Interreg North-West Europe
HeatNet NWE
European Regional Development Fund

LEIE DAL

Transition Roadmap South-West-Flanders, Belgium

Researched by	Checked by	Reviewed by	First Draft	Final Draft
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Deliverable: WP.LT D1.3 Transition Roadmaps

Date: June 2019

About HeatNet NWE

This document has been developed as part of the HeatNet NWE project, which is part-funded through the Interreg NWE programme and aims to increase the uptake of 4DHC networks across North-West Europe. As part of this project, the partners are developing the HeatNet Model, which will help the public sector to begin implementing 4DHC networks, and the Transition Roadmaps, which will outline the partners' experience in developing six district heating pilots across North-West Europe. The HeatNet Guide to Financing is also currently being developed and will give a broad overview of the various sources available to finance district heating schemes.

For further information on these reports and on the HeatNet NWE project, please visit www.nweurope.eu/heatnet.

Table of Contents

This roadmap is a strategic plan that describes the necessary steps to roll-out 4th generation district heating systems (4DHC) in South-West-Flanders. It clearly outlines priorities for action in the near, medium and long term.

Within the HeatNet NWE project, pilot regions develop their Transition Roadmap, facilitated through the evaluation feedback and through transnational support from expert partners. Experiences are captured in a Guide to enable replication. Roadmaps are action plans to support further development of DHC networks (using the HeatNet Model) and transition to 4DHC. The individual roadmaps reflect local contexts (energy sources, development opportunities, stakeholders, current DHC status, finance, …), identify key opportunities for 4DHC development, and propose governance & financing mechanisms. This report represents the transition roadmap for 4DHC systems in South-West-Flanders, Belgium.

Planning and Preparation

In a first phase, desktop research enabled the development of the Transition Roadmap for South-West-Flanders. Research was done on existing DHC systems, local energy sources, stakeholders, policies and financing mechanisms. In a second phase, capacity building workshops[1] for 13 cities and municipalities were organised by the Intermunicipal organisation Leiedal to explore opportunities for 4DHC in South-West-Flanders. The 3 to 5 day workshops involved experts on urban planning and district heating, HeatNet partners, energy and heat suppliers, academia, and local politicians and policy makers. The workshops wanted to establish cooperation among relevant stakeholders on district heating and renewable energy, aimed to find opportunities for district heating systems in South-West-Flanders, and investigated how South-West-Flanders and its municipalities can become CO2- and energy neutral in the future. The results of two capacity building workshops (for the municipalities of Kortrijk, Harelbeke and Kuurne) are reflected in this transition roadmap.

Figure 1: Capacity Building Workshop on renewable energy and sustainable heat, organised for the City of Kortrijk.

[1] A first workshop was organised for the city of Kortrijk from 18 until 22 february 2019. Participants were: Hartwin Leen and Wouter Cyx (Kelvin Solutions), Bram Pauwels (Beauvent), Griet Juwet (VUB), Joseph Jebamalai and Marijke Mahieu (UGent), Gerda Flo and Peter Tanghe (City of Kortrijk), Herman Eijdems (Mijnwater), Kurth Achten (Fluvius), Jan Custers (BUUR) and Veerle Cox, Dominiek Vandewiele, Merel Goossens, Hannelore Fabri (Leiedal). The capacity building workshop of Harelbeke and Kuurne was organised from 26-28 March, Spiere-Helkijn and Avelgem from 24-26 April, Menen and Wervik from 6 - 8 May, Wevelgem and Zwevegem from 14-16 May, Deerlijk and Waregem from 11-13 June, and Anzegem and Lendelede from 24-26 June.

In order for the findings of the workshops to be realised in a short, medium and long term, Leiedal employed a ‘warmteregisseur’ or ‘heat-manager’. The task of the ‘warmteregisseur’ is to execute DHC projects in South-West-Flanders. Moreover, it will be necessary to put in place an organizational structure for projects to be carried out on a long term:

Type	Frequency	Aim	Who?
Political-Administrative	Fortnightly	Political involvement	Project leader and alderman (f.e. of energy)
Steering Committee	Every 3 to 6 months – to prepare decisions	Final step before taking formal decisions	Politicians, heads of department, third parties (developers, net operators, …)
Project team	Fortnightly	Developing/guiding the heatnet project	Project leaders of involved organisations
Group of experts	Ad hoc	Specificities (e.g. contracts)	Project leaders + group of experts
Informal contacts	Continuously	Create goodwill, keeping the project on track	Project leader ->all directly and indirectly involved partners of the project
Citizens & Companies	Every 3 to 6 months	Citizen participation, involvement	Citizens, energy cooperatives, companies, social housing estates, …

Figure 2: Organization structure for projects to be carried out.
Source: Warmtenetwerk Vlaanderen & Kelvin Solutions, adjusted

Sustainable Energy and Heat in South-West-Flanders

The first step in changing a system, is getting to know it. The main aspect of this chapter is establishing the current baseline of (renewable) energy, heat, CO2 emission, economic and other relevant data in order to establish the starting point for the roadmap and baseline upon which to measure distance or ‘gap’ to proposed goals.

In South-West-Flanders, the 13 cities and municipalities signed at the end of 2013 the covenant of mayors of the European Commission. This policy aims to enhance local energy- and climate ambitions, as now the municipalities of South-West-Flanders need to reduce 20% CO2 by 2020 and become climate-neutral by 2050. Moreover, the new covenant of mayors aims to reduce CO2 emissions with 40% by 2030. These ambitions are quite challenging but necessary, as today only 1,5% of the energy is being locally produced which makes South-West-Flanders very dependent on import of electricity and gas. This is proven by the fact that 12,5% of the gross added value of South-West-Flanders is being spent on energy, which is 1,2 milliard euro per year[2]. A large amount of this budget could actually flow back into the region if the local economy and the energy transition go hand in hand.

[2] Between 2005 and 2017 the total energy cost increased with 56%, going up to 1,2 milliard euro. The total energy cost is the sum of all energy invoices of households and industries (electricity, gas, fossil fuels, …), for mobility (petrol and gasoline), agriculture, etc., incl. VAT. The energy cost for households increased with 39% in the period between 2005 and 2017. The energy use of households also increased in the same period, but had a small decline in the year 2014. Currently, 97 million euro is being spent on gas in South-West-Flanders: 55 million on the energy cost, 27 million on distribution and transport, and 15 million on taxes.

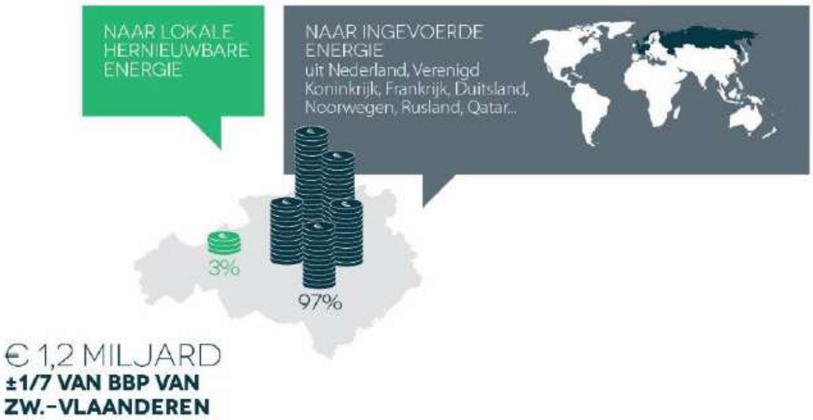
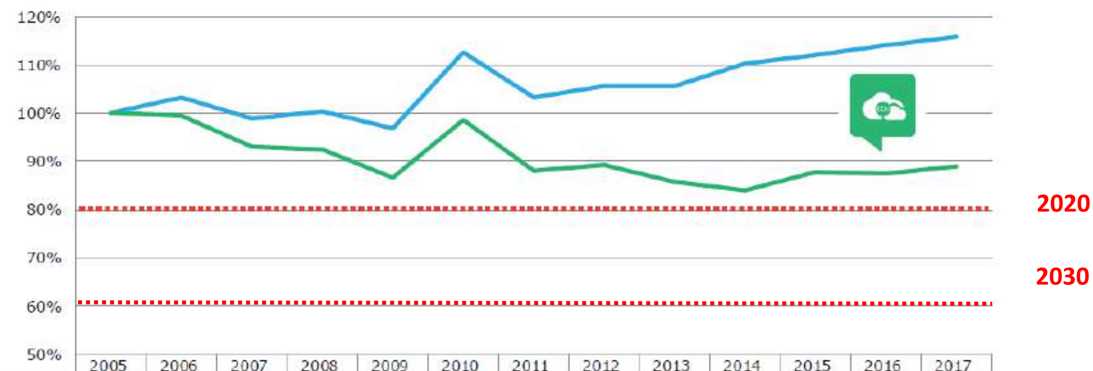


Figure 3: South-West-Flanders has a yearly energy bill of 1,2 milliard euro. Only 3% is spent locally on renewable energy sources.

CO2 Emission and energy Use in South-West-Flanders

The graph below shows the evolution of CO2 emissions (green) and the energy use (blue) in South-West-Flanders, and indicates that CO2 emissions have declined with 11%[3] since 2005. It is remarkable that climatologic circumstances have a major impact on short-term-fluctuations, such as the cold winter of 2010. Despite of these fluctuations, a long term trend can be noted of declining CO2 emissions. This reduction is mainly due to the housing and industrial sector. Dwellings are being renovated over time and production industries get replaced by knowledge industries. However, the main reason why the energy use is still augmenting in South-West-Flanders is due to the increase of motorized transportation on local roads and highways. The graphs below clearly indicates that it will be challenging to achieve a reduction of 20% by 2020. The emission of greenhouse gasses in South-West-Flanders is almost entirely due to the energy use. When fossil fuels are being burnt, CO2 is being emitted which is one of the most important greenhouse gasses. Nonetheless, the graph also shows a clear uncoupling of the energy use and the evolution of CO2-emissions. While the energy use has increased in the period 2005-2017, CO2-emissions lowered with 11% leading to a gap of 37%. This uncoupling is a positive aspect, indicating a more efficient use of fossil fuels and an increase of sustainable energy.



	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
evolutie energieverbruik	100%	103%	99%	100%	97%	113%	103%	106%	106%	110%	112%	114%	116%
evolutie CO2 totaal	100%	99%	93%	93%	87%	99%	88%	89%	86%	84%	88%	88%	89%

Figure 4: The evolution of energy use (blue) and CO2 emission (green) in South-West-Flanders, 2005-2007

[3] 11% equals 1.651.834 ton CO2.

Internal and external causes have an impact on the evolution of CO2-emissions, but local governments can hardly have an impact on external causes. These contain for example the emissions caused by road traffic on highways and the impact of emission trading by the Flemish and the Federal Government. These external causes have a share of 4% in the total CO2-reduction of 11%. Local governments do have an impact on internal causes, whether or not supported by Flemish, Federal and European policies. These contain housing, industry (except of major energy consumers), the tertiary sector, mobility on local roads, public facilities and lighting, and agriculture. These internal causes have a larger impact on CO2 reduction: namely 7 of the total 11%.

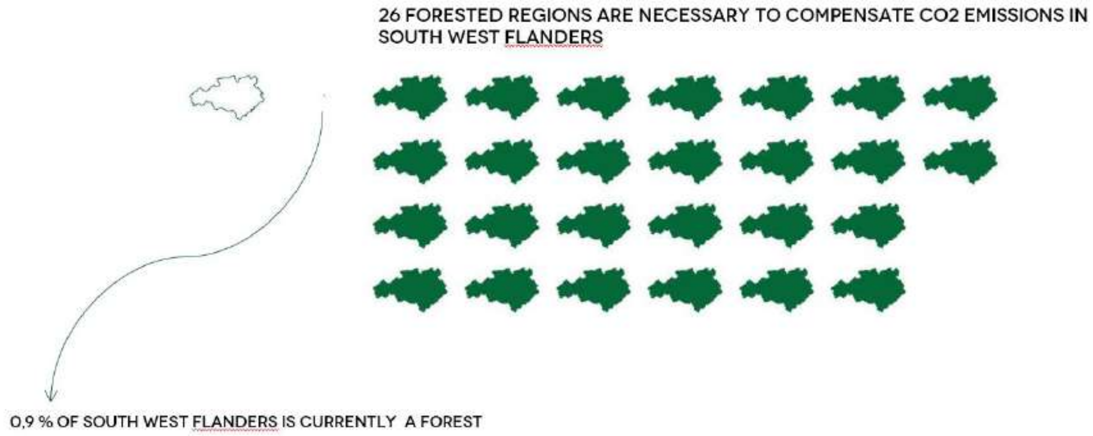


Figure 5: In order to compensate the 1 651 834 TCO2/year of South-West-Flanders, a forest is needed of 1.179.881ha. This forest is 26 times bigger than the region itself.

Almost 50% of CO2 emissions are caused by the housing (24%) and industrial (22%) sector; which indicates that district heating and sustainable heat can have a major impact on the reduction of CO2 emissions in South-West-Flanders and that local governments will have an important role to play in leading the energy transition. The other 2 important sectors are the tertiary sector (retail and services, among which public facilities and public lighting) which accounts for 16% and mobility on local roads (17%), and mobility on highways (18%). CO2 emission by agriculture only accounts for 3%. Diverging trends can be noted among these 6 different sectors. Housing is the most important sector and caused a CO2 reduction of 24% whereas there has been an increase of households (28%) in this period. The industrial sector achieved an important CO2 reduction of 11%. CO2 emissions increased with 3% of the third sector; retail and services. Concerning mobility, a differentiation is made between mobility on local roads and highways due to the internal and external causes explained above. Local mobility has known a sharp increase since 2005 with 22%, and mobility on highways increased with 34%. The last sector, agriculture, has a CO2 reduction of 4%.

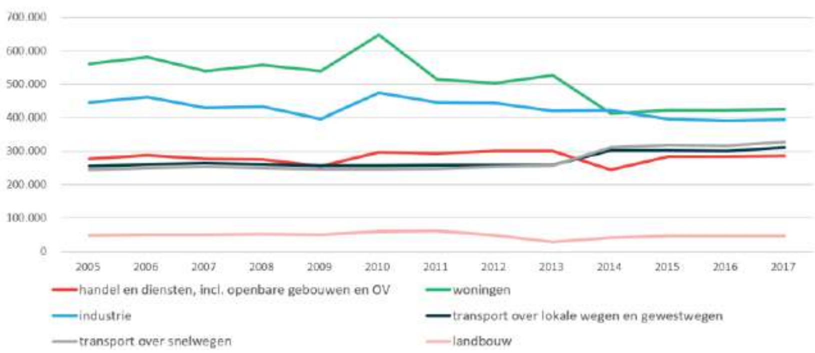


Figure 6: the evolution of CO2-emission per sector (tCO2) 2005-2007
Figure 7: the energy use by different sectors.

Remarkably, South-West-Flanders consumes a lot of its energy for heating and cooling purposes, and most of this thermal energy is used in the housing and industrial sector. Moreover, heat demand in South-West-Flanders covers 53% of the total CO2 emission[4]. This overall percentage is divided over the housing sector (42,5%), the industrial sector (32,5%), the tertiary sector (19,%) and agriculture (0,5%). **These figures clearly indicate that in order to reduce CO2 emissions in South-West Flanders, it will be key to provide sustainable green heat in the future, with district heating having an important role to play.**

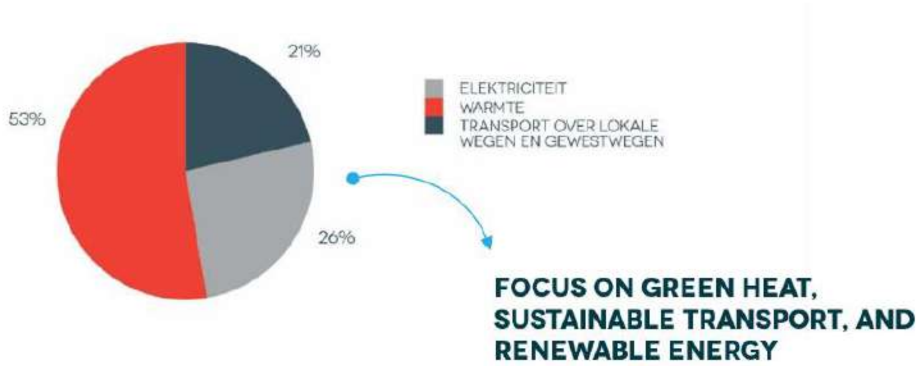


Figure 8: CO2 emissions caused by electricity demand, heat demand, and transport in South-West-Flanders

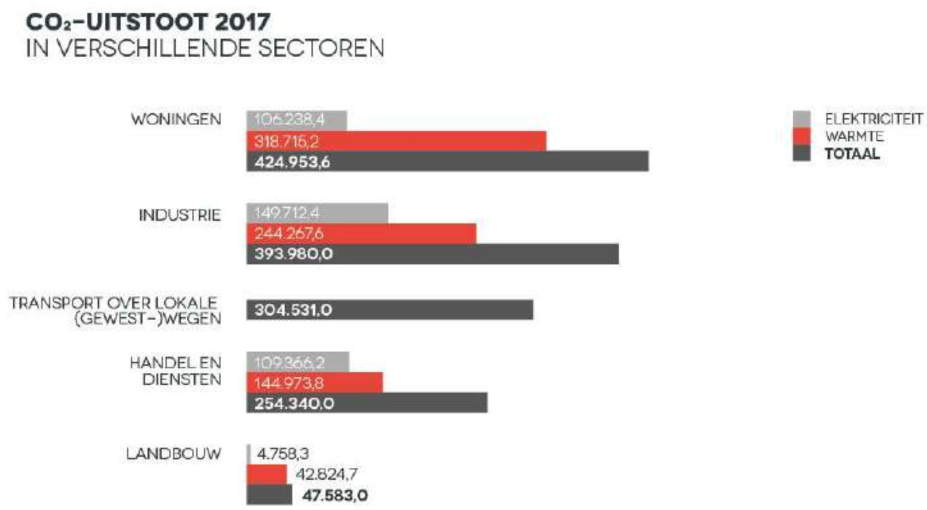


Figure 9: CO2 emission of the housing, industrial, transport, tertiary and agricultural sector. Electricity demand is marked in light grey, heat demand is marked in red (gas).

[4] In 2015, there was a total emission of 1748166 ton CO2, of which 724026 ton CO2 (or 41%) was caused by the heat demand in the housing, industrial, tertiary sector and public facilities. A forest can recuperate 1.4 ton CO2 per hectare per year. In order to compensate CO2 emissions of the entire region, a forest would be needed of 1.179.881ha. This forest is 26 times bigger than the region itself, or about the surface of Flanders (1.352.200 ha). To compensate CO2 emissions caused by the region’s heat demand, a forest would be needed of 517.161 ha. If sustainable green heat is promoted and CO2 emissions can be reduced, a forest is needed of 1.179.881 – 517.161 = 66.270 ha which is about the surface of the provinces East and West Flanders (611.600 ha).

Becoming more energy efficient

Despite an increasing energy demand, the region managed to reduce CO2 emissions with 11% since 2005. Still, a reduction is needed of 20% by 2020. Therefore, South-West-Flanders has to become more energy efficient, and the share of renewable energy and sustainable heat will need to increase. In order to lower the energy demand, the region aims to reduce energy with 38% by 2050 [5]:

- Buildings: heat -60%, electricity -40%
- Industry: -25%
- Mobility: -25%
- Agriculture: -25%

Increasing the amount of renewable energy

The amount of sustainable energy in South-West-Flanders is still limited, but has increased to 8,8%. This includes all locally produced renewable energy sources: solar-energy, wind energy, energy from heat pumps, wood/biomass for heating, energy from cogeneration, biofuels, etc. The purchase of green electricity from outside the region is not being included (for example, the energy use of a family having green energy contracts). Decentrally produced renewable energy sources are increasing in South-West-Flanders; and in record time solar energy became a very important source of renewable followed by biofuel and wind energy. Wind energy in the region accounts for 0.5% of the entire energy demand, solar panels produce 1.8% of the region’s energy. In 2005, this nearly did not exist. The impact of green heat through heatpumps (0.2%) and solar boilars (0.1%) is still limited.

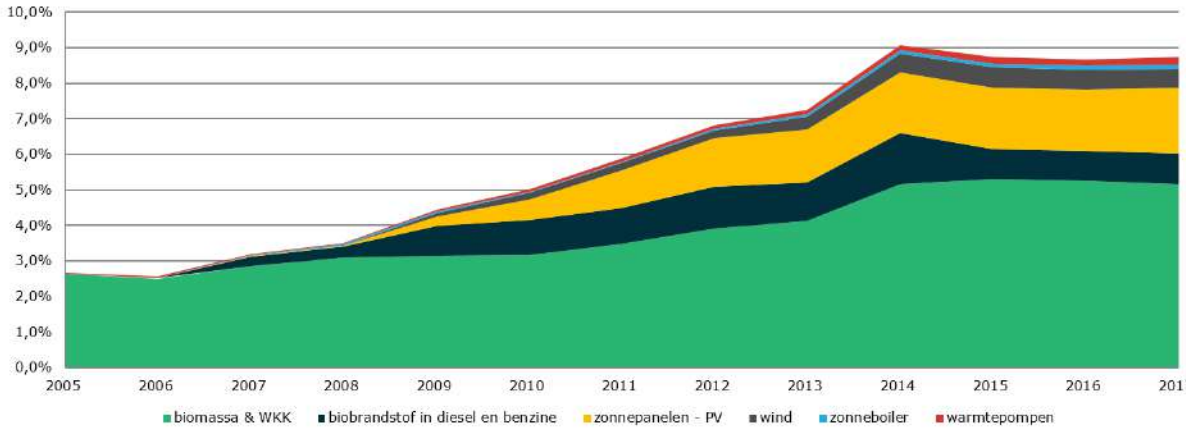


Figure 10: The current share of renewable energy is 8,8% in South-West-Flanders.

[5] The current energy use in the region is 8.271,98 GWh. In 2050, this should become 5.142 GWh or 62%. This means that we will need to reduce 38% of our energy use, which can be achieved by reducing the energy use with 25% in the agricultural, industrial and mobility sector. The heat demand of our built environment needs to be lowered with 60%, and the energy demand with 40%.

To meet climate ambitions in 2050, South-West-Flanders will need to become more energy efficient on the one hand, and increase its amount of renewable energy sources on the other. It is estimated that the energy use – which is still increasing today - will need to decrease with 38% by 2050. The potential of renewable energy sources has as well been calculated, and by 2050 it could cover up to 91%[6] of the region's energy demand, through solar-energy, wind-energy, biomass and ambient heating and cooling.

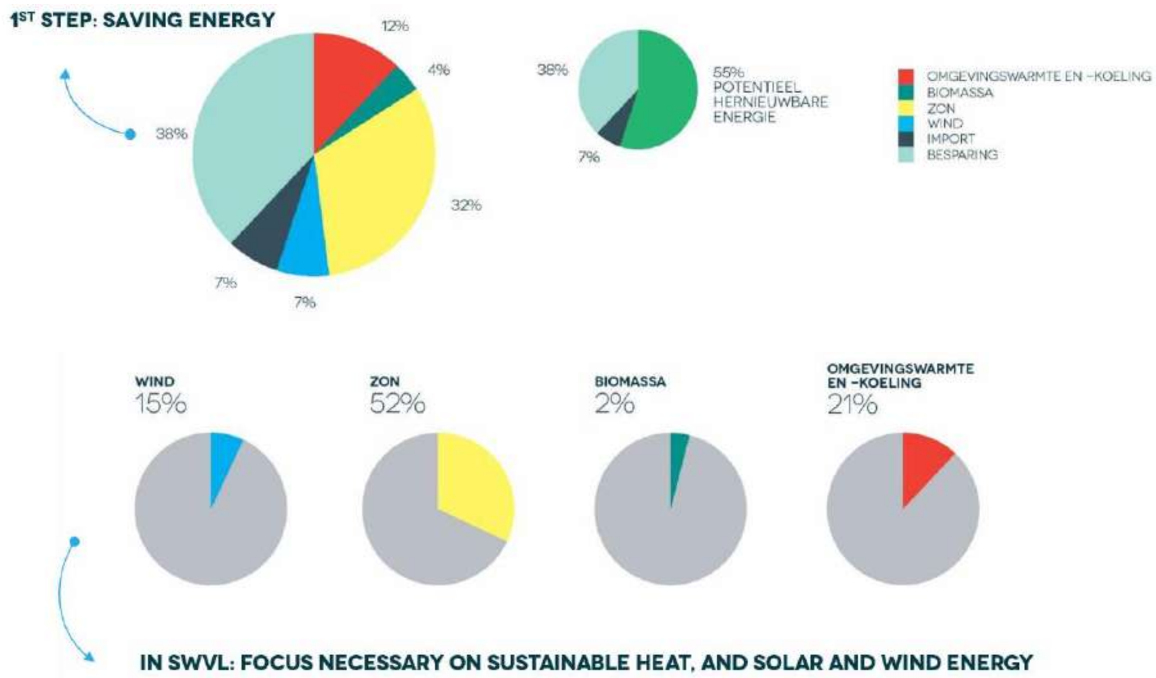
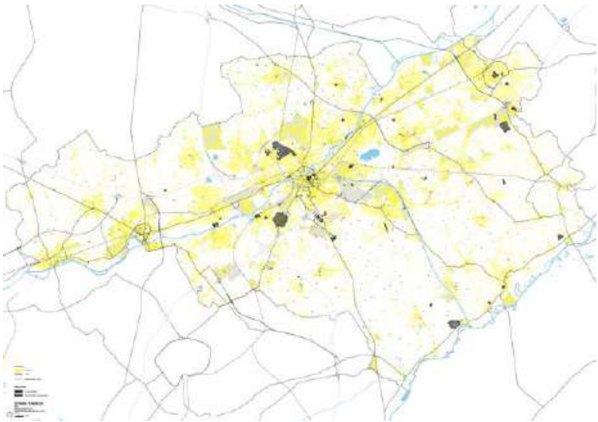


Figure 11: The energy demand will need to decrease by 38% from 2017 until 2050. The potential of renewable energy in 2050 is 91% of the remaining energy demand, namely 4677,83 GWh vs 5141,69 Gwh. Solar energy (yellow) will be the most important renewable energy source compared to wind energy (blue), biomass (green) and ambient heating and cooling (red).

In record time, **solar energy** became a very important source of renewable energy in South-West-Flanders and it will be the most important sustainable energy source in the future. By 2050, solar energy could produce 2.612,32 GWh, which is 55% of the region's entire energy demand (if the energy use reduces by 38%). The map below (left) indicates where solar energy cannot be produced: on agricultural fields in the open space or on heritage sites. The map below (right) indicates where solar energy can be produced: on the roofs of residential areas, industrial factories, retail parks, parking lots, and on the verges of highways.

[6] Based on designerly research and spatial analysis.



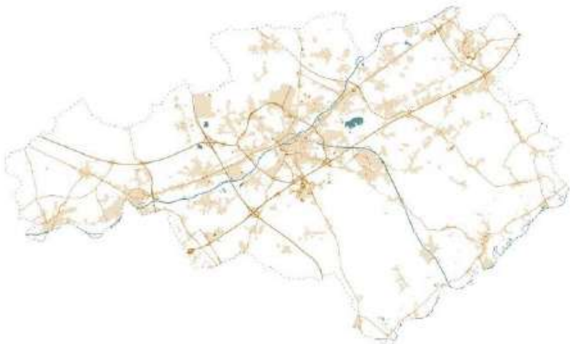


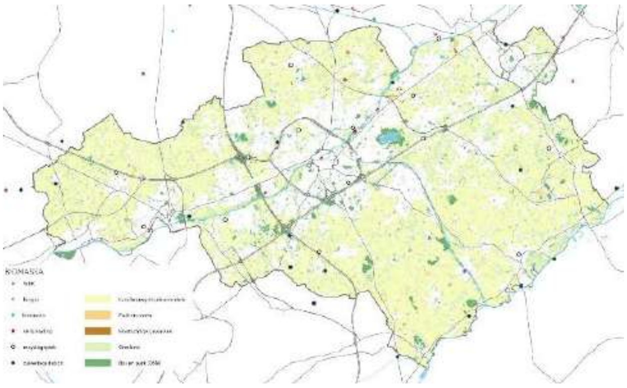
Figure 12 & 13: Potential areas for solar energy in South-West-Flanders.

Figure 14: Potential areas for solar energy in South-West-Flanders.

In Flanders, **biomass** has always been the most important renewable energy source due to the wood stoves people use at home. The map below (left) indicates the main biomass energy sources in South-West-Flanders, such as cogeneration (pink), biogas (blue), waste incineration (red), recycling yards (white), and waste water treatment plants (black). The map clearly shows the very poor availability of forests in the region (dark green) as agriculture dominates the landscape due to very fertile soils. Biomass will most likely not know a major increase in the future. It is estimated that by 2050, it can take up to 7,6% of the energy demand.

The map below on the right indicates a different approach to develop biomass as a renewable energy source in South-West-Flanders. By planting wooded hedges and tree lines along agricultural fields and roads, a local biomass network can be developed. Wooded hedges would be cut every 10 years to provide a local energy source. It is estimated that a network of 825 kilometers would offer green heat to 546 households, which is about half the heat demand of the inhabitants living in Sint-Denijs, a local village. This is based on the rule of thumb that 80 kilometers of wooded hedge offers sustainable heat to 53 households, if it is cut every 10 years.

This clearly shows the huge amount of effort a local biomass network would need. Still, green heat from biomass is a valuable idea for remote areas and villages lacking a gas network and still obtaining heat from fuel. It could be pictured that schools and public facilities could be heated with local biomass in these villages.



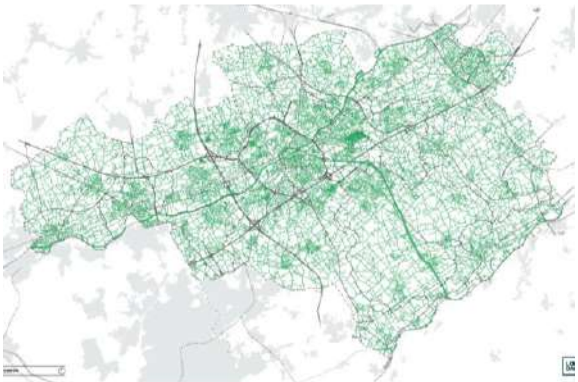
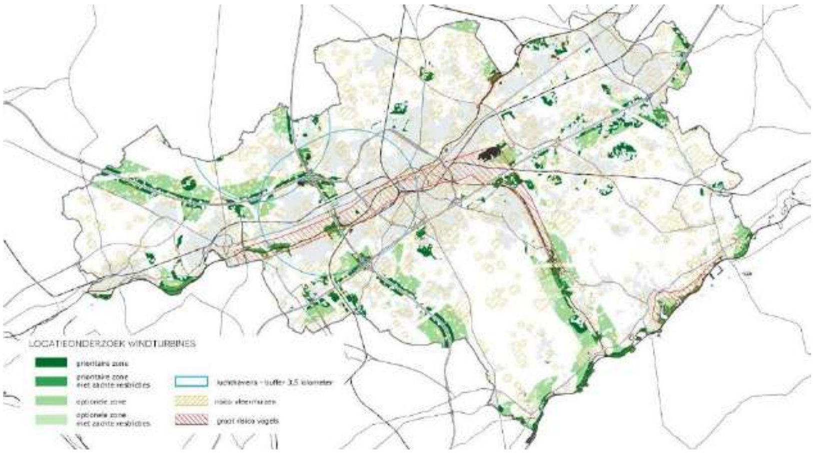


Figure 15 & 16: Potential areas for biomass in South-West-Flanders. Left: obtaining biomass from cogeneration, biogas, waste incineration, recycling yards, and waste water treatment plants. Right: obtaining biomass from a network of wooded hedges and tree lines along agricultural fields and roads.

Figure 17: A local biomass network consisting of wooded hedges and tree lines could go hand in hand with the production of wind energy. The profit gained with the production of wind energy can be invested locally in the requalification of the landscape through f. e. the enhancement of biodiversity, water/green management, …

The (dark) green areas on the map below (on the left) are potential zones for extra wind turbines in South-West-Flanders. These locations were defined by current legislation: wind turbines need to be placed near 'linear infrastructures' such as rivers, canals, highways and major roads. Due to this rule, it is not possible to place wind turbines in open agricultural areas. In addition, a lot of safety measures need to be taken into account so wind turbines would not be constructed near airports, residential areas, nature reserves, railroads, or high voltage power lines. Due to the very dispersed built environment in South-West-Flanders, there are only few locations for wind turbines left. Moreover, local inhabitants often do not support the construction of wind turbines near their homes, and many legal procedures slow down the introduction of renewable wind energy. Nonetheless, a mapping exercise reveals that of about 100 extra wind turbines could be constructed, which would be an increase of 720 GWh of sustainable energy, or 15% of the energy demand in 2050 (if the energy demand reduces with 38%).



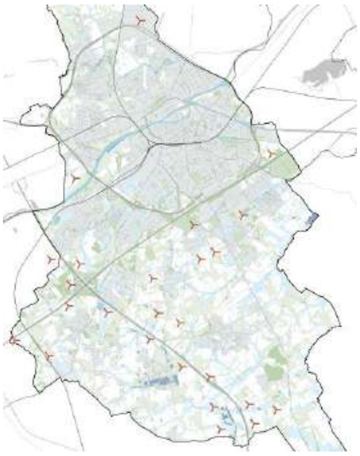
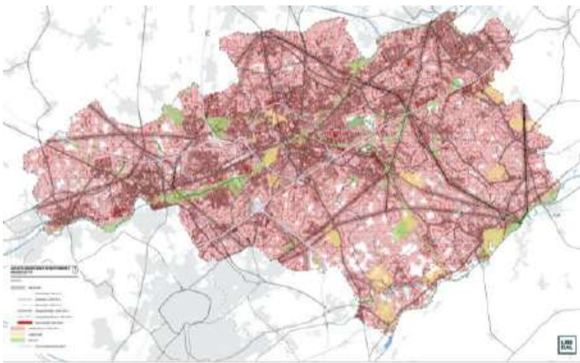


Figure 18: Potential areas for wind energy in South-West-Flanders.
Figure 19: 25 extra wind turbines could be placed in the Kortrijk area.

During the capacity building workshop for the city of Kortrijk, a different methodology was applied to define the most ideal location for wind energy production in South-West-Flanders. This time, wind turbines would be placed in 3 large clusters in the open agricultural areas (map below on the right). The wind energy which is being produced would be locally stored and distributed in large ‘E-hubs’ on industrial sites (marked in grey). The map below on the left indicates all areas where wind energy cannot be produced: near residential areas (red), nature reserves (green and yellow), high voltage power lines (grey), cultural heritage sites (yellow) and so on. Therefore, the white areas on the map are zones where wind energy produces hardly any nuisance. Following this logic, an extra 175 wind turbines could be placed in South-West-Flanders. Over time, housing situated near the 3 wind energy clusters would be phased out so the clusters can expand.



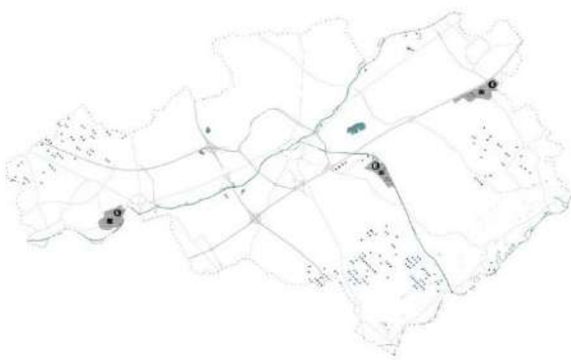


Figure 20: the white areas indicate zones where wind energy production causes hardly any nuisance.
Figure 21: 3 wind energy clusters and E-hubs.

Figure 22: Wind energy clusters in open agricultural areas.

The map below indicates the areas situated near waterways and therefore suitable for cold and heat storage. This map is based on data provided by the 'LATENT' project. 'LATENT' stands for 'Lage Temperatuur EnergieNet evauatieTool' or 'Low Temperature EnergyNet evaluationTool'. The project investigates the operational and legislative conditions to realise collective energy-nets on very low temperatures. The supply of energy for industries and buildings is often provided on an individual basis. Collective heat nets would be an interesting alternative. The current generation of insulated buildings has a very low heat demand and relative important cooling demand. District heating needs to respond to this tendency by exchanging energy on very low temperatures (5-30 degrees) so both heating and cooling becomes possible. The very-low-temperature nets makes use of natural energy sources such as surface and ground water to exchange energy between users.

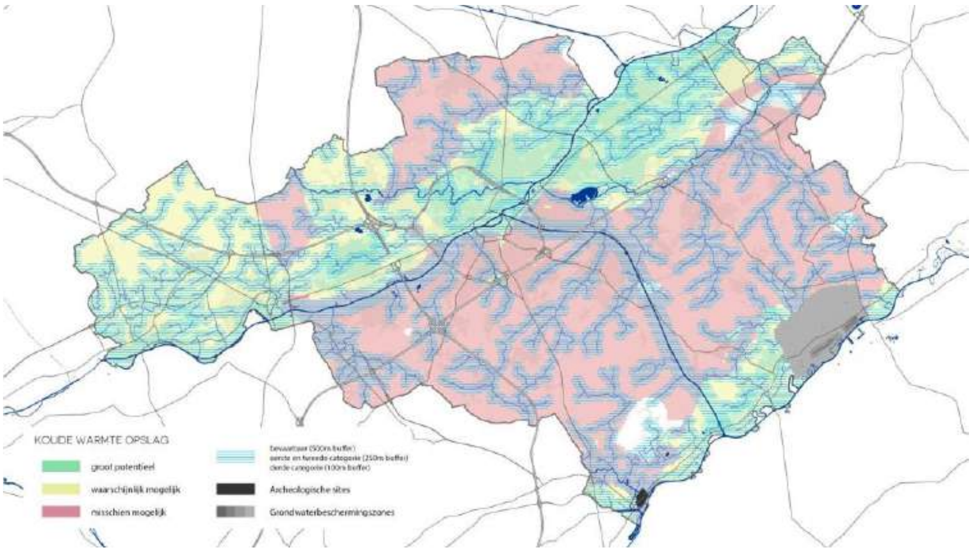


Figure 23: Potential areas for cold and heat storage in South-West-Flanders.

The map below summarizes the above research, and therefore indicates the ‘Energielandschap Zuid-West-Flanders’ or ‘Energy landscape for South-West-Flanders’. In the built environment, and especially on the roofs of industrial factories, solar energy can be produced. In the wide open agricultural fields, there is room for wind energy. The profit generated with the production of wind energy is invested in the landscape and a local biomass network. Energy can be stored and distributed in 3 large ‘Energy hubs’ marked in grey. And of course, centrally we have a large district heating system marked in red, providing sustainable heat to the built environment along the river Lys in South-West-Flanders.

Figure 24: Energielandschap Zuid-West-Vlaanderen / Energy Landscape South-West-Flanders

Conclusion on the potential of sustainable energy and heat in South-West-Flanders

By 2050, 91% of the energy demand can be locally produced with renewable sources if 38% of the energy use is reduced. Solar energy will be the most important source of renewable energy in South-West-Flanders, followed by ambient heating and cooling and wind energy. Moreover, the region’s heat demand currently covers 23% of the total CO2 emission. So, in order to cut CO2 emissions it will be key to provide sustainable green heat in the future, with district heating having an important role to play. By 2050, South-West-Flanders can become climate neutral if financial resources for energy and heating are spent locally. A new energy system would ensure that the region no longer needs to buy energy and gas elsewhere. For this local and integrated energy system, energy efficiency measures need to be taken (such as a profound renovation of the housing stock), and a low temperature district heating network needs to be combined with renewable energy sources.

District Heating in South-West-Flanders

Current urban development pattern and energy system

Urban development in South-West-Flanders is characterised by its very dispersed nature. Settlements were originally oriented towards the river Lys. Over time, layers of infrastructure were added such as district roads, railway lines, and highways. These infrastructures, especially the highways with its many exits, caused many places which were once hard to reach to become very accessible. Consequently, urbanization expanded in the sixties and seventies resulting in urban sprawl and a ‘horizontal metropolis’ concentrated among the river and the many infrastructural bodies. In urban planning terms, we call this the ‘verstedelijkte ladder’ of South-West-Flanders or the ‘urbanized ladder’[7]. Another characteristic of the urban settlement pattern in South-West-Flanders - relevant to the current and future energy system - is the many industrial sites (purple) situated in the middle of residential areas. This results in the availability of waste heat very close to the residential areas having a large heat demand. The map below also indicates the current district heating networks and heat sources in Middle- and South-West-Flanders. The city of Roeselare already has a district heating system since 1986, connecting the waste incineration plant MIROM with the city’s public facilities. This district heating system is now expanding towards (new) residential areas and therefore questions are raised about the future operation of the grid. In South-West-Flanders a new district heating system recently opened in the municipalities Harelbeke and Kuurne from the waste incineration plant IMOG. In the city of Kortrijk a district heating system is currently being developed as one of the pilot cases of the HeatNet project. What characterises these district heating systems, is their close proximity towards the river Lys.

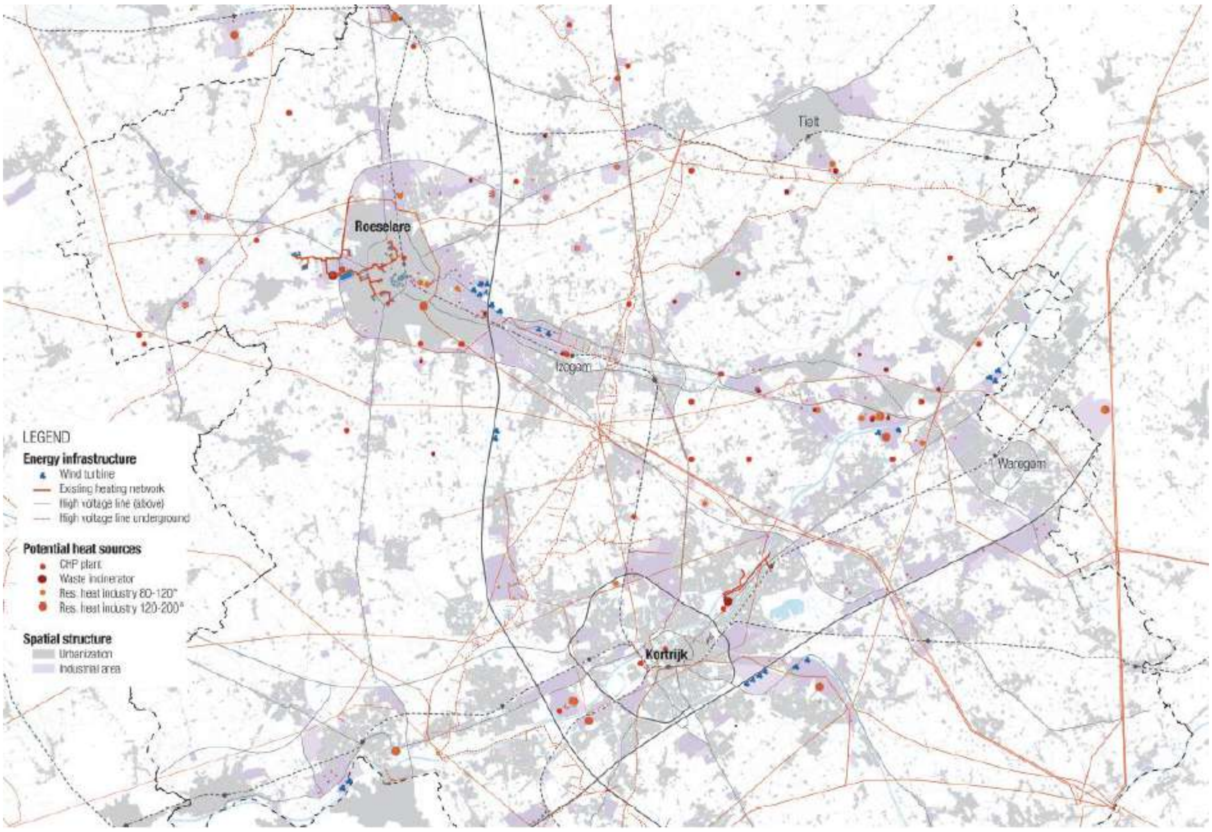


Figure 25: Current urban development pattern and energy system. Source: Griet Juwet, VUB.

Current Situation of Sustainable Heat in South-West-Flanders

The map below situates existing developments encouraging the supply of sustainable heat in South-West-Flanders. For example, new district heating networks are being developed in Harelbeke, Kuurne and Kortrijk. The social housing estate ‘Venning’ supplies heat through a biomass installation. On ‘Transfo’, a former coal power plant, a smart energy grid is being developed, and the crematorium is willing to provide heat towards the university site KULAK, and so on.

[7] This ‘ladder’ consists of the E17, railway lines, and another infrastructures parallel or perpendicular to the river.

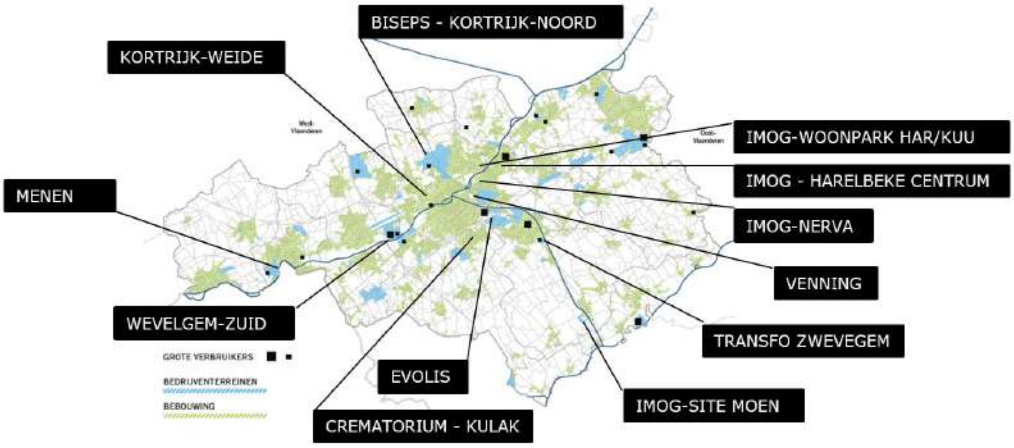


Figure 26: Sustainable Heat in South-West-Flanders. *In South-West-Flanders a new district heating system recently opened in the municipalities Harelbeke and Kuurne from the waste incineration plant IMOG. In the city of Kortrijk a district heating system is being developed as one of the pilot cases of the HeatNet project.*

A future Energy System for South-West-Flanders

Mapping Heat Demand

The Heatmap of Flanders (figure 28) indicates where district heating networks already exist and the areas with opportunities to develop new ones (marked in red). This map was developed by VITO and the Flemish Energy Agency. It is remarkable that the Pan-European Thermal atlas[8] is a lot more detailed than the Flemish heatmap. Nonetheless, the Flemish map ensures that there are opportunities for district heating networks in South-West-Flanders, and the map already indicates the shape of the 'warmteboemerang' (a regional district heating network along the river Lys, which will be explained further).

It was necessary to make a more detailed heatmap for South-West-Flanders in order to have a better view on local opportunities for district heating. In order to make these maps, we made use of open data sources from 'Fluvius', a grid operator. We analysed the open data sources in such a way that it is easy to know the locations where district heating is feasible. It has been empirically proven that district heating networks are opportune from 3MWh heat demand per meter street-length. Extra research is needed when heat demand is between 1,8 and 3 MWh. In this case, surrounding characteristics become important and will determine the feasibility of district heating networks in a certain area (Nussbaumer & Thalmann, 2014). The heat maps of South-West-Flanders and Middle-West-Flanders indicate where district heating networks are definitely feasible (red), and the locations where extra research is needed (yellow). In South-West-Flanders, 24% of the housing stock could be connected to a district heating network, and 49% of the industrial companies.

[8] https://maps.heatroadmap.eu/berndmoller/maps/31157/Renewable-Resources-Map-for-EU28?preview=true#

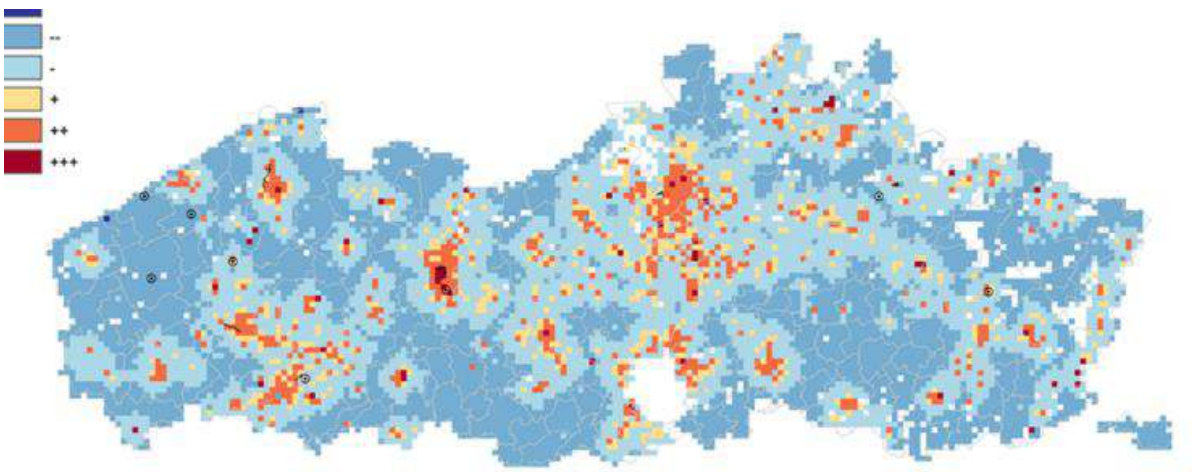


Figure 27: Heat Demand in Flanders. Source: VEA & VITO.

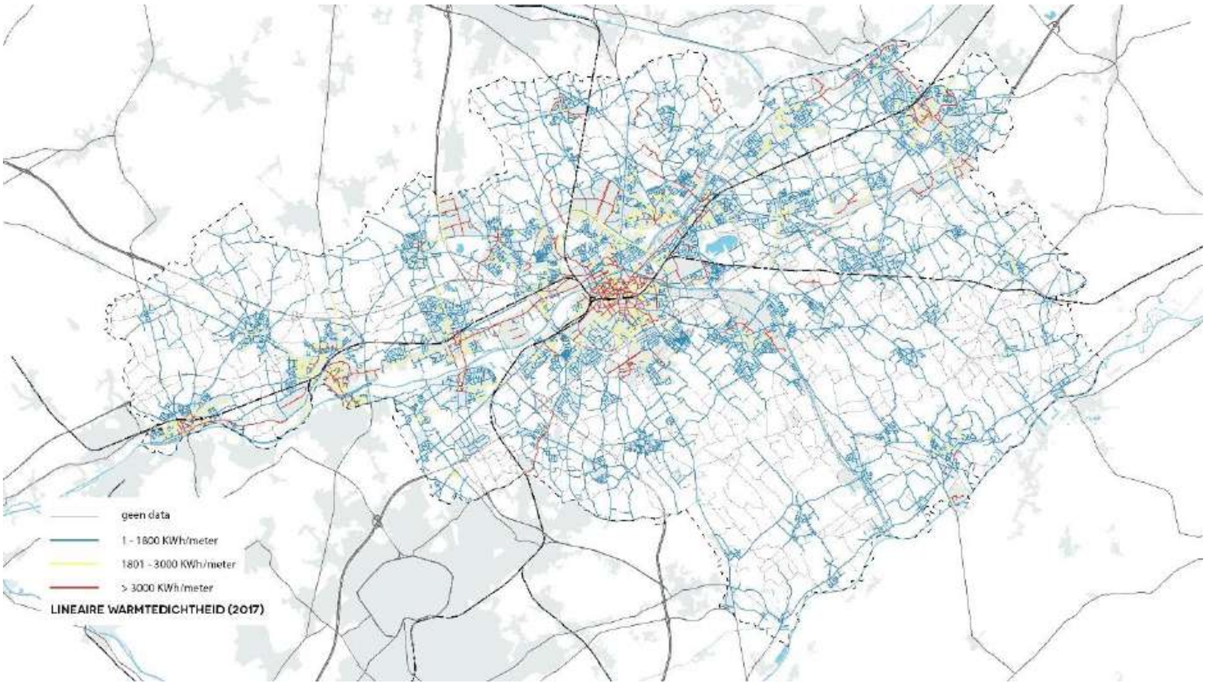


Figure 28: Heat Demand in South-West-Flanders. The colour red indicates the areas where district heating is feasible. The colour yellow indicates where extra research is needed.

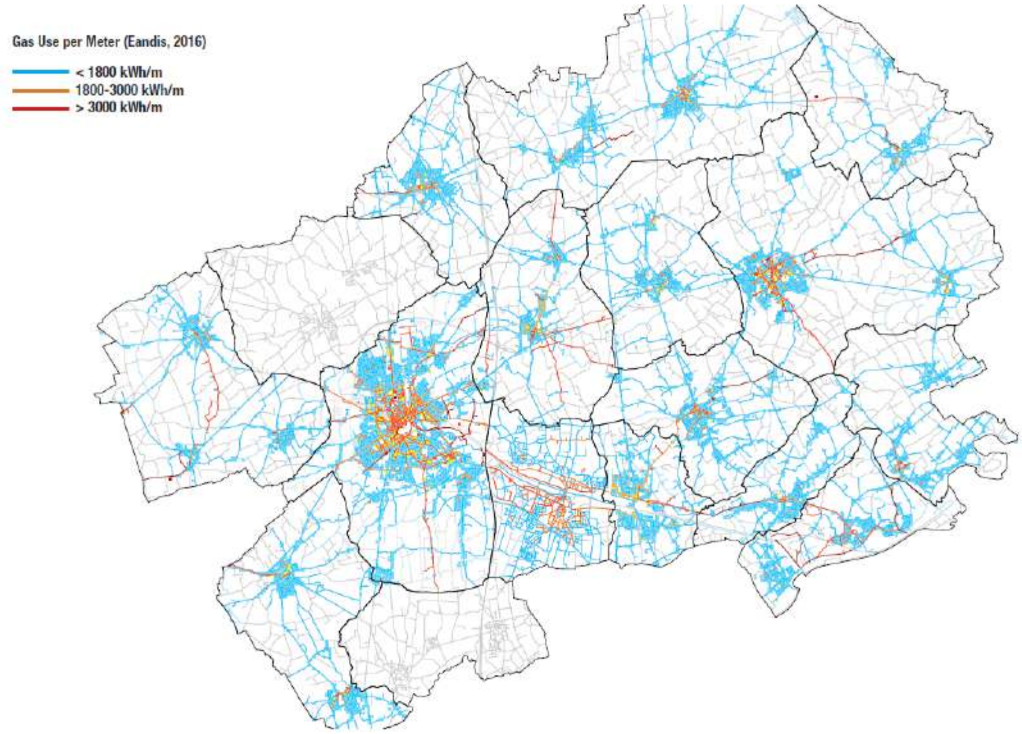


Figure 29: Heat Demand in Middle-West-Flanders. The colour red indicates the areas where district heating is feasible, the colour yellow indicates where extra research is needed. Source: Griet Juwet, VUB.

The table below provides extra insights into the locations where district heating is feasible in South-West-Flanders. On the one hand, it shows that a district heating system could have the opportunity to lower the existing gas use with 74%. On the other hand, the locations where a district heating system would be feasible, show an overlap with the areas where the current gas network is remunerable. (People living in dense urban areas pay for the infrastructure and gas network needed in remote areas - as the gas price is the same).

	Street length (km)	**Number of access points**	**Share of gas use (%)**
District heating is feasible	152	19,337	74%
Extra research is needed to ensure the feasibility of district heating	180	21,177	21%
District heating is not feasible	909	54,685	5%

Figure 30: The areas where district heating is feasible, show an overlap with the areas where the gas-net is remunerable.

The map below demonstrates a different way to map heat demand in South-West-Flanders. In this map, a distinction is made in the type of user and the ‘easiness’ to connect this user to a district heating system. Governmental buildings (dark green), public facilities, hospitals and schools (green) are easier to connect than individual house owners (red). Somewhere in the middle we marked the social housing projects, urban renewal projects and offices (yellow), and industrial companies and heritage sites (orange).

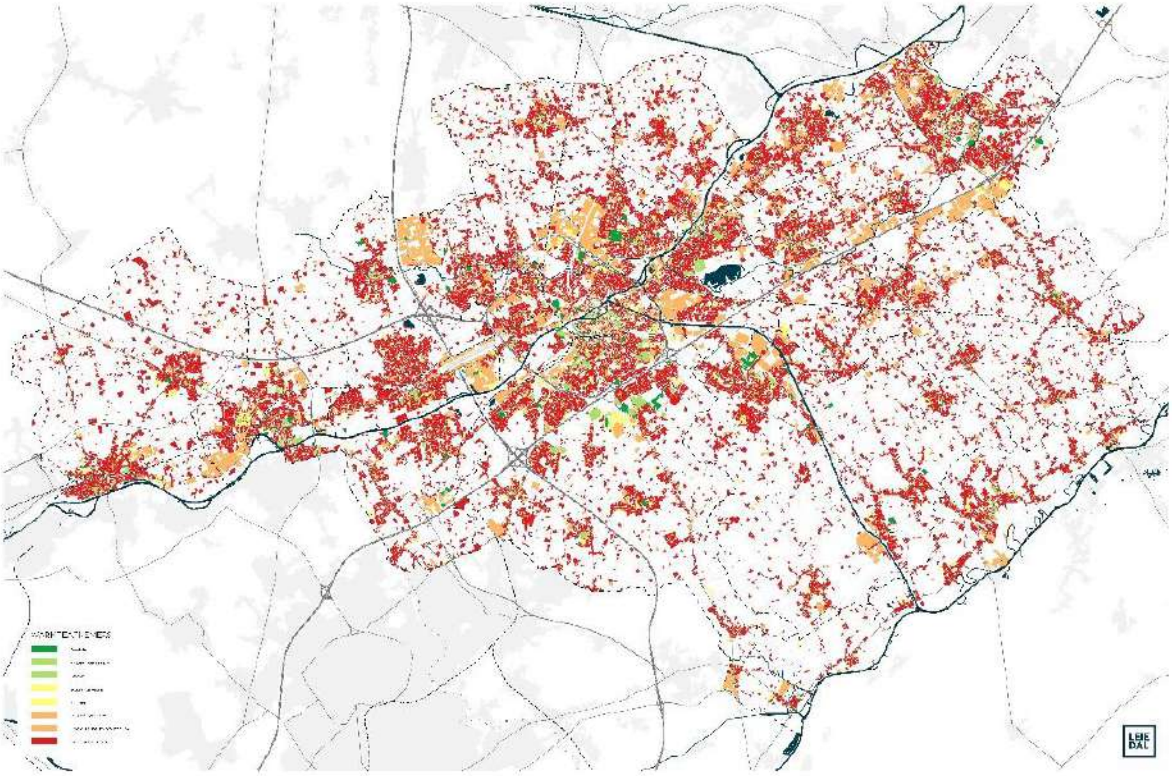


Figure 31: Heat demand mapped according to their users. Governmental buildings and public facilities (green) are easier to connect to a district heating network than individual house owners (red).

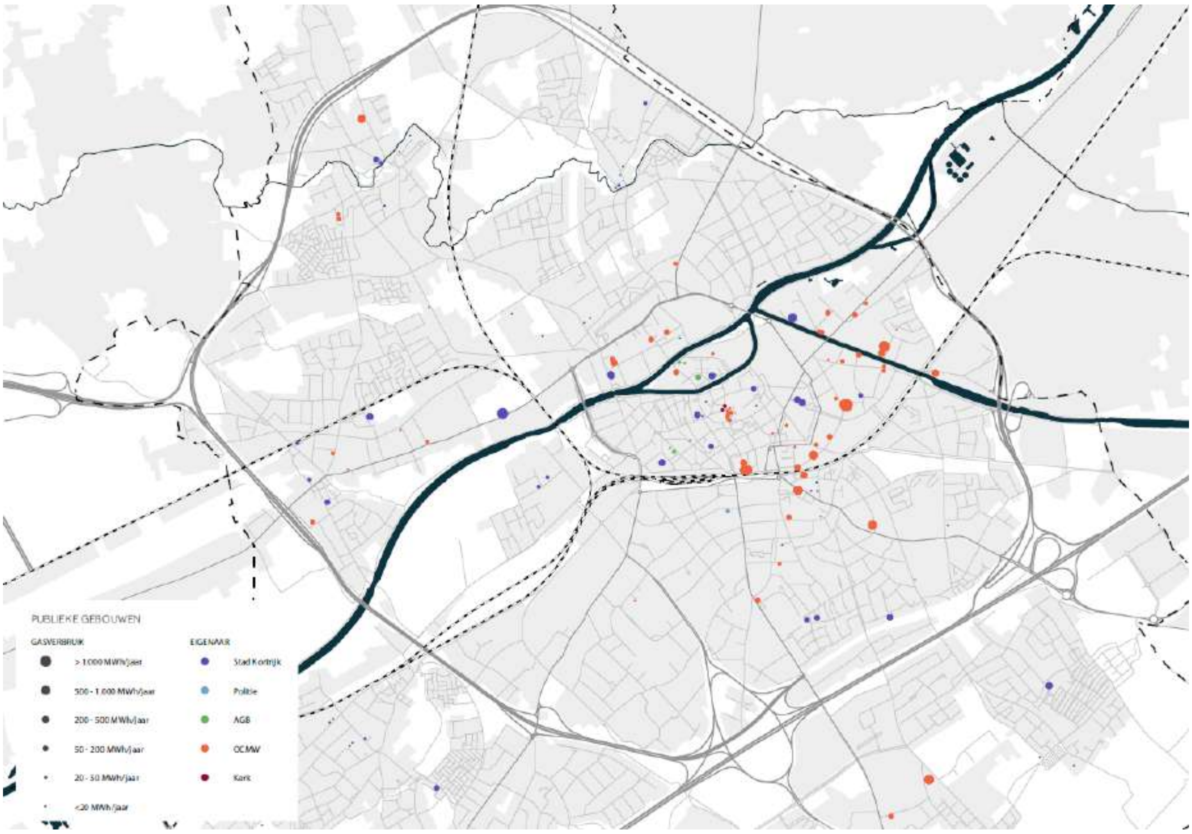


Figure 32: Heat demand by the public facilities of the City of Kortrijk. This map makes it possible to define the trajectories of district heating networks.

Mapping Heat Sources in South-West-Flanders

The ‘POM West-Vlaanderen’ made an interactive heatmap. This map indicates the existing district heating networks (blue lines) and sources of industrial waste heat in West-Flanders. The map is interactive as it is possible to add missing information. The flame-symbols mark sources of industrial waste heat where an energy-audit has been undertaken. The grey dots indicate potential sources of waste heat, as information is still lacking. The green lines show possible new trajectories of district heating in the future.

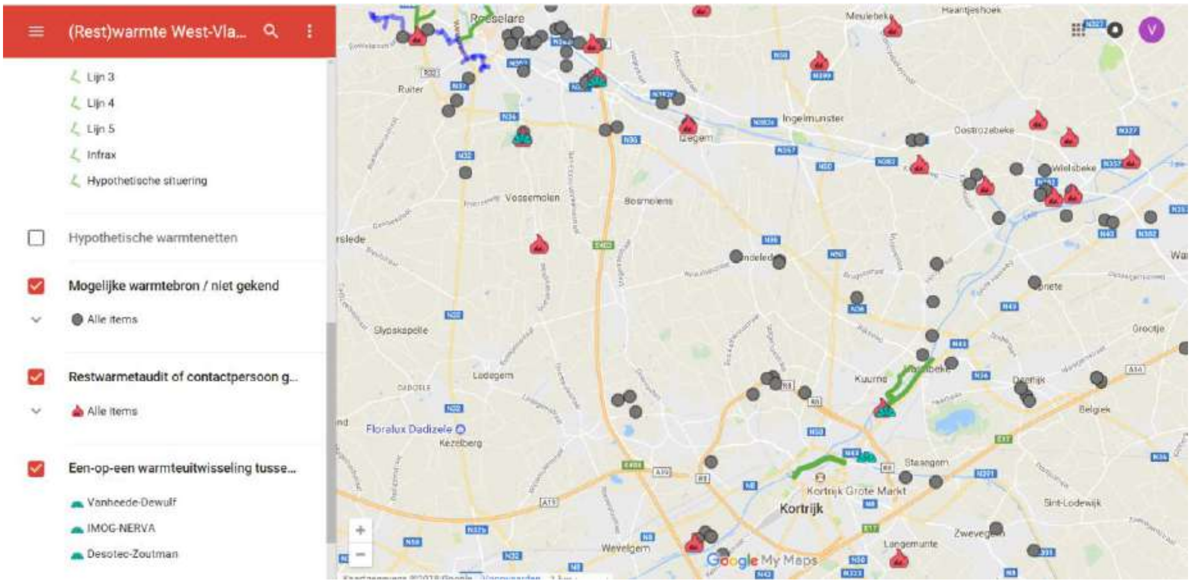


Figure 33: Heat Map Pom West-Flanders. Source: http://www.pomwvl.be/warmtenet

In (Middle) and South-West-Flanders the main heat sources are:

- Waste Heat from installations with electricity production: Biokracht A&S Oostrozebeke, 120GWh heat production
- Waste incineration plants: IMOG, Harelbeke with a potential heat-output of 190 GWh/year and MIROM in Roeselare
- Cogeneration plants: Hogeschool West-Vlaanderen Howest (280 kWe); Biogas-Wkk Alpro Wevelgem (209, 4 kWe); WKK Beaulieu (WKK335) (254 kWe); RWZI Kortrijksesteenweg 308 Harelbeke (200 kWe); WKK AZ Groeninge (142,5 kWe), WKK Knauf Isolava Wielsbeke (254 kWe); WKK-0363 Neegro Ingelmunster (1400 kWe); Senergho Hooglede (1064 kWe); groeikracht Bavikhove (2057 kWe); Franky Galle Ingelmunster (1485 kWe); Depovan Roeselare (1074 kWe); De Sprong Kortrijk (1558 kWe); Tovabo Kortrijk (2000 kWe); Varegro Oostrozebeke (2014 kWe); WKK Balta Avelgem (1758 kWe); WKK Balta St-Baafs-Vijve (5922 kWe); Agristo (537 kWe)
- Waste heat from ‘ETS’ industries: Alpro Wevelgem, Cargill Izegem, Lutosa Sint-Eloois-Vijve, Bekaert Zwevegem, Concordia Textiles Waregem, Balta Industries Wielsbeke, Lano Harelbeke, B.I.G. Floorcoverings Wielsbeke, Verlimas Kortrijk, Dumoulin Bricks Roeselare, Wienerberger Aalbeke, Unilin Wielsbeke, Linopan Wielsbeke, Unilin Oostrozebeke, EDF Luminus Izegem, EDF Luminus Harelbeke,
- Industrial waste heat from SME’s: see map below, e.g. Masureel Wevelgem, Volysstar Lendelede, …
- Biomass: at the social housing estate Venning, IMOG Moen

- Biogas: Leiestroom Menen, Aquafin
- Waste Water: Harelbeke & Waregem. At Harelbeke sludge/mud is being transformed into methane which once again is being transformed into electricity and heat through cogeneration.

Other potential heat sources are: thermal solar panels, Borehole Energy Storage (BES), cold and heat storage, surface water, sewages, geothermal energy, organic waste, …

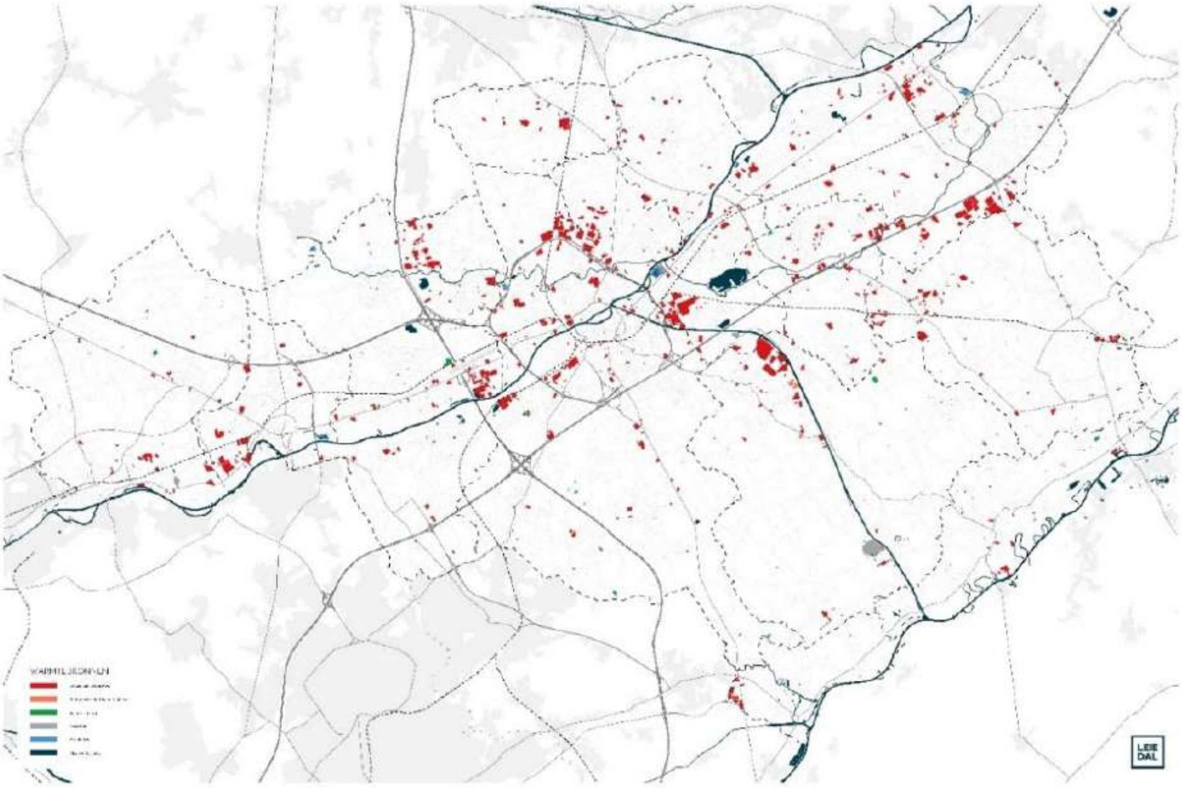


Figure 34: South-West-Flanders: a region of Small and Medium-sized Enterprises. Map indicating (possible) waste heat sources.

Introducing new heat sources to South-West-Flanders?

In order to meet the Paris agreement, the 'energiepact' was made by the federal state and the Belgian regions. This pact draws policies for the coming years aiming for a more efficient energy use and the development of renewable energy production. Several of these policies may impact the regional energy strategy for South-West-Flanders. For example, by 2025 Belgian's nuclear energy production needs to be replaced by gas and renewable energy, and by 2050 there should only be renewable energy. The energypact states that this ambition needs to be supported by 5GW gas fired power plants in 2022-2025. The question is where these will be located, and if they could be connected to local district heating networks. This is already the case in Dusseldorf, where thanks to cogeneration the efficiency of the gas fired power plant increased from 55 to 85 percent. Moreover, as there is a search for extra heat sources[9] in South-West-Flanders, it would be interesting to locate a gas fired power plant in the region. If the region misses out on this opportunity, the idea could be to make use of smaller but multiple WKK's (cogeneration) on a neighbourhood level. Another policy of the energypact which may impact the energy strategy of South-West-Flanders is the phasing-out of oil and gas for

[9] The heat demand of South-West-Flanders is 360 to 720MW. IMOG, the waste incineration plant, can produce 35 MW maximum.

heating. From 2021, new (housing) development projects are no longer allowed to connect to the gas network and from 2035 new gas grids will no longer be constructed.

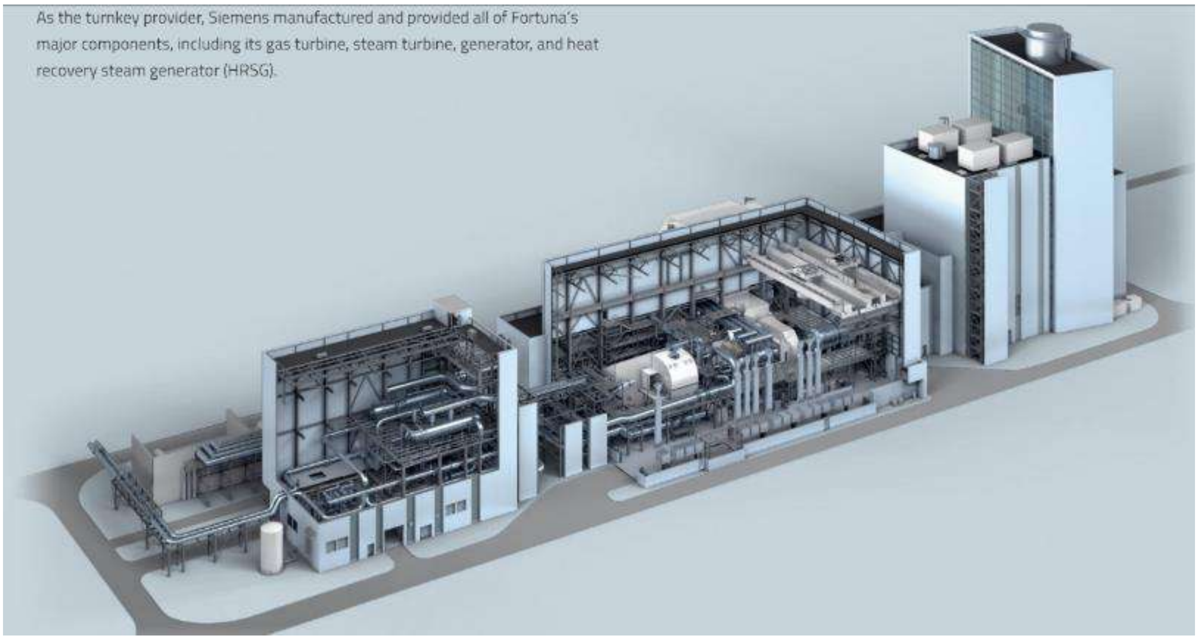


Figure 35: Gas fired power plant in Dusseldorf making use of cogeneration.

Neighbourhood Energy Plans

To make an energy transition possible, and in order to lower the heat demand of South-West-Flanders, it is important to insulate existing family houses and to develop systematic approaches at neighbourhood level[10]. On the one hand, the selection of a certain energy-solution is strongly depended on neighbourhood typologies as they have their specific densities and energy-profiles. On the other hand, neighbourhoods having similar (energetic) characteristics can go through a similar transformation in order to achieve a sustainable energy supply. For example, urban city centres have a high density and energy use, thus a large theoretic potential for a district heating network. The more rural neighbourhoods have a much lower energy-density and so it is a lot more likely that these neighbourhoods need to find energy solutions at building level. Based on this reasoning, we defined 12 different neighbourhood typologies in South-West-Flanders and connected every typology with an sustainable energy and heat solution. In industrial areas, waste heat can be connected to district heating networks, and social housing estates benefit from the fact that there is no fragmented ownership marking large-scale renovations possible (such as the Venning in Kortrijk). In less dense areas, 'all electric' solutions are preferred, such as solar thermal panels or (geothermal) heat pumps.

In the future, gas will be phased out and local municipalities need to be prepared for this transition by having local neighbourhood energy plans. These plans propose sustainable energy-networks and heat technologies for different neighbourhoods (in South-West-Flanders). During the capacity building workshop, local masterplans are made for all 13 municipalities. These plans contain concrete proposals to make municipalities climate neutral by 2050, and indicate where renewable energy sources need to be placed, just as which solutions for green heat (district heating networks or individual installations) are appropriate.

[10] Inspiring sources: "Naar een vergroening van de warmtevoorziening voor huishoudens in Vlaanderen" by Kelvin Solutions and BBL, and "Denkbeelden voor een slimme energiestad Groningen".

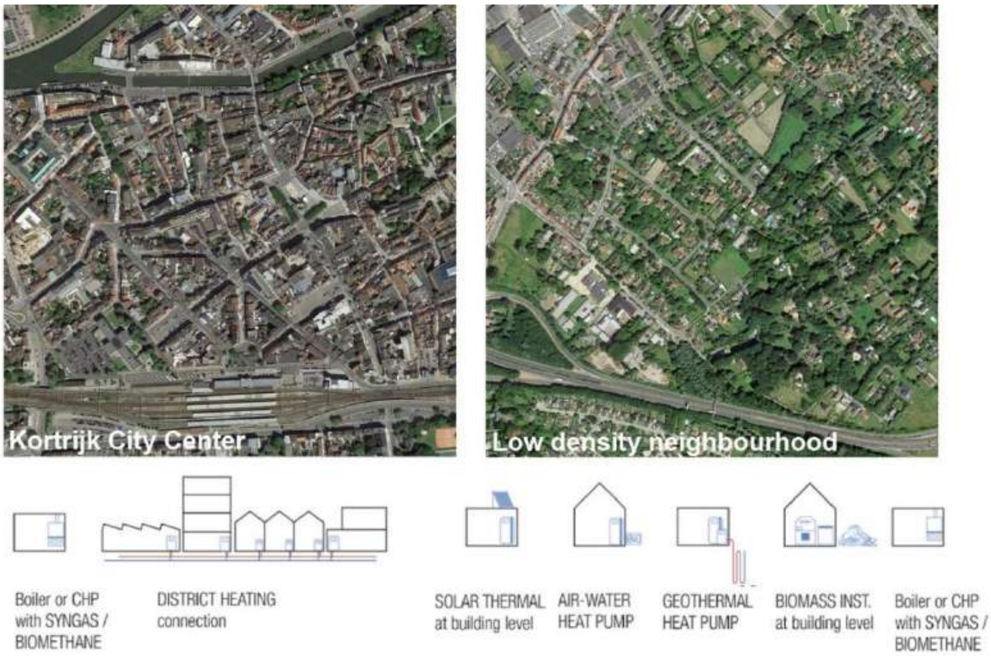


Figure 36: Different energy-solutions for dense urban areas and low density neighbourhoods. Source: Griet Juwet, VUB.

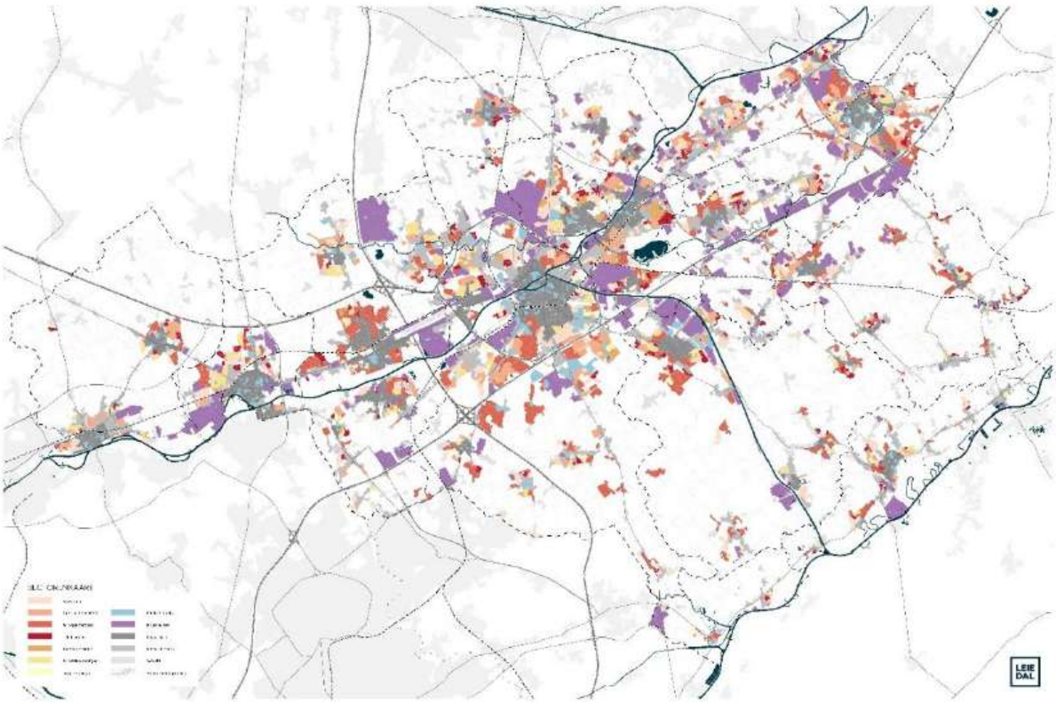


Figure 37: The 'wijkenergiekaart' or 'neighbourhood energy map' of South-West-Flanders indicating 12 different neighbourhood typologies having their own specific sustainable energy and heat solution.

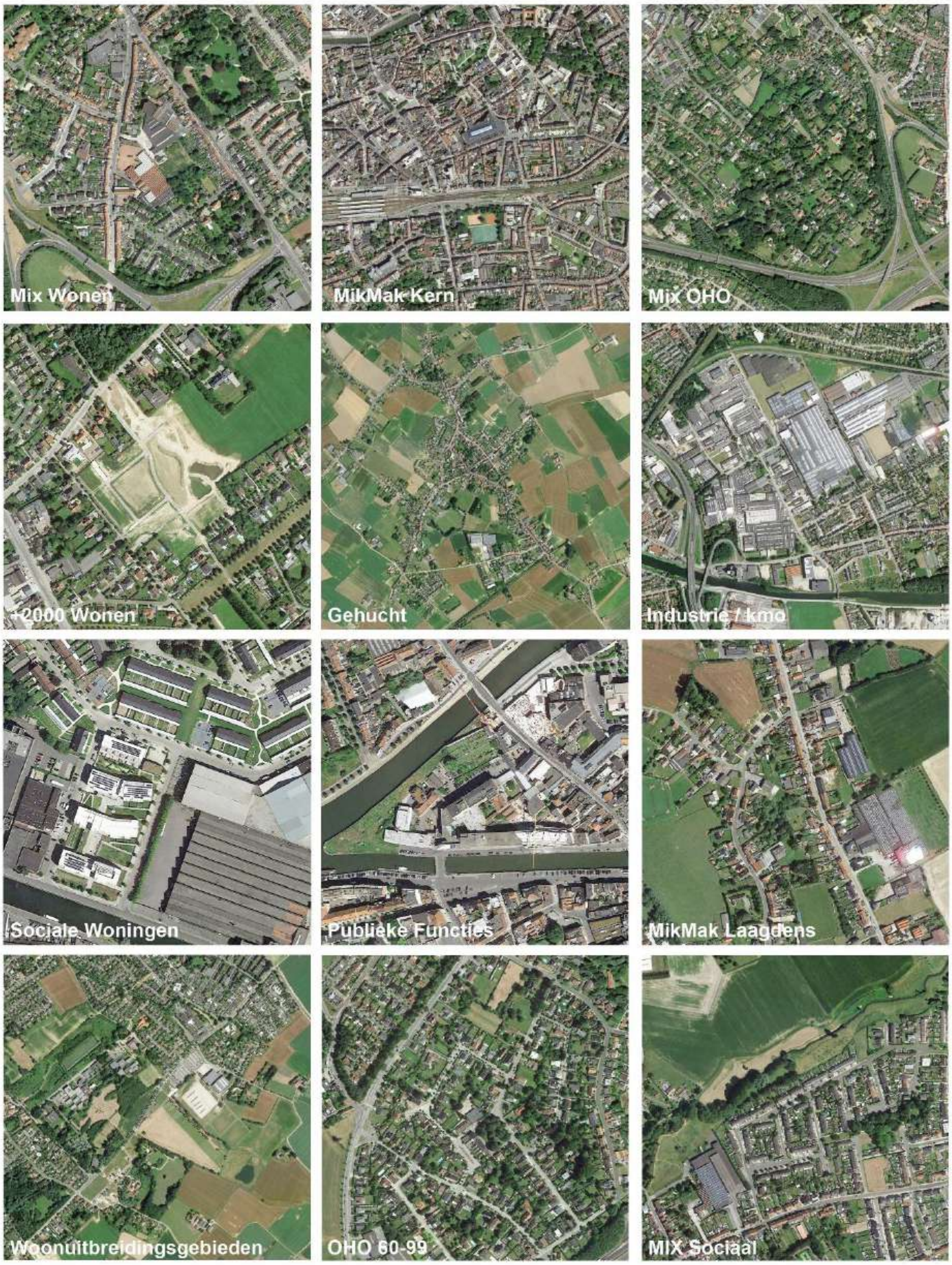
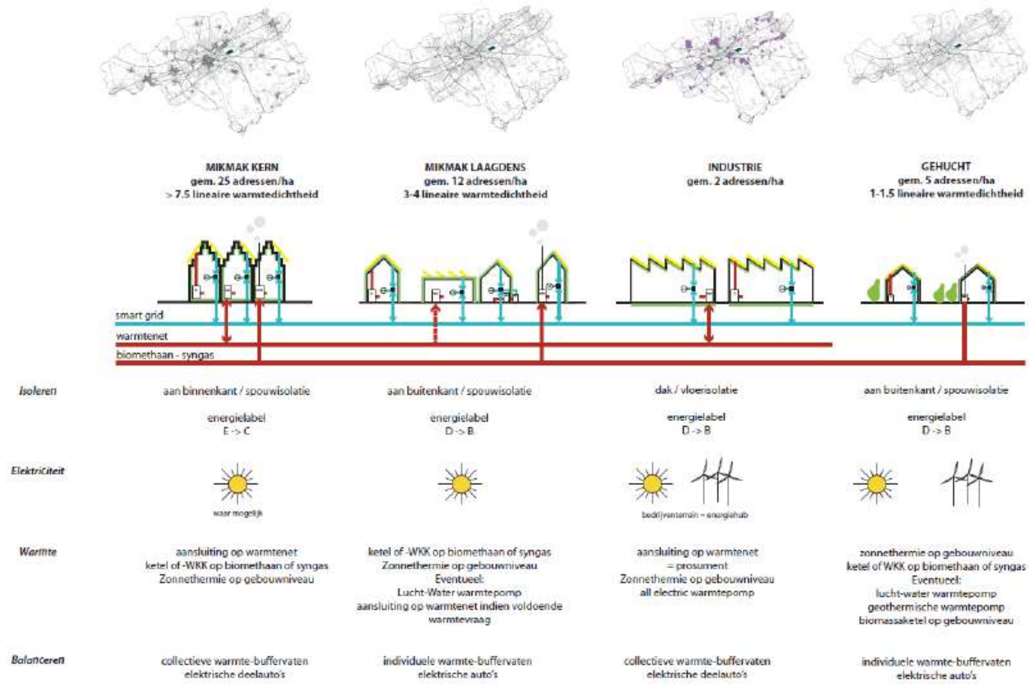
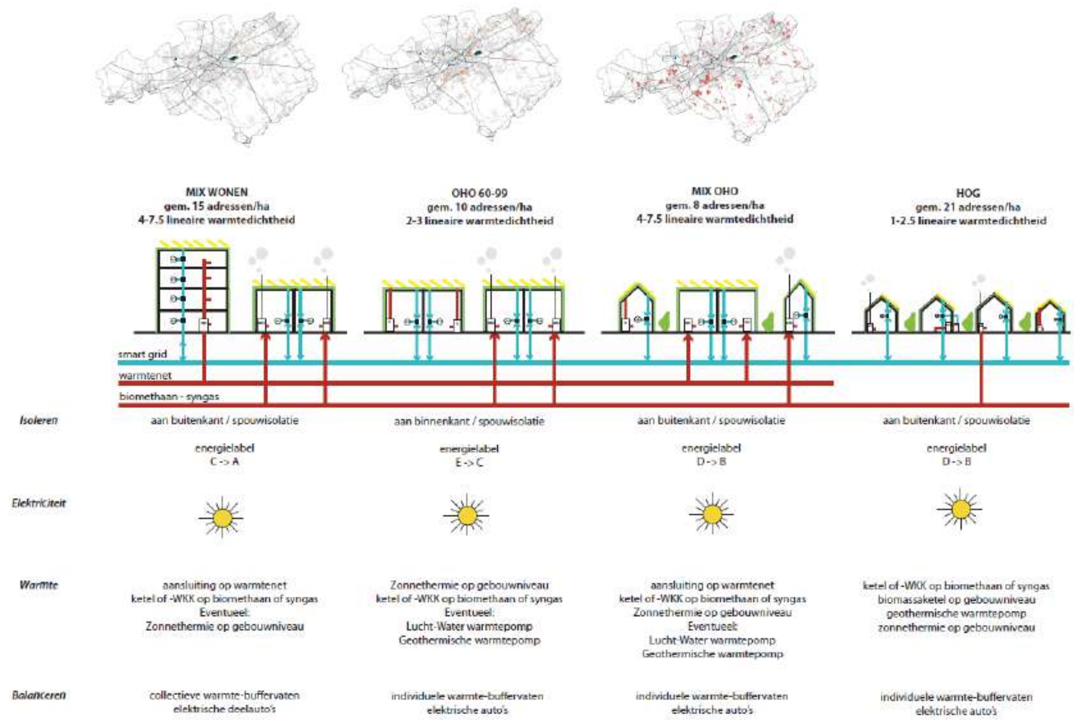


Figure 38: Neighbourhood typologies in South-West-Flanders. Each typology has its own specific density and characteristics. Therefore, they have different energy-solutions.


MIKMAK KERN
gem. 25 adressen/ha
> 7.5 lineaire warmtedichtheid
MIKMAK LAAGDENS
gem. 12 adressen/ha
3-4 lineaire warmtedichtheid
INDUSTRIE
gem. 2 adressen/ha
GEHUCHT
gem. 5 adressen/ha
1-1.5 lineaire warmtedichtheid
smart grid
warmtenet
biomethaan - syngas
Isoleren
aan binnenkant / spouwisolatie
energielabel
E -> C
aan buitenkant / spouwisolatie
energielabel
D -> B
dak / vloerisolatie
energielabel
D -> B
aan buitenkant / spouwisolatie
energielabel
D -> B
Elektriciteit
waar mogelijk
bedrijventerrein = energiehub
Warmte
aansluiting op warmtenet
ketel of -WKK op biomethaan of syngas
Zonnethermie op gebouwniveau
ketel of -WKK op biomethaan of syngas
Zonnethermie op gebouwniveau
Eventueel:
Lucht-Water warmtepomp
aansluiting op warmtenet indien voldoende warmtevraag
aansluiting op warmtenet
= prosument
Zonnethermie op gebouwniveau
all electric warmtepomp
zonnethermie op gebouwniveau
ketel of WKK op biomethaan of syngas
Eventueel:
lucht-water warmtepomp
geothermische warmtepomp
biomassaketel op gebouwniveau
Balanceren
collectieve warmte-buffervaten
elektrische deelauto's
individuele warmte-buffervaten
elektrische auto's
collectieve warmte-buffervaten
elektrische deelauto's
individuele warmte-buffervaten
elektrische auto's


MIX WONEN
gem. 15 adressen/ha
4-7.5 lineaire warmtedichtheid
OHO 60-99
gem. 10 adressen/ha
2-3 lineaire warmtedichtheid
MIX OHO
gem. 8 adressen/ha
4-7.5 lineaire warmtedichtheid
HOG
gem. 21 adressen/ha
1-2.5 lineaire warmtedichtheid
smart grid
warmtenet
biomethaan - syngas
Isoleren
aan buitenkant / spouwisolatie
energielabel
C -> A
aan binnenkant / spouwisolatie
energielabel
E -> C
aan buitenkant / spouwisolatie
energielabel
D -> B
aan buitenkant / spouwisolatie
energielabel
D -> B
Elektriciteit
Warmte
aansluiting op warmtenet
ketel of -WKK op biomethaan of syngas
Eventueel:
Zonnethermie op gebouwniveau
Zonnethermie op gebouwniveau
ketel of -WKK op biomethaan of syngas
Eventueel:
Lucht-Water warmtepomp
Geothermische warmtepomp
aansluiting op warmtenet
ketel of -WKK op biomethaan of syngas
Zonnethermie op gebouwniveau
Eventueel:
Lucht-Water warmtepomp
Geothermische warmtepomp
ketel of -WKK op biomethaan of syngas
biomassaketel op gebouwniveau
geothermische warmtepomp
zonnethermie op gebouwniveau
Balanceren
collectieve warmte-buffervaten
elektrische deelauto's
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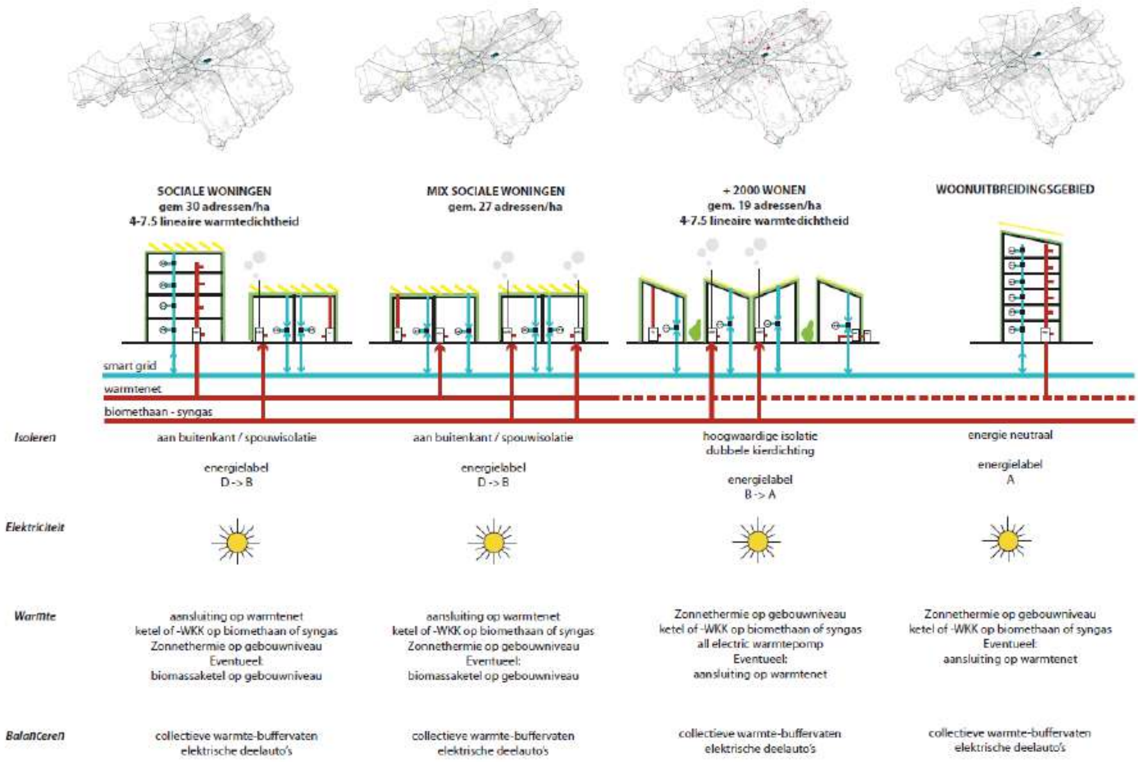

Figure 39: Each neighbourhood typology has its own specific sustainable energy and heat solution.

During the capacity building workshop for the City of Kortrijk a methodology was defined to assist municipalities with the making of their local neighbourhood energy plans. During the workshop it was stated that neighbourhoods only have 3 different options concerning sustainable green heat:

1) District heating possible (marked in red on the map below)
2) District heating is not possible: all electric (marked in blue on the map below)
3) District heating is maybe possible (marked in yellow on the map below)

The map below is based on the average heat demand in every neighbourhood. If it is clear that a neighbourhood cannot be connected to a district heating system (marked in blue), the neighbourhood needs to provide itself with green heat by becoming “all electric”. In a first stage, it will be necessary for the housing stock to lower its heat demand. This can be done by stimulating (through f.e. regulation, subsidies and grants) citizens to thoroughly insulate walls and roofs, and to renovate their houses. In a second stage, the housing stock needs to have low temperature heating systems. In a third stage, “all electric” technologies need to be installed such as (geothermal) heat pumps. Some neighbourhoods, for example building blocks having a shared inner open space, can install a collective heat pump. Concerning sustainable mobility, electric vehicles are interesting as they can also store energy. In a final stage, the gas grid needs to be phased out.

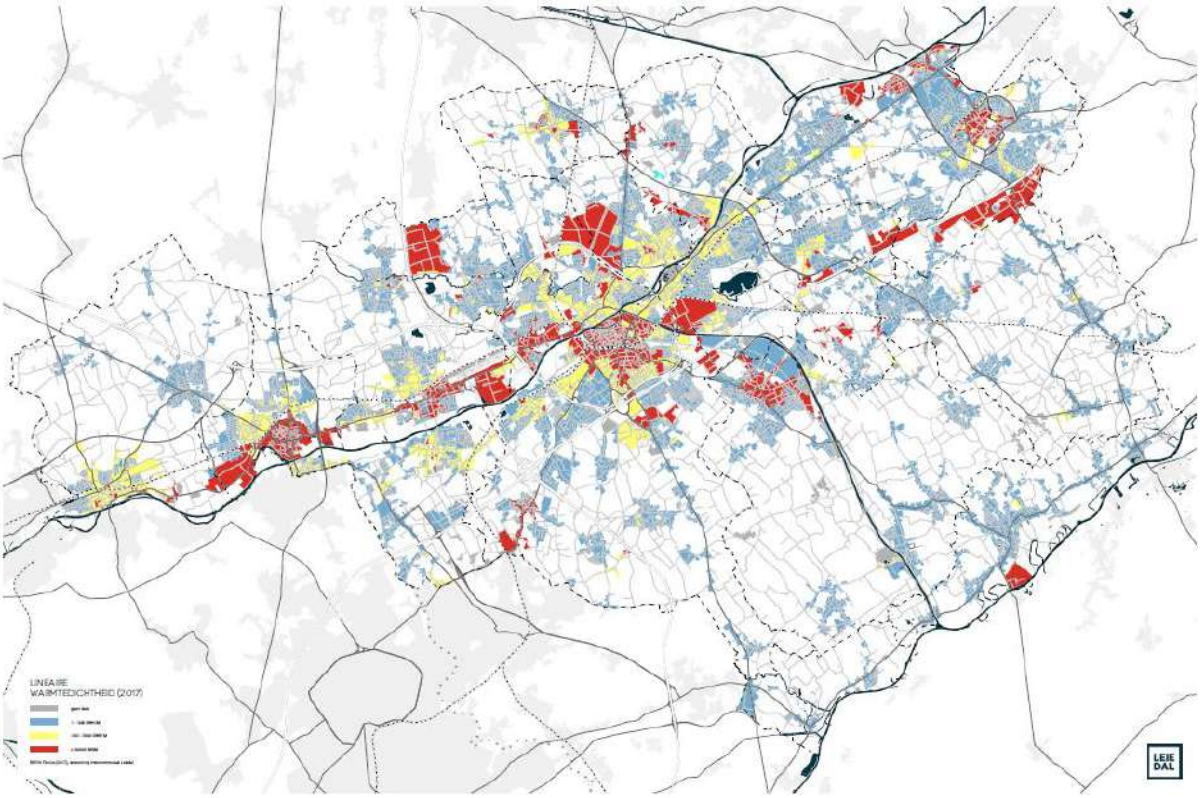

Figure 40: Warmtezoneringskaart Zuid-West-Vlaanderen, or the 'heat zoning map South-West-Flanders'.

For the third category 'maybe' (yellow) a decision tree was made in order to find out what to do, namely opting for a district heating network or 'all electric' solutions. The decision is based on local circumstances:

- Is there an urban renewal project in the neighbourhood?
- Is there a social housing project / public facility in the neighbourhood?
- Is the neighbourhood situated near an existing or future district heating network?
- Is the neighbourhood situated near a railway station and is it therefore interesting to densify the neighbourhood?

If it is opted to connect these zones to a district heating network, it will be necessary to on the one hand gradually renovate the existing housing stock, to lower heat demand and achieve low temperature grids, but also to densify neigbourhoods on the other hand so the heat demand is high enough to make the district heating network remunerative. A densification of neighbourhoods is however only just if these neighbourhoods can also be provided with sustainable transport modes, namely public transportation, railway system, ….

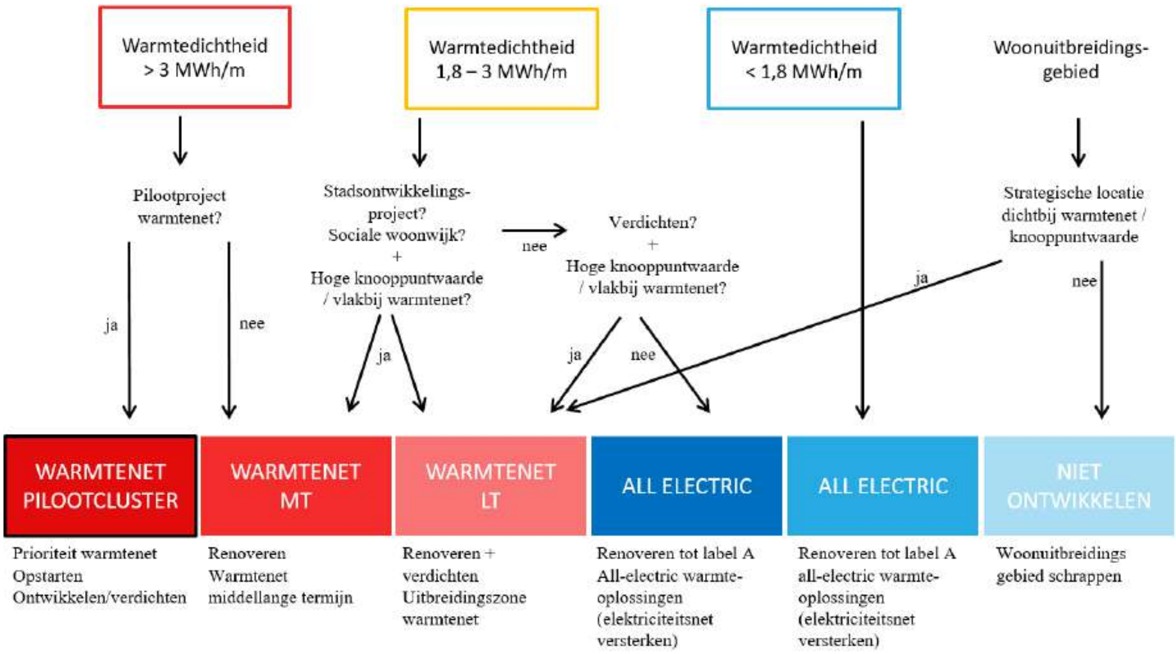

Figure 41: Decision tree for local neighbourhood energy plans.

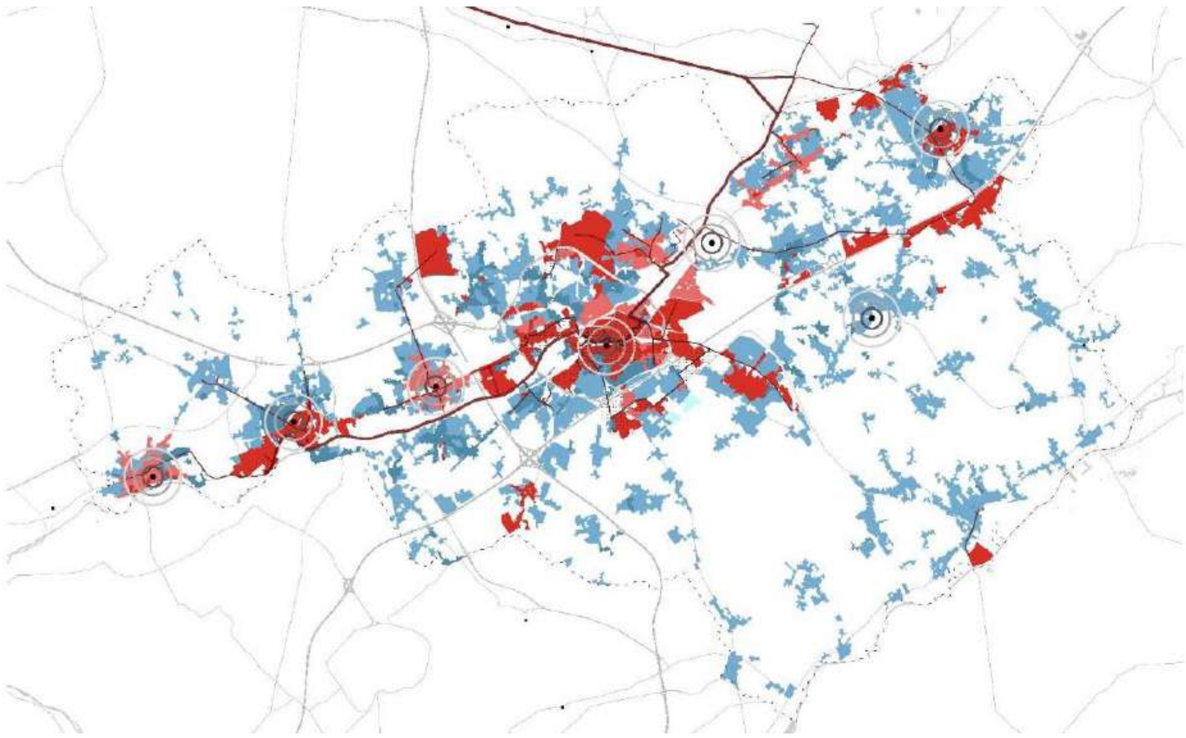

Figure 42: Heat-zoning map South-West-Flanders. Red = district heating system. Blue = all electric. This map was made during the capacity building workshop with the City of Kortrijk, by applying the decision tree to the above heat zoning map of South-West-Flanders.

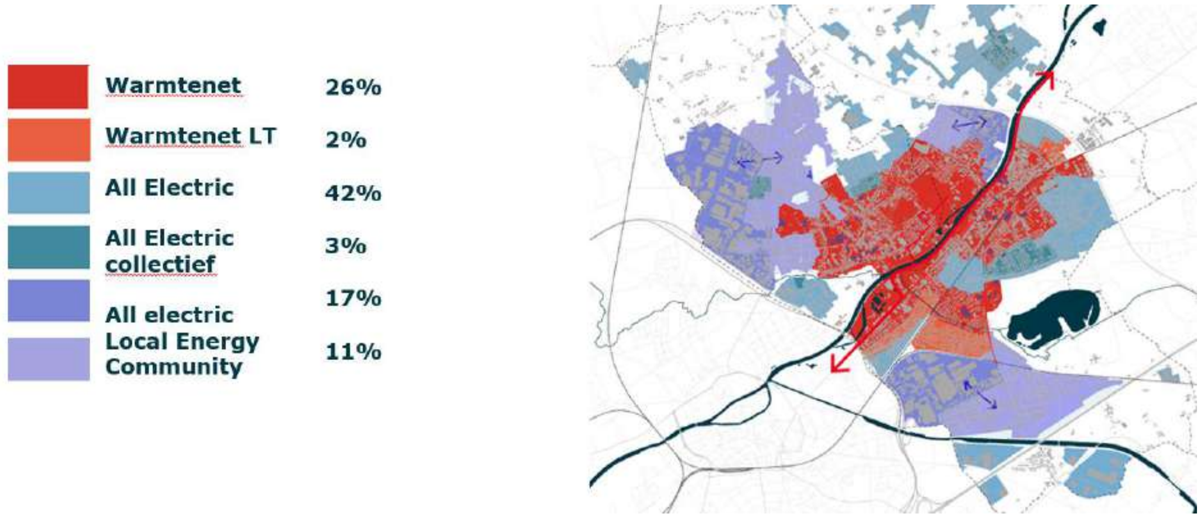

Figure 43: Heat-Zoning map Harelbeke defined during the capacity building workshop Harelbeke-Kuurne. An extra category was introduced, namely 'local energy community' making the exchange of low-temperature heat possible between residential neighbourhoods and industrial sites.

Warmteboemerang

Parallel to the local neighbourhood energy plans, the idea of the 'warmteboemerang' was developed. This 'Warmteboemerang' is a proposal for a district heating network in South-West-Flanders along the river Lys and the canal towards Roeselare. When we look at the heat map of Flanders, and the heat maps based on the open data of Fluvius, we found out that district heating is feasible in the dense urban and industrial areas of Roeselare, Wielsbeke, and Kortrijk. The river Lys and the canal, which connect these urban and industrial zones, would therefore form the ideal backbone or spine of this district heating network. The 'warmteboemerang' follows the principles of a 4th generation district heating network:

- Small- and large scale energy sources
- Renewable: solar, waste incineration, biomass, …
- Use of waste heat: industrial processes, cooling, hydrogen, …
- Every access point is a potential energy source (prosumer)
- Heat available at different temperatures
- Connection possible to a smart electricity grid having renewable energy sources
- Balancing of cold and heat

In South-West-Flanders, there are several planned large-scale development projects which can catalyse the rollout of this district heating network:

- the 'Leiewerken' as the river Lys needs to be broadened for larger ships to pass. This is an investment of 570 million euro, and adding a district heating network would give the project a higher return.
- The development of regional bicycle lanes, such as the connection between Kortrijk and Ghent which would be adjacent to the railway line.

- Adjustments to the public domain: sewage system, water management, mobility, …

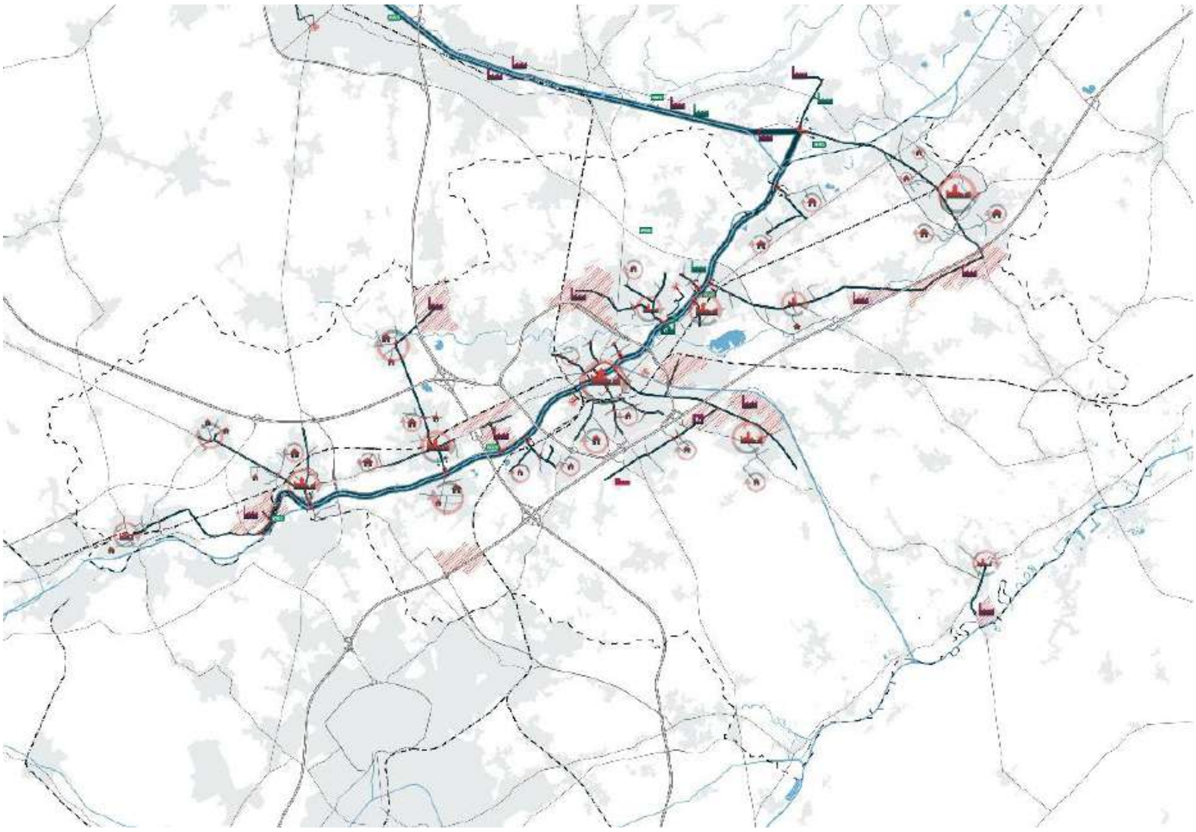

Figure 44: The 'warmteboomerang' which passes the dense urban and industrial areas of Roeselare, Wielsbeke and Kortrijk. This regional district heating network follows the river Lys and the canal towards Roeselare.

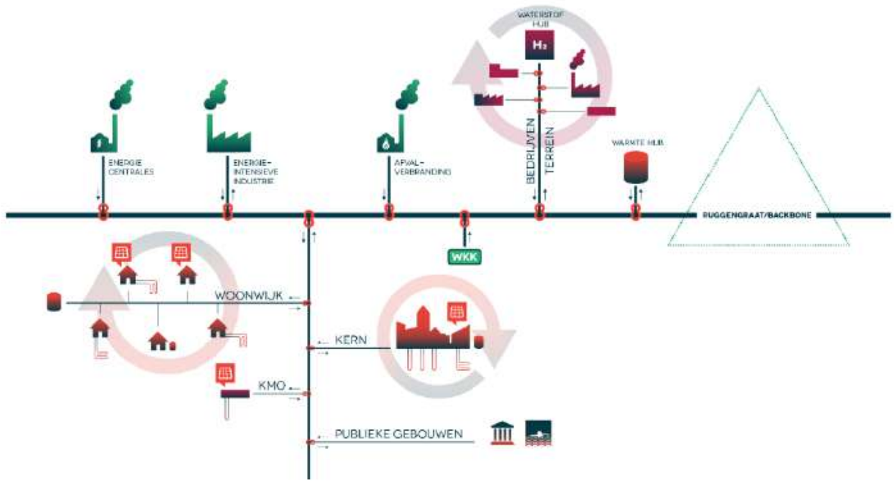

Figure 45: *The 'warmteboemerang' follows the principles of a 4th generation district heating network.* Local branches of the district heating network balance heat demand and heat supply. The excess heat of a local branch feeds the 'warmteboemerang', making a balancing of the system possible on a larger scale level.

District Heating: trajectories of the warmteboemerang in Kortrijk

In the city of Kortrijk a district heating system is currently being developed. In a first phase, a giant hangar was reconstructed to be able to house a local youth centre, an urban sports hall, and an incubator for innovative companies. In addition, two newly built facilities were constructed on 'Kortrijk Weide': a large party hall and a new swimming pool. These plans were the ideal start for a new district heating system in the city of Kortrijk as the swimming pool can provide waste heat to the renovated hangar and the party hall. In a second phase, the district heating system crosses a railroad to connect to the neighbouring 'Campus West' containing buildings of the University of Ghent and Howest. More information on this project can be found on the following website: http://warmtenet.kortrijk.be/

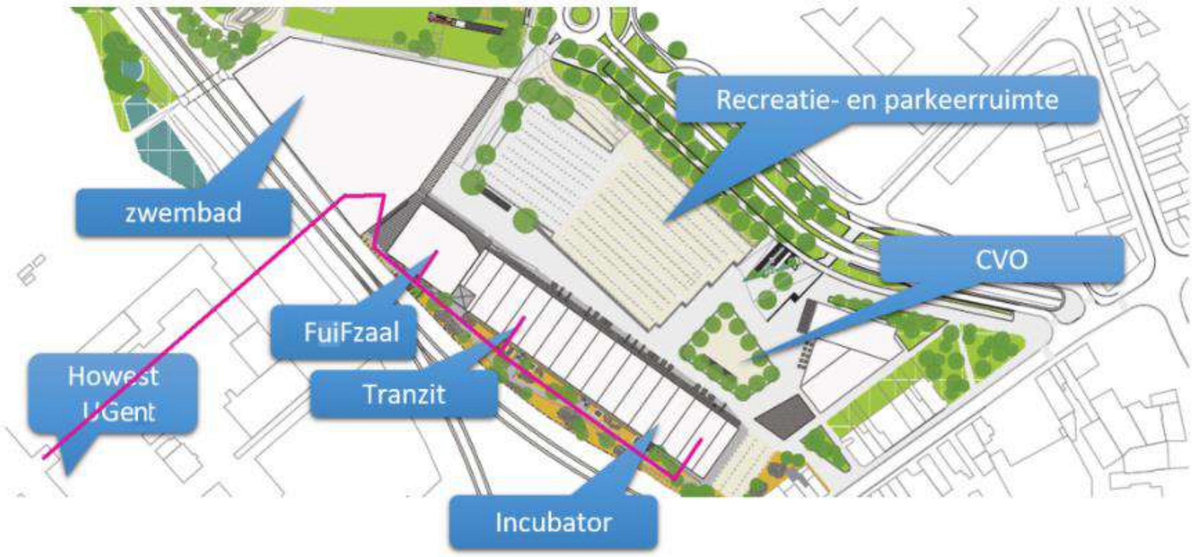

Figure 46: Trajectory of the district heating system in Kortrijk (pink).

During a workshop week a team of experts further explored opportunities for district heating systems in the city of Kortrijk. Climate specialists, spatial planners, engineers, etc. investigated three main questions: how to make the city of Kortrijk energy neutral by 2025-2050 (a promise in the Covenant of Mayors), where can we find opportunities to implement more district heating and how can districts become energy and climate neutral?

Concerning energy neutrality, it appeared to be crucial to keep an "and-and" purpose in mind as all available technologies will need to be used: wind energy (through wind harvesting areas and a lot of extra turbines), solar energy (if we cover 14% of the total region in solar panels, we can be energy neutral), district heating and other measures (like cold-heat storage). Only then the transition story will be viable. For Kortrijk, most of its energy demand is in heat demand for homes, so there is a lot of potential there for carbon reduction. There is also a lot of excess heat available, but not always at the right place or in the right manner. To map all of this, a map was made on which 6 potential sites were marked that have a high potential for installing district heating as an interesting and profitable investment (taking some requirements into account). An expansion of the current district heating system at Kortrijk Weide, within the HeatNet NEW project, is one of those potential sites. The other 5 projects are:

- Connecting the waste incinerator plant IMOG with the public facilities in the centre of Kortrijk

- The East of Kortrijk or the 'giant leap' containing public facilities, schools, social housing facilities, …
- Bissegem, as industrial waste heat is available and a connection to the city of Kortrijk can be made
- Kortrijk Noord: the exchange of waste heat of the large industrial site with its surrounding residential areas
- Hoog Kortrijk: a business site in the South of Kortrijk with quite a few facilities that can exchange heat: a hospital, university buildings, retail, and many company offices.

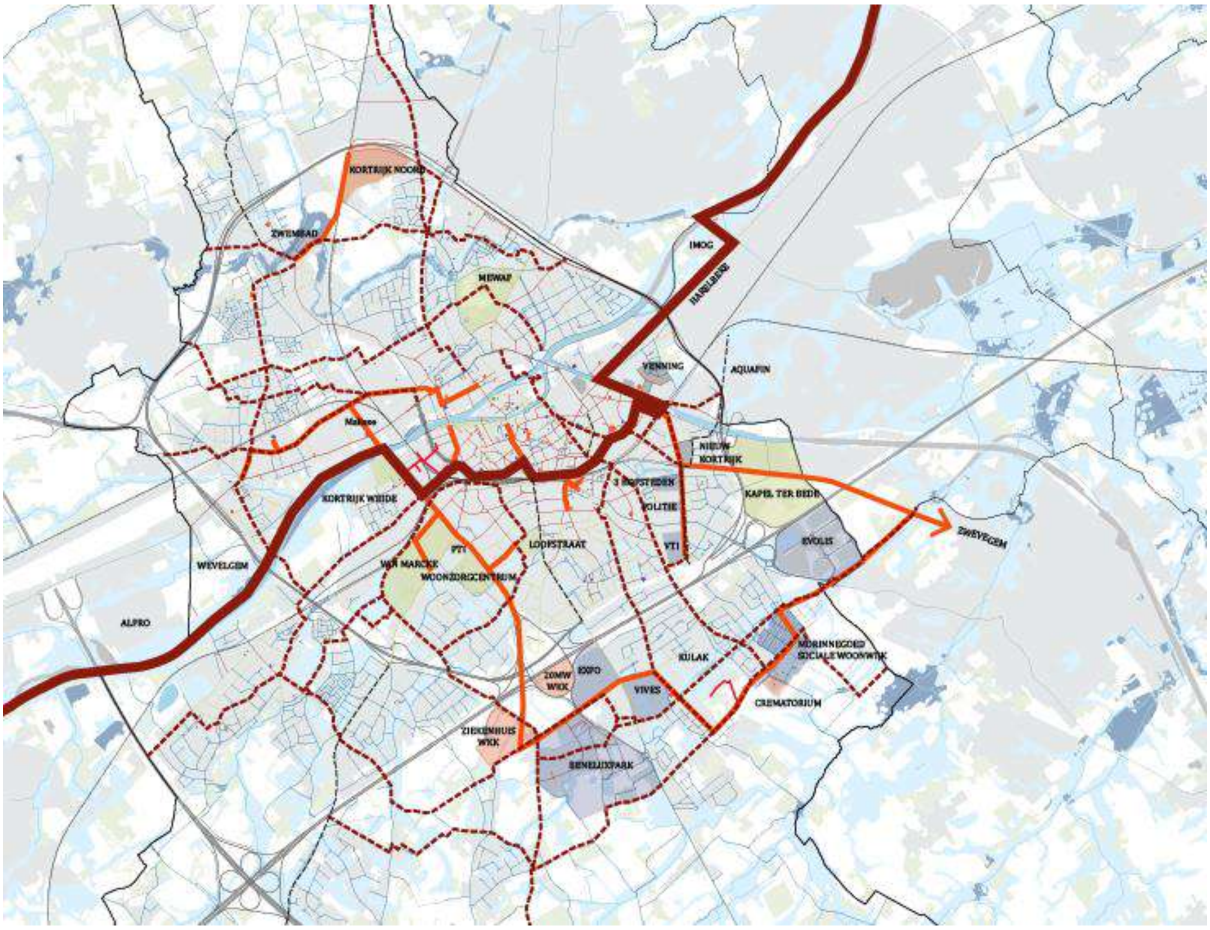

Figure 47: map of the city of Kortrijk showing the expansion of the district heating system: the 'warmteboemerang' (thick dark red line), the current district heating system (red), the expansion of the district heating system (orange). The bicycle network the city of Kortrijk likes to develop (dotted lines) is also an ideal opportunity for grid expansion.

As a result, 46% of the heat demand in Kortrijk can be connected to a district heating system and most public buildings. Doing this could lead to a carbon reduction of 18% in Kortrijk. Where district heating is not viable or profitable, we need to go for energy reduction and 'all-electric' solutions like heat pumps and solar boilers.

Where possible, district heating solutions could be linked with other climate adaptation measures like the construction of bicycle connections and the removal of hard surfaces in cities, thereby creating more space for water and green areas. Where, for example, new bicycle lanes and/or a wadi are installed we could simultaneously insert heating pipes for district heating. This means there would only be road works once, the city loses some hard surface and we can meet some of the heating demand.

Conclusions of the workshop: the time to act is now, if we want to meet the climate neutral goals for the region; we will have to implement all types of renewable energy at the same time and a specific plan of action needs to be made for the city of Kortrijk and the region to be able to make a giant leap and effectively start with the implementation of the work.

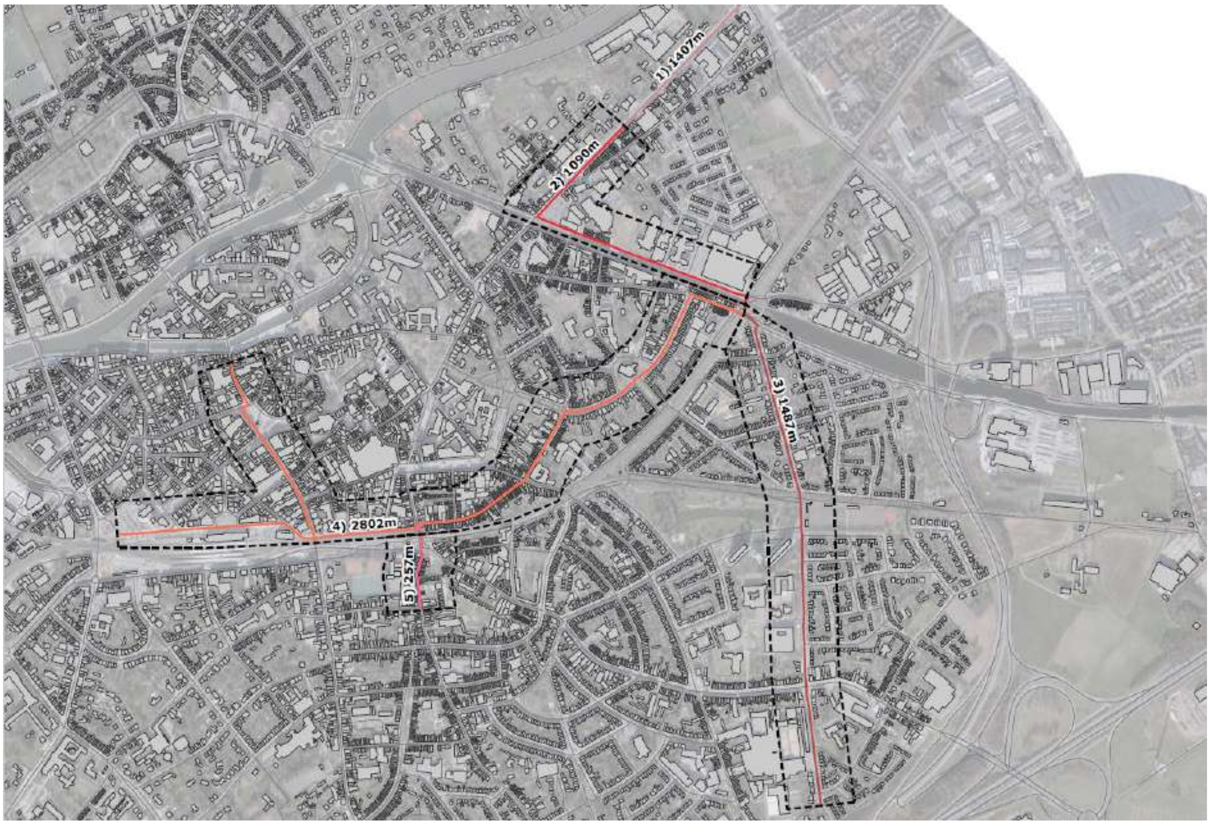

Figure 48: Zoom on 2 clusters in Kortrijk, namely the district heating network in the inner city centre of Kortrijk and Kortrijk East.

Sectie	*Lengte tracé (m)*	*Raming afname (MWh)*	*Lineaire warmtedichtheid*	*Kost*
1	1.407	0	0,00	4.221.000
2	1.090	3.778	1,30	3.270.000
3	1.487	9.697	2,61	8.922.000
4	2.802	35.674	2,55	16.812.000
5	257	1.966	2,87	1.542.000
TOTAAL	***7043***	***51.115***	***1,87***	***34.767.000***

Figure 49: Estimation of the total cost of the district heating network in the centre of Kortrijk (trajectory of the network marked on the above map).

cluster	***Lengte tracé (m)***	***Raming afname (MWh)***	***Lineaire warmtedichtheid***	***Kost***
Sionwijk	*990*	*921*	*0,93*	*1.485.000*
Scheutistenlaan	*870*	*4.154*	*4,77*	*1.305.000*
TOTAAL	***1.860***	***5.955***	***3,20***	***2.790.000***

Figure 50: Estimation of the total cost of the district heating network in the East of Kortrijk (trajectory of the network marked on the map below). 80% of the surrounding buildings can get connected to the grid, making it an interesting business case.

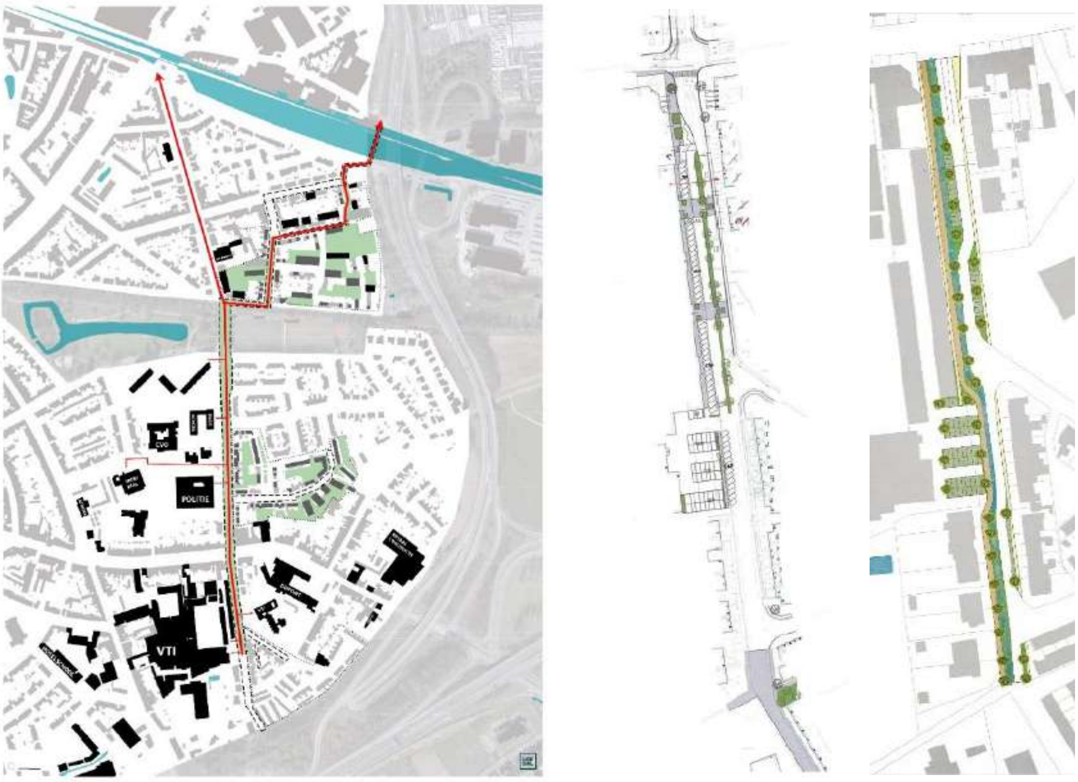

Figure 51: Trajectory of the district heating network in the East of Kortrijk or the 'giant leap'. This trajectory contains public facilities, schools, social housing, … Cogeneration could serve as a temporary heat source, until the connection is made with the waste incineration plant IMOG. The district heating system could go hand in hand with other climate measures, such as soft mobility (cycling), the greening of streets and water infiltration.

Figure 52: Looking for synergies between district heating and other climate themes such as sustainable mobility (cycling), the greening of streets, water management, the urban heat island effect, …

District Heating: trajectories of the warmteboemerang in Kuurne and Harelbeke

The municipalities Harelbeke and Kuurne also have district heating systems. The heat source is the waste incineration plants IMOG. From this plant, 3 different district heating networks provide heat to their surroundings. A first one is connected to a neighbouring concrete factory 'Nerva'. A second network connects a new housing project 'Woonpark Harelbeke – Kuurne', and a third network connects the public facilities of the city of Harelbeke.

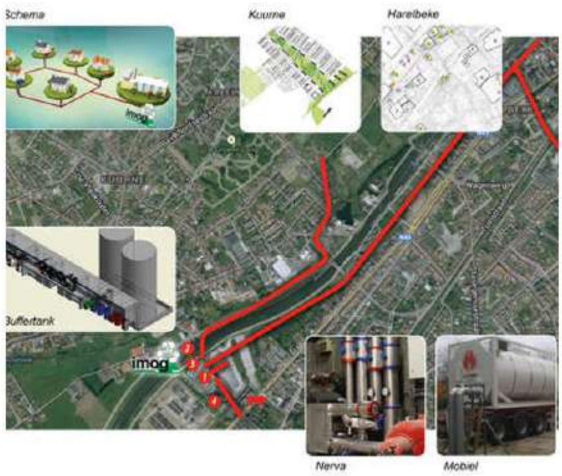

Figure 53 & 54: the district heating networks in the municipalities Harelbeke and Kuurne, and the housing project 'Woonpark Harelbeke-Kuurne'.

During the workshop with the municipalities Harelbeke and Kuurne, it became clear that more opportunities for district heating systems exist. The map below indicates the existing district heating network in a thick red line, and the possible expansion of this network. Four different clusters were defined:

- Further expansion of the network in the centre of Harelbeke towards all public facilities.
- Connection from IMOG towards the 'Collegewijk' and a care centre situated in this neighbourhood.
- Expansion of the existing grid in Kuurne towards neighbouring housing projects and social housing estates.
- Expansion of the existing grid towards the centre of Kuurne, making the connection with public facilities and schools.

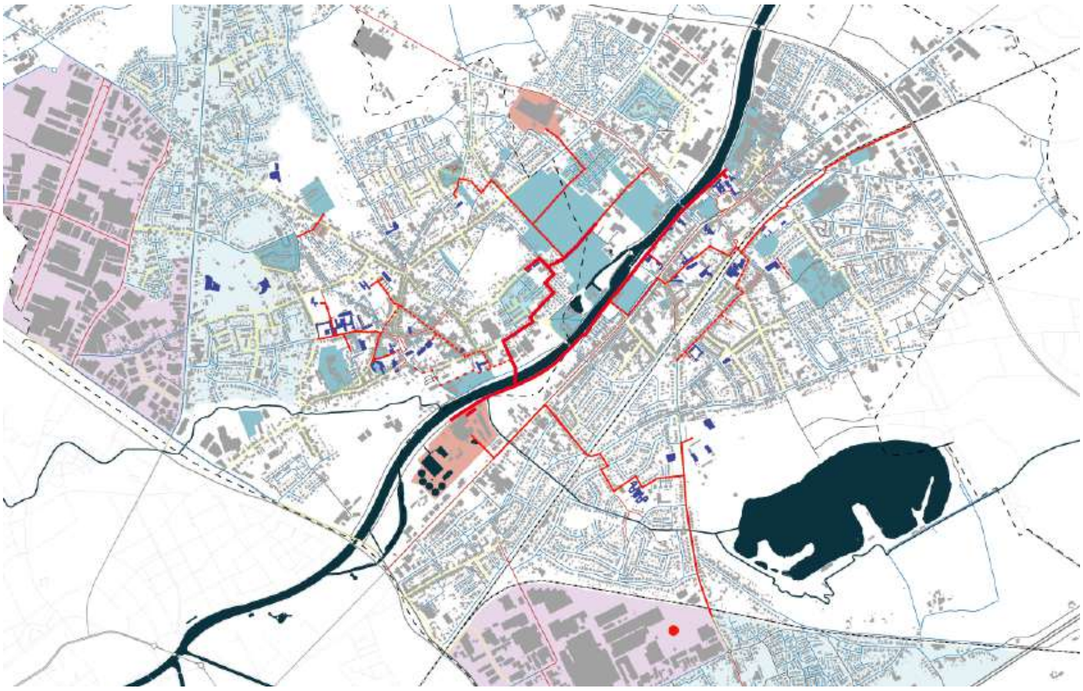

Figure 55: more opportunities for district heating systems exist in the municipalities Harelbeke and Kuurne. The map above indicates the existing district heating network in a thick red line, and the possible expansion of this network.

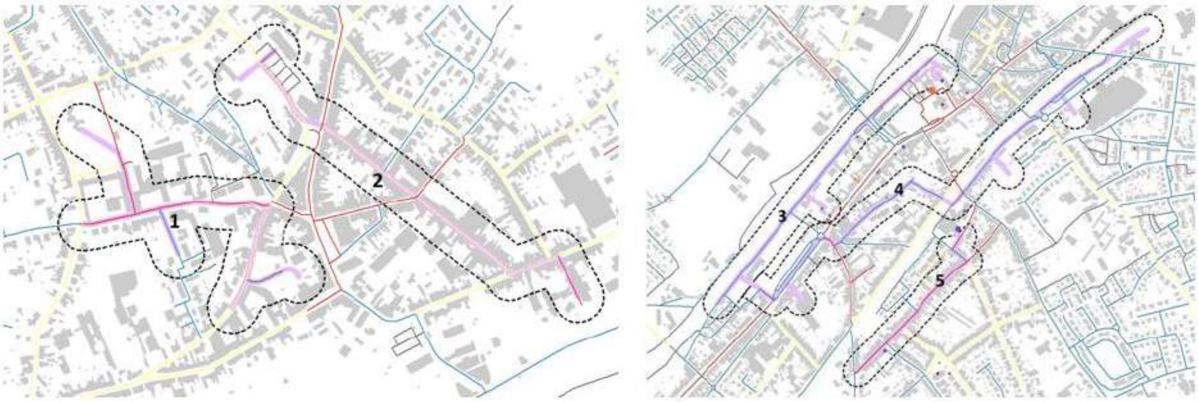

Figure 56: Trajectories of the district heating network in Kuurne (Left) and Harelbeke (Right).

The University of Ghent, a HeatNet partner, facilitated the feasibility check of the above defined grid expansions:

Sectie	**Lengte tracé (m)**	**Raming afname (MWh)**	**Lineaire warmtedichtheid**	**Kost**
1	1.002	3022	1,51	2.505.000
2	926	1727	0,93	2.778.000
3	1.287	2762	1,07	nvt
4	2.069	3186	0,77	6.207.000
5	644	1228	0,95	3.220.000
TOTAAL	**4.641**	**9.162**	**1,01**	**14.710.000**

cluster	***Homes***	***Peak Space heating demand***	***Peak hot tap water demand***	***Simultaneous demand***
1	*730*	*6651 kW*	*23572 kW*	*5000 kW*
2	*946*	*6458 kW*	*30546 kW*	*5000 kW*
3	*1130*	*6814 kW*	*25788 kW*	*4994 kW*
4	*450*	*6946 kW*	*14531 kW*	*4998 kW*
Cost Breakdown				
	Network cost	%		
Service Connection	€ 8.195.094, 53	31		
Distribution	€ 13.760.524,75	52		
Transport	€ 4.481.823,33	17		
Total Cost	€ 26.438.442,61	**100**		

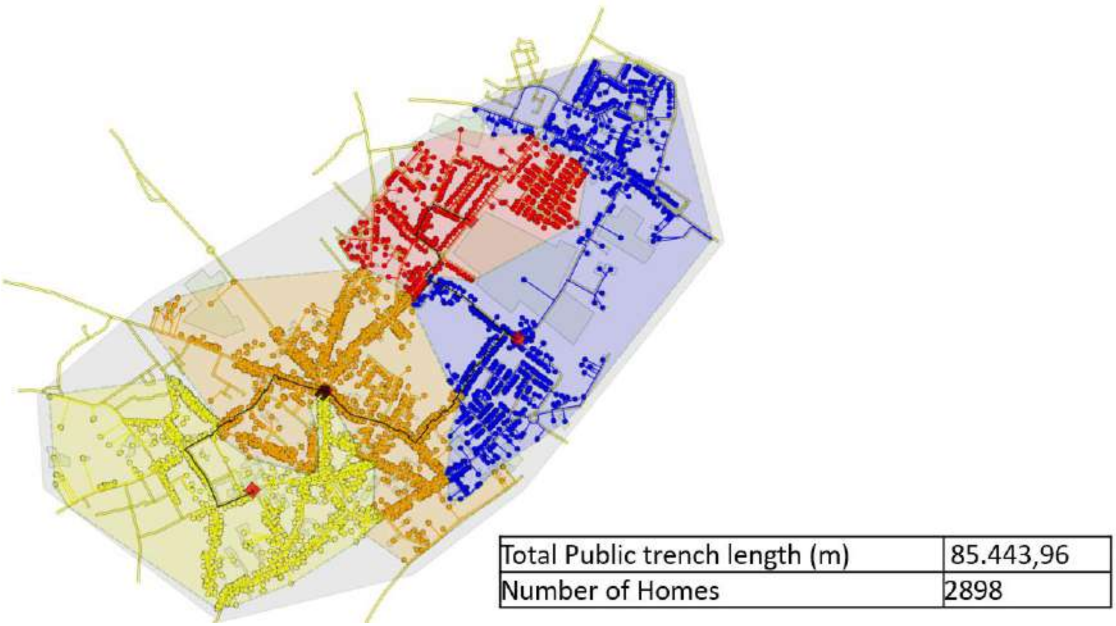

Figure 57: connecting Kuurne to a district heating network requires 15MW heat. The waste incineration plant of IMOG has a capacity of 30MW.

It was further explored how the district heating network in the 'Collegewijk' of Harelbeke, could have synergies with other climate mitigation and adaptation actions. The Collegewijk is a suburban housing area which has a ver low density of 9,7 dwellings per hectare. By introducing a central district heating system, densification of the neighbourhood is recommended along this grid. Other measures can also be introduced, such as stimulating sustainable transport (giving priority to pedestrians and cyclists) in suburban housing areas, requalifying the public domain, and strengthening the existing blue-green network.

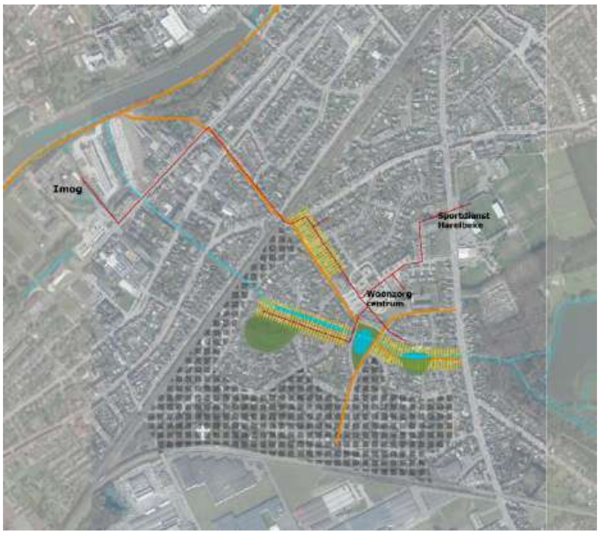

Figure 58: introducing a district heating network in the 'Collegewijk' in Harelbeke, it passes through the neighbourhood and connects the waste incineration plant IMOG with a health care centre and the sport facilities of the municpality. Figure 59: the district heating network stimulates densification of the neighbourhood.

Figure 60: the district heating network stimulates densification of the suburban neighbourhood. The trajectory of the network is combined with pedestrian- and cycling lanes and therefore stimulating sustainable mobility. It also forms an axis (klimaatas) where the blue-green network of the neighbourhood can be strengthened.

Conclusion

This roadmap contains a strategic plan that describes the necessary steps to roll-out 4th generation district heating systems (4DHC) in South-West-Flanders. In order to make this roadmap, a desktop analysis was performed on CO2 emissions in South-West-Flanders, the existing district heating networks, and the current state of heat demand and heat sources. In addition, through a series of capacity building workshops with the municipalities of South-West-Flanders, it was possible to further detail the 'warmteboemerang' with clear 'actions' or district heating opportunities in Kortrijk, Harelbeke and Kuurne. Each of these district heating systems have been checked with a feasibility study, and the 'heat zoning' map of South-West-Flanders (figures 42 and 43) demonstrate which district heating systems can be established in a short, medium and long term.