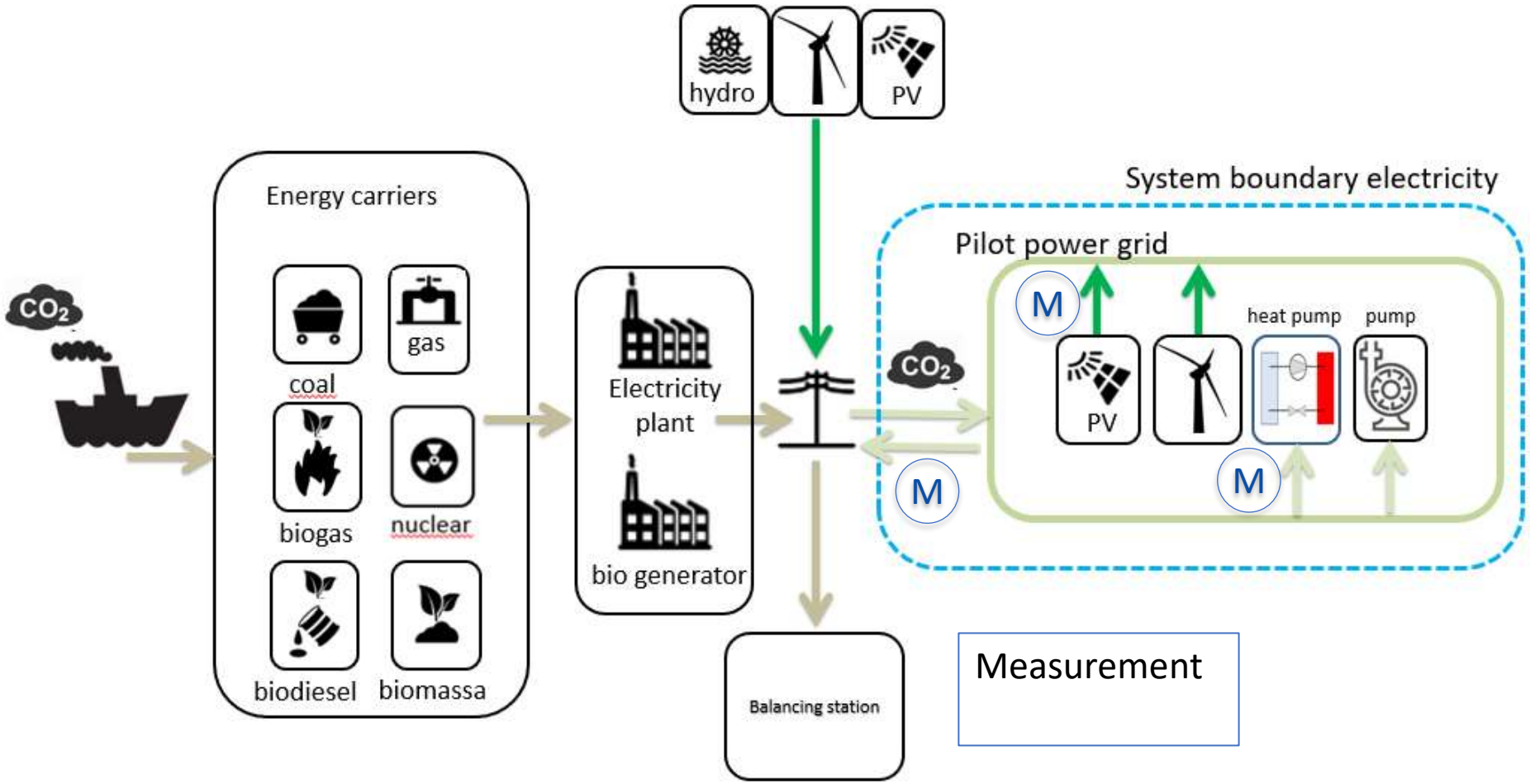
5GDHC Monitoring



Benefits of 5GDHC I

At first a choice must be made if a district/neighbourhood will get a collective thermal supply or individual solutions, if decided for a district approach, the choice is between temperature levels .. or grade of decentralisation, or 2,3,4,5th generation DHC :

- Decentralised installations give end-users the opportunity to connect when they are ready, and modify the energy substation to their (over time changing) demands;
- Substantial heat gains can be achieved from low-temperature sources and the heatflow from the backside of the heatpump is kept in the system;
- Cooling is integrated within one system

Benefits of 5GDHC II

From recent scientific studies is found:

- Reducing the heat distribution temperatures leads to up to 40% annual electric energy savings (from 10.4 kWh/m2 to 6.2 kWh/m^2)
- moving from 3GDH to 4GDH saves 4.5% primairy energy, costs of the system 2.7%
- 5GDHC systems showed a cost reduction of 42% and 56% less CO2 emissions compared to individual heating, ventilation, and air conditioning (HVAC) systems
- Compared to conventional gas-fired district heating system, a 5GDHC network showed a primary energy consumption reductions of 58% and 84% (US/Germany), less CO_2 emissions of 35% and 78%, and reductions in energy costs of 53% and 57%
- Integration of 5GDHC systems with PV generation led to about 30% reduction of grid electricity consumption

Barriers/Opportunities

Decarbonizing urban built environment is a **major operation** on buildings and infrastructure. Key is to **speed up the process** and reduce costs:

- Integrate in urban infrastructure planning;
- Low interest loans (0 % - 1 %);
- Plug and play connections to end consumers, with communication protocol;
- Prefabricated substations, possibly subsoil;
- Plug and play connection for (green) sources and waste heat;
- Avoid hinderance … in buildings, on the street
- Built in resilience and flexibility (adapt to future changes ..)

APPENDIX COVERAGE MIJNWATER

AWARDS

- 2019 Green Solutions Awards

- 2015 GeoTHERM: European Geothermal Innovation Award

REPORTS

- Bloomberg Businessweek: Decades- Old Technology Offers a Greener Way to Cool Buildings, d.d. 2 October 2019.
- Internal due diligence.
- CE Delft: Weg van gas, kansen voor de nieuwe concepten LaagTemperatuurAardwarmte en Mijnwater, d.d. May 2018.
- Parkstad Limburg Energietransitie: PALET 3.0, d.d. 2016.

INNOVATION PROJECTS

Smart control framework:
https://www.storm-dhc.eu/en

Interreg HEATNET-NWE 6 pilots
https://www.nweurope.eu/projects/project-search/heatnet-transition-strategies-for-delivering-low-carbon-district-heat/

LIFE Life4HeatRecovery
http://www.life4heatrecovery.eu/en/

D2Grids: Rolling out 5GDHC
https://www.nweurope.eu/projects/project-search/d2grids-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/

ReWardHeat: Renewable and Waste Heat Recovery for Competitive District Heating and Cooling Networks
https://cordis.europa.eu/project/rcn/224317/factsheet/en

CAGE: Development and demonstration of several cost-saving and output-improving installation technologies
http://www.geothermica.eu/projects/cage/

D2Grids website: https://5gdhc.eu/