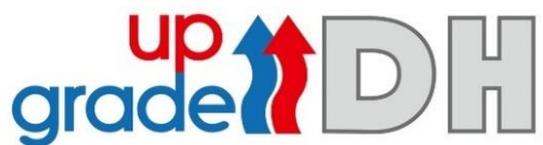




National action plan for retrofitting DH networks in The Netherlands



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Contents

Contents	3
Acknowledgements	4
Abbreviations	5
1 Introduction	6
2 Current policy framework	7
2.1 Current situation of the DH network	7
2.2 The future of CHP plants	12
2.3 Future of renewables in the Netherlands	12
2.3.1 Climate Agreement	12
2.3.2 Regulations (Heat Act "Warmtewet", Gas Act "Gaswet")	13
3 Incentive programmes and funding for the improvement of district heating systems	16
4 Proposed action plan	17
4.1 Production	17
4.2 Distribution	17
4.3 End-use	17
4.4 Regulatory framework, taxation, and legislation	17
5 Promotion of the action plan and recommendations	18
References	19

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Abbreviations

DH:	District Heating
CHP:	Combined Heat and Power
MEP:	Environmental Quality of Electricity Production
ISDE:	Investment Subsidy for Sustainable Energy
SDE:	Stimuleringsregeling duurzame energieproductie (Stimulation of Sustainable Energy Production)
EIA:	Energy Investment Allowance
EIB:	European Investment Bank
EFSD:	European Fund for Strategic Investments

1 Introduction

The overall objective of the Upgrade DH project is to improve the performance of district heating (DH) networks in Europe by supporting selected demonstration cases for upgrading, which can be replicated in Europe.

The Upgrade DH project supports the upgrading and retrofitting of DH systems in different climate regions of Europe, covering various countries: Bosnia-Herzegovina, Denmark, Croatia, Germany, Italy, Lithuania, Poland, and The Netherlands. In each of the target countries, the upgrading process was initiated at concrete DH systems of the so-called Upgrade DH demonstration cases (demo cases). The gained knowledge and experiences are further replicated to other European countries and DH systems (replication cases) in order to leverage the impact.

Core activities of the Upgrade DH project include the collection of the best upgrading measures and tools, the support of the upgrading process for selected district heating networks, the organisation of capacity building measures about DH upgrading, financing and business models, as well as the development of national and regional action plans.

This document specifically focuses on the **development of a national action plan** for the retrofitting of inefficient and the expansion of existing district heating networks **in the Netherlands** and includes the results of the retrofitting approaches (see also the *District Heating Handbook*¹ developed within the project).

In the Netherlands, heat supply from district heating systems represents a relatively small proportion of total heat supply despite the country having over 10.000 networks [1]. The Netherlands has huge domestic reserves of natural gas, which is used for heating, industrial processes and electricity. Due to these large reserves, heating needs are predominantly met through natural gas domestic boilers.

The analysis showed that there are strategies, regulations, as well as incentives and funding programmes relevant for the DHC sector (Chapter 2 and 3). There are clear indications that district heating is going to be promoted in general. It has been stated by the Government that by 2050 natural gas shall no longer be used for heating purposes. However, an integrated strategy for deployment of DHC on the national level is still missing. Therefore, a **list of solutions / actions / activities** that could support the development or retrofitting of DH networks was elaborated and can serve for inspiration for other countries with a similar DH market situation and legislative framework.

More specifically, the Dutch Climate Agreement of 2019 covers many aspects that must be considered for the transition towards the implementation of renewable energy solution in the Netherlands [2]. The Chapter 4 “Proposed action plan” suggests actions that can be considered to increase the possibilities of reaching the target. The solutions can be divided in three main areas, where the district heating is acting: production, distribution and end-use. Furthermore, a fourth area regarding policy and regulation can be considered, which does not directly act on the district heating network but can incentivise its development.

¹ UpgradeDH (2019): “Upgrading the performance of district heating networks Technical and non-technical approaches - A Handbook”, Public (Deliverable 2.5)

2 Current policy framework

2.1 Current situation of the DH network

The district heating sector is going to play an important role for the transition towards a larger renewable energy share in the heating sector as well as for the reduction of CO₂ emissions.

In the Netherlands, the district heating sector do not have a large market share due to an extensive natural gas infrastructure, which is the most common heat source for buildings. Around 400,000 homes are connected to a district heating network, which is equivalent to approximately 6% of homes, in the Netherlands. Since 2010, the number of connections has grown by 4.6%, mainly due to new construction project [3]. This percentage is relatively low, and some measures must be considered to increase the expansion, also in the existing building stock.

The Climate Agreement of 2019 foresees that between 2020 and 2030, the heat grids are going to expand from 20 petajoules to approximately 30 petajoules [2]. Further growth towards 40 petajoules is expected but will depend on the policies adopted [3].

Various industrial complexes also make use of a heat grid for steam production, usually from a CHP. In total, this amounted to 35 petajoules in 2017. This is more than all district heating combined (22 PJ). However, there is not so much information available about these types of networks and their development. It is expected that some growth will still take place due to various initiatives for industrial heat exchange [3].

The Netherlands is characterised by two different kind of networks, the large-scale and the small-scale ones. Large networks consist of more than 5,000 connected customers and the main heat source are usually power plants, waste incinerators, industry and refineries. In 2009, there were 79 municipalities with district heating out of the 418 municipalities in total, while in 2013 it increased to 96 [4].

However, there are thousands of small-scale heat distribution network (<5,000 consumers) spread out across the Netherlands, where the main heat sources are CHP-plants, small cogeneration units, biomass CHP plants and collective boilers.

According to 2016 figures, there were over 10.000 networks in the Netherlands. Over 9.000 of those networks were very small though, with under 50 connections and only in one building [1]. The majority of those were owned by small firms, association of homeowners and other parties. In most cases, these networks count less than 50 connected consumers. The remaining 300 networks are owned by energy suppliers, which use cogenerations unit as heat source. Waste heat, heat pumps or biomass plants are also used on some occasions [4].

Figure 1 shows a list of the main district heating networks located at the different municipalities and their share of the total heat.

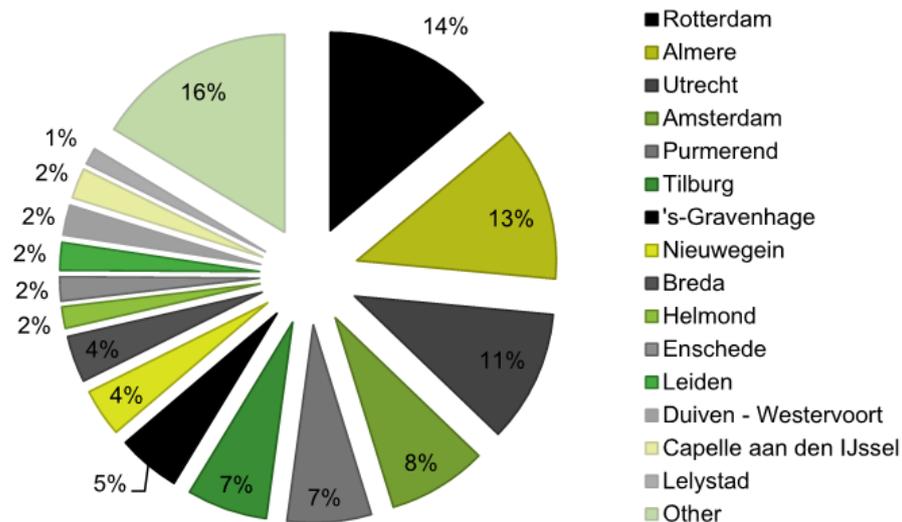


Figure 1. Distribution of dwellings connected to a district heating network over the different municipalities in 2013 [4]

The government is highly committed to make the building stock more sustainable and ensure that a remarkably percentage of buildings will not use natural gas as heat source. This requires major investments in the energy infrastructure in the Netherlands, and municipalities are expected to play a main role in this transition, which must determine how the increased sustainability will be achieved per district, and the infrastructure required to do so [3]. Figure 2 shows the share of energy sources in the district heating sector, highlighting a small share of renewable. As it was already mentioned, the heating sector has in general a small percentage of renewable due to the large natural gas infrastructure that characterise the country.

District heating by source (2013)

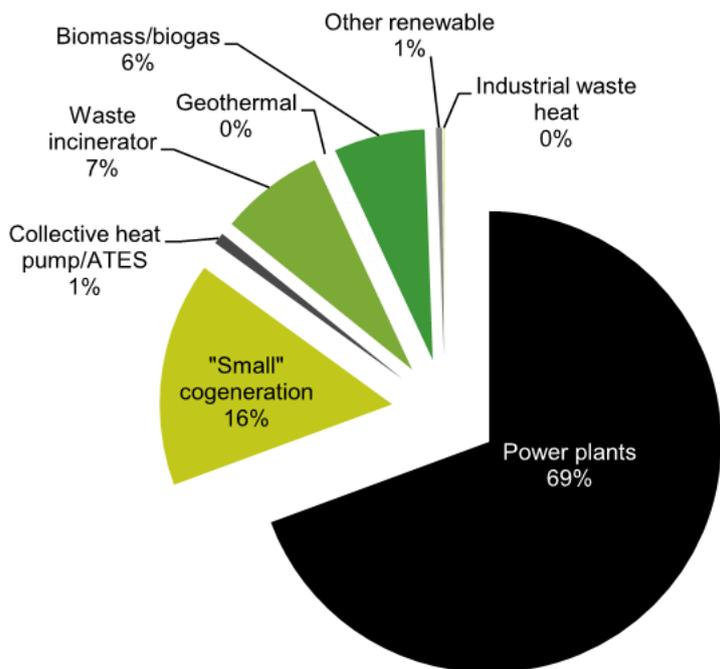


Figure 2. Share of heat sources for district heating in 2013 [4].

In general, in the past, the Netherlands showed a limited renewable energy penetration, even though in the last few years the sector is gaining attention and it is quickly developing. Since 2000, the share of renewable energy according to the European Renewable Energy Directive (Directive 2009/28/EC) has gradually risen from 1.6% to 7.4% in 2018. The main reason for the increase is the subsidy schemes introduced to support the uptake of renewables (MEP in 2003 and ISDE in 2008) and the blending requirement for renewable fuels in transport as of 2007. In 2018, the total gross final consumption was 2,100 petajoules, of which 157 petajoules were from renewable sources. Regarding the sustainable energy sources, approximately 60% was produced from biomass, 23% was from wind energy, 8% was from solar and 6% was from geothermal [3].

A more updated report regarding the actual situation of the district heating network has been published in November 2020 by the Dutch New Energy Research, which is only available in Dutch. However, it contains an updated overview of the current situation in the Netherlands as well as a prediction of the development in the district heating market.

As it is shown in Figure 3, the number of small-scale network (<5000 users connected), owned by energy suppliers (dark green line) are around 350 in 2020 and are expected to be around 800 in 2030. The large-scale networks (>5000 users connected) owned by energy suppliers (orange line) are limited in the Netherlands, around 10, which will approximately double within 2030. It must be mentioned that even though the number of large-scale networks is limited, they cover around 90% of the total heat demand [5].

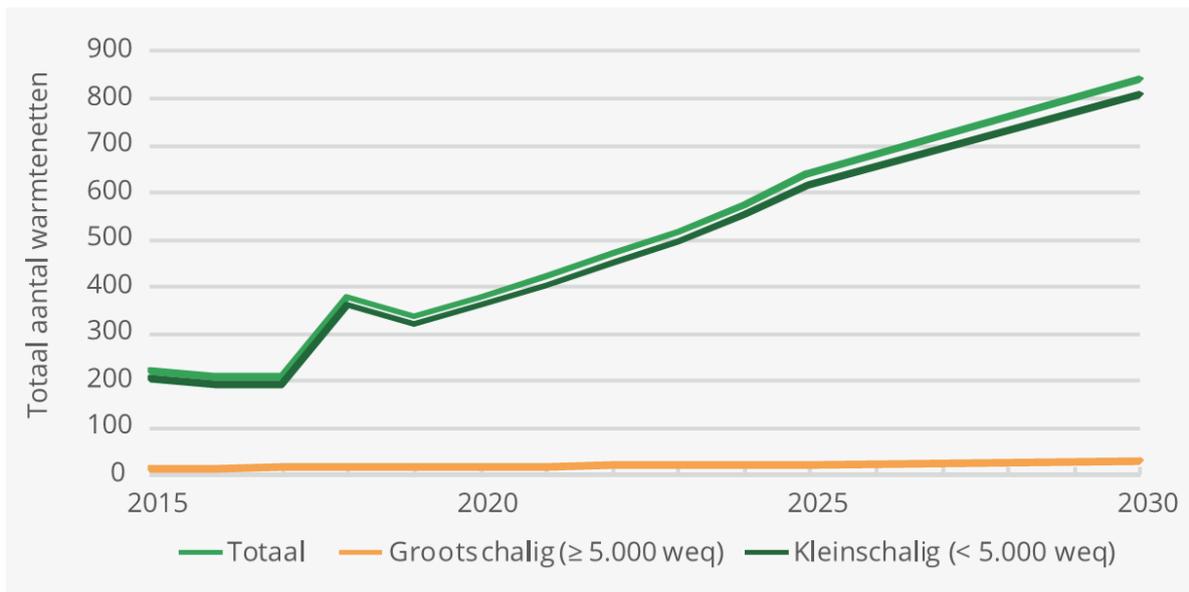


Figure 3. Expected development of the number of heating networks in the Netherlands [5]

Figure 4 shows the development of the total heat delivered by district heating in the Netherlands. As it is noticed, in 2020 the energy supplied by district heating network is approximately 25 PJ, which is expected to increase up to 40 PJ in 2030. This is due to an increase in the number of networks, but also the expansion of existing ones [5]. Compared to what estimated in the Climate Plan, the report from the Dutch New Energy Research forecasts a larger increase of the delivered heat of approximately 10 PJ in 2030.

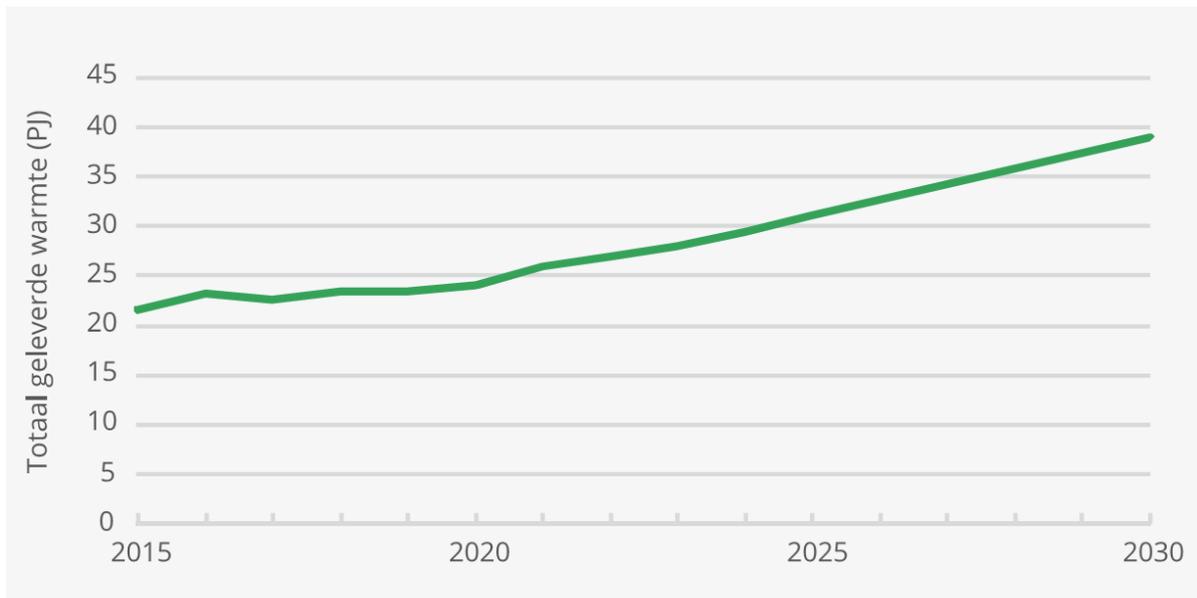


Figure 4. Expected development of the total heat supplied by the district heating network in GJ [5]

The increase of the delivered energy is expected to be achieved partly through incentive policies of the central government and initiatives of local governments. The number of households connected to urban heating will double from about 500,000 in 2020 to more than 900,000 in 2030 [5]. These numbers are more optimistic compared to the ones found in other sources.

Figure 5 shows that heat delivered by the district heating networks divided into the different sectors. In 2020, the office buildings (orange line) use the largest part of the heat supply, approximately 10.5 PJ, followed by existing residential buildings (dark green line) at 6.5 PJ and new residential buildings (light green line) at approximately 5 PJ. A smaller part of the heat delivered by the district heating is used in the industry sector (light blue line), approximately 2 PJ and lastly the agriculture sector (purple line), which is slightly higher than 0.5 PJ. The first three sectors will have a large increase within the 2030, where the delivered energy from the district heating network is expected to be more than double.

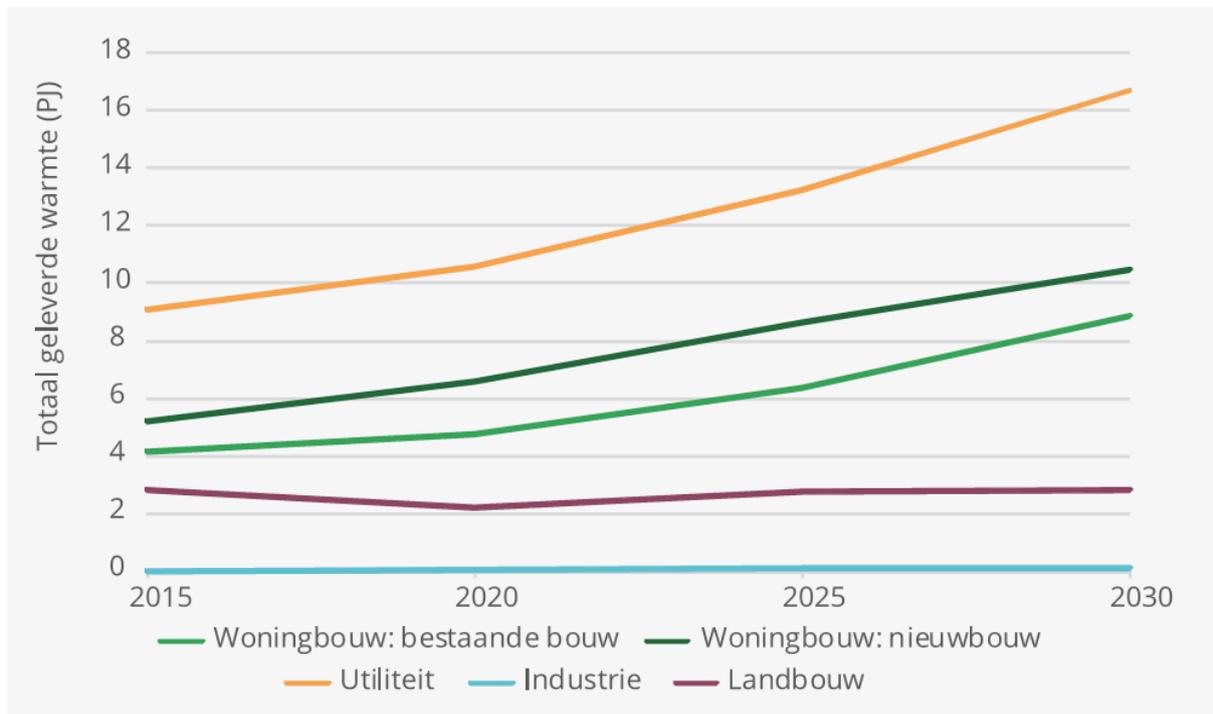


Figure 5. Expected development of the total heat delivered per sector in GJ [5]

Regarding the heat sources in the district heating for the housing sector, Figure 6 shows the actual values for each source and the expected increase until the 2030. In 2020, the biomass energy (light green line) is at approximately 1.8 PJ, while it is expected to increase to 2.5 PJ in 2025 and remain stable until the 2030. The shallow geothermal open systems (purple line) cover 0.5 PJ of the delivered energy and will increase steadily to 1.5 PJ in 2030. For deep geothermal energy (pink line) and aquathermal energy (light blue line) the energy contribution is slightly higher than 0 PJ in 2020, while they remarkably increase after 2025. Solar thermal energy (yellow line) and geothermal energy open system (orange line) are slightly above 0 PJ in 2020 but are not expected to remarkably increase. In the graph, it is also possible to notice the energy from fossil fuels (grey line), which is about 3.5 PJ in 2020 and is expected to decrease.

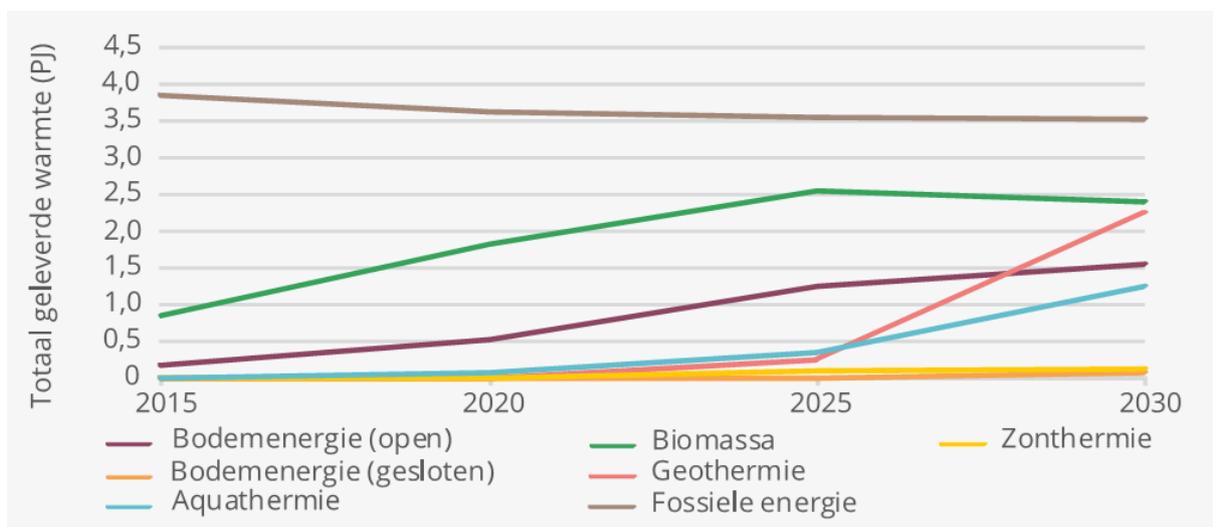


Figure 6. Expected development of the total heat delivered per source in the residential sector in GJ [5]

Figure 7 shows similar trends and shares for the different heat source when related to office buildings, industry and agriculture. In this case, the fossil fuel energy seems to increase, as it might be considered the use of biofuels, even though it was not clearly explained in the text.

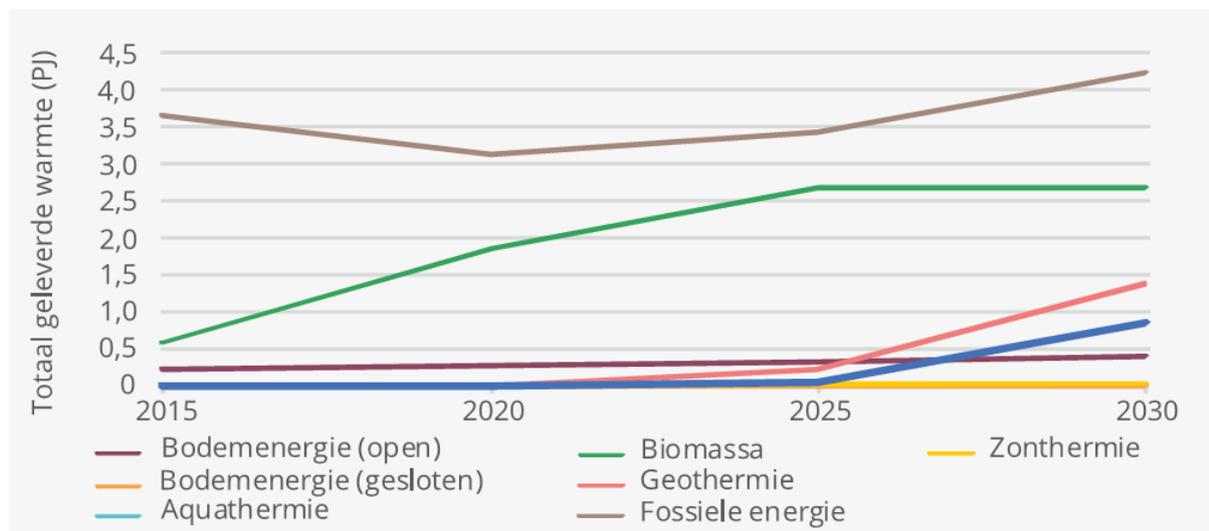


Figure 7. Expected development of the total heat delivered per source in the utility, industries and agriculture in GJ [5]

2.2 The future of CHP plants

In the Netherlands, combined heat and power plants (CHP) are expected to decrease in the next years, after a strong rise between 2007 and 2010 (mainly due to agriculture and horticulture) and a stable number of plants up to now, due to the unfavourable price ratio between natural gas and electricity at the time. In 2017, CHP plants produced approximately 38% of the total consumption. The main energy source of the CHP plants is natural gas, 64% of the total energy, while the remaining is mainly generated from fuel waste, process gas and, for a small part, from coal. CHP will continue to decrease in the coming years following the adopted policies variant, in particularly the central CHPs for district heating. The decentralised CHPs in industry and greenhouse horticulture will remain profitable with the expected gas and electricity prices until 2030 [3].

2.3 Future of renewables in the Netherlands

2.3.1 Climate Agreement

The Climate Agreement defines the strategy adopted to achieve the sustainability target decided by the government, with focus on 5 sectors: large industry, energy sector, mobility, built environment, land use & agriculture.

The plan of the Netherlands is to phase out the use of natural gas for the heating of buildings and introduce sustainable heat sources to achieve the aim defined by the Paris Agreement. The overall target is to achieve 80-95% reduction of CO₂ emission within the 2050. The gradual transition has however to be boosted with incentives and a set of requirements [6].

On a shorter term, the country aims to achieve 49% reduction of CO₂ emissions within 2030, acting on five sectors: industry, mobility, built environment, electricity production, land use and agriculture [7]. For each sector, a specific plan is considered in the Climate Agreement.

The energy sector and large industry are set to be the biggest contributors to the reduction targets while the built environment will have a more modest role in the achievement of the climate targets despite this sector accounting for around 40% of the total energy demand. District heating is considered among the solutions to introduce sustainable energy sources in the built environment, which will help the phase-out of natural gas, both in new and existing buildings. Indeed, Part of the Climate Agreement is new law that bans the use of natural gas in newly built houses and other buildings.

As it was mentioned before, roughly 6% of the buildings in the country are connected to a DH network (~420,000 homes), while it is estimated that by 2050, the percentage will increase to 15-45% (~750,000 homes) depending on the adopted strategy [2].

To implement the transition to renewable sources in buildings, the Climate Agreement of 2019 defines a district-oriented approach which will be promoted and supported by new dedicated regulations. This approach will be applied for both heating grids and renovation projects, which are going to be organised locally, at district level. This solution is considered since case studies have shown that this is more successful, as residents are more willing to collaborate with each other and with the relevant local government authority [2].

The municipalities play a crucial role in the district-oriented approach, since a meticulous process must be completed for defining the best solution for each district, which may differ from the neighbour ones. For the implementation plan at district level, municipal authorities and stakeholders will be supported by a set of guidelines, in which objective information will be made available based on transparent and validated factual data [2].

In the past two years, experience in a lot of cities and towns has shown that the large scale and top-down approach can be complex, as there is a need for intensive interaction with local communities and households.

A gradual shift has taken place, where there is a better balance between the district-oriented approach and an approach aimed at 'no-regret' measures to be taken by individual households (like isolation and hybrid heat pumps). Those no-regret measures were part of the Climate Agreement but have recently received more attention.

Furthermore, dedicated players will be set up to help the different actors involved in the transition. For example, the Netherlands Heating Expertise Centre (ECW) will support the municipalities to enable them to prepare and formulate plans from a harmonised starting point. To that end, the ECW has two key roles:

- Management and support of the guidelines.
- Knowledge centre, chiefly in the field of technical, economic and sustainability aspects, but equally about national developments such as market regulation. Aquathermal and Geothermal energy [2].

Also, DH networks will have a primary role in the transition to sustainable energy sources and towards the reduction of CO₂ emissions. With regards to heating, the Regional Energy Strategy identifies the supply of renewable heating in the region, which involves national data on geothermal and aqua-thermal sources supplemented with residual heating sources identified in each region [2].

To support the transition, incentives will be given to the relevant target groups that are going to implement sustainable solutions in the buildings, which can be in form of energy bill savings or a broad spectrum of attractive, accessible and responsible funding options [2].

2.3.2 Regulations (Heat Act "Warmtewet", Gas Act "Gaswet")

The district heating sector in The Netherlands is regulated by the "Heat Act" (in Dutch: Warmtewet). However, the regulatory framework for district heating will need to be changed to meet the ambitious goals set in the Climate Agreement regarding carbon-neutral heat in buildings and to put up the required infrastructure [6].

The existing Heat Act has been mainly focusing on the consumer protection with tariffs limits and security of supply. Due to the new requirements for the green transition, the new Heat Act will have to focus more on the district heating system in the built environment, in order to facilitate its extension as heat source [6].

Among the rules of the Heat Act, a cap price for the heat is defined by the government, which cannot be higher than the price defined if the heat is provided with gas boilers. Due to the monopoly in the DH sector, in the last period there were some frictions in the country, since

there is a general belief that the heat suppliers have tariffs that are too high. Therefore, a general the idea that it is required to set up an independent heat network operator [6].

However, in a letter published by the economy ministry, it is mentioned that the DH system is so complex to manage and operate that these tasks should be left to utilities specialised in the technology, limiting the possibilities of creating an "open" market. The separation of supply and infrastructure, unbundling, would have a higher negative impact, which can limit the integration of new heat sources in the existing networks. It is important that the heat sector is characterised by specific regulations that guarantee reliability, affordability and sustainability. It is expected that the district heating companies are responsible for the production, distribution and delivery of the heat, without any obligation on the building side. Lastly, a district heating company has no limitation for the possibility of outsourcing tasks to third-party providers along the value chain [6].

On the 1st of July 2019, a revision of the Heat Act came into effect, which defines a new set of multiple cap tariffs on the heat supply at various temperatures, for different types of heat exchangers, for connections and disconnections. The new tariffs took effect at the beginning of 2020. Furthermore, new regulations were set for homeowners and lessors. Lastly, in order to improve the security of supply, tariffs were defined in case of interruptions of supply [7].

In 2022, the new "Heat Act 2.0" is expected to be presented, where new regulations should better define cap tariffs, redefine the DH market design, facilitating the decision making and investments. Furthermore, high attention will be set to the increase of sustainability and the use of sustainable sources to achieve the targets of the Climate Agreement [8].

The district-approach will be the foundation of the transition to renewable energy sources in the heating sector, where different strategies are going to be considered, as it is shown in Figure 8. DH will play an important role and can consider both low temperature and high temperature networks. Besides that, heat pumps and renewable gas are considered as alternative sources.

Natural gas free neighborhoods: 5 strategies

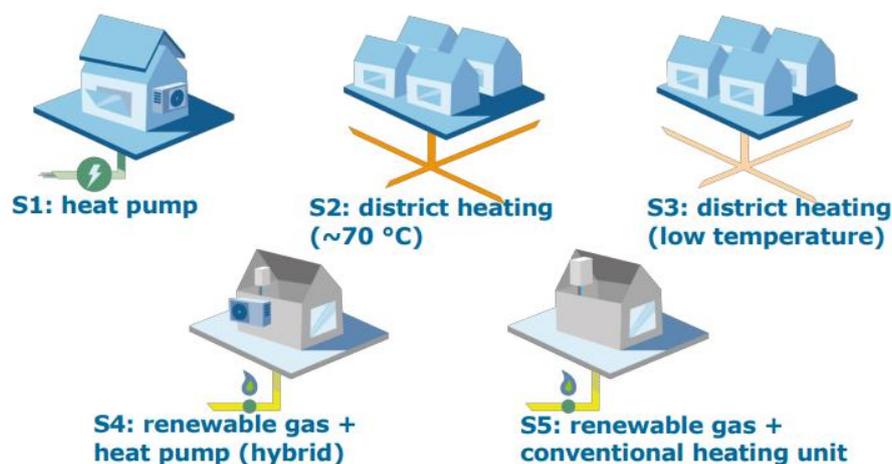


Figure 8. Strategies for the introduction of sustainable energy in the heating sector [2]

As it was mentioned before, the municipalities will play an important role on the diffusion of the DH networks. The new Heat Act 2.0 that is expected to go public in 2022, will define their role in a more specific way. It is expected that they will determine catchment area for district heating and then assign a DH company. However, the assigned heat supplier does not need to be a utility. It is equally possible for a large construction firm to form a consortium with heat suppliers

[8]. The crucial aspect of the new law is that the supplier will bear responsibility for security of supply, reducing CO2 emissions and affordable tariffs.

The DH companies will have the exclusive right and obligation to connect households and other buildings in the catchment area (Figure 9) to their network and will be obliged to provide every building in the catchment area with an offer to connect to the DH network. On the other hand, individual households can opt-out. The important condition of the DH network is that it must retain their costs, through tariff regulation. In addition, possible additional policy measures can be considered to ensure affordability for individual households. Lastly, the aim of the DH network is to reach the sustainability targets of every catchment area [8].

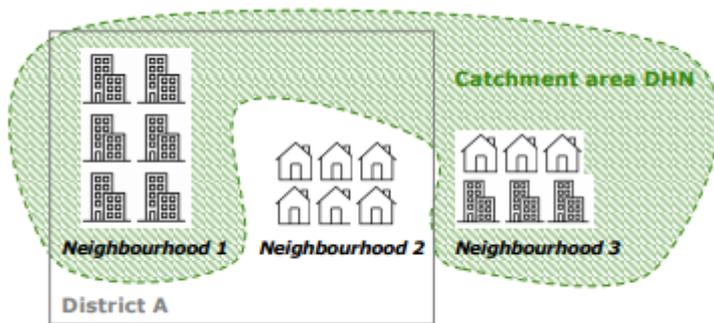


Figure 9. Catchment area defined by the municipalities [8]

The Dutch Gas Act (Gaswet) will also play an important role for ensuring the phase-out of the natural gas in the building environment and encouraging the diffusion of district heating solutions. As a result of the amendment that took place on the 1st July 2018, new buildings will in principle no longer be fitted with gas connections. The change in the law affects new buildings for which the building permit was requested on or after the 1st July 2018. The change applies to all small-scale users (<40 m³ gas/hour), such as homes and small commercial buildings. However, many plans for new housing were already in the pipeline. The parties believe that any projects already in preparation or projects with natural gas connections that have already been approved should preferably be adapted into natural gas-free new construction as much as possible, thus avoiding any additional social costs for the refitting of such houses in the future [2].

3 Incentive programmes and funding for the improvement of district heating systems

As it was mentioned in the previous chapter, the Netherlands aims to phase-out the use of natural gas in the energy market, and introduce renewable energy solutions, which will decrease the CO₂ emission. To achieve the transition targets, the new technologies must be supported to be competitive.

In the last year, one of the key policy measures considered by the government was the SDE+ scheme (de stimuleringsregeling duurzame energieproductie), which ended last tender round was in 2020. The support scheme was reserved for the company and organization of the energy production sector, to provide financial support based on the renewable energy they generated. During autumn 2020, the first tender round of the updated support scheme, called SDE++ was published. The difference with the previous support scheme is that technologies are evaluated based on the avoided tons of CO₂ emissions and not based on the energy produced. New tender rounds are expected in autumn 2021 and during the coming years. This support scheme is highly interesting for district heating companies that intend to phase out their gas boiler and introduce renewable heat sources. The main technologies categories interesting for the heating sector are [9]:

Renewable heat and CHP

- Biomass (fermentation and combustion)
- Composting mushroom compost
- Geothermal (deep and ultra-deep)
- Solar thermal energy

Low-carbon heat

- Aquathermal energy (recovered from surface water (TEO) and wastewater (TEA))
- Daylight greenhouses
- Electric boiler
- Geothermal (shallow)
- Waste heat
- Heat pump

Another form of incentive considered by the Dutch government is a tax reduction scheme, called Energy Investment Allowance (EIA), for companies that invest in CO₂ savings, energy-efficient and environmentally friendly technologies. The company can receive a tax deduction for clearly defined investments (specific) and for tailor-made investments (generic) that result in substantial energy savings. It is possible to deduct up to 45.5% of the investment costs from the taxable profit [10].

On the funding side, a “green financing” scheme can be applied to projects that introduce the latest technologies in terms of low environmental impact. In this case, the loan would have a lower interest than a normal loan [11].

A fundamental role for the funding possibilities is given by the European Investment Bank (EIB), which is financing sustainable projects of different district heating companies in the Netherlands, for a total amount up to €70 million. The financing is supported under the European Fund for Strategic Investments (EFSI), the main component of the European Commission’s Investment Plan for Europe [12].

4 Proposed action plan

The Climate Agreement covers many aspects that must be considered for the transition towards the implementation of renewable energy solutions in the Netherlands.

District heating is going to play a main role in the introduction of the sustainable solution in the built environment, and the following suggested actions can be considered to increase the possibilities of reaching the target. The solutions can be divided in three main areas, where the district heating is acting: production, distribution and end-use. Furthermore, a fourth area can be considered, which does not directly act on the district heating network but can incentivise its development. The proposed action plan can be considered by different actors that are involved or related to the heating sector, such as private or public companies and organizations, municipalities, and government.

4.1 Production

- Increase efficiency of the production side, by introducing modern CHP plants and large-scale heat pumps that exploit renewable heat sources.
- Introduction, development, and expansion of renewable sources such as biomass, solar thermal energy, geothermal energy, aquathermal energy and biogas. Photovoltaic systems and wind energy will also play an important role for increasing the penetration of renewable energy sources in the heating sectors, due to the larger use of electricity on the production side thanks to the use of heat pumps.
- Enhance energy flexibility on the production side by integrating the electricity grid in the heat production and introducing a larger share of thermal storage in the network.
- Larger use of waste heat as heat source from industry or new application such as from new hydrogen production plants or datacentres.

4.2 Distribution

- Reduction of losses in the distribution network by introducing a range of solutions to control and optimise the heat delivery. New digital tools can help the DH companies in lowering the temperatures in the network and achieving lower heat losses. Additionally, old network should be refurbished in case the insulation properties are deteriorated. Lastly, new and optimized substation can be considered to improve the networks.
- Optimisation and extension of the network must be considered to ensure the heat supply of the larger number of customers that will be connected and avoid bottlenecks in the network.

4.3 End-use

- The building renovation will have an important role on the introduction of renewable in the DH network. Refurbished buildings will require lower energy and at the same time allow to reduce the supply temperature delivered by the DH network.
- Through digitalisation and consumer empowerment, the final users are made aware of the energy use at their building, which can lead to a reduction of heat demand.

4.4 Regulatory framework, taxation, and legislation

- Reduction of heat consumption can be achieved by introducing new regulations that set a guide for building renovation which includes new solutions for the digitalization of the built environment, through smart metering and the use of apps.
- Increasing the awareness and acceptance of end-user can be achieved through campaigns on national, regional, or local level. Increasing awareness of professionals, e.g. installers and real estate developers can be done through education, as it was the

case in 2018 with the “Green Deal on heat pumps” which set to train 6000 heat pump technicians [13].

- Under the Climate Agreement, taxes on natural gas will increased stepwise (closing the gap between electricity – which has higher tax – and natural gas) which should support the business case for all kinds of measures both ‘no-regret’ and DHC systems.
- On the other hand, funding and support can be given to those technologies that need to be expanded.
- Heat planning/zoning should be considered on national, regional, and local level to define a better action for the transition towards a more sustainable heating sector. Furthermore, the heat mapping will also help in the decision-making process, so that it is possible to highlight the areas where it is more convenient to expand or introduce DH solutions.

5 Promotion of the action plan and recommendations

The document was shared with representatives of Energie-Nederland, who provided their comments and confirmed that the recommendations are generally in line with national policies and their own advocacy work.

For more information on the Dutch district heating in local language, please consult <https://www.warmtenettrendrapport.nl/>.

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