HEATING IN FLANDERS

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Editor-in-charge
Luc Peeters,
Administrateur-generaal,
Vlaams Energie- en Klimaatagentschap (VEKA)
Flemish Energy and Climate Agency
Koning Albert II-laan 20 bus 17
1000 Brussels
veka@vlaanderen.be
www.energiesparen.be

Contributors
Pieter Vingerhoets, Leen Van Esch, Lorenz Hambsch, Liliane Janssen – Flemish Institute for Technological Research (VITO)
Ines Becue, Frederick Tant – Fluvius

Steering group members
Wim Buelens, Arjan Goemé, Cathérine Vanthienen – Flemish Energy and Climate Agency (VEKA)

Participating stakeholders
Thomas Koch, Pedro Pattijn – Ingenium
Indra Van Sande – City of Ghent
Esther Biermans – Antwerp Province
Griet Maes, David Michiels – Limburg Province
Moira Callens, Michaël Heiremans – East Flanders Province
Jo Neyens – Warmtenetwerk Vlaanderen (WNVL)

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SUMMARY

This report presents the heat map for Flanders. The necessary templates and analyses were made in order to comply with Commission Recommendation (EU) 2019/1659 on the comprehensive assessment of the potential for efficient heating and cooling under Article 14(1) and (3) of Directive 2012/27/EU and the assessment of the potential of energy from renewable sources and of the use of waste heat and cold in the heating and cooling sector in the context of Article 15(7) of Directive (EU) 2018/2001.

The required templates concerning heat demand have been completed and broken down by technology, as specified in the reporting instructions. A strong focus was placed on making heat demand data accessible to local project developers, municipalities, provinces and other stakeholders. Close dialogue with these experts and their involvement in the process ensured that the published map will be of maximum benefit to the development of local heat zoning plans or future green heat projects.

A potential assessment was carried out of renewable technologies for heat supply, as well as for industrial waste heat. A cost-benefit analysis has been presented to create a high-level estimate of the potential of district heating networks. Further detailed research will be needed, as the heat demand data in specific cases can differ significantly from the theoretical assumptions, and also the available waste heat depends on local conditions (e.g. large-scale point sources of waste heat versus dispersed sources).

A projection was made of the heat demand towards 2050, whereby the best possible estimates were made of certain data on the basis of the available data. Existing and planned policy instruments have been included in the relevant template.

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LIST OF ABBREVIATIONS

CAPEX	Capital expenditure
cte	Constant
DNO	Distribution network operator
EPA	Energy Policy Agreement
HTH	High Temperature Heat
IMJV	Integral Annual Environmental Report
SME	Small and Medium-sized Enterprises
LTH	Low Temperature Heat
MTH	Medium Temperature Heat
nOK	Not OK
OPEX	Operating expenditure
UOM	Unit of measure
CHP	Combined Heat and Power
RESID	Residential
SH	Space Heating
DHW	Domestic Hot Water
VBBV	VerificatieBureau Benchmarking Vlaanderen

LIST OF SYMBOLS

T	Temperature
GWh	Gigawatt hour: 1 GWh = 10^6 kWh (kilowatt hours)
MWh	Megawatt hour: 1 MWh = 10^3 kWh (kilowatt hours)
MWe	Megawatt hour electric
MWt	Megawatt hour thermal

1 INTRODUCTION

1.1 European reporting on heating and cooling

As part of the Energy Efficiency Directive and the Renewable Energy Directive, Member States are required to report national figures and plans on heating and cooling by the end of 2020. This is in line with the European Energy Union's strategy to reduce greenhouse gas emissions by at least 55% by 2030 compared to 1990. Article 14(1) and (3) of the Energy Efficiency Directive 2012/27/EU requires Member States to carry out an assessment of the potential for efficient heating and cooling and to provide a vision of the policy instruments that can be used to facilitate this. In addition, Article 15(7) of the Renewable Energy Directive (EU) 2018/2001 requires Member States to carry out an assessment of the potential of energy from renewable sources and of the use of waste heat and cold in the heating and cooling sector. One of the main reporting requirements is to provide a map identifying areas of high and low heat demand. This report meets those reporting requirements. Additionally, the data that is collated and visualised can be an important lever for initiating heat zoning plans or implementing green heat projects on a local level. The resulting maps and data layers will therefore be presented to local governments, project developers and other relevant stakeholders.

A first heat map study dates from 31 December 2015, when the report on national consumption and potential of heat and cold sources was presented to Europe[1] and several heat map layers for the existing situation in 2012 were made available on the geoportal of Geopoint Flanders. The new maps with reference date 2019, which are described in detail in Chapter 3, have a greatly increased level of mapping detail for heat demand. Heat demand is visualised at street section level, whereby large energy consumers can be distinguished from small consumers. The new maps will also be available on the geoportal of Geopoint Flanders and the data can be downloaded from the website. These maps and data form a solid basis, for example, for creating local heat zoning plans.

In addition to the heat demand map, Member States are required to report other data, such as the national overview of heating and cooling and a forecast of the demand for heating and cooling up to 2030 and 2050.

Some of these reports run in parallel with the data collection within the framework of the *energiebalans*:

- an estimate of the amount of useful energy (UE) and quantification of final energy consumption (FEC) by sector,
- the current heating and cooling supplied to sectors, with an indication of the technologies and the share of renewable energy sources,
- identification of installations that could potentially generate waste heat or cold,
- share of energy from renewable sources and waste heat in district heating networks as a percentage of the final energy consumption over the past five years.

The policy instruments must also be discussed:

- a description of the role of heating and cooling in reducing greenhouse gas (GHG) emissions,
- an overview of existing policy instruments on heating and cooling, with an accompanying impact analysis.

One of the priorities of the report is the submission of the map itself:

- a map of the regional territory showing energy-dense areas and possible supply points of waste heat,

[1] Available on https://www.energiesparen.be/warmtekaart

- a high-level cost-benefit analysis that analyses the potential for energy-efficient heat distribution.

Compared to the previously submitted report, a new requirement is the following estimate:

- forecasts of trends in demand for heating and cooling for the next 30 years.

1.2 Purpose and content of this report

The purpose of this report is not only to comply with the European reporting requirements, but also to support local initiatives by collating and visualising the data. Municipalities, provinces, project developers, etc. will be able to use the data provided to develop local plans for increasing the sustainability of heating and cooling. The heat map can be a first step towards a heat zoning plan and further implementation of sustainable heating and cooling projects.

During the process of creating the heat map, it was therefore essential to involve local stakeholders in the preparation of the heat map. The first meetings were held as early as 2019, where the assumptions, visualisation and format of the heat map were discussed with municipalities, provinces and consultants. These stakeholders were also closely involved in the finalisation of the heat map during 2020.

The structure of this report is as follows:

Chapter 2 provides data about the Flemish demand for heating and cooling as an introduction. These include the figures concerning the number of district heating networks, CHP-installations, waste incineration plants and green heat production in Flanders. The relevant data concerning heating and cooling in the *energiebalans* are reported and the existing and planned district heating infrastructure is shown.

Chapter 3 sets out all spatially-specific information that has been collected in connection with the heat demand map. This includes all information relating to the map layers and underlying data that can be used by local stakeholders. It is important that all the data can be downloaded to enable use by local stakeholders. The map data show:

- A detailed map for Flanders, showing the heat demand of small consumers and large consumers separately. Small consumers are shown at a street section level (more detailed than at street level), whereas large consumers are shown individually. This is one of the essential improvements on existing practices, and could be extremely important in the planning of a district heating network or creation of a heat zoning plan.

- An aggregated map of heat density at municipality level and statistical sector (sub-municipality/district) level. This is useful for identifying regions of interest at a higher spatial level where district heating networks could be possible. Additional estimations of fuel oil consumption – with the appropriate disclaimers for assumptions and uncertainties – are also shown.

Chapter 4 describes potential supply points of waste heat.

- CHPs, waste incinerator installations and power plants must be identified within European reporting. These maps will also be made available to the public via the Geoportal of the Flemish government Geopunt.
- A calculation and a map of the estimated potential for industrial waste heat are presented.
- The long-term potential of a number of other renewable technologies is estimated.

Chapter 5 provides an explanation of the cost-benefit analysis. There is a specific focus on the construction of district heating networks in the different sectors These data must be reported to the European Commission. While this can give an accurate picture of how significant the potential of district heating networks is across Flanders, these calculations are not suitable for underpinning a local revenue model. This is because there are too many details that need to be studied before a revenue model is created, such as the availability of waste heat in industry, the possible route of a district heating network and streams or rivers that may need to be sub-tunnelled, the area and type of the subsoil or the fact that other public works are already scheduled to take place (which could make the simultaneous construction of a district heating network much cheaper). In chapter 5, we also elaborate on the commercial and spatial potential of the different technologies that have been quantified in previous studies.

Chapter 6 presents a projection of the demand for heating and cooling towards 2030 and 2050, as mentioned in the European reporting requirements. A sectoral summary is presented of the evolution of the heat demand based on the proposed Flemish Energy and Climate Plan (Vlaams energie en klimaatplan – VEKP), and a possible scenario to 2050 is presented. The policy instruments are discussed with reference to the Flemish Energy and Climate Plan and the long-term renovation strategy.

2 CURRENT FLEMISH INFRASTRUCTURE FOR HEATING AND COOLING

2.1 Overview of heat demand per sector

In this section, we present an estimate of the current demand for useful heat of the various sectors, based on the results of the *energiebalans*[2]. Before going into detail, it is important to give the definition of final energy consumption and useful heat [1]:

- 'Final Energy Consumption': All energy supplied to industry, transport, households, services and agriculture. It excludes the supply to the energy conversion sector and the energy companies themselves. Any differences from the statistics and records available through Eurostat must be explained.[3]
- 'Useful energy': all energy required by end-users in the form of heating and cooling after all the steps of energy conversion have taken place in the heating and cooling equipment.

Two tables are provided as templates in the reporting instructions. The first table shows the heating and useful energy demand per sector as per the aforementioned definition.

Part I: Overview of heating and cooling
1. Reporting of current demand for heating and cooling; 4. Reporting of estimated demand for heating and cooling

			Year						
		Unit	**2019**	2025	2030	2035	2040	2045	2050
Demand for heating, **final** energy consumption	Housing sector	GWh/year	47 712						
	Service sector	GWh/year	17 003						
	Industrial sector	GWh/year	73 852						
	Other sectors => Agriculture	GWh/year	6 871						
Demand for cooling, **final** energy consumption	Housing sector	GWh/year	9						
	Service sector	GWh/year	476						
	Industrial sector	GWh/year	1						
	Other sectors => Agriculture	GWh/year	0						
Demand for heating, **useful** energy	Housing sector	GWh/year	38 222	34 070	29 087	25 315	21 544	17 772	14 000
	Service sector	GWh/year	15 319	14 553	13 634	12 782	11 931	11 079	10 227
	Industrial sector	GWh/year	61 727	67 771	75 023	74 404	73 785	73 166	72 547
	Other sectors => Agriculture	GWh/year	6 435	5 620	4 642	4 642	4 642	4 642	4 642
Demand for cooling, **useful** energy	Housing sector	GWh/year	28	28	28	28	28	28	28
	Service sector	GWh/year	1 429	1 429	1 429	1 429	1 429	1 429	1 429

[2] Publicly available on https://www.energiesparen.be/energiestatistieken

[3] The above definition of the reporting instructions does not explicitly mention that this is final energy consumption specifically for heat, but this is clear from the reporting templates. In the rest of the report we interpret this as 'final energy consumption specifically for heat demand'.

	Industrial sector	GWh/year	3	3	3	3	3	3	3
	Other sectors => Agriculture	GWh/year	0	0	0	0	0	0	0

Table 1: Demand for heating and useful energy in the Flemish sectors (calculated from the energiebalans). The projection values for 2050 are discussed in Chapter 6.

We will explain how these data from the *energiebalans* were calculated.

The final energy consumption per sector is provided in the *energiebalans* results [4]. This has to be converted, in accordance with the European definitions, into 'final energy consumption for heat demand' and 'useful heat'.

For combined heat and power generation (CHP) we make a distinction between:

- non-self-producers (installations operated by or in cooperation with electricity companies (energy sector)), and
- self-producers (company that in addition to its main activity also produces its own electricity for its own use and possible sale to others).

As the fuel consumption for self-producers is also partly used to produce electricity, only the heat production should be counted in the final energy consumption for heat demand.

The final energy consumption is converted into useful heat in three steps, based on the fuel consumption per sector.

In the <u>first step</u>, electricity is not included in the useful heat demand for industry, tertiary and agriculture. For households only, 22% of the household electricity consumption is attributed to heating, according to two-yearly surveys (internal info VEA – VITO).

In the <u>second step,</u> the final energy consumption for heat is converted into useful heat using conversion efficiencies. The value of the efficiency is determined by the ministerial decree on qualitative cogeneration [2]. These conversion efficiencies are listed in Annex 4. This provides the useful heat demand per sector, excluding self-producers.

In the <u>third step</u>, to calculate the final energy consumption for heat, the useful heat of the self-producers in the sector is added to the final energy consumption for heat production excluding self-producers The useful heat for self-producers is reported directly in the *energiebalans* process via the CHP reporting. In Table 2, the two columns on the far right-hand side show the final energy consumption for heat and useful heat per sector. These columns also provide the input for Table 1.

	[GWh] Final energy consumption excluding self-producers	[GWh] Final energy consumption for heat production excluding self-producers	[GWh] Useful heat on site	[GWh] Final energy consumption self-producers	[GWh] Useful heat from self-producers	[GWh] Final energy consumption for heat	[GWh] Useful heat
industry	108 458	67 183	55 058	11 972	6 669	73 852	61 727
tertiary sector	30 406	16 524	14 840	1 750	478	17 003	15 319
households	59 348	47 709	38 219	3	3	47 712	38 222
agriculture	3 218	3 127	2 691	6 306	3 744	6 871	6 435

Table 2: Final energy consumption for heat demand and useful heat energy per sector in Flanders (calculated from the energiebalans).

[4] Publicly available on https://www.energiesparen.be/energiestatistieken

2.2 Breakdown for heat demand according to technology

The second template that was provided in the reporting instructions is given below. The template itself is not a mandatory format and minor changes have been made; for example, we also explicitly report on the 'agriculture, forestry and fishery' sector[5]. We will elaborate on how this table was created.

Part I: Overview of heating and cooling 2.(a) Reporting of current heating and cooling supply				
2019				
On-site energy supply			Unit	Value
Housing sector	Sources of fossil fuel	Heat-only boilers	GWh/year	29 149
		Electric heating	GWh/year	4 919
		High-efficiency CHP	GWh/year	3
	Renewable energy sources	Heat-only boilers	GWh/year	3 188
		High-efficiency CHP	GWh/year	0
		Heat pumps	GWh/year	776
		Solar boilers	GWh/year	186
Service sector	Sources of fossil fuel	Heat-only boilers	GWh/year	14 639
		Other technologies	GWh/year	0
		High-efficiency CHP	GWh/year	154
	Renewable energy sources	Heat-only boilers	GWh/year	9
		High-efficiency CHP	GWh/year	374
		Heat pumps	GWh/year	129
		Solar boilers	GWh/year	14
Industrial sector	Sources of fossil fuel	Heat-only boilers	GWh/year	53 704
		Other technologies	GWh/year	0
		High-efficiency CHP	GWh/year	6 227
	Renewable energy sources	Heat-only boilers	GWh/year	807
		High-efficiency CHP	GWh/year	986
		Heat pumps	GWh/year	4
		Other technologies	GWh/year	0
Agriculture, forestry and fishery	Sources of fossil fuel	Heat-only boilers	GWh/year	2 726
		Other technologies	GWh/year	0
		High-efficiency CHP	GWh/year	3 238
	Renewable energy sources	Heat-only boilers	GWh/year	41
		High-efficiency CHP	GWh/year	429
		Heat pumps	GWh/year	0
		Other technologies	GWh/year	
Off-site energy supply				
Housing sector	Sources of fossil fuel	Waste heat	GWh/year	2
		High-efficiency CHP	GWh/year	0
		Other technologies	GWh/year	1
	Renewable energy sources	Waste heat	GWh/year	2

[5] Hereinafter we will refer to this sector as 'agriculture'.

		High-efficiency CHP	GWh/year	0
		Other technologies	GWh/year	1
Service sector	Sources of fossil fuel	Waste heat	GWh/year	40
		High-efficiency CHP	GWh/year	153
		Other technologies	GWh/year	925
	Renewable energy sources	Waste heat	GWh/year	36
		High-efficiency CHP	GWh/year	106
		Other technologies	GWh/year	0
Industrial sector	Sources of fossil fuel	Waste heat	GWh/year	135
		High-efficiency CHP	GWh/year	4 133
		Other technologies	GWh/year	2
	Renewable energy sources	Waste heat	GWh/year	123
		High-efficiency CHP	GWh/year	9
		Other technologies	GWh/year	0
Agriculture, forestry and fishery	Sources of fossil fuel	Waste heat	GWh/year	0
		High-efficiency CHP	GWh/year	14
		Other technologies	GWh/year	0
	Renewable energy sources	Waste heat	GWh/year	0
		High-efficiency CHP	GWh/year	28
		Other technologies	GWh/year	0

Table 3: Breakdown of the final energy consumption on/off site, per sector and technology (calculated from the energiebalans).

The reporting template explicitly states that a distinction must be made between energy generated on site and off site, including a distinction between renewable/non-renewable and differentiated according to technology. It is not possible to extract these data from the *energiebalans* in this manner, in this format and at this level of detail, so it has been necessary to combine different data sources.

We first address CHPs, for which detailed fuel consumption, sector data and heat production data are available via the annual CHP reporting and which are reported to Eurostat.

In the reporting required for the heat map, we propose distinguishing between the on-site and off-site energy supplies, however, the distinction between on-site and off-site is not conclusively defined. For the CHP inventory, we interpret 'off-site' to mean that the installation is owned and operated by an energy supplier (which de facto makes it part of the conversion sector) and that its heat is supplied to the final sector. We use fuel consumption, which is listed per type of fuel in the inventory, to distinguish between renewable and non-renewable. In line with the Eurostat definitions, only high-efficiency CHPs are considered. We assume that the on-site CHPs in the CHP inventory correspond to the 'autonomous producer or self-producer'.

For all other off-site energy production, the district heating networks report is used, which reports on the energy supplied to sectors via a district heating network. The high-efficiency CHPs are not counted twice, as they were already included in the CHP inventory. The waste incineration plants supplying a district heating network are counted separately, with the supplied heat divided into a share of renewable and non-renewable and shown in Table 3. Other heat supplied per sector is also split into fossil and renewable and is shown in the table under 'other technologies'.

For the energy supplied on site, the 'heat pumps and heat pump boilers' and 'solar boilers', which are listed in the *energiebalans*, are also included in the table. Electric heating at household level is also added. There are no systematic data at installation level available for single heat boilers and other technologies. In line with Table 1 and Table 2, the heat demand is allocated that is not covered by high-efficiency CHP, waste incineration, heat pump or solar boiler.

2.3 Cooling and cooling demand

The amount of data available for the cooling demand is more limited, because this is not systematically reported for the *energiebalans*.

2.3.1 Residential

Cooling demand in the residential sector was estimated at zero in the previous heat map, as reliable data are not available. However, there is an estimate within Eurostat which can be referenced:

Eurostat data Belgian households	[TJ]	[GWh]
Final energy consumption	339 275	94 215
Space cooling	218	61
Space heating	249 269	69 220
Hot water	40 210	11 166
Cooking	5 780	1 605

Table 4: Applications in Belgian domestic final energy consumption 2018 (source: Eurostat)

Eurostat estimates that the residential cooling demand corresponds to the useful heat demand with a factor of 0.074%. If we assume this factor to be the same for Flanders as for Belgium, we can convert the 38 219 GWh useful heat from Table 2 to estimated space cooling. This results in an estimate of 28.3 GWh of residential cooling demand.

2.3.2 Industry and agriculture

No data or estimates are available for the agricultural sector. In the previous heat map, this was assumed to be zero, and we will use the same in this study.

For industry, one plant is known to have generated 11 GWh of cooling in 2019.

2.3.3 Tertiary sector

Eurostat did not release an estimate for cooling in the tertiary sector nor are there any measurement data available. In the previous heat map exercise, cooling by Fluvius (then Eandis) in Flanders was estimated at 1 392 GWh. [3]. This estimate was made on the basis of the building functions, the number of square metres per building function and an old Dutch study that estimated the cooling demand in buildings (Meijer 2008)[6]).

For example, for office buildings, the Meijer study assumed a cooling demand of 70 MJ/m^2 floor area (= 19.4 kWh per square metre of floor area), and the number of m^2 of office buildings could then be used to produce an estimate.

Since 2006, the number of public buildings with cooling has increased from 10% to 25% (source: Long-Term Renovation Strategy) [4]). However, it is not known how this has translated into energy consumption for cooling.

Data centres form a relatively recent major new sector in terms of cooling demand. Internet research looked at 12 data centres in Flanders[7]. The exact floor area was established for 11 of the data centres, giving an average floor area of 1 318 m^2

[6] Meijer 2008, http://senternovem.databank.nl/quickstep/QsBasic.aspx?cat_open=utiliteitsbouw

7 Including http://www.datacenters-benelux.com/belgie.cfm or https://lcl.be/nl-be/nieuws/laatste-updates-artikels/nieuwe-datazaal-lcl-in-antwerpen and *https://datacenterunited.com/*

per data centre. In [5], a Dutch study calculated a cooling demand for a data centre of 1 971 kWh/yr/m^2 floor area. We use this estimate for a number of data centres:

$$cooling(data\ centres) = 12 \times 1318 m^2 \times \frac{1\,971\ kWh}{yr} = \ 31\ GWh$$

This cooling demand has been added to the cooling demand from the previous heat map.

2.4 Existing and planned district heating networks

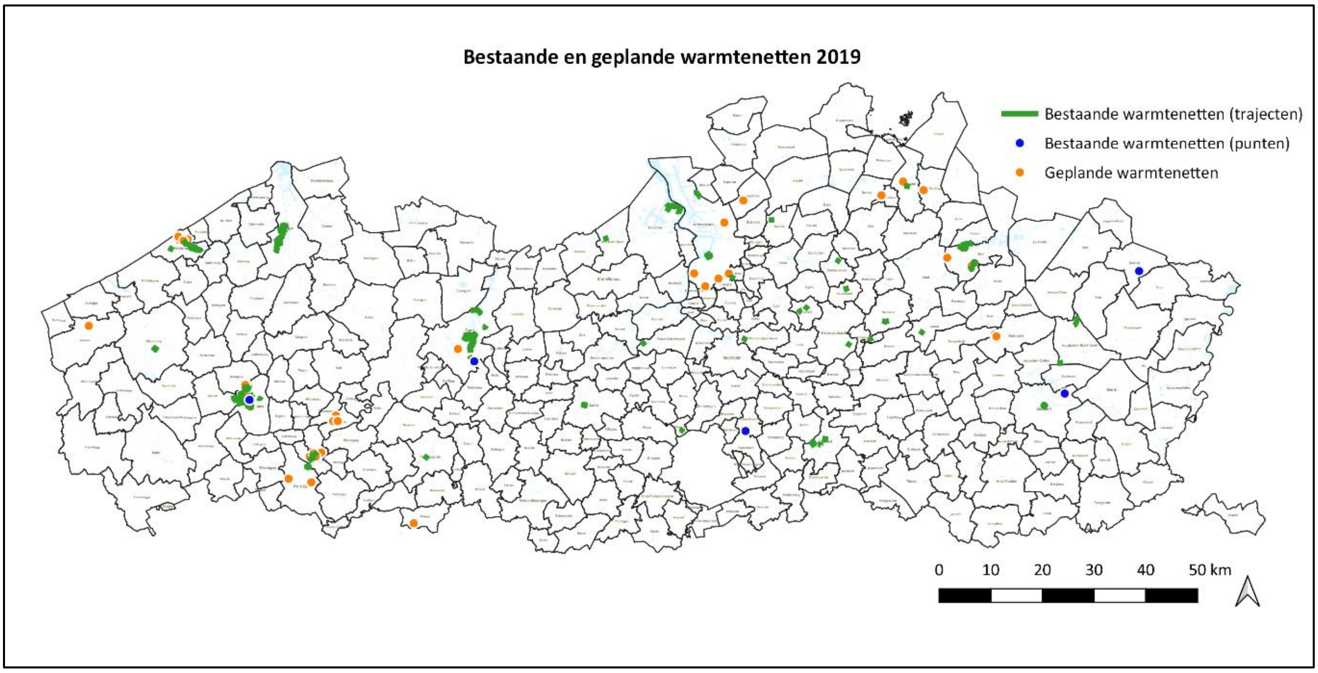


Figure 1: Existing and planned district heating networks 2019

Bestaande en geplande warmtenetten 2019	Existing and planned district heating networks 2019
Bestaande warmtenetten (trajecten)	Existing district heating networks (areas)
Bestaande warmtenetten (punten)	Existing district heating networks (points)
Geplande warmtenetten	Planned district heating networks

There are currently very few district heating networks in Flanders compared to some other Member States. For the year 2019, 58 existing district heating networks could be identified in Flanders, i.e. a total of 92 km (trench length). In Figure 1, 52 of them are shown with the area they cover, while the others are marked by a circle on the map.

The share of renewable energy sources in heat production supplied by district heating networks was 34.1% in 2019. In 2018, this was 34.6%. The share of renewable energy sources for heat production supplied by district heating networks for the year 2017 and earlier is not known.

The table in Annex 2 shows additional information for each existing and planned district heating network.

The information for existing heating systems includes:

- name of the project
- type of network
- municipality
- district heating network operator
- district heating network supplier
- supply to residential (YES/NO/not known)
- supply to industry (YES/NO/not known)

- supply to services & public (YES/NO/not known)
- temperature level of district heating network:
    - < 50 °C: low
    - 50–70 °C: medium
    - > = 70 °C: high
- trench length
- generators
- energy supplied to district heating network (4 categories)
- share of renewable waste heat
- share of non-renewable waste heat
- share of renewable non-waste heat
- share of non-renewable non-waste heat
- funding received? (YES/not known),
- funding sources
- network expansion planned? (YES/not known).

For planned heating systems:

- name of the project
- owner
- postcode
- municipality
- subsidy call green heat/waste heat (YES/NO).

In addition to this overview map, there are a number of detailed route maps of the district heating networks to which more than 20 GWh of energy was supplied in 2019. Any other district heating networks in the area covered by the map are also shown. A detailed map for the Brussels Airport district heating network (20–200 GWh) is not included because the geographical route is not known.

Figure 2: Overview of existing district heating networks in the port of Antwerp

Zandvliet	Zandvliet
Doel	Doel
Lillo	Lillo
Stabroek	Stabroek
Indaver-Amoras	Indaver-Amoras
(Hoe)venen	Hoevenen
(Kiel)drecht	Kieldrecht
Ecluse	Ecluse
N1 Leiding Indaver-INEOS	N1 Pipeline Indaver-INEOS
Kallo	Kallo

(Ver)rebroeck	Verrebroek
Beveren	Beveren
Antwerpen	Antwerp

On the left bank of the Antwerp port area, more than 200 GWh and 20–200 GWh were injected into the steam networks 'Ecluse' and 'N1 Pipeline Indaver-INEOS Pipeline' respectively, with a total trench length of 5.5 km, in order to supply energy to companies in the vicinity. Additionally, the right bank has the high-temperature district heating networks 'Indaver-Amoras', with an energy supply 1–20 GWh and a trench length of 1.3 km. This also supplies energy to local companies. The energy is generated from waste incineration.

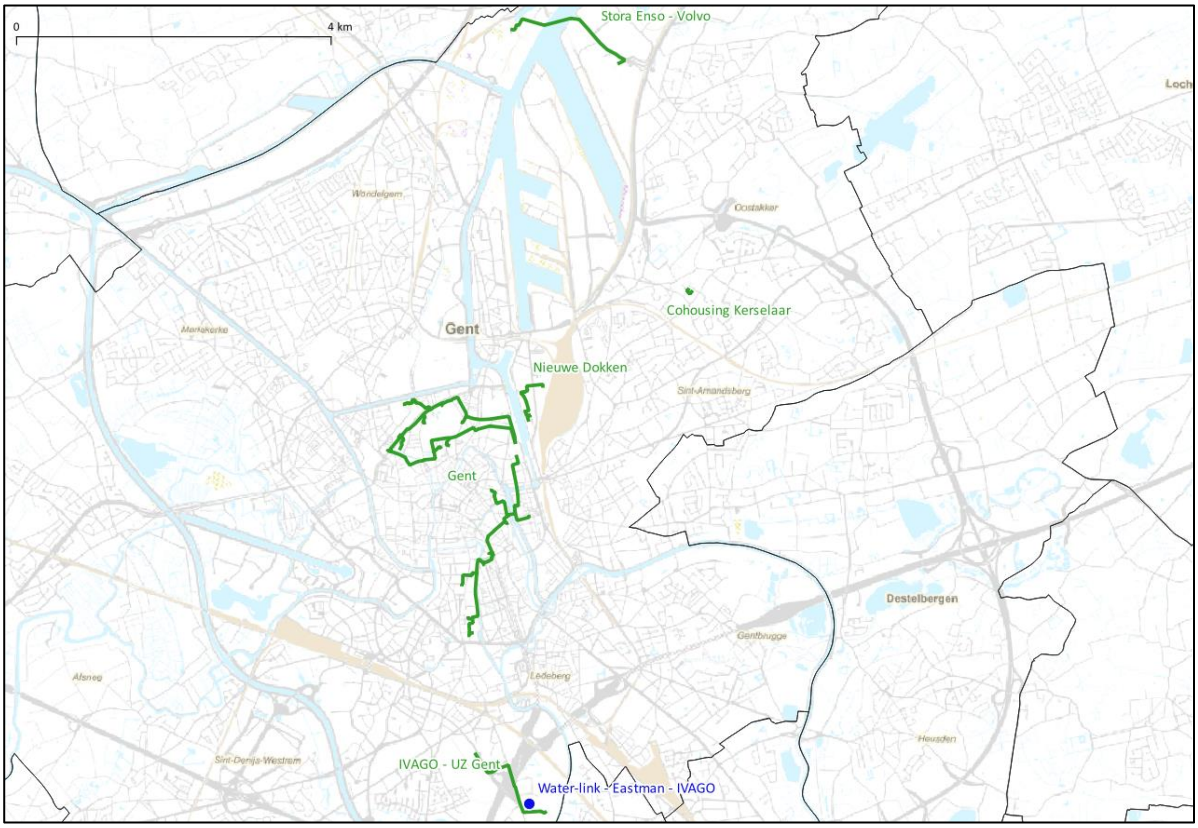


Figure 3: Overview of existing district heating networks in the municipality of Ghent

Stora Enso - Volvo	Stora Enso – Volvo
Loch(risti)	Lochristi
Wondelgem	Wondelgem
Oostakker	Oostakker
Mariakerke	Mariakerke

Gent	Ghent
Cohousing Kerselaar	Cohousing Kerselaar
Nieuwe Dokken	Nieuwe Dokken
Sint-Amandsberg	Sint-Amandsberg
Gent	Ghent
Afsnee	Afsnee
Sint-Denijs-Westrem	Sint-Denijs-Westrem
IVAGO – UZ Gent	IVAGO – UZ Ghent
Water-link – Eastman – IVAGO	Water-link – Eastman – IVAGO
Ledeberg	Ledeberg
Gentbrugge	Gentbrugge
Destelbergen	Destelbergen
Heusden	Heusden

In Ghent, 20–200 GWh of energy are injected into the 'Gent', 'Stora Enso–Volvo', 'IVAGO–UZ Gent' (steam network) and 'Nieuwe Dokken' networks. Together, they have a trench length of 15.85 km. This figure also shows two other district heating networks in Ghent: 'Cohousing Kerselaar' and 'Water-link – Eastman – IVAGO'.

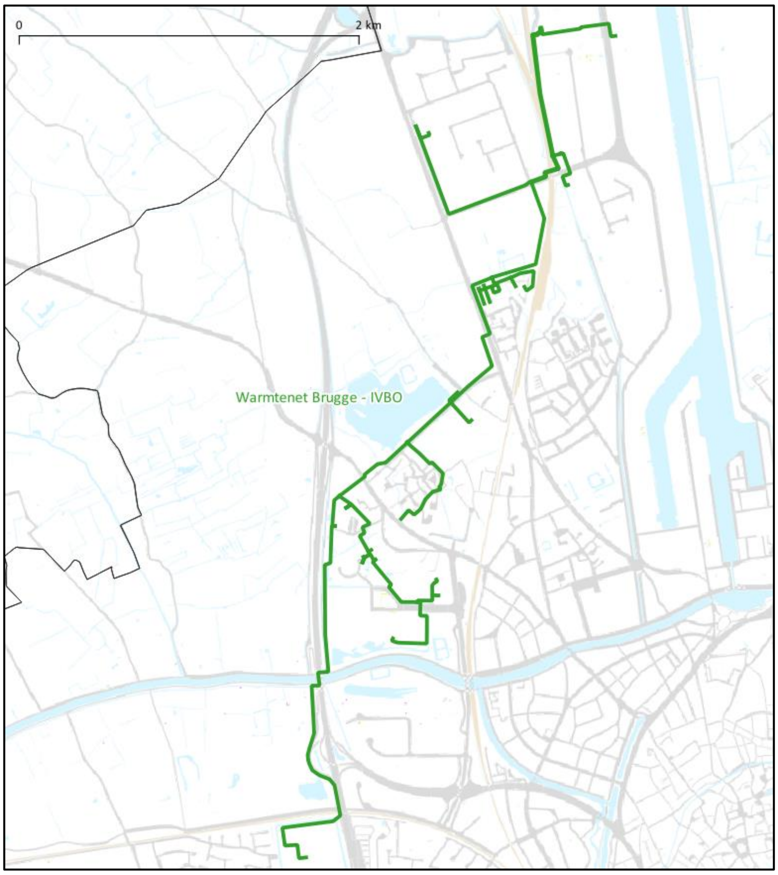


Figure 4: District heating network Bruges – IVBO

Warmtenet Brugge - IVBO	District heating network Bruges – IVBO

The high-temperature heat network 'Brugge [Bruges] – IVBO', with a trench length of 11.4 km, transported between 20–200 GWh of energy from waste incineration to residential, industrial and tertiary customers in 2019.

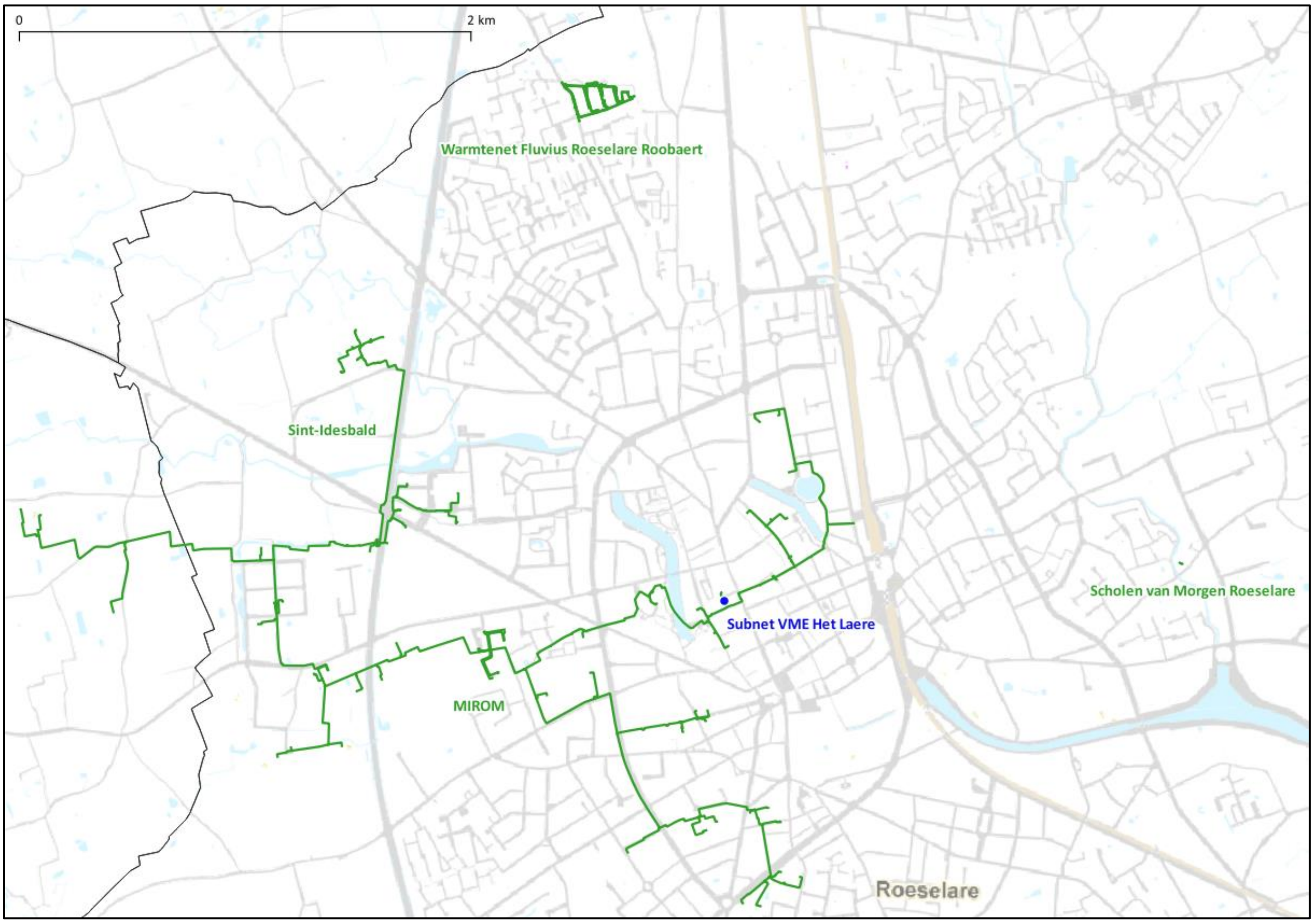


Figure 5: Overview of the district heating networks in Roeselare

Warmtenet Fluvius Roeselare Roobaert	District heating network Fluvius Roeselare Roobaert
Sint-Idesbald	Sint-Idesbald
Subnet VME Het Laere	Subnet VME Het Laere
Scholen van Morgen Roeselare	Scholen van Morgen Roeselare
MIROM	MIROM
Roeselare	Roeselare

In Roeselare, the high-temperature heat network 'MIROM', with a trench length of 11.3 km, provides an energy transport of 20–200 GWh from waste incineration. The 'Sint-Idesbald' district heating network (1.7 km) supplies 1–20 GWh of energy. The district heating network 'Fluvius Roeselare Roobaert' (2 km) and the smaller networks 'Subnet VME Het Laere' and 'Scholen van Morgen Roeselare' are also located in Roeselare.

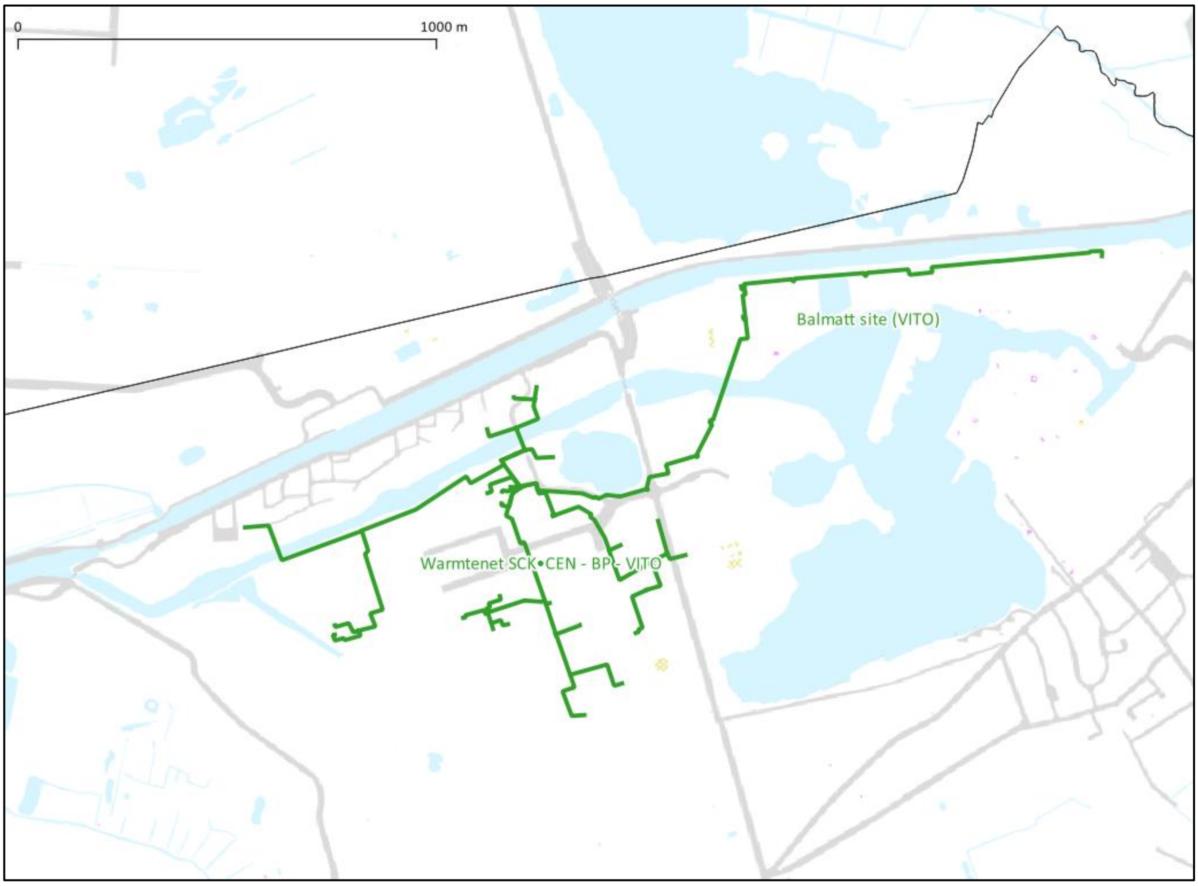


Figure 6: District heating network SCK–CEN–BP–VITO and district heating network Balmatt site VITO

Balmatt site (VITO)	Balmatt site (VITO)
Warmtenet SCK•CEN – BP - VITO	District heating network SCK–CEN–BP–VITO

The 'SCK–CEN–BP–VITO' district heating network transported 20–200 GWh of energy to industry and other businesses in the area in 2019 and has a trench length of 5.9 km. There is also the 'Balmatt site' district heating network, with a trench length of 2 km, but this did not supply any energy in 2019.

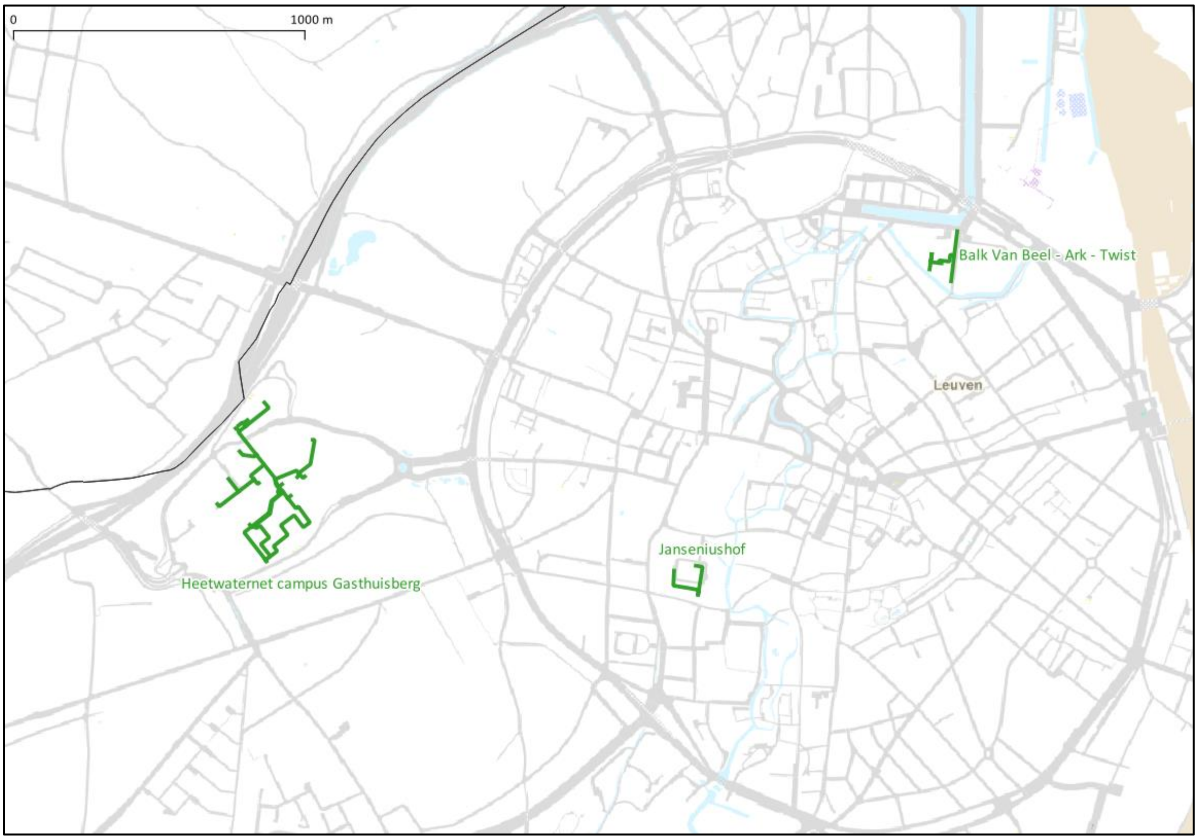


Figure 7: District heating networks in the municipality of Leuven

Balk Van Beel - Ark – Twist	Balk Van Beel – Ark – Twist
Leuven	Leuven
Heetwaternet campus Gasthuisberg	Hot water distribution system Campus Gasthuisberg
Janseniushof	Janseniushof

In Leuven, there are three networks: the high-temperature heat network 'Campus Gasthuisberg' with an energy generation of 20–200 GWh via a natural gas boiler, the cold network 'Janseniushof' (not yet active in 2019) and the high-temperature heat network 'Balk Van Beel – Ark – Twist' with an energy generation of 1–20 GWh via a natural gas boiler.

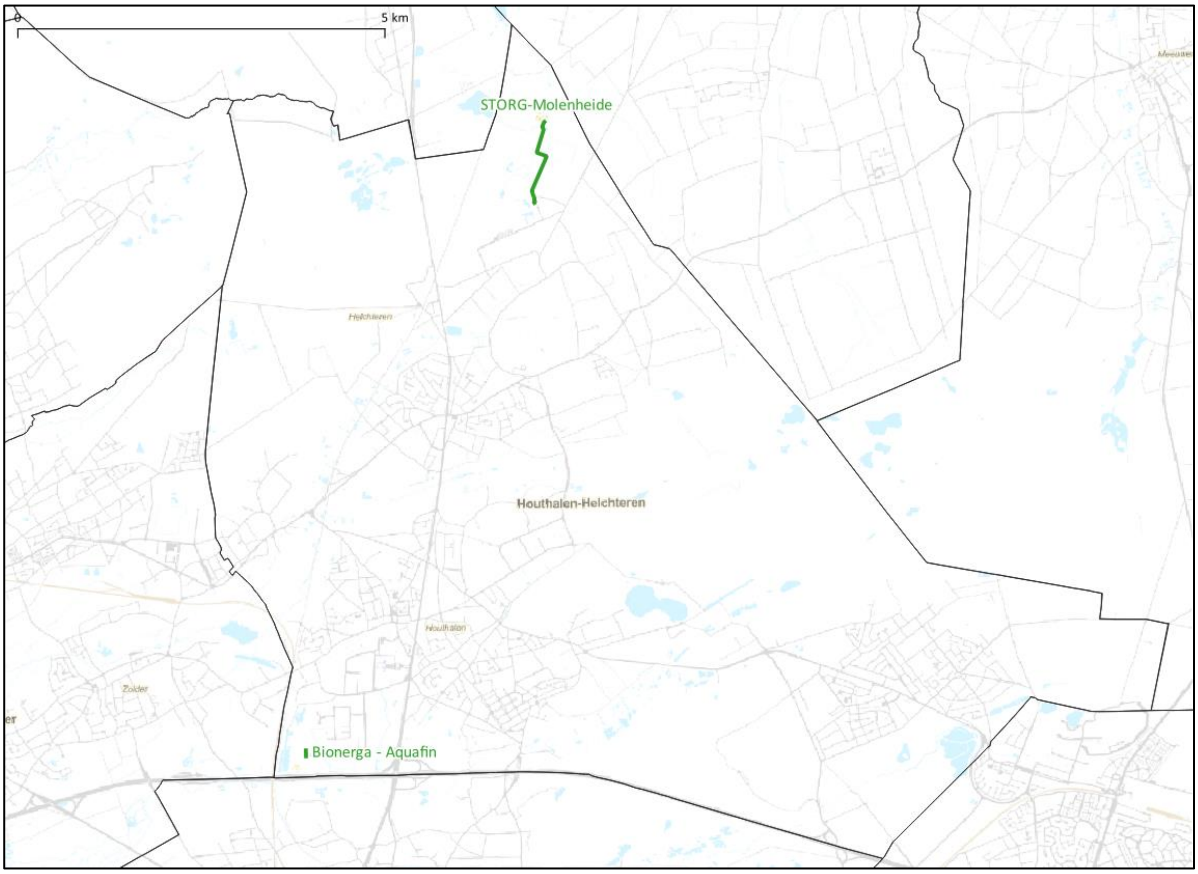


Figure 8: District heating networks in the municipality of Houthalen-Helchteren

STORG-Molenheide	STORG-Molenheide
Meeuwen	Meeuwen
Helchteren	Helchteren
Houthalen-Helchteren	Houthalen-Helchteren
Zolder	Zolder
Houthalen	Houthalen
Bionerga - Aquafin	Bionerga – Aquafin

In the municipality of Houthalen-Helchteren there are two district heating networks: the steam network 'Bionerga – Aquafin' with an energy generation of 20–200 GWh from waste incineration and the high temperature heat network 'STORG-Molenheide' with an energy generation of 1–20 GWh, via a CHP on biogas.

3 THE HEAT DEMAND MAP

This chapter provides an overview of the spatially specific results that were collected within the framework of the new version of the Heat Map. In each case, they describe the situation in 2019. Below is an illustration of the detailed map. On this map, the heat demand of small consumers is shown by coloured street sections. The large consumers are shown as individual circles on the map indicating annual heat demand. A consumer is classified as a large consumer if its annual heat demand is greater than 0.2 GWh. Small consumers include residential properties, apartments with individual heating installations, smaller offices, shops and other smaller tertiary activities. An apartment will therefore be classified as a large consumer if it has a sufficiently large central heating system (> 0.2 GWh/year). The detailed overview and distinction between large and small consumers is essential for local project developers who are planning the construction of a district heating network, or local policy makers creating a heat zoning plan or a climate action plan, etc.

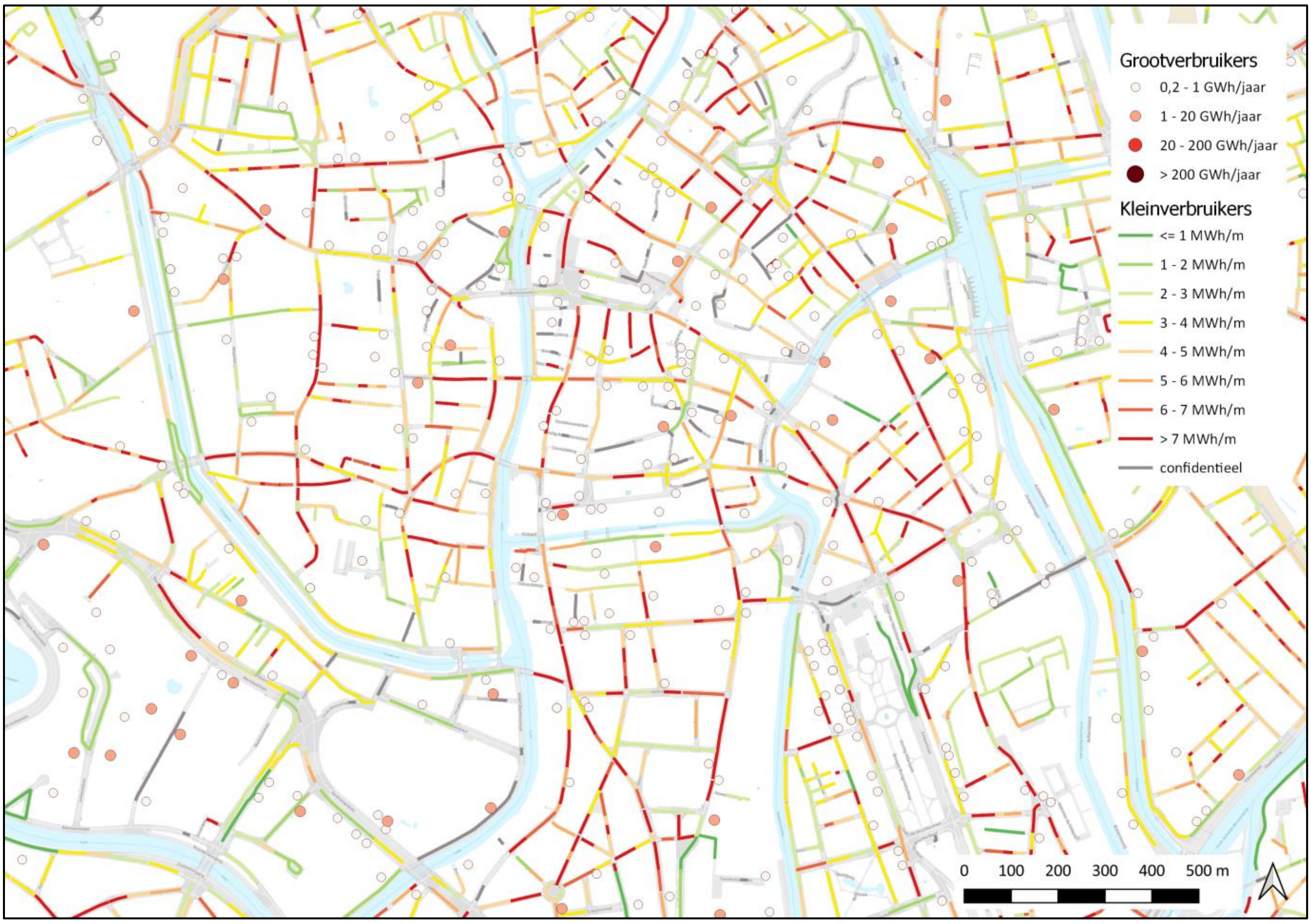


Figure 9: Illustration of the heat map near the centre of Ghent. The heat demand of small consumers is shown by coloured street sections; large consumers are shown as circles on the map. The lowest class of large consumers 0.2–1 GWh/year can also be described as 0.2 < x <= 1 GWh/year. (source: Fluvius, VITO)

Grootverbruikers	Large energy consumers
0,2 – 1 GWh/jaar	0.2–1 GWh/year
1 - 20 GWh/jaar	1–20 GWh/year
20 - 200 GWh/jaar	20–200 GWh/year

> 200 GWh/jaar	> 200 GWh/year
Kleinverbruikers	Small consumers
<= 1 MWh/m	<= 1 MWh/m
1 - 2 MWh/m	1–2 MWh/m
2 - 3 MWh/m	2–3 MWh/m
3 - 4 MWh/m	3–4 MWh/m
4 - 5 MWh/m	4–5 MWh/m
5 - 6 MWh/m	5–6 MWh/m
6 - 7 MHh/m	6–7 MWh/m
> 7 MWh/m	> 7 MWh/m
confidentieel	confidential

In this section, we provide more detail on how the heat map was created and what information is provided. More specifically, the mapping of heat demand is reported at the level of large consumers, small consumers, the totals per municipality and finally also per statistical sector. All this information is publicly available and can be downloaded via the Flemish government's Geoportal, called Geopunt. The second part of this chapter also explains the method that was used to estimate heat demand on the basis of individual consumption data from the network operator Fluvius.

Map layer	Spatial level	Heat demand specification
Large energy consumers	Positioning based on Fluvius database (generally based on CRAB[8])	In classes: 0.2–1 GWh/year (0.2 < x <= 1 GWh/year) 1–20 GWh/year (1 < x <= 20 GWh/year) 20–200 GWh/year (20 < x <= 200 GWh/year) >200 GWh/year (x > 200 GWh/year)
Small consumers	At the level of street section (basic resolution of 10 m).	The exact heat demand is aggregated over at least 5 consumer addresses. Consumers on both sides of the road can therefore be combined in the same road section (see also 3.1.2).
Heat demand per municipality	Per municipality (situation 31 December 2018, 308 municipalities)	In this section, the exact heat demand of the small consumers is combined with the exact heat demand of the large consumers connected to the Fluvius grid. For the other large consumers, the range was translated into a figure.
Heat demand per statistical sector	By statistical sector (9 182 sectors)	In this section, the exact heat demand of the small consumers is combined with the exact heat demand of the large consumers connected to the Fluvius grid. For the other large consumers, the range was translated into a figure.

[8] On the basis of the Central Reference Address Database (Centraal Referentie Adressen Bestand – CRAB), each address is assigned the most accurate position in (x,y)-coordinates known at that time in CRAB. Depending on the address, the position can be associated with a building, a plot, a road connection or the municipality itself. The method of positioning can also vary (manual, derived or interpolated).

Table 5: Overview of spatial and in-depth detail of heat demand for the 4 available heat demand map layers

3.1 Heat demand maps: results

3.1.1 Heat demand of large consumers

Energy consumers with an annual heat demand greater than 0.2 GWh are indicated by a circle on the map. These locations could also act as potential heat supply points in some cases for the creation of a heat zoning plan, but this would require more detailed research. Their heat demand is represented according to 4 classes:

- 0.2 < x <= 1 GWh/year,
- 1 < x <= 20 GWh/year,
- 20 < x <= 200 GWh/year and
- x > 200 GWh/year.

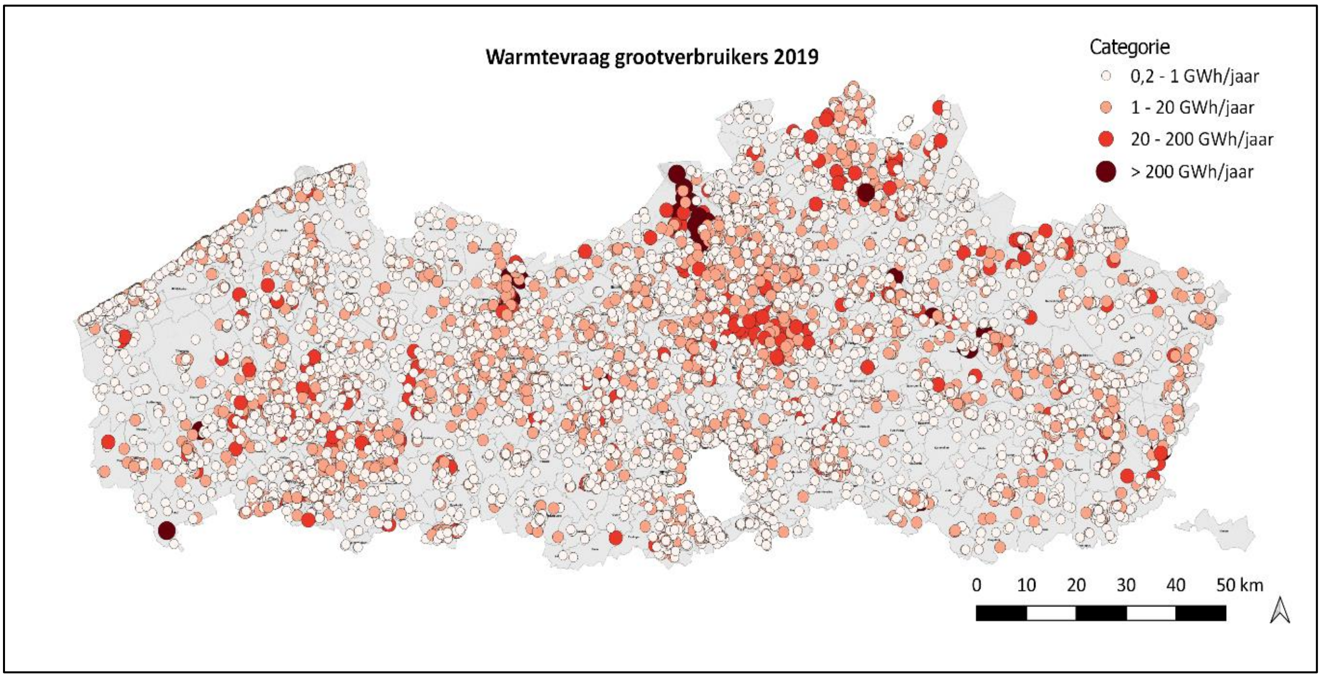


Figure 10: Heat demand of large consumers 2019 (source: Fluvius, IMJV)

Warmtevraag grootverbruikers 2019	Heat demand of large consumers 2019
Categorie	Category
0,2 - 1 GWh/jaar	0.2–1 GWh/year
1 - 20 GWh/jaar	1–20 GWh/year
20 - 200 GWh/jaar	20–200 GWh/year
> 200 GWh/jaar	> 200 GWh/year

The data for assigning each large consumer to a class are obtained from Fluvius for 99.4% of the consumer addresses. For non-Fluvius customers, data from the Integrated Annual Environmental Report (IMJV) is used, where the heat demand is derived from gas consumption[9]. Consumption data from the *energiebalans* are not used. In terms of heat demand, this 0.6% actually represents the largest share of heat demand from large consumers, as these are mainly heavy industry and refineries.

In total, there are 17 445 large consumers for 2019. Their breakdown according to heat demand and sectors is given in Table 6 and Table 7. In the Fluvius data, each large consumer is characterised by a unique account ID, which corresponds to a unique location. This means that one large consumer can be served by several consumption meters (EAN numbers) and can therefore also be linked to several sectors and/or subsectors. For example, the detailed map allows a distinction to be made between apartment buildings that have a central boiler and buildings where each apartment has its own boiler. Apartment buildings with a central boiler room will appear on the map as large consumers with one account ID, while flats with separate account IDs will appear as many small consumers in a coloured street section.

67% of the large consumers belong to the tertiary sector or to a combination of residential and tertiary.

CATEGORY	NUMBER
0.2–1 GWh/year	14 245
1–20 GWh/year	2 866
20–200 GWh/year	295
> 200 GWh/year	39
TOTAL	**17 445**

Table 6: Breakdown of the number of large consumers 2019 by heat demand (source: Fluvius, IMJV)

SECTORS	0.2–1 GWh/year	1–20 GWh/year	20–200 GWh/year	> 200 GWh/year	NUMBER
TERTIARY SECTOR	37.44%	7.85%	0.09%		7 916
RESIDENTIAL + TERTIARY	20.31%	1.55%			3 813
INDUSTRY	5.69%	3.92%	0.91%	0.18%	1 866
AGRICULTURE, FORESTRY AND FISHERY	5.04%	0.99%	0.44%	0.01%	1 129
RESIDENTIAL + INDUSTRY + TERTIARY	3.25%	0.46%			647
RESIDENTIAL	3.38%	0.10%			606
INDUSTRY + TERTIARY	1.25%	0.50%	0.07%		319
RESIDENTIAL + INDUSTRY	0.81%	0.07%			153
RESIDENTIAL + AGRICULTURE, FORESTRY AND FISHERY	0.67%	0.13%	0.07%		151
TRANSPORT	0.60%	0.18%	0.01%		136

[9] 19 companies did not submit their IMJV data with regard to energy consumption, or did so incompletely. For these companies, an 'expert estimate' is shown on the map. The method used for this estimate is as follows:

- Was the company included in the previous heat map? If so, the assumption is that the heat demand category has not changed compared to the previous heat map (data from 2012);
- If the company has a large installation that is registered under the ETS, then the CO_2 emissions are converted back into heat demand via the molar mass of methane/CO_2 and the energy content of methane, and this category is then used;
- If an internet search shows that the company has a similar site and IMJV data are available for this site, this value is also assumed for the other site;
- If no data are available, a classification is made based on the sector:
  - Chemicals, steel and petroleum-related activities are assigned a category between 20–200 GWh;
  - Other industry are assigned 1–20 GWh;
  - Clearly non-energy-related services such as logistics centres, wholesale trade, office space, etc. are assigned 0.2–1 GWh.

UNKNOWN	0.71%	0.05%			132
ENERGY	0.33%	0.07%	0.06%	0.03%	86
ENERGY + RESIDENTIAL + TERTIARY	0.45%	0.03%			85
RESIDENTIAL + AGRICULTURE, FORESTRY AND FISHERY + TERTIARY	0.34%	0.07%			72
PUBLIC LIGHTING	0.17%	0.14%			54
TERTIARY + TRANSPORT	0.19%	0.06%			43
RESIDENTIAL + INDUSTRY + AGRICULTURE, FORESTRY AND FISHERY + TERTIARY	0.18%	0.03%			38
ENERGY + TERTIARY	0.13%	0.05%			31
RESIDENTIAL + TERTIARY + TRANSPORT	0.15%	0.02%			30
AGRICULTURE, FORESTRY AND FISHERY + TERTIARY	0.13%	0.03%			27
RESIDENTIAL + INDUSTRY + TERTIARY + TRANSPORT	0.11%	0.02%			23
ENERGY + RESIDENTIAL + INDUSTRY + TERTIARY	0.07%				12
INDUSTRY + TRANSPORT	0.03%	0.02%	0.01%		11
INDUSTRY + TERTIARY + TRANSPORT	0.02%	0.03%			9
ENERGY + INDUSTRY	0.02%	0.01%	0.01%	0.01%	8
ENERGY + RESIDENTIAL	0.03%	0.01%			8
INDUSTRY + AGRICULTURE, FORESTRY AND FISHERY + TERTIARY	0.04%				7
ENERGY + AGRICULTURE, FORESTRY AND FISHERY	0.01%	0.01%	0.02%		6
INDUSTRY + AGRICULTURE, FORESTRY AND FISHERY	0.02%	0.01%	0.01%		6
RESIDENTIAL + TRANSPORT	0.03%	0.01%			6
RESIDENTIAL + INDUSTRY + AGRICULTURE, FORESTRY AND FISHERY	0.02%				4
TRANSPORT	0.01%	0.01%	0.01%		3
ENERGY + INDUSTRY + TERTIARY	0.01%				1
ENERGY + RESIDENTIAL + AGRICULTURE, FORESTRY AND FISHERY + TERTIARY	0.01%				1
ENERGY + RESIDENTIAL + INDUSTRY + AGRICULTURE, FORESTRY AND FISHERY + TERTIARY	0.01%				1
ENERGY + TERTIARY + TRANSPORT	0.01%				1
ENERGY + TRANSPORT	0.01%				1
INDUSTRY + AGRICULTURE, FORESTRY AND FISHERY + TERTIARY + TRANSPORT		0.01%			1
RESIDENTIAL + INDUSTRY + TRANSPORT	0.01%				1
RESIDENTIAL + AGRICULTURE, FORESTRY AND FISHERY + TRANSPORT		0.01%			1
NUMBER	**14 245**	**2 866**	**295**	**39**	**17 445**

Table 7: Breakdown of the number of large consumers 2019 by sector (source: Fluvius, IMJV)

3.1.2 Heat demand density of small consumers

Energy consumers with an annual heat demand less than or equal to 200 MWh are mapped according to their exact heat demand (grouped). For the year 2019, this concerns 2.7 million consumer addresses.

The mapping of heat demand aims at the highest possible level of spatial detail while still respecting privacy guidelines. This means that the heat demand is aggregated to the level of at least 5 consumers.

Heat demand is mapped at the level of a street section. Street sections refer to smaller sections of streets as they appear in the Large-scale Reference Database (LRD) layer 'Road connection' (version November 2019). In the analysis, each street is initially divided into 10 m sections. Consumers are then linked to these road sections based on the following prioritisation:

- Link to the nearest 10 m road section with the same CRAB code (max. 100 m distance);
- Link to the nearest 10 m road section with the street name and NISCODE (max. 100 m distance);
- Link to the nearest 10 m road section (max. 1 000 m distance);

The next step systematically aggregates sections in order to reach the minimum of 5 consumer addresses. When the minimum of 5 is reached, the merging stops. Figure 11 shows the result of the aggregation for adjacent (not empty) sections. If this still does not give the required number, then empty sections will also be added in order to reach the minimum of 5 consumers (Figure 12). A maximum extension of 200 m is provided for this purpose. Where it is not feasible to achieve a cluster of at least 5 consumers in this way, the consumer addresses are assigned to a street section to be treated as confidential (after being linked to the relevant street section where consumer addresses are located). 1.8% of the total number of consumer addresses are assigned to a confidential street section in this way. These represent 3.2% of total heat demand (and 11.5% of electricity consumption and 1.3% of gas consumption).

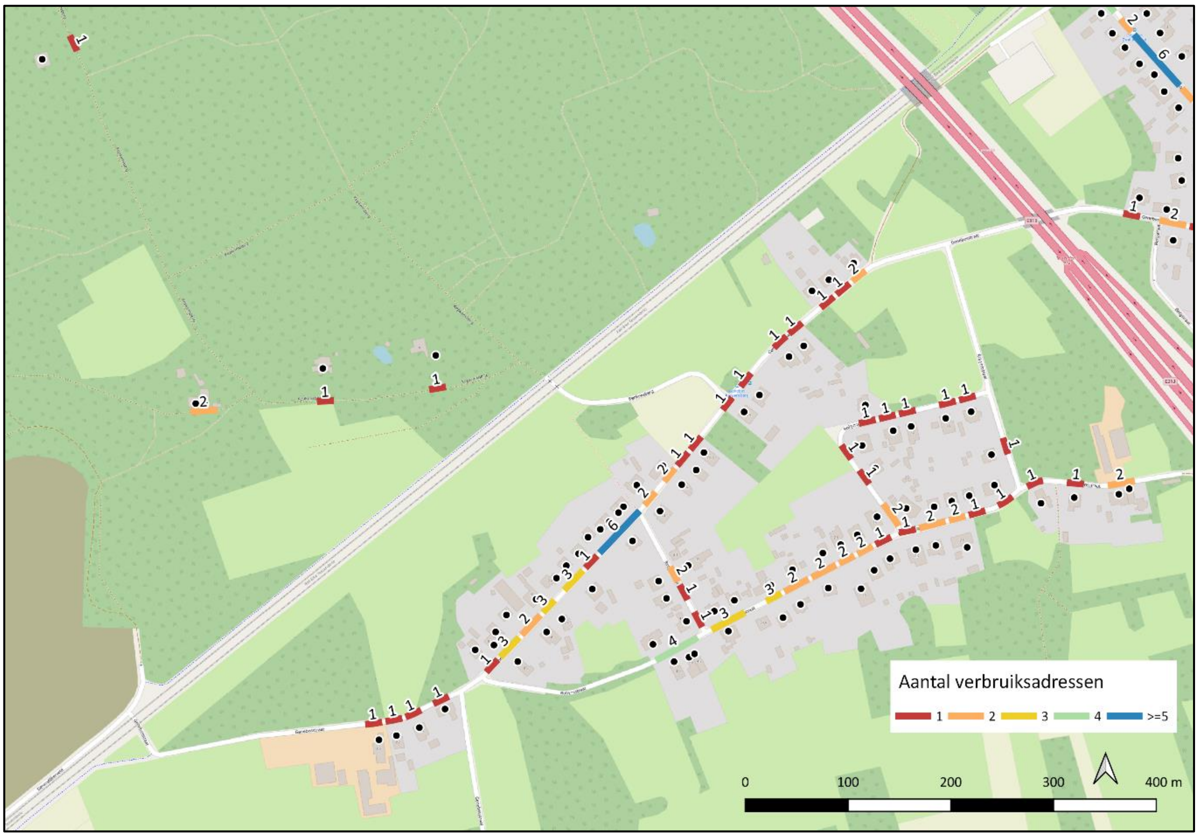


Figure 11: Illustration of linking consumer addresses to 10 m road sections

Aantal verbruiksadressen	Number of consumer addresses

Figure 12: Illustration of the number of final aggregated consumer addresses showing the associated heat density (in MWh/m).

<= 1 MWh/m	<= 1 MWh/m
1 - 2 MWh/m	1–2 MWh/m
2 - 3 MWh/m	2–3 MWh/m
3 - 4 MWh/m	3–4 MWh/m
4 - 5 MWh/m	4–5 MWh/m
5 - 6 MWh.m	5–6 MWh/m
6 - 7 MWh/m	6–7 MWh/m
> 7 MWh/m	> 7 MWh/m
confidentieel	confidential

Figure 13 shows the result of this analysis for the whole of Flanders. The heat demand per street section is expressed here per unit of length (in MWh/m).

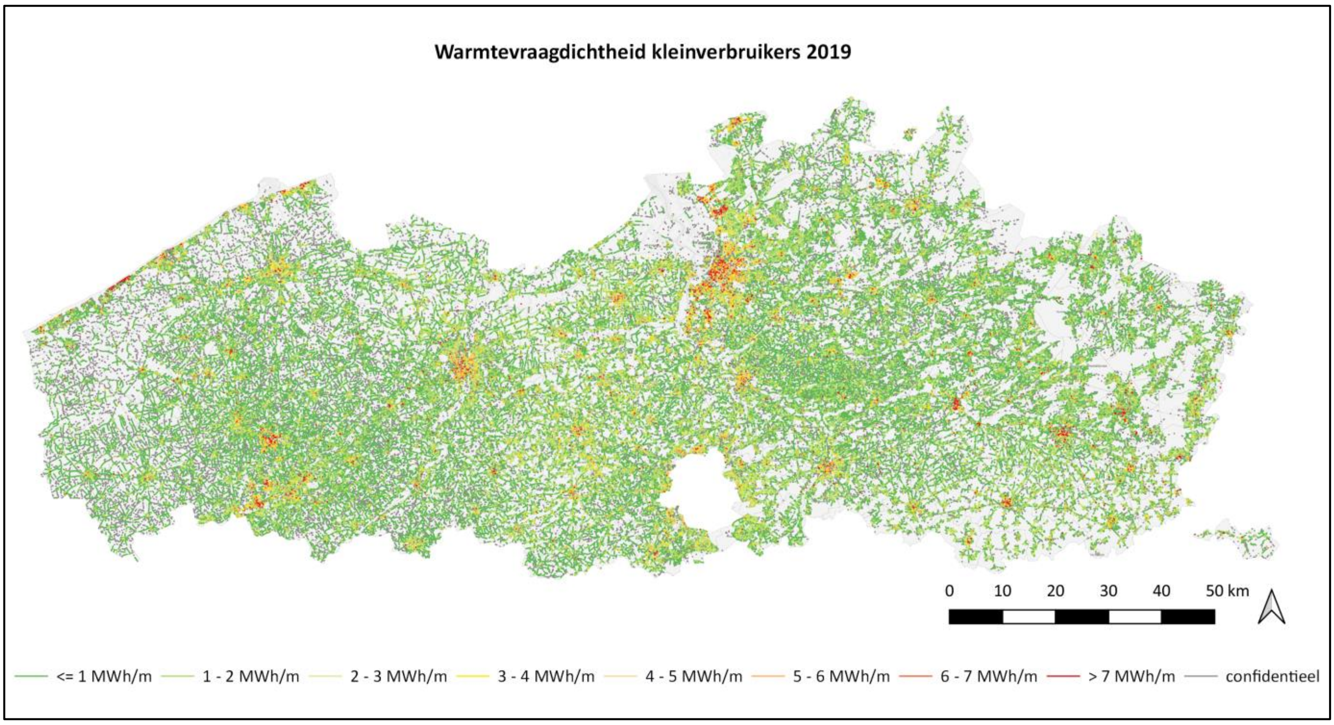


Figure 13: Heat demand density small consumers 2019 (source: Fluvius, VITO, expressed in MWh per linear meter)

Warmtevraagdichtheid kleinverbruikers 2019	Heat demand density small consumers 2019
<= 1 MWh/m	<= 1 MWh/m
1 - 2 MWh/m	1–2 MWh/m
2 - 3 MWh/m	2–3 MWh/m
3 - 4 MWh/m	3–4 MWh/m
4 - 5 MWh/m	4–5 MWh/m
5 - 6 MWh/m	5–6 MWh/m
6 - 7 MWh/m	6–7 MWh/m
> 7 MWh/m	> 7 MWh/m
confidentieel	confidential

3.1.3 Heat demand per municipality

The heat demand per municipality has been calculated by combining the exact heat demand of all small consumers (including the street section to be treated as confidential as referred to in 3.1.2) with the exact heat demand of the large consumers connected to the Fluvius grid. For the other large consumers, the range was converted into a number (the middle for the ranges; for the highest class the lower limit was used). The calculated total mapped heat demand for 2019 therefore amounts to **94 387 GWh**[10].

Figure 14 expresses the total heat demand per municipality in relation to the length of the road network (paved roads included in the LRD 'road connections')

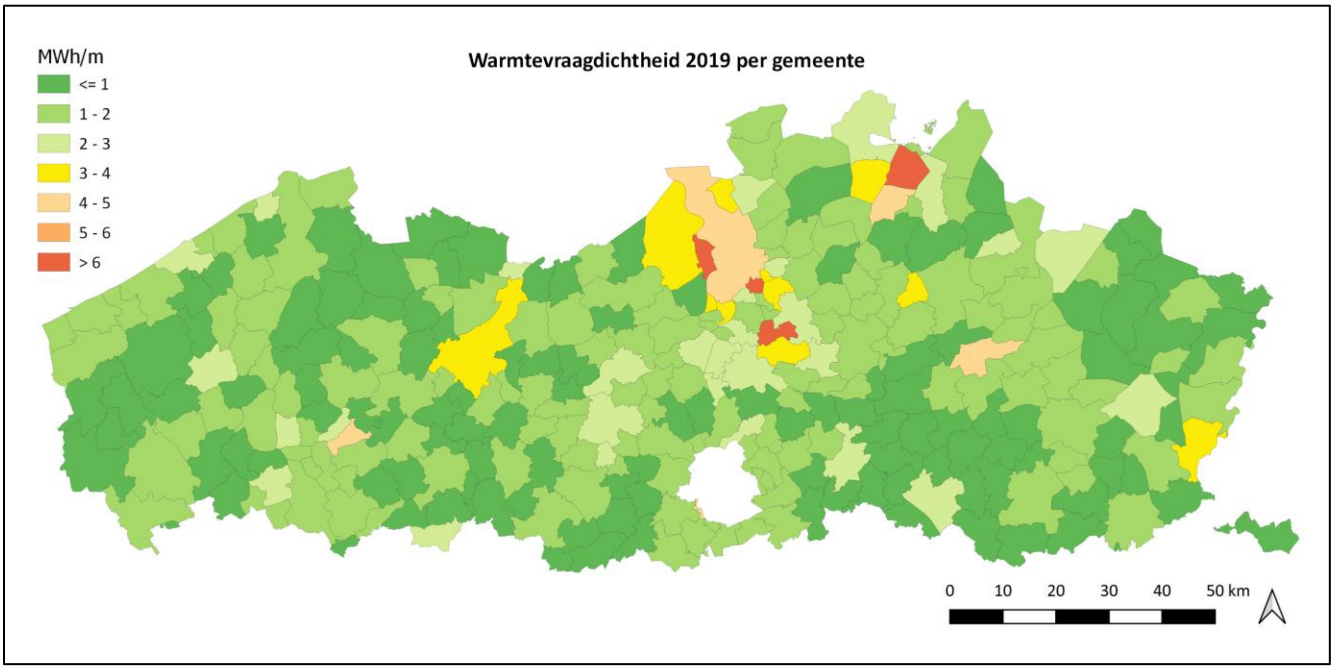


Figure 14: Heat demand density 2019 per municipality (source: Fluvius, VITO, expressed in MWh per linear meter)

Warmtevraagdichtheid 2019 per gemeente	Heat demand density 2019 per municipality
MWh/m	MWh/m
<= 1	<= 1
1 - 2	1–2
2 - 3	2–3
3 - 4	3–4
4 - 5	4–5
5 - 6	5–6

[10] This mapped heat demand differs from the Flemish total mentioned earlier in the report, as the lower limit of the range was chosen for the exact heat demand of the highest class of large consumers.

> 6	> 6

3.1.4 Heat demand density by statistical sector

The statistical sector is the basic spatial unit (BSU) created by the division of the municipalities and former municipalities by Statistics Belgium (Algemene Directie Statistiek – Statbel) for the publication of statistics on a more detailed level than the municipal level.

At the level of the statistical sectors, the total heat demand was estimated in the same manner as in 3.1.3. This time, the spatial detail is considerably higher. However, since the Fluvius consumption data does not always include data on statistical sectors, a small fraction is missing and the total mapped heat demand amounts to **94 369 GWh**[10].

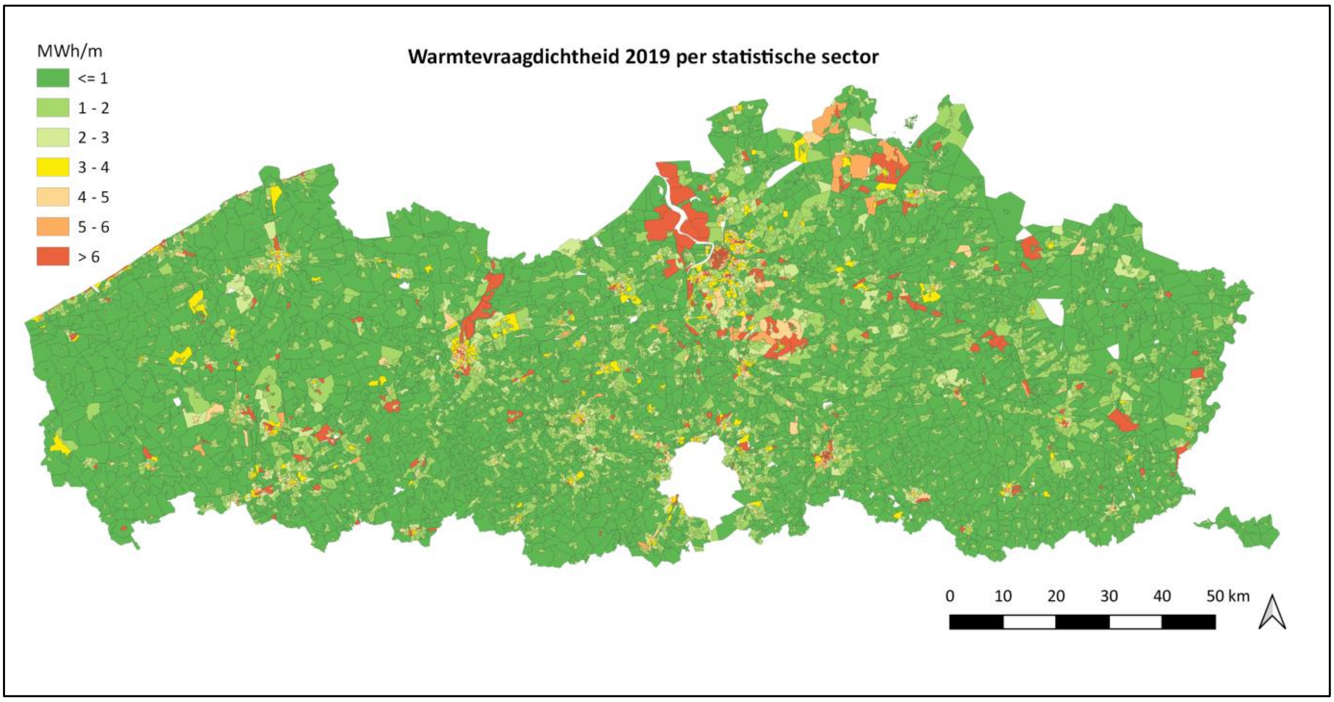


Figure 15: Heat demand density 2019 per statistical sector (source: Fluvius, VITO, expressed in MWh per linear meter)

Warmtevraagdichtheid 2019 per statistische sector	Heat demand density 2019 by statistical sector
MWh/m	MWh/m
<= 1	<= 1
1 - 2	1–2
2 - 3	2–3
3 - 4	3–4
4 - 5	4–5
5 - 6	5–6
> 6	> 6

3.2 Methodology for estimating heat demand

3.2.1 Estimating heating demand based on consumption data

The methodology for estimating the heat demand of Fluvius customers is explained below. Gas consumption is known, but the consumption of other fuels, such as biomass, fuel oil and electric heating, is not known for each location. In the absence of adequate data, an additional estimation is made on the basis of the following methodology below.

DISCLAIMER: Due to the lack of accurate data sources, the results for the additional estimates for heating with fuel oil, biomass and electricity may differ significantly from the actual situation in some areas. These results per municipality and statistical sector are therefore to be considered as indicative.

The first step is to determine whether there is a gas connection at the consumption point. If there is, it is assumed that the entire heat demand is covered by gas consumption, multiplied by the efficiency of the gas boilers[11] to generate the heat demand.

If there is no gas connection on the site, the sector is considered.

For the categories industry, public lighting and transport, it is assumed that there is no heat demand if there is no gas connection.

For the tertiary and agricultural sectors, if there is no gas connection, it is assumed that heating is based on the use of fuel oil and/or biomass. The Fluvius data provide no structural way of deducing whether fuel oil or biomass is used for heating, nor any way of deducing the exact heat demand. The data provided by the *energiebalans* are not used per consumption point due to commercial and privacy considerations. The data for the overall Flemish fuel oil and biomass consumption for heating are taken from the '*Energiebalans Vlaanderen*', and distributed proportionally over each consumption point. It is therefore assumed that each oil or biomass boiler is associated with the same level of consumption.

For the residential sector there is an added complexity. In this sector, there is also a lot of electric heating (8.4% of households [6]), whereas in non-residential sectors electric heating plays less of a role due to the higher cost of electricity. In this case, the electricity consumption is considered if it exceeds 11 500 kWh on an annual basis. It is then assumed that electric heating is being used. Please note that this is an approximation, and in the absence of smart meters there is no way to consistently separate electricity consumption for electric heating from electricity consumption for e.g. electric vehicles and heat pumps (which is currently very limited), nor to determine electricity production by solar panels.

In addition to the sectors mentioned above, some special cases need to be considered. For example, there are properties where the same connection serves different sectors and their corresponding meters. For example, a baker who lives above his bakery or a shopping centre with various types of tenant who are customers. In this case, the sectors are grouped and the above analysis is carried out per type of customer.

[11] The efficiencies are taken from the Ministerial Decree on setting reference efficiencies for the application of the conditions for high-efficiency CHP installations (26/05/2016)

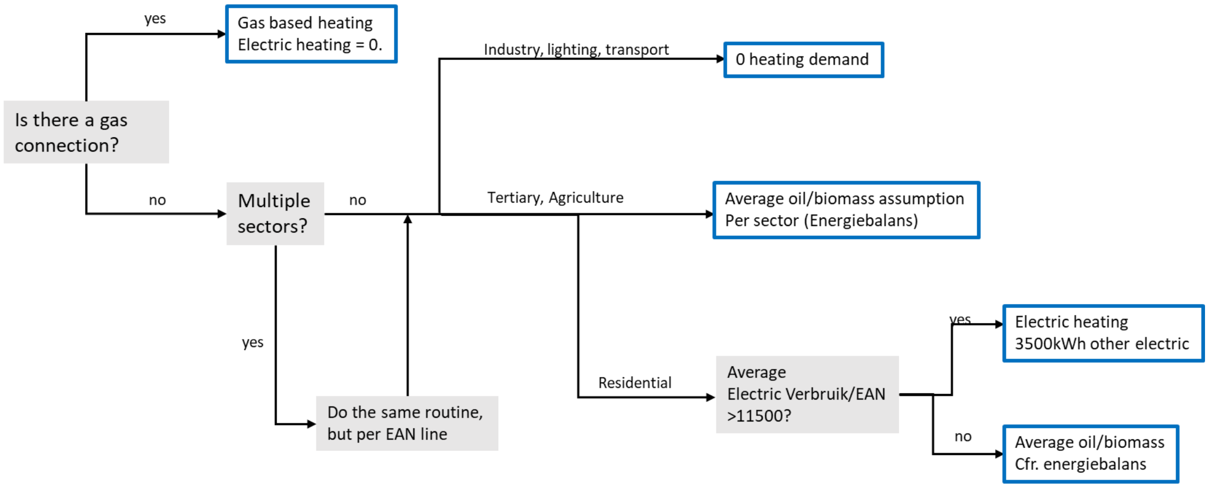


Figure 16: Methodology for deriving heat demand

An apartment building with many residential customers, no gas connection and small electricity demand, will be assumed to have a central fuel oil boiler to meet the heat demand. One can therefore generally identify on the map in which apartment buildings there are numerous small gas consumers and which apartment buildings are presumed to have a central gas boiler or a central oil boiler. In the case of a central boiler, the building will probably appear on the map as a large-consumer point source, while individual boilers will show a red line section with a high number of meters (identified by the EAN code).

3.2.2 Fuel oil-biomass additional estimations per municipality (and statistical sector)

Using the above methodology, additional estimations are also made for fuel oil/biomass consumption. The result is shown below:

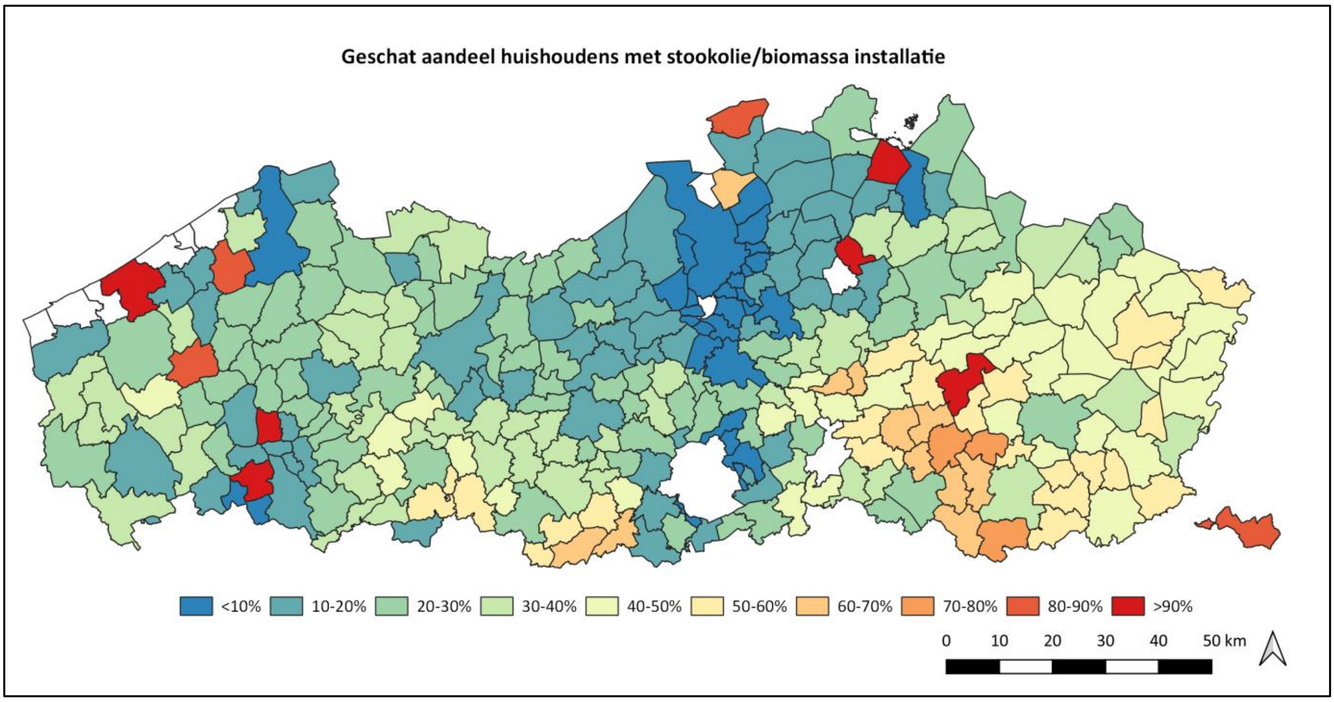


Figure 17: Estimated share of households with fuel oil/biomass installation per municipality (source: Fluvius, VITO)

Geschat aandeel huishoudens met stookolie/biomassa installatie	Estimated share of households with fuel oil/biomass instal-lation

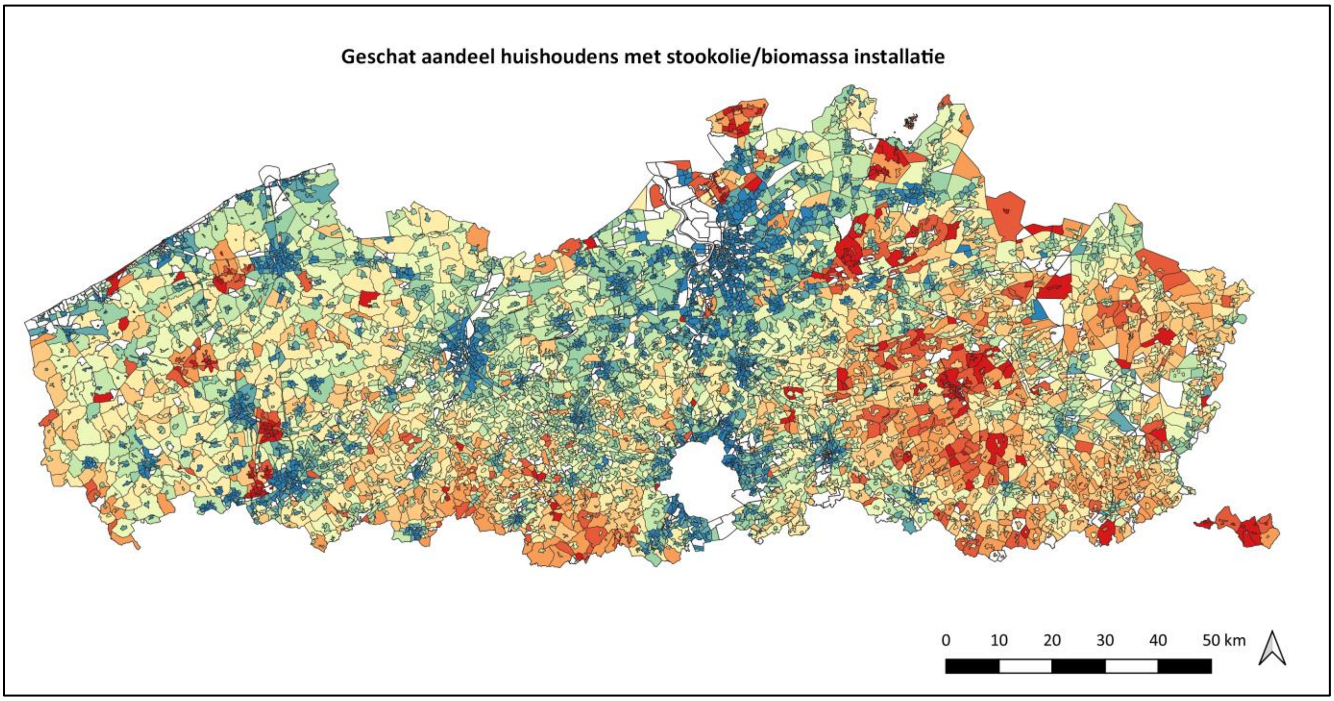


Figure 18: Estimated share of households with fuel oil/biomass installation per statistical sector in 2019 (source: Fluvius, VITO)

Geschat aandeel huishoudens met stookolie/biomassa installatie	Estimated share of households with fuel oil/biomass installation

Households with a suspected fuel oil/biomass installation could be identified via the method of estimating heat demand based on consumption data (see 3.2.1). The structure of the Fluvius consumption data made it possible to obtain a minimum and maximum estimate (see further explanation). The total for Flanders was 652 770 households (min.) versus 729 280 households (max.). Municipalities and statistical sectors with an excessive level of uncertainty regarding the estimate of the number of households with a fuel oil/biomass installation are shown blank in the figures. An excessive level of uncertainty was found in areas with a small population. Areas with many apartment buildings, such as those near the sea, also showed unusually high numbers of oil-fired boilers on the basis of this methodology. The reason for this may be that many of these are second homes and residents are not always there, which means that electricity consumption is very low and it is therefore wrongly assumed that fuel oil is used instead of electric heating. Data on the number of households per municipality were obtained from Statbel. At the level of the statistical sectors, the data were obtained from the *RuimteModel Vlaanderen* (VITO).

3.2.3 Review compared with the *energiebalans* results

The total energy and fuel oil consumption will by definition correspond to the *energiebalans*, since the total consumption was spread over Flanders, as described above.

In the heat map process, in total, 729 308 households were found that were assumed to have fuel oil or biomass as their main source of heating, which corresponds in size (10% overestimation) to the extrapolations from questionnaires in the context of the *energiebalans*. When only one boiler is assumed in each apartment building, this corresponds to 652 770 installations.

For electric heating, 90 120 installations were identified, for a total of 2 231 GWh. The electric heating energy seems to be correct in terms of amount, but the number of installations may be greatly underestimated. The number of installations for electric heating is very unreliable at a local level, as it cannot be distinguished from other large electricity consumers (e.g. an electric vehicle) and it could also be masked by solar panels and a reversing meter. As a result, the number of assumed electric heating installations is not included in the map.

Although the additional estimates for fuel oil, biomass and electric heating are generally in good agreement with other estimates, the results may differ significantly from the actual situation in some areas. For example, there may be buildings that are not heated but where heating is assumed. On the coast, for example, it is possible that electric heating is present, but due to the number of second-home occupants and a low occupancy rate, this is not detected because the flat is empty for a long time and the electricity consumption is below normal values. In that example, fuel oil heating might falsely be assumed to be present. Nevertheless, the methodology used gives results that are well in line with expectations.

4 POTENTIAL SUPPLY POINTS OF HEAT

The reporting requirements state that potential supply points of heat must be included. Large thermal power plants, CHPs and waste incineration plants must be mapped. We also calculate the potential for waste heat and a number of other technologies.

4.1 Thermal power plants, CHPs and waste incineration plants.

4.1.1 Overview of the active waste incineration plants in 2019

An overview of the active waste incineration plants in Flanders in 2019 is given below. Please note that this list covers more than heat from waste incinerators. Some smaller installations such as pocket digesters and gas engines were also included in the map, as this could be useful for local project developers. The ISVAG installation currently only produces electricity, but is included in the mapping as it could in principle be converted to CHP. In the course of 2020, the Biostoom Beringen plant was also commissioned, where a 70 MW steam boiler based on waste incineration supplies heat to an 18 MW turbine and some of the waste heat is supplied to the nearby Borealis site in Beringen.

Name	Location	Type	Capacity (MWe)
BioEnergy (non-CHP)	Lommel	Gas engine	1–2
BioEnergy (CHP)	Lommel	Gas engine	2–5
Biogas Boeye	Haasdonk	Gas engine	2–5
Bionerga	Houthalen-Helchteren	Steam turbine with condenser	>= 5
Biopower Tongeren	Tongeren	Gas engine	2–5
Biostoom Oostende	Ostend	Other	>= 5
De Vuyst	Borsbeke	Gas engine	< 0.5
IMOG	Harelbeke	Steam turbine with condenser	>= 5
Indaver site Antwerp Rotating Drum Furnaces 1 & 2	Antwerp	Steam turbine with condenser	>= 5
Indaver site Doel Grate Incinerator	Doel	Steam turbine with condenser	>= 5
ISVAG	Wilrijk	Steam turbine with condenser	>= 5
IVAGO	Ghent	Steam turbine with condenser	2–5
IVBO	Bruges	Steam turbine with condenser	>= 5
IVM	Eeklo	Other	>= 5
Ivoo Oostende	Ostend	Steam turbine with condenser	>= 5
IVRO / MIROM	Roeselare	ORC	2–5
SLECO Wervelbedoven	Doel	Steam turbine with condenser	>= 5
Stora Enso CHP	Ghent	Steam turbine with condenser	>= 5
Waterleau NewEnergy Ieper	Ieper	Gas engine	2–5
CHP GRL Glasrecycling	Lummen	Diesel engine	0.5–1
CHP Holsteinthema Pocket Digester	Zonnebeke	Gas engine	=< 0.5
CHP IMOG Landfill Gas	Moen	Gas engine	0.5–1

Table 8: Overview of the waste incineration plants 2019 based on the energiebalans.

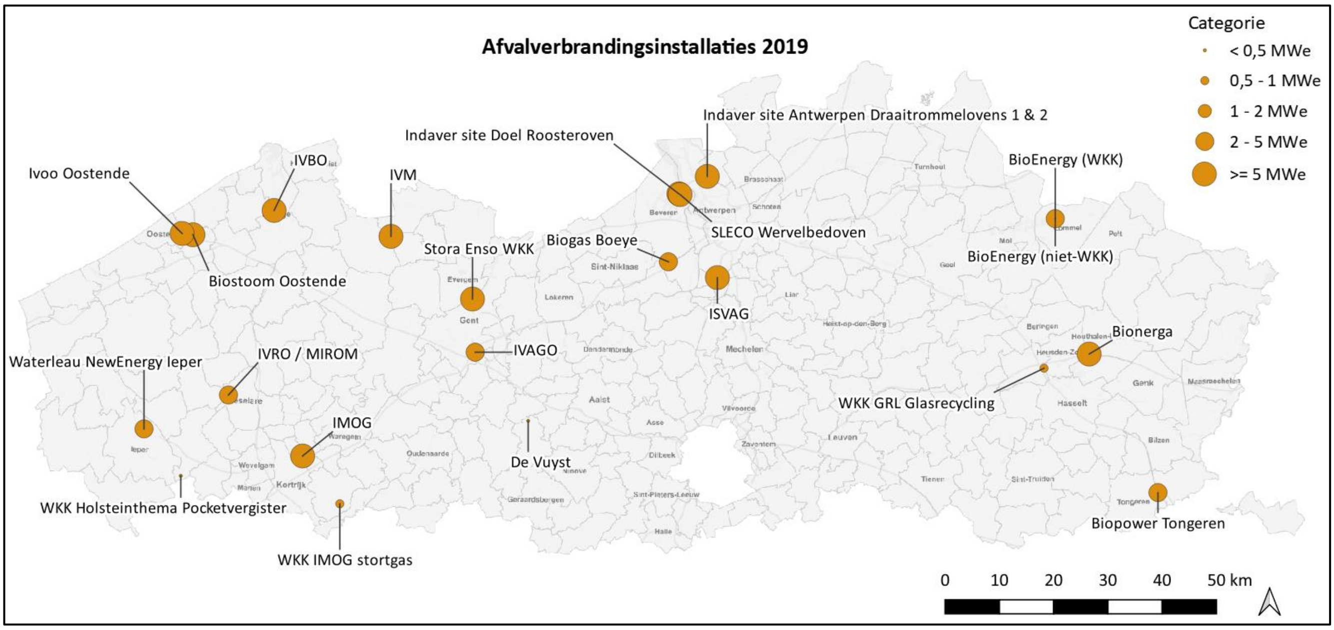


Figure 19: Map of the waste incineration plants 2019 and their electrical capacity.

Afvalverbrandingsinstallaties 2019	Waste incineration plants 2019
Ivoo Oostende	Ivoo Oostende
IVBO	IVBO
IVM	IVM
Biostoom Oostende	Biostoom Oostende
Waterleau NewEnergy Ieper	Waterleau NewEnergy Ieper
IVRO / MIROM	IVRO / MIROM
IMOG	IMOG
WKK Holsteinthema Pocketvergister	CHP Holsteinthema Pocket Digester
WKK IMOG stortgas	CHP IMOG Landfill Gas
Stora Enso WKK	Stora Enso CHP
IVAGO	IVAGO
De Vuyst	De Vuyst
Biogas Boeye	Biogas Boeye
ISVAG	ISVAG
Indaver site Doel Roosteroven	Indaver site Doel Grate Incinerator
SLECO Wervelbedoven	SLECO Wervelbedoven

Indaver site Antwerpen Draaitrommelovens 1 & 2	Indaver site Antwerp Rotating Drum Furnaces 1 & 2
BioEnergy (WKK)	BioEnergy (CHP)
BioEnergy (niet-WKK)	BioEnergy (non-CHP)
WKK GRL Glasrecycling	CHP GRL Glasrecycling
Bionerga	Bionerga
Biopower Tongeren	Biopower Tongeren
Categorie	Category
< 0,5 MWe	< 0.5 MWe
0,5 - 1 MWe	0.5–1 MWe
1 - 2 MWe	1–2 MWe
2 - 5 MWe	2–5 MWe
>= 5 MWe	>= 5 MWe

The heat produced from waste incinerators in 2019 is shown in the *energiebalans* and amounts to 767 GWh in total.

4.1.2 Overview of the active thermal power plants in 2019

The reporting instructions state that thermal power plants with a capacity of 50 MWe that can in theory be converted to CHP mode and supply waste heat must be mapped. This refers to plants that currently produce electricity but are not operational as CHP. These installations are shown in the table below.

Name	Location	Type	Capacity (MWe)	Estimated thermal output after retrofit (MWth)	Estimated Full load time (%)	Possible annual heat generation (GWh)
Biostoom Oostende	Ostend	Other	<= 30	31	40	109
Gent Ringvaart	Ghent	Gas-steam turbine (combined cycle)	200–500	214	40	750
Greenpower Oostende	Ostend	Diesel engine	<= 30	19	40	67
Herdersbrug	Bruges	Gas-steam turbine (combined cycle)	200–500	281	5	123
Knippegroen	Ghent	conventional thermal	200–500	471	60	2 476
Langerlo	Genk	conventional thermal	30–100	53	5	23
Rodenhuize	Ghent	conventional thermal	200–500	393	60	2 066
STEG Drogenbos	Drogenbos	Gas-steam turbine (combined cycle)	>= 500	329	40	1 153

T-Power	Tessenderlo	Gas-steam turbine (combined cycle)	200–500	258	40	904
Expansion Ghent Ham	Ghent	Gas turbine with heat recovery	100–200	178	40	624
Vilvoorde	Vilvoorde	Gas-steam turbine (combined cycle)	200–500	235	5	103

Table 9: Overview of power plants 2019 based on the energiebalans, electrical capacity, estimated thermal output after retrofit to CHP mode, and possible annual heat production based on 8 000 running hours.

For the above-mentioned plants we estimate a theoretical waste heat potential, as requested in the reporting instructions for large-scale installations generating waste heat. This is a theoretical potential; no statement is made about how technically and economically feasible it would be for possible heat consumers in the vicinity to use this waste heat effectively. The possible future supply of waste heat makes these plants de facto CHPs. As a basic assumption for this estimate of potential, we assume the highest possible conversion of the fuel to electricity and heat. As a result, this estimate will yield a technical maximum potential heat supply. In accordance with the European definition of a high-efficiency CHP, we assume that the total efficiency (electric & thermal) of a CHP with a capacity above 20 MWe amounts to 80%. This is therefore the total efficiency we assume for these plants after they have been converted to supply heat. Power plants are installations that are designed to generate as much electricity as possible from the fuel. However, when heat is extracted from these plants to feed a heat network, this leads to a reduction in electrical efficiency. [7] shows how the reduction in electrical efficiency during the retrofit to CHP mode can be taken into account. As in the previous heat map, a Z-factor of 6 is taken into account, this Z-factor being the increase in thermal efficiency compared to the loss in electrical efficiency. A limited sensitivity analysis in the previous heat map showed that the exact value of this Z-factor did not have a decisive influence on the final result in terms of possible waste heat supply [3].

The result is shown in Table 9; the total thermal output after retrofit is possibly 2 462 MW. We make the same assumptions about full load time as in the previous heat map [3]:

- 5% for peak power plants
- 40% for gas and bio-oil power plants
- 60% for biomass or BFG power stations

These assumptions yield a theoretical potential heat production of 8 396 GWh annually.

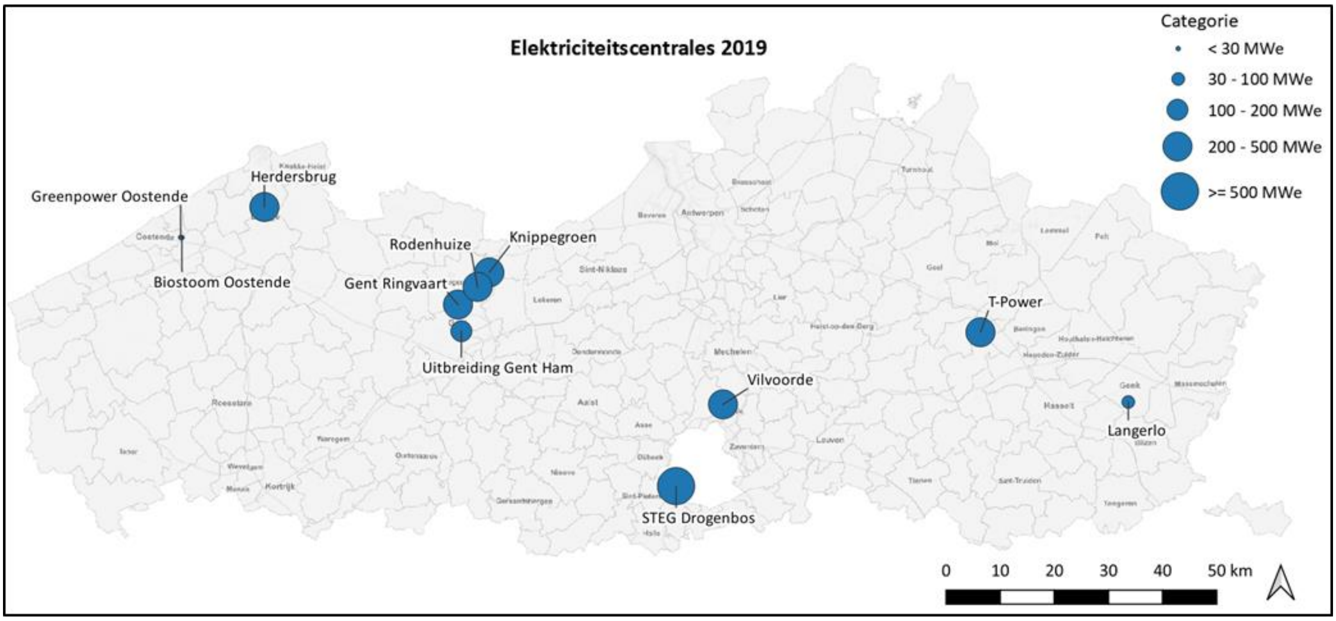


Figure 20: Map of power plants 2019 with waste heat

Elektriciteitscentrales 2019	Power plants 2019
Greenpower Oostende	Greenpower Oostende
Biostoom Oostende	Biostoom Oostende
Herdersbrug	Herdersbrug
Rodenhuize	Rodenhuize
Gent Ringvaart	Gent Ringvaart
Uitbreiding Gent Ham	Expansion Ghent Ham
Knippegroen	Knippegroen
Vilvoorde	Vilvoorde
STEG Drogenbos	STEG Drogenbos
T-Power	T-Power
Langerlo	Langerlo
Categorie	Category
< 30 MWe	< 30 MWe
30 - 100 MWe	30–100 MWe
100 - 200 MWe	100–200 MWe
200 - 500 MWe	200–500 MWe

>= 500 MWe	>= 500 MWe

4.1.3 Overview of active CHPs in 2019

There are a total of 740 operational CHPs in Flanders with capacities shown in the table below. In line with CHP reporting, it was established in 2019 that the high-efficiency CHPs together generated 5 292 GWh of heat.

Capacity (MW)	Number of active CHPs in 2019
=< 0.1	186
0.1 < x < 1	160
1 < x < 5	302
5 < x < 10	43
10 < x < 20	24
20 < x < 30	8
>= 30	11

Table 10: Number of CHPs in Flanders in 2019, ranked according to their capacity

In line with the reporting instructions, the figure below only shows the CHP installations that could possibly have a thermal input of > 20 MW. These large CHPs have a higher potential for supplying waste heat than small local installations.

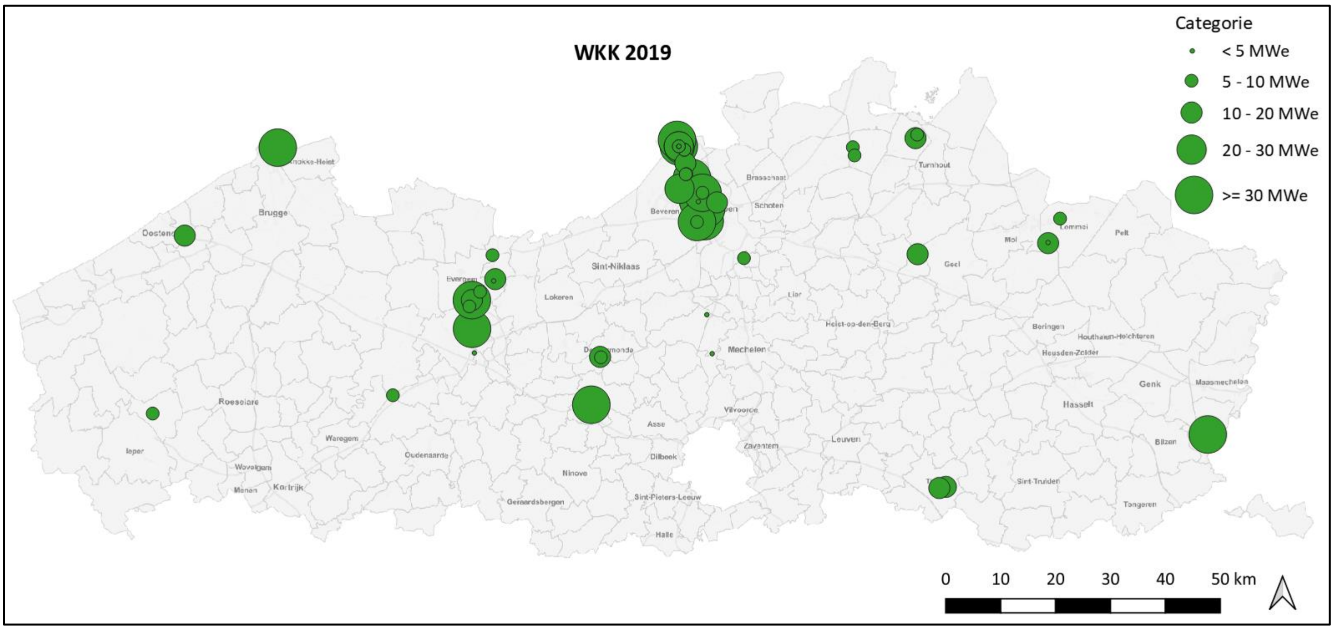


Figure 21: Map of CHPs in 2019 with an estimated thermal input above 50 MW

WKK 2019	CHP 2019
Categorie	Category
< 5 MWe	< 5 MWe
5 - 10 MWe	5–10 MWe
10 - 20 MWe	10–20 MWe
20 - 30 MWe	20–30 MWe

>= 30 MWe	>= 30 MWe

4.2 Industrial waste heat

4.2.1 Calculating waste heat potential in industry

To determine the waste heat potential in industry, we use the same method as in the previous heat map. This method was developed by PDC consultancy and is described below as the 'PDC method'.

The PDC method first translates the net heat demand, i.e. the fuel consumption used to meet the heat demand, into a gross heat demand for the various industrial sectors, divided into:

- High Temperature Heat: > 200 °C
- Medium Temperature Heat: 120–200 °C
- Low Temperature Heat: <120 °C

The PDC method then assumes that half of the heat demand of a higher level is available for internal use at a lower level. The other half is available as waste heat. Ultimately, all the heat demand degrades to waste heat.

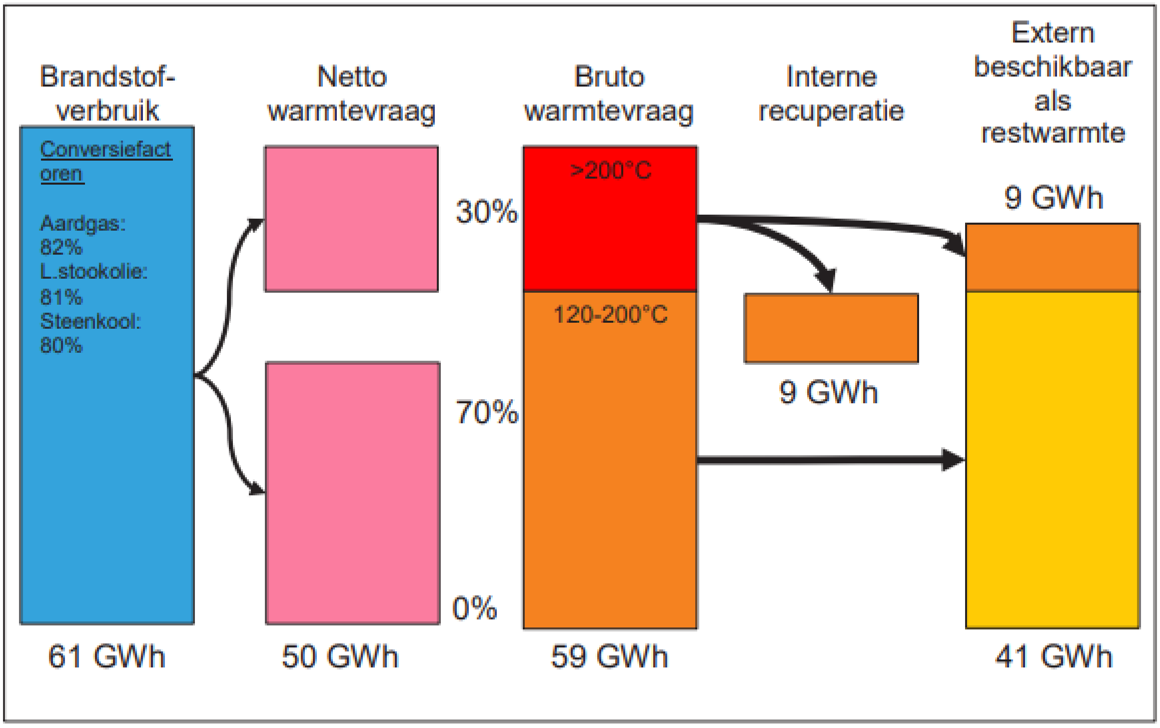


Table 11: Illustration of the PDC method – source: H. Vleeming, E. van der Pol (2011) Ontwikkelen van methodieken voor het opstellen van industriële warmtekaarten [Developing methodologies for creating industrial heat maps]. Process Design Center B.V.

Brandstof-verbruik	Fuel consumption
Conversiefactoren	Conversion factors
Aardgas: 82%	Natural gas: 82%
L.stookolie: 81%	Fuel-oil: 81%
Steenkool: 80%	Coal: 80%

G1 GWh	61 GWh
Netto warmtevraag	Net heat demand
50 GWh	50 GWh
Bruto warmtevraag	Gross heat demand
30%	30%
70%	70%
0%	0%
>200°C	> 200 °C
120-200°C	120–200 °C
59 GWh	59 GWh
Interne recuperatie	Internal recovery
9 GWh	9 GWh
Extern beschikbaar als restwarmte	Externally available as waste heat
9 GWh	9 GWh
41 GWh	41 GWh

The PDC method estimates the waste heat potential by taking into account only the first law of thermodynamics: i.e. all fuel that enters the plant also leaves as waste heat in one form or other. The PDC method does not take into account the second law of thermodynamics; i.e. it does not take into account how the heat becomes available and whether it is technically possible to recover it (e.g. highly dispersed release via dissipation as opposed to release in a concentrated stream as pressurised hot water at for example 150 °C). This estimate of potential is therefore to be considered as a theoretical potential and indicates the upper limit of the waste heat supply potential.

After application of the above method, the results are therefore scaled down using the study carried out by the municipal port authority[12]. From this MIP2HEAT study, correction factors were derived for each cluster within the Antwerp port area. The correction factor for all other companies was derived from the comparison between the results of the MIP2HEAT study and the PDC method in the port of Antwerp. This means, for example, that the waste heat from a chemical company in Ghent calculated by PDC will also be scaled down by the same factor as that from the chemical companies involved in the MIP2HEAT study. This also remains a theoretical estimate. The actual feasible potential can only be determined on a local level and must take into account the specific local framework conditions (e.g. possibility of extraction, distance to customers, time-related factors, etc.).

[12] Antwerp Port Authority (2012) Havenwarmte – Haalbaarheidsonderzoek naar de valorisatie van industriële restwarmte in de haven van Antwerpen.

The IMJV company reports are used as the main source of data. If no data were available for 2019, earlier reports were used for a number of companies. The results per sector are shown in Table 12.

Sector	Heat demand of large companies (GWh)	Theoretical waste heat calculated using the PDC method [GWh]	Estimated theoretical waste heat after rescaling [GWh]	Number of companies included in analysis
Chemicals/Pharma	19 686	16 499	6 973	128
Firewood	466	0	1	17
Steel and iron	4 912	3 179	3 106	41
PVC	5 999	3 516	2 951	63
Mineral non-metal	3 044	3 023	2 998	59
Non-ferrous	2 060	2 060	1 474	22
Other	3 065	1 447	2 050	63
Paper Cardboard Print	3 173	589	2 153	25
Refineries	13 937	13 937	1 514	5
Technology	5 928	6	51	120
Textiles	835	0	0	45
Food	18 523	2 004	2 007	165
Total	81 627	46 266	25 277	753

Table 12: Heat demand and estimated waste heat by sector. The IMJV data set was analysed according to the PDC method and rescaled per sector with additional estimations from the MIP2HEAT study.

The theoretical potential is therefore estimated at 193 TWh; the PDC method results in 46 266 GWh. The rescaled potential of 25 TWh will be a more realistic order of size. On the one hand, the MIP2HEAT study also failed to include all the technical and commercial details for the practical release of waste heat. On the other hand, it is of course possible that smaller companies that do not report their energy use as part of the IMJV may also be able to offer waste heat. This should be investigated on a case-by-case basis in local studies.

4.2.2 Mapping of possible industrial waste heat supply and/or demand in the region

Working from the locations of the large consumers with their category of heat demand, a map was created showing the number of energy-intensive companies, weighted at the level of the statistical sectors, in a 5 km radius around each sector. The large consumers with the lowest heat demand (0.2–1 GWh/year) were not included in the analysis. The large consumers with a heat demand of 1–20 GWh/year are given a weighting of 1, the category 20–200 GWh/year is given a weighting of 2 and finally the category > 200 GWh/year is given a weighting of 3. According to this calculation, 15% of Flemish territory has at least 10 energy-intensive companies within a 5 km radius.

On the basis of the available data, this map gives an initial indication of the potential waste heat supply and/or demand in the region, but it should of course be noted that local conditions may differ from those deduced purely from the heat demand. In these figures, we have no insight into locations where business processes may already have been optimised, so that despite the high heat demand, there may be no waste heat potential.

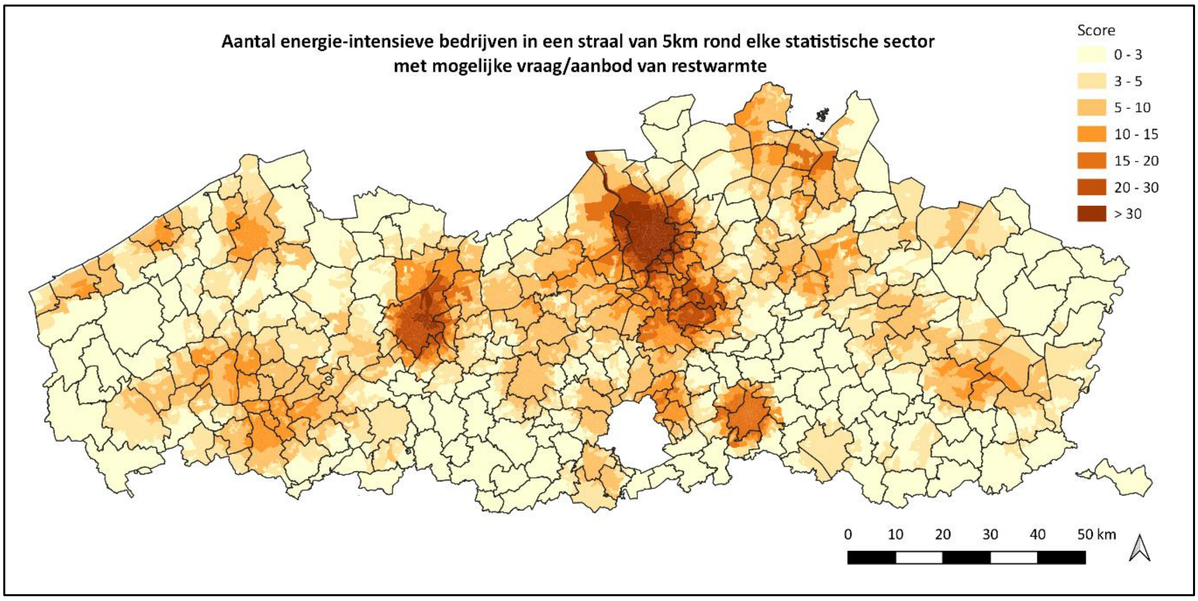


Figure 22: Number of energy intensive companies within a 5 km radius around each statistical sector with possible waste heat supply and/or demand.

Aantal energie-intensieve bedrijven in een straal van 5km rond elke statistische sector met mogelijke vraag/aanbod van restwarmte	Number of energy intensive companies within a 5 km radius around each statistical sector with possible waste heat supply and/or demand.
Score	Score

4.3 Potential for efficient and renewable technologies

This section discusses the potential, in terms of technology and spatially, of the various renewable technologies in Flanders for meeting heat demand. Unless stated otherwise, we have relied on [8]. This study dates from 2016 but the results are still up to date. For all technologies discussed below, the number of heat production installations added in recent years is limited compared to the total potential, so the results are still relevant.

4.3.1 Solar boilers

For solar boilers, the available roof area has been calculated, as well as the orientation of the roofs based on the Large-scale Reference Database (LRD). This allows a distinction to be made between residential and non-residential roofs. The photovoltaic and solar boilers currently installed are taken into account.

For the energy production of solar boilers, a minimum surface of 5 m^2 per installation and a heat production of 0.37 MWh/m^2 per year was assumed. The pure technical potential was capped on the basis of the expected heat demand for domestic hot water.

With these data, the total technical potential was estimated at 4 946 GWh of heat generated annually.

4.3.2 Biomass

The technical potential for the supply of biomass within Flanders has been calculated. Different inflows were mapped out: supply of animal manure, vegetable, fruit and garden waste (VFG) and other green waste, roadside grass cuttings, branches and wood. Different types of installations were investigated: agricultural digesters, pocket digesters, wood combustion installations, and VFG digesters. The efficiency of a biogas engine used for digestion was assumed for roadside grass cuttings.

The study identified a potential of 2 414 GWh of heat and 3 119 GWh of electricity, of which a substantial part has already been achieved (1 686 heat and 2 637 GWh of electricity). This study assumed a mix of electricity, CHP and heat production, but it is equally possible that only heat will be produced in the future. If we convert the potential for electricity into heat demand with the assumed efficiencies used in the report (39% for electricity production, 90% for heat production, and 25%/65% for the electrical/thermal efficiency of CHP), we obtain a total potential of 9 622 GWh for heat production from biomass (of which a significant share has already been achieved).

4.3.3 Shallow geothermal energy

The potential for shallow geothermal energy is very high, and can be expressed in kWh per unit of area. The result will be roughly between 0 and 1 000 kWh/m^2 , depending on the technology, soil and framework conditions. The potential for this analysis was capped on the basis of the total heat demand of the buildings (residential, tertiary and agricultural), while for public installations the potential was capped on the basis of the total local heat demand.

A total potential of 32 933 GWh per year was calculated, of which 43% from private and 57% from public installations. These figures concern only the renewable part of the heat demand from shallow geothermal energy.

4.3.4 Deep geothermal energy

For the potential for deep geothermal energy, reference was made to [9], whereby potential was only estimated for the north-east of Flanders. This was also capped on the basis of the heat demand in the area; a potential of 16 874 GWh was identified.

4.3.5 Waste incineration

To determine the potential of waste incineration, we examine the current power plants. These currently produce 767 GWh of heat from industrial and municipal waste. We assume that the potential for heat from waste incineration will be constant over time, which could be considered an overestimation, given the expected increase in the recyclability of materials.

4.3.6 High-efficiency CHP

Of course, heat demand is expected to become significantly greener by 2050, and CHPs will therefore increasingly run on renewable or synthetic fuels. It can also be assumed that some of the heat currently generated through CHPs will be generated with electricity or geothermal heat by 2050. In 2019, 5 292 GWh of heat was generated by high-efficiency CHP installations in Flanders; we consider this a realistic estimate for the future economic potential.

4.3.7 Industrial waste cooling

The sources for industrial waste cooling are very limited. Generally, cooling is generated on site and there is very little possibility of extracting waste cooling. One important exception is the LNG terminal in Zeebrugge [10]. The gas needs to be converted from liquid to a gaseous form. This process uses either seawater or gas combustion (the latter if the sea is too cold in the winter).

The gas, mainly methane, is transported in large container ships in liquid form with a temperature of 110 K (minus 163 degrees Celsius). Below, we follow the calculation of the Planheat project. [5].

Some typical values are given in: [11]:

- *Temperature (°C)* *-163.5*
- *Weight (g/mol)* *18.3628*
- *Volume (m^3/kmol)* *0.0396*
- *Density (kg/m^3)* *468.1*

The specific heat capacity of methane is known for different temperatures; LNG is usually cooled to just below its boiling point. We neglect the degrees of cooling and calculate the latent heat released in the regasification process [12] [13] :

$$Latent\ heat\ of\ methane\ =\ 5.11\ 10^5\,\frac{J}{kg} =\ 142\,Wh/kg$$

When we take into account the molar mass and volume, we can now calculate the latent heat per m^3:

$$142\,Wh/kg\ \times\ 18\,362.8\,kg/mol =\ 2.60\,Wh/mol$$

$$\frac{2.60\,Wh/mol}{0.0000396 m^3/mol} \approx 66\,kWh/m^3$$

In the Planheat project, the latent heat (in J/kg) released during LNG regasification was converted to latent heat per m^3 of liquid methane. The latent heat of methane is calculated by:

$$Latent\ heat\ gasification\ of\ liquid\ methane\ \approx\ 66\,kWh/m^3$$

Since 1987, the Zeebrugge terminal receives about 80 ships per year [14], if we assume that the average container ship transports 140 000 m^3 of volume, we can estimate the potential of waste cold for the Zeebrugge LNG terminal:

$$80\ LNG\ ships\ X \frac{140000m^3}{ship} \times\ 66\ kWh/m^3 =\ 739\ GWh$$

5 COST-BENEFIT ANALYSIS

In this section, we carry out a high-level cost-benefit analysis for all statistical sectors in Flanders, specifically for the construction of district heating networks. We use the presence of large consumers with a heat demand > 2 GWh/year within a 5 km radius around the statistical sector as an indicator of a possible supply and demand of waste heat.

Please note that this analysis in terms of net present value only gives an order of magnitude of results, and may diverge significantly from results at the local level. For example, there is great uncertainty about the availability of industrial waste heat, and the cost of the construction of a district heating network can also vary greatly depending on local environmental factors, which cannot all be included in this region-wide analysis.

5.1 General

The European reporting requirements specify that a cost-benefit analysis must be carried out that covers the entire national territory, examines different sensitivities and includes relevant technologies. The net present value (NPV) must be used as the point of comparison.

The focus is on the construction of district heating networks, as the identification of regions of interest for the construction of district heating networks is an important input for heat zoning plans. This analysis should therefore be seen as a starting point for estimating how much potential there is for the construction of district heating networks. The completed cost-benefit analysis will not be able to include all the details at the local level, since it covers the entire national territory. The intention is that the analysis in the heat map will be supplemented at local level and on a case-by-case basis by specific projects, possibly inspired by the results in this heat map.

5.2 Assumptions and scenarios

Two scenarios are developed, a 'central' scenario based on decentralised boilers and a 'district heating network' scenario, for which the net present value (NPV) is consistently compared. The data input relies on the results per statistical sector. More specifically, the following data are used per statistical sector:

- Total gas consumption;
- Number of gas connections;
- Total consumption of fuel oil/biomass in the statistical sector;
- Estimated number of additional fuel oil/biomass boilers;
- Number of kilometres of paved road;
- Number of companies with potential waste heat within a 5 km radius around the statistical sector.

The accurate total gas consumption and the exact number of gas connections are known, using the data from the network operator. The consumption and number of fuel oil and biomass boilers are estimated using the procedure described in Chapter 3. The number of kilometres of paved road per statistical sector is derived from the Nationaal Wegenbestand database.

The number of companies with possible waste heat within a 5 km radius around the statistical sector follows from the GIS analysis in 4.2.2[13].

[13] The mapping of possible industrial waste heat supply and/or demand within a 5 km radius around the statistical sector in 4.2.2 covers all large consumers with a heat demand greater than 1 GWh/year. For the cost-benefit analysis, only large consumers with a heat demand greater than 2 GWh/year are included.

Two top-down scenarios are calculated:

- Central scenario: The heat demand in the statistical sector for gas consumption and fuel oil consumption is continued with the same boilers, which will be upgraded;
- District heating network scenario: The heat is distributed via a district heating network, which may or may not be connected to a waste heat source.

In each of the scenarios, three additional sensitivities are calculated to estimate the uncertainty in the potential of district heating networks under different framework conditions:

1. Investment cost in a district heating network EUR 1 000/m (low)–EUR 2 000/m (high)
2. Waste heat availability (low/high)
3. Sensitivity to the price of gas and fuel oil, basic price (low) – additional cost for gas and fuel oil consumption (high)

For the second estimate, the GIS analysis from Chapter 3 is carried out. These are underpinned by the following assumptions:

- Low waste heat availability is assumed: At least 10 companies with a heat demand of more than 2 GWh/year must be located within a 5 km radius around the statistical sector before available waste heat is assumed. This results in a lower availability of waste heat.
- High waste heat availability is assumed: At least 3 companies with a heat demand of more than 2 GWh/year must be located within a 5 km radius around the statistical sector before available waste heat is assumed. This results in a higher availability of waste heat.

The heat demand of companies is also taken into account. A weighted average is used whereby companies with a heat demand > 20 GWh count twice and companies with a heat demand > 200 GWh count three times more than companies with a heat demand between 2 GWh and 20 GWh. The formula is as follows:

$$Number\ of\ companies\ with\ the\ possibility\ of\ waste\ heat\ = \frac{X_{>2GWh,<20\,GWh} + 2X_{>20\,GWh,<200\,GWh} + 3X_{>200\,GWh}}{6}$$

Whereby X is the number of companies with a higher heat demand within a 5 km radius around the statistical sector.

The following parameters are assumed in the calculation of the potential:

Basic parameters		District heating network parameters	
Discount rate	4%	CAPEX costs street	EUR 1 000/m–EUR 2 000/m [18]
CAPEX investment gas boiler	EUR 4 150/connection[14]	CAPEX connection	EUR 10 000/connection [18]
Fixed OPEX gas boiler	EUR 157.80/connection[14]	Fixed OPEX	3% of fixed CAPEX[18]
Gas price	EUR 40/MWh[15]–EUR 66/MWh	Lifespan of the district heating network	50 years [18]
Lifespan of gas boiler	15 years[14]	Assumption of waste heat availability	Low High
Emission factor for gas	203 g/kWh[16]		
CAPEX fuel oil	EUR 6 868/boiler[14]		
Fixed OPEX fuel oil	EUR 279.66/boiler[14]		
Fuel oil price	EUR 37/MWh[17] – EUR 57/MWh	Total cost (CAPEX + OPEX) for extraction + injection of waste heat	EUR 10/MWh [18]
Lifespan of fuel oil boiler	20 years [18]		
Emission factor for fuel oil	263 g/kWh [18]		

Table 13: Assumptions and parameters in the cost-benefit analysis

5.3 Results

The results are summarised in the table below:

Scenario	Waste heat availability	Cost of district heating network	Fuel cost	Number of km of district heating network	% regions with NVP > 0	% heat demand with NPV > 0	Capital Investment (billion euro)	Potential annual avoided emissions (Mton CO_2)
1	high	low	low	5 755	9%	31%	9.7	5.9
2	low	low	low	3 090	5%	19%	5.5	3.6
3	high	high	low	3 217	4%	21%	6.5	4.0
4	low	high	low	1 655	2%	13%	3.8	2.4
5	high	low	high	11 802	23%	52%	25.1	9.7
6	low	low	high	5 886	11%	32%	12.2	5.9
7	high	high	high	7 530	12%	38%	20.1	7.2
8	low	high	high	4 311	7%	25%	11.5	4.7

Table 14: Number of regions and corresponding heat demand for the construction of a district heating network. High/low waste heat availability is determined by the number of companies with a high heat demand within a 5 km radius. High/low cost of a district heating network is EUR 1 000–EUR 2 000/m. Low fuel prices are EUR 40/MWh for gas and EUR 37/MWh for fuel oil; the scenario with higher fuel prices assumes EUR 66/MWh for gas and EUR 57/MWh for fuel oil. Capital investment indicates the initial investment only in those regions where the net present value for the construction of a district heating network is greater than zero.

[14] Source: IPCC, 2006. IPPC guidelines for national greenhouse gas inventories – chapter 1 : Introduction

[15] Source: VREG tariffs September 2020: total price (incl. VAT) for a family with average or high consumption

[16] Source: RVO.nl

[17] Source: Petrolfed, November 2020

[18] Source: agreed after discussion with network operator Fluvius, the Flemish administration and stakeholders

The distribution of the net present value over the statistical sectors in Flanders is shown in the figures below. A positive net present value is strongly correlated with a high heat demand density in the region, and the possible presence of waste heat.

A minority of regions in our country will be suitable for the construction of a district heating network, but as the heat demand density in those regions is high, it can represent a significant part (13–52%) of the heat demand.

When comparing scenarios 1–4 with 5–8, we can draw the conclusion that higher gas and fuel oil prices have a significant effect on how profitable the construction of district heating networks will be and more specifically on the exploitation of waste heat. The figure for possible CO_2 reduction per scenario should be considered indicative, as the availability of waste heat is based on assumptions rather than actual measurement data.

It is important to note that these figures for the whole of Flanders should be interpreted as rough indications of potential estimates and that the results may vary significantly within regions in Flanders. For instance, it is possible that although there are many companies in the area with a potential supply of waste heat, various technical or commercial reasons make the extraction of this waste heat seem unfeasible. It is also possible that within a certain region with a low heat density, a small-scale network is still possible without the entire region being connected.

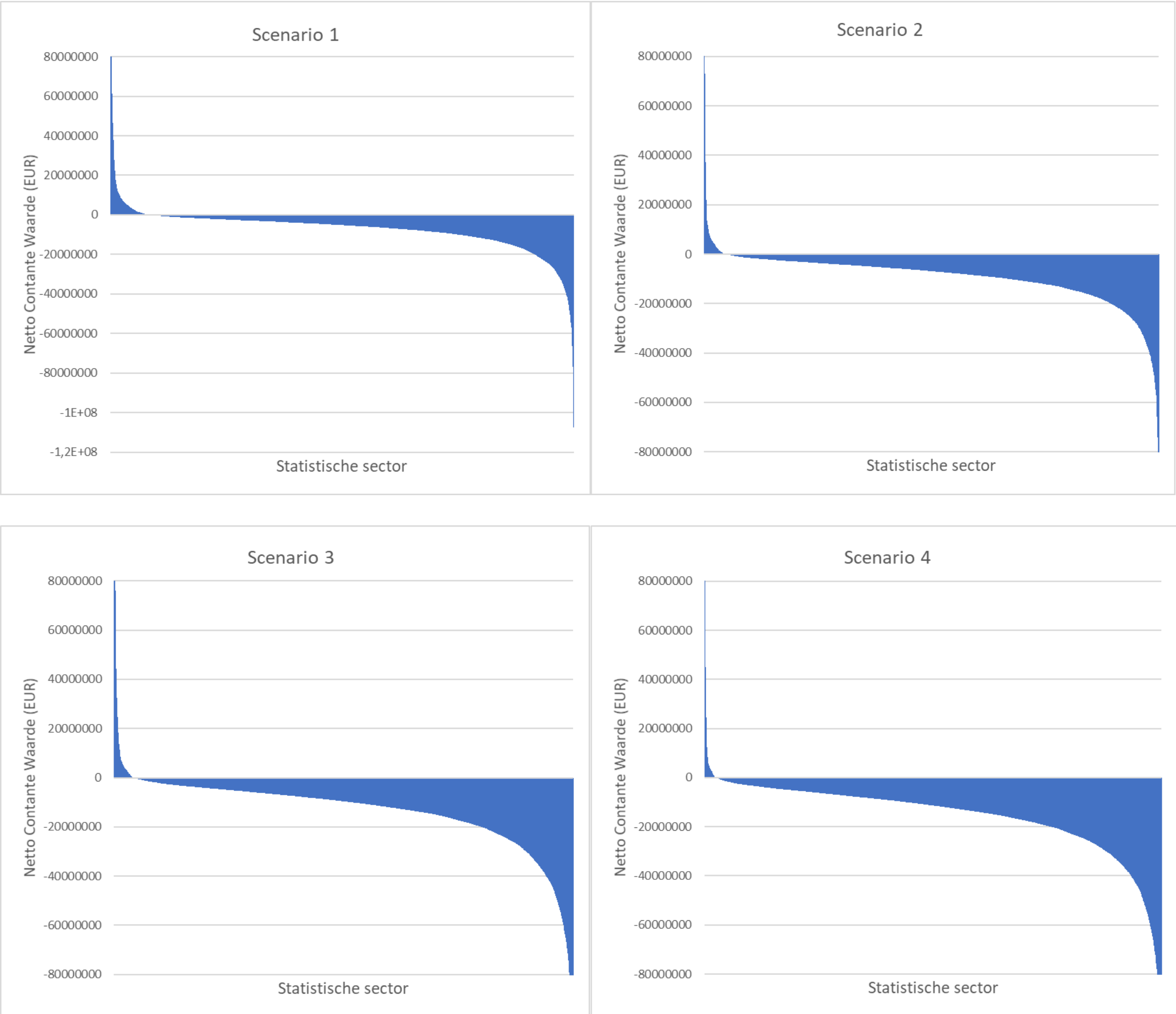
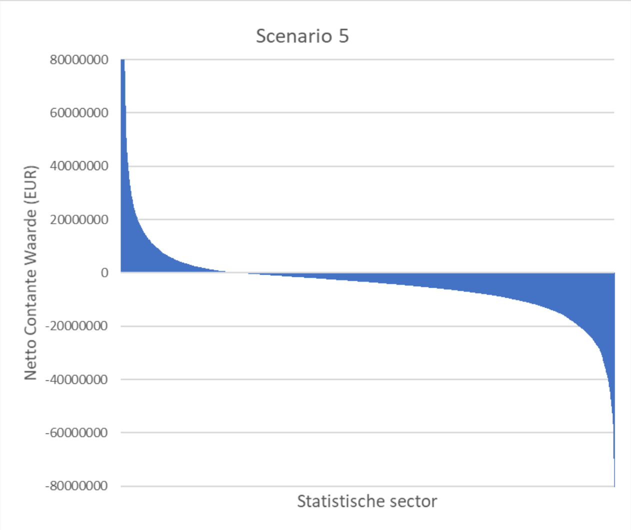
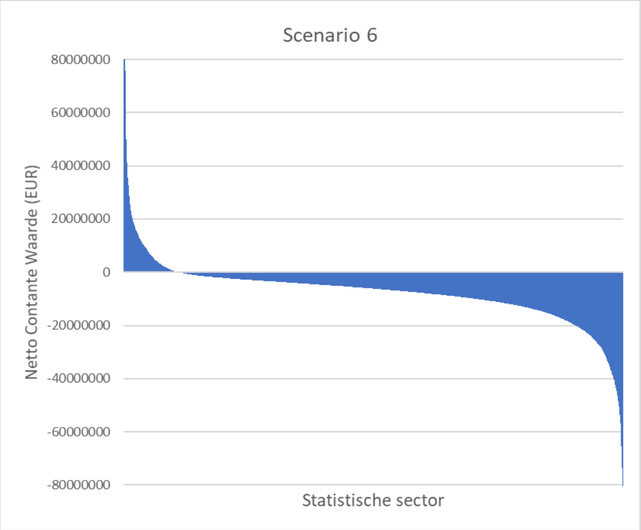


Figure 23: Net present value in statistical sectors according to scenarios 1–4 (see Table 14). In these scenarios 1, 2, 3 and 4, respectively 9%, 5%, 4% and 2% of the 9 184 regions in Flanders have a positive net present value for the construction of a district heating network.

Scenario 1	Scenario 1
Statistische sector	Statistical sector
Netto Contante Waarde (EUR)	Net Present Value (EUR)
80000000	80 000 000
60000000	60 000 000
40000000	40 000 000
20000000	20 000 000
0	0
-20000000	-20 000 000
-40000000	-40 000 000
-60000000	-60 000 000
-80000000	-80 000 000
-1+08	-1+08
-1,2E+08	-1.2E+08
Scenario 2	Scenario 2
Statistische sector	Statistical sector
Netto Contante Waarde (EUR)	Net Present Value (EUR)
80000000	80 000 000

60000000	60 000 000
40000000	40 000 000
20000000	20 000 000
0	0
-20000000	-20 000 000
-40000000	-40 000 000
-60000000	-60 000 000
-80000000	-80 000 000
Scenario 3	Scenario 3
Statistische sector	Statistical sector
Netto Contante Waarde (EUR)	Net Present Value (EUR)
80000000	80 000 000
60000000	60 000 000
40000000	40 000 000
20000000	20 000 000
0	0
-20000000	-20 000 000
-40000000	-40 000 000
-60000000	-60 000 000
-80000000	-80 000 000
Scenario 4	Scenario 4
Statistische sector	Statistical sector
Netto Contante Waarde (EUR)	Net Present Value (EUR)
80000000	80 000 000
60000000	60 000 000
40000000	40 000 000
20000000	20 000 000
0	0
-20000000	-20 000 000
-40000000	-40 000 000
-60000000	-60 000 000
-80000000	-80 000 000





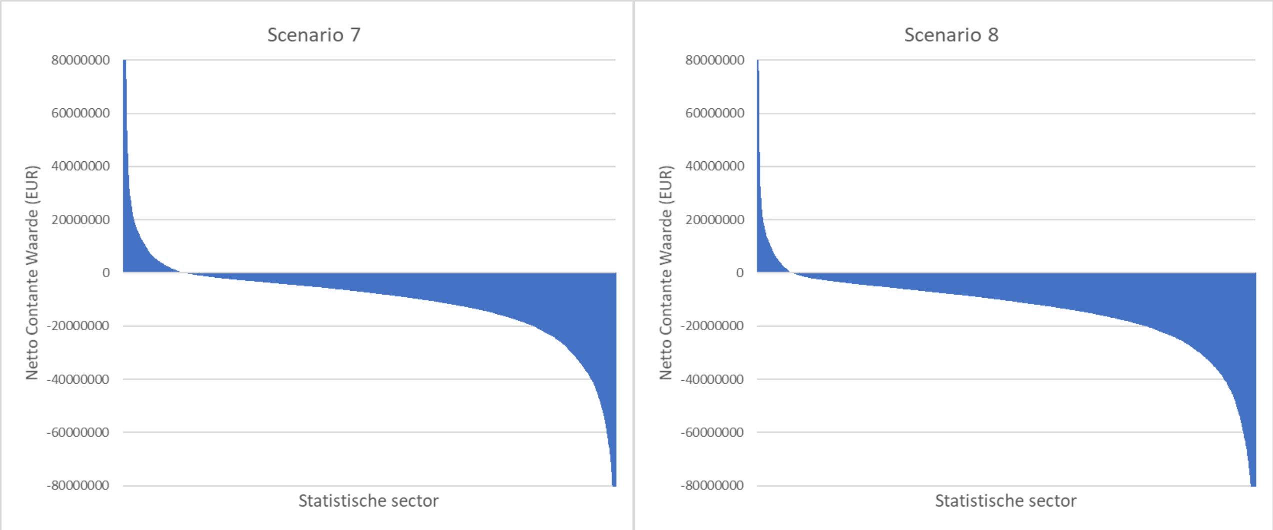


Figure 24: Net present value in statistical sectors according to scenarios 5–8 (see Table 14). In these scenarios with high fuel prices, scenarios 5, 6, 7 and 8, respectively 23%, 11%, 12% and 7% of the 9 184 regions in Flanders have a positive net present value for the construction of a district heating network.

Scenario 5	Scenario 5
Statistische sector	Statistical sector
Netto Contante Waarde (EUR)	Net Present Value (EUR)
80000000	80 000 000
60000000	60 000 000
40000000	40 000 000
20000000	20 000 000
0	0
-20000000	-20 000 000
-40000000	-40 000 000
-60000000	-60 000 000
-80000000	-80 000 000
Scenario 6	Scenario 6
Statistische sector	Statistical sector
Netto Contante Waarde (EUR)	Net Present Value (EUR)
80000000	80 000 000
60000000	60 000 000
40000000	40 000 000
20000000	20 000 000
0	0
-20000000	-20 000 000
-40000000	-40 000 000
-60000000	-60 000 000

//

-80000000	-80 000 000
Scenario 7	Scenario 7
Statistische sector	Statistical sector
Netto Contante Waarde (EUR)	Net Present Value (EUR)
80000000	80 000 000
60000000	60 000 000
40000000	40 000 000
20000000	20 000 000
0	0
-20000000	-20 000 000
-40000000	-40 000 000
-60000000	-60 000 000
-80000000	-80 000 000
Scenario 8	Scenario 8
Statistische sector	Statistical sector
Netto Contante Waarde (EUR)	Net Present Value (EUR)
80000000	80 000 000
60000000	60 000 000
40000000	40 000 000
20000000	20 000 000
0	0
-20000000	-20 000 000
-40000000	-40 000 000
-60000000	-60 000 000
-80000000	-80 000 000

6 HEAT DEMAND PROJECTION 2030 AND 2050

6.1 Projection of heat demand until 2030

The current total heat and cold demand in Flanders was discussed in Chapter 2; the results are given in Table 1. With the help of the Flemish Energy and Climate Plan, a projection can be made of the heat and cold demand until 2030 [15].

The final energy consumption until 2030 is set out in the Flemish Energy and Climate Plan per sector and per type of fuel, but not both per sector and per type of fuel, as is specified in the *energiebalans*.

This means that the final energy consumption must be converted to heat demand, which is not a straightforward process on the basis of the projections in the Flemish Energy and Climate Plan. For example, there is no indication of how much of the industrial final energy consumption or residential heating is expected to be electrified. It does indicate how much of the total energy system is expected to be electrified, but, for example, electrification of transport demand cannot be distinguished from electrification in heat production on the basis of these figures. As electric heating has a higher efficiency than fuels, the resulting heat demand calculated from final energy consumption may differ.

As details of the projection are not available, it is possible to make the assumption that the ratio of fuels across sectors will not change between the latest *energiebalans* data and the projection until 2030.

For future projections, only the figures for useful heat can be given. The approach is as follows:

1. The final energy consumption per sector is provided in the *energiebalans* (see Table 1).
2. With reference to fuel consumption, it is possible to estimate how much final energy consumption is made available for the heat demand (similar to the process in the *energiebalans* where the share of renewable energy sources in heat demand is calculated, see Table 1 and Table 2).
3. Taking into account the efficiencies, an estimate is made of the useful heat per sector (similar to the *energiebalans*, see Table 1). These efficiencies are listed in Annex 4.
4. Using the ratio of useful heat to final energy consumption from Table 2, and assuming that the fuel mix per sector does not change until 2030, the With Additional Measures (WAM) projections for final energy consumption from the Energy and Climate Plan are converted to useful heat. One exception is the residential sector, as a more accurate estimate of heat demand was calculated in the more recent long-term renovation strategy.

With the above factors, the WAM scenario of the Flemish Energy and Climate Plan (VEKP) can be converted to heat demand.

Energy [GWh]	[GWh] Final energy consumption 2019	[GWh] Final energy consumption 2030 VEKP	[GWh] Total useful heat 2019	[GWh] Total useful heat 2030	[%] Difference 2030–2019
Industry	108 458	131 820	61 727	75 023	+21.5
Tertiary sector	30 406	25 821	15 319	13 634	-11.0
Households	54 428	42 791	38 222	29 087	-23.9
Agriculture	8 666	6 251	6 435	4 642	-28.3

Table 15: Conversion of final energy consumption to useful heat in 2030 based on the VEKP (source: [15]). Useful heat 2030 for the tertiary sector and for the domestic sector was calculated on the basis of the more recent long-term renovation strategy [16]).

An exception is made for the residential sector, where a more accurate prediction is available in the more recent long-term renovation strategy through a modelling of the building stock. Here, final energy consumption for domestic hot water and space heating is calculated to decrease by 23.9% between 2020 and 2030. If the useful heat demand is reduced by the same factor, 29.1 TWh of useful heat is obtained. This is in line with the above-mentioned methodology.

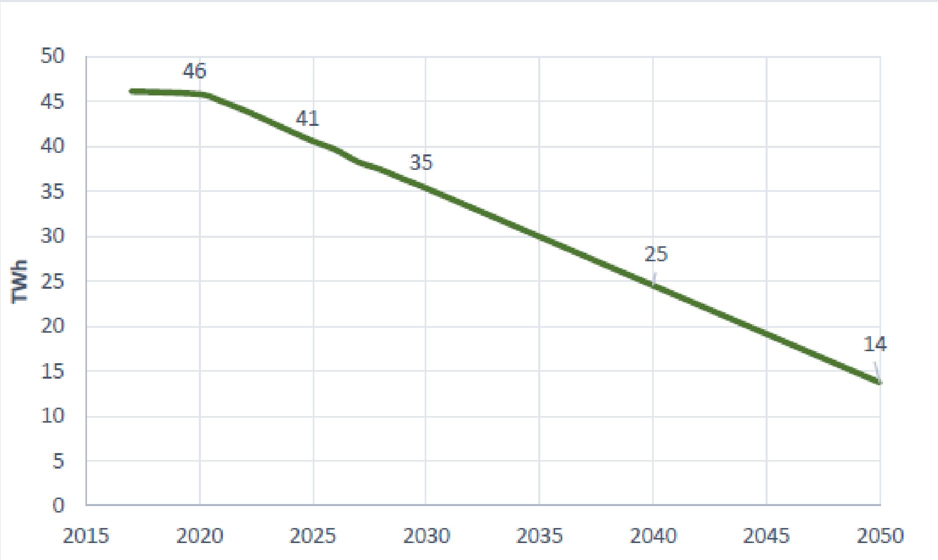


Figure 25: Final energy consumption for space heating and hot water consumption in a residential context (source: Long-term renovation strategy. [15])

TWh	TWh

For the tertiary sector, the long-term renovation strategy proposes an 11% reduction in final energy consumption by 2020. If we consider this 11% reduction in relation to 2019, we obtain final energy consumption of 27.1 TWh in 2030 and 13.6 TWh useful heat demand. This is consistent with the final energy consumption in the VEKP.

For industry, the VEKP foresees an increase in final energy consumption, related to planned investments in the port of Antwerp. For agriculture, a decrease of almost a quarter in final energy consumption is forecast.

6.2 Projections for 2050

The projections to 2050 are based on the well-known and documented calculations in the PRIMES reference scenario 2016 [17]. Where available, the projection in the long-term renovation strategy is used, which is based on more detailed modelling [15].

6.2.1 Residential

For the residential sector, a recent estimate is available up to 2050 for space heating and hot water (see Figure 25); the projection assumes a useful heat demand of 14 TWh in 2050. Of this, 11 TWh is still assumed to be supplied by fossil sources.

The graph in table Figure 25 can be used for the entire period.

For the current cooling demand, an estimate of 28.3 GWh was made in 2.3.1. The cooling demand in 2050 is not reflected in the PRIMES scenario and this needs to be estimated. Active cooling is not financially encouraged under current regulations. Linking the expected evolution of cooling demand to the expected evolution of geothermal heat pumps and passive cooling is currently not possible, as a scenario calculation is not available.

We assume that the cooling demand will remain constant over time.

6.2.2 Industrial sector

The final energy consumption in industry in 2019 was converted into useful heat demand for the year 2019 in Table 18. The various available sources are described below:

Final energy consumption industry [TWh]	2019	2020	2030	2050
Energiebalans Vlaanderen	108.5	N/A	N/A	N/A
VEKP Flanders	N/A	113.3	131.8	N/A
PRIMES BE (Belgium)	N/A	130.7	118.9	115.0

Table 16: Available projections for industry in Belgium

For the projection for 2020 to 2030, we use what is set out in the Energy and Climate Plan. For the projection towards 2050, we take the estimated evolution in the PRIMES reference scenario. [17]. This is a projection that was only carried out at national Belgian level, and therefore it is necessary to calculate the Flemish final energy consumption. For this, we use the Eurostat data and the Flemish *energiebalans* data from the year 2018 (the most recent year that is validated and available on Eurostat):

[TWh] Final energy consumption 2018	[TWh] Belgian data from Eurostat 2018	[TWh] Flemish data from the *energiebalans* 2018	(%) Ratio Flemish-Belgian
Industry	124.1	111.0	89.4

Table 17: Dividing the Flemish final energy consumption for industry by the Belgian final energy consumption.

Three assumptions are made:

1. Until 2030, the projected final energy consumption of Flemish industry is used, as described in the Flemish Energy and Climate Plan. Between 2030 and 2050, the limited decrease is used as described in PRIMES BE.
2. Between 2018 and 2050, the ratio of industrial final energy consumption in Flanders and in Belgium remains constant.
3. The ratio of useful heat production to final energy consumption remains constant between the current year and 2050. This ratio was based on fuel consumption. This does not imply that the fuels are the same, e.g. fossil fuel can be replaced by a synthetic or renewable fuel with the same conversion efficiency. However, in the case of large-scale electrification, the efficiency of the overall mix could change. While this assumption may cause significant deviations from the actual future situation, it has to be seen in the context of the existing large uncertainties concerning industrial production in 2050.

In PRIMES BE, industrial final energy consumption decreases by 0.2% per year between 2030 and 2050, or 3.3% cumulatively.

If this is applied to Flemish industry, starting from final energy consumption of 131.8 TWh in 2030, we arrive at a figure of 127.5 TWh in 2050.

This results in the following table as an indicative forecast, taking into account large and increasing uncertainties in longer term projections:

[GWh] Industrial sector in Flanders	2019	2030	2050
Final energy consumption [GWh]	108 458	131 820	127 470
Useful heat [GWh]	61 727	75 023	72 547

Table 18: Projection of industrial final energy consumption in Flanders until 2030 and 2050, based on data from the National Energy and Climate Plan and the PRIMES reference scenario, respectively.

6.2.3 Tertiary sector

For the tertiary sector (both public and private buildings), the long-term renovation strategy proposes a 33% reduction in final energy consumption. If we consider this in relation to 2019, we arrive at a final energy consumption of 20.3 TWh in 2050. However, this was not translated into a breakdown between useful heat, electricity for cooling or electricity for other uses. Also, no details were given about the technologies that would generate the heat, so a conversion from final energy consumption to useful heat is not possible as the efficiencies are not known.

The PRIMES 2016 reference scenario projections for the tertiary sector can be converted to Flanders in the same way as for industry (see above).

[GWh] Tertiary sector in Flanders	2019	2030	2050
Final energy consumption [GWh]	30 406	25 821	20 372
Useful heat [GWh]	15 319	13 634	10 227

Table 19: Tertiary final energy consumption and useful heat projected to 2050

However, this requires the assumption that the ratio between useful heat and final energy consumption will not change, which in the tertiary context may mean an underestimation of useful heat. After all, it is to be expected that with a higher penetration of heat pumps replacing gas boilers, more useful heat can be generated with the same amount of electricity.

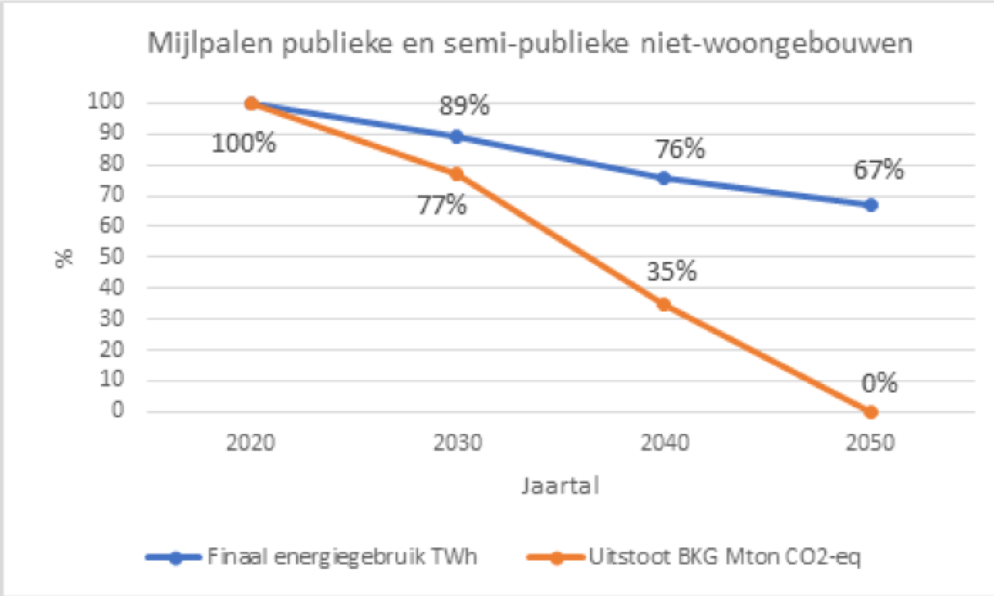


Figure 26: Final energy consumption in public non-residential buildings (source: long-term renovation strategy)

Mijlpalen publieke en semi-publieke niet-woongebouwen	Milestones public and semi-public non-residential build-ings
Jaartal	Year
Finaal energiegebruik TWh	Final energy consumption TWh
Uitstoot BKG Mton CO2-eq	GHG emissions Mton CO_2-eq

6.2.4 Agriculture sector

For agriculture, we cannot use the PRIMES 2016 scenario for rescaling purposes, as this sector was not explicitly modelled. We assume that the agricultural sector follows the ambitions of the climate plan towards 2030, and will have a constant final energy consumption and heat demand between 2030 and 2050.

[GWh] agriculture, forestry and fishery	2019	2030	2050
Final energy consumption [GWh]	8 666	6 251	6 251
Useful heat [GWh]	6 435	4 642	4 642

Figure 27: Final energy consumption (source: energiebalans) and useful heat (source: Table 1 for 2019, VEKP for 2030) for the agricultural sector

6.3 Policy instruments for heating and cooling

6.3.1 Objectives, strategies and policies

The table below shows the policy instruments for heating and cooling in Flanders.

(Part II:) Existing objectives, strategies and policies						
Name of the policy, strategy or objective	**Main objective of policy or strategy**	**Indicative national energy efficiency contribution, based on primary energy or final energy consumption, primary energy or final energy savings, or energy intensity*.**	**Brief description (exact scope and operational arrangements)**	**Relevant dimension of the Energy Union (see below) and intended impact, if applicable**	**Implementation period**	**Status of implementation**
Heat Plan 2020	Contributing to the binding national target of 2020 for the use of energy from renewable sources + Contributing to the promotion of energy efficiency in Flanders	The use of district heating in Flanders is historically very low. However, since the introduction in 2013 of financial support via regular tenders for green heat, waste heat, district heating networks and geothermal energy, a significant number of new projects have been completed and are still in the planning. At the end of 2017, about 600 GWh of heat was supplied through district heating networks. On the basis of planned and approved projects, this is expected to increase to 1 500 GWh by 2020. In the Energy Plan 2021-2030, an average increase of 250 GWh/year is projected (4 000 GWh by 2030). Renewable energy provided 39% of the heat for these district heating networks in 2017, and this is projected to increase to 52% by 2020.	- Subsidy calls re green heat, waste heat and biomethane with a budget of EUR 10.5 million/year (for increase of budget see additional measures).- Establishing the objective for the expansion of district heating networks up to 2030. - Identifying zones with potential for district heating networks on the basis of a highly detailed heat map and other available energy data. - Setting up procedures to inform and relieve local authorities of the burden of installing district heating networks. - Regulatory framework for guarantees of origin for green gas and green heat. - Optimising the integration of district heating networks in energy performance regulations. - Increasing efficient support for micro-CHP: investment support instead of operating support.- Introducing sustainability criteria for biomass. - Transferring support for green electricity to heat recovery (CHP). - Increasing minimum share of renewable energy in energy performance regulations. - Identifying potential for large-scale solar boilers. - Refining the potential for heat pumps. - Identifying and removing barriers to heat pumps. - Developing a guarantee system for geological risks in deep geothermal energy. - European project, cooperation and support through Geothermal ERA NET. - Including deep geothermal energy in the EPB – energy performance regulations. - Supporting organisations that promote sustainable energy: biogas-E, ODE, Warmtenetwerk Vlaanderen, Cogen Vlaanderen. - Creating a renewable energy atlas to calculate the renewable energy potential for each municipality in Flanders and visualise it on an interactive map for Flanders.	Dimension: decarbonisation (renewable energy) + General Energy Efficiency	2017–2020, ongoing until 2030	Already implemented or ongoing
REG-ODV solar boiler (Rational energy use under public service obligations)	Contributing to the promotion of energy efficiency in Flanders	Calculated cumulative final energy savings in the period 2021–2030 (in accordance with Article 7 of the Energy Efficiency Directive): 113 GWh	Financial support via network operators (approximately EUR 4 million/year)	General energy efficiency	Since 2003	Ongoing (continuation of existing support programme)

REG-ODV premium for heat pump	Contributing to the promotion of energy efficiency in Flanders	Calculated cumulative final energy savings in the period 2021–2030 (in accordance with Article 7 of the Energy Efficiency Directive): 1 048 GWh	Financial support via network operators (approximately EUR 3 million/year)	General energy efficiency	Since 2003	Ongoing (continuation of existing support programme)
REG-ODV premium for heat pump boiler	Contributing to the promotion of energy efficiency in Flanders	Calculated cumulative final energy savings in the period 2021–2030 (in accordance with Article 7 of the Energy Efficiency Directive): 493 GWh	Financial support via network operators (approximately EUR 1.8 million/year)	General energy efficiency	2019-2023	Ongoing (continuation of existing support programme)
Connecting SMEs to district heating networks	Contributing to the promotion of energy efficiency in Flanders	Calculated cumulative final energy savings in the period 2021–2030 (in accordance with Article 7 of the Energy Efficiency Directive): 6 111 GWh	See also subsidy call re green heat, waste heat and biomethane	General energy efficiency	Since 2013	Ongoing (continuation of existing support programme)
Accelerating the renewal rate and optimisation of the performance of existing natural gas and fuel oil boilers	Contributing to the promotion of energy efficiency in Flanders	This will result in a final energy saving of 2 136 GWh in 2030	- In order to follow up on the maintenance obligation and to make the heating of the buildings more sustainable, the documents for inspection and maintenance will be digitised and the development of a database with this information about the main heating used per building will be started in 2020. In the period 2021-2022 the database will updated. The database will be made available via the digital *woningpas*. Via the *woningpas,* owners can be notified when their central heating maintenance needs to be scheduled, etc. A well-maintained central heating system results in significant energy savings, is good for the environment and reduces energy bills. - At the same time as the database is being developed, the regulations are being amended. The elements of the heating audit around efficiency calculation are included in the documents for inspection and maintenance, as is information on the correct sizing of these heating systems. The calculations of the required output are relatively simple. When routine maintenance is carried out, the energy-efficient operation of the boiler is also optimised through a precise adjustment of the system (optimisation of the settings). - From 2021 onwards, we will start raising awareness among owners through various channels. In order to support owners in their choice of a sustainable heating system, we will develop a decision tree in 2020. We are conducting communication and awareness-raising campaigns about the energy efficiency of heating and air-conditioning installations through, for example, Veilig verwarmen [safe heating] (www.veiligverwarmen.be) aimed at individuals and engineers as well as local authorities and intermediary organisations (e.g. housing associations) and Koel je goed [cool down well] (www.koeljegoed.be). - From 2021, we will no longer grant protected consumers a subsidy for replacing a fuel oil boiler if there is natural gas present in the street. To encourage more sustainable heating, protected consumers will only be granted higher subsidies for condensing natural gas boilers and heat pumps. - In Flanders, smart meters for electricity and natural gas will be installed at all low-voltage connections up to 56 kVA in the coming years. When the smart meter for natural gas is installed, the boiler must be disconnected. To ensure that the installation proceeds smoothly, users will be asked by letter prior to the installation to ensure that their boiler has been inspected and serviced in accordance with the regulations in force. If complications arise with a correctly inspected boiler after the installation, the costs of a restart or recalibration will be borne by the distribution network	General energy efficiency	From 2020	In start-up phase

			operators. If the boiler has not been inspected, the users will be responsible for the costs. This ensures widespread communication with an accompanying financial incentive to promote the inspection of boilers. -Important for this action with a significant impact on energy use and CO_2 emissions is also the solid enforcement framework of the maintenance obligation. Effective enforcement will lead to better compliance with the maintenance obligation and compliance with the efficiency requirement so that the replacement rate will increase. The enforcement of these measures is the responsibility of the local authorities. It is currently hardly enforced. Decentralised heating appliances are not covered by the regulations. Together with the local authorities, we will look at ways to improve the enforcement of this measure and this can be accompanied with an appropriate educational, communication and information flow, so that an effective enforcement framework can be rolled out from 2025 onwards.			
No natural gas connection for residential properties in new large developments and apartment buildings	Contributing to the promotion of energy efficiency in Flanders	This will result in a final energy saving of 76 GWh in 2030.	From 2021, residential properties in new large developments and large apartment buildings can only be connected to natural gas for collective heating via CHP or in combination with a renewable energy system as the main source of heating.	General energy efficiency	From 2021	In start-up phase
No fuel oil boiler in new residential properties and during Major Energy Renovations starting in 2021 or when existing fuel oil boilers are replaced	Contributing to the promotion of energy efficiency in Flanders	This will result in a final energy saving of 10 GWh in 2030.	Residential new-builds and major energy efficiency renovations are no longer allowed to install fuel oil boilers. Existing fuel oil boilers can no longer be replaced by other fuel oil boilers if there is a possibility to connect to a natural gas network in the street, unless it is demonstrated that the fuel oil boilers will be replaced by a new fuel oil boiler if there is no natural gas connection.	General energy efficiency	From 2021	In start-up phase
Additional measures non-residential buildings:	Contributing to the promotion of energy efficiency in Flanders	This will result in a final energy saving of 4 601 GWh in 2030.	- In order to gain a clearer understanding of the current energy performance of non-residential buildings, all large non-residential buildings (where heating or cooling is provided) must have a non-residential energy performance certificate by 2025. From 2030 onwards, these buildings must achieve the minimum energy performance label. Government buildings within the Flemish Region are setting a good example by meeting the requirements for this label before 2028. - In 2021, we will also introduce a ban on fuel oil boilers in new buildings and carry out major energy renovations in non-residential buildings. Existing fuel oil boilers can no longer be replaced by other fuel oil boilers if there is a possibility to connect to a natural gas network in the street, unless it is demonstrated that the fuel oil boilers are as efficient as the latest natural gas condensing boilers. - Buildings in new large developments and large apartment buildings can only be connected to natural gas for collective heating via CHP or in combination with a renewable energy system as the main source of heating. We will develop a decision tree in order to also support these owners in their choice for a sustainable heating system. - Municipalities, cities, municipal associations, public centres for social welfare (openbaar centra voor maatschappelijk welzijn – OCMWs), provinces and autonomous municipal companies are asked to achieve an average annual primary energy saving of 2.09% in their buildings (including technical infrastructure, excluding non-movable heritage) from 2020.	General energy efficiency	From 2021	In start-up phase
Energy label standard for new construction and major energy renovations	Contributing to the promotion of energy efficiency in Flanders	Not available	New-builds as well as major energy renovations and renovation works that require a permit are subject to Energy Performance of Buildings (EPB) requirements. From 2021 onwards, building according to the NZEB principles (nearly zero-energy buildings) will be the standard for new construction in Flanders. Residential properties must then achieve an energy label lower	General energy efficiency	Since 2006	Ongoing

			than or equal to E30. For non-residential buildings, requirements are set according to their function.			
Long-term renovation strategy 2050	Contributing to the promotion of energy efficiency in Flanders	70% reduction in energy consumption by 2050 for residential buildings 67% reduction in energy consumption by 2050 for non-residential buildings	The Flemish Climate Strategy 2050 sets the target for buildings of reducing greenhouse gas emissions by more than 80% compared to today. For residential buildings, this amounts to a reduction of almost 75%, while for non-residential buildings the aim is to be climate neutral by 2050. In order to achieve the ambitious objectives of the Climate Strategy, existing residential properties must achieve a similar energy performance level to new residential properties with a 2015 building permit by 2050 at the latest. This long-term objective means that by 2050, the average EPC score of the entire housing stock will be reduced by 75%. On the EPC scales with energy labels (A to F), this corresponds to label A (EPC score 100). This objective is also differentiated according to housing categories. On the basis of data from the EPC database, it has been established that at present, approximately 3.5% of the existing housing stock of almost 3 million homes (houses and apartments) meet this target. This means that 2.9 million homes still need to be upgraded to the 2050 objective (96.5% of the housing stock). To achieve this, the strategy places a strong emphasis on thorough renovations at key moments such as the purchase of a property, inheritance, change of tenant, etc. But beyond these key moments, increasing the renovation rate remains a permanent necessity. For existing housing, renovation of the building envelope is clearly the first priority, so that the total heat demand is first reduced and the new heating system can be sized accordingly to meet the remaining heat demand. Where possible, Flanders is focusing on district heating networks that are fuelled by waste heat or green heat produced centrally. For non-residential buildings, Flanders is aiming for a carbon-neutral building stock for heating, domestic hot water, cooling and lighting by 2050, with the government taking a leading role. For public office buildings, the proposal is to set the example by meeting the long-term objective of achieving a carbon-neutral building stock by 2045. The semi-public buildings (schools, health care) and private buildings (offices, retail, hospitality, etc.) have until 2050 to meet the long-term objective. In order to increase the renovation rate of non-residential buildings, this strategy focuses on: - Implementing a renovation obligation within 5 years after purchase for tertiary buildings. - Introducing a mandatory EPC for all large non-residential buildings. In the further rollout of this strategy, for both residential and non-residential buildings, efforts will also be made, where possible, to remove some of the burden from building owners and to utilise the opportunities offered by digitalisation.	General energy efficiency	2021-2050	Ongoing
Support for cities and municipalities to support the transition into sustainable and smart cities in Flanders	Contributing to the promotion of energy efficiency in Flanders	Not available	In order to support cities and municipalities in the development and implementation of their local energy and climate policy, the Flemish Government has set up an 'Expertise Network on Local Energy and Climate Policy' in cooperation with the Association of Flemish Cities and Municipalities (Vereniging van Vlaamse Steden en Gemeenten – VVSG). This expertise network will encourage dialogue and cooperation between the different policy levels and will provide professional support in drawing up local heat	General energy efficiency	2020-2024	Ongoing

			plans, local renovation strategies and strategic real estate plans for the energy renovation of the municipal building stock. Successful projects and standardised solutions will be easily shared with the 300 cities and municipalities in Flanders via theme days, learning programmes and a digital practice database. The expertise network will also support the cities and municipalities in their search for financial solutions and become the central point of contact for cities and municipalities with regard to energy and climate policy. The Flemish Government is making EUR 4 million available to finance this network for the period 1 September 2020 to 31 December 2024.			
Mini-Energy Policy Agreements	Contributing to the promotion of energy efficiency in Flanders	Calculated cumulative final energy savings in the period 2021–2030 (in accordance with Article 7 of the Energy Efficiency Directive): 3 308 GWh		General energy efficiency	During 2021	In start-up phase
Industry standards framework	Contributing to the promotion of energy efficiency in Flanders	Calculated cumulative final energy savings in the period 2021–2030 (in accordance with Article 7 of the Energy Efficiency Directive): 49 110 GWh	For the non-energy-intensive companies (annual energy consumption < 0.1 PJ), the focus is on disseminating new solutions within the Flemish industrial network. This can be organised as incentives for energy advice or as support for specific consulting projects. The European obligation to develop specific initiatives focused on the energy consumption of SMEs is being met through an action plan to make SMEs more energy-efficient and through stronger legislation. The starting point is to build up knowledge about energy consumption and to identify useful measures. Sector-specific characteristics are taken into account.	General energy efficiency	From 2021	In start-up phase
Energy policy agreements (ongoing and expanded)	Contributing to the promotion of energy efficiency in Flanders	Calculated cumulative final energy savings in the period 2021–2030 (in accordance with Article 7 of the Energy Efficiency Directive): 49 110.15 GWh	To tackle the current obstacles and barriers for this target group, the relevant policy instruments to reach and support the different target groups more adequately will be provided. The most efficient classification into smaller enterprises and smallest enterprises will be made on the basis of an analysis that ensures the optimal functioning for companies and government. In addition, a pilot project will be set up with industrial sectors to detect obstacles and opportunities in a possible extension of the voluntary agreement for smaller companies.	General energy efficiency	2004-2030	Ongoing
Decarbonisation, including the reduction and removal of GHG emissions and contributing to the trajectories of the sectoral share of renewable energy in final energy consumption						
General energy efficiency, including the contribution to achieving the EU's 2030 energy efficiency target and indicative milestones for 2030, 2040 and 2050;						
Energy security, including diversification of energy supply, increasing the resilience and flexibility of the energy system and reducing import dependency;						
Internal energy markets, including improving interconnectivity, transmission infrastructure, competitively priced and involvement-oriented consumer policy and alleviating energy poverty						
Research, innovation and competitiveness, including the contribution to private research and innovation, and the deployment of clean technologies.						

Table 20: Overview of objectives, strategies and policies

6.3.2 Overview of potential new strategies and policies

The table below shows the new policy instruments for heating and cooling in Flanders.

(Part IV:) Overview of potential new strategies and policies							
Brief description of potential new strategy or policy	Main objective of new strategy or policy	Anticipated reduction in greenhouse gas emissions	Primary energy savings, GWh/year	Impact on the share of high-efficiency CHP	Impact on the share of renewable energy in the national energy mix and in the heating and cooling sector	Links to national financial programming and cost savings for public budgets and market participants	Estimated government aid measures, with annual budget and indication of the potential aid component
Heat Plan 2025-2030 in preparation with various measures, including: - budget increase for subsidy calls re green heat, waste heat, district heating networks - update of comprehensive assessments pursuant to Article 14 and Annex VIII of Directive 2018/2002/EU	Articles 3, 23 and 24 of Directive 2018/2001/EU	Increasing to 500 ktonnes per year in 2030 via district heating networks (in addition to other continuous actions from the Heat Plan 2020)	250 GWh additional savings per year via district heating networks, 2 500 GWh by 2030	High share will remain	Achieving 1 100 GWh extra green heat by 2030		Including EUR 50 million extra budget already planned on top of the Heat Plan 2020 for the subsidy calls re green heat, waste heat, district heating networks in the legislature until 2024

Table 21: Overview of potential new strategies and policies

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ANNEX 1: COMPLETED REPORTING TEMPLATES

Part I: Overview of heating and cooling 1. Reporting of current demand for heating and cooling; 4. Reporting of estimated demand for heating and cooling									
			Year						
		Unit	**2019**	2025	2030	2035	2040	2045	2050
Demand for heating, **final** energy consumption	Housing sector	GWh/year	47 712						
	Service sector	GWh/year	17 003						
	Industrial sector	GWh/year	73 852						
	Other sectors => Agriculture	GWh/year	6 871						
Demand for cooling, **final** energy consumption	Housing sector	GWh/year	9						
	Service sector	GWh/year	476						
	Industrial sector	GWh/year	1						
	Other sectors => Agriculture	GWh/year	0						
Demand for heating, **useful** energy	Housing sector	GWh/year	38 222	34 070	29 087	25 315	21 544	17 772	14 000
	Service sector	GWh/year	15 319	14 553	13 634	12 782	11 931	11 079	10 227
	Industrial sector	GWh/year	61 727	67 771	75 023	74 404	73 785	73 166	72 547
	Other sectors => Agriculture	GWh/year	6 435	5 620	4 642	4 642	4 642	4 642	4 642
Demand for cooling, **useful** energy	Housing sector	GWh/year	28	28	28	28	28	28	28
	Service sector	GWh/year	1 429	1 429	1 429	1 429	1 429	1 429	1 429
	Industrial sector	GWh/year	3	3	3	3	3	3	3
	Other sectors => Agriculture	GWh/year	0	0	0	0	0	0	0

Part I: Overview of heating and cooling
2.(a) Reporting of current heating and cooling supply

2019

On-site energy supply			Unit	Value
Housing sector	Sources of fossil fuel	Heat-only boilers	GWh/year	29 149
		Electric heating	GWh/year	4 919
		High-efficiency CHP	GWh/year	3
	Renewable energy sources	Heat-only boilers	GWh/year	3 188
		High-efficiency CHP	GWh/year	0
		Heat pumps	GWh/year	776
		Solar boilers	GWh/year	186
Service sector	Sources of fossil fuel	Heat-only boilers	GWh/year	14 639
		Other technologies	GWh/year	0
		High-efficiency CHP	GWh/year	154
	Renewable energy sources	Heat-only boilers	GWh/year	9
		High-efficiency CHP	GWh/year	374
		Heat pumps	GWh/year	129
		Solar boilers	GWh/year	14
Industrial sector	Sources of fossil fuel	Heat-only boilers	GWh/year	53 704
		Other technologies	GWh/year	0
		High-efficiency CHP	GWh/year	6 227
	Renewable energy sources	Heat-only boilers	GWh/year	807
		High-efficiency CHP	GWh/year	986
		Heat pumps	GWh/year	4
		Other technologies	GWh/year	0
Agriculture, forestry and fish-ery	Sources of fossil fuel	Heat-only boilers	GWh/year	2 726
		Other technologies	GWh/year	0
		High-efficiency CHP	GWh/year	3 238
	Renewable energy sources	Heat-only boilers	GWh/year	41
		High-efficiency CHP	GWh/year	429
		Heat pumps	GWh/year	0
		Other technologies	GWh/year	

Off-site energy supply

Housing sector	Sources of fossil fuel	Waste heat	GWh/year	2
		High-efficiency CHP	GWh/year	0
		Other technologies	GWh/year	1
	Renewable energy sources	Waste heat	GWh/year	2
		High-efficiency CHP	GWh/year	0
		Other technologies	GWh/year	1
Service sector	Sources of fossil fuel	Waste heat	GWh/year	40
		High-efficiency CHP	GWh/year	153
		Other technologies	GWh/year	925
	Renewable energy sources	Waste heat	GWh/year	36
		High-efficiency CHP	GWh/year	106
		Other technologies	GWh/year	0
Industrial sector	Sources of fossil fuel	Waste heat	GWh/year	135
		High-efficiency CHP	GWh/year	4 133
		Other technologies	GWh/year	2
	Renewable energy sources	Waste heat	GWh/year	123
		High-efficiency CHP	GWh/year	9
		Other technologies	GWh/year	0
Agriculture, forestry and fish-ery	Sources of fossil fuel	Waste heat	GWh/year	0
		High-efficiency CHP	GWh/year	14
		Other technologies	GWh/year	0
	Renewable energy sources	Waste heat	GWh/year	0
		High-efficiency CHP	GWh/year	28
		Other technologies	GWh/year	0

Part I: Overview of heating and cooling
2.(b) Reporting of established available waste heat

YEAR 2019

	Threshold	Unit	Value
Thermal power generation plants	50 MW	GWh/year	8 396
High-efficiency CHP	-	GWh/year	5 292
Waste incineration plants	-	GWh/year	767
Renewable energy installations	20 MW	GWh/year	0
Industrial installations	20 MW	GWh/year	25 277
The renewable energy installations > 20 MW were already included within incineration plants or high-efficiency CHP and therefore set to 0 to avoid double entry.			

Part III: Reporting of the economic potential of efficient and renewable heating and cooling technologies identified in the context of the cost-benefit analysis

YEAR 2050

	TOTAL GWh/year
Industrial waste heat	25 277
Industrial waste cold	739
Waste incineration	767
High-efficiency CHP	5 292
Renewable energy sources	
Geothermal energy (shallow + deep)	49 807
Biomass	9 622
Thermal solar energy	4 946
Other renewable energy sources	-

Heat pumps	28 869[19]
Reduction of heat loss from existing district heating and cooling networks	0

[19] The potential for heat pumps in 2050 is the sum of the useful heat demand in 2050 in the residential, tertiary and agricultural sectors.

(Part II:) Existing objectives, strategies and policies						
Name of the policy, strategy or objective	**Main objective of policy or strategy**	**Indicative national energy efficiency contribution, based on primary energy or final energy consumption, primary energy or final energy savings, or energy intensity*.**	**Brief description (exact scope and operational arrangements)**	**Relevant dimension of the Energy Union (see below) and intended impact, if applicable**	**Implementation period**	**Status of implementation**
Heat Plan 2020	Contributing to the binding national target of 2020 for the use of energy from renewable sources + Contributing to the promotion of energy efficiency in Flanders	The use of district heating in Flanders is historically very low. However, since the introduction in 2013 of financial support via regular tenders for green heat, waste heat, district heating networks and geothermal energy, a significant number of new projects have been completed and are still in the planning. At the end of 2017, about 600 GWh of heat was supplied through district heating networks. On the basis of planned and approved projects, this is expected to increase to 1 500 GWh by 2020. In the Energy Plan 2021-2030, an average increase of 250 GWh/year is projected (4 000 GWh by 2030). Renewable energy provided 39% of the heat for these district heating networks in 2017, and this is projected to increase to 52% by 2020.	- Subsidy calls re green heat, waste heat and biomethane with a budget of EUR 10.5 million/year (for increase of budget see additional measures). - Establishing the objective for the expansion of district heating networks up to 2030. - Identifying zones with potential for district heating networks on the basis of a highly detailed heat map and other available energy data. - Setting up procedures to inform and relieve local authorities of the burden of installing district heating networks. - Regulatory framework for guarantees of origin for green gas and green heat. - Optimising the integration of district heating networks in energy performance regulations. - Increasing efficient support for micro-CHP: investment support instead of operating support. - Introducing sustainability criteria for biomass. - Transferring support for green electricity to heat recovery (CHP). - Increasing minimum share of renewable energy in energy performance regulations. - Identifying potential for large-scale solar boilers. - Refining the potential for heat pumps. - Identifying and removing barriers to heat pumps. - Developing a guarantee system for geological risks in deep geothermal energy. - European project, cooperation and support through Geothermal ERA NET. - Including deep geothermal energy in the EPB – energy performance regulations.- Supporting organisations that promote sustainable energy: biogas-E, ODE, Warmtenetwerk Vlaanderen, Cogen Vlaanderen. - Creating a renewable energy atlas to calculate the renewable energy potential for each municipality in Flanders and visualise it on an interactive map for Flanders.	Dimension: decarbonisation (renewable energy) + General Energy Efficiency	2017–2020, ongoing until 2030	Already implemented or ongoing
REG-ODV solar boiler (Rational energy use under public service obligations)	Contributing to the promotion of energy efficiency in Flanders	Calculated cumulative final energy savings in the period 2021–2030 (in accordance with Article 7 of the Energy Efficiency Directive): 113 GWh	Financial support via network operators (approximately EUR 4 million/year)	General energy efficiency	Since 2003	Ongoing (continuation of existing support programme)
REG-ODV premium for heat pump	Contributing to the promotion of energy efficiency in Flanders	Calculated cumulative final energy savings in the period 2021–2030 (in accordance with Article 7 of the Energy Efficiency Directive): 1 048 GWh	Financial support via network operators (approximately 3 million euro/year)	General energy efficiency	Since 2003	Ongoing (continuation of existing support programme)
REG-ODV premium for heat pump boiler	Contributing to the promotion of energy efficiency in Flanders	Calculated cumulative final energy savings in the period 2021–2030 (in accordance with Article 7 of the Energy Efficiency Directive): 493 GWh	Financial support via network operators (approximately EUR 1.8 million/year)	General energy efficiency	2019-2023	Ongoing (continuation of existing support programme)

Connecting SMEs to district heating networks	Contributing to the promotion of energy efficiency in Flanders	Calculated cumulative final energy savings in the period 2021–2030 (in accordance with Article 7 of the Energy Efficiency Directive): 6 111 GWh	See also subsidy call re green heat, waste heat and biomethane	General energy efficiency	Since 2013	Ongoing (continuation of existing support programme)
Accelerating the renewal rate and optimisation of the performance of existing natural gas and fuel oil boilers	Contributing to the promotion of energy efficiency in Flanders	This will result in a final energy saving of 2 136 GWh in 2030	- In order to follow up on the maintenance obligation and to make the heating of the buildings more sustainable, the documents for inspection and maintenance will be digitised and the development of a database with this information about the main heating used per building will be started in 2020. In the period 2021-2022 the database will updated. The database will be made available via the digital *woningpas*. Via the *woningpas,* owners can be notified when their central heating maintenance needs to be scheduled, etc. A well-maintained central heating system results in significant energy savings, is good for the environment and reduces energy bills. - At the same time as the database is being developed, the regulations are being amended. The elements of the heating audit around efficiency calculation are included in the documents for inspection and maintenance, as is information on the correct sizing of these heating systems. The calculations of the required output are relatively simple. When routine maintenance is carried out, the energy-efficient operation of the boiler is also optimised through a precise adjustment of the system (optimisation of the settings). - From 2021 onwards, we will start raising awareness among owners through various channels. In order to support owners in their choice of a sustainable heating system, we will develop a decision tree in 2020. We are conducting communication and awareness-raising campaigns about the energy efficiency of heating and air-conditioning installations through, for example, Veilig verwarmen [safe heating] (www.veiligverwarmen.be) aimed at individuals and engineers as well as local authorities and intermediary organisations (e.g. housing associations) and Koel je goed [cool down well] (www.koeljegoed.be). - From 2021, we will no longer grant protected consumers a subsidy for replacing a fuel oil boiler if there is natural gas present in the street. To encourage more sustainable heating, protected consumers will only be granted higher subsidies for condensing natural gas boilers and heat pumps. - In Flanders, smart meters for electricity and natural gas will be installed at all low-voltage connections up to 56 kVA in the coming years. When the smart meter for natural gas is installed, the boiler must be disconnected. To ensure that the installation proceeds smoothly, users will be asked by letter prior to the installation to ensure that their boiler has been inspected and serviced in accordance with the regulations in force. If complications arise with a correctly inspected boiler after the installation, the costs of a restart or recalibration will be borne by the distribution network operators. If the boiler has not been inspected, the users will be responsible for the costs. This ensures widespread communication with an accompanying financial incentive to promote the inspection of boilers. -Important for this action with a significant impact on energy use and CO_2 emissions is also the solid enforcement framework of the maintenance obligation. Effective enforcement will lead to better compliance with the maintenance obligation and compliance with the efficiency requirement so that the replacement rate will increase. The enforcement of these measures is the responsibility of the local authorities. It is currently hardly	General energy efficiency	From 2020	In start-up phase

			enforced. Decentralised heating appliances are not covered by the regulations. Together with the local authorities, we will look at ways to improve the enforcement of this measure and this can be accompanied with an appropriate educational, communication and information flow, so that an effective enforcement framework can be rolled out from 2025 onwards.			
No natural gas connection for residential properties in new large developments and apartment buildings	Contributing to the promotion of energy efficiency in Flanders	This will result in a final energy saving of 76 GWh in 2030.	From 2021, residential properties in new large developments and large apartment buildings can only be connected to natural gas for collective heating via CHP or in combination with a renewable energy system as the main source of heating.	General energy efficiency	From 2021	In start-up phase
No fuel oil boiler in new residential new-builds and during Major Energy Renovations starting in 2021 or when existing fuel oil boilers are replaced	Contributing to the promotion of energy efficiency in Flanders	This will result in a final energy saving of 10 GWh in 2030.	Residential new-builds and major energy efficiency renovations are no longer allowed to install fuel oil boilers. Existing fuel oil boilers can no longer be replaced by other fuel oil boilers if there is a possibility to connect to a natural gas network in the street, unless it is demonstrated that the fuel oil boilers will be replaced by a new fuel oil boiler if there is no natural gas connection.	General energy efficiency	From 2021	In start-up phase
Additional measures non-residential buildings:	Contributing to the promotion of energy efficiency in Flanders	This will result in a final energy saving of 4 601 GWh in 2030.	- In order to gain a clearer understanding of the current energy performance of non-residential buildings, all large non-residential buildings (where heating or cooling is provided) must have a non-residential energy performance certificate by 2025. From 2030 onwards, these buildings must achieve the minimum energy performance label. Government buildings within the Flemish Region are setting a good example by meeting the requirements for this label before 2028. - In 2021, we will also introduce a ban on fuel oil boilers in new buildings and carry out major energy renovations in non-residential buildings. Existing fuel oil boilers can no longer be replaced by other fuel oil boilers if there is a possibility to connect to a natural gas network in the street, unless it is demonstrated that the fuel oil boilers are as efficient as the latest natural gas condensing boilers. - Buildings in new large developments and large apartment buildings can only be connected to natural gas for collective heating via CHP or in combination with a renewable energy system as the main source of heating. We will develop a decision tree in order to also support these owners in their choice for a sustainable heating system. - Municipalities, cities, municipal associations, public centres for social welfare (OCMWs), provinces and autonomous municipal companies are asked to achieve an average annual primary energy saving of 2.09% in their buildings (including technical infrastructure, excluding non-movable heritage) from 2020.	General energy efficiency	From 2021	In start-up phase
Energy label standard for new construction and major energy renovations	Contributing to the promotion of energy efficiency in Flanders	Not available	New-builds as well as major energy renovations and renovation works that require a permit are subject to Energy Performance of Buildings (EPB) requirements. From 2021 onwards, building according to the NZEB principles (nearly zero-energy buildings) will be the standard for new residential properties in Flanders. Residential properties must then achieve an energy label lower than or equal to E30. For non-residential buildings, requirements are set according to their function.	General energy efficiency	Since 2006	Ongoing
Long-term renovation strategy 2050	Contributing to the promotion of energy efficiency in Flanders	70% reduction in energy consumption by 2050 for residential buildings 67% reduction in energy consumption by 2050 for non-residential buildings	The Flemish Climate Strategy 2050 sets the target for buildings of reducing greenhouse gas emissions by more than 80% compared to today. For residential buildings, this amounts to a reduction of almost 75%, while for non-residential buildings the aim is to be climate neutral by 2050. In order to achieve the ambitious objectives of the Climate Strategy, existing residential properties must achieve a similar energy performance level	General energy efficiency	2021-2050	Ongoing

			as new residential properties with a 2015 building permit by 2050 at the latest. This long-term objective means that by 2050, the average EPC score of the entire housing stock will be reduced by 75%. On the EPC scales with energy labels (A to F), this corresponds to label A (EPC score 100). This objective is also differentiated according to housing categories. On the basis of data from the EPC database, it has been established that at present, approximately 3.5% of the existing housing stock of almost 3 million homes (houses and apartments) meet this target. This means that 2.9 million homes still need to be upgraded to the 2050 objective (96.5% of the housing stock). To achieve this, the strategy places a strong emphasis on thorough renovations at key moments such as the purchase of a property, inheritance, change of tenant, etc. But beyond these key moments, increasing the renovation rate also remains a permanent necessity. For existing housing, renovation of the building envelope is clearly the first priority, so that the total heat demand is first reduced and the new heating system can be sized accordingly to meet the remaining heat demand. Where possible, Flanders is focusing on district heating networks that are fuelled by waste heat or green heat produced centrally. For non-residential buildings, Flanders is aiming for a carbon-neutral building stock for heating, domestic hot water, cooling and lighting by 2050, with the government taking a leading role. For public office buildings, the proposal is to set the example by meeting the long-term objective of achieving a carbon-neutral building stock by 2045. The semi-public buildings (schools, health care) and private buildings (offices, retail, hospitality, etc.) have until 2050 to meet the long-term objective. In order to increase the renovation rate of non-residential buildings, this strategy focuses on: - Implementing a renovation obligation within 5 years after purchase for tertiary buildings. - Introducing a mandatory EPC for all large non-residential buildings. In the further rollout of this strategy, for both residential and non-residential buildings, efforts will also be made, where possible, to remove some of the burden from building owners and to utilise the opportunities offered by digitalisation.			
Support for cities and municipalities to support the transition into sustainable and smart cities in Flanders	Contributing to the promotion of energy efficiency in Flanders	Not available	In order to support cities and municipalities in the development and implementation of their local energy and climate policy, the Flemish Government has set up an 'Expertise Network on Local Energy and Climate Policy' in cooperation with the Association of Flemish Cities and Municipalities (VVSG). This expertise network will encourage dialogue and cooperation between the different policy levels and will provide professional support in creating local heat plans, local renovation strategies and strategic real estate plans for the energy renovation of the municipal building stock. Successful projects and standardised solutions will be easily shared with the 300 cities and municipalities in Flanders via theme days, learning programmes and a digital practice database. The expertise network will also support the cities and municipalities in their search for financial solutions and become the central point of contact for cities and municipalities with regard to energy and climate policy. The Flemish Government is making EUR 4 million available to finance this network for the period 1 September 2020 to 31 December 2024.	General energy efficiency	2020-2024	Ongoing

Mini-Energy Policy Agreements	Contributing to the promotion of energy efficiency in Flanders	Calculated cumulative final energy savings in the period 2021–2030 (in accordance with Article 7 of the Energy Efficiency Directive): 3 308 GWh		General energy efficiency	During 2021	In start-up phase
Industry standards framework	Contributing to the promotion of energy efficiency in Flanders	Calculated cumulative final energy savings in the period 2021–2030 (in accordance with Article 7 of the Energy Efficiency Directive): 49 110 GWh	For the non-energy-intensive companies (annual energy consumption < 0.1 PJ), the focus is on disseminating new solutions within the Flemish industrial network. This can be organised as incentives for energy advice or as support for specific consulting projects. The European obligation to develop specific initiatives focused on the energy consumption of SMEs is being met through an action plan to make SMEs more energy-efficient and through stronger legislation. The starting point is to build up knowledge about energy consumption and to identify useful measures. Sector-specific characteristics are taken into account.	General energy efficiency	From 2021	In start-up phase
Energy policy agreements (ongoing and expanded)	Contributing to the promotion of energy efficiency in Flanders	Calculated cumulative final energy savings in the period 2021–2030 (in accordance with Article 7 of the Energy Efficiency Directive): 49 110.15 GWh	To tackle the current obstacles and barriers for this target group, the relevant policy instruments to reach and support the different target groups more adequately will be provided. The most efficient classification into smaller enterprises and smallest enterprises will be made on the basis of an analysis that ensures the optimal functioning for companies and government. In addition, a pilot project will be set up with industrial sectors to detect obstacles and opportunities in a possible extension of the voluntary agreement for smaller companies.	General energy efficiency	2004-2030	Ongoing
Decarbonisation, including the reduction and removal of GHG emissions and contributing to the trajectories of the sectoral share of renewable energy in final energy consumption						
General energy efficiency, including the contribution to achieving the EU's 2030 energy efficiency target and indicative milestones for 2030, 2040 and 2050;						
Energy security, including diversification of energy supply, increasing the resilience and flexibility of the energy system and reducing import dependency;						
Internal energy markets, including improving interconnectivity, transmission infrastructure, competitively priced and involvement-oriented consumer policy and alleviating energy poverty						
Research, innovation and competitiveness, including the contribution to private research and innovation, and the deployment of clean technologies.						

(Part IV:) Overview of potential new strategies and policies							
Brief description of potential new strategy or policy	**Main objective of new strategy or policy**	**Anticipated reduction in greenhouse gas emissions**	**Primary energy savings, GWh/year**	**Impact on the share of high-efficiency CHP**	**Impact on the share of renewable energy in the national energy mix and in the heating and cooling sector**	**Links to national financial programming and cost savings for public budgets and market participants**	**Estimated government aid measures, with annual budget and indication of the potential aid component**
Heat Plan 2025-2030 in preparation with various measures, including: - budget increase for subsidy calls re green heat, waste heat, district heating networks - update of comprehensive assessments pursuant to Article 14 and Annex VIII of Directive 2018/2002/EU	Articles 3, 23 and 24 of Directive 2018/2001/EU	Increasing to 500 ktonnes per year in 2030 via district heating networks (in addition to other continuous actions from the Heat Plan 2020)	250 GWh additional savings per year via district heating networks, 2 500 GWh by 2030	High share will remain	Achieving 1 100 GWh extra green heat by 2030		Including EUR 50 million extra budget already planned on top of the Heat Plan 2020 for the subsidy calls re green heat, waste heat, district heating networks in the legislature until 2024

ANNEX 2: OVERVIEW OF DISTRICT HEATING NETWORKS IN FLANDERS 2019

Existing district heating systems - part 1

Id	Project	Type	Municipality	Operator	Supplier	To_residential	To_industry	To_tertiary	Temp_level	Trench length_km	Generators	Energy_supplied	Renewable_waste	Non-renewable_waste	Renewable_non-	Non-renewable_non-	Financing_re-	Funding_sources	Expansion_planne
2019_11	Nieuwe Dokken	District heating network	Ghent	DuCoop cvba	DuCoop cvba	No	No	Yes	Medium	0.85	Waste heat, Heat pump, Biogas boiler, Natural gas boiler	20–200 GWh/year	0%	0%	0%	100 %	Yes	Subsidy call green heat/waste heat	Yes
2019_12	Cohousing Kerselaar	District heating network	Ghent	Cohousing Kerselaar	Cohousing Kerselaar	Yes	No		Low	0.2	Heat pump	< 0.2 GWh/year	0%	0%	67%	33%			
2019_15	Stora Enso – Volvo	District heating network	Ghent	Stora Enso Langerbrugge NV	Stora Enso Langerbrugge NV	No	Yes		High	2	Waste incineration (CHP)	20–200 GWh/year	82%	17%	0%	1%	Yes	Strategic environmental support	
2019_16	Ostend	District heating network	Ostend	Beauvent cvba	Beauvent cvba	No	Yes	Yes	High	5	Waste incineration	1–20 GWh/year	48%	52%	0%	0%	Yes	Strategic environmental support, subsidy call waste heat	Yes
2019_17	Hot water distribution system Campus Gasthuisberg	District heating network	Leuven	UZ Leuven	UZ Leuven	No	No	Yes	High	2.85	Natural gas boiler	20–200 GWh/year	0%	0%	0%	100 %			
2019_18	Scholen van Morgen 's Gravenwezel	District heating network	Schilde	DBFM Scholen van Morgen NV	DBFM Scholen van Morgen NV	No	No	Yes	High	0.001	Natural gas boiler	0.2–1 GWh/year	0%	0%	0%	100 %			
2019_19	Scholen van Morgen Oudenaarde	District heating network	Oudenaarde	DBFM Scholen van Morgen NV	DBFM Scholen van Morgen NV	No	No	Yes	Medium	0.038	Natural gas boiler	0.2–1 GWh/year	0%	0%	0%	100 %			
2019_20	Scholen van Morgen Wemmel	District heating network	Wemmel	DBFM Scholen van Morgen NV	DBFM Scholen van Morgen NV	No	No	Yes	High	0.001	Natural gas boiler	< 0.2 GWh/year	0%	0%	0%	100 %			
2019_21	Scholen van Morgen Sint-Katelijne-Waver	District heating network	Sint-Katelijne-Waver	DBFM Scholen van Morgen NV	DBFM Scholen van Morgen NV	No	No	Yes	High	0.001	Natural gas boiler	< 0.2 GWh/year	0%	0%	0%	100 %			
2019_22	Scholen van Morgen Mortsel	District heating network	Mortsel	DBFM Scholen van Morgen NV	DBFM Scholen van Morgen NV	No	No	Yes	Medium	0.01	Natural gas boiler	0.2–1 GWh/year	0%	0%	0%	100 %			
2019_23	Scholen van Morgen Oostende	District heating network	Ostend	DBFM Scholen van Morgen NV	DBFM Scholen van Morgen NV	No	No	Yes	Medium	0.01	Natural gas boiler	< 0.2 GWh/year	0%	0%	0%	100 %			
2019_24	Scholen van Morgen Roeselare	District heating network	Roeselare	DBFM Scholen van Morgen NV	DBFM Scholen van Morgen NV	No	No	Yes	High	0.01	Natural gas boiler	< 0.2 GWh/year	0%	0%	0%	100 %			
2019_25	Scholen van Morgen Bocholt	District heating network	Bocholt	DBFM Scholen van Morgen NV	DBFM Scholen van Morgen NV	No	No	Yes	High	0.01	Natural gas boiler	< 0.2 GWh/year	0%	0%	0%	100 %			
2019_26	Scholen van Morgen Sint-Amands	District heating network	Puurs-Sint-Amands	DBFM Scholen van Morgen NV	DBFM Scholen van Morgen NV	No	No	Yes	High	0.01	Natural gas boiler	< 0.2 GWh/year	0%	0%	0%	100 %			
2019_27	Scholen van Morgen Sint-Gillis-Waas	District heating network	Sint-Gillis-Waas	DBFM Scholen van Morgen NV	DBFM Scholen van Morgen NV	No	No	Yes	High	0.01	Natural gas boiler	< 0.2 GWh/year	0%	0%	0%	100 %			
2019_28	MIROM	District heating network	Roeselare, Staden	Mirom Roeselare o.v.	Mirom Roeselare o.v.	Yes	Yes		High	11.287	Waste incineration	20–200 GWh/year	48%	52%	0%	0%	Yes	Climate Fund, Call green heat/waste heat	Yes
2019_31	Sint-Idesbald	District heating network	Roeselare	Fluvius System Operator cvba	Fluvius System Operator cvba	No	No	Yes	High	1.699	Waste incineration	1–20 GWh/year	48%	52%	0%	0%	Yes	Subsidy call green heat/waste heat	Yes
2019_343	Subnet VME Het Laere	District heating network	Roeselare	VME Het Laere – 1 – Hoofdvereniging	VME Het Laere – 1 – Hoofdvereniging	Yes	No		High	0.142	Above ground district heating network MIROM, natural gas boiler	0.2–1 GWh/year	47%	53%	0%	0%			

2019_346	Water-link - Eastman - IVAGO		Ghent	Water-link	Water-link	No	Yes										Yes	Subsidy call green heat/waste heat	
2019_347	Warmtenet Bocholt	District heating network	Bocholt	Landschapsenergie CVBA	Landschapsenergie CVBA	No		Yes	High	0.2	Biomass boiler	< 0.2 GWh/year	0%	0%	100%	0%			
2019_348	Warmtenet Domein Kiewit		Hasselt	City of Hasselt	City of Hasselt	No		Yes											
2019_3491	Warmtenet G16 - Terminal & ABD zone	District heating network	Zaventem	Brussels Airport Company	Brussels Airport Company	No	No	Yes	High	11	Natural gas boiler	20–200 GWh/year	0%	0%	0%	100 %			
2019_3492	Warmtenet G702 - Brucargo	District heating network	Zaventem	Brussels Airport Company	Brussels Airport Company	No	No	Yes	High	1	Natural gas boiler	1–20 GWh/year	0%	0%	0%	100 %			
2019_35	Warmtenet SCK•CEN - BP - VITO	District heating network	Mol	SCK•CEN	VITO NV	No	Yes	Yes	High	5.9	CHP on natural gas, natural gas boiler	20–200 GWh/year	0%	0%	0%	100 %			
2019_36	Rodekruislaan	District heating network	Mol	Fluvius System Operator cvba	Fluvius System Operator cvba	No	No	Yes	High	0.38	Natural gas boiler	1–20 GWh/year	0%	0%	0%	100 %			
2019_37	Hof ter Bloemmolens	District heating network	Diksmuide	Fluvius System Operator cvba	Fluvius System Operator cvba	Yes	No		High	1.35	Natural gas boiler	0.2–1 GWh/year	0%	0%	0%	100 %			
2019_38	IMOG-Nerva	District heating network	Harelbeke	IMOG cv Opdraver	IMOG cv Opdraver	No	Yes		High	0.3	Waste incineration	1–20 GWh/year	48%	52%	0%	0%			Yes
2019_39	Bionerga – Aquafin	Steam network	Houthalen-Helchteren	Bionerga NV	Bionerga NV	No	Yes			1	Waste incineration	20–200 GWh/year	48%	52%	0%	0%			

Existing district heating networks – part 2

Id	Project	Type	Municipality	Operator	Supplier	To_residential	To_industry	To_tertiary	Temp_level	Trench length_km	Generators	Energy_supplied	Renewable_waste	Non-renewable_waste	Renewable_non-	Non-renewable_non-	Financing_re-	Funding_sources	Expansion_planne
2019_40	IVAGO – UZ Ghent	Steam network	Ghent	IVAGO	IVAGO	No	No	Yes		1.5	Waste incineration (CHP)	20–200 GWh/year	48%	52%	0%	0%			
2019_41	District heating network Bruges – IVBO	District heating network	Bruges	IVBO	IVBO, Residentie Park De Blauwe Reiger VME	Yes	Yes	Yes	High	11.445	Waste incineration	20–200 GWh/year	48%	52%	0%	0%			Yes
2019_42	VMM St-Elisabeth	District heating network	Aalst	Veolia nv-sa	Veolia nv-sa	Yes	No	Yes	High	0.5	Natural gas boiler	1–20 GWh/year	0%	0%	0%	100 %			
2019_43	Guido Gezellestraat	District heating network	Mol	Fluvius System Operator cvba	Fluvius System Operator cvba	Yes	No		High	0.09	Natural gas boiler	0.2–1 GWh/year	0%	0%	0%	100 %			
2019_46	Ecluse	Steam network	Beveren	Ecluse	INDAVER NV, Slib en co verwerkingsinstallatie	No	Yes			5	Waste incineration	> 200 GWh/year	48%	52%	0%	0%	Yes	Strategic environmental support	
2019_48	Cordium Broeker Winning	District heating network	Hasselt	Cordium cvba	Cordium cvba	Yes	No		Medium	0.516	Heat pump	< 0.2 GWh/year	0%	0%	23%	77%			
2019_49	Indaver-Amoras	District heating network	Antwerp	INDAVER NV	INDAVER NV	No	Yes		High	1.3	Waste incineration	1–20 GWh/year	0%	100%	0%	0%			Yes
2019_50	Balk Van Beel – Ark – Twist	District heating network	Leuven	Fluvius System Operator cvba	Veolia nv-sa	Yes	No	Yes	High	0.11	Natural gas boiler	1–20 GWh/year	0%	0%	0%	100 %			
2019_52	District heating network Fluvius Roeselare Roobaert	District heating network	Roeselare	Fluvius System Operator cvba	Fluvius System Operator cvba	Yes	No		High	2.007	Natural gas boiler	0.2–1 GWh/year	0%	0%	0%	100 %			
2019_53	Niefhout	District heating network	Turnhout	Fluvius System Operator cvba	Veolia nv-sa	Yes	No	Yes	High	0.315	Natural gas boiler	0.2–1 GWh/year	0%	0%	0%	100 %			
2019_54	Nieuw Zuid	District heating network	Antwerp	Fluvius System Operator cvba	Fluvius System Operator cvba	Yes	No		High	1.97	Natural gas boiler, solar boiler	1–20 GWh/year	0%	0%	0%	100 %			Yes
2019_55	Ghent	District heating network	Ghent	Luminus NV	Luminus NV, WoninGent, University of Ghent	Yes	Yes		High	11.5	CHP on natural gas, natural gas boiler	20–200 GWh/year	0%	0%	0%	100 %			
2019_56	N1 Pipeline Indaver-INEOS	Steam network	Beveren	INEOS Phenol Belgium NV	INDAVER NV, Slib en Co verwerkingscentrale NV	No	Yes			0.5	Waste incineration	20–200 GWh/year	48%	52%	0%	0%			
2019_57	Janseniushof	Cold network	Leuven	KWOnet.bvba	KWOnet.bvba	Yes	No			0.5	Cold/heat storage	No energy supplied to the cold network yet in 2019							
2019_58	Fluvius warmtenet transportnet Kuurne	District heating network	Kuurne	Fluvius System Operator cvba	Fluvius System Operator cvba	No	No		High	2.037	Waste incineration	1–20 GWh/year	48%	52%	0%	0%	Yes	Subsidy call green heat/waste heat	Yes

2019_59	Kuurne Rietvoornstraat	District heat-ing network	Kuurne	Fluvius System Operator cvba	Fluvius System Operator cvba	Yes	No		High	0.39	Waste incineration	0.2–1 GWh/year	48%	52%	0%	0%	Yes	Subsidy call green heat/waste heat	Yes
2019_60	Kuurne-weidenstraat	District heat-ing network	Kuurne	Fluvius System Operator cvba	Fluvius System Operator cvba	Yes	No		High	0.118	Waste incineration	< 0.2 GWh/year	48%	52%	0%	0%	Yes	Subsidy call green heat/waste heat	Yes
2019_61	Fluvius Harelbeke	District heat-ing network	Harelbeke	Fluvius System Operator cvba	Fluvius System Operator cvba	Yes	No		High	2.37	Waste incineration	0.2–1 GWh/year	48%	52%	0%	0%	Yes	Subsidy call green heat/waste heat	Yes
2019_62	STORG-Molenheide	District heat-ing network	Houthalen-Helchteren	STORG bvba	STORG bvba	Yes	Yes	Yes	High	1.2	CHP on biogas	1–20 GWh/year	0%	0%	100%	0%			
2019_63	Warmtenet Wijk Venning	District heat-ing network	Kortrijk	Wonen Regio Kortrijk	Wonen Regio Kortrijk	Yes	No	Yes	High	1.31	Biomass boiler 300 kWth–1 MWth, natural gas boiler, liq-uid biofuel CHP	1–20 GWh/year	0%	0%	54%	46%			
2019_64	Zonnige Kempen Winterhof	District heat-ing network	Berlaar	Zonnige Kempen	Zonnige Kempen	Yes	No		High	0.003	Natural gas boiler, solar boiler	< 0.2 GWh/year	0%	0%	0%	100 %			
2019_65	Zonnige Kempen Welvaartstraat	District heat-ing network	Berlaar	Zonnige Kempen	Zonnige Kempen	Yes	No		High	0.01	Heat pump, natural gas boiler	0.2–1 GWh/year							
2019_66	Zonnige Kempen Pleinstraat	District heat-ing network	Heist-op-den-Berg	Zonnige Kempen	Zonnige Kempen	Yes	No		High	0.003	Natural gas boiler	< 0.2 GWh/year	0%	0%	0%	100 %			
2019_67	Zonnige Kempen Wijnrankplein	District heat-ing network	Grobbendonk	Zonnige Kempen	Zonnige Kempen	Yes	No		High	0.003	Wood pellet boiler, natural gas boiler	0.2–1 GWh/year	0%	0%	50%	50%			
2019_68	Zonnige Kempen Lindelaan	District heat-ing network	Herenthout	Zonnige Kempen	Zonnige Kempen	Yes	No		High	0.025	Natural gas CHP, nat-ural gas boiler	0.2–1 GWh/year	0%	0%	0%	100 %			
2019_69	Zonnige Kempen Stationsstraat	District heat-ing network	Hulshout	Zonnige Kempen	Zonnige Kempen	Yes	No		High	0.006	Natural gas boiler	< 0.2 GWh/year	0%	0%	0%	100 %			
2019_70	Zonnige Kempen Wijngaardbos	District heat-ing network	Laakdal	Zonnige Kempen	Zonnige Kempen	Yes	No		High	0.005	Heat pump, natural gas boiler	0.2–1 GWh/year							
2019_71	Zonnige Kempen Schietboomstraat	District heat-ing network	Westerlo	Zonnige Kempen	Zonnige Kempen	Yes	No		High	0.005	Natural gas boiler	< 0.2 GWh/year	0%	0%	0%	100 %			
2019_72	Zonnige Kempen Sint Antonius	District heat-ing network	Westerlo	Zonnige Kempen	Zonnige Kempen	Yes	No		High	0.01	Heat pump, solar boiler, natural gas boiler	0.2–1 GWh/year							
2019_74	Balmatt site (VITO)	District heat-ing network	Mol	Fluvius System Operator cvba	Kempens Warmtebedrijf	No		Yes	High	2.017	Deep geothermal en-ergy	No energy supplied to the heat network yet in 2019					Yes	Call green heat/waste heat	Yes

Planned district heating networks

Id	Project	Owner	Postcode	Municipality	Sub_call_g
2019_290	Veurne Suikerpark	Fluvius System Operator	8630	Veurne	Yes
2019_291	District heating network Waste incineration plant MIROM	Fluvius System Operator	8800	Roeselare	Yes
2019_292	Waste heat from Agfa-Gevaert, Mortsel	Warmte Verzilverd	2000	Antwerp, Edegem, Mortsel	Yes
2019_293	City-wide district heating network in Ostend	Beauvent	8400	Ostend	Yes
2019_294	Heat recovery from waste incineration plant IMOG	Fluvius System Operator	8530	Harelbeke	Yes
2019_295	Heat recovery from waste incineration plant IMOG	Fluvius System Operator	8530	Harelbeke, Kuurne	Yes
2019_296	District heating network Waste incineration plant MIROM	MIROM Roeselare	8800	Roeselare	Yes
2019_297	Heat supply Antwerp Nieuw-Zuid	Fluvius System Operator	2650	Edegem, Wilrijk	Yes
2019_297	District heating network Fluvius – Biomass installation	Fluvius System Operator	2400	Mol	Yes
2019_299	De Coene biomass plant	FIBRIMMO	8510	Marke (Kortrijk)	Yes
2019_300	Main grid of the Antwerpen-Noord district heating network	Fluvius System Operator, Port of Antwerp	2030	Antwerp	Yes
2019_301	District heating network ISVAG	IVEG – Infrax	2000	Antwerp, Kiel-Antwerp, Wilrijk, Edegem, Hoboken	Yes
2019_302	City-wide district heating network in Ostend	Beauvent	8400	Ostend	Yes
2019_303	District heating network with green heat from non-recyclable waste wood and materials to Unilin, Agristo and a residential area	A&U Energie	8710	Wielsbeke	Yes

2019_304	District heating network with green heat from non-recyclable waste wood and materials to Unilin, Agristo and a residential area	A&U Energie	8710	Wielsbeke	Yes
2019_305	District heating network with green heat from non-recyclable waste wood and materials to Unilin, Agristo and a residential area	GROEP HUYZENTRUYT	8710	Wielsbeke	Yes
2019_306	De Kaart Brasschaat	Van Roey Vastgoed	2930	Brasschaat	Yes
2019_307	Rinkkaai	Rinkkaai	9000	Ghent	Yes
2019_308	Binnenhof	Van Roey Vastgoed	2360	Oud-Turnhout	Yes
2019_309	Pont West Biomassa Centrale (PWBC)	Biosynergy	9600	Ronse	Yes
2019_312	District heating network Waste incineration plant MIROM	Fluvius System Operator	8800	Roeselare, Hooglede	Yes
2019_313	District heating network Waste incineration plant MIROM	Fluvius System Operator	8800	Roeselare	Yes
2019_314	Heat recovery from waste incineration plant IMOG	Fluvius System Operator	8520	Kuurne	Yes
2019_316	District heating network Waste incineration plant MIROM	Dumobil Construct	8800	Roeselare	Yes
2019_317	Deep geothermal energy on the Balmatt site in Mol	VITO	2400	Mol, Geel	Yes
2019_319	Turnhout Heizijdse velden - upgrade from DN150 to DN300	City of Turnhout	2300	Turnhout	Yes
2019_320	Deep geothermal energy on the Janssen Pharmaceutica – Beerse site	Janssen Pharmaceutica	2340	Beerse	Yes
2019_323	Deep geothermal energy on the Janssen Pharmaceutica - site Beerse	Janssen Pharmaceutica	2340	Beerse	Yes
2019_324	Deep geothermal energy on the Janssen Pharmaceutica - site Beerse	Janssen Pharmaceutica	2340	Beerse	Yes
2019_327	City-wide district heating network in Ostend	Beauvent	8400	Ostend	Yes
2019_328	Biostoom	Biostoom Beringen	3580	Beringen	Yes
2019_329	Bionerga: Green power generation and a district heating network to Borealis	Bionerga	3583	Beringen	Yes
2019_331	Waste heat recovery Crematorium – KULAK Kortrijk	Beauvent	8500	Kortrijk	Yes
2019_332	City-wide district heating network in Ostend	Beauvent	8400	Ostend	Yes
2019_334	District heating network ISVAG	ISVAG (Intercommunale voor Slib en Vuilverwijdering [Intermunicipal sludge and waste disposal] Antwerp Municipalities)	2610	Wilrijk	Yes
2019_338	Heat recovery from waste incineration plant IMOG	Eandis	8530	Harelbeke	Yes

ANNEX 3: OVERVIEW OF AVAILABLE GIS INFORMATION HEAT MAP

	Map layer	Available info (main attribute)	Spatial resolution
1	Heat demand of large consumers	Name Sector & sub-sector **Heat demand (4 classes)** Number of EAN electricity Number of EAN gas PV system Address Source	Circle
2	Heat demand small consumers	CRABCODE of the road connection in which the segment is located Address Municipality Length Heat demand of the section **Heat demand density per section** Total electricity consumption Total gas consumption Number of consumer addresses Number of EAN electricity Number of EAN gas Number of consumer addresses with PV installation	Street section
3	Heat demand per municipality	NISCODE Name of the municipality Total heat demand **Heat demand density (per street length)** Total electricity consumption Total gas consumption Number of EAN electricity Number of EAN gas Proportion of households with fuel oil/biomass installation	Municipality
4	Heat demand per statistical sector	CODE of the statistical sector Name of the statistical sector Total heat demand **Heat demand density (per street length)** Total electricity consumption Total gas consumption Number of EAN electricity Number of EAN gas Proportion of households with fuel oil/biomass installation	Statistical sector
5	Existing district heating network outlines	Project Type of network Municipality District heating networks operator District heating network supplier Supply to residential Supply to industry Supply to services & public Temperature level of district heating network Trench length (km) Generators Energy supplied to district heating network Renewable waste heat Non-renewable waste heat Renewable non-waste heat Non-renewable non-waste heat Funding received Financed by Planned network expansion	Line

6	Existing district heating networks points	Project Type of network Municipality District heating networks operator District heating network supplier Supply to residential Supply to industry Supply to services & public Temperature level of district heating network Trench length (km) Generators Energy supplied to district heating network Renewable waste heat Non-renewable waste heat Renewable non-waste heat Non-renewable non-waste heat Funding received Financed by Planned network expansion	Circle
7	Planned district heating network points	Project Owner Postcode Municipality Subsidy call green heat/waste heat	Circle
8	Number of energy intensive companies within a 5 km radius with possible waste heat supply and/or demand	CODE of the statistical sector Name of the statistical sector Number of consumer addresses within a 5 km radius 0.2–1 GWh/year Number of consumer addresses within a 5 km radius 1–20 GWh/year Number of consumer addresses within a 5 km radius > 200 GWh/year **Score**	Statistical sector
9	Waste incineration plants	Name Location Type **Capacity (5 classes)**	Circle
10	Power plants	Name Location Type **Capacity (5 classes)**	Circle
11	CHP	Name Location Sector_nace Type **Capacity (5 classes)**	Circle

ANNEX 4: REFERENCE EFFICIENCIES

The reference efficiencies used to convert fuel consumption to useful heat demand in Chapters 1 and 6 are based on [2] and are listed in the table below.

GROENE brandstoffen	biobenzine	biodiesel	biobrandsto	koolzaadoli	palmolie	bio-olie	stortgas	biogas	slib	olijfpitten	houtpellets	stukhout	houtafval	houtkrulle	houtzaagse	houtstof	hout	afval deel H	koffie
referentierendementen voor gescheiden opwekking van warmte																			
bron: bijlage I- II van het Ministerieel besluit inzake de vastlegging van referentierendementen voor toepassing van de voorwaarden voor kwalitatieve warmtekrachtinstallaties 6oktober 2006																			
stoom/warm water r	0,89	0,89	0,89	0,89	0,89	0,89	0,7	0,7	0,8	0,8	0,86	0,86	0,86	0,86	0,86	0,86	0,86	0,8	0,8
stoom/warm water r	0,84	0,84	0,84	0,84	0,84	0,84	0,65	0,65	0,75	0,75	0,81	0,81	0,81	0,81	0,81	0,81	0,81	0,75	0,75
direct gebruik verbra	0,81	0,81	0,81	0,81	0,81	0,81	0,62	0,62	0,72	0,72	0,78	0,78	0,78	0,78	0,78	0,78	0,78	0,72	0,72

FOSSIELE brandstoffen	Koolteer	Kolen	Cokes	Aardolie en	Raff.	LPG	Benzine	Gas-en	Lamppetro-	Zware	Petroleum-	Andere	Aard- en	Cokes-	Hoog-	Andere
bron: bijlage I- II van het Ministerieel besluit inzake de vastlegging van referentierendementen voor toepassing van de voorwaarden voor kwalitatieve warmtekrachtinstallaties 6oktober 2006																
stoom/warm water rendementen		0,88	0,88	0,89	0,89	0,89	0,89	0,89	0,89	0,89	0,88	0,89	0,90	0,8	0,8	0,8
stoom/warm water rendementen		0,83	0,83	0,84	0,84	0,84	0,84	0,84	0,84	0,84	0,83	0,84	0,85	0,75	0,75	0,7500
direct gebruik verbrandingsgass		0,8	0,8	0,81	0,81	0,81	0,81	0,81	0,81	0,81	0,8	0,81	0,82	0,72	0,72	0,7200

GROENE brandstoffen	GREEN fuels
Biobenzine	Biogasoline
Biodiesel	Biodiesel
Biobrandsto	Biofuel
Koolzaadoli	Rapeseed oil
Palmolie	Palm oil

Bio-olie	Bio-oil
Stortgas	Landfill gas
Biogas	Biogas
Slib	Sludge
Olijfpitten	Olive pits
Houtpellets	Wood pellets
Stukhout	Logs
Houtafval	Wood waste
Houtkrulle	Wood shavings
Houtzaagse	Sawdust
Houtstof	Wood dust
Hout	Firewood
Afval deel H	Waste part H
Koffie	Coffee
Referentierendementen voor gescheiden opwekking van warmte	Reference efficiencies for separate heat generation

Bron: bijlage I- II van het Ministerieel besluit inzake de vastlegging van referentierendementen voor toepassing van de voorwaarden voor kwalitatieve warmtekrachtinstallaties 6oktober 2006	Source: Annexes I–II of the Ministerial Decree on setting reference efficiencies for the application of the conditions for high-efficiency CHP installations October 2016
Stoom / warm water	Steam / hot water
Stoom / warm water	Steam / hot water
Direct gebruik verbra	Direct use of combustion gas
FOSSIELE	FOSSIL
Brandstoffen	Fuels
Koolteer	Coal tar
Kolen	Coal
Cokes	Coke
Aardolie en	Petroleum and [...]
Raff.	Refinery [...]
LPG	LPG
Benzine	Petrol
Gas-en	Gas and [...]

Lamppetro-	Kerosene
Zware	Heavy [...]
Petroleum-	Kerosene [...]
Andere	Other [...]
Aard- en	Gas and [...]
Cokes-	Coke [...]
Hoog-	High [...]
Andere	Other [...]
Bron: bijlage I- II van het Ministerieel besluit inzake de vastlegging van referentierendementen voor toepassing van de voorwaarden voor kwalitatieve warmtekrachtinstallaties 6oktober 2006	Source: Annexes I–II of the Ministerial Decree on setting reference efficiencies for the application of the conditions for high-efficiency CHP installations October 2016
Stoom / warm water rendementen	Steam / hot water efficiencies
Stoom / warm water rendementen	Steam / hot water efficiencies
Direct gebruik verbrandingsgass	Direct use of combustion gas