



# The natural gas phase-out in the Netherlands



*Committed to the Environment*

# The natural gas phase-out in the Netherlands

Delft, CE Delft, February 2022

Publication code: 22.210381.016

Climate / Agreement / Greenhouse gases / Carbon dioxide / Emissions / Natural gas / Consumption / Reduction / Buildings / Heating / Cooking / Policy / Measures  
FT: Phase out/ Overview / The Netherlands

This briefing is prepared by: Emma Koster, Katja Kruit, Marianne Teng, Florian Hesselink

## **CE Delft**

Committed to the Environment

CE Delft is helping build a sustainable world through its independent research and consultancy work. Our expertise is leading-edge in the fields of energy, transport and resources. We support government agencies, NGOs and industries in pursuit of structural change with our wealth of know-how on technologies, policies and economic issues. For 40 years, the skills and enthusiasm of CE Delft's staff have been focused on achieving this mission.



## Summary

This briefing describes the Dutch transition from natural-gas based heat towards carbon free heating by 2050. The briefing intends to support other jurisdictions in Europe and the USA to reduce greenhouse gas emissions from buildings, and it therefore has a strong focus on policy and the role and perspective of gas and electricity grid operators.

### Use of natural gas in the built environment is still strongly dominant

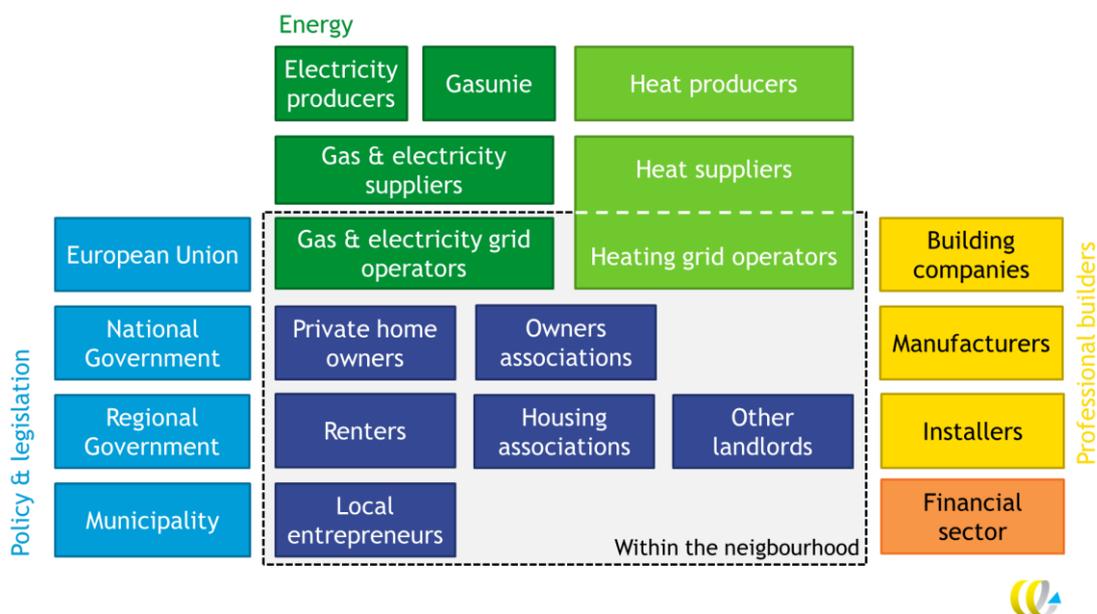
Phasing out the use of natural gas is necessary to meet the climate goals which follow from the Paris Climate Agreement. Over 90% of residential and commercial buildings currently use natural gas or fossil fuel oil for heating and cooking. Meeting the climate goals requires the implementation of new heating and cooking systems powered by renewable energy sources. Future alternatives for heating include electric heat pump, district heating and carbon-free gasses. These new technologies need to be complemented by building insulation to reduce energy consumption. To meet the transition goal, a major renovation of buildings, heating appliances and energy infrastructures is therefore warranted.

### Dutch approach focusses on affordability and feasibility

The Netherlands bases its approach on its 2019 Climate Agreement. The government creates its policies around two core principles: affordability and feasibility (Minister van Binnenlandse Zaken en Koninkrijksrelaties, 2021). The condition of affordability poses a significant challenge, as the financial benefits of natural-gas free housing often do not outweigh the costs as yet.

The feasibility aspect of the Dutch heat transition aims to ensure that the right conditions exist for all stakeholders to make the transition towards sustainable heating systems. The playing field of stakeholders is diverse, as can be seen in Figure 6. A feasible transition requires national and local governments to align the interests of these stakeholders with sustainability.

Figure 1 - Overview of main stakeholders in the local heat transition



Policy instruments in the transition towards sustainable heating include:

- regulation to enforce sustainable heating for new construction;
- energy performance of buildings: monitoring for all, regulations for office buildings and advice on dwellings;
- energy taxes on gas and electricity;
- district-oriented approach, where municipalities create local heating plans and run pilots;
- voluntary and binding agreements with housing associations; and
- subsidies and loans for sustainable heating

### **Role and perspective of grid operators**

Gas and electricity grid operators play a key role in the transition as their gas grids lose their purpose and their electricity grids need to accommodate higher peak demands. This briefing describes their perspective and role, focussing on the impact of the heat transition on their business operations, bottlenecks in policy and regulation, and the technological changes required by the transition. The main challenges are the significant amount of work they foresee in a tight labour market and the current tariff regulation that makes early depreciation of gas grids and investments in the additional capacity required for the electricity grid that is foreseen in the next decades difficult.

### **Possible future policy to accelerate the transition**

We conclude this briefing with a reflection, where we advise on future policy. From our perspective, future policy should include organising and accelerating the insulation of existing buildings, setting energy performance standards for heating appliances and taking steps towards decarbonising energy carriers.

# 1 Introduction

## 1.1 Background

Under the 2015 Paris Climate Agreement, 196 parties, including the Netherlands, committed to limiting global warming to well below 2 degrees Celsius by 2050. The European Union and many other entities, countries, states and municipalities henceforth set goals to reduce greenhouse gas (GHG) emissions by 85, 95 or 100% by 2050. Achieving these goals will require all sectors to adapt, including the built environment. Many residential and commercial buildings use natural gas or fuel oil for heating and will need to implement new heating systems powered by renewable energy sources.

In the 2019 Dutch Climate Agreement (*Klimaatakkoord*), the Dutch government expressed the goal of reducing climate emissions by 49% by 2030 compared to 1990 levels and by 95% by 2050. As Dutch buildings are mainly heated using natural gas, the Netherlands, too, will need to switch to renewable forms of heating. This process is referred to as the heat transition (Dutch: *warmtetransitie*).

## 1.2 Objective

In order to support other jurisdictions in Europe and the USA in reducing greenhouse gas emissions from buildings, the European Climate Foundation has requested CE Delft to develop a policy briefing. The aim of this briefing is to provide an overview of Dutch policies for the phase-out of natural gas in buildings, and more broadly, to provide inspiration and lessons to policymakers outside the Netherlands facing similar challenges.

## 1.3 Reading guide

Chapter 2 provides an overview of Dutch gas phase-out goals. In it, we describe which goals the Netherlands has set for the heat transition and how it intends to achieve them. Some further context describing the current situation and history is provided in this chapter.

The current approach used by the Netherlands to achieve a successful heat transition is described in Chapter 3. Here, we also introduce the most important stakeholders and describe the current set of policy measures being used. Recent developments involving the new government's coalition agreement are also summarised in this chapter.

In Chapter 4 we focus on gas and electricity system operators. Based on a set of interviews, we describe their role in the heat transition, their strategies, challenges and dilemmas. Finally, in Chapter 5 we reflect on the broader challenges facing the Dutch heat transition and potential solutions.

## 2 Dutch gas phase-out goals & progress

### 2.1 Dutch climate goals

Under the 2015 Paris Climate Agreement, 196 parties, including the Netherlands, committed to limiting global warming to well below 2 degrees Celsius by 2050. The European Union has translated this into the target of achieving climate neutrality by 2050 and an intermediate goal of a 55% reduction in emissions by 2030 compared to 1990 levels.

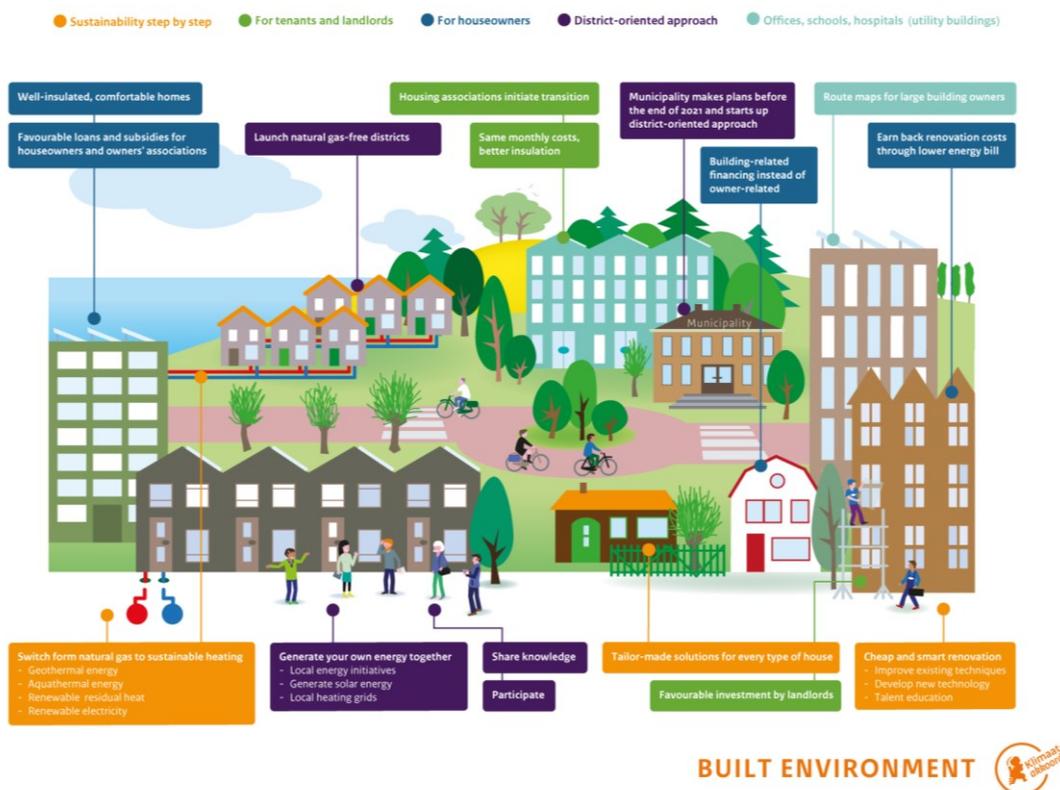
The Dutch goals are based on the Paris Climate Agreement. The Dutch government committed to a 49% reduction of greenhouse gases by 2030 and 95% reduction by 2050 in the Dutch Climate Agreement (Rijksoverheid, 2019a). This Agreement is the most important policy framework for climate change mitigation in the Netherlands. It was established through The Dutch goals are based on the Paris Climate Agreement. The Dutch government committed to a 49% reduction of greenhouse gases by 2030 and 95% reduction by 2050 in the Dutch Climate Agreement (Rijksoverheid, 2019a). This Agreement is the most important policy framework for climate change mitigation in the Netherlands. It was established during a process of consultation and negotiation between the government and societal stakeholders in 2018 and 2019 to implement the Paris Climate Agreement in the Netherlands. It contains emission reduction targets for all sectors, including the built environment, and describes which measures will lead to the emission reduction targets. The 2030 targets were in line with the EU targets at that time, but the new EU-wide emission targets require increasing the target level of the Dutch Climate Agreement.

#### Targets for the built environment

For the built environment, the Dutch Climate Agreement aims to phase out natural gas for heating and increase the energy performance of buildings. All dwellings and other buildings should be heated without natural gas by 2050. An intermediate goal is also defined for 2030. By that year, 1.5 million of the almost 8 million dwellings in the Netherlands should be heated without natural gas. Policy choices for alternative heating steer towards the lowest cost alternatives as much as possible (Rijksoverheid, 2019b). An overview of the Dutch Climate Agreement for the built environment is given in Figure 2.

Institutional and political support for the phase-out of natural gas is not exclusively based on the Paris Climate Agreement. In 2012, natural gas extraction was identified to be the cause of earthquakes in the north of the country. The earthquakes and the resulting damage to homes have increased public support for the phase-out of natural gas. Through public pressure, production was reduced from 2018 onwards. For the first time in its history, this has made the Netherlands a net importer of natural gas since 2018 (CBS, 2019a).

Figure 2 - An overview of the Dutch Climate Agreement for the built environment



Source: (Rijksoverheid, ongoing).

## 2.2 What needs to happen?

### Current energy provision in the built environment

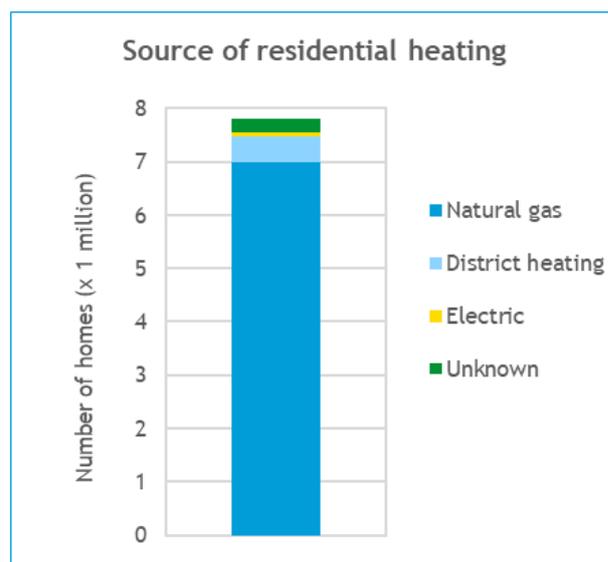
The Netherlands has approximately 17.4 million inhabitants and is densely populated (500 residents per km<sup>2</sup> or 1,300 per mi<sup>2</sup>), with most people living in the western parts of the country (CBS, 2021c). There are 8 million residential buildings and 1 million non-residential buildings. Although the country is very urbanized, more than 80% of homes are single-family residences, of which about half are terraced houses (CBS, 2016). In contrast, about 20% of homes are free-standing, and about 15% are apartments. Most of these buildings were constructed between 1965 and 1984.

Situated along the North Sea, the Netherlands has a maritime climate (KNMI, 2020). As a result, both winters and summers are relatively mild. Over the period 1991-2020, the average low in January was 0.9°C (33.6°F), the average high in July was 23.1°C (73.6°F). Further information about the climate is available in Appendix A.

Natural gas is the most important energy carrier in the Dutch energy system. Most buildings use gas boilers for heating, and buildings connected to district heating are primarily powered using natural gas. Over half of electricity production uses natural gas too (for more information on electricity production, see Appendix 0). This dependency is attributable to the presence of a very large natural gas field in the north of the Netherlands. The country's energy system has developed around natural gas since its discovery in the 1960s.

As shown in Figure 3, over 90% of homes in the Netherlands use natural gas for heating and cooking. Approximately 6% are connected to district heating (with natural gas and/or renewable energy sources), 1% use hybrid or fully electric heating, such as heat pumps and the remaining 3% are unknown (CBS, 2021a). It is not known how many homes have a cooling system, but estimations lie between 2 and 11% of homes. The general expectancy is that the number of homes with a cooling system will increase, but by how much is very uncertain (W/E Adviseurs, 2018).

Figure 3 - Energy carriers for residential heating in the Netherlands



Source: CBS, (2021a).

The average home uses 1,180 m<sup>3</sup> (41,700 ft<sup>3</sup>) of gas<sup>1</sup> per year (CBS, 2021d). One-fifth of residential buildings were built before 1945 and are often poorly insulated and lack cavity walls which makes insulation challenging. The energy performance of buildings is expressed as an energy label, which is a letter between G and A++++. The energy label is based on the fossil energy use in kWh/m<sup>2</sup>/yr. Energy labels are required for all homes that are being built, sold or rented. As of January 2020, approximately 50% of homes had an energy label, of which almost 40% have the best-performing Label A or B (Rijksoverheid, 2020a). As all newly built homes have energy labels, the national share of well-insulated homes is expected to be lower.

## Steps to reach the climate goals for the built environment

The targets in the Dutch Climate Agreement are to make 1.5 million existing houses and non-residential buildings sustainable by 2030 (~20% of the total number) and the complete phase-out of natural gas by 2050. This means transitioning 150,000 existing buildings per year from natural gas heating to alternative energy carriers and infrastructure, in other words, 'natural gas-free' (*aardgasvrij*).

<sup>1</sup> The Netherlands uses low-calorific gas, containing 82% methane.

In order to reach a zero-emission built environment, three areas need to be targeted:

1. Reducing energy demand through renovation (insulation) of existing buildings.
2. Switching to electric and district heating appliances and infrastructure (for a large fraction of the building stock).
3. Decarbonising energy carriers.

#### Text box 1 - Parallels with the transition from coal to natural gas

The Netherlands previously had a heat transition just over half a century ago. Before the 1960s, homes were heated using coal. With the discovery of a large natural gas reservoir, the Netherlands build a nation-wide gas grid within two decades. The phase-out of natural gas for heating means that the Netherlands faces another major revision of the energy system. The two transitions are alike, but differ on several points.

The introduction of natural gas gave households a cleaner, safer way of heating. The supply of the fuel through underground infrastructure was also far more beneficial. The advantages for a household from the phase out of natural gas, however, are far less profound. This makes this transition harder to sell. Also, citizens have become more critical in recent decades and are less likely to follow government advice. Still, the past achievements are an inspiration for the current transition.

One lesson we can take from the transition to natural gas is attention to employment opportunities and the local economy in areas that produce or manufacture natural gas. With the closure of coal mines, mining communities impoverished. The local economy in Groningen, which is the location of the gas reservoir, is the focus of public debate.

## Options for future gas-free heating in the Netherlands

Although the current energy provision for buildings is quite homogeneous, as 90% are heated with natural gas, future alternatives for renewable, natural-gas-free heating are much more diverse. Alternative heating systems can be categorised based on the energy carrier.

- Electric heat pumps. Switching to a heat pump<sup>2</sup> requires a certain minimal insulation level<sup>3</sup>. In some cases, the electricity grid needs to be reinforced. In many neighbourhoods, the electricity grid capacity is currently not sufficient to provide the necessary loads (for heat pumps, but also for rooftop solar and EV charging).
- District heating systems based on waste heat, geothermal and low-temperature ambient heat. About 6% of Dutch households already heat using district heating. Most of the existing district heating systems supply high temperatures (90°C, or 194 F). They generally have a natural gas-based peak provision. Future heating grids are expected to supply lower temperatures and a sustainable peak provision, such as a thermal buffers or electric heat pumps. Homes connected to low temperature district heating need better insulation than they would with high temperature heating. Better insulation reduces peak demand during morning hours as homes lose less heat during the night. This greatly reduces the required heating grid capacity.
- Carbon-free gas (biogas/green gas, hydrogen). Renewable, carbon-free gas can heat homes using boilers or hybrid heat pumps. Hybrid heat pumps use electricity for heating most of the time, but for very cold days and warm tap water it uses a built-in boiler for

<sup>2</sup> Regular electric heating is not preferred, both due to higher monthly electricity consumption (and thus energy bills) and high net capacity.

<sup>3</sup> A heating demand of 50 kWh/m<sup>2</sup> is considered to be adequate for low-temperature heating solutions such as most heat pumps (Merosch, 2020). Furthermore, Dutch governmental organisations have worked with industry partners to establish 'Insulation Standards' for existing homes so as to be 'ready' to become natural gas-free (RVO, 2021c).



additional capacity. Gases offer a low-investment option for households as they offer high temperatures and thus the current radiators and insulation level often suffice. However, the availability and affordability of carbon-free gases for the built environment is uncertain as other sectors such as industry and mobility have a competing interest.

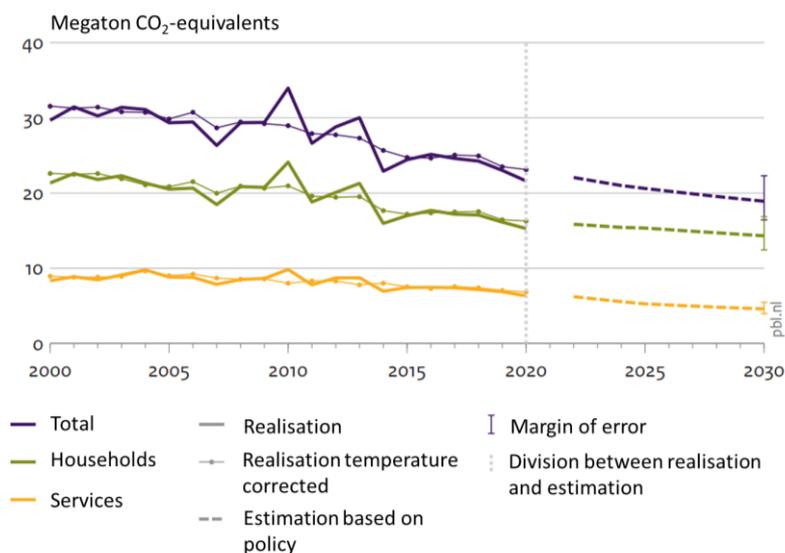
Which type of heating system is the best fit for which building depends on many factors, including energy performance (insulation level), building type, building density and available heat sources. Cost and feasibility studies indicate that in most scenarios a combination of systems will have the lowest overall costs. No one system is therefore expected to become dominant in the future. In the short and medium term, the potential for the feed-in of renewable gas with the natural gas mix is limited. In the past, national policy has therefore mainly focussed on developing all-electric and district heating alternatives. More recently, hybrid heat pump/convection boiler systems have become a focus as a short to medium-term solution to reduce emissions. An obligation for energy companies to blend natural gas with renewable gas is currently being developed, although the availability of renewable gas is currently limited.

### 2.3 Progress towards gas phase-out and climate goals

PBL, the Netherlands Environmental Assessment Agency, publishes an annual Climate and Energy Outlook (PBL, 2021). The Dutch Climate Agreement sets an emission target for the built environment of 15.3 million metric tonnes (Mton) CO<sub>2</sub> equivalents by 2030. PBL estimates the 2030 emissions in this sector will be 18.9 Mton. It is likely, therefore, that the reduction target will not be met. This estimate is based on autonomous trends and current as well as planned policies.

Figure 4 shows that greenhouse gas emissions of households and services have decreased over the past two decades by 27%. The majority of greenhouse gas emissions of Dutch households and services are caused by heating with natural gas. The decrease in emissions is thus largely attributable to a decrease in household use of natural gas. This relationship is shown in Figure 5.

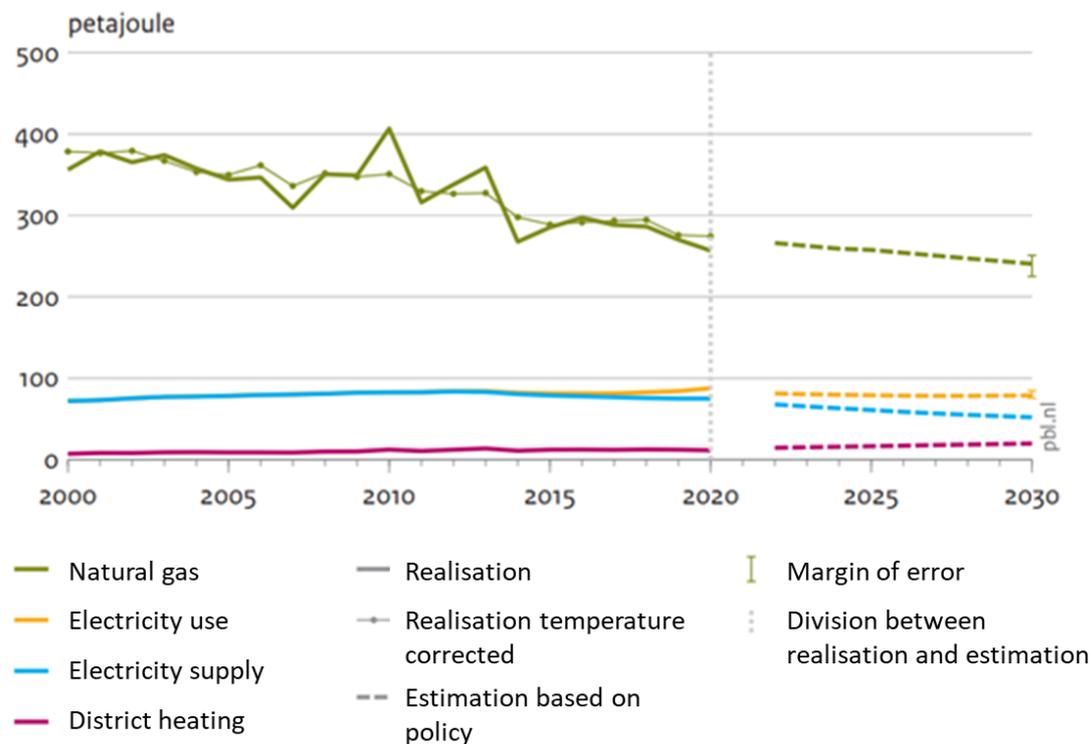
Figure 4 - Greenhouse gas emissions in the built environment



Source: PBL, (2021).



Figure 5 - Final energy use of households in the Netherlands

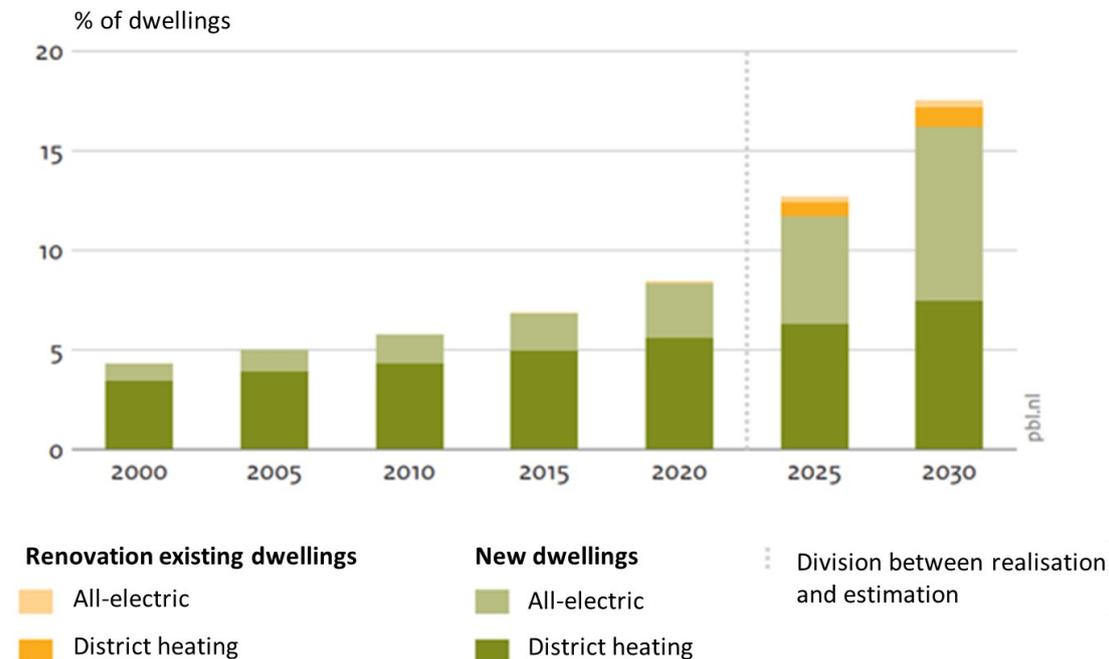


Source: PBL, (2021).

The decrease in gas consumption has several causes. The most significant are the insulation of homes and the increasing efficiency of heating systems and other appliances. Another noticeable trend is that less gas is being used for cooking, with alternatives like induction stoves and electric ovens becoming more prevalent. In 2020, 83% of the stoves purchased were electric (Natuur & Milieu, 2021). Finally, the increase in temperatures due to climate change reduces the demand for gas. According to PBL, 10% of the estimated gas-use reduction between 2000 and 2030 is attributable to this effect.

Figure 6 shows that the percentage of gas-free buildings has increased over the past two decades. This increase is mostly due to new buildings being built gas-free – not because a significant number of buildings are being retrofitted (PBL, 2021).

Figure 6 - The percentage of dwellings that are gas-free and their heating system



Source: PBL, (2021).

Current progress is primarily being driven by the construction of new gas-free dwellings. The pace at which existing dwellings are renovated is not high enough to ensure that the 2030 targets for the built environment will be met. The effects of the approach described in the next chapter are therefore carefully being monitored, and additional measures are expected to be put in place.

## 3 Dutch approach

This chapter describes the Dutch approach to the transition to a ‘natural gas-free’ built environment which was introduced through the Dutch Climate Agreement. We describe the main stakeholders and their roles in the process. We then describe the policy instruments being used and proposed, and the results they have delivered.

### Core principle

The policy of the Dutch government is based on the two core principles that the heat transition must be affordable and feasible (Minister van Binnenlandse Zaken en Koninkrijksrelaties, 2021). Arguably the most important overall condition is affordability. The Climate Agreement states that the transition should be ‘living-cost neutral’ for households. This means that a household’s total energy costs (including discounted investments) for a sustainable alternative should not be higher than the costs of using natural gas. This condition poses a significant challenge, as the financial benefits of natural-gas free housing often do not outweigh the costs as yet, and not all external costs are currently internalised.

An important part of affordability is that the heat transition should not exacerbate energy poverty. Currently, large investments are needed for natural gas-free heating, which can result in higher annual costs for households (financing the investments, maintenance plus energy costs). It remains to be seen if innovation and scale size will reduce the costs enough to make the heat transition ‘cost neutral’. A number of households already struggle to pay their energy bills. Natural gas-free heating should, according to this principle, be accessible for everybody and should not result in an increase in poverty.

#### Text box 2 - Energy poverty in the Netherlands

Although the Netherlands has one of the lowest rates of poverty in Europe (CBS, 2019b), recent sharp increases in energy prices have spurred increased attention to energy poverty. 8.8% of Dutch households spend over 8% of their income on energy bills and for 5.5% of households, their net income is insufficient to meet fuel costs after minimum living costs and housing costs have been met (CE Delft, 2021).

Energy poverty is most prevalent in social housing, but also occurs in privately rented and owner-occupied homes. Owner-occupants in energy poverty face additional challenges as they usually do not have the financial means to invest in sustainability measures such as insulation and gas-free heating.

The feasibility principle of the Dutch heat transition aims to ensure that the right conditions exist for all stakeholders to move to sustainable heating systems. In order to be feasible, the government needs to align existing legislation with fiscal policy to stimulate sustainable alternatives.

### 3.1 Stakeholders in the heat transition

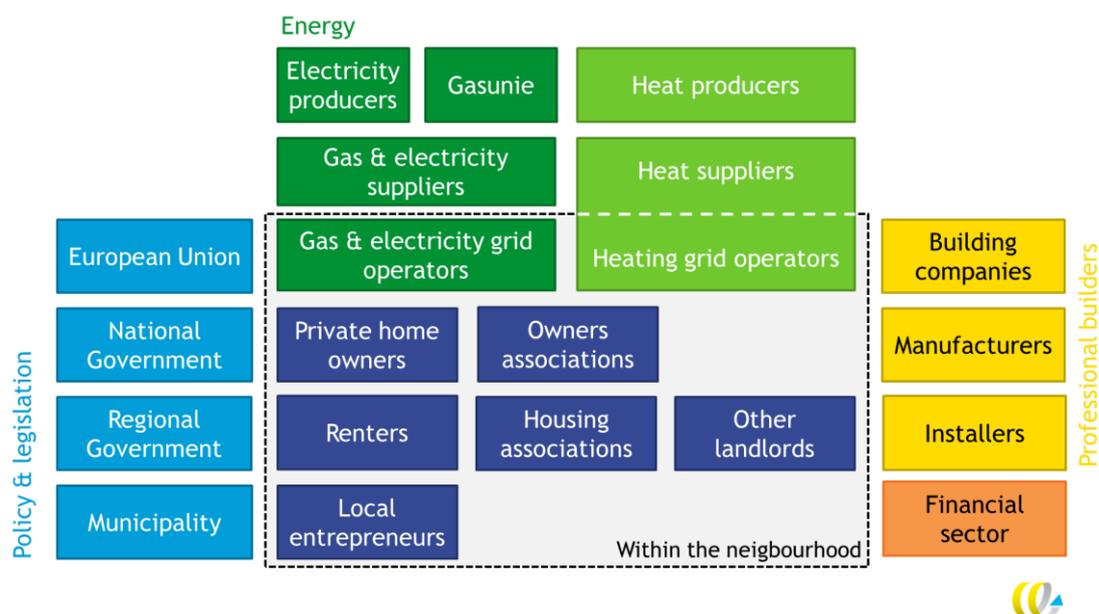
The local heat transition requires coordination between a large number of different stakeholders. Figure 7 provides an overview of the most important stakeholders in the Netherlands. The physical changes required for the heat transition are mostly in residential neighbourhoods. It requires investments and new habits in the homes of Dutch citizens, company buildings of entrepreneurs and the energy distribution and transmission grids. Neighbourhoods are therefore at the centre of the overview.



Electricity, heat and renewable gases will replace natural gas in neighbourhoods. This implies major changes in the energy sector, which are shown at the top. Grid operator companies and energy supply companies are separate entities. The Dutch Energy Act regulates the responsibilities and permitted activities of grid operators as they have a monopoly in their region. Renewable gases might become an alternative business model for energy companies, but their exact positioning in the energy landscape is still to be determined.

National and local governments legislate, subsidise and oversee the transition, as shown on the left. The professional builders, shown on the right, will make the physical changes. Builders are rarely part of the debate on energy transition, but many buildings will have to be renovated and infrastructure will have to be changed to make it happen. The capacity of builders is, however, limited and the current shortage of building materials limits the pace of the transition. Finally, the figure shows the financial sector, which is essential to finance the transition.

Figure 7 - Overview of main stakeholders in the local heat transition



### 3.2 Policy measures

A number of policy measures can be identified that significantly contributed to progress in the gas phase-out. Broadly speaking there are five categories of measures:

- Regulation: minimum energy requirements for new construction and, to a lesser extent, existing buildings.
- Pricing: taxation of energy use.
- District-oriented approach with municipalities taking the lead.
- Voluntary and binding agreements with housing associations.
- Incentivisation of consumers through positive price signals, such as subsidies and loans.

## Regulation: Requirements for new construction

Since July 2018, all new construction has to be built without a gas connection (Ministerie van BZK & Ministerie EZK, 2018). This was enacted by a change in the Gas Act (*Gaswet*). While electricity and gas grid operators were previously obliged to connect all consumers to the grid, in 2018 gas DSOs (Distribution System Operators) were prohibited from connecting new construction, with some exceptions (Ministerie van BZK & Ministerie EZK, 2018). In 2019, 70-80% of new homes were built without a gas connection; in 2020, this was 87% (Netbeheer Nederland, 2021).

Of the several hundred thousand dwellings that are currently gas-free, only a few thousand are existing homes that have made the transition from heating with natural gas to district heating or an all-electric heat pump. Almost all homes that are currently gas-free, are relatively new homes that were gas-free from the moment they were built. From this we can conclude that the requirement for new homes to be gas-free is an important and effective step to increase the number of gas-free homes and avoid issues in the future.

Since January 2021, all new construction must meet the NZEB (Nearly Zero Energy Buildings) requirements. These requirements were legislated through the European Energy Performance of Buildings Directive (EPBD). The NZEB requirements define strict maximum values for energy demand & primary fossil energy consumption, as well as a minimum percentage of renewable energy use. The exact values vary, based on the type of building and its compactness. The exact requirements were defined in partnership with the construction industry.

## Regulation: Energy performance of buildings

A system of applying energy labels to buildings has been used in the EU since 2002. These labels, ranging from G (worst-performing) to A (best-performing) indicate how energy efficient buildings are. Attributes such as fossil energy use and renewable energy production are also attributes used in determining the label of a building.

All existing office buildings are required to have energy Label C by 2023, which translates into a maximum total energy use of 225 kWh/m<sup>2</sup> (20.9 kWh/ft<sup>2</sup>) per year. Furthermore, a predecessor of the Climate Agreement states the portfolio of homes owned by housing associations should have an average energy Label B by 2021. This is generally considered to be sufficient for heating with a heat pump. This means a portion of these homes will be sufficiently insulated for gas-free heating ('gas-free-ready'), but others will still need additional insulation.

Existing privately-owned homes currently have no energy performance requirements. There are, however, guidelines which inform homeowners which insulation level is regarded to be futureproof in switching away from natural gas. These levels were developed in 2021 in a follow-up to the Climate Agreement and are referred to as the 'Insulation Standard'. The recommended insulation levels should ensure that heating with a temperature of 50°C is possible in homes built after 1945 and 70°C in homes built before 1945. While these guidelines are currently only a communication instrument, the introduction of more binding instruments is under consideration (Ministerie van BZK, 2021).

## Pricing: Energy tax

The Dutch energy taxation rates are used as an instrument to incentivise energy savings. Gas and electricity have separate tax rates and both taxation systems have five tax brackets based on the amount of energy users consume. Low-volume consumers (households and low-volume commercial customers) pay higher rates than high-volume users, such as industry and horticulture.

In the Climate Agreement, it was decided to increase the rate for gas incrementally between 2020 and 2026 by € 0.10 per m<sup>3</sup> (€ 3.00 per MMBTU) in total, while decreasing the tax on electricity (Rijksoverheid, 2019a) by € 0.05 per kWh. For an average household, this results in a € 124 increase in gas taxes and a € 137 reduction in electricity taxes annually by 2026. In this way, households and businesses are incentivised to move away from natural gas.

In a study of the effectiveness of Dutch energy taxation, it was concluded that taxes are effective in energy saving for households and low-volume commercial consumers (CE Delft & Ecorys, 2021). It is estimated that total gas consumption would be about 9% higher if there were no energy tax. Taxation is less effective for high-volume consumers due to the lower tax rates.

Energy tax based on the quantity of energy incentivises energy efficiency. GHG reduction can however also be achieved by a switch in energy carriers, for example from fossil gas to biogas or renewable electricity. This could be incentivised through a CO<sub>2</sub>-based tax, which was introduced in 2021 for industry but not for other sectors. An alternative way to put a price on CO<sub>2</sub> has recently been proposed by the European Union: an Emission Trading System for Buildings and Road Transport (ETS-BRT). Similarly to the existing ETS for industry and energy generation, this scheme would impose a cap on carbon emissions from buildings and road transport. This would lead to a price increase in carbon-emitting energy carriers.

### *District-oriented approach with municipalities taking the lead*

The phase-out of natural gas in existing buildings is built around what is called a district-oriented approach. In this approach, municipalities take the lead in the heat transition.

## Programme for Natural Gas-free Districts

A national programme (PAW, Programme for Natural Gas-Free Districts) was created in 2018 to support the first districts that make the transition towards natural gas-free heating. Through this programme, municipalities can apply for additional funds to support the transition. Additionally, municipalities can apply their general instruments, i.e. provide funds themselves, receive extra funds from the national government or issue loans with favourable conditions for energy efficiency measures.

Besides a funding scheme, the PAW has played a key role in gaining experience for coordinating large-scale building renovations. In this way, practical barriers to going gas-free (such as legal, financial, organisational, capacity-related issues) are identified, lessons learned can be shared and signalled to the national government. The evaluation of the scheme concludes that municipalities did learn a lot about the complexity of the task, which they will take with them in future projects (KWINK & Rebel, 2020). The evaluation identified several improvement points for the learning aspect of the programme. In the future, regional governments will provide more support to smaller municipalities to ensure higher success rates.



So far, the progress made by the PAW in realising natural gas-free houses is lagging behind schedule. It has not led to the expected results in terms of number of homes switching to sustainable heating. The progress report of the PAW states that this is due to the gas phase-out in a neighbourhood being technically, organisationally and financially more complex than initially thought (PAW, 2021).

## Local heating plans

On the basis of the Dutch Climate Agreement, municipalities are obliged to develop a vision of the local heat transition (*'Transitievisie Warmte'* or TVW). In this document, the municipalities, together with stakeholders such as district heating companies, housing corporations and utility companies, develop an indicative time path for realising alternative (natural gas-free) heating, neighbourhood by neighbourhood. For those neighbourhoods where the gas phase-out will take place before 2030, the municipalities indicate the most suitable alternative to gas. From the beginning of 2020 onwards, each municipality was obliged to prepare and submit such a plan before January 1<sup>st</sup> 2022.

After these local heating visions, municipalities are obliged to develop individual neighbourhood execution plans (*'Wijkuitvoeringsplannen'* or WUP), in which they commit to a timeline and heating technology. Citizen participation is widely regarded as an important part of the execution plans.

In both the local heating visions and the neighbourhood execution plans, the technical alternatives must be based on the lowest cost (according to the affordability principle). Different parties, including the Netherlands Environmental Assessment Agency (PBL), have developed projections of lowest-cost scenarios based on modelling of the built environment.

The calculations of PBL result in a natural gas free technique with the lowest total cost for each neighbourhood (an area with on average around 600 houses). Figure 8 shows the distribution of techniques for all buildings in the Netherlands according to the lowest-cost scenario modelling. In the results, slightly more than a third of the buildings will be heated by electric heat pumps, slightly more than a third are expected to be served by district heating and roughly a quarter of the buildings are expected to be heated with biogas. Figure 9 shows the results on the map of the Netherlands. According to these results, it is most cost effective to use biogas and heat pumps in more rural areas and to use district heating in the urban areas.

Figure 8 - The results of the lowest-cost scenario bases modelling of the built environment by PBL; shares of heating techniques for buildings

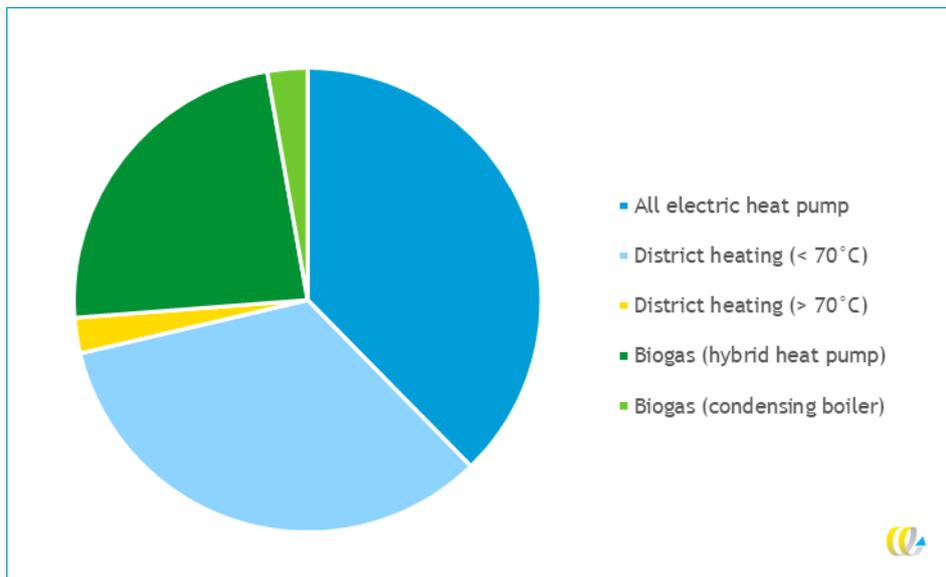
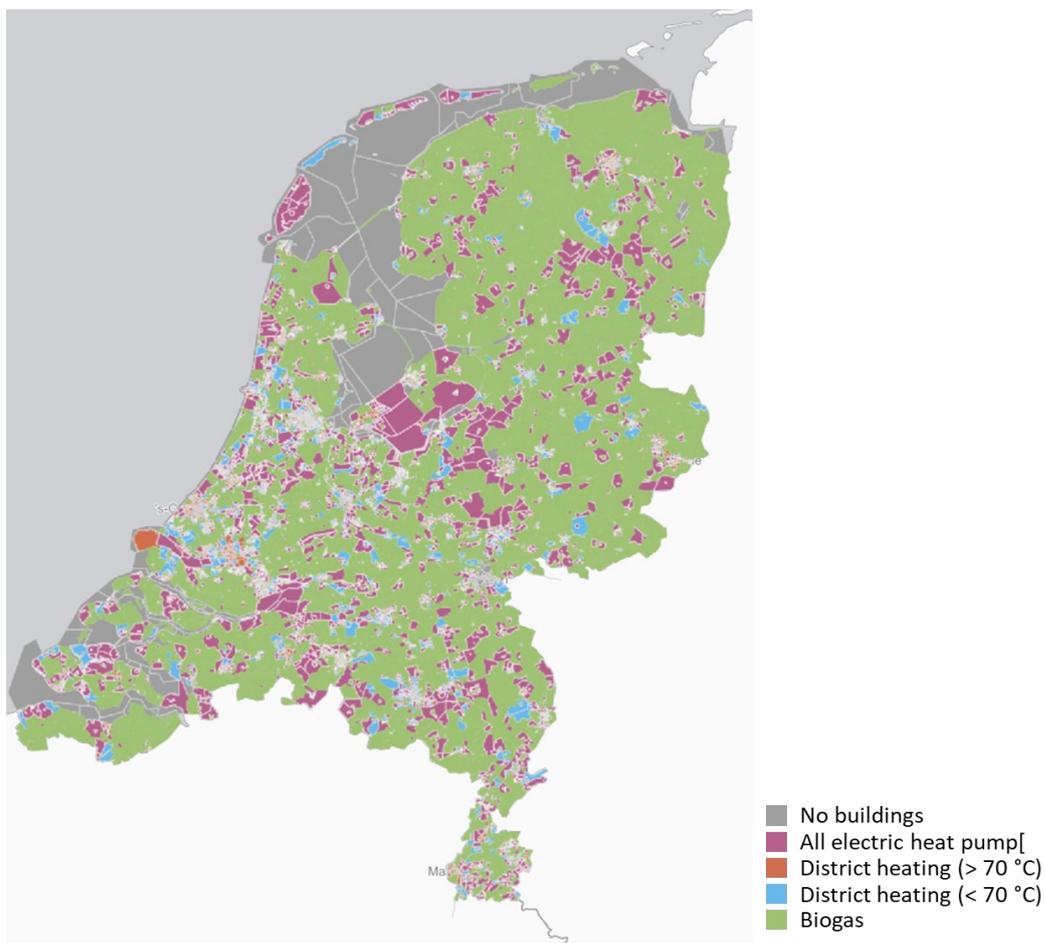


Figure 9 - The results of the lowest-cost scenario bases modelling of the built environment by PBL; geographical distribution of techniques



## Municipalities lack policy instruments for implementation

Municipalities are instructed to play a key role in creating a sustainable built environment and are obliged to contribute to various processes under the Dutch Climate Agreement. In the years following the Climate Agreement, municipalities have expressed concerns with regards to the feasibility of various programmes. They currently lack some of the policy instruments that are necessary to renovate the built environment to be gas-free at the nationally decreed pace. Not only are the financial and human resources of municipalities strained, but in many cases they lack the power to oblige parties to take action. Heating plans, for example, are currently not legally binding documents and the municipality does not have the ability to force residents to change their heating system. Furthermore, municipalities need financial instruments to ensure the affordability of the transition. Finally, the role and legal position of municipalities in the development and exploitation operation of heating grids needs to be decided upon. To this end, an improved Heating Supply Act (*Warmtewet*) is being developed.

Municipalities currently do the following: create the previously discussed local heating plans and neighbourhood implementation plans, take part in the PAW, as well as maintaining a platform that provides information and advice to private homeowners on how to take energy efficiency measures. They can provide subsidies and loans to private homeowners and make agreements with housing associations. Municipalities furthermore are responsible for organising the development of district heating systems. They bring stakeholders together, or set requirements for the sustainability of the heat sources or heating companies. Occasionally, municipalities take a more hands-on facilitating role, for example by (partly) guaranteeing sustainable investments to offset financial risks.

### *Voluntary and binding agreements with housing associations*

Housing associations are private non-profit organisations which develop, maintain and rent out social housing units. There are about 300 housing associations in the Netherlands, which mostly operate at the local level. Together, they own about 2.4 million of in total 7.9 million (30%) residential dwellings. For low income households the rent is capped. Although housing associations are technically private organisations, they fulfil a mostly public function by providing affordable housing to citizens with lower incomes (*Werk aan Wonen*, ongoing). Because they fulfil a public function, the government has designated housing association-owned real-estate as a ‘Start Motor’ for becoming natural gas-free: they are expected to be ‘early adopters’ and provide much of the renovation progress in the coming decade. The Start Motor framework agreement between associations and government (based on the Climate Agreement) stipulates that by 2022, 100,000 units will either be natural gas-free or sufficiently insulated to switch to natural gas-free heating (i.e. ‘gas-free-ready’), over half of which will be connected to district heating. Although housing associations are more organized than conventional homeowners, the complexity of renovating the housing stock through this Start Motor remains high. Housing associations experience a significant organizational challenge because many apartment complexes and terraced streets that were originally built by them are no longer fully association-owned. Large-scale insulation programs or collective heating systems often require near-100% participation to be financially viable or even technically feasible.

Housing associations cannot simply increase rents to invest in sustainability because the maximum base rent is regulated by law. The energy performance restitution (*energieprestatievergoeding*, or EPV) is an important mechanism for housing corporations to invest in reducing energy demand/fossil free energy supply. The EPV is an additional charge which housing associations can levy on their renters based on the net heating demand per square meter (RVO, 2021a). The EPV can generally not be levied for single insulation measures,



since the criteria for this net heating demand is high. The surcharge can generally be added after a deep building retrofit or for newly built Net Zero Energy Buildings (NZEBs). Renters are - in part - compensated for this extra fee through a lowered monthly energy bill (which is not regulated by law). The mechanism is not specifically designed to have a cost-neutral effect for tenants. Instead, it focuses on improving the business case for housing associations.

Local governments are highly influential with regard to social housing, they are involved in public planning and work together with housing associations extensively. Because of a mutual dependency, housing associations agree to performance agreements with municipalities. These agreements cover topics such as quality, affordability and sustainability. Sustainability goals are generally subdivided into four 'tracks'. These are insulation, energy savings through behavioural changes, energy generation using solar panels and disconnecting homes from the natural gas grid. Such goals might focus on a percentage change in energetic performance within a four-year period. Monitoring of these agreements is mostly done by the associations themselves, and failure to meet targets does not usually result in formal penalties. In practice, the majority of housing associations are motivated to agree to and act upon performance agreements.

Performance agreements or covenants have also been negotiated between the sector association Aedes and the national government. In 2012 the housing authority sector agreed to a covenant aiming to realise an average energy Label B by 2020. The sector failed to meet this goal but is on track for meeting it in 2021 (Aedes, -). In addition to the average-label-B goal, the sector agreed to convert 80% of its buildings to energy Label C or better by 2020, thus further reducing the number of poorly insulated dwellings. As a result, the social housing sector is much further along in energy transition than the private renting sector and home owners (MinBZK et al., 2012).

### *Incentivisation: Subsidies and loans*

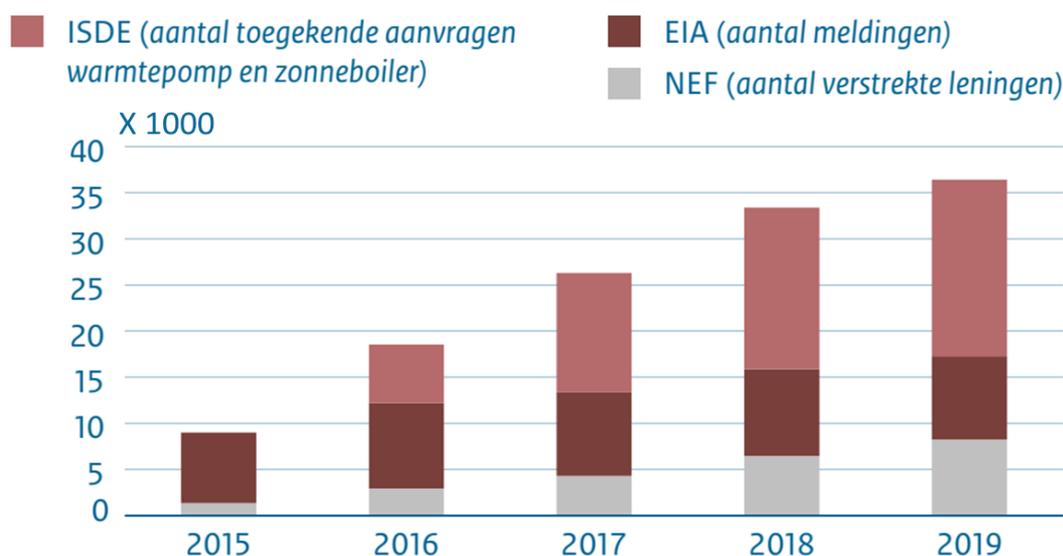
The national government prevails upon building owners through various subsidy schemes and access to favourable green loans. These instruments are tailored to the various ownership situations: private homeowners, renters/landlords and housing associations have access to some different schemes.

The most important scheme is the ISDE (Investment Subsidy Sustainable energy and Energy savings), which provides funds for the purchase of a heat pump/contributes towards connections to a district heating network or the installation of building insulation. The ISDE subsidy covers roughly 20% of the total investment costs. The total amount that is available for this scheme is capped annually. This fund is (almost) always empty at the end of the year (RVO, 2021b). Between 2016 and 2018, the ISDE provided 215 million euros and contributed to the purchase of 114,000 heating appliances, such as heat pumps, solar water heaters and pellet boilers (EZK, 2019).

Another financial support instrument is the 'Warmtefonds', a loan for private homeowners and schools. In 2022, private homeowners can borrow up to € 65,000 at an interest rate below 2% to finance measures like solar panels, insulation, connecting to a heating grid or energy monitor.

The Climate Policy Monitor (Rijksoverheid, 2020b) shows to what extent homeowners and owners of commercial buildings make use of the subsidies and loans provided by the Dutch government. The number of applications for subsidies and loans that were granted increased by 300% between 2015 and 2019 (see Figure 10).

Figure 10 - The number of applications for subsidies. The number of applications for the ISDE subsidy (light red) for heat pumps and solar water heaters has significantly increased since 2016<sup>4</sup>



Source: Rijksoverheid, (2020b)

In the years following the Climate Agreement, subsidies and loans were the most prominent policies used to stimulate the gas phase-out among private homeowners. These policies did not have an explicit quantitative target with regard to energy savings or the number of gas-free buildings realised (CE Delft, 2022). However, since the CO<sub>2</sub>-reduction is still lagging behind, it can be concluded that the combined effect of the policies is still insufficient.

### Reflection on core principles: affordability and feasibility

As stated at the beginning of this chapter, the national government formulated two core principles for the Dutch heat transition: affordability and feasibility. The policies implemented following the Climate Agreement adhere to these principles in the following ways:

- Binding regulations are avoided in order to allow households the freedom to invest only if they have sufficient means. The requirement for new construction to be gas-free is no exception, as the gas-free provision does not impose significant cost increases for new homes.
- Energy tax increases have so far been accompanied by an increase in the fixed energy tax relief in order to keep average energy bills constant.
- Municipalities are encouraged to develop local heating plans in close consultation and collaboration with stakeholders and citizens in order to ensure the feasibility of the plans.
- Agreements with housing associations are made after extensive negotiations so that the agreements are affordable and feasible for the housing associations.

<sup>4</sup> Furthermore the graph indicates in dark red the number of reports of use of tax reductions for companies that invest sustainable energy usage and in grey the number of loans provided by the national energy reduction fund.

- A revised Heating Supply Act is being developed that aims to improve the business case for district heating for more neighbourhoods, while ensuring tariffs are both fair and cost-covering.

### 3.3 Recent developments

The Dutch Climate Agreement has been in effect since 2019, and in the past two years a diverse set of policy measures (as described in the previous section) has have been implemented. As was noted in Paragraph 2.3, the progress so far does not indicate that the 2030 goals for the built environment will be met. Additional measures will therefore be necessary. The new Dutch cabinet presented a coalition agreement on December 15<sup>th</sup>, 2021 (Kabinetsformatie, 2021). This agreement proposes additional policy interventions that aim to increase the pace of emission reductions in the sector. The suggested interventions are especially relevant since they aim to address some key problematic areas that currently represent important barriers. These barriers specifically are: cost, lack of skilled staff and not enough focus on insulation and hybrid heat pumps.

The coalition agreement suggests the following additional policy measures:

- Organising large-scale insulation efforts through a ‘national insulation programme’.
- Requiring and incentivising renters and private homeowners who live in poorly insulated houses to insulate.
- Requiring heating installation suppliers to install an increasing number of (hybrid) heat pumps when replacing existing condensation boilers.
- Requiring energy companies to blend green gas with natural gas to a minimum percentage.
- Creation of an educational programme that aims to increase the availability of technical staff.
- Creation of a large fund that provides subsidies for insulation, (hybrid) heat pumps, district heating and other interventions.
- Subsidising currently unprofitable district heating network business cases.

Although not yet part of official government policy, the addition of these measures to existing policy will likely accelerate the move away from natural gas-heating and towards a sustainable built environment.

## 4 Perspective of gas & electricity grid operators

This chapter describes the perspective of gas and electricity grid operators on the phase-out of natural gas. The chapter is based on three interviews we conducted. We interviewed Gasunie, the national operator of the transmission systems of gas (in Europe referred to as Transmission System Operator or TSO, in US the Independent System Operator or ISO) and Liander and Stedin, the two largest distribution system operators of local gas and electricity grids (in Europe referred to as Distribution System Operator or DSO, in US more akin to a Regional Transmission Organisation or RTO).

Below, we outline the perspective of the system operators, starting with overall developments in their roles. We then describe the impact of the heat transition on their business operations, bottlenecks in policy and regulation, and technological changes required by the transition.

### 4.1 Operator overview

Activities in the Dutch energy system are unbundled, which means that the energy supply and generation are separated from the operation and transmission networks. Both gas and electricity networks are split between transmission system (TSO) and distribution system (DSO) operators. TSOs are owned fully by the Dutch State while DSOs are in the hands of regional and local governments. Other economic energy-related activities, such as production and wholesale, are performed by utility and energy companies, which are not permitted to operate any transmission or distribution infrastructure. A national regulator, ACM, oversees the performance, tariffs and investment decisions of the operators (ACM, 2017). The distribution grids for gas and electricity are maintained and operated by six DSOs (Enexis Groep, 2021). The DSOs each serve a different region where they operate both the gas and electricity grids.

#### Obligations and developments

Operators are responsible for transmission/distribution, maintenance, expansion and decommissioning. DSOs are obliged to connect consumers to the electricity grid, and until 2018 this was also the case for gas. Since 2018, the Gas Act limits the building of new gas connections for new construction, thus enforcing the use of more sustainable heating sources (Ministerie van BZK & Ministerie EZK, 2018).

The energy transition requires the phase-out of natural gas, which means that a significant part of the gas infrastructure will have to be decommissioned early. This accelerated devaluation of gas assets has led to the hesitance of DSO regarding new investments and seeking ways to repurpose the infrastructure, such as hydrogen. It will furthermore lead to a predicted increase in future energy tariffs (Energie Nederland, 2020). DSO charged homeowners a fee of up to 800 euros for removing gas connections in buildings up until March 2021. Because this fee was perceived as a barrier and contradictory to the climate goals, the decision was made to socialise the costs (Duurzaam Bouwloket, 2020).

The current electricity grid is not suited to accommodate significant additional demand and supply from heat pumps, EVs, solar panels, wind turbines and other electrification. The transmission and distribution grids will thus need to be strengthened significantly. Consumers who need a larger capacity connection due to their increased electricity consumption or supply pay a fee to the grid operator to finance part of these investments (Hieropgewekt, 2019). Other costs required for the upgrades are recuperated through increased tariffs.



## 4.2 Overall developments in operators' roles

The long-term goal of phasing out natural gas has significant implications for the role of the system operators. As Gasunie is owned by the Dutch state, it supports the transition towards sustainable heating and is dedicated to contributing to this goal. Its role in natural gas transport will decrease in the coming years. Therefore, Gasunie has been exploring new roles in markets that emerge as a result of the heat transition. Currently it is exploring the transport of hydrogen, waste heat and green gas as well as CCS. These activities fit within Gasunie's areas of expertise, which is the development and operation of large scale infrastructure and safe and reliable energy services. Although Gasunie's revenue from natural gas infrastructure will decrease, these upcoming activities will help to keep the company in existence.

Both the DSOs interviewed, foresee significant work coming their way with regard to the removal of the gas grid and reinforcement of the electricity grid. The ownership of the electricity grid in addition to the gas grid ensures their continued existence beyond natural gas. Similarly to Gasunie, the DSOs are exploring new roles they could adopt, such as the distribution of hydrogen and green gas and the development of heating grids. Currently, the Dutch Energy Act restricts most of these activities. The DSOs run pilot projects, which are permitted and supported by the government.

## 4.3 Impact on business operations

The phase-out of natural gas and other developments related to the heat transition have an impact on how system operators' business operations are organised. The main impact on the business relate to the construction of future energy infrastructure, the delivering of sustainable gases, employee motivation and capabilities, and a new role as a contributor of public data and models.

### Constructing and reinforcing the future energy infrastructure

The operators foresee that major changes in the energy grids are necessary as a result of the energy transition. This is not only due to the heat transition, but also the adaptation of electric transportation and solar cells. The DSOs will need to make changes in each neighbourhood. This means that the number of electricity distribution substations will need to double, resulting in a many fold increase in workload and high demand for locations in the built environment in the years to come.

Yet it is hard to predict where investments will need to be made for both the gas and electricity grids as long term prognoses are difficult, due to a lack of clarity about future heating technology and unpredictable individual choices of consumers. Meanwhile the operators plan 10 years ahead, which means that they need a concrete plan and certainty. This requires close cooperation with municipalities about their plan for the heat transition and coordination of work in public places. Municipalities, in turn, need help in developing and implementing local heat plans.

With the increasing workload, the operators need to organise their work more efficiently. On one hand, this involves a reorganisation of their internal processes. On the other hand, they only want to upgrade each location once. This can be achieved, for example, in current projects by increasing the grid capacity more than today's electricity demand requires. However, the national regulator currently restricts this because it would inflate customer costs above a strictly necessary level.

## Transporting and delivering sustainable gases

As stated in the introduction of this chapter, each of the operators is looking to adopt new roles. The transition to heating with sustainable gases is their main focus. Biogas and hydrogen gas are the main alternatives. While biogas is usually purified to natural gas quality, hydrogen has different properties, necessitating not only adapted infrastructure but also adjusted malfunction and safety measures, maintenance, and expertise.

The DSOs state the importance of small pilots in these new roles in order to learn and to illustrate opportunities and successes. The operators learn what sustainable gases require from their business model and how to transport these gases safely.

As these markets are still in development, it is still unclear how big of a role sustainable gases will play in the future. Gasunie expects high-temperature process industry to adopt hydrogen before any other sector does. Therefore it focuses on this sector to build the market for hydrogen.

For households and small companies, the availability of sustainable gases is uncertain. The production of these gases is expected to be limited and the industry and transportation sector may have a stronger need for them as they have fewer alternatives. Still, sustainable gases would make the transition to natural gas-free heating easier as they produce high temperatures and reduce the necessity of home insulation.

## Employee motivation and capabilities

The changes in business will affect the number of employees system operators need and the capacities they should possess, as well as the motivation and morale of the employees.

Gas employees will have to cope with the realisation that the infrastructure they work on will be removed over the coming years. Even more so, they are the ones that will need to remove it. This could be regarded as demoralising and may affect the pride they have in their work. The operators feel communication is key as well as offering training in sustainable gas distribution. Many employees are enthusiastic about obtaining hydrogen certification. Meanwhile, electricity employees see an increasing workload. They are motivated to avoid grid congestion and focus on finding smart solutions in collaboration and technology.

This makes it increasingly difficult to attract new employees to work on the gas supply chain. Although the work on the gas grid will decrease in the future, there will be plenty of work in the coming years. Many of the current group of mechanics are approaching retirement age. This helps to avoid forced redundancies, but will present a challenge in the coming years. Liander will have approximately 2,000 gas and electricity open vacancies over the next three years for building the future energy grids. But as the labour market is already tight, it will be hard to fill those vacancies.

The capabilities required of staff will change as well. Collaboration with other stakeholders will become more important as the energy system gets more complex and the interests of stakeholders change. Liander has therefore invested in consultancy skills.

## New role as contributor of data and models

The two DSOs that were interviewed both identify a public need for more transparent data and models regarding the heat transition. Municipalities, along with housing associations, citizens and district heating companies, often lack information about energy infrastructure and costs. DSOs have this expertise and many DSOs have developed open data and models to share with municipalities and/or the public in order to facilitate the market and accelerate the transition.

Although this is not part of the DSOs' regulated role, these actions are legitimised by their ownership by public shareholders: DSOs have a mission and responsibility to contribute to the public cause of sustainable energy. Liander now offers an online tool that shows the age and condition of the gas and electricity infrastructure as well as advice on which neighbourhoods to start execution. Stedin advises municipalities using a model study on the most cost-effective heating technology per neighbourhood, as well as advice on what neighbourhoods to start in.

## 4.4 Bottlenecks in policy and regulation

In certain areas, policies and regulation regarding operators are not fit for the new situations arising from the heat transition. They will need to adapt to be able to facilitate the transition. In this paragraph, we describe the current policy bottlenecks and possible solutions.

### Tariff regulation

DSOs, as system operators, have a monopoly position. The Dutch Energy Act protects its citizens and companies by regulating the maximum tariffs per operator. The regulator ACM calculates these tariffs based on the expenses made by and performance required of the operators. This ensures fair and equal tariffs for everybody, regardless of where in the country they are situated. The law also restricts the use of money earned from one energy infrastructure to be used to invest in another. Money made from gas or electricity may therefore not be used to develop hydrogen infrastructure.

Although this system of setting maximum tariffs based on costs and performance required protected consumers in the past, it may result in high tariffs in the future. As more and more people will move away from gas to sustainable heating technologies, the costs of the early depreciation and maintenance of the remaining gas grid will be borne by the decreasing number who are still connected. In addition, the costs of the electricity grid will rise as well. This is due to the necessary investments in grid reinforcements for heat pumps, solar cell and electric transportation. As the tariffs for distribution and transport are equal for all customers of an operator, even consumers whose electricity use remains the same will pay for the grid reinforcements required elsewhere.

According to the system operators, this will result in an unfair situation and may affect those households that lack the money to invest in sustainable heating the most. A partial solution is to reflect the anticipated early depreciation of the gas grid in the current tariffs. Regulator ACM has chosen to allow Gasunie to do so from 2022 onwards (ACM, 2021). Second solution is to avoid the depreciation, by using the gas infrastructure for other purposes, such as the distribution of renewable gases. Even if these solutions are implemented, the tariffs will rise. After all, with fewer connected customers but stable operational expenses, the cost per consumer will rise. The government would need to provide financial assistance to DSOs or consumers to help mitigate excessive costs.

The regulator ACM is looking for ways to support the energy transition within the Energy Act. As of 2022, it allows system operators more flexibility to pre-invest in grid reinforcement where they expect the demand to rise in the future. However, the operators believe they need more scope to pre-invest if they are to avoid capacity problems on their networks.

### **Clarity on future role of sustainable gases**

In recent years, operators have seen a shift in the government position and policy on sustainable gases. In the past, national policy mainly focused on electrification. More recently, the government has given more attention to the role of sustainable gases in the future energy system and has accordingly introduced incentives for innovation and production.

The operators see considerable advantages in the use of sustainable gases, as these offer a way to store energy and an opportunity to keep the gas infrastructure in use. However, the future role of gases remains uncertain and depends on their future availability and their allocation to user groups. More clarity would help DSOs make decisions regarding the maintenance and replacement of gas infrastructure.

### **Right to shut off last remaining consumers**

Currently, all consumers with a connection to the gas grid have the right to maintain their connection, even if they are the last remaining consumer on the grid. When an increasing number of consumers switch away from gas, it will become increasingly costly for the DSO - and thus for the remaining consumers - to maintain a neighbourhood's gas grid. DSOs currently do not have the right to shut off the last remaining customers and there is no way to enforce the remaining households to switch. Though this is currently not yet an issue, it will become more urgent in the future.

### **Clear role and permission to innovate**

The Energy Act restricts the activities system operators may take on. This arises from the monopoly position of the operators. The Energy Act prevents the investment of the tariffs paid by consumers in activities other than those directly provided by the service. The energy transition nevertheless involves innovation and new activities. The government acknowledges and encourages this. The operators are well equipped to accelerate innovation, but are held back by the Energy Act. If they are to contribute to innovation, they need clear role descriptions in the Energy Act that give them permission for these types of activities.

## **4.5 Technology**

System operators also face technological challenges. Heating makes up 80% of household energy consumption. This percentage emphasises the need to switch to sustainable heating and at the same time underlines the challenge to do so: especially in wintertime, heating creates large energy demand peaks while renewable electricity may not have the capacity to supply this. The system operators see four solutions, which are district heating, sustainable gases, flexibility in the electricity grid and energy storage. As heating grids and sustainable gases have been discussed in the previous chapters, we will only discuss flexibility and energy storage here.

## Flexibility of the electricity system

Flexibility in the electricity grid focuses on aligning electricity production and demand in both time and place, thereby reducing the transport of electricity. Flexibility is part of the national energy market, but in the future it would have a local role as well.

The development of local flexibility is a new market in which the roles and business models are still unclear. The energy transition offers an opportunity here, as peak shaving off of (hybrid) heat pumps, solar panels and smart EV charging offer flexibility on the demand side.

## Energy storage

Energy storage is another way to align energy production and consumption. Energy storage can help to reduce the imbalance on a day, but also between seasons. For example, summer solar energy can supply the winter heating demand. This is especially relevant for electricity and heat. As with flexibility, this is a new market where the players, legislation and business models are still in development. However, energy supplier Eneco is developing a heat buffer in Utrecht that supplies heat during morning peak demand. As this peak demand is currently covered by fossil fuel boilers, this will help reduce CO<sub>2</sub> emissions.

## 4.6 Challenges for system operators

Chapter 4 lists the challenges confronting system operators. A short summary is:

- **Shortage of trained staff**  
System operators, too, face a shortage of trained staff. They are already behind on their workload, which will increase as the operators need to remove the existing gas infrastructure and reinforce the electricity grid to accommodate heat pump, solar cells and e-mobility.
- **Major investments in energy infrastructure adaptations**  
Grid investments are very capital intensive. As the gas and electricity grids require major changes, the investments are major, too.
- **Uncertainty on where to invest**  
As it is unclear which homes and utilities will switch to which natural gas-free heating alternative, it is also unclear where the system operators need to do what. This arises from the lack of decisive and execution power of the municipalities with regard to future heating technologies. Also, the regulator forbids pre-investments. This affects mainly the electricity grid. System operators need to experience capacity problems or receive requests from clients before they may invest. This could result in inefficient investments and inefficient usage of time.
- **Investments needed to remove unused gas piping, without any benefits**  
System operators are required by law to remove unused gas infrastructure. This investment, however, does not result in any financial gain.
- **Gas tariffs will rise as more clients disconnect**  
The regulator sets the operator tariffs based on the capex and opex costs operators incurred in the past year. As more and more people switch to gas-free alternatives, fewer clients remain to pay the costs of maintaining and removing the gas grid. Gasunie partially solved this by reducing the depreciation period of the infrastructure thus increasing the capex costs while the majority of the Netherlands still contributes. Nevertheless, the operational and gas removal costs remain.
- **Impossible to enforce disconnection from the gas grid**  
Energy users are free to maintain their gas connection, even if the municipality of system operator wants them to disconnect. Thus municipalities lack the power to enforce a new, sustainable heating technology and system operators potentially face high costs for maintaining gas grids with few connections.



- **Restrictions on adopting new roles**

The Dutch Energy Act restricts the activities and investments of a system operator. The operators see a need to adopt new roles to ensure reliable energy supply, but are held back from doing so.

#### **4.7 Policy solutions for grid operators**

The following policy measures address the challenges faced by system operators.

- Tariff regulation: allow operators to reflect the early depreciation of the gas grid in current tariffs.
- Allow system operators to pre-invest in sustainable infrastructure, such as reinforcement of the electricity grid.
- Financial assistance to DSOs or consumers to help mitigate the operational costs of the gas grid in areas where the majority of consumers have disconnected from gas.
- Allow system operators to shut off natural gas supply and/or remove the gas infrastructure, after a reasonable warning period, if only a small fraction (e.g. less than 30%) of a neighbourhood still uses gas.

## 5 Reflection

In this chapter, we reflect on the current status of the natural gas phase-out in the Netherlands, and suggest areas where policies can be strengthened.

### 5.1 Overall analysis of current situation

Despite some disappointing results in the first phase of the gas phase-out, the targets for 2050 are still in place. The current policies are mainly focused on financial support (subsidies and loans), learning and communication, but lack stronger measures. Recent developments, notably the 2021 Coalition Agreement, offer more binding instruments to bring the goals within reach, such as a blending obligation for biogas, the announcement of a ban on renting homes with low energy labels, and obligations for suppliers of heating installations.

The main overarching challenges that remain for the heat transition are the lack of a good financial business case for homeowners, split incentives in the rental sector, and non-financial barriers such as hassle, waiting time and difficulty in finding contractors, as well as grid challenges. These challenges are aggravated due to recent increases in the lack of skilled staff and scarcity of building materials.

Public support for the gas phase-out differs. A majority support the phase-out of natural gas, mainly for climate reasons and as a result of the earthquakes in the north of the country. On the other hand, around 20% of people do not support the gas phase-out. The main argument of this group is that they view natural gas as a relatively clean fossil fuel with low CO<sub>2</sub> emissions. Higher costs of alternatives are also arguments (CBS, 2021b). In the neighbourhoods that are part of the PAW programme, public support is a delicate issue. Negative media attention on the programme or certain technologies such as biomass or district heating, undermine the efforts made in those neighbourhoods (PAW, 2021).

Recent gas price spikes have made the transition away from natural gas all the more urgent and improve the business case for sustainable heating.

### 5.2 Focus areas for policy strengthening

In order to reach a zero-emission built environment, the focus needs to be on three areas:

1. Reducing energy demand through renovation (insulation) of existing buildings.
2. Switching to electric and district heating appliances and infrastructure (for a large fraction of the building stock).
3. Decarbonising energy carriers through the increase of renewable electricity and renewable gasses.

In all three areas, a combination of regulatory policies, pricing policies and financial support is needed. In this paragraph, we will outline the policies being considered by the Dutch government for strengthening its policy package and additional regulatory instruments that could be introduced as backstops.

#### 1. Renovation of existing buildings

Current subsidies reimburse a percentage of the purchase costs of insulation. In order for larger groups of households to be able to renovate, more of the upfront costs must be mitigated for lower-income groups and homeowners must be assisted both financially and organisationally, for example by ‘insulation teams’ that make comprehensive offers, neighbourhood by neighbourhood. In November 2021, a National

insulation programme was announced, focusing on higher reimbursement rates and more support for low-income households and housing associations.

Pricing instruments are already in place to incentivise energy savings. The current energy tax on gas will be increased annually, as presented in the 2019 Climate Agreement. However, at the current prognoses, deep renovation is still not financially favourable in many situations. Besides, the energy tax does not distinguish between renewable and fossil gas (see the paragraph on decarbonising energy carriers).

Regulatory instruments can deliver more far-reaching results. Mandatory performance standards for all existing homes could be introduced and applied at key moments, such as at the time of sale, change of tenants or major renovations. Currently, only new construction and office buildings are subject to a minimum energy performance requirement. Besides that, there are agreements with housing associations to reach a minimum energy performance. The Dutch government developed a voluntary differentiated insulation standard with insulation advice for homeowners, but it does not have legal status as yet. In the proposal for the revision of the European EPBD (Energy Performance of Buildings Directive), minimum energy performance standards for the 30% worst performing existing buildings is introduced (Euractiv, 2021). This legislative proposal will be the subject of negotiations between all EU Member States, the European Parliament and the European Commission. The Dutch government will need to implement this EU Directive in its national policy for it to take effect.

The Coalition Agreement proposes to eventually prohibit the renting out of homes with low energy performance. Such regulations could be further expanded in the future to include other sectors as well, in order to completely phase out low-energy-performing buildings.

## **2. Heating appliance and infrastructure switch**

Switching from gas-fuelled heating to different energy carriers requires different technology in the home (electric heat pump, district heating connection) as well as in the public infrastructure. This entails different investment decisions: heating with electricity requires the building owner to invest in a heat pump, while district heating requires a collective investment in a district heating network.

Again, current policies mainly focus on financial support. There are subsidies for the purchase of heat pumps and a number of municipalities provide financial support to homeowners to switch to district heating in neighbourhoods where new systems are being developed.

The current energy tax, including the intended development thereof, on gas and electricity favours the switch to electric heat pumps and hybrid heat pumps, which yield intermediate emission reductions. Tariffs for district heating are regulated to protect consumers, but an amendment is being developed that allows heating companies to pass on the actual costs. This will make the development of heating grids financially more attractive, but poses the risk that costs may increase for some consumers.

Regulatory instruments to phase out fossil heating systems include energy performance standards for heating installations. A requirement for new heating installations to have a certain minimum efficiency will replace inefficient and fossil-fuelled burners with (hybrid) heat pumps and collective heating. The Coalition Agreement proposes a

requirement for heating installation suppliers to install an increasing number of (hybrid) heat pumps when replacing existing condensation boilers. If this requirement is successfully introduced and the obligation to install heat pumps is steadily increased, this could be an important way to reduce gas-fired heating in homes.

### 3. Decarbonising energy carriers

Finally, the remaining energy demand must be decarbonised. Financial support in this area is geared towards supporting the production of renewable gas, heat and electricity.

In the current energy tax system, there is no incentive to increase the percentage of renewable energy in the electricity or gas mix. A CO<sub>2</sub> tax or a CO<sub>2</sub> budget system would put a price on CO<sub>2</sub>, favouring renewable energy in the mix.

Also in this area, regulatory policies are needed as a backstop to ensure decarbonisation of the energy carrier. For electricity, this is already ensured in the EU Emission Trading System (ETS). For gas, two options are a cap on CO<sub>2</sub> emissions of energy carriers for energy companies (CO<sub>2</sub> budget system) or a renewable energy blending obligation for heating fuels. A CO<sub>2</sub> budget system could include trading of CO<sub>2</sub> emission rights. The EU Green Deal package proposes to introduce a European emission trading system for buildings and road transport; such a system could also be introduced at the national level (Germany introduced a national ETS in 2021, and Sweden and Norway have had carbon pricing for heating fuels in place for several decades).

The Coalition Agreement announced a blending obligation for gas fuel. This will increase the amount of renewable (bio)gas in the gas mix. The limited availability of biogas would probably lead to higher gas prices. Due to this limited availability, it is unclear to what extent the obligation can be increased while maintaining both affordability and ensuring the sustainable origin of the biogas.

#### Other supporting instruments

Besides measures in these three key areas, overarching measures are needed to address overarching barriers to the transition. Scarcity of trained staff was listed in the previous paragraph as an overarching challenge; increased training of insulation and installation staff is necessary to overcome this.

Furthermore, we also listed avoiding increased energy poverty as a condition for the transition. Energy saving measures can reduce the risk of energy poverty for households, but in addition, support for low-income households to compensate rising costs for heating is also needed.

#### Overarching coordinated implementation programme

In addition to these separate policy instruments, it is widely agreed that a scale-up of the transition can only be achieved with a long-term vision for infrastructure (energy carriers) and a large-scale implementation programme per neighbourhood.

- Long-term vision for energy infrastructure: local heat plans should indicate which alternative energy carrier is foreseen, but not all heat plans provide this alternative for all neighbourhoods. In addition, heat plans are not binding and thus

do not provide sufficient certainty for investment decisions of households or companies.

- Coordinated large-scale implementation programme per neighbourhood: there are currently small-scale collective purchasing initiatives, but increasing the speed and scale requires bringing together stakeholders and the market, and making competitive offers for insulation and appliances to large groups of consumers. This could bring down the cost and make more efficient use of the scarce manpower and materials.
- Regulation is needed to prevent consumers from installing undesirable technologies such as electric heaters and wood stoves.

This approach currently forms the basis of the Dutch Climate Agreement for the built environment, but the current policy package still lacks fundamental instruments to carry out the transition. The Coalition Agreement presented in 2021 offers some promising regulative and supporting instruments, which could strengthen the Dutch approach towards reaching its climate targets.

## 6 Literature

- ACM, 2017. Incentive regulation of the gas and electricity networks. The Hague, Autoriteit Consument & Markt (ACM).
- ACM. 2021. *ACM: GTS mag kosten eerder in rekening brengen om te anticiperen op gevolgen energietransitie* [Online]. Available: <https://www.acm.nl/nl/publicaties/acm-gts-mag-kosten-eerder-rekening-brengen-om-te-anticiperen-op-gevolgen-energietransitie> [Accessed 07-02- 2022].
- ACM. ongoing. *Ik kan mijn warmtenota niet betalen. Wat moet ik doen?* [Online]. Autoriteit Consument & Markt (ACM). Available: <https://www.acm.nl/nl/onderwerpen/energie/afnemers-van-energie/warmte/veelgestelde-vragen-over-de-regels-bij-dreigende-afsluiting-van-warmte> [Accessed 9 December 2021].
- Aedes. -. *Op weg naar energielabel B in 2021* [Online]. Available: <https://aedes.nl/verduurzaming/op-weg-naar-energielabel-b-2021> [Accessed 9 december 2021].
- CBS. 2016. *Vier op de tien huishoudens wonen in een rijtjeshuis* [Online]. Available: <https://www.cbs.nl/nl-nl/nieuws/2016/14/vier-op-de-tien-huishoudens-wonen-in-een-rijtjeshuis> [Accessed 1-10 2020].
- CBS. 2019a. *2018: eerste handelstekort in aardgas* [Online]. Available: <https://www.cbs.nl/nl-nl/nieuws/2019/11/2018-eerste-handelstekort-in-aardgas> [Accessed 20 January 2022].
- CBS, 2019b. The Netherlands on the European scale 2019. The Hague, Statistics Netherlands.
- CBS. 2021a. *92 procent woningen op aardgas begin 2019* [Online]. Available: <https://www.cbs.nl/nl-nl/nieuws/2021/07/92-procent-woningen-op-aardgas-begin-2019> [Accessed 3 November 2021].
- CBS. 2021b. *Klimaatverandering en energietransitie : opvattingen en gedrag van Nederlanders in 2020* [Online]. Available: <https://www.cbs.nl/nl-nl/longread/rapportages/2021/klimaatverandering-en-energietransitie-opvattingen-en-gedrag-van-nederlanders-in-2020/3-opvattingen-over-energietransitie> [Accessed 2021].
- CBS. 2021c. *Statline : Voorraad woningen; gemiddeld oppervlak; woningtype, bouwjaar, regio* [Online]. Available: <https://opendata.cbs.nl/statline/#/CBS/nl/dataset/82550NED/table?dl=3FEF6> [Accessed 9 December 2021].
- CBS. 2021d. *Statline: Energieverbruik particuliere woningen; woningtype en regio's* [Online]. Available: <https://opendata.cbs.nl/#/CBS/nl/dataset/81528NED/table?dl=5BE74> [Accessed 9 december 2021].
- CE Delft, 2021. *Energiearmoede in de warmtetransitie: Onderzoek naar beleidsinstrumenten*. Delft, CE Delft.
- CE Delft, 2022. *Doorlichting beleidsartikel 4.1 [IN CONCEPT]*. Delft, CE Delft.
- CE Delft & Ecorys, 2021. *Evaluatie energiebelasting*. Delft, CE Delft.
- Duurzaam Bouwloket. 2020. *Afsluitboete voor verwijderen gasaansluiting verdwijnt tijdelijk* [Online]. Available: <https://www.duurzaambouwloket.nl/nieuws/afsluitboete-voor-verwijderen-gasaansluiting-verdwijnt-tijdelijk> [Accessed 6 January 2022].
- Energie Nederland. 2020. *Eerlijke verdeling kosten gastransportnet noodzakelijk (persbericht)* [Online]. Available: <https://www.energie-nederland.nl/persbericht-eerlijke-verdeling-kosten-gastransportnet-noodzakelijk/> [Accessed 9 December 2021].



- Enexis Groep.** 2021. *Door Energie in Verbinding : Jaarverslag 2020* [Online]. Available: [https://www.enexisgroep.nl/media/3100/jaarverslag\\_2020\\_enexis\\_holding\\_nv.pdf](https://www.enexisgroep.nl/media/3100/jaarverslag_2020_enexis_holding_nv.pdf) [Accessed 9 December 2021].
- Euractiv.** 2021. *LEAK : Draft EU law introduces new standards to decarbonise buildings by 2050* [Online]. Available: <https://www.euractiv.com/section/energy/news/leak-draft-eu-law-introduces-new-standards-to-decarbonise-buildings-by-2050/> [Accessed 10 December 2021].
- EZK,** 2019. Kamerbrief d.d. 12 november 2019 m.b.t. Kabinetsreactie beleidsevaluatie Investeringsubsidie Duurzame Energie (ISDE) Den Haag, Tweede Kamer der Staten Generaal.
- Hieropgewekt.** 2019. *Kosten van een netaansluiting* [Online]. Available: <https://www.hieropgewekt.nl/kennisdossiers/kosten-van-een-netaansluiting> [Accessed 9 December 2021].
- Kabinetformatie,** 2021. Coalitieakkoord 'Omzien naar elkaar, vooruitkijken naar de toekomst'. The Hague, Ministry of General Affairs.
- KNMI.** 2020. *Klimaatviewer* [Online]. Available: <https://www.knmi.nl/klimaat-viewer> [Accessed 23 November 2021].
- KWINK & Rebel,** 2020. Tussentijdse evaluatie Programma Aardgasvrije Wijken. Rotterdam, Rebel Energy, Water & Climate.
- Loonen.** 2020. *TKI Urban Energy kennisdossier cooperatieve warmtenetten* [Online]. Available: <https://www.topsectorenergie.nl/sites/default/files/uploads/Urban%20energy/kennisdossier/Cooperatieve%20warmtenetten/Kennisdossier%20co%C3%B6peratieve%20warmtenetten%20DEF.pdf> [Accessed 9 December 2021].
- Merosch,** 2020. Isolatiepakketten ten behoeve van het CEGOIA model. Bodegraven, Merosh.
- MinBZK, Aedes & Vastgoed Belang,** 2012. Convenant Energiebesparing Huursector. Den Haag: Ministerie van Binnenlandse Zaken en Koninkrijksrelaties; Aedes vereniging van woningcorporaties; Vereniging Nederlandse Woonbond; Vastgoed Belang Vereniging van particuliere beleggers in vastgoed.
- Minister van Binnenlandse Zaken en Koninkrijksrelaties.** 2021. *Kamerbrief d.d. 6 juli 2021 m.b.t. over betaalbaarheid van de energietransitie in de gebouwde omgeving* [Online]. Den Haag: Tweede Kamer der Staten Generaal. Available: <https://www.rijksoverheid.nl/binaries/rijksoverheid/documenten/kamerstukken/2021/07/06/kamerbrief-over-betaalbaarheid-van-de-energietransitie-in-de-gebouwde-omgeving/kamerbrief-over-betaalbaarheid-van-de-energietransitie-in-de-gebouwde-omgeving.pdf> [Accessed 30 November 2021].
- Ministerie van BZK,** 2021. Kamerbrief van de Minister van Binnenlandse Zaken en Koninkrijksrelatiesministerie d.d. 18 maart 2021 over standaard voor woningisolatie. Den Haag, Tweede Kamer der Staten Generaal.
- Ministerie van BZK & Ministerie EZK.** 2018. *Factsheet wijziging gasaansluitplicht per 1 juli 2018* [Online]. Den Haag: Rijksdienst voor Ondernemend Nederland (RVO). Available: <https://www.rvo.nl/sites/default/files/2018/07/Factsheet-gasaansluitplicht-vanaf-1-juli-2018-02.pdf>. [Accessed 2021].
- Natuur & Milieu,** 2021. Gasmonitor 2021. Utrecht, Natuur & Milieu.
- Netbeheer Nederland.** 2021. *87 procent van de nieuwbouwwoningen in 2020 aardgasvrij opgeleverd* [Online]. Available: <https://www.netbeheernederland.nl/nieuws/87-procent-van-de-nieuwbouwwoningen-in-2020-aardgasvrij-opgeleverd-1424> [Accessed 6 January 2022].
- PAW,** 2021. Monitor 2020 Voortgangrapportage Programma Aardgasvrije Wijken Programma Aardgasvrije Wijken (PAW).
- PBL,** 2021. Klimaat- en Energieverkenning (KEV) 2021. Den Haag, Planbureau voor de Leefomgeving (PBL).
- Rijksoverheid,** 2019a. Klimaatakkoord. Den Haag, Rijksoverheid.



- Rijksoverheid, 2019b. Klimaatakkoord : C Afspraken in sectoren, C1 Gebouwde omgeving. Den Haag, Rijksoverheid.
- Rijksoverheid. 2020a. *Compendium voor de leefomgeving (CLO) : Energielabels van woningen, 2010-2019* [Online]. Available: <https://www.clo.nl/indicatoren/nl0556-energielabels-woningen> [Accessed 2021].
- Rijksoverheid. 2020b. *Monitor Klimaatbeleid* [Online]. Den Haag: Rijksoverheid. Available: <https://www.rijksoverheid.nl/documenten/publicaties/2020/10/30/monitor-klimaatbeleid-2020> [Accessed 2021].
- Rijksoverheid. 2021. *Volksgezondheidszorg.info : Bevolkingsomvang* [Online]. Available: <https://www.volksgezondheidszorg.info/onderwerp/bevolking/regionaal-internationaal/bevolkingsomvang#bron--node-tabel-bronnen-bij-de-cijfers-over-bevolking> [Accessed 7 December 2021].
- Rijksoverheid. ongoing. *Infographics Gebouwde Omgeving Built Environment English* [Online]. Rijksoverheid. Available: <https://www.klimaatakkoord.nl/documenten/afbeeldingen/2019/11/12/infographics-gebouwde-omgeving-english> [Accessed 2021].
- RVO. 2021a. *Energieprestatievergoeding (EPV)* [Online]. Available: <https://www.rvo.nl/onderwerpen/duurzaam-ondernemen/gebouwen/wetten-en-regels/bestaande-bouw/energieprestatievergoeding> [Accessed 9 December 2021].
- RVO. 2021b. *ISDE: Stand van zaken budget* [Online]. Available: <https://www.rvo.nl/subsidie-en-financieringswijzer/isde/budget> [Accessed 9 December 2021].
- RVO. 2021c. *Standaard en streefwaarden voor woningisolatie* [Online]. Available: <https://www.rvo.nl/onderwerpen/duurzaam-ondernemen/gebouwen/wetten-en-regels/standaard-en-streefwaarden-voor-woningisolatie> [Accessed November 2021].
- Vulpen, 2021. De warmtewet 2 en de regierol van gemeenten. *Binnenlands bestuur*.
- W/E Adviseurs, 2018. Ontwikkeling van koudevraag van woningen. Utrecht ; Eindhoven, Rijksdienst voor Ondernemend Nederland (RVO).
- Werk aan Wonen. ongoing. *Woningcorporaties* [Online]. Available: <https://www.werkaanwonen.nl/woningcorporaties/> [Accessed 2021].



## A Dutch climate

The Netherlands has a mild maritime climate, with moderately warm summers and cool winters. Figure 11 shows the average, record high and record low temperatures for the last decade (1991-2020). The effects of climate change are noticeable in the Dutch temperatures. Temperatures in the summer are increasingly higher and winters are less cold. Temperatures below  $-10^{\circ}\text{C}$  occur but are increasingly rare. In the previous decade, minimum temperatures below  $-10^{\circ}\text{C}$  were measured on only thirteen days (KNMI, 2020). In the Netherlands there is a need for heating almost half of the year. There is little need to cool, but this is increasing. Currently utility buildings often have a cooling system, but most houses do not.

Figure 11 - The average, the record high and record low temperatures for the last decade (1991-2020)

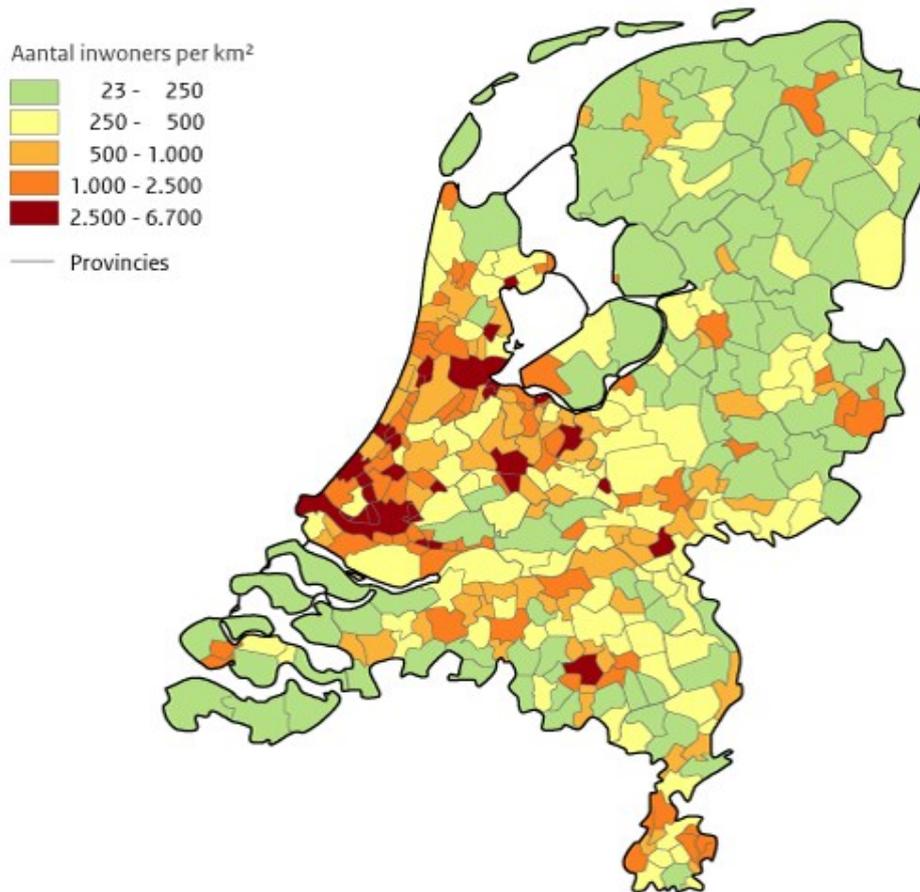
Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Record high °C (°F)	17.2 (63.0)	20.5 (68.9)	25.6 (78.1)	32.2 (90.0)	35.6 (96.1)	38.4 (101.1)	40.7 (105.3)	38.6 (101.5)	35.1 (95.2)	30.1 (86.2)	22.0 (71.6)	17.8 (64.0)
Average high °C (°F)	6.1 (43.0)	7.0 (44.6)	10.5 (50.9)	14.8 (58.6)	18.3 (64.9)	20.9 (69.6)	23.1 (73.6)	22.9 (73.2)	19.5 (67.1)	14.8 (58.6)	9.9 (49.8)	6.7 (44.1)
Daily mean °C (°F)	3.6 (38.5)	3.9 (39.0)	6.5 (43.7)	9.8 (49.6)	13.4 (56.1)	16.2 (61.2)	18.3 (64.9)	17.9 (64.2)	14.7 (58.5)	10.9 (51.6)	7.0 (44.6)	4.2 (39.6)
Average low °C (°F)	0.9 (33.6)	0.7 (33.3)	2.4 (36.3)	4.5 (40.1)	8.0 (46.4)	10.8 (51.4)	13.0 (55.4)	12.5 (54.5)	10.0 (50.0)	7.1 (44.8)	3.9 (39.0)	1.6 (34.9)
Record low °C (°F)	-27.4 (-17.3)	-26.8 (-16.2)	-20.7 (-5.3)	-9.4 (15.1)	-5.4 (22.3)	-1.2 (29.8)	0.7 (33.3)	1.3 (34.3)	-3.7 (25.3)	-8.5 (16.7)	-14.4 (6.1)	-22.3 (-8.1)

Source: KNMI, (2020).

## B Population density

Figure 12 shows that the population density in Netherlands is quite high in some municipalities (2,500 residents per km<sup>2</sup> is equal to 6,475 per mi<sup>2</sup>). The most urbanised areas are in the west of the country.

Figure 12 - Population density of the Netherlands per municipality; number of inhabitants per square km

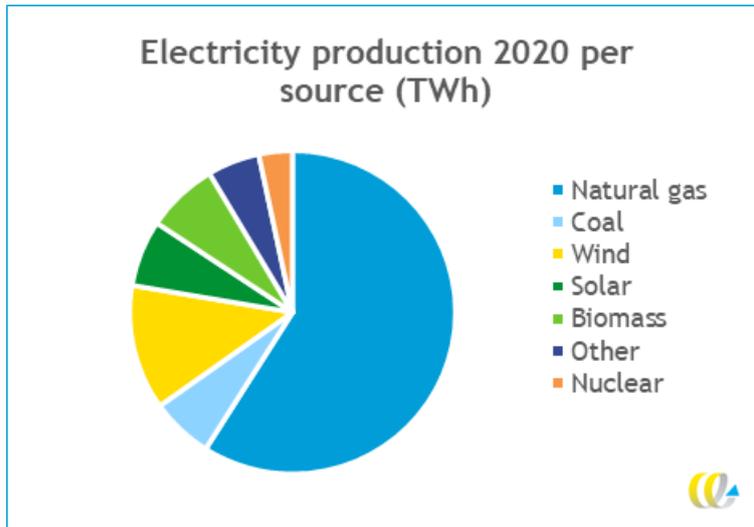


Source: [Volksgezondheidszorg.info](https://volksgezondheidszorg.info) (Rijksoverheid, 2021).

## C Electricity sources

Electricity is partly sourced from renewable sources. In 2019, the average emission factor of electricity was 0.37 kg CO<sub>2</sub>/kWh (0.82 lb CO<sub>2</sub>/kWh) (PBL, 2021).

Figure 13 - Energy sources for electricity production



Source: PBL, (2021).

## D Role of district heating companies

### Market overview

Due to the historical abundance of natural gas, district heating currently has a relatively small market share in the Netherlands. Currently, 50 district heating companies operate 231 district heating networks. These networks supply about 400,000 Dutch households (~6% of total) with heat. The five largest district heating companies furthermore have a 40% district heating market share. Currently, about 19% of heat is sourced sustainably, primarily through the incineration of biomass in waste incineration plants (Loonen, 2020).

### Development

Government policy aims to increase the market share of district heating and reduce the amount of fossil fuels used, which often requires the reduction of the supply temperature. The Dutch Climate Agreement goal is that about half of the 1.5 million homes to be disconnected from gas will make use of district heating by 2030. Currently, most heat is generated using fossil fuels, but several sustainable alternatives are in development. Geothermal energy, for instance, is regarded as a high potential sustainable alternative in a large part of the country. Other sources of heat being considered include industrial waste heat, aquathermal heat and cold energy. Many municipalities are currently investigating options to expand or build new heat network infrastructure.

### Regulations

The regulations for district heating companies are codified in the Dutch Heating Supply Act (*Warmtewet*). The Heating Supply Act regulates tariffs, access and market ordering. District heating companies generally both produce and distribute the heat, and thus hold a monopoly position. The Act aims to protect connected customers, since there is a captive market and consumers cannot switch to another district heating company. A revised law, 'Heating Supply Act 2', is expected to come into effect in the coming year (Vulpen, 2021).

Tariffs for heat are regulated, and currently based on the principle that heating should not be more expensive than using natural gas. This levelized playing field enabled the historical development of the district heating networks that exist today. Fossil fuel price-coupling has become undesirable, as these costs have little to no relationship with the costs of more sustainable heat alternatives. Changes in the price of natural gas due to taxation, carbon pricing and market volatility are currently reflected in heat tariffs, even if that heat is generated without the use of natural gas. In the new Heating Supply Act this principle will therefore be changed to a cost-based tariff regulation structure.

District heat networks have a monopolistic nature. Both heat distribution and production are often performed by the same party. European energy directives have in the past focused on unbundling monopolies, most notably in the electricity and gas networks. District heating, however, has not been unbundled to the same degree. The next Heating Supply Act will not outlaw a monopolistic arrangement, but does aim to stimulate open access networks and unbundling of network functions. Heating grid companies are regulated by the national regulatory authority, and are not allowed to disconnect users for non-payment in winter time (ACM, ongoing).